UNIVERSITY OF CRETE
SCHOOL OF PHILOSOPHY
DEPARTMENT OF PHILOLOGY
DIVISION OF LINGUISTICS

PHONOLOGICAL DEVELOPMENT OF A CHILD'S L2 ENGLISH IN BILINGUALISM

DOCTORAL DISSERTATION
BY
ELENA BABATSOULI

JUNE 2013

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DEDICATION

To Maria Sofia and Dimitri

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ABOUT THE AUTHOR

Elena Babatsouli was born and raised in Greece. She left Greece to undertake university studies in English language and literature at Royal Holloway of the University of London. After graduating with honors, she studied Italian in Florence for a year. Elena obtained a Master's degree in European Languages and Business from London South Bank University. Following several years of teaching, she decided to pursue doctoral studies in Linguistics that had been her aspiration since her undergraduate years. As first author, Elena Babatsouli has co-authored a paper with Ioanna Kappa titled 'Transfer of Greek palatals in L2 English', which appears in 'Achievements and perspectives in the acquisition of second language speech: New Sounds 2010', edited by M. Wrembel, M. Kul & K. Dziubalska-Kołaczyk and published by Peter Lang, Frankfurt. Furthermore, Elena has presented different topics of her doctoral dissertation at several international conferences, orally at: '6th International Symposium on the Acquisition of Second Language Speech 2010' in Poznan, Poland; '4th Chaotic Modeling and Simulation International Conference 2011' in Agios Nikolaos, Greece; '8th International Symposium on Bilingualism 2011' in Oslo, Norway; 'CUNY Phonology Forum: Conference on the Segment 2012' in New York, USA; '31st Annual Second Language Research Forum 2012' in Pittsburgh, USA; '7th International Symposium on the Acquisition of Second Language Speech 2013' in Montreal, Canada, and in poster at: 'International Child Phonology Conference 2011' in York, UK and '14th International Clinical Phonetics and Linguistics Association 2012' in Cork, Ireland. Elena plans to teach and conduct research in the field of Linguistics.

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CHAPTER 1
INTRODUCTION

'In children's language learning [bilingualism] can be observed in a nascent state, with the detail of a slow-motion picture and the speed of a fast-motion picture'.
Leopold (1953/1954:14)

The development of phonology in children has been the subject of extensive research for the last one hundred years. The research is based on children's speech data from birth to about school age. The study of children's evolving speech production has provided groundwork for theoretical deliberations that shed light into the elusiveness of cognitive, neurolinguistic and biological mechanisms at work during language acquisition for normal or phonologically disordered children. Alongside the study of acquisition of phonology in a first language, there has been an increasing interest in understanding how a second language's phonology is acquired in bilingualism or after acquisition of the first language. Definitions of terms and a comprehensive review of the literature in these areas are given in chapters 2 and 3 of the dissertation. Some of the questions that remain unanswered in the literature and will be the subject of research in the present study are:

i. Can a child at an early age naturalistically acquire a language in bilingualism, when input to the language is solely provided by a non-native speaker in an environment foreign to the language? Is it acquisition or learning? To which extent is this language acquired compared to monolingual norms during development?
ii. Does the child's acquisition level of the native language match monolingual norms during development?
iii. Is there evidence in such a child's phonological development to support the existence of innateness and of the effect of the environment in language acquisition? Is there proof of universality of principles and patterns in the development of consonantal sounds, i.e. in terms of acquisition stages, milestones, the order of phoneme appearance, substitution patterns, alignment constraints and in terms of implicational hierarchies? Would the child exhibit linguistic behavior (e.g. period of silence, code switching, language choice and preference) that is similar or different to that of other children (monolingual or bilingual)?
iv. If there are idiosyncratic patterns in the production of sounds in such a child's phonological development, are they grounded in general universals or not? Do these idiosyncrasies operate in both languages or are they only found in the language acquired through non-native exposure?
v. Are the phonological systems in the child's bilingualism separated/differentiated during development and, if so, to what degree?

vi. How does a child's developmental speech performance across two languages compare, given the differences in the two languages in terms of sounds, word length, word complexity, morphological conditions and phonotactic rules?
vii. Is a child's acquisition level of consonantal sounds progressive all along development or are there different stages? If different stages exist, how long do they last? What is the path that the acquisition level follows in each of the stages? Is there dependence of the acquisition level of consonantal sounds on word position? Can the U-shaped pattern of development be supported on a quantitative basis for the overall shape of the acquisition level of consonantal sounds? Is the developmental pattern dependent on word-position?
viii. How do the substitution patterns of consonantal sounds vary during a child's phonological development? Is the variation word-position dependent? Can non-linearity in the dominant patterns of consonantal productions be supported on a quantitative basis and at which stage during a child's development does it occur?
ix. It is known that speech sounds that have been acquired in a native language transfer in a second language during its acquisition. What happens during child phonological development when even the native (L1) sounds have not been acquired and, at the same time, a second language (L2) is being acquired? Do developmental substitutions of a consonant transfer from the native language to the second language?
x. The phenomenon of consonant sequence/cluster production by epenthesis in child developmental speech has not been analyzed or understood in the literature. The compound term *sequence/cluster* is used here to include both the commonly called 'consonant cluster' and 'consonant sequence' such as a pre-nasalized consonant. At which stage during phonological development does it occur? Is it lexically dependent? Does it relate to the consonants' acquisition level? What is the articulatory relationship between the two consonants? Is the epenthetic consonant affected by the phonological environment of the word that it occurs, or of words in the same or preceding utterances in the child/interlocutor's speech?
xi. Lastly, what does the child acquire: phonetics, phonology or both? Does the bilingual child acquire the L2 English phonetics and/or phonology?

This dissertation aims at contributing in answering these questions by investigating selected aspects in the phonological development of a female bilingual child during her simultaneous acquisition of English and Greek, longitudinally from age 2;7 to 4;0; the focus is on the development of English, being the L2 or weaker language in her bilingualism. This is an individual child's longitudinal case study based on an experiment carried out by the author of the dissertation that aims to make a contribution to the understanding of developmental phonology, informing issues relevant to both first and dual language acquisition (Ingram, 1989a; Keshavarz & Ingram, 2002).

The longitudinal span of the study over a period of seventeen months and the density of the child speech data collected on a daily basis is a reply to consistent appeals in the literature (e.g. Bernhardt & Stemberger, 1998; Duff, 2008; Young-Scholten, 2009; Stoel-Gammon, 2011; Wei, 2010; Schmid, Verspoor, & MacWhinney, 2011; van Dijk, Verspoor, & Lowie, 2011; Vihman & Keren-Portnoy, 2011) that concede to their scarcity and recognize their necessity. Also, this is the first longitudinal case study in bilingual Greek with any other language.

The experimental work of the thesis that records spontaneous child speech in naturalistic interaction with the mother/adult interlocutor, who is also the author, fills in an acknowledged gap in the literature (e.g. Place & Hoff, 2011) for studies of children's language acquisition in exogenous bilingualism whereby one of the languages is based primarily on non-native input. Given the idiosyncratic nature of the child's linguistic milieu with regard to the English language in terms of input and environment, it is assessed whether the nature of English input has affected the child's developmental milestones in English.

Innateness versus the environment in language acquisition (e.g. Piattelli-Palmarini, 1980; Chomsky, 2007), phonological universals in terms of a universal order of acquisition of segments and feature contrasts (e.g. Jakobson, 1941/1968; Dinnsen, 1992), developmental milestones in terms of the acquisition level of consonants and their substitution patterns (e.g. Smit, Hand, Freilinger, Bernthal, & Bird, 1990; McLeod, 2007), and individual variation patterns of consonant productions (e.g. Ingram, 1979) during phonological development are re-assessed in chapters 4 and 5, in light of this child's data that may, or may not, prove idiosyncratic.

A comparison of the child's speech performance in the two languages is made in chapter 4 at age 2;7, the first month of the study, to determine the degree of differentiation (Paradis, 2000; 2001) in the phonological systems of the child's two languages and their L1/L2 status (e.g. Meisel, 2007) in terms of individual consonant performance, whole word correctness (e.g. Schmitt, Howard, & Schmitt, 1983), word complexity in terms of singleton consonants, consonant clusters and the number of syllables (Ingram & Dubasik, 2011), average length of sentence (Nice, 1925), mean length of utterance (Brown, 1973) and phonological mean length of utterance (Ingram, 2002).

As the two languages differ in word length, word complexity, grammatical forms, in permitting different consonants, in permitting common consonants in different word positions and in having different phonotactic rules, the comparison made aims to set standards for future comparisons on child speech performance between different languages. Moreover, this is done in order to show which is the stronger language in bilingualism on a quantitative basis and to compare the child's acquisition level in each language to monolingual norms at 2;7.

In addition, a consonants' production portrait was created on a quantitative basis for each of the child's two languages which includes the acquisition level of every consonant and its substitutions per language. This way, it is examined whether Jakobson's (1941/1968) 'minimal consonantal system' is quantitatively adhered to in both languages, the native language (L1) and the second language (L2), and to which extent known phonological processes (fronting, devoicing, assimilation, deletions, etc.) are present in each of the child's two languages at this stage. The effect of the consonants' word position on acquisition level and types of substitutions is also investigated.

The present study is the only longitudinal case study of a child's language acquisition, to date, in either monolingualism or bilingualism that uses quantifiable data as evidence of the precise developmental trajectories of consonantal segments in respect of acquisition level and substitution patterns. This enables identification of stages in development (e.g. Ingram, 1989a; Bernhardt & Stemberger, 1998) and patterns within and between them. Therefore, the research questions on the nature of the developmental path of consonants, whether it is linear/nonlinear (e.g. Menn, 1978; Mohanan, 1992; Bernhardt & Stoel-Gammon, 1994; Bernhardt & Stemberger, 1998; Prince & Smolensky, 2004) or what form it has, and on the possible existence of discontinuities (e.g. Waterson, 1971; Ferguson & Farewell, 1975; C. Levelt, 1994; Dresler, 1998) are answered in chapter 5.

The development of individual consonants, mainly in English, that have not been completely acquired by age 2;7, is examined in detail. These consonants are: the voiceless interdental in both English and Greek, the voiced interdental in English, the labio-velar approximant in English which does not exist in Greek, the voiced labio-dental fricative in English, the English rhotic, the voiced and voiceless velar stops in English, and the voiceless fricatives, /h/ in English and [ç] in Greek. The development is explored in single words as well as cumulatively for all the words in the child's monthly speech. The dependence of the acquisition level and substitution patterns on consonant word position is also examined. For the aforementioned consonants, it is investigated whether there are similar stages in their developmental acquisition levels and similar paths of development in each stage.

For the first time in the literature, therefore, the nature and length of each stage will be quantitatively established as well as whether the U-shaped pattern depicts the overall development of consonants and, if so, what is the U's length and depth. Near a consonant's complete acquisition, when there are few substitutions, each substitution of a consonant is quantified in terms of its ratio to all substitutions of the consonant and not in terms of its ratio to the consonant's targets. This enables identification of dominant substitutions near complete acquisition and comparison with dominant substitutions at earlier stages, for the first time in the literature. Such a comparison determines the existence of non-linearity in phonological development.

Comparisons are also made on the acquisition level and the substitutions of common and similar consonants in the two languages during the whole span of the study. This way, the transfer of developmental substitutions of non-acquired L1 consonants into the L2 is investigated for the first time in the literature both at a certain age and longitudinally. Rules on the child's developmental substitution patterns are also formulated in terms of consonant articulation features and phonological processes.

The pattern of consonant sequence/cluster creation by consonant epenthesis in the child's development is examined and phonological processes are identified in chapter 6. Consonant sequence/cluster creation by epenthesis is a phenomenon occurring in normal and phonologically disordered children as well as in adults cross-linguistically. The phenomenon has been scarcely reported in the literature for normal (Stemberger, 1989) as well as for phonologically disordered children (Leonard, 1985) and has not been analyzed or understood. It will be investigated whether consonant epenthesis is lexically dependent, at which stage it occurs during development and whether it depends on the acquisition level of the added consonant. The relationship between the two consonants in the sequence/cluster in terms of their articulation features will be studied as well as that between the targeted consonant and its production in the created cluster. Last, the interference of the epenthetic consonant with another consonant outside the sequence/cluster, in the same word that it occurs or in other words in the child's or the interlocutor's utterance will be explored.

The first part of chapter 2 makes a comprehensive review of major themes in language acquisition literature together with an account of major constructs and definitions in first language, second language and bilingual acquisition as an integrated whole. This is deemed necessary in order to set the theoretical framework for confirming the child's bilingualism. The second part of the chapter outlines the foremost themes and theories employed in the understanding of child phonological development which has facilitated the identification of gaps in it and has allowed the establishment of valid research questions for the present study.

The methodology employed in the thesis, discussed in chapter 3, is in line with current trends emerging in research methodology (e.g. De Bot, 2011), whereby qualitative data and interpretative approaches, including emic narrative (Duff, 2012), are combined in triangulation (e.g. Denzin, 1970) with detailed quantification of data, organized visually in graphs, tables and matrices in order to demonstrate various aspects of the child's phonological development in English within the context of bilingual first language acquisition (Meisel, 1989).

The child/participant is introduced describing her micro and macro sociocultural milieu, the maternal scaffolding enabling the acquisition of English in bilingualism and examining the forces behind her dual linguistic accomplishment. This emic narrative is qualitative data on language learning experience and use demonstrating the child's linguistic behavior (e.g. period of silence, code switching, language choice and preference) for the purpose of comparing it to other monolingual or bilingual children. This is considered necessary due to the lack of a precedent as a yardstick for comparison with this child's bilingual acquisition and, partly, because of the open-endedness of terminologies in the literature with regard to who is bilingual and what is an L2.

A rich CLAN (MacWhinney, 2000) database in CHAT file format is created by the author of the dissertation which includes alignment to digital sound recordings of both child and mother in the course of conversation, as well as, orthographic and IPA phonetic transcriptions of the child's full utterances in both languages. In addition, the processes observed in the child's consonant productions are coded, based on the transcriptions of the produced and targeted speech. The created files facilitate access to the sound recordings and enable the handling of the large amount of data and its subsequent analysis. Entering the interlocutor's speech in interaction with the child in the CHAT files also allows the investigation of interference of the child's productions with the interlocutor's speech; the possibility of such processes has been indicated in the literature before (e.g. Ervin & Miller, 1963), though not fully investigated to date.

In addition, a database log is created (presented in Appendix A and discussed in chapter 3) to summarize information on the digitally recorded data in each language: the situational context of the recordings; audio file names and duration; the child's exact age in terms of years, months and days in each audio file; the number of utterances and word tokens per audio file; the tokens to utterance ratio per audio file; and the types to tokens ratio per audio file. In the child's English speech data, there are 31,684 utterances containing 137,000 word tokens. The child's speech data in Greek comprise 13,940 utterances containing 69,289 word tokens. In total, there are more than 200,000 productions of words in the child's speech data which were digitally recorded and transcribed by the mother/interlocutor, author of the dissertation.

The results of the dissertation, besides their interest in child phonological development in monolingualism and bilingualism, as discussed above, will provide a yardstick for comparing a child's speech performance across two different languages and aim to contribute in the evaluation of child speech in development and in helping phonologically delayed or disordered children to improve. The below-the-norm acquisition level of a child's consonants at certain ages before school age may give the impression that the child is phonologically delayed or disordered. However, as this study will show there may be a much faster progression later on, before school age, catching up or even surpassing the norms. Therefore, parents, teachers and speech pathologies should not rush to judgements with regard to evaluating a child's speech skill.

Moreover, speech pathologists employ small-sonority-distance consonant clusters that are permitted in the language as a strategy to improve production of consonant clusters of larger sonority distance in child speech (Barlow, 2004). The present study will show that a normal child in development creates small-sonority-distance consonant clusters by epenthesis, which are not permitted in the language. It will be interesting to see if utilization of such clusters by speech pathologists could also prove beneficial to children in enhancing correct production of large-sonority-distance consonant clusters that are permitted in the language.

Last, the results of the dissertation will also provide a perspective on adult L2 speech acquisition from various L1s (Weinberger, 2013) where, although phonological processes are known to match in general child speech in development (Flege & Davidian, 1984), the effect of the proficiency level of L2 speakers on substitution patterns, longitudinally, has not been fully explored. An understanding of this will enhance teaching methods in second language phonology accelerating native-like attainment.

CHAPTER 2
REVIEW OF LITERATURE

This chapter attempts a comprehensive review of relevant major themes in language acquisition literature and the development of phonology. Although it is beyond the scope of the thesis to contribute empirically to all these theoretical aspects deliberated, the review aims to be a theoretical background that mirrors the author's own rationalization progress during preparation of the thesis. As the acquisition of English by the child/participant of this case study is a scarce (if not first) phenomenon in the literature, a review of what constitutes first, second and dual language acquisition was deemed relevant and distinctly necessary considering the diverse feedback the author has had from experts and non-experts regarding the status of the English language in the child's linguistic development. This may partly be because of the vagueness and open-endedness of terminologies used in the literature with regard to *what is an L2, who is bilingual,* etc. and, also, due to the lack of a precedent as a yardstick for comparison. Furthermore, although the focus of the study is on the phonological development of consonants, it made little sense to make of review of literature on this specific aspect without acknowledging the fact that the development of phonology in this (or any) child, as a human, is multifaceted and complex and, thus, a holistic and interdisciplinary outlook ought to be maintained. This kind of approach is currently found in Grosjean & Li (2013).

The following review is organized in three main parts. In the first part of this chapter (§2.1-§2.3), a history of theoretical points in the acquisition of language is advanced with an enumeration of major constructs and definitions in first language, second language and bilingual acquisition as an integrated whole. The multifaceted theoretical framework shows that language acquisition has been investigated with psycholinguistic, cognitive, neurolinguistic and biological approaches that are indicative of the complexity involved. The second part of the chapter (§2.4) centers on the acquisition of phonology, this being the focus of the present study and outlines the foremost themes and theories employed in the understanding of child phonological development tackling developmental issues, the nature of the child's phonological representation in perception and production and, lastly, issues that pertain to purely linguistic models and phonological theory. Section §2.5 makes a conclusive remark.

2.1 Language acquisition: an overview

Linguistic competence is a primary attribute that differentiates humankind from the animal kingdom. This has been accredited to a change, some 300,000-400,000 years ago, of a gene called FoxP2 in the DNA of primates (e.g. Lai, Fisher, Hurst, Vargha-Khadem, & Monaco, 2001). Humans seemingly acquire the language of their environment without much effort. What's even more wondrous is that humans acquire language in a general sense, involving more than just one linguistic system as the phenomenon of contemporary multilingualism attests. Knowledge of language is the result of a complicated process of human learning, the acquisition of language. For a discussion on the crucial distinction made in the literature between learning (conscious and explicit) and acquisition (unconscious and implicit) of language see section §2.1.5 below. Language acquisition begins early in life with recognizing the intonation and other sound patterns of that language, identifying speech sounds as carrying meaning for the purpose of communication and gradually developing the ability to produce those sounds heard in meaningful conversation. Familiarity with language starts with our first actual hearing experiences and, nowadays, it is assumed that humans listen to speech signals as early as in the womb (e.g. Mampe, Friederici, Christophe, Wernicke, 2009). This premature hearing aptitude of the fetus coincides with concomitant brain and other physiological development combining forces to gradually build up one's primary perception and, consequently, production of language. Comprehension, what De Houwer (2009:153) refers to as 'breaking the code' is the first stage of linguistic development (e.g. Lust & Foley, 2004) and is part of language acquisition/learning whether in native or first language (NL/L1), second language (L2) or bilingual acquisition. Speech, even in the rudimentary form of exclamations, facilitates communication and, consequently, is the foremost feature of language, the only one that is biologically endowed. Variable types of speech sounds in a particular language form its phonological system which set it apart from the rest in the world's tower of Babel. The processes that evolve during the development of the speech, that is the acquisition of phonology of any language acquired in isolation or of a combination of languages acquired, either simultaneously or successively, are very revealing for our understanding of language acquisition.

2.1.1 Speech production and perception in language acquisition

A brief discussion of speech perception and articulatory phonetics in this section is meant to acknowledge the primacy of their role in the acquisition of phonology. There are two primary areas in the human brain that relate to speech, both thought to be located in the left hemisphere and connected: Broca's area that is responsible for speech articulation and Wernicke's area responsible for comprehension (e.g. Gerschwind, 2004). Although these areas are generally assigned to the faculty of speech, the 'brain seems to have no single location where language is created or stored' but rather 'many different cerebral centers' (Abutalebhi, Cappa, & Perani, 2005:498). For a discussion on neurological foundations of speech acquisition, see e.g. Bates, Dale & Thal (1995), McLeod & Bleile (2003) among others. The process of associating speech signals to meaning in infancy is known as 'fast mapping' (Carey, 1978; Dollaghan, 1985). Perception, overall, facilitates comprehension that leads to the eventual ability to produce language. Production of speech in childhood is subject to the outgrowth of biological constraints relating to maturation (e.g. Gleitman, 1981). The study of phonological development as it relates to motor development has come to be known as 'baby biography' although Kent (1992) finds that 'the two fields … have not been particularly interactive' (66). Ease of articulation, or 'the principle of least effort' (Schultze, 1880/1971), is a decisive element in the understanding of developing phonologies. For a discussion and schematic representation of the differences between infant and adult vocal tracts, see e.g. Kent (1992) and Vihman (1996). A description of the anatomy and physiology involved in the actual production of adult speech can be found in e.g. Gut (2009).

Parallel to mapping a speech signal onto meaning, the language acquirer (monolingual or bilingual, infant, child or adult) is expected to have the ability to segment the speech stream heard into isolated meaningful units. This proves to be especially difficult because the acoustic signal in speech is not broken up into noticeably distinct sections, as if in a Morse signal, whereby each section corresponds at all times to a particular word. On the contrary 'not all word boundaries show up as breaks in the speech wave' (Jusczyk, 2000:5) because the speech act involves a combination of complex articulatory movements that result in the co-articulation of sounds inside and between words that would be heard differently if realized individually. If language is to be mastered through exposure to speech, co-articulation (e.g. Liberman, Copper, Shankweiler, & Studdert-Kennedy, 1967), or the overlapping of speech sounds, needs to be disentangled segmenting fluent speech into discrete parts. Despite some criticism on the use of the term speech *sounds* to refer to phonological segments (e.g. Ard, 1989), such use is widely accepted in the literature on phonology (e.g. Ferguson & Farewell, 1975; Maddieson, 1984; Best, 1994; Gildersleeve-Neumann, Kester, Davis & Peña, 2008).

The view that perception of the acoustic signal is affected by the way certain sounds are articulated has been advocated by the 'motor theory' (Liberman, Copper, Shankweiler, & Studdert-Kennedy, 1967) of speech perception and processing, following the finding that categorical perception is compromised in listeners of speech. Categorical perception is the ability to identify speech sounds as belonging to specific category boundaries embedded in speech contexts, not just simply discriminating them acoustically. It is thought that it may prove useful during speech processing in that it 'recodes the acoustic signal in a way that preserves just those distinctions (i.e. phonemic differences) that are relevant to distinguishing among different words' (Jusczyk, 2000:48). Jakobson (1941/1968) was influential in construing this viewpoint since he was the first one to argue that children gradually acquire a system of phonemic contrasts (see §2.4.4.1). Consequently, recognizing a word in speech has been thought to relate to ease of perception (Olmsted, 1971) and, more specifically, whether prosodic features and phonetic contrasts are identified. A biological model of perceptual and motor factors in phonological development can be found in Kent (1992:82-83).

Meltzoff & Moore (1977) made a break-through in infant perception by identifying that babies have intermodal perception, that is, their brains combine perceptions of two different activities, which is virtually the first form of thinking. Cutler (1994) maintained that the rhythm of the language may help infants to segment the speech stream. Studies of infant speech perception have shown that infants are able to discriminate prosodic differences and phonetic contrasts in the speech wave early on. Investigations have shown that babies discriminate syllables based on their intonational characteristics (e.g. Morse, 1972; Jusczyk & Thompson, 1978) so, for instance, stressed syllables are perceptually 'prominent' (e.g. Echols, 1993). Like adults, infants have categorical perception and can discriminate some speech-sound contrasts within the first month of life (e.g. Eimas, 1974; Eimas & Miller, 1980; Kuhl, 1983) or even at birth (e.g. Bertoncini, Bijeljac-Babic, Blumstein & Mehler, 1987). For instance, among a number of other studies, Eimas' (1974) and Eimas & Miller's (1980) classic studies on sucking rate showed that infants could discriminate place and voicing contrast. Furthermore, the 'magnet effect' (e.g. Kuhl, Conboy, Coffey-Corina, Rivera-Caxiola, & Nelson, 2008) showed discriminatory ability in human infants' phonetic perception at age 0;6 (i.e. six months). Kuhl (2010) argues that, during the two month period between 6 and 8 months of age, babies 'turn from citizens of the world' to 'language bound listeners', that is, by becoming increasingly more sensitive to the distributions and statistics of their own language, their perception of the sound systems becomes very language specific before their first birthdays. Their claim is that 'native language phonetic performance is indicative of neural commitment to the native language, while non-native phonetic performance reveals' (979) the opposite. Although this may be true for monolingual children, there is evidence that bilingual children show increased neural activity in response to completely unfamiliar languages even by the end of the first year (Pettito, Berens, Kovelman, Dubins, Jasinska, & Salinsky, 2012).

2.1.2 The mental lexicon

Human cognition is an advanced facility that is typified by general interconnected logical structures and the human brain functions much like a superior computer that processes information (auditory, visual, contextual, etc.), stores it and has the capacity to retrieve it upon request. This abstract storage system is generally referred to as the mental lexicon in the field of linguistics. The lexicon has a central place in linguistic theories indicating its significance in language acquisition. Information concerning lexical items (words, affixes, idioms, etc.) and their semantic, phonological and morphological structure in a speaker's language is stored in the mental lexicon that guides both the comprehension (e.g. Altmann, 1990) and production of speech (e.g. Levelt, 1989). Mental representations for lexical items and their predictable phonetic properties for a particular language become dictionary entries for those words while the unpredictable phonetic properties, specified by phonological rules are not entered in the lexicon (White, 1989). The validity of lexical-phonological interaction during development has been clearly substantiated in both monolingual (e.g. Stoel-Gammon, 2011; Vihman & Keren-Portnoy, 2011) and bilingual (e.g. Kehoe, 2011) acquisition. Within an Optimality Theory perspective (e.g. McCarthy & Prince 1994; Prince & Smolensky 2004), the mental lexicon exhibits a 'richness of the base' (Smolensky, 1996) in that it comprises all possible lexical forms and it is the grammar of each language that determines the exact output form depending on hierarchical constraints and specificities that characterize that grammar. Consequently, the lexicon is limited by lexical structural constraints to what is known as the 'poverty of the base' (Boersma, 2009).

A brief review of the extant models of lexical processing includes Forster's (1976) 'model of lexical access', Morton's 'logogen model' (1979) and Marslen-Wilson's 'cohort model' (1993). Levelt's (1989:181) 'blue print for the speaker' attributes a central facilitating role to the lexicon, as 'an essential mediator between conceptualization and grammatical and phonological encoding'. According to this proposal, speech production begins in the conceptualiser, continues in the formulator and ends in the articulator. Language is managed in the lexicon by identifying components that process both *what* is spoken and *how* something is spoken, therefore lexical information includes lemmas, referring to semantics and grammar, as well as lexemes, referring to morphophonology. Although Levelt's model has not incorporated bilingual processing in its proposition it has differentiated between adult and child lexicon by acknowledging that the connection between conceptualiser and formulator is terminated at some stage in development.

In Cognitive Theory, levels of representation in the child's lexicon have been discussed in terms of both single and double lexicons. 'Single-lexicon models' in child language (e.g. Smith, 1973; Stampe, 1979; Macken, 1980b) postulate that children have adult-like underlying representations (URs) in their lexicons; their actual phonetic productions are the result of rules and processes on two levels: the high level that differentiates between URs and surface phonological representations (SRs) and the low level differentiating between SRs and the actual realization. The single-lexicon representation however does not account for the variability in child speech during development. Variability in child speech is a normal consequence of neurocognitive development and in itself an actual manifestation of what Hohenberger & Peltzer-Karpf (2009) call 'variation in the self-organization of neural systems'. The idea was also hinted earlier in Brown's (1958/1970:5) statement that 'cognitive development is increasing differentiation'. Individual variation finds relevance in phonological theory (e.g. Goad & Ingram, 1987) and its source is located in three factors: biological constraints, environmental effects and linguistic complexity (Ingram, 1981a). Ingram (1988a, 1991, 1992) has criticized the emphasis that the Stanford Child Phonology Group (e.g. Ferguson & Farewell, 1975; Macken, 1979; Menn, 1983; Macken & Ferguson, 1987) working with primarily early productions has placed on individual variation. He argues that neither individual nor cross-linguistic variation is as extensive as argued and that this is evident as early as in beginning productions. 'Two-lexicon' models of child speech development (e.g. Ingram, 1974a; Kiparsky & Menn, 1977) attempt to account for this variability in child speech. Ingram (1974a) was the first one to use the terms 'input representation' and 'output representation' in child phonology. The three-level model proposed by Kiparsky & Menn (1977) postulates for the existence of three levels: the URs, storage of phonetic representations and actual surface forms. Menn (1983) further claimed that a word is subject to selection rules before being stored in the 'input lexicon'; subsequently more rules and constraints ('articulatory instructions') modify the perceptual representation before being entered in the 'output lexicon' ('production store'). So the effect of these rules is not part of on-line production, as in the single-lexicon models. The child's actual production is directed by the 'output lexicon' rather than the original single lexicon. In other words, processes do not affect realization every single time but are guided off-line by memorized processing in the output lexicon. The model was revisited in Menn & Matthei (1992) to account for factors beyond language as a self-contained system, such as 'psychological reality' and 'to reflect changes in an individual child's "guesses" about the adult language (or rather about the varieties and registers of the ambient language) (214). Overall, the 'two-lexicon model' claims that child production shows: a/ reduction of information (i.e. of existing abstract knowledge) and inertia, b/ mapping of processes that reflect limited production capacities, and c/ a lower level of knowledge, or idiomatic use, (that is the child's own practice as opposed to the adult abstract representation) which also affects production.

Beckman, Munson, & Edwards (2007) have subsequently discussed two-level representations on a different set of parameters: an item-based level with a finer spoken and heard representation associated with the word, and a more abstract level of sub-lexical phonological patterns. Lastly, Sosa & Bybee (2008) advocate a usage-based account of phonology in which representations are not static entities but develop 'by generalizing over existing forms and extracting patterns of similarity' (484). Within this perspective, a single word may have multiple representations.

2.1.3 Input and the logical problem of acquisition

The present thesis aims to provide further evidence supporting the supremacy of linguistic input in linguistic competence as well as in favor of the logical problem of acquisition, discussed in this section. Among the first theoretical approaches to understanding language acquisition were those of behavioral psychologists (for a review see Ingram, 1989a) claiming that language and, thus, words and speech sounds are acquired via imitation of the linguistic input they receive (e.g. Bloomfield 1933; Skinner 1957). Skinner (1938) claimed that verbal behavior is the result of some 'originating force' (51): 'a discriminative stimulus acting prior to the response' which 'is the almost universal rule' (178-9). This originating force in language acquisition is the linguistic input, what Chomsky (1981) calls the Primary Linguistic Data (PLD). 'Motherese' (Newport, 1976) is the kind of speech mothers (and other adults) employ when addressing an infant and has been attested in several studies of L1 acquisition (Nice, 1915; Goodluck, 1991). It has been widely thought to provide a simplified version of the adult language (e.g. Snow & Ferguson 1977). Snow (1979:363) argued against the necessity of such terminology, a point also found in Ingram (1989a). She, further, claimed that this kind of linguistic code utilized when addressing infants has certain characteristics that distinguish it from speech to other adults and children: these special features include fluency and intelligibility, adherence to grammar and overall shortened sentences. White (1989) states that the input available to children is ‘undetermined’ (5) (i.e. not immediately obvious), ‘degenerate’ (12) (i.e. not always perfect) and does not explicitly reveal the ungrammaticality of language which is an unconscious knowledge in adult competent speakers (12). Marcus (1993) postulates that linguistic input takes the form of both ‘positive evidence’ (i.e. the presence of all available grammatical constructs) and ‘negative evidence’ (i.e. explicit correction provided by an adult to a child). ‘Negative evidence takes many forms such as recasts, expansion, hints, clarifications, and explicit correction’ (Aier, 2005). L1 acquisition research has shown that children are not normally corrected during their language acquisition (e.g. Brown & Hanlon 1970) and that they are impervious to change even when they do get corrected (e.g. Braine, 1971, Marcus, 1993). That negative evidence is totally unavailable has been questioned in the literature (e.g. Bohannon & Stanowicz, 1988). For a discussion on negative evidence theory and misconceptions, see White (1989:13-15). In monolingual phonemic acquisition, input is necessary for the child to gain linguistic knowledge, but ‘input alone may not be sufficient in metalinguistic tasks’ as it does not seem to ‘influence the conceptualization of featural relationships’ and phonemic categorization across all children (Gierut, 1996:47). In both bilingualism and second language acquisition (SLA) theory, the quality and quantity of input (e.g. Müller & Hulk, 2001; Piske & Young-Scholten, 2009) are important factors in determining ultimate attainment and native like competence. Accounts of the quality and quantity of linguistic input available to the child/participant investigated in this thesis are provided as narrative evidence in section §3.4 of the following chapter, as well as, a description in terms of functional grammar in Chapter 4 (§4.2.2).

John Locke in his famous *An Essay Concerning Human Understanding* (1960/2000) uses the Latin equivalent of the Aristotelian *γραμμάτειον* (unscribed tablet) to describe the human mind as a *tabula rasa*, a blank slate upon which experience (or input) and, consequently, knowledge (including linguistic competence) accumulates. This notion has since become the central notion of empiricism (e.g. Skinner, 1957) and has played a key role in the formation of linguistic theory as we know it. The empiricists and behaviorists approach, however, did not account for children’s learnability that is, prompt acquisition of language in spite of insufficient input, in what is known as the poverty of the stimulus argument. ‘Learnability’ (e.g. Wexler & Culicover, 1980) primarily refers to the children’s ability to learn the formal principles (or grammar) of their native language’s system but, in a wide-ranging sense, it refers to the way that children generally acquire language (e.g. Goodluck, 1991). Evidence of the validity of learnability theory for normal language acquisition has been abundant (e.g. Roeper & de Villiers, 1992). But is the infant’s mind just an empty dictionary with entries progressively building up? If that was the case, then how can we explain the resourceful use of linguistic information by a child learning to speak? Plato’s problem (e.g. Landauer & Dumais, 1997), also known as the ‘logical problem of language acquisition’ (Hornstein & Lighfoot, 1981; Chomsky, 1986) focuses on settling the breach between available linguistic experience and attained competence: how it is that humans acquire complex and rich knowledge that considerably exceeds the input data they are exposed to. The theme is depicted in a long-standing debate on how children in general acquire language by simply attending to input. De Saussure (2006) had differentiated between the raw linguistic data, *parole*, and the theoretical underlying system, *langue*. Chomsky (1959) claimed that language could not be examined by looking only at the observable facts since production, even in adult speech, is inadequate and incomplete as evidence. He made a clear differentiation between 'performance', or parole, and actual linguistic 'competence', or langue, which he argued ought to be discovered. In 1986, he makes a distinction between externalized language (utterances that can be produced) and internalized language (grammar). Both acquisition of language and its result, competence in a language, are claimed to be subconscious. The logical problem of language acquisition, also known as the 'projection problem' (Peters, 1972), therefore, determines the mapping of primary linguistic data onto the acquired grammar. This study makes for yet another illustration in support of the argument that at least in terms of phonology there is prompt acquisition of language in spite of undermined input.

When addressing the issue of learnability, theoreticians have viewed child language acquisition in terms of the relationship between the adult and child grammar (for a review, see Pinker, 1994) and how their representations of grammar compare. Theorists of abstract phonology have viewed child phonologies as 'flawed' and 'impure' when compared to the more balanced adult phonologies (for a discussion, see Bernhardt & Stemberger, 1998) due to the manifestation of variability. Developmental phonologists in the 1960s, on the other hand, have viewed the child as having a language of his/her own rather than as a flawed speaker of adult language. Developmental errors are only wrong when measured against adult speech, but not by default so (e.g. Waterson, 1971; Ferguson and Farewell, 1975; Menn, 1983). Interestingly, though, variation is not exclusively an attribute of child developmental speech (e.g. Dinnsen, 1992). Stemberger (1996) has further argued that child phonology phenomena are by and large the same as in adult phonology. Smith (1973) advocates the claim that the child's phonology would better be seen in terms of adult grammar deformation rules. In this monograph, Smith also gives credit to Stampe's 1970 unpublished manuscript for having voiced this view before. He further proposes twenty six 'realization rules' according to which developmental changes are treated as changes in the rules that control 'the realization of classes of items' such as units of a 'phonemic rather than a featural nature' (120). Despite this claim, Smith (1973) admits that the child's actual phonetic output is a self-contained system. In other words, the reduced system presented is not as simple as implied because allophony and free variance are hard to account for simply through the realization rules. The overall claim, however, that has found much relevance in phonology (e.g. Dinnsen, 1992) has been that the child's grammar during acquisition is a subset of the adult's grammar (e.g. Wexler & Culicover, 1980; Tesar & Smolensky, 1998).

2.1.4 Universal grammar and universals

The solution to the logical problem of acquisition implicates innateness in language acquisition. As discussion of the results in subsequent chapters will show, there is distinct evidence of universals showing up in the linguistic development of the child in this study that is regardless of the non-native linguistic input, universals both in terms of patterns of linguistic behavior (e.g. period of silence, codeswitching, etc. see §3.4), as well as, phonological universals as part of the general acquisition of grammar (e.g. stages of acquisition, substitution patterns, etc. see chapters 4 and 5). The assumed automaticity, or the creative aspect, of language acquisition in children involves an innate component of linguistic knowledge which according to rationalism is specific to humans only. Chomsky (1966) assumed the central doctrine of Cartesian linguistics that all languages share general characteristics reflecting fundamental 'properties of the mind' (59). He developed his own theory of language, according to which there is an innate linguistic component as part of the human mind's genetic make-up, the 'universal grammar' (UG) which becomes discernible in occurrences of common, universal principles in language. This inherent component in humans is known as the 'language acquisition device' (LAD) (Chomsky, 1981). While grammar is the theory of a particular language (for definitions of grammar, see e.g. Lust & Foley, 2004:2), 'UG is a theory of the initial state S_0 of the relevant component of the language faculty', which encompasses 'the theory of languages and the expressions they generate' (1995:167). UG includes 'principles' (abstract grammatical rules) and 'parameters (markers or switches): these are not learned as such but triggered during language acquisition depending on the input (positive and negative evidence) available to the child, thus making up for the specificities required by each particular language that is being acquired (Chomsky, 1986). Dresher & Kaye (1990) propose the 'cue-based' theory for the acquisition of phonology according to which UG also comprises certain 'cues' relating to each of the parameters of the language. These cues are part of the child's mental representations for specific components of grammar. Just like child phonological development, acquisition of second language adult phonology is thought to also engage in parameter setting (or rather re-setting) based on linguistic evidence at specific time and frequency thresholds (Archibald, 1998). In a teleological perspective of causality, however, phonological behaviours are not always consciously monitored but are the teleological explication of speech acts. An 'isomorphy between causal process and rule' ought not be taken for granted and this, consequently, forms the 'basic mistake of generative grammar' in 'its total integration of paradigmatic, higher order knowledge with the basic knowledge of conditions on speech acts' (Linell, 1979:15-35).

The quality of automatic, idealized acquisition (Chomsky & Halle, 1968) also supported by other nativists (e.g. Pinker, 1994) has been questioned (e.g. MacWhinney, 2004), however. Children acquiring a first language often do not recover from erroneous inferences such as over-regularizing plural forms without corrective feedback (Ramscar & Yarlett, 2007). While the mind is claimed to be modular (Chomsky, 1980; Lightfoot, 1984), that is, LAD is one of many interacting 'mental organs' which together with input data produce linguistic competence, understanding and using language requires pragmatic knowledge and common sense that is nurtured as well as innate (Tomasello & Slobin, 2005). This has been ardently debated by Chomsky and Piaget (Piattelli-Palmarini, 1980). In a 'usage-based approach' (Tomasello, 2000:77), children are claimed to have a general learning mechanism that enables them to recognize patterns in utterances and build grammar in a bottom-up manner that is opposite to that in the UG approach. Chomsky himself (2007:15) has subsequently summoned 'experience' (no matter how limited), as well as, 'principles unspecific to language' (like an individual's neurocognitive self-organization) as two more principles that mediate equally with genetic predispositions in child language acquisition. 'Genetics' and 'environment' are 'interdependent from conception to death. Without an environment in which to operate, genes cannot initiate the growth of structures, and structures must receive environmental stimulation if they are to develop fully the capacity to produce or process language' (Locke, 1990:622). The present study is a vivid illustration that environmental stimulation, even in less ordinary circumstances, may produce ordinary results.

The notion underlying the UG approach, i.e., occurrences of common, universal principles in language is based on linguistic universals, that is, statements that are generally true for all languages as, for instance, all languages have consonants and vowels. The primary workings of universal grammar are mostly evident in the phonological acquisition of language. Roman Jakobson's (1896-1982) pioneering work on the acquisition of child segmental phonology has been seminal in the advance of structural linguistics as developed by the Prague School at the beginning of the 20th century. The influential linguist argued that every phonological system is essentially multi-layered and that the hierarchy of these layers is universal and invariable. In other words, there are universal patterns in the acquisition of the smallest segmental units of sounds of every language that occur both in the 'synchronic' development of child phonology as well as in the 'panchronic ordering' of the languages of the world (Jakobson, 1941/1968). When Jakobson talked about universal and invariable tendencies in the development of phonology, he laid down the foundation of universals, that is, timeless, 'panlinguistic' (literally meaning 'of every language') similarities, not only in terms of child language acquisition processes but also in terms of the distribution of sounds across the languages of the world. This proposition was later advanced in typological terms in the work of Greenberg (1963) who derived a series of forty five (45) basic universals, mostly dealing with syntax, from some thirty languages. Greenberg's typology of markedness expanded on the idea of 'implicational laws' suggesting an 'implicational hierarchy' which denotes that the presence of an attribute B first implies the presence of an attribute A. The reasonable assumption since has been that if there are universal operations across the world's languages, then the innate operations of universal grammar manifest during the acquisition of first or subsequent language and bilingualism, as well. More specifically, just as there are universal processes in the acquisition of the phonological system of a first language (e.g. Goodluck, 1991) and this applies to any child in the world learning any language, there are similarly universal processes and common recurrent features in the phonological acquisition of a second language (e.g. Eckman, 1984).

Chomsky (1965) distinguished between 'formal' universals (the restrictions on the operation and interaction of linguistic rules) and 'substantive' universals (the building blocks of linguistic rules such as the set of articulatory and/or acoustic specifications that characterize speech sounds). Linguistic universals are either absolute (non-implicational) meaning that they apply to every known language, or implicational (statistical tendencies) implying that the existence of a feature in a language is complemented by the existence of another feature. They are also either bidirectional (implying the existence of each other) or unidirectional (the implication goes one way). Absolute universals are very few and they suggest the existence of only one particular feature. Tendencies are less common in the languages of the world but their very presence is not accidental. Although, both Chomsky and Greenberg sought to discover the universal structures underlying human language, Greenberg's functionalist approach (as opposed to Chomsky's rationalist approach) was empirical and logic deductive. For a discussion of universal repair strategies and phonological processes in language acquisition, such as substitution, assimilation, regularization and markedness, see Macken & Ferguson (1987). A 'panorama' of 'the major theoretical positions regarding universals from the beginning of linguistic reflection up until modern times' that attempts to reconcile Greenberg's and Chomsky's approaches is provided in Mairal & Gil (2006:vii).

Ohala (1980) defined phonological universals as the 'systematic patternings of speech sounds cross-linguistically' (181) and argued that they are evidenced in a number of disparate phenomena like segmental inventories, phonotactics, allophonic variation, patterns of sound substitution by first and second language learners, sound change, dialectal and morphophonemic variation as well as the frequency of occurrence of sounds in the lexicon, in connected speech, etc. In order to avoid methodological pitfalls and bias in the sampling of languages for universals, an identified universal ought to be supported 'inductively' by the sheer frequency of the supporting evidence (and scarce counterexamples) as well as 'deductively' (183), supported by known theoretical principles operating on the production and perception of speech.

2.1.5 Acquisition vs. learning

A discussion on the difference between *acquisition* and *learning* in the development of linguistic skill is apposite and mandatory for resolving the status of English in this child case study where exposure to and, consequently, competence in the English language ensued naturalistically rather through instruction. By arguing that linguistic knowledge is a type of cognitive learning, a crucial distinction has been made in the literature between conscious and unconscious knowledge, that is, implicit and explicit learning (e.g. Ellis, 1994). Implicit learning is defined as an unconscious, 'automatic process whereby the structural nature of the stimulus environment is mapped into the mind of the attentive subject' (Reber & Allen, 1978:191). Explicit learning is an active, conscious and selective mode of learning in which learning products are accessible to metacognitive processes (Reber, 1993). Weinert (2009:242) argues that 'implicit compared to explicit learning processes are rather independent of age and thus available to the very young child' and that 'explicit learning processes are predominantly focused on semantic and conceptual aspects of the environment, while implicit learning is equally functional in learning phonological and conceptual regularities'. For a discussion of learning systems ('procedural, declarative and episodic') prompting the development of child phonology, see Velleman & Vihman (2006). In second language acquisition theory, the differentiation between implicit and explicit becomes 'acquisition' versus 'learning' (Krashen, 1982). The 'monitor hypothesis' (Krashen, 1987) states that the acquired system produces language focusing on meaning, whereas the learned system serves as an 'inspector' of the acquired system, that is, a monitor of the actual grammar. First language acquisition, as opposed to learning, is equated with naturalistic input in infancy. The constructionist approach emphasizes the gradual building-up of knowledge through steps by advocating that a new 'stage n will consist of everything at stage n plus the new feature(s) of stage n+1' (e.g. Ingram, 1989a:73). Krashen (1982) refers to this as the 'i+1' level of knowledge with regard to language learning in instructional settings. Krashen (1987) further acknowledges the manifestation of an 'affective filter' in second language acquisition where affective factors, like motivation, self-confidence and anxiety play an important role. Such factors are admittedly present in bilingual acquisition as well (e.g. Schlyter, 1993; McLaughlin, 1995).

2.1.6 The critical period hypothesis

Together with linguistic input, age of exposure to language is a biological factor that plays a crucial role in ultimate linguistic acquisition. Complete acquisition of an L1 grammatical system takes place between the fourth and fifth year of life although individual children are known to reach it a couple of years later (Ingram, 1989a). Complete acquisition in an L2 is known as 'ultimate attainment' (Birdsong, 1992). The 'critical period', initially proposed by Penfield & Roberts (1959) and outlined in Lenneberg's (1967) 'critical period hypothesis' (CPH) recognizes the existence of an upper age limit in child language acquisition in general and in phonological development in particular. Beyond this uncertain age limit, humans progressively lose both the capacity of perceiving linguistic sounds as well as the ability to realize accurately and consistently a specific sound. Such critical period effects have been evidenced in other species, as well (Lenneberg, 1967). A well-cited study in favor of the CPH is that of Genie (Curtiss, 1977), a girl who failed to acquire normal use of language due to suffering extreme linguistic and social deprivation in early childhood. Lenneberg (1967) argued that our potential for language learning is neurologically dependent; it starts to decline at the age of two and closes at around puberty because the brain gradually matures and loses its plasticity as the hemispheres become specialized during cerebral lateralization. Krashen (1973) claimed that brain lateralization occurs earlier, around the age of five. Ervin-Tripp (1987) discusses the notion of a 'universal bioprogram', initially proposed by Bickerton (1984) with respect to what makes some linguistic structures more difficult than others in both first and second language acquisition. The Critical Period Hypothesis is pertinent to SLA (e.g. Birdsong, 1999; Young-Scholten, 2001) and has been referred to as the 'sensitive period' (e. g. Patowski, 1980). Interestingly, Bates, Dale, & Thal (1995) challenge these ideas of 'a universal maturational timetable for early language development' (96) based on individual variation evidence that is thought to be affected by both genetic and environmental factors. Age as well as timing of exposure in language, so deep-seated in the phonological acquisition of a first language, are equally decisive factors in the acquisition of a second language. An examination of age and timing of exposure to the second language are crucial determinants in this thesis because although the child in the study was not exposed to the second language from birth (as in the case of her L1 Greek), she was subject to it by the first birthday which falls well within the critical period, thus, allotting close-to-first-language status to her second language. This theme will be further elaborated in following discussions on what constitutes an L2 and bilingualism and how these relate to the child in the study.

2.2 Second language acquisition (SLA)

What are those traits that differentiate first and second language acquisition, though? In a general sense, a first language is chronologically and numerically one that is acquired first. Accurate production of the phonological system of a language, or native pronunciation, is the end result of the acquisition of a first language's phonological system; native competence in L2 speech is fundamentally age and input related. Children worldwide begin schooling and, consequently, are more likely to, and do, embark on the formal education of a second language after the age of six or seven. However, people of all ages are exposed to a second language either naturalistically or through education. Even though a second language speaker (SLS) may not necessarily be highly educated in his/her native tongue, this speaker is, nevertheless, proficient in his/her native language's phonology by the age of six. As a result, it is assumed that second language acquirers/learners are already experienced and skillful speakers of a first language. An L2, therefore, differs from an L1 in that it is the language someone learns after the mother tongue has been acquired. L2 may refer to any other language being acquired subsequently to the L1, be that the second, the third, the fourth and so on (Gass & Selinker, 2008). An L2 is acquired through native input accessible to SLSs in the language's environment (e.g. country where the language is primarily spoken), or via native speakers in a foreign environment. However, an L2 is also a *foreign* language, one that is being *learned* abroad, rather than acquired, with minimal access to native input (Gass &

Selinker, 2008). It may be surprising to find a review of Second Language Acquisition (SLA), which usually pertains to adult language learners, in a thesis examining early linguistic/phonological development. A comparison to child SLA may have been more apt. However, the author trusts that, as far as the acquisition of phonology is concerned, child (as opposed to infant/toddler) and adult SLA are analogous due to the effect of the CPH outlined above.

L1 and L2 acquisition are similar notions in that acquisition, rather than learning, takes place in a naturalistic setting with the language being picked up as a matter of course in social interaction rather than being learned in an educational setting through formal instruction or through a combination of both. Ellis (2008) argues that factors that 'affect L2 acquisition differ according to social context' and setting: 'Natural settings' are distinguished into those where the L2 is: a/ the native language of the majority, b/ an official language when the majority speaks another, or c/ a language used in heterogeneous settings. 'Educational settings' involve: a/ 'segregation' (L2 is learned separately from the majority group), b/ 'mother tongue maintenance' (the minority group's L1 is being taught), c/ submersion (the L2 is taught where the L1 is dominant), d/ 'immersion' (L2 is available through bilingual speakers), and e/ 'foreign language classrooms'. Although a more general term, 'second language studies' has been advocated (Gass & Selinker, 2008) to encompass both L2 acquisition and foreign language learning, SLA is a term in the literature with a broader reach and more widely used. Doughty & Long (2003:3) state that SLA 'encompasses basic and applied work on the acquisition and loss of a second (third, etc.) language and dialects by children and adults, learning naturalistically and/or with the aid of formal instruction, as individuals, or in groups, in foreign, second language, and lingua franca settings'. If one assumes that 'children' in this definition includes early childhood, then the acquisition of L2 English in the present study occurring naturalistically through non-native exposure in a foreign setting could well be part of a wider ranging SLA field that includes bilingualism. For a detailed review of second language acquisition and theory see, among others, Klein (1986), Larsen-Freeman & Long (1991), Gregg (1994), Towell & Hawkins (1994), Ritchie & Bhatia (1996), etc. Volumes tackling both L1 and L2 acquisition of phonology include e.g. Ioup & Weinberger (1987), Yavaş (1994), Hannahs & Young-Scholten (1997), Hua & Dodd (2006).

2.2.1 Interlanguage

L2 knowledge includes variable degrees of linguistic ability from beginner to native-like. Second language speech like child developmental speech is in the process of developing (e.g. Selinker, Swain & Dumas, 1975). It has been postulated that the SLS's phonological system is distinctive in that it differs not only from one's native language but also from the target language (TL), or L2. Initially named a 'learner-language' system (Sampson & Richards, 1973) or an 'approximative' system (Nemser, 1971), this intermediate linguistic system between NL and TL is widely referred to as the 'interlanguage' (IL) (Selinker, 1972). Interlanguage is formed by a combination of grammatical features coming from the L1, the L2 and universals and results in overall erroneous production in the L2 and, in the case of phonology, to what is widely referred to as a foreign accent (e.g. Gut, 2007). A 'global foreign accent' (Major, 2001:18) is the outcome of inconsistency in the production of individual segments, of their combinations and of prosodic features while lack of mastery of all three phonological levels prevents near-native production. Amount of exposure and L2 use are deciding corollaries for the extent of accent in adult and child second language speakers (Major, 2008:71). The 'interlanguage hypothesis' (Selinker, 1972) postulates that like Lenneberg's (1967) 'latent psychological structure' in the CPH, there is in SLA an age sensitive 'latent language structure' which becomes active after puberty and which is known to affect linguistic competence in the L2 as a direct byproduct of late exposure to it (e.g. Ioup, 2008). As a criticism to this, however, De Bot, Lowie, & Verspoor (2006) among others state that it is unclear how the CPH can account for the fact that some L2 acquirers do reach native competence. Together with citing cognitive and socio-psychological explanations in the literature, the authors further discuss findings that link neural modification and neurogenesis in SLSs to environmental, behavioral and cognitive changes. Hohenberger & Peltzer-Karpf (2009) have argued that throughout and beyond development, plasticity (i.e. the brain's ability to re-organize in response to external factors) should be made responsible for the '(in)determinism of language'. The interlanguage is not random but rather exhibits common trends among speakers. Selinker, Swain, & Dumas (1975) identify four variables that demonstrate that second-language speech shows recurrent, identifiable strategies: the 'stability' of errors in IL over time, 'mutual intelligibility' among speakers of the same IL, 'systematicity', that is recognizable strategies, at one particular point in time, and 'backsliding' or the regular reappearance in L2 speech of fossilized errors that were thought to be eradicated. It is overall claimed that the IL hypothesis extends to child second language speech in the case of unbalanced bilingual acquisition (e.g. Selinker et al., 1975, Schlyter, 1993) when the weaker language behaves less like L1 and in the absence of native speaker input, as in the 'interlanguage ambiguity hypothesis' (e.g. Paradis, 2000). As will be shown in chapters 4 and 5, the phonological system of the child in this study exhibits characteristics that are universally valid as in L1 acquisition, as well as, IL-like patterns similar to those of child/adult L2 speakers. One such pattern is transfer.

2.2.2 Transfer

One of the major constructs in our understanding of second language acquisition is the notion of transfer that psychologists have investigated as a corollary in any process of learning (for a review, see Major, 2008). Once a certain stage in any general learning process has been achieved, this gained knowledge or skill may become either a foundation or an inhibitor to further learning and, quite often, both. Transfer, therefore, is this twofold effect of a ‘previously learned’ language ‘on subsequently learned ones’ (Edwards & Zampini, 2008:2). The manifestation of transfer is complex, as it is present in all aspects of language (phonology, syntax, semantics and pragmatics, etc.) and manifests itself, not only as errors but also as ‘avoidance, overuse and facilitation’ (Ellis, 2008:29). Both terms ‘transfer’ and ‘interference’ (Weinreich, 1953) between languages during acquisition (see section §2.3.1.2 for more) are being used as well as, the more current one, ‘cross-linguistic influence’. There are two methodologies employed so far for the determination of transfer: comparisons between L1, L2 and IL (Selinker, 1969) and an examination of structures present in L1 only (see Odlin, 2008 and reference therein). It has been claimed that transfer will be shown convincingly by the presence of the following three characteristics in the evidence: similarities between native language and IL, intragroup homogeneity, i.e. internal consistencies in the use of L1 and IL, and intergroup heterogeneity, i.e. similarities/differences of use by speakers of different L1s (Jarvis, 2000).

Historically, within the ‘contrastive analysis hypothesis’ (CAH) (e.g. Fries, 1945, Lado, 1957), a research method involving comparative linguistics, transfer was considered to be the only cause of errors in second language speech. CAH was built on issues of similarity-difference between the two compared languages and it concentrated on explaining and predicting the errors involved in the transition from monolingual to bilingual. CAH, primarily assuming the tenets of structuralism is essentially mapping one language’s structure on another’s and has seen a decline in our days due to the decisive influence of more complex, cognitive theoretical approaches. The influential works of Chomsky and Piaget (e.g. Piattelli-Palmarini, 1980) and later, Selinker (1972) and Selinker et al. (1975) have shaped the view that SLS errors result from a combination of universals, developmental and environmental factors, as well, as transfer. The ‘ontogeny phylogeny model’ (OPM) proposed by Major (2001) claims the following: there are similar phenomena in L1 and L2; L2 acquisition is slower than L1 acquisition; while L2 acquisition progresses, transfer progressively shrinks; UG and universals play a smaller role in the L2 acquisition process; all of these factors have variable influence on the L2 acquirer/learner, as all have to add up to 100 per cent.

Transfer has been documented in numerous phonological studies as on segments (e.g. Flege & Davidian, 1984) and loan phonology (e.g. C. Paradis, 2006). With respect to native Greeks acquiring a second language, Babatsouli & Kappa (2011) discuss the phonological transfer of L1 Greek palatal allophones into L2 English. The central theme of competence/performance in first language acquisition is just as pertinent in SLA because competence emphasizes what speakers *know* while performance refers to what they can *do* with the language in real time (e.g. White, 1989). These notions also introduce individual variability in linguistic production which means that speakers have different speech outputs resulting from the interplay of varying competence and performance factors relating to age and individual variation: the ‘Tarone (1990) - Gregg (1989) debate’. Mispronunciations of L2 segments are classified as phonemic, phonetic, allophonic and distributional (e.g.

Moulton, 1962). Major (2008:68) asks 'what is being transferred?' referring to the theoretical controversy of whether transfer is phonemic or phonetic. While he takes into account features in general (Trubetzkoy, 1939/1958; Jakobson, 1941/1968), the 'feature competition model' (Hancin-Bhatt & Govindjee, 1999) and 'underspecification theory' and 'feature geometry' (e.g. C. Brown, 2000), he concludes that a reconciliation of the controversy between abstract phonology and phonetics is far from being resolved.

Explanations of transfer in the literature are rooted in both production and perception. With an emphasis on surface phonetic forms, Flege (1991) argues that L2 learners unknowingly replace new, similar or identical foreign sounds with L1 sounds as they are 'forcing square pegs into round holes' (151) in a top down manner. Second language theory has attempted to explain transfer in terms of the similarity/difference of sounds, the newness of sounds and the ease/difficulty of sounds, as they compare between a first language and a second language. According to the 'speech learning model' (Flege, 1995), new sounds are more readily perceived and acquired in the L2 than similar ones. An IL realization can be one of three things: either an L1 sound that is similar or distinctively different from the L2 sound, an L2 sound used in the wrong context, or a sound distinctively different from any in the L1 or the L2. Thus, the error may be an L1 transfer, an L2 overextension, or individual variation often the result of universals at work. The surface and underlying forms of L1 sounds affect the L2 speaker's perception of L2 sounds (e.g. Flege, 1991). Perceived similarity of L1 and L2 sounds determines the level of L2 sound assimilation (Best, 1995). The phonetic decoding that adjusts representations into language specific ones is facilitated by acoustic proximity (Kuhl, 2000) and proximity of subtle articulatory gestures (Best & Strange, 1992). Such substantive factors account for phonological bias (Wilson, 2006) in favor of the L1 phonological system. For comprehensive reviews of the transfer phenomenon in second language research see e.g. Gass & Selinker (1983), Major (2008) and Odlin (2008). Although transfer is known to exist during the acquisition of a second language in child/adult L2 speakers (e.g. Flege & Davidian, 1984) or as input-related in bilingualism (Paradis, 2000; Place & Hoff, 2011), what is original in the present thesis is identifying its likely presence longitudinally as part of the child's normal phonological development.

2.3 Bilingual language acquisition

2.3.1 Definitions and taxonomies of bilingualism

A determination of bilingual linguistic status for this child demands a systematic review of definitions and related constructs on bilingualism, which follows in this section. Roeper (1999) ventures the argument that 'the concept of bilingualism has never received a widely acknowledged formal definition'. As early as 1967, Mackey states that 'bilingualism, far from being exceptional, is a problem which affects the majority of the world's population' (11). With more than half the world's population being bi- or multilingual (Crystal, 1995), bilinguals are very diverse and the resulting terminological ambiguity discloses this. That the actual nature of bilingualism is very intricate leading to 'open ended semantics' (Baetens Beardsmore, 1982) is also suggested in Grosjean's (2008) statement that researchers do not yet fully understand who bilinguals really are. In its general sense, bilingualism is the ability to speak two languages, as the obvious etymology of the term also reveals: *bi* (Latin for 'two') + *lingua* (Latin for 'language') and it makes sense that it is should include speakers of two languages. Haugen's (1953) minimalist position states that bilingual is the speaker of one language that can produce meaningful utterances in another.

However, the debate on defining bilingualism is an on-going process with researchers recognizing that, like a chameleon, it may take many different forms depending on the situation and it is therefore difficult to pinpoint an exact definition. This is exemplified by some thirty-seven (37) types of bilingualism recited in just one table by Gass & Selinker (2008:27-28), including terms like: '*incipient bilingual*: someone at the early stages of bilingualism where one language is not fully developed'; '*dominant bilingual*: someone with greater proficiency in one of his or her languages and uses it significantly more than the other language(s)'; '*simultaneous bilingual*: someone whose two languages are present from the onset of speech'; '*unbalanced bilingual*: someone who is not equally fluent in the two languages; *additive* (*vs. subtractive*) bilingual: someone for whom both languages have socially and emotionally equal value, etc. The authors acknowledge that the table is incomplete and, while they themselves cite Valdés' 'mythical bilingual' (2001) as just one more case, they admonish the reader to look into Wei (2000) for even more definitions. Among these definitions, 'heritage speakers' are those bilinguals raised in a home where one language is spoken but subsequently switch to another (Polinsky & Kagan, 2007).

Hamers & Blanc (1983) summarize the taxonomies of factors determining bilingualism: age and context of acquisition, relative status of the two languages, group membership and cultural identity, motivation and context of use. Pienemann & Keßler (2007:248) propose at least three 'yardsticks' for measuring language in bilingualism: developmental trajectories, competence and proficiency. Chapters 4 and 5 discuss in detail competence in terms of consonant correctness and developmental trajectories, respectively, as these yardsticks relate to the child's bilingualism in this study. A brief discussion on the principal factors follows which will help define the exact nature of this child's bilingualism.

2.3.1.1 Age and timing of first exposure

The most confounding factor within the field of bilingual development, as in SLA, is 'age'. The term refers to biological age, maturational age (brain lateralization and plasticity) and the individual speaker's own level on the developmental trajectory. Deuchar & Quay (2000:1) characterize bilingualism as the 'acquisition of two languages in childhood'. A definition of bilingual acquisition may well start from an acknowledgement of the phenomenon as prevalent and conventional. Early bilingualism is bred within the family in an endogenous setting and 'depends upon the family for encouragement if not for protection' (Fishman, 1965:71). There are perhaps as many bilingual children in the world as there are monolingual children (Tucker, 1998). Bilingualism is an asset with cognitive and social-cultural advantages that ought to be fostered (e.g. McLaughlin, 1995; Genesee, 2009). Numerous studies have shown that child bilingualism provides a brain boost and that bilinguals outperform monolinguals in various cognitive tasks e.g. De Lange (2012) and references therein.

The notion of the two languages in bilingualism developing as if there were each one first language in the child originally appeared in Swain (1972). 'Simultaneous' and 'successive' language acquisition are terms devised by MacLauglin (1978) and are extensively employed (e.g. Hoff, Core, Place, Rumiche, Señor, Parra, 2011) with regard to child bilingualism distinguishing between one set of languages that develop concurrently and another whereby one language succeeds the other. 'Bilingual first language acquisition' is a technical term devised by Meisel (1989) that also refers to the simultaneous acquisition of two languages with exposure to both of them before three years of age (see also McLaughlin, 1978, 1995; Genesee, 1989; Montrul, 2008) or one with exposure by at least the one-word stage (Bhatia & Ritchie, 2006). 'Dual' language acquisition (Keshavarz & Ingram, 2002) is another synonym of simultaneous bilingualism that is being used broadly (e.g. Hoff et al., 2011; Paradis et al., 2011; Genesee, 2009, etc.). Meisel (2010:225) argues that 'linguistic as well as neuropsychological evidence' suggests an 'onset between age 3 and 4' as a necessary though not sufficient condition for acquiring native competence in bilingualism. He further claims that the CPH 'should be understood as a cluster of sensitive periods, each defined in terms of an optimal period for the development of specific features of grammar' (225). Meisel (2004:98) claims that 'phonological knowledge appears to become inaccessible before syntactic knowledge' and that 'subcomponents of phonology seem to fade out at different points of development' with the peak beginning shortly before the second birthday, gradually declining by age five and ending sometime between ages seven and ten. The cited author further argues that more linguistic and neuropsychological research is needed in order to verify these age breaks. Sequential bilingualism is also used as a synonym for successiveness meaning acquisition of the L2 either in childhood (between age 4-12 years) ('early sequential bilingualism') or in post-puberty and adulthood ('late sequential bilingualism') (McLaughlin, 1978). Padilla & Lindholm (1984) proposed that exposure to one of the languages much later than birth ought to be regarded as 'consecutive' or 'successive' language acquisition. De Houwer (e.g. 1995, 2009) also espoused this point and introduced the acronym BFLA, standing for Meisel's (1989) 'bilingual first language acquisition' to also refer to simultaneous bilingualism with exposure to the two languages, at the latest, a week from birth. De Houwer (2009), additionally, proposed the terms 'bilingual second language acquisition' (BSLA) referring to exposure to one of the languages well after the first month but by the second birthday and to 'early second language acquisition' (ESLA) which means exposure to a second language at a later stage 'with some regularity over and above their L1 (e.g. through day care and preschool)' (2). The terms, BSLA and ESLA match what is vaguely referred to in the literature as 'early L2'. As seen, the breaching point between simultaneousness and successiveness is overall unclear and not clearly resolved with empirical evidence to date (e.g. De Houwer, 1995; Hua & Dodd, 2006).

2.3.1.2 The status of the languages

Language context and content and what determines language choice in social and situational contexts are equally important correlates in bilingualism. The acronyms ‘L1/L2’ (e.g. Meisel, 2007) have been used alongside the terms ‘dominant/weak’ (e.g. Yip & Matthews, 2007) to distinguish between the two languages because it is known that in bilingualism one language is always more dominant than the other (e.g. Genesee, 2009). The term ‘dominant’ represents the stronger language though it may be an inaccurate term as proficiency is sometimes context-specific (e.g. Kohnert, 2008). Social interaction based on language is a prerequisite for language development (Trevarthen & Aiken, 2001). The ‘microsociological’ and ‘macrosociological’ aspects of bilingualism show that ‘societal concepts such as language vitality, ethnicity … have to use Hakuta’s words (1986:192) ‘psychological reality as concepts in bilinguals’’ (Wei, 2007:44) and are affected by domain variance. Fishman (1965) identifies three controlling factors in the ‘language choice’ of bilinguals: ‘reference group membership’ (with both objective and subjective socio-psychological criteria), ‘situation’ (that is, circumstances at the time of communication that include code-switching), and ‘topic’ as a regulator of language use in multilingual settings. Reference group (e.g. society) is more important to bilinguals than situation variance (e.g. family) or intimacy (e.g. role relations). Language ‘context’ refers to the environment in which bilingual children experience each language, such as at home, school, other social contexts, etc. and language ‘content’ refers to the interactional context (who is/are the interlocutors), as well as, the quality (grammatical accuracy and complexity of input) and quantity (how much exposure) of the linguistic input (e.g. Kohnert's 2008). Differences in environmental exposure to a language may account for the functional modulation in the bilingual’s brain (Perani, Abutalebhi, Paulesu, Brambati, Scifo, Cappa, et al., 2003).

Studies (e.g. Marian & Spivey, 2003) have shown that the two languages in bilinguals are constantly competing for attention. Grosjean (2001) has identified this to be the ‘language mode continuum’. That is, ‘in their everyday lives, bilinguals find themselves at various points along a situation continuum which induce different language modes’, with the ‘base’ language (L1) often impacting the ‘guest’ language (L2) at variable levels of the ‘base-language effect’ (Macnamara & Kushnir, 1971) and vice versa. The move from base to guest mode, fluctuating back and forth along this continuum, is facilitated by a process of brain activation (Green, 1986). He viewed the bilinguals’ control of the two languages in terms of varying levels of ‘activation’: ‘selected’ (controlling speech output), ‘active’ (an on-going mental processing but no access to the speech production) and ‘dormant’ (stored in long-term memory but not surfacing in ongoing processing or production). That language control, in general, is related to activation has also been hinted for adult second language speech where an accommodating lag is sometimes necessitated (e.g. Major, 1977) and ‘automatic switches’ are evidenced elsewhere (Poulisse, Bongaerts, & Kellerman, 1990). Language automaticity as a cognitive task relates to cerebral resources. For a review of language automaticity in SLA, see e,g. Segalowitz (2003). These psycholinguistic orientations on language activation also relate to evidence in the neurolinguistics literature (e.g. Abutalebhi et al., 2005).

Language mixing in the form of code-switching is the linguistic manifestation of the bilingual brain's activation levels and it is evident in bilinguals, native-like SLSs and monolinguals of two speech registers (i.e. the standard language and the dialect). Code-switching refers to the intentional or unintentional alteration between two languages at phrase ('intra-utterance code-mixing') or sentence ('inter-utterance code-mixing') level (Genesee, Paradis, & Crago, 2008) during discourse among people with variable skills in the languages. Though highly stigmatized as evidence of lack of proficiency in a language, code-switching is known for quite a while to be a behavioural norm and a conversational feature among interacting (even competent) bilinguals (e.g. Poplack, 1980; Zentella, 1999). Bilinguals, like monolinguals, are 'human communicators' but they simply communicate differently (Grosjean, 2008). Code-switching signals the bilingual's conduct as floating along the 'language mode continuum' (Grosjean, 2001) with cerebral activation facilitating the fluctuation between languages. As a result, language mode affects the extent and frequency of code-switching. The opening word in the interlocutor's utterance has been said to switch on the bilingual's lexicon (e.g. Grainger & Dijkstra, 1992). The 'gap-filling hypothesis' (Genessee et al., 2008:102) states that bilingual children 'mix words from language X because they do not know the appropriate word in language Y'.

Bilingual children are very sensitive to the language behavior of the adults they are with (Genesee, Boivin, & Nikoladis, 1996) and to language context (Lleó & Kehoe, 2002). Bilingual children distinguish their languages before their first birthday and they match them to the interlocutors by their second birthday (e.g. Genesee et al., 1996; Maneva & Genesee, 2002). If an adult is 'at least receptively bilingual … the bilingual child knows this' (Deuchar & Quay, 2000). During bilingual development, the 'one parent-one language rule', or 'the Grammont rule' (Ronjat, 1913) is a common practice, referring to the 'pattern of parental use in bilingual families in which each parent uses only, or primarily, one language (usually his or her native language) with the child (Genesee et al., 2008:98). As the myth in bilingual development is that bilingual children are 'confused' (e.g. Genesee, 2009), the Grammont rule is adhered to in order to ease language acquisition through separated linguistic input. The pattern of one parent, one language use, also utilizing code-switching, has been reported in the literature (e.g. Brulard & Carr, 2003). Among others (e.g. Huerta, 1977; De Houwer, 1995; Genesee et al., 2008) argue that strict adherence to this pattern of parental use, although recommended, does not substantially matter. There is 'little systematic evidence in support of, or contrary to' (98) the possibility of a child growing up bilingually, even if exposure to the languages is not in a separated fashion. Studies have shown, however, that bilingual children adjust the rates of code-switching to match adult interlocutors (e.g. Comeau, Genesee, & Mendelson, 2007). De Houwer & Bornstein (2003) have likened language use patterns in bilingual families with young children to 'balancing on a tightrope' because, together with code-switching, conversations in bilingual households may run 'dilingually' (e.g. Johnson & Wilson, 2002). A dilingual conversation is one in which the parent speaks his/her language while the child insists on using the other one for reasons of preference or dominance. Resistance to shift language has also been evidenced in inner speech (Fishman, 1965), that is, the mental process of thought. De Houwer (2009) has stated that if dilingual conversations are allowed to become the norm they steer towards downright eradication of the weaker language.

It is not unreasonable to argue that code-switching is the manifestation of interference on the conversational level. Interference, a notion similar to transfer that has found application mostly in the field of bilingualism, becomes evident in the mixing-up of grammatical aspects of two languages. It is defined as deviations from the norms of either language (or errors) in bilingual speech as a result of the bilingual's familiarity with more than one language. Brière (1968:11-12) argues that, with regard to interference 'the hierarchy of difficulties predicted by the linguist may be completely different from the hierarchy of difficulties predicted by the psycholinguist'. The linguist views interference in terms of articulatory or classificatory features while the psycholinguist sees interference as either 'retroactive' or 'proactive' with regard to the degree of similarity between the languages, between convergent/divergent structures and between the learning contexts. Both approaches are being extensively used in understanding interference in bilingualism. As in the case of transfer, segment mispronunciations in interference are classified as phonemic, phonetic, allophonic and distributional (e.g. Moulton, 1962). The basic errors in bilingual phonology involve: 'underdifferentiation of phonemes' when weaker language sounds are not distinguished in the dominant language and, thus, are confused; 'overdifferentiation of phonemes' when dominant language phonemic distinctions are imposed on the weaker language; 'reinterpretation of distinctions' when the bilingual distinguishes weaker language phonemes by redundant features that are, however, relevant in the dominant language; 'actual phone substitution' when phones are pronounced differently but have the same phonemic constitution in the two languages and 'hypercorrectness' when the bilingual shows excessive caution against underdifferentiation (Brière, 1968 and references therein).

The more different the grammar systems of the two languages are, the more difficult will the learning process be and higher the possibility of interference (Weinreich, 1953). It is also known that the appearance and extent of interference relates to whether the bilingual converses with a monolingual or a bilingual interlocutor, limiting interference in the first case but freely succumbing in the second case (Weinreich, 1966). Grosjean (2012:13) provides a review of subsequent definitions on interference and, recognizing them to be too broad, suggests a differentiation between 'transfers', or 'static elements' that reflect the permanent traces of one language on the other and 'interferences' or 'dynamic elements' that show ephemerally in the other language. In other words, interferences are linked to processing and have to be accounted for by encoding mechanisms. As the two languages are in contact within the same person, interference within intermingling entities is inevitable and, thus, it is a normal feature in bilingualism (Grosjean, 2008). That existing definitions of transfer and interference should not be considered full-proof is also claimed by Odlin (2008).

2.3.1.3 Degree of competence

Balance, fluency and native-like ability have equally concerned the field of bilingualism towards determining a definition. 'Overall, there is no consensus of what constitutes bilingualism and how bilingual competence is represented' (Auer & Wei, 2007:246). Edwards (2006:7) states that bilinguals 'differ in terms of degree'; her contention, on one end of the argument, is that if someone knows just a couple of words in a foreign language, this alone indicates 'some command' of that language and, as a result, 'everyone is bilingual'. On the other end, the argument (as in SLA) is that the 'true' bilingual is equally fluent in both languages and that only balanced competence makes for a real bilingual (e.g. Bloomfield, 1933; Thiery, 1978). In this position, the fact that 'not all bilingual exposure results in active bilingualism' (De Houwer, 2002) would have no grounding at all. 'Passive' bilingualism, nevertheless, is an established phenomenon in the field (e.g. De Houwer, 2002 and references therein) and results when linguistic competence assumes receptive but not productive knowledge (Nation, 2001), that is, the child comprehends speech in both languages but consciously refuses to speak the weaker one. Bilingual households may neither compel bilingual development, as passive bilingualism attests (e.g. De Houwer, 1995; von Raffler-Engel, 1965), nor assure bilingualism. Bilingual children are known to eradicate the use of one language when linguistic and social settings shift (e.g. Major, 1977). Attrition in young children's L1 (e.g. Tsimpli, 2007), as well as, incomplete acquisition in bilingualism (Montrul, 2008; 2011) are known facts. Grosjean (1989) postulates that, for successful bilingual acquisition to ensue, 'the critical factor is need'. His holistic view of bilingualism advocates the idea that the bilingual speaker should not be considered as the sum of 'two complete or incomplete monolinguals', that is, as having 'two separate and isolable language competencies' but as someone 'with a unique and specific linguistic configuration' (Grosjean, 1985:470). The argument is that bilinguals should not be described and evaluated in terms of fluency and balance in their languages and the monolingual speaker ought not to be the model of the 'normal speaker-hearer' (ibid) against which bilingualism must be measured.

This viewpoint, also hinted earlier in Oksaar (1983), is widely accepted in the literature of bilingualism (e.g. Schlyter, 1993; Meisel, 2004; De Houwer, 2007; Norbert, 2011). Bilinguals are argued to be seldom balanced; there is an 'ebb and flow' in bilingualism (McLaughlin, 1995) as bilinguals show a trade-off between L1 and L2 proficiency (Grosjean, 1985). In 'early bilingualism', in particular, ultimate attainment is open-ended (Gass & Selinker, 2008:27) because bilinguals cannot always have the 'enormous amount of practice' (De Keyser & Larson-Hall, 2005:97) required due to the very circumstances in their bilingualism. Some bilinguals have proficient oral and writing skills in both languages;

others may speak but are not educated in one of the languages; and others use one of the languages in certain environments as only at home, only at work, or only with a group of friends. 'The complementarity principle' (Grosjean, 1989) demonstrates this arguing that the languages in bilingualism are acquired for different purposes, with different people and in different situations. As a result, fluency in the languages is domain specific and will depend on the need for that language. The 'weaker language hypothesis' (Schlyter, 1993) addresses the issue of whether the weaker (non-dominant) language of simultaneous bilingual acquisition comes to resemble a second language. Affective factors (e.g. McLaughlin, 1995), cognition and personality, attention, motivation, memory and language ability also influence linguistic competence (e.g Perani, Paulesu, Sebastian-Galles, Dupoux, Dehaene, Betinardi, Cappa, Fazio, & Mehler, 1998). Cook (1992) argues that the bilingual's multicompetence is more than just one of degree, as it involves metalinguistic awareness not present in monolinguals. Valdés (2001) demonstrates the variability in bilingualism visually with a linear bilingual continuum. Here we provide the adapted version in Gass & Selinker (2008:28): A Ab Ab Ab Ab Ba Ba Ba Ba Ba Ba B, where A represents the monolingual speaker of one language and B the monolingual speaker of the other language. Bilinguals of the two languages fall between the two in varying degrees of aptitude. Such a linear representation of the varying levels of aptitude in bilinguals, however, is relatively incomplete and one-dimensional for the simple reason that aptitude for each of these bilinguals in the line is not strictly a constant. Grosjean's 'language mode continuum' and Green's activation levels underline the inherently unsteady interplay of the languages in the bilingual person that are, *by default*, in flux not only constantly competing during daily language-mode shifts but also due to *dominance* variance in the lifespan. As discussed in the next section, if a bilingual mental lexicon is assumed with 'separate formulators' and 'lexical subsets' for each language, 'it is plausible that the bilingual can keep the two language systems separate' (Grosjean, 2008). A discussion of balance, fluency and native-like ability in this study will ensue in Chapter 4 where the child's two languages are closely compared at the onset of data collection as well as their developmental trajectories in Chapter 5.

2.3.1.4 Bilingualism vs. SLA

There are three constructs that differentiate bilingualism from SLA: age of exposure to the L2, acquisition-vs.-learning and their direct consequence: native or non-native competence. The CPH (Lenneberg, 1967; Krashen, 1973) which relates the acquisition of language to limitations in neural development and the 'acquisition-versus-learning hypothesis' (Krashen, 1982) are the principal parameters that disallow bridging the gap between the fields of SLA and bilingualism. The 'fundamental difference hypothesis' (FDH) postulates that the adult L2 acquirer does not have the same potential for language acquisition as a child L1 learner (Bley-Vroman, 1989) and, thus, a bilingual child acquirer (Montrul, 2009). Similarly, early childhood (i.e. infant and toddler) studies of L2 are not in the scope of SLA as such an inclusion would oppose its principal dictum that an L2 is being acquired or learned after the L1 is well-established. Interestingly, the process of acquiring a second language past childhood has been equated with bilingualism (e.g. Haugen, 1953, Bhatia, 2006). However, 'skilled adult bilinguals' are known to employ different cognitive processes than those of adult second language speakers (Kroll & Sunderman, 2003) who are struggling to achieve native-like aptitude in the L2 as a direct byproduct of their late exposure to it (Ioup, 2008). Despite the argument that native competence is within the reach of L2 acquirers (e.g. De Bot et al., 2006; Gut, 2009), it is not the norm in L2 acquisition irrespective of the nature of the input and, therefore, bilingualism will very rarely be the end result of the second language acquisition process (Kroll & Sunderman, 2003). SLA acknowledges bilingualism but places it at an extreme high point of linguistic aptitude in both languages, a notion that is barely realistic. Valdés (2001) suggests bridging the gap between SLA and bilingualism by arguing that bilingualism should be the study of both the process of linguistic development, as well as, ultimate attainment.

Native competence is *sine qua non* in L1 acquisition due to the exposure to only one (consequently, native) input but also a *differentia specifica* between L1 and L2. In bilingualism, however, the differentiation is not as clear-cut. One parent's native language is often the other parent's L2 (e.g. Major, 1977) and, as a result, there is second language exposure in bilingual acquisition since native input providers to the bilingual child have at least one common language of communication between themselves. The presence or absence of the L2 community accounts for the difference between endogenous and exogenous 'bilinguality' (Pienemann & Keßler, 2007). Paradis (2000:177 and references therein) makes an 'interlanguage ambiguity hypothesis' arguing that cross-linguistic transfer in bilingualism is likely when there is interlanguage ambiguity in the input. Cross-linguistic interaction is not evidence against the claim that the simultaneous acquisition of two languages should be qualified as first language development in each of the languages acquired (Meisel, 2004). Although early bilingual development based primarily on non-native input in one language has not been dismissed in the field, there are no studies to make a claim of its existence (e.g. Place & Hoff, 2011). Historically, the British philosopher, John Stuart Mills, is anecdotally acknowledged (Friedrick, Ludtke, & Mehrtens Calvin, 1983) to have been learning non-native Greek at the early age of three. Hakuta (1986) states that the narrow view of bilingualism signifying native competence is less preferable, since only few bilinguals have native-like control in both languages. De Houwer (2009) says that children 'do not hear accents, they hear people! And people do not always talk exactly the way that you would expect based on phonological descriptions for a particular language' (158). To Roeper (1999), bilingualism and '[i]ts cousins, dialects, interlanguage, foreign language, and speech register all remain important social terms, but unclear theoretical terms'. These arguments become a more absolute postulate in Grosjean (1989) who defines bilingualism as the everyday use of two languages irrespective of native-like fluency. The present study comes to fill in some of this gap in the literature by examining the toddler's acquisition of L2 English through non-native exposure in exogenous bilingualism.

2.3.2 Major theoretical constructs in bilingualism

2.3.2.1 The bilingual mental lexicon

The mental lexicon is as important in bilingualism as in language acquisition in general. How bilinguals process lexical items in their two languages has been the focus of interdisciplinary discussion (e.g. Pavlenko, 2008) with the earliest assumption being that words and concepts are stored separately and that lexicon organization in the bilingual is one of three kinds: 'compound' (single concept/separate entries per language), 'coordinate' (separate concept and entry pairs per language) or 'subordinate' (single concept but no direct link for the L2 entry (Weinreich, 1953). Subsequent positions regarding the bilingual lexicon have ranged from holistic (e.g. Kirsner, Smith, Lockhart, King, & Jain, 1984; Green, 1986) to those that view it as separated (e.g. Grainger & Jacobs, 1994). Arguments in favor of some degree of lexicon separation include that retrieval of language following brain damage takes place one at a time not precluding the reappearance of the L2 first (Singleton, 1999). Although the proposition of total lexicon integration (e.g. Brysbaert, 1998) may be difficult to sustain, the opposite extreme of completely disconnected L1 and L2 lexicons cannot not be clearly claimed either, since code-switching and interference are strong tendencies of bilingual speakers. De Bot (1992) adapted Levelt's (1989) monolingual speaker model of the lexicon, recognizing the need for such a model of bilingual speech production. De Bot's model assumes many different processing components or levels. While the conceptualizer is partly language specific and partly language independent, there are different formulators for each language and the output reaching the articulator employs non-language-specific motor strategies. The bilingual version of the model has incorporated various bilingual speech aspects such as code-switching, lexical storage and retrieval, etc. In support of De Bot's bilingual model, Singleton (1999:190) argues that 'the two systems are in communication with each other –whether via direct connections between … L1 and L2 lexical nodes, or via a common conceptual store (or both)'. De Bot's bilingual production model, however, has been criticized for being one of static bilingualism rather than a model of bilingual language acquisition (Grosjean, 2008).

Evidence from studies in bilingual lexicon development has been contradictory. Celce-Murcia (1978) studied lexical selection in an English/French bilingual two-year old and found avoidance patterns as evidence of language differentiation. Volterra & Taeschner's (1978) well-cited study of Lisa and Giulia's bilingualism in Italian and German focused on both the lexicon and morphosyntax. Their linguistic model hypothesized three stages: a unified ensemble of lexicon and syntax initially, separation of the two lexicons but one syntactic component in the intermediate stage and full differentiation of lexicons and syntax between the languages by the third year. In their proposal, there is a single lexical system with just one entry per language and no translation equivalents while separation establishes itself around age two. Fantini's (1985) postulation is in the same line of thought. Vihman (1985) was among the first ones to disconfirm the lack of early translation equivalence and Pye (1986) subsequently confirms the claim by re-examining her data. Yavaş (1995:189) studied the phonology of the first 50-words in a Portuguese-Turkish bilingual child and found lexical avoidance patterns 'related to language independent segmental restrictions'. Quay's (1995) study of an English/Spanish bilingual child, Manuela, produces evidence that 36% and 40% of her vocabulary in English and Spanish respectively at 1;5 was matched by equivalents in the other language, a finding that has been further substantiated (e.g. Pearson, Fernandez, & Oller, 1993; Vihman, 2002). It is known that monolingual children's acquisition of vocabulary is grounded on the principle of mutual exclusivity, that is, new words refer to new referents (e.g. Markman, Wasow, & Hansen, 2003). The 'competition model' (e.g. Bates & MacWhinney, 1987) postulates that the bilingual child learns individual words independently rather than through a translation route whereby the L2 word is added as a subsequent token of the L1 referent-token. Thus, early translation ability in bilingual children suggests that they are acquiring two languages rather than one (Patterson & Person, 2004).

2.3.2.2 One vs. two phonological systems

A long-standing discussion revolves around the one-versus-two phonological systems hypothesis in early bilingual acquisition which parallels that on the bilingual lexicon. The controversies both in terms of lexis and phonology are indicative of the profound complexity of the issue that seems unlikely it will be eased within the simplified perspective of a single/double analogy. Hua & Dodd (2006) summarize the state of the matters by saying that little is known about the degree of relatedness of the phonological systems in the bilingual child, irrespective of whether they are learned simultaneously or successively. Historically, the theme of bilingual linguistic systems sprung up in loanword research (e.g. Bloch, 1950) that questioned the phonological status of loans (i.e. words used in one language borrowed from another) in a language's phonological system. The ambiguity of this theme jump-started a parallel investigation in bilingual research in the early 1950s on whether a bilingual's languages have distinct and separate grammar components or are dealt with as a unified whole (e.g. Weinreich, 1953; Erwin & Osgood, 1954). Weinreich (1953:9-10) classified bilingual linguistic systems into three types: *coexistent systems*, functionally independent at both the phonetic and phonological levels, *merged systems*, a single phonological system but a two-member phonetic level, and *super-subordinate systems* with a dominant L1 system at both levels, classifications similar to those of the bilingual lexicon discussed in the previous section. Researchers since, have focused on identifying the nature of the bilingual phonological organization at its start. Swain wrote about a 'common storage model' according to which all rules, even those specific to one language, are originally stowed together and are only subsequently identified separately for each language through a process of differentiation (e.g. Swain, 1972; Swain & Wesche, 1975). With respect to language mixing, Redlinger & Park (1980:334) wrote: 'the subjects were involved in a gradual process of language differentiation and are in agreement with … the one system approach to bilingual acquisition'.

Evidence from studies in bilingual acquisition of phonology has been as contradictory as those in bilingual lexicon development. An increasing number of such case studies had a focus on segmental acquisition of phonology although, to our knowledge, no study has examined the one-versus-two systems hypothesis in bilingual Greek/English acquisition. With his prodigious longitudinal study on Hildegard's German/English bilingualism on all grammatical levels, Leopold (1949) is the earliest advocate of an initial integrated phonological system arguing that 'infants exposed to two languages from the beginning … weld the double presentation into one unified speech system' (Leopold, 1953/1954:24). A 'split into two contrasting languages' was, however, observed to take place 'toward the end of the second year' (Leopold, 1953/1954:141). Burling (1959/1978) likewise favors a single linguistic mechanism 'forged largely from Garo' notwithstanding 'the addition of English vocabulary and a few extra English phones' (184). His son, Stephen, separated the vowel systems by 2;9 but failed to differentiate the consonant system before 3;9, when contact with Garo is reportedly ceased. Eileen's (Vogel, 1975) Romanian/English developmental snapshot at the age of two follows in a similar line deducing that the child showed analogous phonological and phonotactic processes but that some differences were also noticed reflecting the different 'phonological distribution of the two languages'(51).

A case in American English/Brazilian Portuguese bilingual acquisition was investigated by Major (1977) reporting that after an initial lack of phonetic differentiation, Sylvia's languages clearly breach at 1;9. Volterra & Taeschner's (1978) study, discussed in 2.3.2.1, had an instrumental effect in subsequent discussions of the phonological systems in bilingualism signifying once more the importance of the lexicon in phonological development. Ingram (1981a:96) infers that Volterra & Taeschner's second stage also suggests separation of the phonologies before syntax. Krasinski (1989) interprets the results in Leopold (1953/1954), Burling (1959/1978) and Major (1977) as verifying Volterra & Taeschner's initial undifferentiated stage. The single-system stance in bilingual beginnings has been postulated as the 'unitary language systems hypothesis' (Genesee, 1989). Interestingly, an initial single system hypothesis has been claimed (e.g. Wode, 1980; Watson, 1991) to also epitomize the phonological systems of successive bilinguals whereby the L2 system is differentiated by altering and adding on the L1 system. Fantini (1985) presents evidence for this by examining Mario's phonological systems in Spanish/English successive bilingual development.

The alternative to the unitary model is the 'differentiated language systems hypothesis' (Genesee, 1989) or the 'dual hypothesis model' (Keshavarz & Ingram, 2002), a perspective that claims children acquire separate phonologies from the onset of word acquisition.

Evidence for this comes from the fact that children are very sensitive to language specific differences at an early point of phonological acquisition (Ingram, 1989b). In Ingram (1981b), evidence for the emergence of two phonological systems was attested in an Italian/English bilingual, L., in that 'specific tendencies in the output … help identify' differentiation although consonant inventories were nevertheless 'highly similar' (103). A comparison of Andreas' Norwegian/English bilingual systems (Johnson & Lancaster, 1998) also reveals evidence of early differentiation but the question on whether there are two distinct systems is admitted difficult to answer. Comparison of two studies in Spanish/English bilingual acquisition of segments draws attention to the importance of individual child differences in acquisition: Fernando (Schnitzer & Krasinksi, 1994) did not separate the Spanish/English consonant systems until 2;7 while his sibling, Zevio (Schnitzer & Krasinksi, 1996:560) 'developed two systems of phonology without passing through a single system period'. Deuchar & Clark (1996) studied Manuela's phonetic realizations in developing English/Spanish and report early separation of the languages in terms of voicing contrast. They found no single, unified English/Spanish system, yet they admit to the child's progression from 'a lack of system in either language at 1;11 to the establishment of a clear voicing' distinction at 2;3 (363).

Holm & Dodd (1999) reported the development of two Cantonese/English bilingual two-year-old children assessed on a monthly basis after the introduction of the second language and found evidence of separate phonological systems for each language. This is a noteworthy finding in that these successive bilingual two-year olds would be expected to be building their L2 system by superimposing on their L1 (e.g. Wode, 1980; Watson, 1991) as discussed earlier in this section. Bunta, Davidovich, & Ingram (2006) compute surface separation of the phonological systems of R.'s Hungarian/English on the phonetic level but argue in favor of a common underlying phonological system. This is explained in terms of an 'underlying unitary hypothesis' (UUH) whereby the acquisition of similar languages will provide counter-evidence for the separation of the systems. In arguing in favor of two-systems, Paradis (2000) introduces the theme of degree of separation: the limited amount of cross-linguistic effects is evidence of language specific sensitivities as a single phonological system would reveal itself in unsystematic interference. She argues that 'the dual linguistic representations of a bilingual child are probably not hermetically sealed' but there is interaction in development just as there is 'overlap between the final state systems' in adult bilinguals. Further, Lleó & Kehoe (2002:234) assume the presence of two systems 'as evidenced by pragmatic separation' and have argued that cross-linguistic differences allow a distinction between bilingual and monolingual children's phonological patterns, although finer grained phonetic evidence is more reliable through acoustic analysis. Early differentiation of French/English segmental patterns was observed by Brulard & Carr (2003) in their son's developing phonologies in terms of consonant harmony, overgeneralization of word-final /t/ and avoidance of word-initial fricatives.

Relatively fewer studies have attempted investigation of the one-versus-two systems hypothesis in terms of prosody but the evidence is just as inconsistent. Paradis (1996) examined the truncation patterns in multisyllabic words by a group of English/French bilingual two-year olds and compared them with those of the respective monolinguals. She found truncation patterns that were specific to either English or French but because of differences in syllable structure between the bilingual and monolingual groups, she advocated that phonological systems are not autonomous but rather in interaction with each other. Gut (2000a, b) investigated the acquisition of intonation by three German/English speaking children, Hannah, Laura and Adam between the ages of 2;1 and 5;5 and concluded that, although suprasegmental phonologies are found to develop separately, an initial fused system for nucleus placement, pitch and intonation phrasing was also attested. Early separation in terms of prosodic aspects in bilingual phonological development was supported in a child case study by Keshavarz & Ingram (2002). In Arsham's acquisition of Farsi and English, the results in stress patterns between the languages are shown to support the dual hypothesis model in general, although a considerable amount of mutual influence is evidenced on the segmental level. This finding emerges in reverse order in Brulard & Carr (2003:17), discussed previously, since Tom had a 'single prosodic production phonology' at the beginning despite his early patterns of phonetic differentiation.

Vihman (2002) questions both the single and double system formulations by maintaining that there is no linguistic system at the very beginning. It is implicit knowledge that allows the child to obtain distributional knowledge on the languages while explicit learning, developed via a whole-word or templatic approach becomes the basis for the subsequent acquisition of detailed phonological knowledge. What is interesting in this approach is that development of phonology is seen as corollary of lexical acquisition, underpinning the significance of the mental lexicon and the dominance of meaning over form (as discussed in sections §2.1.2 & 2.3.2.1). This thesis aims to shed some more light into this debate by examining the child's phonologies in the two languages at the age of 2;7 to determine how age of exposure and non-native input in the second language affects existing knowledge on the one-versus-two phonological systems hypothesis (discussed in Chapters 4, 5 and 7).

2.3.2.3 Monolingual vs. bilingual acquisition

Simultaneous bilingualism is affected by factors that operate in monolingual acquisition as well as those specific to bilingualism, that is, combinations of different languages, context, amount and consistency of exposure. Both Meisel (2001) and MacWhinney (2001) have claimed that simultaneous bilingualism may well be the point where the barriers between first and second language acquisition may be brought down and a more unified theoretical framework can be embraced. Monolingual and bilingual child language acquisition is acknowledged to be guided by fundamentally the same 'universal operating principles' (Slobin, 1973) as far as the general course of language development is concerned. 'The main distinction between actively bilingual children on the one hand and monolingual children on the other is that the first are able to make themselves understood in two languages whereas the latter are not. Apart from this, there are far more similarities than differences' (e.g. De Houwer, 2002:8). It is a predominant view in the literature that bilingual child phonological acquisition is consistent with monolingual acquisition (e.g. Ingram, 1981b; Paradis, 1996, 2001; Johnson & Lancaster, 1998; Lleó & Kehoe, 2002; Bunta, Fabiano-Smith, Goldstein, & Ingram, 2009). The 'logical problem of bilingual acquisition' (Yip & Matthews, 2007) centers on the question of why bilingual acquisition isn't marked by significant delay and defective mastery across both languages considering the varied and more subtle input ambiguity cross-linguistically in bilingualism. Bilingual children go through the same linguistic stages as monolingual children and start off their meaningful holophrases in the second year of life (e.g. Ronjat, 1913; Ingram, 1981b; Brulard & Carr, 2003). A noticeable period of silence is evidenced to sometimes precede speech production in bilingual acquisition (e.g. Genesee et al., 2008), as is the case in first language acquisition (e.g. Vihman, Macken, Miller, Simmons, & Miller, 1985), discussed in section §2.4.1.3 below, and in second language acquisition (e.g. Winitz, 1984). Tabors (2008) states that children acquiring a second language go through similar stages as in L1 and bilingual acquisition, that is: L1 use; non-verbal period; telegraphic formulaic use and, lastly, productive sentences.

Bilingual children, like monolingual children, exhibit 'individual variation' (e.g. Leonard, Newhoff, & Mesalam, 1980; Bates et al., 1995) because their propensities affect the onset of speech, the speed and time of complete acquisition. Individual variation renders minute differences between monolingual and bilingual acquisition harder to determine (e.g. Johnson & Lancaster, 1998; Paradis, 2000). Bilingual children's first utterances relate to their input languages (e.g. De Houwer, 1995; Deuchar & Quay, 2000) and their mistakes are guided by similar processes such as overgeneralization, reduplication, overextension, underextension, etc., as found in L1 acquisition. Children, generally, are able to comprehend more than they are capable of saying whether monolingual (e.g. Bates et al., 1995) or bilingual (e.g. Pearson, Fernandez, & Oller, 1993). Monolingual and bilingual children acquiring the *same* language exhibit similar characteristics in terms of patterns and mistakes (De Houwer, 2002). Despite the similarities involved, though, the general agreement is that most differences between monolingual and bilingual acquisition are those resulting from linguistic competence rather than the process of acquisition.

Bilingual competence, as discussed earlier, is affected by the complex interplay of the two codes in bilingualism. While simultaneous bilingual children are commensurate to monolingual children in terms of lexical and morpho-syntactic development (e.g. Nicoladis & Genesee, 1996), their phonological development is not always so (e.g. Werker & Byers-Heinlein, 2008). Paradis (2000:181) argues that such phonological and phonetic differences 'may well be indistinguishable … except by precise instrumental measurement' though such early differences are unlikely to have 'perceptible consequences … in the long run' (Genesee, 2009). In successive bilingualism, distinctions are a lot more evident as a result of the more pronounced effects of the variability of exposure. Studies have shown (e.g. Hoff,

2006) that there is an enormous range of variability in how much speech children with dual language exposure hear. Bilingual children may well hear as much in either language as some monolingual children hear in one (De Houwer, 2009). Typically, though, a child exposed to two languages is likely to hear less of each one than a monolingual child exposed to a single one (Hoff, Core, Place, Rumiche, Señor, & Parra, 2011). That relative amount of exposure in each language is a strong forecaster of children's speed of development in those languages has already been established (Place & Hoff, 2011).

2.4 Phonological development and theory: an Overview

The study of phonological development comprises a division of the study of language acquisition, in general, by focusing on language acquisition theories, as well as, the interplay between language acquisition data and phonological theories. Crystal (2003:8) invokes a differentiation between the terms 'acquisition', referring to the learning of a linguistic rule (of grammar, phonology, etc.) and 'development' referring to its actual application in social use. However, the term *acquisition* is mostly used in the literature to refer to general language learning processes, whether it is a first language, a second or bilingualism (e.g. Lust & Foley, 2004; Ritchie & Bhatia, 1996; De Houwer, 2009) but both terms, *acquisition* and *development*, are interchangeably used to refer to the learning of phonology by children (e.g. Vihman, 1996; Bernhardt & Stemberger, 1998; Fabiano-Smith & Barlow 2010; Smith, 2010). In the present thesis, the term *acquisition* is used to refer to language learning in general, while *phonological development* in particular refers to the dynamic process during which a speaker attains competence/performance in a language's phonological system. Acquisition is also used here in the sense of complete or ultimate attainment to differentiate between the process on the move (development) and a *fairly* static outcome (acquisition). The child's linguistic 'system in the process of build-up' (Jakobson, 1941/1968) is an intermediate language in its own right: 'each child must construct his or her own version of the adult system' (Menn & Matthei, 1992:222) but there is, in the literature, no *single term* of reference to it (to my knowledge). With the expressions 'protowords' (Bates, 1976, see section 2.4.1.3 below and Menn, 1976) and 'interlanguage' (Selinker, 1972) in mind, one could coin the term *protolanguage* (*proto* meaning *first*) to refer to the child's developing linguistic system from initial reflexive vocalizations to the acquisition of adult-like production. This same term, previously used by Halliday (1979) refers to what Vihman (1996:130) describes as 'relatively stable child forms with relatively consistent use which *lack* any clear connection with the form + meaning unit of the conventional adult model'.

The remaining section will outline the major themes and theories in the phonological development of protolanguage, the term referring to the extended chronology introduced here. As argued earlier in the multifaceted theoretical framework (§2.1), phonological development has been investigated in terms of psycholinguistic, cognitive, neurolinguistic and 'biological' (or 'perceptuomotor' Vihman, 1996:31) approaches that are, by and large, relevant to language acquisition in general. Phonological development, like acquisition, involves a process of learning. *Development*, however, further implies that language learning is not a stationary process occurring at a certain interval in time (long or short) but it involves progression (as well as regression) over a longer span of time. This has been a main controversy between language acquisition research and child language research (e.g. Ingram, 1989a; Kappa, in press). The study of phonological development has, consequently, tackled developmental issues, such as, stages of acquisition, the order of phonological acquisition, phonological processes, continuity/discontinuity themes, the nature of the child's phonological representation in perception and production and, lastly, the makeup of the child's lexicon as compared to the adult's. Parallel to these general theoretical approaches, phonological development has also been guided by purely linguistic models and phonological theory. Although it is not in the scope of the thesis to contribute empirically to every single aspect, the extended review is meant to emphasize the complexity of the subject and the need for maintaining a holistic outlook. Although a single-aspect focus on a research question does provide an in-depth investigation, such a one-sided approach may not acknowledge the potential limitations in result interpretation. This is clearly illustrated in the results and interpretations discussed in Chapter 6. This thesis further anticipates making a substantial and original contribution in the field of phonological development as it is the first study that traces and portrays development schematically based on actual statistics obtained from data that were both frequent in quantity and longitudinal in span (Chapter 5). Sections 2.4.1-2.4.2 and 2.4.5-2.4.6 review themes that are core research themes here and will facilitate understanding of this study's results and their interpretation (see Chapter 5). Furthermore, the results obtained in this study will show that an interpretation of child developmental data only in terms of purely linguistic models and phonological theory may be an inadequate approach (see Chapters 5 and 6).

2.4.1 Stages in language acquisition and phonological development

2.4.1.1 What is a stage?

The term *stage* may refer to a phase, a period, a step, a point, a juncture, as well as, time. Due to the multiple semantic references involved in it, *stage* has been arbitrarily used in both language acquisition and phonological development to refer to similar, but not the same, entities. The general agreement in the literature is that the intended meaning of the term should be clearly defined in studies that involve it, if results between different studies are to be comparable and relatable (e.g. Ingram, 1989a:32; Bernhardt & Stemberger, 1998:6-7). This is because the ultimate goal for the presence or absence of stages is to provide substantial evidence for a theory of language acquisition.

Ingram (1989a) relates four different meanings to the term *stage* in language acquisition as a: 1. 'point on a continuum' where linguistic phenomena are judged at specific points in time. At these points, both progression and regression are possible, 2. 'plateau', that is, a static and more permanent halt in the development (as in the cases of complete acquisition or ultimate attainment), 3. 'transition', where the plateau is a temporary halt in development and, 4. a phase of 'acceleration', i.e. a spurt in linguistic development. These definitions are given with respect to the behavior of a *single* developing linguistic phenomenon. With regard to how *multiple* linguistic phenomena interrelate and interact during development, Ingram (1989a) states that a stage can also be seen as a: 1. 'succession', whereby one phenomenon succeeds another, 2. 'overextension' or generalization of one phenomenon to refer to something else, 3. 'co-occurrence', whereby a phenomenon is continually present through multiple phases and, 4. 'correlation', whereby two occurrences not necessarily related may be accounted for by the presence of a common principle exercising on both. Lastly, a stage may be 'implicational', in that the presence of a phenomenon implies the presence of another phenomenon or a 'principle' stage, meaning there is no interrelation between the two observed phenomena. Ingram further mentions Brainerd's (1978) classifications of 'descriptive' stages (i.e. phenomena undergo change due to the effect of certain variables) and 'explanatory' stages (both phenomena and effecting variables may subject to external measurements) summarizing the above. Overall, some 'cause' should be proposed for the definition of stage; descriptive stages determined by measurements or 'evidence' are the first step for finding explanatory stages (Ingram, 1989a:54-55). Beers (1995:5) argues that most studies of language acquisition propose descriptive stages since the 'independent evidence' of explanatory stages 'is often difficult to obtain'.

2.4.1.2 The continuity and discontinuity hypotheses

The lack of unanimous agreement on 'what is a stage' has led to a deep-rooted theoretical controversy in phonological development. Is phonological development from onset to complete acquisition continuous or discontinuous? The major constructs influencing the answer towards either continuity or discontinuity relate to innateness, cognition and mental representations with researchers vacillating between such perspectives. The definition of stage as 'a "period" or "point" of acquisition' with 'no prescribed set of behaviors … a necessary step in an invariant sequence' (Bernhardt & Stemberger, 1998:6) is largely advocated by researchers supporting continuity in phonological development. Variability in child phonology together with 'intermediate stage' grammars (Dresher, 1994, quoted in Bernhardt & Stemberger, 1998:7) fall within this perspective as normal steps without an adverse effect on the end result. Stampe (1979), Wexler & Culicover (1980), Chomsky (1986), among others, are proponents of the continuity argument as the child is believed to gradually and naturally go from an initial, innate stage (or UG) to the adult end-state by early setting the parameters found in the available linguistic input. Macken (1995:675) renames this stance as the 'strong identity thesis' in that there are no qualitative differences between child and adult grammars as advocated by the innateness paradigm but only quantitative.

Assuming that there is continuity in UG, Dressler (1998) claims that principles and dependencies will be acquired 'in a universally determined order, while still allowing for considerable variation'. Weissenborn, Goodluck, & Roeper (1992) have differentiated between 'strong continuity' (all UG principles and parameters are available and operative from the beginning; early representations may or may not obey the parametric values of the TL) and 'weak continuity' (UG totally constrains the child's representations early on with reference to syntax. According to Fikkert (2007) most theories nowadays, e.g. in the nativist view of 'optimality theory' (OT) (Prince & Smolensky, 1993, 2004; Tesar & Smolensky, 1998) assume continuity: 'child phonology has the same substance as adult phonology: a set of universal markedness constraints on outputs and computational principles to determine optimal input-output mappings (faithfulness constraints and correspondence relations)'. Evidence for the continuity hypothesis in bilingual Spanish/English acquisition of phonology has been provided by Fabiano-Smith & Barlow (2010).

The opposite view, whereby a stage is a compulsory step in the developmental sequence with clearly defined, non-interrelating steps, adopts a more strict perspective and is mostly advocated by proponents of discontinuity in development. Discontinuity arguments are often relatable to the presence of distinct maturational advances in the biology of humans and other species (e.g. Lenneberg, 1967). Well-cited is Jakobson's (1941/68) contention that there is discontinuity between babbling and the canonical onset of speech in children, though this has been subsequently refuted (Vihman, 1992) based on biological approaches in phonological development (Locke, 1983). An early proposition in the development of phonology contents that children initially go from whole word representations to more abstract URs that relate to segments and features thus suggesting discontinuity in development (e.g. Waterson, 1971; Ferguson & Farewell, 1975; C. Levelt, 1994). This approach is, nowadays, more widely known as the 'templatic approach' (e.g. Vihman & Croft, 2007) in early phonology and is generally assumed to apply to very young children before they have acquired 50 words. Bernhardt & Stemberger (1998) have emphasized incongruity between this stance and Vihman's (1992) claim that there are segmental and syllabic similarities and, consequently, continuity between babbling and speech. In addition to this, the opposite argument has also been made: older children (past the 50-word stage but under 5 or 6 years old) similarly have a more 'wholistic' representation of the word's pronunciation as compared to adults who 'judge the similarity of two words on the basis of how many phonemes match exactly' (Stemberger, 1989:176 and references therein).

A more lax approach on the continuity/discontinuity issue has been forwarded by Fikkert (1994), who found evidence of stages in the phonological development of monolingual Dutch children and argued that progression through stages is subject to individual variation and can occur even within consecutive utterances rather than in the span of time. This interpretation seems to relate more to qualitative aspects of development (such as the admitted variation in speech development) rather than to distinct developmental milestones in the acquisition of phonology. Fikkert's (1994) findings might find relevance in Vihman's

(1996:4) statement that 'both continuity and discontinuity can fairly be illustrated in children's development'. It appears, however, that the continuity/discontinuity issue is discussed in terms of anything that seems to be remotely relevant to the etymology of the words. For instance, Stemberger (1992a) and Bernhardt & Stemberger (1998) argue that a two-lexicon view of child phonology as opposed to the one-lexicon in adults introduces discontinuity between adult and child phonology. In deciding on the continuity or discontinuity issue, one should perhaps pose the question differently: what is it that is being continued or discontinued? Once this is clearly determined then the exact nature of stage and thus, a definition for it, will reveal itself as either continuous or discontinuous. Moreover, it may well be that the continuity/discontinuity issue is not one-dimensional but one that ought to be seen on a multi-planar scale and this is the reason for the abstruseness involved in it. In line with this thought is Menn & Matthei's (1992:221) argument that 'surface discontinuity may be the result of an underlying continuous development'.

2.4.1.3 Grammatical stages and order of acquisition

Some of the earlier propositions for stages (meaning time-periods of distinct changes in an aspect of grammar) have been in terms of general grammatical development, as the child moves from the pre-linguistic stage in the first year to gradually more advanced aspects of grammar. The most significant early attempts agree that there are four to five stages in the acquisition of language: Stern & Barwell (1924) identify four of them in syntactic development; Nice (1925) adds an extra stage, as well as, quantification by measuring the Average Length of Sentence (ALS) in terms of words. ALS is the number of uttered words in a sentence averaged over the number of sentences in the sample; Brown (1973) also distinguishes five stages and introduces Mean Length of Utterance (MLU), as a more sensitive measure of ALS and a better predictor of level of acquisition by counting morphemes instead of words. MLU is the number of morphemes in an utterance averaged over the number of utterances in the sample (see Brown, 1973:54 for the formula). Brown also defined an Upper Bound (UB) measure referring to the number of morphemes in the longest utterance in the sample. Although MLU and UB have been and, still are, widely employed in multiple studies, the measure has been criticized with the shortcoming of being universally inapplicable as it was developed for the English language but cannot be applied directly to other languages to enable comparison between two languages (e.g. Crystal, 1974). Further, ALS (which was later termed MLU in words, MLUw,) and MLU in morphemes, MLUm, were compared by Parker & Brorson (2005) for 40 language transcripts of 28 typically developing English speaking children between the ages of 3;0 and 3;10. The two measures were found to be perfectly correlated suggesting that, the simpler to calculate, ALS may be used instead of MLU. To sum, the stages claimed in these studies in terms of age are roughly divided as follows: 'preliminary stage' or the period of prelinguistic development (0-1); 'first period or single word utterance' period (1-1;6); 'second period or first word combination' (1;6-2;0); 'third period or short sentence stage' (around 3;0) and 'fourth period' or complete sentence stage (around four) (see Ingram, 1989a for details). Furthermore, it has been contented that child language acquisition is a continuous process of cumulative complexity and stages are invariant even if children do not acquire language at the same pace (Brown, 1973).

Ingram (1989a:64) argues that the two-stage generative proposition of 'pre- and post-parameter setting' whereby the child's grammar is adult-like once the parameter is set is rather simplistic; a theory of acquisition should be viewed in terms of principles other than UG that account for the stages the child goes through to reach the adult grammar. Ingram (1975) had argued that 'the spontaneous language of children around age 5 and 6 is still unlike that of the adult' (101). The constructionist assumption emphasizes the gradual building-up through steps by advocating that a new 'stage n will consist of everything at stage n plus the new feature(s) of stage n+1' (Ingram, 1989a:73). Children are generally assumed to have 'passive control' of phonological features before they achieve active control in that the child is able to hear the phonetic contrast but not produce it. So if one repeats the child's mispronounced realization of the targeted word will find that the child rejects this version as incorrect (e.g. Ervin & Miller, 1963).

Stark (1980) distinguishes five stages of pre-linguistic development: a/ 'reflexive vocalizations', like crying, sucking and sneezing (0-2 months); b/ 'cooing' (vowel-like productions) and laughter (2-4 months); c/ 'vocal play' (4-8 months) with the first back consonants (e.g., [g], [k]) being produced around 2–3 months, and front consonants (e.g., [m], [n], [p]) starting to appear around 6 months of age); d/ 'reduplicated babbling' (or 'canonical babbling' (Oller, 1986), that is repeating the same CV sequence (6-10 months); e/ 'nonreduplicated babbling' (or 'variegated babbling' (Oller,1986), that is combinations of consonants and vowels in syllables (10-14 months). 'The principle of least effort' (Schultze, 1880/1971), or ease of articulation, is a decisive element in the understanding of early developing phonologies: those sounds which are easiest to articulate are acquired first. Contrary to this statement, however, comes the claim that the widest variety of sounds (e.g. clicks, palatalized, rounded or pharyngealized consonants, affricates, sibilants, etc.) are produced during this period of babbling (e.g. Jakobson, 2004). For a comprehensive review of 'stages of phonological development qua development anatomy' in the first year of life, see Kent (1992). A period of 'silence' has also been evidenced to precede the production of recognizable words (e.g. Vihman et al., 1985; Goodluck, 1991). This period of 'silence' before the transition from babbling to meaningful words is subject to individual variation sometimes occurring as complete silence, as decreased babbling or not occurring at all, as a child may uninterruptedly continue from babbling into the linguistic stage (Ervin & Miller, 1963:111). Waterson (1971) noticed that all of her son's early production forms fell within one of five basic word structures that were called 'prosodies' or 'canonical forms'. Bates (1976) has argued that during the transition from babbling to first words, children produce 'protowords', that is, first words that do not exist in the TL vocabulary but are consistently realized by the child to express the same intended meaning. First words are accurate as they seem 'preselected' (Ferguson & Farewell, 1975). For a comprehensive description of early-phonology theory, see e.g. Velleman & Vihman (2006). In the early stage of first words, children's realizations show 'minimal accommodation of the adult language' (Vihman, 1993:418). Arguing in the 'templatic' approach, first words match 'vocal schemata' and 'adult word patterns' into production templates that have not yet started becoming variable to mark the beginnings of consistent word use (e.g. ibid; Vihman & Croft, 2007). At the beginning of this transitory stage, 'many words are built according to the same recipe' (Macken, 1992; C. Levelt, 1994; Fikkert: 2007:12): initially children have only one place specification per word which is either coronal or labial, then, they have a pattern that is [labial consonant-vowel-coronal consonant-vowel] and, finally, they gradually make more differentiations.

Ingram (1976b) has stated that there are three sets of rules operating on any child's developing system: perceptual conditions, organization rules and production rules that are not separate, independent processes but rather stages through which universal phonological processes proceed. A first comprehensive description of *actual* stages in the acquisition of first language phonology is found in Ingram (1989a). These stages are: 'prelinguistic vocalization and perception' (birth to 1;0); the 'phonology of the first 50 words' including the one word (or holophrastic) stage (1;0-1;6); the 'phonology of single morphemes' or multi-word utterance stage (1;6-4;0) that includes the 'telegraphic stage' when children speak only content words. One word utterances, referring both to meaningful one-morpheme and two-morpheme units, are evidenced in children as early as 12-15 months (e.g. Ingram, 1989a) but their first occurrence may happen later in some children subject to individual variation (Ingram, 2012, pers. comm.). The appearance of meaningful words 'marks the onset of an active phonological system replacing unsystematic phonetic preferences' (Ervin & Miller, 1963:111). The 'period of single morphemes' between 1;6-4;0 is the longest (and perhaps most complex) in phonological development and has elsewhere been referred to as 'the period of greatest phonological development' (Macken & Ferguson, 1987:8), 'the period of real words' (Bernhardt & Stemberger, 1998:xi), or the 'pre-reading period' (Stoel-Gammon, 2011) and it is during this period that the systematic structure of the sound contrasts can be observed.

2.4.2 What does complete acquisition mean?

A broad answer to this question would involve mastery (meaning that the child's grammar is that of the adult speaker of the TL) on two planes: a/ acquisition of representations of grammar alongside cognitive development, whereby the child has learned all principles and has set all parameters involved in the grammar of his/her TL and, b/ articulatory maturation and prowess, since a child learning to speak must overcome mechanical difficulties in the articulation of sounds as she gradually matures and develops consistent control of the oral cavity muscles together with a mastery of varying combinations of actions of the related speech production organs. This is known as the 'articulation filter' (e.g. Vihman, DePaolis, & Keren-Portnoy, 2008). Quantitative approaches have viewed the aforementioned question in terms of statistical frequencies revealing the extent to which a certain grammatical structure is *adequately* proven to be acquired. Measuring acquisition in phonological development has been of much interest (e.g. Ingram, 1981c; Freedman & Barlow, 2012; Macleod, Laukys, & Rvachew, 2011). The measures applied have correctness as their common denominator and concern segments (Ingram, 1981c; Stoel-Gammon & Dunn, 1985; Shriberg, Austin, Lewis, McSweeny, & Wilson, 1997), syllables (Bernhardt & Stemberger, 1998) or whole words (Ingram & Ingram, 2001; Ingram, 2002; Bunta et al., 2009; Burrows & Goldstein, 2010). In methodological procedures for phonological analysis, Ingram (1981c) proposed the following gradient classification for the acquisition of segments at any certain point in time: 'not-used, 'infrequent', 'used' and 'frequent'. Shriberg et al. (1997) proposed the Proportion of Consonants Correct (PCC) formula to measure correct production of targeted consonants, that is, the correct consonants produced in context divided by the targeted consonants. The type of measurement, where the sum of the numbers is divided by the size of the collection results to the weighted average, where instead of each of the data points contributing equally to the final average, some data points contribute more than others. The *arithmetic mean* (or unweighted average) is the central tendency of a collection of numbers taken as the sum of the numbers divided by the size of the collection. Both tabulations are used in the literature (e.g. Ingram, 1981c; Shriberg et al. 1997; Secord & Donohue, 2004) though the arithmetic mean is preferred as a more accurate estimate of actual performance (Ingram, 1981c; pers. comm., 2012).

Beyond PCC, other measures for assessing phonological similarity among children have been proposed. In Ingram & Ingram (2001) and Ingram (2002), the Phonological Mean Length of Utterance, PMLU, was introduced as a comparable measure to MLU (Brown, 1973) that took into account singletons in the utterance as opposed to morphemes. PMLU further differs from MLU in that it does not count all the measurable segments equally but doubles the count of consonant segments produced correctly in the context of their intended target in order to emphasize the fact that children's errors most often occur on targeted consonants (Ingram, 1981c; Stoel-Gammon & Dunn, 1985). Subsequently, phonological whole-word proximity, PWP, was introduced as a measurement of the phonological proximity between produced and target words in child speech. PWP was defined as the ratio of the produced phonological mean length of utterance, PMLU, to the targeted one in which all the consonants are by definition correct in context. When the utterance involves more than one word, PMLU and PWP were defined as the arithmetic mean of their corresponding single word values (Ingram & Ingram, 2001; Ingram, 2002). Several studies (Bunta et al., 2009; Burrows & Goldstein, 2010; Macleod et al., 2010; Freedman & Barlow, 2012) have used these measures to quantify the level of phonological development in normal monolingual, bilingual, as well as, phonologically impaired children. Ingram & Dubasik

(2011), in a multi-dimensional analysis, proposed the following nine measures for assessing phonological similarity among children: a/ Phonological mean length of utterance (pMLU) of target words (Ingram, 2002), b/ pMLU of child words, c/ Whole-word proximity, obtained by dividing the child's pMLU of each word by the pMLU of each target word, then averaging across all words, d/ number of preferred syllable shapes. e/ proportion of monosyllables, f/ phonetic inventory articulation score (PIAS) onsets, g/ PIAS codas, h/ relational articulation score (RAS) onsets in word initial position, i/. RAS codas in word final position.

Complete acquisition is sometimes referred to as the *ceiling effect* in statistical terms in that performance variability reaches a stabilization point. Different researchers, though, have different criteria (see references below) resulting in different methodologies and, thus, not always inter-relatable results. However, 'children's productions of sounds in word contexts are usually examined in terms of degree of production accuracy and the percentage of children in an age group who reached the level of accuracy in phoneme production' (Dodd, Holm, Crosbie, & Bloomfield, 2006:26). Two approaches in phonology have set the 70% (e.g. Ingram et al, 1980) and 75% correct use of a structure in obligatory environments (e.g. Diedrich & Bangert, 1980; Olswang & Bain, 1985; PAL, 1995; Kappa, in press) as criterions of adequate performance. Cazden (1968) and, subsequently Brown (1973), established the criterion of 90% correct and consistent use for morpheme acquisition though it has subsequently also been used for other grammatical structures by many researchers. The more rigid criterion of 100% correct use of a structure in obligatory environments was employed by Stemberger (1992b). The taxonomy proposed by Sander (1972) considers group performance: production is 'customary' if the group average in a large sample study is over 50% correct, while 'mastery' is attained when the group average is 90% correct. Group averages of 75% correct production (e.g. Wellman, Case, Mengert, Bradbury, & Templin, 1931; Smit, Hand, Freilinger, Bernthal, & Bird, 1990) and 100% correct production (e.g. Poole, 1934) have also been posited. Following e.g. Dodd et al. (2006), a study ought to clarify whether the resulting average suggesting complete acquisition of phonology refers to a phoneme in all word positions: word-initial, -medial and -final (as in e.g. Poole, 1934; Templin, 1957) or just two positions: word-initial and final (as in e.g. Wellman, Case, Mengert, & Bradbury, 1931). Ingram (1989b) has further argued that three patterns of sound development ought to be considered when deciding whether a sound is or is not part of the child's system: a/ 'lexical', i.e. a sound is only found in a single word, b/ 'gradual', i.e. the sound spreads gradually to more and more words and c/ 'abrupt', i.e. a sound appears abruptly in many words at a time.

Complete acquisition of segments is indispensably linked to children's age of acquisition. First attempts to provide normative data for the ages of acquisition of particular phonemes in English appear in the 1930s in the work of Wellman et al. (1931) and Poole (1934). A more comprehensive study was carried out by Templin (1957) and followed by Arlt & Goodban, (1976) and Prather, Hedrick, & Kern (1975). A more recent, wide-cited study for the age of acquisition of English consonants is that of Iowa-Nebraska Articulation Norms Project (Smit et al., 1990) that has provided tables based on normative data by monolingual English children between 3 and 9 years old. The ages of acquisition in Smit et al., (1990) are based on both the 75% and 90% accuracy criterion and are collectively presented in table 2.3 below. Each consonant was tested in both word-initial and word-final positions; a dash (-) before or after the segment in the table below indicates those cases where the consonant was tested in only one of the two prosodic positions.

Table 2.3 Ages of acquisition for English speech sounds *

by age	**Girls**		**Boys**	
	75%	**90%**	**75%**	**90%**
3;0	p, b, f, t, d, s, m, n, k, g, h-, w-	p, b, d, m, h-, w-	p, b, t, d, m, n, k, g, h-, w-	p, b, m, n, h-,w-
3;6	j-	f-, n, k, g	f, j-	f-, t, d, k
4;0	v, ð-, ʃ, ʧ	t, j-	ʤ	g
4;6	l, ʤ	ð-	v	
5;0	z	l-	s, ʃ, ʧ	j-
5;6	θ, -ŋ	-f, v	ð-, ɹ	-f, v
6;0	ɹ	θ, ʃ, ʧ, ʤ, -l	θ, z, l, -ŋ	l-
7;0				ð-, ʃ, ʧ, ʤ, -l
8;0		ɹ-, ɚ		θ, ɹ-, ɚ
7;0-9;0		s, z, -ŋ		s, z, -ŋ

* table made from information taken from Smit et al. (1990)

Smit et al., (1990) claimed 75% acquisition at ages that were similar or younger than those of Templin (1957) with the exceptions of /ɹ/ and /ŋ/ that were acquired later in their study. The following normative acquisition patterns were reported by Dodd et al. (2003:637): 90% of children over 6 in the study showed no errors; voicing is acquired by 3;0; stopping disappears by 3;6 and fronting by 4;0; de-affrication and cluster reduction resolved by 5;5; liquid gliding persist until 6;0, while most error patterns affecting groups of sounds are resolved 'between 2;5 and 4;0 years'. Comprehensive reviews of cross-sectional studies of children showing the age of acquisition of monolingual English consonant sounds are provided in e.g. Dodd et al. (2003), McLeod & Bleile (2003) and, also, McLeod (2007) where tables with the ages of acquisition of consonants are given per country for English (e.g. British English, General American and Australian English), as well as, for Greek. Differences in the age of acquisition of consonants as reported in those studies will be elaborated in more detail, where pertinent, in the remaining chapters.

An assessment of phonetic and phonological development carried out by the Panhellenic Association of Logopaedics (PAL, 1995) is the largest cross-sectional study on the phonological development of standard (i.e. non-dialectal) Modern Greek. It sampled 300 children of ages between 2;6 and 6;0 during the three-year period from 1989-1992. Table 2.4 below shows the acquisition age of consonants by Greek children, as reported in PAL (1995).

Table 2.4 Acquisition age of consonants by Greek children (boys and girls)*

	90% criterion
2;6-3;0	b, n, ɲ, g
3;0-3;6	p, v, m, c, ɟ, x, ɣ
3;6-4;0	t, d, l, ç, ʝ, k
4;0-4;6	f, s, z
>6;0	θ, ð, ʦ, ʣ, ɾ, ʎ

* table made from information taken from PAL (1995)

PAL (1995) also gives a 75% criterion according to which: p, b, t, d, m, n, ɲ, c, ɟ, ç, ʝ, k, g, x, ɣ were acquired by the age of 2;6 when the study started; f, v, θ, ð, l were acquired between 3;0-3;6; s, z, were acquired between 3;6-4;0; ʎ between 4;0-4;6; ʦ, ʣ between 4;6-5;0; and ɾ between 5;6-6;0. A 50% criterion gave that f, v, s, z, ʦ, l, ʎ were acquired by 2;6 while θ, ð, ʣ were acquired between 3;0-3;6 and ɾ between 4;6-5;0.

There are three more studies with a focus on the phonological development of Modern Greek consonantal singletons. Magoula (2000) studied 4 children between the ages of 1;5-2;6, three of which were studied for 9 months and one for 7 months. However, she only reported age of correct productions of consonants on a qualitative basis, yet not on a quantitative basis, meaning that consonants produced correctly at least once were reported. Her work was subsequently cited as if it were quantitative, thus, interpreting erroneously her results to mean age of acquisition (e.g. McLeod, 2007). Her results are reproduced in table 2.5.

Table 2.5 Phonetic inventories of Greek children*

1;5-1;8	p, t, d, m, n, l, ʝ
1;9-2;0	b, v, l, k, c
2;1-2;2	f
2;3-2;6	ð, ɾ

* table made from information taken from Magoula (2000)

Papadopoulou (2000) also studied single consonant acquisition in Greek between the ages of 3;7-4;6 and the phonetic inventories given, largely, agree with the PAL (1995) Assessment. For an overview of the acquisition of Greek phonology, see Mennen & Okalidou (2007) and Kappa (in press). Thomadaki & Magoula (1998) report acquisition of Greek palatal allophones [ɲ] and [ʎ] by age 2;6.

2.4.3 What is being acquired?

In the field of phonology, whether reference is made to protolanguage (and, consequently, *protophonology*), interlanguage or bilingual production, a common underlying controversy lies in what Vihman (1996:4) has referred to as the 'phonetics/phonology interface'. A previous reference to this was made in section 2.2.3 (see Major, 2008). An underlying uncertainty in this interface, universally applicable in the understanding of acquisition of phonology (no matter who the language acquirer is: first, second or bilingual) is whether one is acquiring 'a phonology' or just 'phonetics'. Different researchers invoke different arguments. Work in developmental phonology in the eighties has been criticized as focusing on the 'phonetics of acquisition' (Macken, 1992). In reply to her own query 'where is phonology?' in phonological development, the cited author follows the generative viewpoint that it is abstract phonology that is being acquired through UG right from the beginning. This relates to the need of a two-lexicon model in child phonology accounting for development of phonology on many levels, i.e. input and output representations and articulatory maturation. Because language itself is a system of many parts and each module is in charge of specific facets of the system (Bernhardt & Stemberger, 1998 and references therein), such a multi-planar viewpoint is necessitated. A consideration of phonology (theorizing) relies on a consideration of phonetics (evidence) and the two are inter-related.

Van der Hulst (2009:318) defines phonology with regard to two aspects: the representational (i.e. 'well-formedness') and the derivational (regarding operations that change representations that violate constraints). He further states that it is important to re-affirm the necessity of two phonological levels. Going beyond the usual dichotomy between phonology and phonetics, he argues that there appear 'different phonologies' dealing with the sound structures of languages because phonological theories and 'subtheories' (316) use the term *level* in many ways, not just derivationally related, as e.g. the underlying and surface representation; sound structures comprise of 'actual' sound combinations as well as cognitive structures that trigger processing, production and perception. In a 'dual articulation' model, 'morphosyntactics' (i.e. the semantics) and 'phonotactics' (i.e. the sound structure) are complementary and constitute the 'skeleton of language', as its 'life and mind' and 'bodily appearance' respectively. Both are combinatorial systems, not sequentially stashed or overlapping as claimed to date, but parallel organizations. They consist of 'primitives', e.g. features, and 'constraints', e.g. combinatorial rules, that create 'structural analogy' between hierarchical representations on different levels or stages, layers and planes within those levels (van der Hulst, 2000).

Part of the learnerability problem, or problem of acquiring phonology, can be traced in the abstractness of underlying forms. Underlying forms may be quite distant from surface forms or, even more, so 'opaque' (Kiparsky, 1973) that they may not be 'learnerable' at all. The learner may perceive the contrasts from an early age but may not know how to set the phonemic contrast. A theory of phonology should be argued 'to sufficiently constrain the choices available to a learner' (Dressler, 1998:307). This is accomplished by further classifying and elaborating on the types of rules a learner posits which explains the modular conception of phonology into different subtheories or 'tiers' (Marlett & Stemberger, 1983). Beyond the morpheme discussed by e.g. van der Hulst (2009), the phonotactic well-formedness of the word in the post generative era has been equated with the well-formedness of the syllable. Phonotactic constraints are also known to apply on multiple hierarchical levels, as on the edge of the syllable, beyond it (e.g. intonation), within the word as well as on the utterance level; these domains are sequentially shown as: syllable – foot – word – clitic group – phonological phrase – intonation phrase – utterance (van der Hulst, 2009 and references therein). Such a multi- planar evaluation helps minimize the distance between surface and derivational levels and, consequently, decreases the abstractness involved. Posing the question 'what is being acquired' in the present thesis is meant to acknowledge the complexity of issues involved in the acquisition of speech and it will be discussed with respect to the evidence in this child's dual language acquisition in chapter 7.

2.4.4 Phonological development and abstract phonological theories

Any study that aims to make a contribution in understanding phonological development ought to exhibit knowledge of the various relevant theoretical issues and debates as discussed in past and recent literature. One such review relates to abstract phonological theory, ordinarily developed for adult speech and applied to child developmental data. The sufficiency of applying adult phonological theory to child data and, the reverse, the suitability of language acquisition data for the verification of abstract theories of phonology has been a matter of dispute in the field of phonological development for a number of reasons: child and adult systems, though similar, are not the same; abstract phonological theories are usually based on evidence from one language not directly applicable to all languages. The nature of developmental phonology is variable, unsystematic and multi-planar and, thus, any distinct conclusions on phonological abstractness are rendered difficult to reach (Dressler, 1998). Phonologists more interested in developmental issues advocate that variability in child speech, as an important correlate of phonological development, should not be considered a flaw in the comparison with the more *steady* adult phonologies (e.g. Waterson, 1971; Menn, 1983; Macken & Ferguson, 1987). There seems to be some overall agreement among child phonologists, however, that adult phonologies are not as steady as ordinarily assumed during abstract phonological theorizing, either: ‘there is no evidence that adult speakers of a language share an identical grammar (Vihman, 1996:5); adult phonology is also in the process of development as part of historical change and, therefore, ‘synchronic patterns reflect diachronic constraints’ (Bernhardt & Stemberger, 1998:5). Bernhardt & Stemberger (1998)’s argument is that the ultimate theory (phonology) will account for all kinds of evidence (phonetics) in first and second language data, adult and child data, universal tendencies, as well as, particularities. Child developmental data, therefore, are just as suitable for the advancement of phonological theory as adult synchronic data. The following sections provide a historical review of phonological development theory that may be used where pertinent to interpret results in this thesis.

2.4.4.1 The Prague circle

The original theory of sound classification was proposed by the Prague Circle of structuralists, namely, linguists N. Trubetskoy (1890-1938) and R. Jakobson (1896-1982). Jakobson (1941/1968) advocated that phonological segments are assessed in terms of sets of ‘distinctive features’ that catalogue all possible human speech segments in an intricate network of articulatory and acoustic correlates. Segments (or *phonemes/phones* in phonological parlance), divided into classes of ‘prosodic’ and ‘inherent’ features (Jakobson & Halle, 1956), are the smallest units differentiating the meaning of words; prosodic features are found in segments with reference to the syllable e.g. the syllabic lateral [l̩], while inherent features are displayed in phonemes irrespective of their role within the syllable e.g. clear [l]. The notion that individual phonemes are in contrast and opposition with each other was introduced by Trubetskoy (1939) stating that, as every segment may only have one or the other property, there is a binary opposition between two classes of sounds.

Jakobson (1941/1968) is the earliest scholar to identify an order in the acquisition of phonology in terms of successive feature contrasts that economizes the analysis of the learning process. His momentous influence on general phonological theory is paralleled by his contribution to our understanding of children’s acquisition of phonology. As an application of his theoretical postulations, he identified articulatory stages in phonological development, explained by the principle of maximal contrast, that are also universally applicable in the languages of the world and in aphasic speech. Referring to the onset of speech and the order of phoneme appearance, Jakobson (1941/1968) defined the ‘minimal consonantal system’ (MCS) as the requisite opposition first between oral and nasal stop /p:m/ and then between labial and coronal stop /p:t/, meaning that the presence of the oral/nasal contrast is the first step leading to subsequent acquisition of the labial/dental opposition for stops. In 1956, the following statement was made: ‘The development of the oral resonances in child language presents a whole chain of successive acquisitions interlinked by laws of implication’ (Jakobson & Halle, 1956:54). A chart of the temporal sequences of phonological acquisition is provided in the same monograph designating acquisition stages in articulatory terms with those at the top of the chart chronologically preceding those following. The chart has been modified here (see table 2.5 below) to exclude acquisition of vowels in the chronological sequence, as the study of vowel acquisition is beyond the scope of this thesis.

Table 2.5 Sequences of phonological acquisition of consonants

dental vs. labial ……………………………………	0.1
velopalatal vs. labial and dental ……………………	0.112
palatal vs. velar ……………………………………	0.1121
pharyngealized vs. non- pharyngealized …………...	0.1122
palatalized vs. non-palatalized ……………………..	0.1123

(adapted from Jakobson & Halle, 1956)

The stages are also denoted by sequences of numbers starting with 0, as if in a decimal fraction, meaning that the first digits of any sequence S_x following the first one S_1 are identical with those of S_1. In accordance with the implicational laws, this denotes that in phonological development, the acquisition of a subsequent stage B implies former acquisition of a previous stage A, formalistically represented with B→A, i.e. if there is an A then there is also a B. Jakobson & Halle's chart is an elementary demonstration of Jakobson's (1941/1968) general 'laws of irreversible solidarity' that are universally true in child phonological development and in the languages of the world. 'Solidarity', in the author's own words is 'the necessary connection of elements' (51). According to these laws, formalistically represented with *A* < *B*, i.e. *A appears earlier than B*: i/. the acquisition of consonants with a backward place of articulation (PoA) presupposes acquisition of front consonants (*Front* < *Back*), ii/. the acquisition of voiced consonants presupposes earlier acquisition of voiceless consonants (*Voiceless* < *Voiced*) and iii./ the acquisition of fricatives (e.g. in terms of manner of articulation, MoA) presupposes earlier acquisition of stops (*Stops* < *Fricatives*).

Ervin & Miller (1963:113-4) succinctly summarize the acquisition of contrasts below. The first distinction is between a vowel and a consonant (as the two are more distinct than other parts of the system). The remaining features are acquired as follows: a/ front < back (e.g. labials vs. coronals, velars, etc.), b/ stop < continuant (continuant being a fricative or nasal), c/ PoA < voice contrast, d/ voiceless < voiced, e/ when two consonants differ in PoA but are similar in MoA, then labial < coronal, f/ nasals < liquids, g/ coronals < dorsals, h/ plain consonants < palatalized, i/ sonorants < obstruents. Following acquisition of these rudimentary maximal contrasts in an invariant for all children chronological order, subtler and more intricate distinctions are also eventually attained. Dressler (1998:310) has called the Jakobsian theory of 'binary fissions' the 'continuous dichotomy hypothesis' and accordingly argues that: a/ all sounds are initially assumed to be variants of a single phoneme, b/ the binary distinction (dichotomy) is first made on the basis of one of the universal set of distinctive features, and c/ the dichotomy keeps applying to the remaining sets until all distinctive sounds have been differentiated. With regard to the position in the word, the tendencies are that initial consonants are acquired earlier than final or medial consonants and contrasts apply to initial position before other positions.

Further alignment constraints that have been proposed are: a/ back consonants are less marked in syllable final position and vice versa for front consonants (Ingram, 1974b), b/ features are first aligned to the edges of the word rather to the entire word (e.g. Slobin, 1973; Velleman, 1995) c/ marked segments occupy psycholinguistically prominent positions (J. Smith, 2002), d/ [labial] attaches to the left edge (e.g. Jakobson, 1941/68; Macken 1992; C. Levelt, 1994; Kappa, 2001) and [dorsal] to the right edge (e.g. C. Levelt, 1994) and e/ [+continuant] attaches to the right edge (e.g. Ferguson, 1978; Kappa, 2000) and [-continuant] to the left edge (e.g. Kappa, 2000). Like syllable rhyme (e.g. Brooks & MacWhinney 2000; Storkel, 2002) and stressed syllables (e.g. Echols, 1993), word onset has been claimed to be perceptually more prominent (e.g. Fikkert, 2007). Consonantal clusters generally appear late as children's productions are subject to what Fikkert (1994) has called the 'minimal onset parameter'.

The laws of solidarity are not reversible in that there is no requisite constraint for the presence of posterior consonants in the presence of their anterior counterparts. Jakobson's theory of phonological acquisition that supports the notion of acquisition of features has been verified in subsequent studies, e.g. in monolingual English phonological development (e.g. Velten, 1943; Templin, 1957; Burling, 1959/1978; Sander, 1972; Smith, 1973; Ingram 1981c, 1989a; Stoel-Gammon, 1985; Smith, 2010), in monolingual Greek (e.g. Kappa, 2000, 2009) and in bilingual acquisition (e.g. Leopold, 1953/1954; Major, 1977). His theory still remains prominent and is widely cited despite some criticisms of being oversimplified; there are arguments, for instance, that individual children's order of acquisition might not agree with the general Jakobsian postulations in certain details (e.g. Menn, 1971; Macken, 1980a). Specifically, Daniel Menn (Menn, 1971) and Jacob (Menn, 1976) 'acquire one of the two front stops and the velar stop before acquiring the second front stop' (Macken, 1980a:148). Another problem lies in that different contrasts sometimes exist in different positions and they often develop differently (e.g. Fikkert, 1994) For a comprehensive review of studies supporting or criticizing Jakobson's proposals, see Beers (1995:31).

2.4.4.2 Generative theory and markedness

The Praguian propositions have formed the basis of subsequent phonological theory, with the generative approach in *The Sound Pattern of English* (Chomsky & Halle, 1968), SPE, being one of the most influential. In this approach, segments are considered to be composed of feature matrices in which all features are binary, which is notated by a *plus [+]* or *minus [-]* value/specification at the two ends of the binary opposition. Segments are identifiable by unique for them feature matrices, that is, different combinations of features with variable [±]

specifications identifying and classifying precise articulatory properties, e.g. place or manner of articulation, the vocal fold action, the airstream mechanism and the position of the velum. The formulaic theory postulated in the SPE, however, is deficient in terms of the 'naturalness condition' (Postal, 1968 in Dressler, 1998) which hypothesizes that phonological rules are also governed by cognitive principles, not just articulatory and/or acoustic factors applying to surface structure.

'Naturalness' is not totally dismissed, though, in that it is the 'content of features and not the form of the definition that decides these questions' (Chomsky & Halle, 1968:401). Admitting this as an 'unresolved problem' (400), the SPE postulated in favor of a markedness theory derived by and mostly limited to the set of processes proposed by the Prague Circle. The principles of this theory are summarized as follows: a/ the simplest lexical entry *u* (i.e. 'unmarked') is phonologically vacuous, thus, 'neutral' in that it contains no segments, b/ a non-vacuous lexical entry *m* (i.e. 'marked') that contains segments will have a specific phonological structure stated by the [+] and [–] specifications, c/ the complexity of *m* is dependent on the number of features that are not left unmarked in the matrix representation, d/ a new entry in the lexicon is viewed in terms of how it is differentiated from *u* by a minimal set of marked features, e/ as unmarked features do not add to the complexity of a grammar there are not specified and, thus, excluded from the lexicon. The possibility of underspecifying these features in SPE is possible but has not been much explored (Dressler, 1998 and ref therein). On the other hand, aspects of markedness theory have been incorporated in subsequent postulations on both feature geometry and underspecification theory (e.g. Steriade, 1995).

A major divergence between the Praguian view of markedness and the generative approach in the SPE is argued to be that 'in the former, the marked coefficient of a feature was assumed always to be [+] and the unmarked coefficient always [-]' (404). The ensuing hierarchy of difficulties is based on considerations such as the distribution of classes within linguistic systems and 'functional load', i.e. the extent to which a given sound is used to distinguish one word from another. King (1967:831) provides an exhaustive description of functional load from more general, as 'the extend and degree of contrast between linguistic units/minimal pairs found for a given opposition' to more specific in phonology, that is, 'it is a measure of the work which two phonemes (or features) do in keeping utterances apart, or in other words a gauge of the frequency with which two phonemes contrast in all possible environments'. He further argues that although associated with the Prague Circle, functional load had found expression before the 1920s. Ingram (1991) has argued that it is the phonological prominence of the sound that determines its functional load not its frequency of occurrence in the target language.

Basing his theoretical argumentation on Chomsky & Halle (1968)'s generative perspective, using distinctive features as the basic unit of analysis and other notational procedures, Smith (1973:140) has postulated that 'the process of acquisition of phonology is *rule-governed* rather than atomistic in nature'. Segment substitutions (or, variants, or realizations, or alternating forms, or errors, or mismatches) during phonological development are explained in terms of adult grammar deformation rules and representations that can be predictable by phonological theory. Regularity in the change of the system becomes more evident as the child's grammar approximates that of the adult. He advocated the following twenty-six 'realization rules':

1. a nasal consonant is deleted before any voiceless consonant,
2. a voiced consonant is deleted after a nasal consonant,
3. the alveolar consonants /n, t, d/ become velars [ŋ, g] before a syllabic [l̩],
4. syllabic [l̩] vocalises to [u],
5. a continuant consonant preceded by a nasal and a vowel, sometimes becomes a nasal,
6. /l/ is deleted finally and preconsonantally,
7. /s/ is deleted preconsonantally,
8. in a word of the structure /CwCV/ the second consonant becomes bilabial (e.g.[p], [m], [f]),
9. in a word of the structure /sVC/ the /s/ is optionally deleted if the C is labial or alveolar,
10. in a word of the structure /ʃVC/ the /ʃ/ is optionally deleted if the C is labial or alveolar,
11. /z/ is deleted finally,
12. a nasal consonant following an unstressed vowel becomes alveolar [n],
13. /h/ is deleted everywhere
14. an initial or post-consonantal unstressed vowel is deleted,
15. /t/ and /d/ are optionally deleted before /r/,
16. post-consonantal sonorants /l, r, w, j/ are deleted,
17. non-nasal alveolar and palato-alveolar consonants harmonise to the point of articulation of the preceding velar,
18. /l, r, j/ are neutralized as [l] when they are the only consonants in the adult word or become /w/ or deleted when intervocalic,
19. alveolar and palato-alveolar consonants harmonise to the point of articulation of the following consonant,
20. /f, v/ become [w] prevocalically,
21. post-consonantal alveolar consonants are deleted,
22. post-consonantal alveolar consonants are deleted,
23. alveolar consonants are optionally deleted in the final position,
24. all alveolar and palato-alveolar consonants fall together as alveolars,
25. all sonorants consonants are non-continuant, non-strident, non-affricated and non-lateral,
26. all consonants are voiced and all non-vowels are true consonants.

Smith (ibid:169) argues that there are exceptions to these rules, as in e.g. the case of 'irregular forms' and developmental changes are viewed in a two-fold analysis: firstly, one that treats adult surface forms as the child's URs which, subsequently, lead to the child's output forms; and secondly, one whereby the child's system is seen as independent. Some of Smith's general observations are overall summarized as follows: a/ there is a many-to-many correspondence of segments, b/ changes in output occur to phonologically defined classes of items, not piecemeal to individual lexical items, c/ there is regularity in the production both at specific times but also longitudinally, d/ synchronic analysis should be paired with diachronic analysis, e/ the child's phonetic repertoire shows evidence of non-English sounds, d/ evidence of recidivism in the loss of contrasts already established, e/ evidence of the child's ability to understand his own speech, f/ child is operating in terms of segments of a phonemic rather a 'featural' nature which makes the realization rules inadequate to that extent, g/ there is no evidence that the child has a phonemic system of his own, and h/semi-vowels are treated as consonants, and i/ notable is the 'puzzle-puddle' phenomenon whereby children represent adult words correctly in underlying representations and errors are due to realization rules that operate in production. With regard to this last statement, Macken (1980a) argued that there are also perceptual 'miscodings' in child language that may explain why Amahl would realize the voiced alveolar stop substituting the sibilant in *puzzle*, but not in its targeted context in *puddle*, where it was substituted by a velar.

2.4.4.3 Natural phonology

Stampe (1979) criticized the formulaic processes in SPE as being principally context-free evaluations of underlying representations and, as a result, limited in potential. The term 'processes', used to mean 'natural responses to phonetic forces' (Donegan & Stampe, 1979:130) was first introduced within Stampe's (1979) theoretical framework of 'natural phonology': a child's phonological representations mentally approximate that of the adult's but his/her actual productions differ as a result of articulatory (i.e, phonetic) and perceptual limitations. The term 'naturalness' refers to processes, whereas 'markedness' refers to segments and features. Stampe's theory of natural phonology is much in line with Cairns' (1969) hypothesis, developed only for initial consonant clusters, that children have an innate set of neutralization rules that they gradually unlearn as they are able to produce more complex realizations and that the order of acquisition may be 'definite' in that 'the child loses N-rules because the acquisition of some skills may presuppose the prior acquisition of some others' (88). Phonological processes in natural phonology: a/ are not learned but are innate, universal and, thus, natural, b/ are hierarchical in that some are more basic than others, c/ apply in their entirety from the beginning of the child's 'language-innocent' state, d/ do not evolve as in the bottom-up, rule-based generative theory of phonological acquisition, but are context-based and gradually 'suppressed', limited or ordered by the child since they do not meet the criteria of the adult grammar, e/ unlike rules, are subject to no exceptions, and f/ have no phonemic substance but are thought to be close to the adult's surface forms. Ingram (1976b) graphically states that phonological processes 'slide through the child's system, appearing first as constraints on perception, later on organization and production until they are ultimately suppressed' (1).

The workings of phonological processes within the natural phonology framework are summarized 'into two opposing pairs: 'the syntagmatic processes which make sequences easier to pronounce …, and the paradigmatic processes which make individual segments easier to perceive and … pronounce' Major (1977:88). Much in line with Jakobson's early postulations, examples of paradigmatic processes in natural phonology are provided by the cited author's analysis of his daughter's bilingual development of phonology in English and Portuguese. Examples of syntagmatic processes are: [+obstruents] → [-voice], [+obstruents → [-continuant], [+anterior, +coronal] → [+laminal]; examples of syntagmatic processes are: [+obstruents] → [+voice] / [+voiced], [+obstruents] → [+continuant] / V_, [+sonorants] → [+nasal] / [+nasal] (p. 89). Stampe's theory of phonological development is considered to explicate Jakobson's implicational laws that extent synchronic phonological rules to diachronic and universal processes applicable in the adult languages (e.g. Vihman, 1996:21). However, Kappa (in press) mentions that Drachman (1978:124) questions the applicability of child phonological processes in adult languages cross-linguistically on the grounds that some early child phonological processes like, consonantal harmony, are not productive in adult speech. That consonantal harmony is not extensively productive in adult speech has been reported elsewhere as well (Vihman, 1996). The idea of naturalness behind linguistic explanations in both perception and production has been more recently utilised in terms of functional and semiotic principles in the framework of 'natural linguistics' and has been discussed in relation to OT (Balas, 2009:35 and references therein).

2.4.4.4 Neo-Jakobsian theory

Recall with regard to Cognitive Theory (section §2.1.2) that Ingram (1974a) introduced the idea that a child's phonological knowledge differs from that of the adult's, though not without exceptions. Neo-Jakobsian theory (e.g. Ingram, 1974a, 1988a, 1989a, 1991, 1992) incorporates Jakobson's proposition that the feature is the basic unit of analysis as opposed to the word (e.g. see the Stanford Group) and of the universality of first contrasts. One of the main postulates of neo-Jakobsian theory is that children's perceptual abilities (themselves immature at onset of speech) precede their phonetic skills and that the child's perception of the adult form is phonetic rather than, as argued by Smith (1973), phonemic. Children's representation of early vocabulary in fully specified feature matrices has been proposed as the 'acoustic representation hypothesis' (Ingram, 1991). Unlike in Jakobson's theory, neo-Jakobsian theory states that there is cross-linguistic variation in the acquisition of contrasts. For an elaborate outline of neo-Jakobsian theory, see Beers (1995, 41-47). In this approach, phonological processes play an important role. Phonological process analysis is 'an attempt to explain a child's substitutions by describing them in terms of general patterns of simplification' (Ingram, 1981c). Phonological (or simplification) processes, defined as 'a simplifying tendency on the part of the child to alter natural classes of sounds in a systematic way' (ibid:77) and considered finite, are classified under generalized statements in eight major types: a/ substitution processes, b/ assimilatory processes, c/ syllable structure processes, d/ dynamic considerations of phonetic variability, e/ simultaneous occurrence of advanced and 'frozen forms' (Ferguson & Farewell, 1975), f/ non-isomorphic processes where substitution patterns are affected by the occurrence of adjacent phonological processes, g/ individual variation or 'phonological preferences' among children, and h/ prosodic considerations relating to the place of the sound in the word, also subject to individual variation (Ingram, 1979). Though not claimed conclusive or inclusive, simplification processes are further classified (ibid) with regard to English in terms of:

a/ *Syllable structure processes*: deletion of final consonants (FCD) (e.g. nasals, voiced and voiceless stops, voiced and voiceless fricatives), reduction of consonant clusters (CR) (e.g. liquids, nasals and /s/-clusters reduced to consonant, consonant deleted, cluster deleted), syllable deletion, syllable reduplication, reduction of disyllables (RD) by deleting the unstressed syllable in the disyllabic word, unstressed syllable deletion (USD), reduplication (R) of the stressed syllable (Ingram, 1989a).

b/ S*ubstitution processes*: fronting of palatals or depalatalization (Dep), fronting of velars (VF), stopping of initial voiceless/voiced fricatives and affricates (S), simplification of liquids and glides (Liquid Gliding), denasalization (DN) to an oral, de-affrication (DeA) when an affricate changes into a fricative, initial consonant deletions (ICD), apicalisation (AP), i.e. the shift from a labial to an apical production, labialization (LB). Ingram (1981c) found the following 'basic' set of word-initial consonants: [p, b, f, m, w, t, d, s, n, k, g, h] with children's inventories being a subset of this set by age 2. Subsequent research showed that inventories may vary cross-linguistically (e.g. Pye, Ingram, & List, 1987; Ingram, 1992).

c/ A*ssimilatory processes* (within the same syllable): velar assimilation (VA), labial assimilation (LA), prevocalic voicing (PV), devoicing of final consonants (FS). In consonant harmony (CH), defined as an 'assimilation-at-a-distance' process (Vihman, 1978), features from one consonant spread to a non-contiguous consonant. Note that Grunwell (1981a) and Stoel-Gammon & Dunn (1985) also treat voicing/devoicing as assimilatory processes with voicing occurring pre-vocalically and devoicing word-finally. Smith (1973) uses the term 'laxing' rather than voicing.

Furthermore, *fusion* (or *coalescence*) is another syntagmatic process in child phonological development that is argued to explain some substitution processes; two contiguous consonants forming a cluster are simplified to a singleton combining features of both segments (e.g. Stemberger & Stoel-Gammon 1991; Chin & Dinnsen, 1992). For a review of other classification systems proposed in the literature, see e.g. Beers (1995:87) and Dodd et al. (2003). The Assessment of phonetic and phonological development carried out by the Panhellenic Association of Logopaedics (PAL, 1995) postulated simplification processes that are in line with those proposed for the English language, e.g. fronting, stopping, voicing/devoicing, labialization, coronalization, gliding, etc. including the palatalization of anterior consonants, e.g. /f, s, θ, ts/ → [ç]. Also, PAL (1995) showed that while coronal stops are acquired before dorsal stops, dorsal fricatives in Greek are acquired before coronal fricatives. Edwards, Beckman, Magoula, Nikolaidis & Tserdanelis (2004) have argued that consonant frequency and vowel context are important parameters for the understanding of the development of lingual obstruents in Greek.

Grunwell (1981b) proposed a 'chronology of phonological processes' from age 2;0 to 5;0 based on small numbers of English speaking children. By age 3, the following processes are found to be a/ *still present*: fronting of palatals, cluster reduction of /s/+consonant, weak syllable deletion, b/ *waning*: final consonant deletion, cluster reduction: obstruent + approximant, gliding, fronting of velars and affricates, regular stopping of interdental fricatives, inconsistent stopping of/v/, /s/ and /z/, and c/ *gone*: reduplication, consonant harmony, context-sensitive voicing. Following a detailed review of similar chronologies of phonological processes, 'patterns of co-occurrence and disappearance of the most frequent simplification processes' have been proposed and adapted here in Table 2.6 (Beers, 1995:98 and references therein; PAL, 1995 *in bold* for Greek).

Table 2.6 Co-occurrence/disappearance patterns of simplification processes

	<2;0	**2;0-2;6**	**2;6-3;0**		**3;0-3;6**		**3;6-4;0**	
	Eng	Eng	Eng	**Grk**	Eng	**Grk**	Eng	**Grk**
Reduplication	√	√						
Prevocalic voicing	√	√						
Weak syllable deletion	√	√	√			**√**		**√**
Final consonant deletion	√	√	√	**√**		**√**		**√**
Assimilation	√	√	√	**√**		**√**		
Stopping	√	√	√	**√**	√	**√**		
Fronting of velars	√	√	√	**√**	√			
Vocalization	√	√	√		√		√	
Fronting of palatals	√	√	√		√		√	
Gliding	√	√	√		√		√	
CC Reduction	√	√	√	**√**	√	**√**	√	**√**
Devoicing		√	√		√		√	

(Beers, 1995; PAL, 1995)

2.4.4.5 Optimality theory

Phonological processes within Optimality Theory, OT, (e.g. Prince & Smolensky, 1993, 2004; McCarthy & Prince, 1994) are viewed as 'constraints' on the form of the child's realizations. Following generative theory, children's lexical representations in OT are like the adult's but unlike generative theory that reduces phenomena to an expression of rules and representations OT dispenses of rules altogether and assesses the wellformedness of optimal production across representations. In OT, there is a set of markedness constraints that are part of UG and are violable. The child is innately endowed with such universal unordered constraints that limit her outputs as she starts off with unmarked forms to linearly proceed towards skillfulness and adult production; not all constraints are part of the grammar of every language, either. Therefore, the difference between child and adult grammars as well as cross-linguistic variation in OT results from differences in such constraint ranking. Constraints relate the UR (input) to the surface representation (output) and computational principles made up of constraints (on faithfulness to the UR) and correspondence relations determine optimal input-output mappings. Therefore, constraints compete and some are violated in order to satisfy other constraints that are ranked higher. In the early stages of development, no constraint is hierarchically ranked, so ranking occurs with demotion of structural constraints (e.g. Demuth, 1997). During this process, structural constraints are demoted by faithfulness constraints but can be activated as the child resorts to unmarked output(s) - a process that is termed the 'emergence of the unmarked' (McCarthy & Prince, 1994). In subsequent elaborations of the theory, the ranking of constraints is done through the promotion rather than demotion of constraints (e.g. Gnanadesikan, 2004) or through a combination of both (e.g. Boersma, 1997). Optimality theory, as the term suggests, advocates relative (or 'optimal') rather than absolute correspondence to the UR and has its own formalisms to designate the process, as well as, a specific list of constraint names. Nevertheless, OT's focus and elaborations on constraint demotion and promotion have been criticized as insufficient to explain every possible phenomenon occurring during human language learning (e.g. Bernhardt & Stemberger, 1998; Stemberger, Bernhardt, & Johnson, 1999). For a more detailed elaboration on this stance from the perspective of constraint-based nonlinear phonology (Bernhardt & Stemberger, 1998), see section 2.4.6 below.

2.4.4.6 Feature geometry

As stated earlier, a multi-planar evaluation of phonological development helps minimize the distance between surface and derivational levels and, consequently, decreases the abstractness involved during human learning of phonology. In terms of the segment, adding more detail to the structure enhances our understanding of underlying representations. Menn (1978) was the first one to identify nonlinear representations by specifying different features on separate tiers (levels of organization) as well as allowing the unspecified ordering of segments on the same tier. For a review of 'constraints-based nonlinear phonological theories' see Bernhardt & Stemberger (2008). The stance that each feature is an autonomous unit appearing on a separate tier has been known as 'autosegmental phonology' (e.g. Goldsmith, 1979) with other terms also following this lead, e.g. 'nonlinear' or 'multilinear' phonology. Features are hierarchically grouped together in ways that show dependency relations (Clements, 1985). Rice & Avery (1995:314) formulated a structure which proposes that all features are single-valued and grouped together under organizing nodes in a hierarchical fashion with Root being the main directory containing separate organizing nodes for: Laryngeal, Airflow, Spontaneous Voicing, and Place. Such a structure grouping features together within a segment is known as feature geometry. A 'common view of feature geometry' is adapted below from Bernhardt & Stemberger (1998: 92)

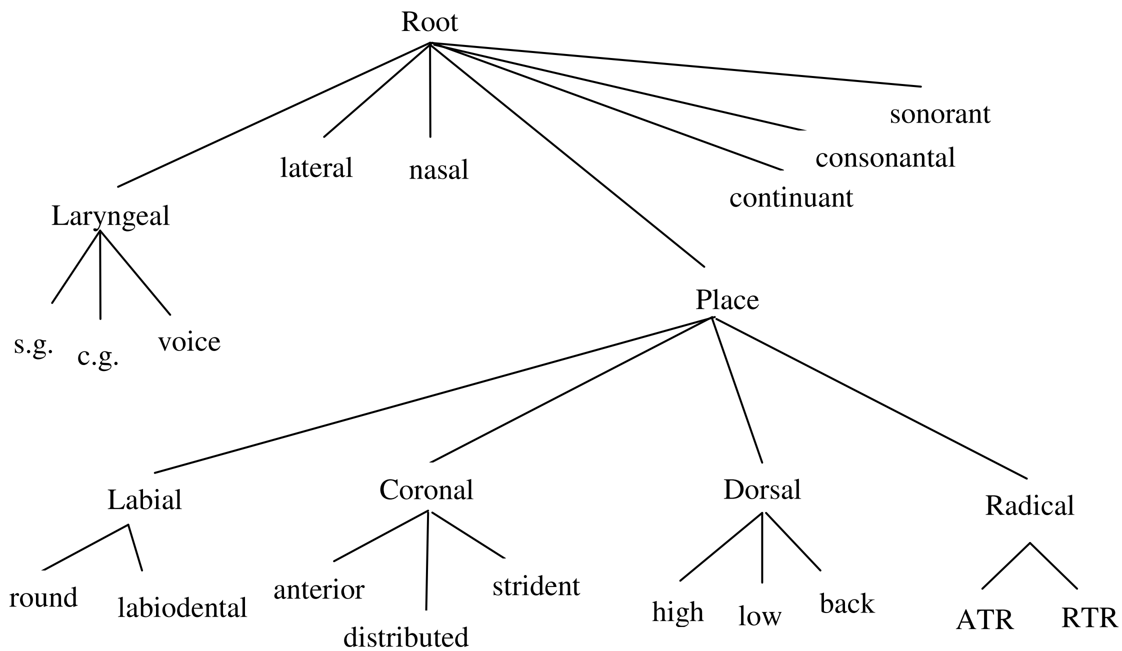


Figure 2.1 Segment Feature Geometry

In figure 2.1, [s.g.] denotes [spread glottis], as in the voiceless aspirated stops and [h]; [c.g.] represents [constricted glottis] as in the glottal stop, while [ATR] refers to [Advanced Tongue Root], as in high vowels, and [RTR] for [Radical Tongue Root], as in pharyngeal and pharyngealized consonants.

A natural consequence of the autosegmental framework is that elements need not be represented on all tiers leaving out predictable features. The possibility of underspecifying features is present in the SPE framework but has not been much explored (Dressler, 1998 and ref therein). In generative phonology, all active features are *fully specified*. Ingram (1991) in his 'acoustic representation hypothesis' has postulated that children represent their *early* vocabulary in *fully* specified feature matrices and his 'distinctive feature hypothesis' claims that children gradually develop constraints on their representations of distinctive features as their phonological and phonetic skill advances. The default or 'maximally underspecified' consonant in all languages is [t] and so are its respective features: PoA: [+coronal], [+anterior]; MoA: [-sonorant], [+consonantal], [-continuant], [-nasal], [-lateral]; Voicing: [-voice] (Archangeli, 1984). This is predominant in phonological development as well, where the underspecified for [place] coronal (or default) adopts features spreading from other consonants in the word, as in the case of consonantal harmony (CH) (e.g. Stemberger & Stoel-Gammon, 1991; Fikkert, 2007) e.g. /dʌk/ → [gʌk] (Menn, 1978). Nevertheless, there are exceptions based on variation across children with labial or dorsal being the default PoA and fricative being the default MoA (e.g. Bernhardt & Stemberger, 1998). For a criticism of the underspecified nature of the [coronal] PoA holding for the entire class of coronals (both marked [θ, ʃ] and unmarked [t, s]) and its re-percussions for underspecification theory, see Itô, Mester & Padgett (1995). The following segmental hierarchies of place markedness have been proposed in the literature: a/ Dorsal >> Labial >> Coronal, (cf. Prince & Smolensky 1993), b/ Labial, Dorsal >> Coronal (Kiparsky, 1994; Kappa, 1999), c/ Coronal > Dorsal > Labial (Malikouti-Drachman, 2001a), where >> means more marked than and > means stronger than.

Dinnsen (1992) proposed a featural model of phonological development that like Jakobson & Halle's (1956) is general enough to allow for universal tendencies as well as variability in the development of phonology. The hierarchy of features in this model is divided into five levels of increasing articulatory skill: Level 1 contains [syllabic], [consonantal] and [sonorant] whereby all consonants are stops, all obstruents are voiceless and unaspirated, and all sonorants are nasals; In Level 2, differentiation between voiced and voiceless obstruents assumes; In Level 3, [continuant] and [delayed release] become contrastive; In Level 4, sonorants are divided into [+nasal] or [-nasal], i.e. into nasal and liquid; lastly, Level 5 divides liquids into [+lateral] and [-lateral]. The doctoral thesis written by Magoula (2000) analyzing monolingual Greek consonantal development was based on this model.

In theoretical 'feature geometry' (e.g. Sagey, 1988), segments not only need not be represented on all tiers but may be inherently unspecified for certain features. This has led to underspecification theory (UT) with a number of different proposals. The necessity of underspecified input representations, even within an OT framework, is considered of essence in the understanding of 'chain shifts' i.e. change in development (Dinnsen & Barlow, 1998). UT links phonological inactivity, lack of markedness and redundancy. Contrastive Underspecification (UR) (e.g. Steriade, 1995; Clements, 1988) assumes that features that are not contrastive, i.e. they do not distinguish segments in underlying representations, are left blank (i.e. they are neither [+], nor [-] but [0]), whereas those that are contrastive are specified for both values. Following the operation of syntagmatic processes, or P rules (Stanley, 1967 in Steriade, 1995) on the minimally specified UR, the blank values are subsequently predicted by context-free rules, or 'redundancy rules' that mirror the markedness statements in reverse; in a sequential, derivational analysis, they 'express the derivational transition between the underlying system in which all features are privative and a surface system in which all features are binary (Steriade, 1995:119). Redundancy rules are usually formalized as e.g. [] → [+nasal], i.e. a consonant is not oral in UR but filters are sometimes used instead: *[+oral].

Radical Underspecification (RU) (e.g. Archangeli, 1984; Stemberger, 1991) assumes that only one value of the feature, the unpredictable one, may be specified in underlying representations; the other one is estimated. Though generally [place] and [voice] are privative features, every specified feature in underlying representations is considered to be privative within UT. Radical underspecification is thought to better describe phonological development (e.g. Ingram, 1989b; Kappa, 2000). However, the presence of predictable features (as e.g. in certain words only, or default values or redundant features e.g. [+voice] is redundant in sonorous consonants) in underlying representations is not totally dismissed in underspecification theory, as argued by Combinatorial Underspecification (Archangeli & Pulleyblank, 1994). Transparency (e.g. the [-voice] of obstruents) comes either from absence of the value as in RU or from its non-existence as in privative voicing theory (Itô et al., 1995 and refs therein). In Default Underspecification, Bernhardt & Stemberger (1998) argue further that although predictable features may be allowed in UR, these should not be default features if some phonological patterns in child phonology are to be accounted for. When *fusion* occurs as a substitution pattern, for example, the child chooses the underlying nondefault feature in the output rather than the underlying default feature: so /sp/ → [f] but not *[t] because /t/ is the underlying default (ibid and refs therein). A number of studies have applied underspecification theory in the understanding of various aspects of phonological development, like place assimilation (e.g. Dinnsen, Barlow & Morrisette, 1997; Kappa, 2000), acquisition of manner (e.g. Tzakosta, 2001a) or harmonies (e.g. Stemberger & Stoel-Gammon, 1991; Kappa, 2001; Reiss, 2003).

2.4.5 Other parameters in phonological development

Ervin & Miller (1963:115) have argued that substitution patterns in phonological development further relate to a process of ‘anticipation’ to the production of the adult interlocutor, i.e. the production of a segment in the adult’s speech as a substitute for a targeted segment in the child’s speech. This is claimed by the authors to be hardly uncommon in child phonological development, though not ordinarily noticed by parents; Morris Swadesh, in personal communication with the cited authors, is argued to have noticed in his son’s realizations this complex, external to the child’s UR, pattern of substitution. Such repair strategies could perchance provide explanation for what is elsewhere attributed to allophony and free variance (e.g. Smith, 1973), or may relate to what Stemberger (1989) calls ‘non-contextual errors’ and to what Stemberger, Bernhardt, & Johnson (1999) call ‘uncorrelated pure regressions’ – see following section §2.4.6 for more. An argument is that ‘non-contextual’ pronunciations are characteristic enough of child speech so they get classed as systematic errors. Alternatively, some ‘non-contextual’ errors that happen to resemble real words might be misclassified as phonologically related word substitutions’ (Stemberger, 1989:169).

Stemberger (1989) identified and comprehensively elaborated on 'nonsystematic' speech errors in his two daughters' developing phonologies – errors that closely resemble those of adults. These are: a/ a larger proportion of word substitution errors involving phonologically related words, b/ the 'misordering' of segments between two words, within one word, or that are 'non-contextual' with no obvious source (though adults and children differ quantitatively on all comparisons), c/ errors involve mostly consonants, fewer vowels and even fewer consonant/vowel combinations, d/ children and adults do not differ in the proportion of vowel errors, nor in the proportion of consonant errors (once the adult errors are adjusted to the more common neutralized consonant contrasts in child speech), e/ 'illegal' sequences of segments violating phonotactics are quite rare, f/ elements that interact in errors tend to be quite similar (segments tend to differ by a single feature and originate from parallel positions in their respective syllables), g/ the same distribution of errors by number of features and the same relative rate of error involving any given feature or combination of features, h/ adult and children show the same low rate of cross-position errors (e.g. syllable-initial errors of syllable-initial consonants) and a bias toward errors in syllable-initial position, i/ ambisyllabic segments interact with both syllable-initial and syllable final proportions, j/ consonant addition errors in clusters are similar, k/ difference in vowels features does not increase the rate of initial consonant errors, l/ there is no evidence that the child's realizations (as opposed to the adult target) affect the way segments interact.

A child's lexical knowledge and breadth of vocabulary influences the rate and pace of phonological acquisition (e.g. Ervin & Miller, 1963; Stoel-Gammon, 2011) mostly noted during the early stages of phonological development (Stoel-Gammon, 1998b) but is also pertinent past the 50-word threshold (Storkel & Morisette, 2002 and refs therein). Children produce new words composed of acquired sounds more frequently than new words composed of non-acquired sounds (e.g. Leonard, Schwartz, Morris, & Chapman, 1981). There are three principal lexical qualities that may predict and are expected to affect speech development: a/ the *frequency that words occur* in the language (e.g. Pye, Ingram & List, 1987; Ingram, 1988b; Bernhardt & Stemberger, 1998; Morrisette & Gierut, 2002) with high-frequency words being recognized and produced faster and more accurately (e.g. Stoel-Gammon, 2011; Ellis, 2002). b/ *neighborhood density*, i.e. phonological similarity of words in the mental lexicon often differing by one phoneme through substitution, deletion or epenthesis (Luce & Pisoni, 1998); neighborhoods are classified into 'dense' and 'sparse' depending on the number of neighbors in the group, and c/ *phonotactic probability* i.e. effects of phoneme-sequence frequency in terms of which sound patterns in the language are more likely to occur than others (e.g. Menn, 1971; Freedman & Barlow, 2012). Sound change in development and historically in the languages of the world, is argued to occur both across-the-board, i.e. abruptly in all relevant contexts as well as through lexical diffusion, i.e. gradually on an individual word-by-word basis. Lexical diffusion in phonological development is affected by four interrelated factors: a/ input, b/ the implementation of sound change as either phonetic or phonemic, c/ the manner class undergoing sound change and, d/ the context of sound change (Ingram, 1989b).

‘Carol Stoel-Gammon has [recently] made a real contribution in bringing together two fields that are not generally jointly addressed’ (Vihman & Keren-Portnoy, 2011:41). Stoel-Gammon (2011) emphasizes the overlap present between lexical processing (in children and in adults) and phonological development by summarizing them in four main postulates that include extended elaboration: a/ *lexical acquisition is influenced by a child’s prelinguistic vocalizations*: babbling underlies the phonological patterns of early word productions and provides practice through the formation of an auditory–articulatory loop; reduced canonical babbling is associated with delays in lexical development; adult–child vocal interactions influence infant babble and provide support for word learning, b/ *lexical development is affected by the adult phonological form and by the child’s productive phonology*: some children show preferences for words with particular sounds and sound classes and some build vocabulary around the ‘whole-word’ phonological patterns of adult words; patterns of lexical selection are also evident beyond the first-50-word period, c/ *lexical development and phonological development are commensurate* with those advanced/delayed in terms of vocabulary being also advanced/delayed in terms of their phonology, and d/ *underlying representations change as the vocabulary increases*: when the vocabulary is small, underlying representations are stored as single, unanalyzed units; increases in the size of the vocabulary size result in finer-grained underlying representations and influence productive phonology.

In terms of production variability, Stoel-Gammon (2011) argues that it may indicate that: a/ a word has a ‘fuzzy’ (29) underlying representation with lesser-formed details, b/ there is a transition between successive or non-successive outputs, or c/ articulatory skill is still immature. Frozen forms/archaisms (see next section §2.4.6 for definitions) may be subject to different interpretations, however, in that the underlying representation may be: a/ stable but incorrect, b/ stable and adult-like but the mispronunciation relates to incorrect articulatory habits, or articulatory immaturity. Furthermore, the majority of early patterns in lexical selection relate mostly to individual production preferences than to characteristics of the ambient language. Demuth (2011) has, additionally, argued that variable production is also dependent on: a/ word length, b/ the position in which the lexical item occurs in the utterance and c/ acoustic cues and feature contrasts that children have but adults cannot detect. Kehoe (2011) has comprehensively shown that lexical and phonological development are also commensurate in bilingual acquisition; she has discussed this in terms of ‘lexical selection and avoidance’, separate phonological strategies per language, ambient language specificities and cross-linguistic influences.

2.4.6 Linearity, non-linearity and the U-shape

Another generic theme in phonological development has been concerned with whether development is linear (i.e. going from one thing to the next in a direct and logical way as if building on a line) or nonlinear (i.e. involving further complexity that is multi-planar). The generative perspective originating in Chomsky & Halle (1968) with its explanation of phonology in terms of rules and representations, as well as, theories stemming from it e.g. OT (e.g. Prince & Smolensky, 2004) are not only essentially mathematical in their outlook but also linear. Despite the significant impact of these theories in the understanding of phonology, the overall agreement, to date, seems to be that phonological development is nonlinear both in terms of general language acquisition theory and particular phonological theorizing (e.g. Mohanan, 1992; Macken, 1992; Bernhardt & Stoel-Gammon, 1994; Fikkert, 1994; Rice & Avery, 1995; Vihman, 1996; Gierut, 1996; Bernhardt & Stemberger, 1998; Wong & Stokes, 2001; Werker, Hall, & Fais, 2004, etc.).

Bernhardt & Stemberger (1998) provided a developmental model of child speech acquisition from the perspective of constraint-based nonlinear phonology acknowledging the lack of 'a fully elaborated theory of learning of constraint rankings by young children' (261-263). The general suggestion is that 'output constraints do not depend on representational analysis, but do undergo changes as learning proceeds' (258). The framework assumes that a re-ranking (or change of ranking) of constraints may be necessary at various stages of a given child's phonological development which cannot be accounted by strictly linear constraint demotion, as is the case for the child's data in the present dissertation, discussed in chapter 5. Each child starts out with some stable ranking of constraints which cause unfaithfulness of the child's production to the adult target; the most frequent outputs are ranked as defaults. An internal component of the language system is assumed which compares child and target production and initiates re-ranking of constraints in the following stages of development. In the final stage, the constraint ranking reached allows the child's output to be faithful to the adult pronunciation. The authors adopt the formalistic framework of OT to designate the process and introduce their own constraint names that can be found in Appendix C of their book. For example, **Not(…)** refers to constraints that do not allow an element in the child's output, **Survived (…)** refers to constraints that force an element in the underlying representation to be present in the surface pronunciation, and **LinkedUpwards** means that an element must be anchored in time relative to other elements for the purpose of preventing its deletion. Identification of the relevant constraint is also claimed to be an issue, as sometimes constraint lists may be inadequate. It is clearly stated by the authors that child phonology phenomena have their roots in physiology, in perception and in cognitive processing and that their model based on child speech production does not purport to fully account for all of these variables.

Bernhardt & Stemberger (1998) posit the following limitations of the optimality theoretic approach when applied to developmental phonology: a. inability to account for regressions that are common in child phonology, b. incorrect predictions with regard to variability in child speech and c. undue low ranking of faithfulness constraints that do sometimes rank high in child speech. In particular, it is argued that like the suppression of phonological processes, discussed by Stampe (1979), evidence of regression indicates additional rerankings rather than the disappearance of constraints previously ranked high. Thus, a regression, sometimes a 'trade-off', may be one of three things: the perpetrator constraint ranks high both before and after the reranking, less powerful constraints may themselves rerank and, last, a high constraint remains high but repair processes are different (265-266). Agreeing with Macken (1980b), they, further, support that some variability may arise from the child's misinterpretation of the constraint rankings in adult speech and that an 'alternative learning mechanism' (259) will be needed to account for this incongruence between child and adult representations. Last, it is said that the nature of the underlying representation in acquisition is vaguely dealt with by OT, as shown by the fact that faithfulness to the adult form is itself an integral part of the development.

Other nonlinear accounts of phonological development have been postulated in terms of a/ 'self-organizing systems' whereby 'phase shifts' including progression and regression are typical of emergent systems (Thelen, 1989) or b/ 'dynamic systems' (e.g. van Geert, 1994; Vihman, De Paolis & Keren-Portnoy, 2008) in which there are sets 'of variables that mutually affect each other's changes over time' (van Geert, 1994). Both of these nonlinear viewpoints generally fall under the premises of the 'science of complexity' (Prigogine & Stengers, 1984), that is, chaos theory. The general idea, which has also been argued to apply in SLA (e.g. De Bot et al., 2006), is that language is a self-organizing, dynamic system that creates complex patterns through the interaction of various 'fields of attraction' between each other together with articulation and perception. Contrary to the classic generative perspective, phonological development is not gradual 'knowledge discovery and deduction' via default URs and subsequent parameter setting but rather a nonlinear, dynamic 'morphogenesis' (meaning the creation of form) in the sense of 'pattern formation and adaptation' (Mohanan, 1992).

Non-linearity in phonological development has also been seen in terms of developmental patterns. The U-shape has been identified in the literature as a pattern in speech development (e.g. Ingram, 1989a; Stemberger et al. 1999; Stoel-Gammon, 2011) which traces behaviors that first appear (progress), then they disappear (regress) and then, apparently, reappear (progress again) over time. Historically, Ebbinghaus (1913), who pioneered the experimental study of memory, first spoke of a forgetting and a learning S-curve, that is, often referred to as the logistics curve (or function) of growth of some population *P* originally due to P. F. Verhulst (1804-1849). Bills (1934) elaborated on this with a more detailed description of learning curves identifying three properties: negative acceleration, positive acceleration and plateaus. In economics, development refers to a system learning process with varying rates of progression and the S-curve has different appearances depending on the time-scale of observation. Stemberger et al. (1999) state that 'U-shaped learning appears to be especially prevalent in the development of phonology, where it is known as *regression*' (1). Phonological regressions are described in two-dimensions: as 'trade-offs vs. pure' and as ‘correlated vs. uncorrelated’. ‘Trade-offs’ refer to the regressions resulting from the alteration of the system to achieve accuracy on one dimension of a form, whereas ‘correlated’ are those regressions in forms that were not possible before but relate to a change in the system elsewhere. There are four basic types of regressions: ‘correlated trade-off’, ‘uncorrelated trade-off’, ‘correlated pure’ and ‘uncorrelated pure’. Uncorrelated pure regressions are argued to be rare and to have no explanation in any theory of learning. Stoel-Gammon (2011:18) has referred to the U-shaped pattern in phonological development as ‘peaks and valleys’. ‘Re-construing U-shaped functions’, Werker, Hall, & Fais (2004) have talked about an N-pattern in language acquisition whereby the development of phenomena starts out non-adult like and proceeds with progression and then regression again before complete acquisition.

Within the autosegmental approach of consonantal acquisition, Gierut (1996) argues in favor of ‘laryngeal-supralaryngeal cyclicity’ as a principle model of subsegmental structure without, however, minimizing the importance of other principles operative in phonological development. The principal postulates that: a/ laryngeal and supralaryngeal properties (the latter referring to both place and manner features) are ‘coequal’ functioning ‘in a sister relationship’ (49) and are elaborated in a continuous, consecutive and recursive cycle with expansion of the inventory first in one domain and then in the other, b/ there is no stipulation on whether the cycle begins with a laryngeal or supralaryngeal domain, c/ specific phonological distinctions are not predicted in each phase but left ‘underdetermined’, so the same segmental property can be realized differently across children, d/ the simultaneous emergence of two different distinctions (e.g. a unique laryngeal property and a unique supralaryngeal property) at the same point in the same cycle is excluded. Contrary to this, Ingram (1992) has argued that place distinctions are distinguished before voice distinctions. As in adult languages, the supralaryngeal node in child development adds necessary structure in the UR. In line with nonlinear postulations of phonological development, Tzakosta (2004) and Revithiadou & Tzakosta (2004) argue, following Kiparsky’s (1993) ‘multiple-grammars approach’ proposed for adult speech production, that phonological learning in childhood does not consist of a series of linearly ordered grammars but proceeds through a system of multiple grammars or co-grammars that are associated with certain developmental stages.

Further to the nonlinear approach found in formalistic autosegmentalism and underspecification theories, non-linearity in developmental phonology has further proposed that during initial stages whole levels of representation (both segmental and skeletal) may be lacking (e.g. Menn & Matthei, 1992) or that the child’s UR may not have branches either at word level, i.e. when monosyllabic words are produced only, or at the syllable level when e.g. no word-final codas or clusters are produced (e.g. Vihman, 1996:40-41). Despite evidence of progression in the system elsewhere, non-linearity in children’s developing phonology is further evident in the persistent adherence to an undeveloped ‘frozen form’ (Ferguson & Farewell, 1975), that is ‘a hold-out word … a regressive phonological idiom’ (Menn & Matthei, 1992:215), as if the child is emotionally holding on to a ‘teddy bear’ (Gut, 2011 pers. comm.). ‘Phonological idioms’, referring to production sequences that do not generalize to similar words, is a term first coined by Moskowitz (1971). Such phonological idioms that persist over time and do not uniformly improve across the board have been referred to as ‘archaisms’ by Ervin & Miller (1963:116) who attributed them to stylistic factors and the incongruity between a large vocabulary set and a primitive phonological system. Lastly, a ‘fluctuation’ phenomenon (Dodd, Holm, Hua & Crosbie, 2003:622), whereby sounds appear acquired for a period and then they disappear until a later stage is known as ‘reversal’ (Wellman et al., 1931).

2.5 Conclusions

This chapter has made a review of the theoretical background to phonological development by placing it in the wider context of language acquisition, in general. An account of major constructs and definitions in first language, second language and bilingual acquisition was also given in order to put the child/participant’s acquisition of the English language alongside Greek within perspective. The importance of purely linguistic models and abstract phonological theory in the understanding of underlying representations of segments has also been acknowledged. A psycholinguistic approach that relates cognitive, neurolinguistic and biological approaches was adopted in the review as a necessary framework for a study that tackles the comparison of languages in the bilingualism of a developing toddler both at a fixed point, i.e. during the first month of available data, as well as, longitudinally during the seventeen months covered by the study. The holistic outlook enables an understanding and analysis of developmental data that a strict linguistic perspective may have fallen short of.

CHAPTER 3
METHODOLOGY: CHILD CASE STUDY, DATA COLLECTION & ORGANIZATION

The first section (§3.1) of this chapter provides an introduction on the nature and scope of case study research which is the method employed in the present thesis and discusses specific aspects in research methodology that relate to case study research in applied linguistics in general, as well as, to the examination of the development of consonantal phonology by children, in particular. The methodological issues that pertain to the segment, as the unit of analysis in this thesis, and data organization are also discussed (§3.2-3.3). Section §3.4 of this chapter introduces the child (participant in this case study), describes her micro and macro sociocultural milieu, the maternal scaffolding (or actual practices employed) facilitating the acquisition of English in bilingualism and the background context of the study including the rationale leading to the child's bilingualism. In line with triangulation in research methodology, this emic narrative account is meant as qualitative evidence of the child's experience on language learning and use which is a common practice in qualitative research. By examining the forces behind the child's dual linguistic accomplishment, those qualities that define bilingualism are identified with the purpose of verifying her bilingual status qualitatively alongside a consideration of theoretical stances in first, second and bilingual acquisition. In the second part of the chapter (§3.5), key issues and concerns pertaining to the core methodology of the thesis, such as the nature of data and timelines, are discussed while the exact procedures relating to data elicitation, collection, transcription, organization and analysis are also clarified. Section §3.6 makes a conclusive remark.

3.1 Case study research

3.1.1 Definitions

Case study research focuses on the thorough analysis of an individual case, meaning an individual person, a group of people or some other entity (e.g. Hesse-Biber & Leavy, 2006) and it has been undertaken in an array of fields including linguistics, psychology, sociology, medicine, biology, etc. Yin (2003:5) identified three types of case study: the 'exploratory' study outlining questions and hypotheses for subsequent research; the 'descriptive' study depicting a phenomenon within its context; and the 'explanatory' study that looks for cause-effect relationships in the presentation of data. Case studies are rather rare and few (Gut, 2009). Within the field of applied linguistics, case study methodology has been employed in developmental linguistics (e.g. Nice, 1925; Brown, 1973), in child SLA (e.g. Hakuta, 1976; Itoh & Hatch, 1978), adult SLA (e.g. Shapira, 1978; Singleton, 1987), as well as, the study of language pathology (e.g. Wernicke, 1874; Ingram, 1976a) usually examining a specific feature of a person's linguistic performance with regard to e.g. phonology, syntax, morphology, etc. Hatch (1978) has edited a collection of seventeen case studies of individuals of various ages (children and adults) acquiring a second (or third) language naturalistically as opposed to in instructional setting. Understanding of the process of language development has sometimes come from reports (or, memoirs) of one's own experience of acquiring language (e.g. Augustine, 1952; Schmidt & Frota, 1986). Case studies sometimes analyze the linguistic abilities of atypical individuals (e.g. Smith & Tsimpli, 1991). One such case is Genie (Curtiss, 1977), a girl that failed to acquire normal use of her L1 due to suffering extreme abuse and deprivation in early childhood.

3.1.2 Case studies of children

Language acquisition and, in particular, the development of phonology in a language has been enriched by both large-sample studies of children with regard to English (e.g. Wellman et al., 1931; Templin, 1957; Olmsted, 1971; Irwin, & Wong, 1983; Stoel-Gammon, 1985; Dodd et al., 2003) and Greek (e.g. PAL, 1995; Magoula, 2000; Papadopoulou, 2000, Tzakosta, 2004), as well as, by studies focusing on individual children. Among the first scholars to pioneer observation in a single child was Charles Darwin publishing "A biographical sketch of an infant" in 1877. Darwin's detailed naturalistic observation of his son, done in note cards and field books has been repeated since (e.g. Piaget, 1955; Shinn, 1900) and is generally known as 'baby biography' (e.g. Kent, 1992). It has subsequently set the ground for a surge of parent-linguists' investigations of their off-springs' linguistic development in the form of diary notes (e.g. Preyer, 1882; Stern & Stern, 1907; Kenyeres, 1938; Szuman, 1955) that were sometimes anecdotal in scope (e.g. Ronjat, 1913). The most influential longitudinal case-studies in the development of phonology have been Smith's (1973) generative analysis of his son's system in development and Leopold's (1949) prodigious study of his daughters' German/English bilingualism, with the main focus on Hildegard's (the first daughter's) phonological development.

Phonological development has been investigated by the study of many individual children as the extensive work of several developmental phonologists has shown (e.g. Moskowitz, 1971; Waterson, 1971; Ingram, 1974a, 1976b; Ferguson & Farewell, 1975; Smith, 1973; Menn, 1976; Macken, 1979; Stampe, 1979; Macken & Barton, 1980; Stoel-Gammon, 1985; Vihman, 1985; Stemberger, 1989; Fikkert, 1994; C. Levelt, 1994; Vihman & Velleman, 2000; Kappa, 2001; Kehoe, 2001; Kehoe, Lleó, & Rakow, 2001; Tzakosta, Levelt, & van de Weijer, 2005, etc.). An enumeration of bilingual English/Other-language case-studies in phonological development was outlined in Chapter 2 (§2.3.2.2). For a comprehensive review of bilingual acquisition studies in general, see De Houwer (2002). Sole examples in dialectal development and the acquisition of phonology by bilingual English-Spanish twins are represented in Tse & Ingram (1987) and Ingram, Dubasik, Liceras, & Fernández Fuertes (2010), respectively. Cross-generational research has also made a first appearance with Smith's (2010) case study comparing his son's and grandson's phonologies in development (see Stemberger, 2012 for review).

Slobin's (1997) publication on L1 acquisition across many languages was often based on case studies, including the study of three children acquiring L1 Greek (Stephany, 1997). The study of the acquisition of monolingual Greek phonology began in the work of Drachman and Malikouti-Drachman (e.g. Drachman & Malikouti-Drachman, 1972, 1973; Drachman, 1975; Malikouti-Drachman & Drachman, 1976). Single subject case-study research in monolingual acquisition of Greek phonology is represented in the work of e.g. Kappa (e.g. 2000, 2002, 2009) and Tzakosta (2001b). An early study comparing later syntactic (not phonological) development between Greek monoglot and English/Greek bilingual children is found in Natsopoulos (1976). Various other aspects, such as the role of age of onset and input in bilingual acquisition of Greek/Other-language have also been discussed (e.g. Unsworth, Argyri, Cornips, Hulk, Sorace, & Tsimpli, 2011). A group study of VOT production in early Greek/Australian English bilinguals was carried out by Antoniou, Best, Tyler, & Kroos (2010). To the author's knowledge, there are no case studies of an individual child's phonological acquisition of the English consonantal system in Greek-English bilingualism. Also, the author has found a lack of longitudinal studies on the phonological development of bilingual Greek-English (irrespective of whether English input was native or not) or of monolingual Greek spanning a longitudinal and uninterrupted period of seventeen months.

3.1.3 Naturalistic and longitudinal data

There are a number of approaches to collecting language production data that include elicited narrative, word-list reading and spontaneous speech (Ratner & Menn, 2000). The collection of spontaneous productions in a naturalistic setting is the oldest most preferred method extant and is testified in an abundance of studies, such as Velten (1943), McCurry & Irwin (1953), Menn (1971), Waterson (1971), Ingram (1974a), Ferguson & Farwell (1975), Major (1977), Macken & Barton (1980), Vihman (1985), Schnitzer & Krasinski (1994, 1996), Shriberg, Austin, Lewis, McSweeny & Wilson, (1997), Kehoe (2001), Bunta, Fabiano-Smith, Goldstein & Ingram, (2009), Kappa (2009), Fabiano-Smith & Barlow (2010) to mention just few. Despite the large bulk of language acquisition studies to date in both monolingualism and bilingualism that are undertaken by parents (e.g. Velten, 1943; Smith, 1973; Major, 1977; Vihman, 1985; Schnitzer & Krasinski, 1994, 1996; Johnson & Lancaster, 1998), parent-linguists investigations are by no means exclusive as clearly shown by an abundance of other studies (e.g. Swain & Wesche, 1975; Ingram, 1981c; Fabiano-Smith & Goldstein, 2010). De Houwer (2002) has demonstrated that only 8 out of the 58 children in her cited studies on bilingualism are the authors' own children. Bates et al. (1995:99) argue that 'parents have a far larger dataset than researchers … more representative of the child's ability'.

One of the advantages of case studies is that they are longitudinal in timespan and can, therefore, account for developmental changes in their subject(s) diachronically. 'A longitudinal study gives a description of linguistic performance at several points of time, analyzing changes which occur between point t1 and point t1+1' (Meisel, Clahsen, & Pienemann, 1981). Ortega & Iberri-Shea (2005) postulate that the length of a case study depends on sample size, frequency of observation and how much detail of the phenomenon examined is required. Bernhardt & Stemberger (1998) state that in terms of methodology, '*many* longitudinal data sets will be needed, sampled at intervals of less than a month' (8). Leopold's (1949) prodigious study of Hildegard's German/English bilingualism on many grammatical levels, including phonology, is monumental in span and depth of analysis but also in its longitudinal scope having observed the child from her onset of speech to the age of about six years. Another widely influential study is Smith's (1973) extensive theoretical elaboration in generative phonology of his son's, Amahl's, phonological acquisition of English as a first language from the age of 2 to 4 that has recently been matched by a cross-generational follow-up (Smith, 2010). Macken's (1979) study also, in a rare longitudinal account of child Si's acquisition of Mexican Spanish in the U.S., spans a period of 10 months with recordings and transcriptions on a weekly basis for up to 30 minutes at a time.

3.1.4 Qualitative aspects of case study research

Research method textbooks for applied linguistics excluded the case study in their discussions of methodology before the 1990s (Duff, 2008), surprisingly in spite of its long tradition and productivity. The reason may well be that case studies are widely associated with qualitative research. Qualitative research has traditionally been viewed as less scientific due to its descriptive (or non-experimental) design "examining and interpreting observable phenomena *in context*" (Duff, 2008:30) that can easily become anecdotal in nature. Epistemological theories examine the extent to which researchers' interpretations of an event, behavior or an examined phenomenon can be objective and the nature of truth based simply on the grasp of human awareness. Regardless of the productiveness of such argumentation, interpretivism (e.g. Ritchie & Lewis, 2003) is a widely accepted approach in qualitative research in that 'the social world is not governed by law-like regularities but is mediated through meaning and human agency' (17). In this line of thought, an investigator's subjectivity cannot be totally isolated from his/her research findings in that these findings, even in the case of quantitative methodology, undergo an analysis or are presented from a viewpoint that is inevitably influenced by his/her own perspective, theoretical outlook and values.

Patton (1990:78) argues that each individual person is part of a faction of sociological, linguistic, sociolinguistic and other 'systems' which comprise the background context of the case study and ought to be taken into account. Most case studies of children provide a section (usually brief) that discusses such issues relating to the child and his/her milieu (e.g. Leopold, 1949; Smith, 1973; Curtiss, 1977; Hakuta, 1976; Schnitzer & Krasinksi, 1994, 1996; Keshavarz & Ingram, 2002; Brulard & Carr, 2003, etc.). During the author's presentation at the CUNY 2012 Conference on 'Segment in Phonology', a question from the audience centered on whether acquisition of English by this child was easy or not, expressing an interest on the actual circumstances that led to the child's bilingual acquisition. As an indication of a more wide-spread interest, focusing on the child and her acquisition of English beyond the strictly linguistic perspective is considered of essence in this study. Socio- and psycholinguistic contexts are important in child bilingual acquisition (for multidisciplinary perspectives see: Pavlenko, 2008), as well as, maternal scaffolding. Scaffolding as a notion in language learning is first found in the work of psychologist Vygotsky (e.g. 1987). In this lead, Bruner (1983) argued that language learning takes place in appropriate interactional settings with the caregiver (usually the mother) providing the required structured framework within expected routines, such as reading books together and conversations in the course of the day. Cazden (1983) distinguished between vertical scaffolding (when the caregiver instigates speech production by asking questions) and sequential scaffolding (when conversation runs casually during games, meals, bed times, etc.). Furthermore, the section presenting the child and her milieu is purposefully written in the manner of 'verisimilitude' (Adler & Adler, 1994:381), that is, description of actual incidences in a tangible manner. The purpose is to bring the reader close to the individual, so that her (the subject's) world can be clearly felt. At the same time, the qualitative forces behind the child's dual linguistic accomplishment are examined and those traits that define bilingualism are identified in order to verify the child's bilingual status qualitatively. Exemplifying theoretical insights by means of illustrations and vignettes is a recognized practice in qualitative research (e.g. Merriam, 1998).

3.1.5 Quantitative aspects of case study research

Although case study research has traditionally been associated with qualitative research, quantitative analysis is not precluded in its design but can complement the case study design by constituting a control context implemented by descriptive, time-series statistics (e.g. Mellow, Reeder, & Forster, 1996). Many case studies have produced quantifiable data as, for instance, in SLA (see Ortega & Iberri-Shea, 2005 for a review of studies) but these data are often averaged out or not consistent enough in terms of the size and uniformity of the sample of participants to warrant reliable inferential statistics. In the study of phonological development, statistics are often used to allot individual children or groups of children within a general quantified framework according to variable constructs, e.g. the Percentage Consonant Correct (PCC) metric (Shriberg et al., 1997), the Phonological Word Proximity (PWP) formula (Ingram, 2002), the age of acquisition of specific segments along the stages of development (e.g. the criterion of 90% presence in obligatory contexts (e.g. Cazden, 1968; Brown, 1973) or variance analysis (e.g. De Bot, 2011). The longest spanning case-studies of children's phonologies in the literature (e.g. Leopold, 1949; Smith, 1973, Hakuta, 1976; Schnitzer & Krasinski, 1994, 1996; Smith 2010), however, have been qualitative in that they used narrative and detailed linguistic accounts and examples to present the data (e.g.

the segment) in terms of phonological theory, but are completely lacking in their representation of quantitative distributions both synchronically (at a certain stage in development), as well as, diachronically (over the longitudinal span of these studies). In the case studies of both his son, Amahl, and his grandson, Zachary, Smith (1973; 2010) has provided appendices of the pronunciation of all identifiable words, however, there has been no quantification of the errors. Subsequent and more recent research has shown a change in the direction of methodology that supports a combination of qualitative and quantitative methods (e.g. Brown, 1973; Shriberg et al., 1997; Ingram, 2002; Bunta et al., 2009; Macleod, Laukys, & Rvachew, 2011) arguing that 'descriptive statistics displayed in the form of frequencies, percentages, and proportions, and other analytical tools, such as visual displays and implicational scaling, are favored' (Ortega & Iberri-Shea, 2005:29). The present thesis aims to fill in some of this gap in the literature with a distinctly quantitative focus in the representation of phonological development.

3.1.6 Triangulation

Denzin (1970) advocated in favor of triangulation in research methodology. Since reality is complex, one method of examination may provide for one-sided views or representations. Triangulation (denoted as **TΔ**) refers to the utilization of mixed methodologies (both quantitative and qualitative) for the multi-faceted examination of a phenomenon through converging perspectives (Duff, 2012) 'in order to provide possibly more complex and ideally more valid insights into observed or tacit linguistic behavior and knowledge' (Duff, 2008:144). The term, originating in the fields of surveying and navigation, assumes a process of starting out with one or two reference points (e.g. data points) and concludes with finding a third. During **TΔ**, different accounts are combined, juxtaposed or integrated in the conclusive analysis including triangulation of theories, e.g. sociocultural (Vygotsky, 1987), functional linguistic assessments (e.g. Bernhardt & Stemberger, 1998), statistics (e.g. Shriberg et al., 1997), as well as, narrative accounts as evidence (i.e. genuine qualitative data) of experiences on language learning and use (e.g. Schmidt & Frota, 1986). Triangulation may be 'emic', in that participants in a study are themselves functional in the research involved or, 'etic' i.e. external to it (Duff, 2012). Such a mixed methodological stance has been utilized in the literature (e.g. Schmidt & Frohta, 1986; Barnard & Torres-Guzman, 2009) and is sometimes referred to as 'crystallization' (e.g. Richardson, 2000; Ellingson, 2009). The present study in its multifaceted perspective that includes a narrative account by the author/interlocutor as evidence (i.e. genuine qualitative data) of the child's linguistic behavior and experience in language learning and use; a theoretical interpretation of the child's qualitative speech data; and an interpretation of the child's quantitative speech data attempts to make a contribution in this regard.

3.1.7 Universal scope and necessity of case study research

At the mention of the term *case study*, researchers respond on average with something like: just one. The obvious criticism against case study research, therefore, targets the fact that there is usually only one, or at the very best few subjects/participants involved, consequently, questioning and curtailing the universal applicability of any findings and deductions elicited from such a study. Larsen-Freeman & Long (1991:12) use the term 'ungeneralizable' to describe the results of the longitudinal approach or case study. The same is not true in criticisms of quantitative studies in spite of the small number of participants or other inadequacies (Chapelle & Duff, 2003) which is indicative of a certain degree of bias in methodological reviews. Arguments on individual variation (e.g. Goad & Ingram, 1987; Leonard, Newhoff, & Mesalam, 1980) aside for a minute, the existence of universal properties in language is well known, as exemplified by the theory of Universal Grammar (Chomsky, 1965), implicational universals (Greenberg, 1963), phonological universals in development (e.g. Jakobson, 1941/1968; Johnson & Newport, 1991) 'universal operating principles' (Slobin, 1973), the 'interlanguage as chameleon' (Tarone, 1979) and, so on. If such universal patterns are witnessed in data elicited from individual case studies then the reverse (i.e. the universality of findings of such studies) ought not to be dismissed as 'ungeneralizable' (Larsen-Freeman & Long, 1991:12) but rather as inviting further substantiation to determine their scope universally. Bernhardt & Stemberger (1998:16) argue that although 'generalizability is compromised', 'what is needed are detailed longitudinal records of many subjects (single subject designs multiply replicated)'.

By the same token, if case-study findings provide substantial proof for the existence of a phenomenon vaguely remarked elsewhere that is also proof against the 'ungeneralizability', to rephrase, argument. Reminding ourselves that one of the goals of case study research is exploratory (i.e. to outline questions and hypotheses for subsequent research (Yin, 2003:5), the claim that case studies often establish the 'base-line' upon which subsequent cross-sectional studies can be performed (Rosansky, 1976) is not coincidental. De Bot (2011) looks at arguments regarding the universal applicability of case findings from a different perspective arguing that 'one might wonder whether there is any research in AL [applied linguistics] that would rightfully claim to be generalizable beyond the sample it is based on' (125). What this signifies is that a sample can never be representative enough of the population it is assumed to represent due to individual variation and differences, as well as, the type of data used. So, in this approach, one does not intend to generalize from a sample to a population but rather check the validity of established theories with the new data in 'what might be called "theory-based generalization", thus, sometimes strengthening the theory and other times refuting it (126). With this viewpoint in mind, it is not surprising that a group of independent studies claiming to examine the *same kind of sample* end up with contradictory findings in favor or against a particular standpoint. Conclusively, Bernhardt & Stemberger (1998:15) state that: 'in language research … we are interested in … not just the frequent patterns for the human population, but the full range of what is possible'.

An aura that envelopes case-study research as ascertained by various researchers' remarks at scientific conferences (e.g. ICPC, 2011; ICPLA, 2012) is that case studies are currently out-of-fashion, limited in applicability, luxury material for researchers that should establish their work through cross-sectional research or, just, too easy if the data are collected in one's home. Contrary to such auras, nevertheless, data-driven research based on longitudinal, observational case studies of individuals is, admittedly, entreated in much recent published work that examines monolingual acquisition (e.g. Stoel-Gammon, 2011; Vihman & Keren-Portnoy, 2011), bilingual acquisition (e.g. Wei, 2010), and second language acquisition (e.g. Duff, 2008; Young-Scholten, 2009; Schmid, Verspoor, & MacWhinney, 2011). Fikkert (2007) states that 'a web search for 'acquisition of phonology' delivers more hits that refer to learnerability than to data-driven acquisition studies' (538). As van Dijk, Verspoor, & Lowie (2011) say, "if we really want to know how an individual … develops over time we need data that is dense (i.e. collected at many regular measurement points), longitudinal (i.e. collected over a longer period of time), and individual (i.e. for one person at a time and not averaged out)" (62). As a result, case studies ordinarily burst with an overflow of data that, if presented well, are characterized by comprehensiveness, detail and thickness of description. Because of these qualities, case studies are often experimental (descriptive, explanatory and exploratory) though they have also been abstractly theoretical in their scope (e.g. Smith, 1973; 2010), thus, often laying the grounds for subsequent research from a number of different perspectives. For instance, Brown (1973) compared the mean length of utterance (MLU) of the three children in his study with data from Leopold's (1949) study. Smith's (1973) 'database has frequently been mined by other researchers' (Stemberger, 2012). Evidence and counter-evidence available in the data of case-studies might direct following hypothesis testing and theoretical elaboration. Case studies of atypical or exceptional individuals are very interesting for examining the applicability and universality of recognized theories, as was the attestation of the CPH (Lenneberg, 1967; Krashen, 1973) in the case of Genie (Curtiss, 1977).

3.2 The unit of analysis: methodological issues

When undertaking research, an investigator is asked to determine in advance what its focus and level of required analytic detail will be and to anticipate the direction and emphasis of the final report. In the study of phonological development the primary unit of analysis may be e.g. the segment (consonant or vowel), the syllable or a prosodic feature. Ohala (1980) has stated that 'all languages code speech in terms of phonemes' (183) but went on to question the 'psychological and/or physical reality' of phonemes and all their properties. A similar stance, questioning the *reality* of the segment as a valid unit of analysis has also been espoused elsewhere (e.g. Bernhardt & Stemberger, 1998; Fulop & Golston, 2012). Nevertheless, 'consonant mastery is one of the most widely used metrics of typical phonological acquisition' (Edwards & Beckman, 2008:937), as evidenced in innumerable, needless to recount, studies. Roca & Johnson (1999) have cautioned that 'there is no single English vowel system or inventory but, rather, very many worldwide. This together with the fact that the IL English input provided to the child in terms of the vowel inventory is less consistent than the consonantal one, consonants were chosen in this study for being a more measurable evaluation metric.

Transcription (for a discussion see e.g. van Lier, 2005) of the raw data in a universally recognized and shared orthography is a minimum requirement. It is well-known (e.g. Duff, 2008, Schmid et al., 2011) that narrow phonetic transcription is labor intensive and 'a formidable task' MacWhinney (1998:485). Despite some efforts to automate this transcription and phonological analysis per se (Weinberger & Kunath, 2011), it seems that phonetic transcription can, at this time, only be done by humans (Weinberger, 2012). Despite the contention that 'all systems of transcription leak a little bit' (Crystal, 2012) and that 'there are cross-linguistic differences in the denotational values of the transcription system itself' (Edwards & Munson, in press), the most widely used transcriptional system in the case of phonology is the chart (graphemes, diacritics and suprasegmentals) proposed by the International Phonetic Association (IPA). Phonetic transcription might seem like a mechanical process but it is often during this labor intensive procedure that the investigator/transcriber (i.e. the one familiar with the data) makes significant observations that lead to subsequent analyses. In other words, transcription is 'an integral and important initial phase of data analysis' (Duff, 2008:154) and also guided by theory (Silverman, 2000), since new observations can be made if one is already familiar with theoretical issues and what is already advocated in the field.

This is further exemplified by the necessity for coding during transcription. While 'transcription focuses on the production of a written record that can lead us to understand … the flow of the original interaction' … 'coding, on the other hand, is the process of recognizing, analyzing, and taking note of phenomena in transcribed speech' (MacWhinney, 2000:17). The extent and conventions underlying transcription and coding procedures are shaped by the research question and the amount of detail required. If we acknowledge linguistic development as a dynamic system (e.g. van Geert, 1994; Larsen-Freeman, 1997; Lowie, 2010; Verspoor, De Bot, & Lowie, 2011), however, the process of coding linguistic phenomena could prove especially complex as one simply 'cannot be confined to counting errors' but might have to consider coding 'not only across obligatory, but across all possible contexts' (Schmid et al., 2011:40), including phonotactic probability and word length (Edwards & Beckman, 2008). Nevertheless, despite being aware of the magnitude of such complexities, the investigator is forced to limit transcription, coding and thus the scope of the study within realistic specifically focused boundaries. A further consideration regarding transcription relates to the transcriber's ability, as a human being, to provide accurate transcription. Macken (1980a:154), for instance, provides evidence of adult 'listening bias' in that adult categorical perception might conceal sub-phonemic contrasts evident in children's productions, such as the acoustically tested voicing contrast in the short-lag region. That perception might be a detriment to identifying speech sounds exactly is well-attested in the literature (e.g. Flege, 1991; Best, 1994, 1995; Wilson, 2006; Blevins, 2007). Issues in collecting and transcribing speech samples are discussed in Louko & Edwards (2001). Edwards & Beckman (2008) question the validity of transcription as a dependable tool for understanding phonological development, in general. Their study evaluated word-initial consonant accuracy in isolated-words from 2- and 3-year-olds in four different first languages (English, Cantonese, Greek and Japanese), consequently, representing a range of variable consonant systems. As a first measure, the authors recommend that original transcription should be supplemented by the perceptual judgments of native phoneticians. Subsequently they claim that even that may not be representative of the majority of listeners' perception in a given child's speech community and, thus, acoustic analysis of the transcribed data is eventually proposed.

A number of methodological issues in consonantal acquisition that relate to this thesis have been further discussed by Edwards & Beckman (2008). The authors identify two major methodological issues: one relating to the elicitation method of the production sample and the other to how the sample is analyzed. They suggest elicitation of connected spontaneous speech or a-single-word list via picture-naming or a word repetition task as two data elicitation techniques. The single-word list is meant to account for issues of incomprehensibility (i.e. when the researchers cannot decipher the child's target in question), as well as, for the lack of specific contexts in the data sample (i.e. 'a child may not produce all sounds of interest in a natural speech sample'). With regard to the second point, Edwards & Beckman (2008) stipulate that spontaneous data might not be inclusive enough in that 'segmental contexts cannot be controlled'. Such an argument, though, is pertinent in the case of production sampling that has taken place in far and between intervals rather than consistently, continuously and on a longitudinal basis. It may also make sense for those instances when the subject of the study voluntarily avoids specific structures as in 'lexical selection and avoidance' (e.g. Ferguson & Farewell, 1975; Stoel-Gammon, 2011). Yet even then, avoidance itself is not a methodological detriment per se but a normal (as its own instantiation proves) occurrence in the acquisition of language. In support of this, Schmid et al. (2011) argue that: "the full range of the linguistic repertoire can only be truly investigated on the basis of … data produced under … natural conditions – that is data where all aspects of the linguistic production process" (39). Furthermore, Vihman, & Keren-Portnoy (2011:44) conclude that 'both IN and OUT consonants were more successfully produced in real words' since, together with motor skill, 'experience with sound sequences affects relative difficulty for the child'.

Another strong stipulation for spontaneous data research relates to the 'degree of spontaneity' which Edwards & Beckman (2008) propose should be held constant in sampled productions. Fikkert (1994) states that imitative productions mirror short memory competence rather than the state of the child's grammar. Olmsted (1971) contended that imitation in children's speech leads to better pronunciation, thus indicating phonetic differentiation in speech spontaneity. In an early classic study of 480 children between three and eight years old, nevertheless, Templin (1957) found that there is no difference in the speech production of children with regard to imitative versus spontaneous speech. Another study that ‘offers strong support for the practice of including imitative data in corpora to be subjected to analyses of phonological production characteristics’ is Leonard, Schwartz, Folger, & Wilcox (1978). A final methodologically relevant issue discussed by Edwards & Beckman (2008) relates to the analysis researchers perform as they are counseled to take into consideration aspects like phonotactic probability and word length in examining children’s consonant production.

3.3 The state-of-the-art in phonological analysis software

Thorough guidelines of procedures for the phonological analysis of children’s language were introduced by Ingram (1981c) in ‘an attempt to incorporate the analytic methods within the more quantitative approach of language disorders’ (2), as exemplified in earlier work (Ingram, 1976a). An example of more recent work on procedures for phonological analysis is Burquest (2006). Measuring the reliability of manual annotation of speech corpora was examined by Gut & Bayerl (2004). With the advent of technology and the establishment of related software programs as tools for the transcription and analysis of sound in speech, the use of such data-retrieval tools to increase reliability, facilitate automation of the analytic processes and ease subsequent sharing of data among researchers has been considered of essence. An investigator using such tools must perform an analysis that requires metalinguistic knowledge and enter this information into the computer in the form of codes which the computer tallies and organizes subsequently (Long & Channell, 2001). Among such tools available are: *FAN* (e.g. Beers, 1995); *SALT*: Systematic Analysis for Language Transcripts (Miller & Chapman, 1983), mostly used by speech therapists; *CAP*: Computerized Assessment of Phonological abilities (Masterson & Oller, 1999); *PRAAT* (Boersma & Weenink, 2001) mostly used for acoustic analysis; *PHON* (Rose, MacWhinney, Byrne, Hedlund, Maddocks, O'Brien, Wareham, 2005); Max Planck Institute’s *ELAN* (e.g. Sloetjes & Wittenburh, 2008); *LIPPS* (2000) and *ChildPhon* (e.g. C. Levelt, 1994). A widely-recognized, though by no means exclusively used, software program for the analysis of child language data in particular is CLAN (MacWhinney, 2000) that offers separate tools to implement transcription, i.e. Codes for the Human Analysis of Transcripts (CHAT) and to analyze language samples, i.e. Computerized Language Analysis (CLAN). CLAN is the backbone of CHILDES, the Child Language Data Exchange System, (MacWhinney & Snow, 1985) that is currently the only repository for samples of children’s language and a major linguistic resource. Detailed accounts and links to all monolingual and bilingual corpora (including Stephany’s, 1997 data for monolingual Greek) can be found in the CHILDES website: http://childes.psy.cmu.edu. The present study utilizes CLAN for the organization, retrieval and first analysis of the collected data (see §3.5.2-3.5.5).

3.4 The child and her milieu

> 'In teaching our child the English language, we talked to her as to an adult except our words were simple and concrete. In general our practice has been not to correct her mistakes, trusting to the force of good example.'
>
> Nice (1915:566)

Maria Sofia is a healthy, normally developing child. An only child, born on 1st September, 2006, she is being raised in Greece and has never travelled abroad to the present day. Greek is the language of her ambient environment, extended family and her parents' L1. Both parents are fluent L2 speakers of English with university undergraduate and graduate studies in native English speaking countries and extended residence experience. The parents have been regularly interacting in the L2 at home as a matter of course before the child's birth and during the year following it. Code-switching, known to be a norm among interacting bilinguals (e.g. Poplack, 1980) is a pattern developed during their extended residence abroad in the past that subsisted upon their return to Greece. Despite the intermittent role of English in the child's linguistic environment at the beginning, it was decided by her first birthday that an attempt be made to raise her bilingually. It made sense that at least one parent should consistently address her in English, trusting that she would pick up the language naturally, as she was expected to do for Greek. Her tentative skills in English were vaguely anticipated rather than guaranteed. The Grammont rule (Ronjat, 1913), whereby each parent speaks one language to the child, was inevitably adhered to. Genesee, Paradis & Crago (2008) argue that strict adherence to the Grammont rule, although recommended, does not substantially matter in the outcome of bilingual acquisition. Beginning around the child's first birthday, daily consistent English input came through the mother's L2 English IL, while the father only spoke Greek to her; both parents spoke Greek to each other and only code-switched to English between them when the child was not present.

Maria Sofia spent the overwhelming majority of time with her mother, rather than with her father during the first two years of her life. Her exposure in the English language, therefore, was bigger than to Greek in the year before she became two. At two years of age, the child started attending day-care for 7 hours a day 5 days a week, thus, interacting in English with her mother only for the remaining intervals. Since the age of 3;6, Maria Sofia has been immersed for two hours twice a week in a playgroup at a local cross-cultural center where only English is spoken. The center carers are native-English speakers and the Greek/English bilingual children have dissimilar language dominance patterns. To her surprise, Maria Sofia figured out that all children at the centre also speak Greek when she was about 5. The child still attends this setting today and has been the only one receiving exclusively IL English input. Studies have shown (e.g. Hoff, 2006) that there is an enormous range of variability in how much speech children with dual language exposure hear. Typically, though, a child exposed to two languages is likely to hear less of each one than a monolingual child exposed to a single one (Hoff, Core, Place, Rumiche, Señor, & Parra, 2011). It is an estimate that Maria Sofia heard more Greek than English following her second birthday but this estimate cannot fully account for the variability in her dual language exposure. My reading to her age-appropriate books in English has been customary since the beginning. Book reading in a language has maximal effects even above the amount of exposure to that language (Patterson, 2002). She was, further, exposed to native English through audio and video material (songs, stories, DVDs). As bilingualism is a sociocultural phenomenon, language proficiency goes hand-in-hand with knowledge of the native culture.

3.4.1 The rationale and practices fostering the L2

This section elaborates on the rationale that led to Maria Sofia's bilingualism. One parent's native language is often the other parent's L2 (e.g. Major, 1977) and this setting inevitably ploughs the ground for bilingualism. Nevertheless, bilingual households may neither compel bilingual development as in the case of Amahl (Smith, 1973) nor assure it as for 'the boy' (von Raffler-Engel's 'il ragazzo', 1965). Passive bilingualism (e.g. De Hower, 1995; von Raffler-Engel, 1965) is an established phenomenon in bilingualism and results when linguistic competence assumes receptive but not productive knowledge (Nation, 2001). Amahl's and 'the boy's' passive bilingualisms contrast mainly with respect to the parents/authors' attitude to it. Smith (1973:8) advocates his son's monolingual English but the child's mother is unequivocally argued to speak many languages with 'Standard Indian English' being one of them, while Amahl himself is said to have demonstrated both receptive and productive knowledge of Hindi for a spell. On the other hand, although 'the boy's' bilingualism similarly never materialized, von Raffler-Engel's analysis was carried out with bilingualism in mind (clear in the title) which also indicates that the child's bilingual production may have been desirable.

That Maria Sofia is *not* a passive bilingual despite her primarily non-native exposure in English enables this very study. The italics emphasize the child's competence in English as an accomplishment on her part and also stress her bilingual speech production as neither inevitable nor automatic. There is an inherent factor of *choice* in bilingualism lacking in monolingualism: it presupposes a twofold consent among parents and between parents and child. The term 'language organ' (e.g. Anderson & Lightfoot, 2000) clearly portrays how alive and perishable language is and conscious effort is required to nurture it with proper use through life. Bilingual children are known to eradicate the use of one language when linguistic and social settings shift (e.g. Major, 1977). These arguments defend the view that bilingual development and its upkeep involve both conscious choices and active efforts necessary to uphold those choices. Bilingualism is an asset with cognitive and social-cultural advantages that ought to be fostered (McLaughlin, 1995). It is this recognition and the socioeconomic advantages of English as a *langue blanc* that dictated it in many educational systems worldwide, often at the first grade of elementary schools. In this study, the parents' decision to start the child early in the second language, other than providing structure in the existent linguistic input, also meant to ease the conscious laboriousness of subsequent second language learning. Her bilingualism has been the outcome of these forces, choices and efforts.

The remaining of this section describes the practices utilized to foster the acquisition of English. Maria Sofia's actual acquisition of English mirrors such theoretical realms of children acquiring knowledge as Piaget's (1977) interactive and participatory processes of learning. English input was provided naturally in the daily routine and I spoke to her in English as if in my native language pointing out and naming objects, describing and elaborating on things *in situ*, asking questions and encouraging her involvement. The anxiety that the child is not hearing enough English shaped my general conduct, thus our time together was as constructive and rich in language exposure as could be possibly ensured. On her return home from day care, mother and child would spend plenty of time on a one-to-one basis. Daily play sessions involving sketching, colouring, crafting, make-believe situations with toys and a variety of games could last more than an hour. Brief intervals, such as having a snack, would incorporate browsing a book and elaborating on the pictures. Routines such as her evening bath would mean differentiating between e.g. water being clean, soapy, running, spilling, splashing, sprinkling, flooding, etc.

Maria Sofia was addressed in proper adult language, what Ronjat (1913) called 'franc'. Though unaware, 'motherese' was instinctively employed by me during our interactions initially, meaning that my speech was characterised by fluency, intelligibility, adherence to grammar and overall shortened sentences. These are characteristics distinguishing 'speech addressed to children' as opposed to adults, attested in several studies of L1 acquisition (e.g. Snow, 1979:363). My language was generally conveyed in an appropriate manner to match her requirements. By adhering to grammar, the context of conversation was restricted within the bounds of the child's experience. I would only talk of e.g. *igloos* if a visual or situational referent could be created for the child. Her lexical knowledge was built as with blocks, upon previously acquired skills which is the constructionist approach emphasizing the gradual building-up through steps by advocating that a new 'stage n will consist of everything at stage n plus the new feature(s) of stage n+1' (e.g. Ingram, 1989a:73). Krashen (1982) refers to this as the '*i+1*' level of knowledge with regard to language learning in instructional settings. So, if I wanted to tell her about the *desert*, I would start with familiar terms like *beach* and *sand*. Further, I impulsively developed a habit of regularly recasting her utterance, evidenced to be a universal norm among parents speaking to their children (e.g. Gropen, Pinker, Hollander, Goldberg & Wilson, 1989). This served multiple purposes. As positive evidence (e.g. Marcus, 1993), it was a sign of confirmation to her inquisitive deportment. When her utterance was elusive, my response would reiterate what I thought she was targeting. This gave me an opportunity to verify her intention as she would normally contest it if in disagreement. It also gave her the prospect of added feedback in the form of negative evidence. Although verbatim repetitions were avoided, especially of ungrammatical utterances, sometimes I would just recast with an interrogative tone but not adhering to expected syntax. So, if she typically said: "I want to play", I might reply: 'You want to play?' rather than 'Do you?' Typically, I would mostly ignore her grammar and move on. These practices are substantiated in the recorded sessions of the database.

3.4.2 L1/L2 as a first language

Human beings instinctively know that language is a means of communication with the environment. The child had witnessed me early on speaking my native language to everyone around us. My knowing Greek was a drawback for her progress in English for psychological and social aspects of bilingualism rather than just purely linguistic ones. When the criterion of communication is met by the L1, the necessity of a second language is rendered obsolete and choice looms distinctly. Challenging the child to communicate with me in the second language was puzzling to her. To justify this, let's take things from the beginning.

The onset of Maria Sofia's recognizable speech marked the end of a noticeable silent period, as is evidenced to precede sometimes speech production in first (e.g. Vihman, Macken, Miller, Simmons & Miller, 1985), bilingual (e.g. Genesee et al., 2008) and subsequent language acquisition (e.g. Winitz, 1984). Her first one-word utterance, meaning an identifiable bi-syllabic word used intently for a referent (Ingram, 1989a) is evidenced in a Greek token: /ja.'ja/ *granny* at 1;7. This word, though not regularly heard, was triggered in a form-function relation to a here-and-now situation when we were visiting her grandmother far from home. Why did she first speak when away from home, addressing a third person rather than her parents with whom she solely interacted at home? This will not be interpreted as coincidental but as evidence of her linguistic dilemma and determining the L1. During her silence, Maria Sofia is rationalizing the diversity of the bilingual input and, being at odds, rejects both inputs. The tension is relieved when in an exclusively Greek-speaking environment where even her mother speaks just Greek when addressing her. It was this breakaway with its social and cultural underpinnings that determined her L1. In her immediate home, secluded from wider social interaction, both languages were competing in the infant's mind for precedence over production leading to temporary speechlessness. As the social setting is abruptly broadened at a critical point in her linguistic development, pragmatic competence is enhanced and the L1 takes precedence. Fishman (1965) identifies three controlling factors in 'language choice' in multilingual settings: 'reference group membership' 'situation' and 'topic'. Signifying her reference group, the child says at 3;6.5: 'grannies don't speak English!'. The battle of the languages continues for a long time but the predominance of L1 was laid down then.

One word utterances are evidenced in children as early as 12-15 months (e.g. Ingram, 1989a) and bilingual language acquisition is guided by fundamentally the same 'universal operating principles' (Slobin, 1973). Children also exhibit 'individual variation' (e.g. Leonard, Newhoff, & Mesalam, 1980) as their propensities affect the onset of speech, speed and time of complete acquisition. Maria Sofia's first word utterance at 1;7 is not unusual for either monolingual or bilingual acquisition as other children have reached this stage at comparable ages. Note monolingual Amahl's (Smith, 1973) and bilingual Tom's (Brulard & Carr, 2003) first word at 1;8. During this early stage, speech development is typically slow (Ingram, 1989a) with Maria Sofia's first token in English, *mammy*, being produced at 1;9. Bilingual children distinguish their languages before their first birthday and they match them to the interlocutors by their second one (Maneva & Genesee, 2002). Maria Sofia is thought to have been aware of the two different linguistic patterns in her life. From the start, she would never address her father in English, yet, when addressing me, she always started her English utterances with *mammy* and her Greek ones with *μαμά*. At 3;9.20, she explicitly says: 'the doll speaks Greek, that's why we should speak Greek'.

The child took her time acquiring language specific rules in English, some predictably taking longer (e.g. interrogative syntax), some affected by the quantity and quality of input (Young-Scholten, 2009) (e.g. accent) and some seemingly fossilized (e.g. preposition use). Fossilization is defined by Selinker (1972) as stabilization in learning. In children's developing phonology this takes the form of persistent adherence to an undeveloped form. English *yellow* ['le.ləu] and Greek *because* /ja.'ti/ → [ta.'ti] are two instances of Maria Sofia holding on to earlier assimilated structures. Though such phenomena are eventually abandoned, it is known (Marcus, 1993) that even with explicit correction children's grammars are impervious to change. The same holds for patterns of interference/transfer in child lexicon. Interference is defined as those instances in the bilingual's output that deviate from the norms of either language (Weinreich, 1953) and transfer is 'the process whereby a feature or rule from a learner's L1 is carried over to interlanguage grammar' (e.g. Archibald, 1998:3). A differentiation between transfer: 'static permanent trace' and interference: 'dynamic ephemeral element' has been suggested recently (Grosjean, 2012:13).

Two examples of phonetic interference follow. At 2;12.15, the child pronounces Greek /i.sto.'ɾi.es/ *stories* as [**ç**i.sto.'lies] thus epenthesizing onset /h/ from English *history* as [ç] to the Greek word. In monolingual English development, /h/ is normally deleted in this context. The /h/→[ç] pattern is a transfer coming directly from L1 dominance or via her parents' L2 English input (Babatsouli & Kappa, 2011). Having only occurred once, this is a transfer instance that came full circle and returned to the L1 as ephemeral interference. A similar pattern in her speech was more insistent: *helicopter* was transferred as [**ç**e.li.'to.te.lo] for Greek /e.li.'ko.pte.ɾo/. Despite negative evidence in her father's Greek speech, this occurred repeatedly for a while and disappeared long afterwards on its own. Such fleeting interferences and singular mingling of lexical structures are common in her bilingual production.

A non-phonetic interference example in her English further illustrates that contrasting transfer and interference in terms of permanence of occurrence (Grosjean, 2012) is not clearly substantiated. Greek differentiates *hair* in singular /mɑ.'li/ and plural /mɑ.'liɑ/ and so does Maria Sofia. In English, **hairs* is never used by either the mother or the child. In numerous child references (109) to *hair* in the database, there is not a single occurrence of **hairs*. In sentences including *to be*, Maria Sofia adheres to the English grammar: e.g. 'your hair is cuddly' at 3;4.20, 'there is her hair!' at 3;5.03. At 5;0, the child shifts her representation signifying plural in *hair* by transferring the plural to the verb: 'my hair *are nice today.' Interference, rather than transfer, surfaces loudly here as the child is not directly transferring Greek grammar of 'my *hairs is* nice today'. Note that Greek third person plural of *to be* is the same as its singular form. This pattern, interchangeably used with correct English use for a while, stabilised to a more static interference pattern. This is not a 'static transfer' (Grosjean, 2012) because, despite its more stable nature, it lacks the value of being a distinct L1 pattern with unaltered use in the L2. Her last interference example, whether fleeting (dynamic) or permanent (static) is actually a deviation from the norms of either language following Weinreich's original definition. When at 5;6, I attempted to reverse this pattern by drawing the child's attention to *hair* as one quantity, the child continued adhering to the interference pattern regardless. Though an exhaustive analysis of analogous phenomena is beyond the limited scope here, such solitary illustrations further epitomize the mutable nature of bilingualism.

3.4.3 Aspects of the child's performance

Chomsky (1959) made a clear differentiation between 'performance' and actual linguistic 'competence' as even adult speech production is inadequate evidence for linguistic knowledge. Maria Sofia's productive vocabulary during the span of the study was not necessarily indicative of her knowledge, as she would sometimes forget terms that she spontaneously used at other times. Despite the fathomless nature of cognitive processes in her mind, my speech has been 'comprehensible input' (Krashen, 1985:2) to her. The child never seemed baffled. At 3;9.17, there is an incident of me telling her: 'there is a tag hanging off your shorts' to which she replied 'what are you talking about?'. Fearing she hadn't understood, I turned to look at her by which time she had already stuck the tag inside. Related negative apprehensions have generally been dismissed as the child had several opportunities to interact with native English speakers. At 2;3 she met a member of the extended family, an American English speaker. Enjoying the interaction, she did as told and was able to swiftly react to direct admonitions as 'mind your fingers'. The British attendant (with a Yorkshire accent) at the English playgroup center comments favorably on her comprehension and her productive vocabulary as early as 3;6. Maria Sofia's comprehension relates to how fast, advanced or elaborate adult speech is and whether it associates to her experiences. At 5;5 watching a movie in English, the child complained at not understanding something. In a parallel situation in Greek, she would just ask us to clarify without the emotional outbreak, though. The remaining adults at the English centre are native speakers of either Standard American or RP. The extent to which such variable input has been advantageous to the child's comprehension and production of speech cannot be easily evaluated. Maria Sofia has been competitive compared to the other children in the English group despite being the youngest (the oldest being two years older) and has acquired literacy skills. She now voluntarily reads in both languages, her literacy in English going alongside literacy in Greek. An example of her reading level in English at age 5;6 is book 11, Murray & Corby (1970).

Although Maria Sofia's Greek leads the way overall, her English is very competitive and closer examination of her developing phonological data shows its unequivocal precedence in certain aspects, such as the rate and age of acquisition of specific singletons. A singular example is developing /ð/ in the minimal pair of homonyms: *the* /ðə/ and Greek *δε* /ðe/ *don't*. From the beginning, English /ð/ develops faster, is acquired earlier and shows different substitution patterns than Greek /ð/ in the homonymic pair. In Ingram (1981b), evidence for the emergence of two phonological systems was attested in an Italian-English bilingual. The separation of phonological systems is considered established in bilingual literature (e.g. Fabiano-Smith & Barlow, 2010). The example here evokes the differentiation of Maria Sofia's systems longitudinally.

3.4.4 Keeping the balance

The child's bilingual development has emerged in my eyes as a confrontation on many levels: linguistic, social and emotional. The attested silent period took on an additional face in Maria Sofia as she was initially socially hesitant even about L1 use. Having attracted attention for being quieter than average during the first year (age 2;0-3;0) at Greek day-care, 'selective mutism' was the suggested scenario (e.g. Black & Uhde, 1995), an anxiety disorder in which a child normally capable of speech is unable to speak in given situations. The school counsellor withdrew her opinion, though, when I informed her of Maria Sofia's dual language development. The child was left to her own devices and the subject was dropped when, by the following year, she became more sociable. Placing her in day-care at the tender age of two virtually immersed the child in a foreign to her environment. Despite having her father's Greek input intermittently, she wholly interacted in English with me during the day. Her reticent conduct indicates her bewilderment at the changed circumstances, such as the sudden increase in her exposure to Greek.

Having become more sociable at day-care, she was keen on showing off her increasing Greek vocabulary as she returned home. Most frequently, she either lacked the translation equivalent or was too excited to switch automatically to English. Automaticity as a cognitive task relates to cerebral resources. Differences in environmental exposure to a language may account for the functional modulation in the bilingual's brain (Perani, Abutalebhi, Paulesu, Brambati, Scifo, Cappa, et al., 2003). In those intervals of Maria Sofia's slower English activation, our conversations ran dilingually with me speaking English and her speaking Greek. Direct translation between the two languages was never purposefully adapted. But, as the child code-switched, my affirmation in English as a response to her Greek was often a one-directional translation. Upon her return home, Maria Sofia seemed perplexed and viewed the mother's appeals to speak English as reproach and rejection. It gradually became clear that the child required space, as if to catch her breath, a phase that eased the language shift from school to home. By acknowledging this and permitting to run its course, the child effortlessly yielded and sprung back to the home language, sometimes even manipulating English use to get her way. Resistance to shift language has also been evidenced in inner speech (Fishman, 1965): she free played in Greek more often than in English but she also code-switched during free-play. It may not be unreasonable to argue that code-switching is the manifestation of interference on the conversational level.

At 3;4.2, Maria Sofia says: 'I will tell her in Greek, I speak Greek and English to you.' Code-switching signals the bilingual's conduct as floating along the 'language mode continuum' (Grosjean, 2001) with cerebral activation facilitating the fluctuation between languages. Overall failure to shift between languages, though, was not Maria Sofia's unconditional prerogative. English was implemented as a family rule and she abided despite occasional denials, similar to refusing to take a bath. There was a tacit pact between us that switched English on. The child associated a regular practice on my part of being *distracted* with the stipulation to switch language. At 2;10 she is calling out in the next room: 'μύγα!' (*fly*) to which I replied honestly not having heard: 'What's that?' Again, she interpreted that to mean 'switch language', thus recasting: 'a fly!' However, the child resisted overall. Maria Sofia was expected to eventually recognize the need for English but the rule provided structure for implementation and sustenance. Maintaining her level in English, boosting progress and aiming at fluency has been an on-going struggle as acquired structures regressed depending on the frequency of input and output. Maria Sofia's weaker skill in English is not unusual. Bilinguals show a trade-off between L1 and L2 proficiency and, though often evaluated in terms of it, they are seldom balanced (e.g. Schlyter, 1993; Meisel, 2004; De Houwer, 2007; Norbert, 2011). 'The complementary principle' (Grosjean, 1989) demonstrates this, arguing that bilinguals' fluency in the languages is domain specific, depending on the need for each language.

3.4.5 Foreign language as first language

Gass & Selinker (2008) differentiate between acquiring L2 in the language's environment and learning it abroad with minimal access to native input. By such a viewpoint, Maria Sofia has been acquiring a foreign language, yet the actual act of nursing her into it hardly renders English foreign to her. Her acquisition of English completely invalidates the term 'mother tongue'. Openly stating our practice in English during social interactions was avoided, though, as it felt out of place and it offended monolingual Greek speakers. When the extended family was informed, the reaction was scepticism and latent disapproval, but not dismissal. Maria Sofia grew up voluntarily veiling her knowledge of English where impertinent. While in a public place at 3;0, she tells me: 'don't speak English'. Similarly, at the English center with her father she has admonished him to 'not speak Greek here!' Other bilingual children in similar situations may not demonstrate such reserve. Shifting the view of the social spectrum, it also seemed sensible to her parents to expose Maria Sofia to peer interaction in English. Attempts of associating her with native-English speaking children in the vicinity did not materialise despite being upfront with our intentions (or perhaps because of it).

What is conventional in a monolingual setting becomes bizarre in a foreign one. An element of disbelief was also floating about as child language acquisition is equated with *native* input. 'Does she understand?' has been a recurrent question by native speakers of either language. If researchers in the field 'do not yet fully understand who bilinguals really are' (Grosjean, 2008), the same may hold true for society. Maria Sofia has ultimately balanced contradictory feelings about her bilingualism as the need for L2 emerges socially, e.g. her kindergarten class has participated in educational collaborations across Europe (Comenius 2010-2012).

3.5 Methodology: data collection, organization in CLAN & analysis

> 'I have little patience with prolonged "tooling up" for research. I always want to get started.'
> Brown (1973:53)

3.5.1 Data collection

The emphasis that qualitative research places on observable phenomena in their own context is employed in this study for the collection of data. The child's linguistic development is captured in a naturalistic setting meaning that the task environment during data collection was not set up for the purpose of research but was integrated in the participants' naturally occurring routine. A recorder at work is not invisible yet the child can be said to have been oblivious of the process of data collection in that this was never explicitly stated. The data were collected longitudinally on an almost daily basis for 5-6 days a week. Diary notes in broad phonetic transcription of the child's speech production in both languages were kept by the author since the onset of the child's speech but these notes were not consistently collected nor are they numerous; they were only used as general reference points to provide a guide in this thesis regarding the initial stages of the child's phonological development. The child entered the telegraphic or two word stage (Ingram, 1989a) in English at 2;6. Matching her increasing production in English that was voluble enough to facilitate data collection, digital audio recordings of mother-child interactions on an almost daily basis began at 2;7. The recordings were made with a hand-held *Olympus WS11-311M* digital voice recorder held (or resting) close to the child (usually within 1-1.5 m).

With regard to the ethics involved, the parents' conscious decision from the start was that no recording device would be attached on her to ensure that the data collection process was minimally intrusive for the child. It was the author's initial intention to have routine recording sessions at a specific time each day but this did not prove practical during the early months because the child was not necessarily accommodating and often produced little speech during the designated time. Therefore, it became habitual to keep the recorder within reach in the course of the day and to utilize it when the child spontaneously spoke, which ended up being the adopted pattern preserved in the long run as well. As a result, recording sessions span different natural situational contexts, i.e. during play together, free play, meals, bath and bed time, book reading, walking etc., as well as locations, i.e. at home, in the car, at a restaurant, on a holiday, etc. Details on such situational and contextual information are provided at the beginning of the CHAT files and, as necessary, when the context changed (see Appendix A). Edwards & Beckman (2008) have stipulated in favor of holding the degree of spontaneity in child consonant production constant during consonant acquisition studies. In an early study of 480 children between three and eight years old, Templin (1957) found that there is no difference in the speech production of children with regard to imitative versus spontaneous speech. Olmsted (1971) contended that imitation leads to better pronunciation. In the present study the child's speech was recorded during natural speech interactions/conversations between the author and the child so it included some imitative productions in the first three months. However, the purpose of this thesis does not include separating the effects. Although recordings did not take place in sound proof space, recording sessions were avoided when external noise could not be kept to a minimum.

The child's speech was digitally recorded on an almost daily basis from the age of 2;7 to 4;0 for a total of seventeen (17) months as presented in Appendix A and discussed in the following section. The frequent recording rate and the longitudinal span of data collection are very significant aspects of the study as they will account for minute changes in the child's production strategy and the existence of different stages. The majority of individual audio files include the author's commentary on the date of the recording, usually at the beginning of the audio file. The child's entire recorded utterances were transcribed by the author on the same day in notebooks while contextual factors were still fresh in her memory. As the phonetic transcription was a very time-consuming process, the task of finishing the entire transcription per recorded sessions was not always feasible on the same day and was sometimes continued within 24 hours. The entire recorded utterances were played using headphones and written out in notebooks on two separate lines: a narrow IPA phonetic transcription followed by its orthographic transcription of the adult target words. These transcriptions (orthographic and phonetic) provide a written record of the original interaction. All utterances in the notebooks are separated by language and are marked with the respective audio file name (e.g. WS310011) including the age of the child on that date. There are a total of nineteen (19) notebooks with an average notebook size of 250 pages, thirty lines per page, thirteen (13) of which contain only the utterances in English and the remaining six (6) containing the Greek ones. As the initial focus of the study was primarily on the acquisition of the English language, the child's Greek was not purposely recorded separately in discourse with a monolingual Greek speaker although there are few such instances. Some of the recordings of Greek utterances are done during the child's interaction with the father or at free play. Similarly, as English developed alongside Greek, the child's pattern of code-mixing and code-switching in interaction with the mother did not allow complete isolation of English from Greek. There are, however, extended sections in the recordings when she was on a one-language mode, solely speaking English or Greek. These one-language mode sections could have been identified and studied separately, (e.g. Johnson & Wilson (2002) but this was not deemed necessary for the focus of the present thesis that has included all utterances in the data for analysis.

3.5.2 The CLAN database

At the age of 4;0, the child reached an acquisition stage in her consonantal sound development that was over 90% of adult-like productions with few exceptions of sounds, like Greek [ʎ] that was still developing, and English /ɹ/ mostly realized by transferring Greek [ɾ]. At this point, all the raw data were written out and transcribed in notebooks and the digitally recorded files were saved in compact discs on a monthly or bi-monthly basis. In order to: a/ facilitate time-alignment of transcription to sound, b/ allow closer transcription, c/ ensure easier and more organized access, d/ increase the reliability of the data, e/ improve and organize data retrieval, and f/ make frequency counts of segments more reliable, it became necessary to utilize a computerized language analysis tool that would ensure all of the above. For this purpose, Computerized Language Analysis (CLAN) (MacWhinney, 2000) was chosen for being a widely-recognized tool for the analysis of child language data. CLAN was studied and employed leading to the creation of a database of all recorded interactions between interlocutor and child being time-aligned in CHAT format and easily retrievable at the press of a button. The transcriptions of the child's speech were done anew consulting the orthographic (rather than the phonetic) transcription in the notebooks only in those few cases when the child's production (having occurred months before) was unintelligible to the author. As explained in the previous section, it was not deemed necessary to code and analyze imitative and spontaneous utterances separately. All transcription was done using headphones since it was more difficult to identify the sound coming from a loud speaker. The focus of narrow phonetic transcription was on consonantal segments only. Vowels were generally transcribed broadly. This is so for a number of reasons: this thesis is not interested in vowels; children's errors in consonants do not vary nearly as much as in vowels between transcribers (e.g. Powell, 2001); and vowels are mostly acquired by age three (e.g. Dodd et al., 2003). It is seen subsequently that the two separate transcriptions (in notebooks and CLAN) for individual consonant segments are overall in agreement. The process of entering the entire data in CLAN was very laborious, pedantic and time-consuming. That narrow phonetic transcription, in particular, is a labor intensive process is well known (e.g. Schmid et al., 2011; Duff, 2008). MacWhinney (1998:485) has stated that 'the construction of a complete %pho tier for even a few hours of data is a formidable task'. For each word in the child's speech it took the author on average 3 minutes of time-alignment of speech to text, orthographic and phonetic transcription as well as coding in CHAT file format, meaning that it took the author about 10,000 hours of transcription for the entire CLAN database alone which comprises over 200,000 words, not including the time spent to do by hand the preceding transcription in notebooks. Leah Fabiano-Smith of the University of Arizona, together with two more native English phoneticians at her Bilingual Phonology Lab, transcribed samples of Maria Sofia's English speech containing 3,627 consonant tokens and performed inter-rater reliability tests. It was found that, among them, there was a 97% agreement and a 92% agreement between theirs and my transcription.

The database created includes all recorded audio files and respective transcript files made from 2;7 to 4;0. The *Olympus WS-311M* digital audio files have a default *.wma* format which is incompatible with CLAN. This led to reformatting the original audio files into *.wav* format using sound-converter software i.e. *Switch Sound File Converter*. The converted files comprise the contents of the default *Media* folder in CLAN in layers of subfolders marking the difference in years and months, i.e. *Folder 2009* containing individual month folders from *April 2009* to *December 2009* (total of 8 months) and *Folder 2010* containing individual month folders from *January 2010* to *August 2010* (total of 9 months). Every month folder contains its respective audio files with their original names, e.g. *WS310027*. The database comprises a total of 511 CHAT files of variable duration with utterances in both languages as they actually occurred in situ. The number of total utterances for the entire database aggregates to a total of 31,684 child utterances in English and 13,940 child utterances in Greek. Utterance here is defined as the child's uninterrupted speech from beginning to stop irrespective of grammatical considerations of what constitutes a sentence. Utterances, therefore, vary in length from a single-word utterance, such as *yes* or *no* to sometimes more than one sentence. Each CHAT file corresponds to an individual audio file rather than an entire recording session, as audio files were sometimes interrupted although the recording session continued shortly afterwards. Every CHAT file is named accordingly to reflect this and, thus, carries a name like: *2;7.05 WS310027* stating the child's age on the day of the recording (e.g. 2;7.05) and the standard name of the *Olympus* audio file (e.g. WS310027). As a result, the structure of the *CHAT files* folder, default in CLAN, mirrors the multi-layering of the *Media* folder separating subfolders by year and month.

The default CHAT file is blank. Typed-in transcripts in each CHAT file are preceded by headers (some of them a required minimum if CLAN commands are to be run successfully) that provide general information on the file. Such information includes: the language(s) spoken, the participants present, the date of the audio file, the corresponding age of the child, the date the file was created, the name of the transcriber, the interaction type, the location at the time of recording, the name and duration of the corresponding audio file and some micro-contextual information regarding the task environment or discourse context. Ordinarily, headers in files look like this (figure 3.1):

Figure 3.1 Example of information headers in a CHAT file

@Begin
@Languages: eng, ell
@Participants: CHI Target_Child, CHIL Target_Child, MOT Investigator
@Date: 03-MAR-2010
@Birth of CHI: 01-SEP-2006
@File Date: 12-OCT-2011
@Investigator & transciber: Elena Babatsouli
@Interaction Type: private
@Location: Chania Crete
@Media: WS310662 audio
@Time Duration: 00:18:26
@Situation: at home, playing

As already stated, every chat file includes alignment of sound to text of the entire interaction between interlocutor and child. All files contain three identifiably main lines: one for utterances corresponding to the mother's speech and two for utterances corresponding to the child's speech, one per language. Some files include an extra main tier corresponding to the father's speech during the child's interaction with the father in Greek only. A typical utterance produced by the mother looks like this: **MOT: xxx* stating the speaker (i.e. MOTher) and some identifiable *xxx* utterance in default CLAN code that can be played in the file but has not been transcribed in regular orthography to save time. A typical utterance produced by the father looks like: **FAT: xxx* accordingly. Transcripts of the child's utterances are marked separately as **CHI* for utterances in English and as **CHIL* for utterances in Greek. The **CHI* code is default in CLAN referring to the child speaker but **CHIL* was devised to refer to the child's utterances in Greek (or Hellenic) by abbreviating the word *child* to include *L* at the end. The same pattern is adhered to when the child code-switches, thus breaking an original child utterance in two separate **CHI* and **CHIL* tiers. If only a single word in one language is produced by the child in an utterance otherwise produced entirely in the other language, this is shown with an *[xxx]* code in the longer sentence, which in the default CLAN coding scheme refers to something else (i.e. unintelligible speech treated as word). **CHI* tiers provide the child's utterances in English alphabet orthography and **CHIL* tiers provide the child's utterances in Greek alphabet orthography, e.g. **CHIL*: έκλαψα στο σχολείο γιατί ήθελα εσένα (2;7.27 WS310054). When an utterance is incomprehensible by the investigator, the same *xxx* code is used on the **CHI* or **CHIL* tier. In these cases, the tier is ignored in the calculations.

Every **CHI* or **CHIL* tier is complemented by three subsequent tiers: *a/* the first one is preceded by a *%mod* code that provides a transcription of the expected *model* speech, i.e. the underlying form of adult target speech, *b/* the second one is preceded by a *%rep* code that provides a transcription of the child's *replica* i.e. the surface form of the child's actual production and *c/* the final tier is preceded by a *%pho* code, which is the CLAN default tier for phonetic transcription. In the present study, the *%rep* tier takes the place of the *%pho* tier, thus making it specific to the child's production rather than any phonetic transcription, in general. In its present use, the *%pho* tier matches the model and replica tiers using a specific coding scheme, to be elaborated below. *Mod* and *rep* are abbreviations of the terms *model* and *replica* similar to the default *modrep* command in CLAN but also alluding to the differentiation made between model (adult) and replica (child) speech in Macken & Ferguson (1987). A typical child utterance (e.g. **CHI* or **CHIL*) with its phonetic transcripts and coding looks like a *four-tier cluster*: (figure 3.2):

Figure 3.2 Example of a child utterance in English and tiers

*CHI:	come inside the room, come inside, come, sit down on the carpet.
%mod:	k^{h}ʌm ɪnsaɪd ðə ɹu:m k^{h}ʌm ɪnsaɪd k^{h}ʌm sɪt daʊn ɒn ðə k^{h}ɑ:pɪt
%rep:	kʌm ɪsaɪt ə lum tʌm ɪsaɪt^{h} tʌ çi: daʊn ɒn ə tɑ:pət
%pho:	k^{h}-ʌm ɪn-saɪdT ð-ə ɹLu:m kT^{h}-ʌm ɪn-saɪdT^{h} kT^{h}-ʌm- sC̼ɪt-0 daʊn ɒn ð-ə kT^{h}-ɑ:pət

(2;7.27 WS310054)

The coding scheme on the *%pho* tier operates on the following logic: the transcription on the *%mod* tier is repeated onto the *%pho* tier. Any consonant differences between the *%mod* and the *%rep* tiers including substitutions, deletions, epenthetic segments or syntagmatic processes like assimilations and coalescences are noted following the *%mod* target segment. To exemplify this, the word *inside* from the utterance in Figure 3.2 is used. The coded forms ***i*n-*saɪ*dT** and ***i*n-*saɪ*dT^{h}** on the *%pho* tier in essence repeat the two instances of /ɪnsaɪd/ on the *%mod* tier and interpret the variants in the child's productions [ɪsaɪt] and [ɪsaɪt^{h}] on the *%rep* tier as follows:

n-	i.e. /n/ → Ø
dT	i.e. /d/ → [t]
dT^{h}	i.e. /d/ → [t^{h}]

The codes chosen are symbols that are easily available on the keyboard so, for instance, while *Ø* would be pertinent to mark a deletion, a plain dash '–' is preferred because it can be typed faster. In general, capitalized letters stand for the respective segments, e.g. a [t] realization for any target is coded as [T]. This coding applies to IPA symbols *p, b, f, v, t, d, s, z, ts, dz, l, m, n, j, c, w, k, g, h* that may be easily capitalized. By the same token, IPA symbols that find equivalence in the Greek alphabet, i.e. *θ, x, ɣ*, are coded with their respective capitals in the Greek alphabet, e.g. *Θ* ['θi.ta], *X* ['çi], *Γ* ['ɣa.ma]. The voiced interdental *ð* is also coded with the Greek capital letter that represents the sound, i.e. *Δ* ['*ðe*.lta]. The flap, *ɾ*, in Greek is coded with capital *R*. The alveolar approximant, *ɹ*, in English is coded with capital *R* and the IPA diacritic, ̼, i.e. *R̼*. The diacritic was chosen randomly. Similarly, *ʃ, ʒ, tʃ, dʒ, ʎ, ŋ* and *ç* are coded as *S̼, Z̼, TS̼, DZ̼, L̼ N̼* and *C̼*, respectively. The dark lateral, *ɫ*, is coded with capital L and the IPA diacritic, ~, chosen because the final visual effect is similar, i.e. *L̃*. The same is true for the Greek palatals *ɲ* and *ɟ* coded with *N˫* and *J˫*;

respectively. Syntagmatic processes, like assimilation, coalescence, etc. were also coded using numeric symbols. This was done in detail for the data at the age of 2;7 but an exhaustive analysis and coding of these processes in the entire database was beyond the purpose of this study. The number codes used for syntagmatic processes are: 0 (assimilation), 5 (coalescence) and 6 (metathesis). Finally, the following symbols are also used for coding: ‘-’ (deletion), ‘=’ (consonant harmony or reduplication) and ‘;’ (epenthesis). As an example, metathesis coded on the *%pho* tier is shown below:

Figure 3.3 Example of coded metathesis

```
*CHI:   flower.
%mod:   flawəɹ
%rep:   falə
%pho:   fl-'al;6w-əɹ-
                        (2;8.06 WS310059)
```

Vowels on all tiers are generally in broad transcription and are ignored by the coding scheme. A key to the codes used is given next (table 3.2).

Table 3.2 Key to coding scheme

IPA symbols and their Codes																						
	p	b	f	v	t	d	s	z	θ	ð	ʦ	ʣ	l	ɾ	m	n	j	c	w	k	g	x	ɣ	h
Capitalized	P	B	F	V	T	D	S	Z	Θ	Δ	TS	DZ	L	R	M	N	J	C	W	K	G	X	Γ	H
	ɹ	ʃ	ʒ	tʃ	dʒ	ʎ	ŋ	ç															
Capitalized̰	R̰	S̰	Z̰	TS̰	DZ̰	L̰	N̰	Ç̰															
	ɫ	ɲ	ɟ																				
Capitalized~	L̃	N̵	J̵																				
	assimilation	coalescence	metathesis																				
Numerical	0	5	6																				
	deletion	reduplication	epenthesis																				
Other	**-**	**=**	**;**																				

It should also be noted that notation of the child’s production on the main tier was exact even when the utterance was ungrammatical. In order to clarify possible semantic ambivalence, a *%gls* tier was added in the 4-tier cluster when necessary. The *%gls* CLAN default code stands for glossary. This tier provides the author’s interpretation of the child’s intention on the grounds that she was a co-participant in the conversation. An example of the *%gls* tier is shown below:

Figure 3.4 Example of the %gls tier

*CHI: why Papi stay at the steps?
%mod: waɪ p^{h}api steɪ æt ðə steps
%rep: waɪ p^{h}api steɪ æt lə steps
%pho: waɪ p^{h}api steɪ æt ðLə steps
%gls: why did Papi ...
(3;1.01 WS310293)

3.5.3 Data retrieval and categorization

Having entered the data in the CHAT files with the method explained in the previous section, the process of data retrieval became automated because 'CLAN provides several programs to facilitate analysis' MacWhinney (1998:485). Default CLAN commands can be utilized to target retrieval of specific information for the categorization of data in separate identifiable folders. For the purposes of this study several CLAN commands were utilized to elicit both general information e.g. illustrating the specifics of the database and specific information relating to the research questions already set. For instance, the following command enables the tabulation of total utterances produced by the child in both languages:

```
mlu  +t*CHI -t%mor:   @
```

In chapter 4, where a thorough analysis of the systems in the two languages was necessary, a command was run per language on the total number of words used to determine vocabulary status in the two languages. The command for the word production in English was:

```
freq   +t*CHI -t*CHIL  @
```

A snapshot from the outcome of this command looks like this:

```
freq +t*CHI -t*CHIL @
Mon Jul 30 13:10:16 2012
freq (28-Mar-2012) is conducting analyses on:
  ONLY speaker main tiers matching: *CHI;
****************************************
From file <f:\ebab Database\CHAT files\2009\4.April 2009\2;7.05 WS310027_D.cha>
  1 I
  1 bowl
  1 box
  1 cereal
  1 inside
  1 milk
  2 now
  1 want
------------------------------
    8  Total number of different item types used
    9  Total number of items (tokens)
0.889  Type/Token ratio >
```

For the purpose of examining the production of individual word types at 2;7, the default CLAN *kwal* command was utilized adding a specification for phonetic output, as well. What follows is a keyword search for *again*:

```
kwal +t*CHI +t%rep +sagain @
Fri Jul 27 10:03:20 2012
kwal (28-Mar-2012) is conducting analyses on:
  ONLY speaker main tiers matching: *CHI; and those speakers' ONLY dependent tiers matching:
%REP;
****************************************
From file <f:\EBAB DATABASE\CHAT FILES\2009\4.April 2009\2;7.05 WS310010_A.cha>
----------------------------------------
*** File "f:\EBAB DATABASE\CHAT FILES\2009\4.April 2009\2;7.05 WS310010_A.cha": line 22
Keywords: again, again
*CHI:    again, again .
%rep:    əd̪eñ əd̪ɛn
```

As one of the goals of the study has been to track the developmental acquisition patterns of consonantal segments longitudinally, reliable retrieval and computation of their frequency of occurrence over time was paramount. The following specific commands were used to tabulate frequencies of the:

1. Targeted segments on the %mod tier.

The following command was used to tabulate how many times a segment, for instance /b/, was targeted by the child in her speech:

```
phonfreq +b%mod -t*CHIL +s"b"  @
```

The command was run separately for each one of the targeted segments in the child's English utterances on the entire database. The output was saved under a main Targets Folder matching the respective search. Separate sub-folders per language were included under the main one organizing individual segments in files by manner of articulation. To account for the change in language, the command was slightly modified and run separately for all the targeted segments in the child's Greek utterances for month 2;7, e.g.

```
phonfreq +b%mod -t*CHI +t*CHIL +s"b"  @
```

A quick glimpse into the output files (that are quite extensive) would look like this for targeted /b/:

```
phonfreq +b%mod -t*CHIL +sb @
Tue May 01 09:00:12 2012
```

```
phonfreq (28-Mar-2012) is conducting analyses on:  ALL speaker main tiers EXCEPT the ones
matching: *CHIL; and  those speakers' ONLY dependent tiers matching: %MOD;
****************************************
From file <e:\ebab Database\CHAT files\2009\4.April 2009\2;7.06 WS310031_D.cha>
 19  b    initial =  17, final =   0, other =   2
```

2. *Produced segments on the %rep tier*

The following command run on %rep tier provides all the child's [p] realizations including those correct in context, those that are substitutions in place of other targets, as well as, epenthetic ones that are not there in the underlying representation.

```
phonfreq +b%rep -t*CHIL +s"p"     @
```

As it was important to tabulate how many times a segment e.g. [p] was produced correctly in context, this command was used instead:

```
modrep  +t*CHI -t*CHIL +b%mod +c%rep +o"*p*" +n"*p*"
```

The command was run separately for each one of the targeted segments in the child's English utterances on the entire database. The output was saved under a main Replicas Folder matching the respective search. Separate sub-folders per language were included under the main one organizing individual segments in files by manner of articulation. The same command modified to account for the change in language was run separately for all the targeted segments matching correct production in the child's Greek utterances for month 2;7. A section of this command's output that is usually quite lengthy looks like this:

```
modrep +t*CHI -t*CHIL +b%MOD +c%REP +o*p* +n*p* @
Sun Feb 12 14:51:52 2012
modrep (02-Oct-2011) is conducting analyses on:  ONLY speaker main tiers matching: *CHI; and
those speakers' ONLY dependent tiers matching: %MOD; %REP;
****************************************
From file <e:\EBAB DATABASE\CHAT FILES\2009\4.April 2009\2;7.06 WS310034_D.cha>
  1 pʰɪk
     1 pɪt
  1 ʌp
     1 pʌp
From file <e:\EBAB DATABASE\CHAT FILES\2009\4.April 2009\2;7.09 WS310036_D.cha>
  1 tʰɒp
     1 tʰɒp
```

3. *Substitutions produced.*

The following command was used to first identify the substitutions corresponding to individual segments in the child's speech. This was done running the *freq* command on the %pho tier, identifying the particular segment examined and adding a specification for sensitivity to upper-case letters, i.e.:

freq +t*CHI -t*CHIL +t%pho +s"*p*"

This specific command will output the target segment paired with its substitution. The command was run separately for each one of the targeted segments in the child's English utterances on the entire database. Adhering to the same procedure, the command was run for the segments in the child's Greek at 2;7, e.g.

freq -t*CHI +t*CHIL +t%pho +s"*p*" +c1

A brief example section from these output files looks like this:

freq +t*CHI -t*CHIL +t%pho +s"*p*" @
Tue May 01 09:49:24 2012
freq (28-Mar-2012) is conducting analyses on: ONLY speaker main tiers matching: *CHI; and those speakers' ONLY dependent tiers matching: %PHO;
****
From file <e:\ebab Database\CHAT files\2009\4.April 2009\2;7.06 WS310031_D.cha>
  1 ipB'ʊʃ
From file <e:\ebab Database\CHAT files\2009\4.April 2009\2;7.11 WS310041_D.cha>
  1 **pT^{h}='ikT**

The outputs were saved under a main Variants Folder with separate sub-folders per language organizing individual segments in files by manner of articulation. The product of the command will automatically yield other coded forms, where present, in that it outputs the entire coded word. As a result, an assimilatory effect is seen in the second word type of the present example. The coded word **pT^{h}='ikT** for *CHI: *pick* shows that the velar stop is realized as [t] and then /p/ is harmonized to this coronal substitution, i.e. /p/ → [t]. The %rep transcript of the coded version is [t^{h}it]. Once the substitutions are identified from these outputs, then it is possible to calculate the frequency of occurrence of each one. So in the following example, all the [b] substitutions targeting /p/ are retrieved:

freq +t*CHI -t*CHIL +t%pho +s*pB* @
Tue Jul 31 07:34:45 2012
freq (28-Mar-2012) is conducting analyses on: ONLY speaker main tiers matching: *CHI; and those speakers' ONLY dependent tiers matching: %PHO;
****
From file <f:\EBAB DATABASE\CHAT files\2009\4.April 2009\2;7.06 WS310031_D.cha>
  1 ipB'ʊʃ
----
  1   Total number of different item types used
  1 Total number of items (tokens)

1.000 Type/Token ratio
From file <f:\EBAB DATABASE\CHAT files\2009\4.April 2009\2;7.10 WS310038_D.cha>
1 pBʰ-'eɪdʒ
----
1 Total number of different item types used
1 Total number of items (tokens)
1.000 Type/Token ratio

By running each substitution again with the respective modrep command, e.g. modrep +t*CHI -t*CHIL +b%mod +c%rep +o*p* +n*b*@, I found a very small number of typing errors during the coding on %pho tier which I corrected. If all the [b] substitutions need to be calculated irrespective of the segment targeted, the following can be run:

freq +t*CHI -t*CHIL +t%pho +s"*B*" @

By the same token, specific code symbols, like deletion or epenthesis, can be specified in the command to limit the output data accordingly. In the example below only deletions of /k/ are elicited:

```
freq +t*CHI -t*CHIL +t%pho +s*k-* @
Fri Jul 13 12:53:40 2012
freq (28-Mar-2012) is conducting analyses on: ONLY speaker main tiers matching: *CHI; and those speakers' ONLY dependent tiers matching: %PHO;
****************************************
From file <e:\EBAB DATABASE\CHAT files\2009\4.April 2009\2;7.06 WS310032_D.cha>
  1 tDʰ-eɪk-
------------------------------
   1 Total number of different item types used
   1 Total number of items (tokens)
1.000 Type/Token ratio
```

The same command specifying the search for epenthesis, coded as ‘;’, retrieved all instances of epenthetic consonants. This enabled the identification of non-contextual clusters in the output (shown below) that were, subsequently, examined in chapter 6.

```
freq +t*CHI -t*CHIL +t%pho +s*;* @
Tue Jul 31 09:00:40 2012
freq (28-Mar-2012) is conducting analyses on:
  ONLY speaker main tiers matching: *CHI;
        and those speakers' ONLY dependent tiers matching: %PHO;
****************************************
From file <f:\EBAB DATABASE\CHAT files\2010\1. January 2010\3;4.03 WS310494.cha>
  1 d'ol;minə
  1 d;hS'ɪəɹL̃
  1 dT'un;
  1 kʰ-anɔn;t
```

```
  1 l;ðD'ɪs
  1 s;it-
  1 t;=it
  1 w'id;
  1 æts;6
  1 ðLɾ;'iːs
  1 ʌndl;əɹ-
------------------------------
   11  Total number of different item types used
   11  Total number of items (tokens)
1.000  Type/Token ratio
```

All of the commands listed above were run more than once per month per segment because the output window in CLAN will not produce the results of all the files collectively when the data exceed its default capacity, which was permanently the case in this study.

3.5.4 Computations in Excel

As seen through the brief illustration in the previous section, CLAN output provides numerical computations on the data but these are far from being final. In all cases, the numerical data need to be tabulated further to obtain a conclusive report depending on the focus of specific information required. Consequently, the elicited numbers from the output files were, subsequently, entered by the investigator in separate Excel files in accordance with their themes. Excel facilitates automated sums and other calculations based on pre-entered arithmetic formulas. The results of these calculations have enabled conclusive numerical reports upon which illuminating visual display organizers and mapping techniques (such as graphs, tables, matrices, tree diagrams), as advocated by Miles & Huberman (1994), were generated to facilitate comprehensive presentation of the data and ease the process of analysis. A *'how to'* seminar and practice material on such recently presented techniques, similar to those utilized in the present study, can be found in Verspoor, Lowie, van Geert, van Dijk & Schmid (2011).

3.5.5 The database log

Using the CLAN database, a database log was made which is given in Appendix A. The log contains 12 columns which are titled according to their content. Column 1 shows the child's age at which her speech was recorded; column 2 briefly describes the situational context of the recording; column 3 indicates the name of the audio file; column 4 shows the audio file's duration in hours, minutes and seconds; column 5 comprises the number of utterances in English per audio file; column 6 has the corresponding number in Greek; column 7 depicts the total number of words (tokens) in English per audio file; column 8 shows the corresponding number in Greek; in column 9 the word tokens to utterance ratio in English

(TURE), calculated from columns 5 and 7, is shown; in column 10 the corresponding ratio in Greek (TURG), calculated from columns 6 and 8, appears; in column 11 the word types to tokens ratio in English (TTRE) is shown, so that multiplying it with the corresponding cell of column 9 gives the number of different words (types) per utterance; and column 12 depicts the corresponding ratio in Greek (TTRG) to that of column 11.

The quantities above, which are per audio file, are calculated cumulatively per month. The monthly average of columns 9 and 10 is the weighted average of the individual audio file's ratios for the month. That is, the monthly cell of column 9 results from dividing the corresponding monthly cell of column 7 by that of column 5. Similarly, to obtain the monthly cell of column 10, the corresponding monthly cell of column 8 is divided by that of column 6. However, the monthly averages of columns 11 and 12 are the arithmetic means of the individual audio file's ratios rather than their weighted averages for the month. The reason is that it will make no sense to add up the word types in the month since words repeat themselves and, therefore, they will no longer be word types but tokens.

The same rules apply in calculating the average ratios for the 17-month period, which is the span of the longitudinal study. On average, each file comprises 89.3 utterances each lasting 10.7 seconds containing 4.54 word tokens for a total of 45,624 English and Greek utterances and 207,158 English and Greek word tokens. In English there are 31,684 utterances containing 137,869 word tokens while in Greek there are 13,940 utterances with 69,289 word tokens. English utterances contain on average 4.35 word tokens while Greek utterances 4.97, with the word types per utterance being also larger for Greek at 3.23 than for English at 2.04. There is a considerable increase in these ratios over the length of the study. At age 2;8, the child has 2.02 word tokens per utterance in English and 3.68 in Greek while at age 4;0 she has 6.77 in English and 6.50 in Greek. This means that by the end of the study the child uses English with the same ease as Greek even though in the beginning her English was well behind her Greek. However, the same is not true for her word types per utterance. Her English increased from 1.39 at 2;8 to 2.57 at 4;0 while her Greek from 2.65 to 5.80, meaning that the child's vocabulary is richer in Greek than in English.

3.6 Conclusion

This chapter has elaborated on specific aspects in research methodology that relate to case-study research in applied linguistics and, in particular, examining the developmental acquisition of consonantal phonology. The methodology adopted in this thesis utilizes state-of-the-art software and encompasses both qualitative and quantitative traits in line with triangulation in research methodology. First, the hypothesis that developmental acquisition of language through primarily non-native input is feasible in a bilingual setting is substantiated responding to a lack in the literature. This is done qualitatively by viewing the child's acquisition of English within its actual sociocultural context and by isolating and relating such processes and theoretical attributes that define early bilingual acquisition by means of illustrations and vignettes, a recognized practice in qualitative research (e.g. Merriam, 1998). Parallel to this, the research context is carefully described illuminating the longitudinal and concentrated timeline of the study and the particular methodological procedures employed in data retrieval, collection, organization in a CLAN database, etc. that are of absolute essence for ensuring the quantitative focus of the thesis. The methodology of the thesis, just described, is in line with the current trends emerging in research methodology as identified by De Bot (2011), that is, a 'soft' approach that is 'qualitative and interpretive in nature' and 'an approach that is more hard science-like and mathematical … characterized by the use of different ways of quantifying data' (127).

CHAPTER 4
THE BILINGUAL CHILD'S PHONOLOGICAL SYSTEMS AT 2;7

This chapter is organized as follows: section 4.1 introduces the scope and research questions dealt with in the chapter, §4.2 discusses the consonantal systems of Greek and English and presents the mother's inventory in them, §4.3 first provides the child's lexical repertoire in the two languages with targets and productions in IPA transcription. Next, the average length of sentence and mean length of utterance is computed in both languages. Furthermore, whole word correctness is examined in detail for words containing only singleton consonants and words with a consonant cluster both in mono- and multi-syllabic context. Comparison between the two languages is made, §4.4 presents the child's phonetic repertoires in the two languages quantitatively, in terms of target consonants, correct productions, substitutions and deletions. Correctness is further analyzed in terms of singletons and clusters, in mono- and multisyllabic word context. The phonological mean length of utterance and cumulative consonants correctness are also computed. Comparisons with monolingual norms are made, §4.5 examines quantitatively substitutions and deletions in terms of singletons and clusters, in mono- and multisyllabic word context and compares them with monolingual norms, and §4.6 makes conclusive remarks for the chapter.

4.1 Introduction

Maria Sofia's phonologies in Greek and English at age 2;7 are examined in this chapter. This month was isolated because, as in Brown (2004:335), the child was 'just beginning to speak multi-word utterances in English, had highly intelligible to me speech' and was 'voluble' enough in English to facilitate the beginning of data collection in sound recordings. This chapter will set the necessary framework for evaluating the data in the following months covered by the study in the two subsequent chapters.

The child's bilingual status was verified qualitatively in section §3.4 by examining the forces behind her naturalistic dual language acquisition and by identifying those qualities that define bilingualism. The examination of the data at 2;7 begins by assuming simultaneousness of acquisition between the two languages, that is, first language status for both languages; this is grounded on the existing theoretical stances that define simultaneousness in accordance with first exposure to either language before three years of age (e.g. McLaughlin, 1978, 1995; Meisel, 1989; Genesee, 1989; Montrul, 2008) and disqualify cross-linguistic interaction (e.g. interference between the child's languages or transfer present in the input) as evidence against bilingual first language acquisition (e.g. Hakuta, 1986; Grosjean, 1989; Roeper, 1999; Paradis, 2000; Meisel, 2004).

The goals of this chapter are two-fold. First, the child's consonantal productions in the two languages are analyzed at the earliest possible age of available data in order to assess her level and order of consonantal acquisition for comparison to existing norms. Having explained the idiosyncratic nature of the child's linguistic milieu with regard to the English language (see §3.4), the comparison aims to assess whether the nature of English input (i.e. L2) has affected this child's developmental milestones in the acquisition of either of the languages. The present study, thus, fills in an acknowledged gap in the literature with regard to early bilingual development based primarily on non-native input (e.g. Place & Hoff, 2011). Though monolingual and bilingual language acquisition is known to abide to the same developmental course and milestones (e.g. Slobin, 1973, see also §2.3.2.3), is this true for Maria Sofia's languages and, especially, for English that is being acquired through non-native exposure in exogenous bilingualism?

The comparison of phonological systems in terms of consonants is made on many levels because the phonological acquisition of consonants is complex and subject to multiple factors: a universal order of acquisition of segments and feature contrasts (e.g. Jakobson, 1941/1968, Dinnsen, 1992); the role of word position and alignment constraints on individual consonant correctness (e.g. Jakobson, 1941/1968; Ingram, 1974b, Macken 1992; C. Levelt, 1994); well-defined phonological processes, such as assimilation, devoicing, final consonant deletion that have been found to be universally present (e.g. Ingram, 1976b, Macken & Ferguson, 1987); the role of individual variation (e.g. Ingram, 1979); the types of realizations that include deletions as they relate to markedness theory (e.g. Dinnsen, 1992; Prince & Smolensky, 1993; Bernhardt & Stemberger, 1998); whole word correctness and complexity in terms of singletons, clusters and the number of syllables being the context for the acquisition of the segment (e.g. Schmitt et al., 1983; Ingram & Ingram, 2001; Ingram & Dubasik, 2011). These issues have been discussed extensively in monolingual acquisition, mostly on a qualitative basis in case studies and also quantitatively in cross-sectional studies that have established norms (e.g. Prather et. al., 1975; Ingram et al., 1980; Smit et al., 1990; PAL, 1995).

Here, these issues are re-addressed on a detailed quantitative basis in a case study of bilingual phonological development, for the first time in the literature. Furthermore, as English and Greek differ in their phonotactics, for example, Greek permits only two consonants, /s, n/ in word final position, consonant clustering abides by different rules in the two languages, the number of monosyllabic words in English is much greater than in Greek, the quantitative comparison of the two languages aims to provide guidelines for establishing standards for future studies in bilingual phonological acquisition.

Second, the analysis will shed light on the controversial issue of single/separate phonological systems in bilingualism. Re-examination of this last issue should not be seen as repetition of a subject much studied, and perhaps long resolved, but rather as mandatory and interesting on its own right as this child's data provide the ground for re-addressing the rudimentary question in the debate. The controversy in bilingualism has shifted in time from those proposing a single phonological system (e.g. Leopold, 1949; Swain, 1972; Volterra & Taeschner, 1978; Redlinger & Park, 1980; Burling, 1959/1978; Major, 1977) to those proposing two phonological systems both in simultaneous bilingualism (e.g. Ingram, 1981b; Schnitzer & Krasinksi, 1994 & 1996; Deuchar and Clark, 1996; Johnson & Lancaster, 1998;

Keshavarz & Ingram, 2002), as well as, in successive bilingualism (e.g. Holm & Dodd, 1999). Paradis (1996) has argued that developing phonological systems are not autonomous but rather in interaction with each other, as in the final state of adult bilinguals where interference (Weinreich, 1953) is also evident. The most recent approach in the controversy is that the acquisition of similar languages provides counter-evidence for the separation of the systems; thus, the 'underlying unitary hypothesis' (Bunta, Davidovich, & Ingram, 2006) advocates surface separation but a common underlying phonological system.

The above studies have discussed the controversy in terms of phonetic realizations of segments, though the same issue has been discussed elsewhere in terms of prosody with parallel results (e.g. Paradis, 1996; Gut, 2000b; Brulard & Carr, 2003). Despite the increasing number of studies in bilingualism with a focus on segmental acquisition of phonology, the present study is the first one tackling consonantal acquisition in Greek-English bilingualism. The analysis of Maria Sofia's bilingual data at 2;7 is the first reply in the literature to the demand for determining exact degree of separation between the languages (e.g. Paradis, 2000). The qualitative and quantitative assessment of the order and level of acquisition of consonants in the two languages will facilitate this together with a comparison of substitution patterns between consonants that are common, as well as, different in the two languages. The analysis will provide grounds for identifying possible transfer/interference patterns between the child's languages and their extent. Furthermore this chapter will determine whether Greek or English is the dominant language (or L1) in the child's simultaneous bilingualism relating the results to the qualitative interpretations made in §3.4, regarding the status of the languages in the child's bilingualism.

Though the main focus is an analysis of the child's phonetic inventories at 2;7, the significance of the lexicon in phonological development is also acknowledged. Schreuder & Weltens (1993) emphasize that 'vocabulary acquisition is an essential prerequisite for the development of language' with the lexicon being 'a link between form and meaning. A child's lexical knowledge and breadth of vocabulary influences the rate and pace of phonological acquisition (e.g. Ervin & Miller, 1963; Stoel-Gammon, 2011). This is evident in bilingualism with the parallel controversy on the single/double bilingual lexicon (see §2.3.2.1). Therefore, the child's early lexical repertoires in the two languages at 2;7 are provided in full which allows, additionally, for a comparison of vocabularies between the two languages and with monolingual norms (see §4.3.1 and §4.3.2 below).

4.2 The languages and input

A comparison of the phonological systems of the child's two languages, Greek and English, together with an assessment of the phonological input in English, is made in this section.

4.2.1 Greek and English consonantal inventories

In table 4.1a, the consonantal systems of Greek and English are compared. Greek has twenty (20) consonantal phonemes and English has twenty-four (24) shown in bold; fifteen (15) of them are common between them. Allophones in both languages are also shown in the table in brackets. This table was assembled based on tables found in Gut (2009) for English and Arvaniti (2007) for Greek.

Table 4.1a Consonantal inventories in Greek and English

	Common (15)	**Greek only** (16)	**English only** (17)
Labial	**p**, **b**, **m**, **f**, **v**	[^{m}p, ^{m}b, ɱ]	[p^{h}, m̥]
Coronal	**θ**, **ð**, **t**, **d**, **s**, **z**, **n**, **l**,	**ts**, **dz**, **ɾ**	**ɹ**, **ʃ**, **ʒ**, **tʃ**, **dʒ**, [t^{h}, n̥, l̥, ɹ̥]
Palatal	**-**	[c, ɟ, ç, ɲ, ʎ, ʝ]	**j**
Velar	**k**, **g**	**x**, **ɣ**, [ŋ, ^{ŋ}g]	**ŋ**, **w**, [ɫ, k^{h}]
Glottal	**-**	-	**h**

N.B. Bold symbols denote phonemic and phonetic status and brackets denote allophones

A consonant feature matrix for adult English is given, among others, by Bernhardt & Stemberger (1998:73, table 3.1) and for adult Greek, among others, by Nespor (1999:69, figs. 2, 4) and are adapted below in tables 4.1b and 4.1c, respectively. Of the 15 common phonemes 6 are oral stops /p, b, t, d, k, g/ and 2 are nasal stops /m, n/. They also share the clear lateral /l/ and 6 fricative sounds: 4 coronal consonants of which 2 are [+strident (grooved)] /s, z/ and 2 are [-strident] /θ, ð/ and 2 labials, the labial-dental fricatives /f, v/. Other than the six fricatives common between them, Greek also has two velar fricatives /x/, /ɣ/ while English has two palato-alveolar sibilants /ʃ, ʒ/ and the glottal fricative /h/. Affricates in Greek are [+anterior]: /ts, dz/, while in English [-anterior]: /tʃ, dʒ/. The rhotic is [+consonantal] in Greek, the flap /ɾ/, but [-consonantal] in English, the approximant /ɹ/. Besides the approximant /ɹ/, English also has glides /j/ and /w/. Literature citing standard Modern Greek consonantal inventories (e.g. Nespor, 1999; Mennen & Okalidou, 2007) does not usually assume the presence of glides, /j/ and /w/, in the language. However, it has been argued (e.g. Setatos, 1974; Rytting, 2005) that postvocalic /i/ may surface as a palatal approximant, as for example, in *νεράϊδα* (fairy) /ne.ɾa.i.ða/→[ne.ɾaj.ða]. Baltazani & Topintzi (2013) recently verified this claim using acoustic analysis. Furthermore, Baltazani & Topintzi (2010) provide evidence of [w] in Northwestern Greek dialects. In the present chapter where the child's Greek is examined at 2;7, there is no instance of [w] or postvocalic /i/. As far as the child's Greek is concerned for the sixteen months that follow, there were few instances of postvocalic /i/ which in the author's estimation were surfaced as [i] rather than [j]. The velarized alveolar nasal /ŋ/ has phonemic status in English but it is allophonic in Greek [ŋ] when /n/ precedes a velar obstruent, e.g. άγχος (stress) [aŋ.xos].

Table 4.1b. Consonant feature matrix for adult English*

	p	t	ʧ	k	b	d	ʤ	g	f	θ	s	ʃ	v	ð	z	ʒ	m	n	ŋ	l	ɹ	w	j	h
sonorant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+
consonantal	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-
continuant	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	-	-	-	+	+	+	+	+
nasal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-
lateral																				+				
Laryngeal	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
voiced	-	-	-	-	+	+	+	+	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	-
spread-glottis	+/-	+/-	+/-	+/-					+	+	+	+												+
constricted-glottis	+/-	+/-	+/-	+/-																				
Place	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
Labial	√				√				√			√					√				√	√		
round																					+	+		
labiodental									+				+											
Coronal		√	√			√	√			√	√	√		√	√	√		√		√	√		√	
anterior		+	-			+	-			+	+	-		+	+	-		+		+	-		-	
distributed		-	+			-	+			+	-	+		+	-	+		-		-	+		+	
grooved		-	+			-	+			-	+	+		-	+	+								
Dorsal				√				√											√			√	√	
back				+				+											+			+	-	
high				+				+											+			+	+	
low				-				-											-			-	-	

* adapted from Bernhardt & Stemberger (1998)

Table 4.1c. Consonant feature matrix for adult Greek (adapted from Nespor, 1999)

	p	b	t	d	k	g	c	ɟ	ʦ	ʣ	f	v	s	z	x	ɣ	m	n	l	ɾ	ç	j	ɲ	ʎ
syllabic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
consonantal	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
sonorant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	-	+	+	+
voice	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	+	+	+	+	-	+	+	+
continuant	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	-	-	+	+	+	+	-	-
slow release	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
lateral	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	+
back	-	-	-	-	+	+	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-
front	+	+	+	+	-	-	+	+	+	+	+	+	+	+	-	-	+	+	+	+	+	-	+	+
coronal	-	-	+	+	-	-	-	-	+	+	-	-	+	+	-	-	-	+	+	+	-	-	-	-

With regard to their common consonants, aspiration, palatalization, velarization, pre-nasalisation and phonotactic syllable constraints differentiate the two languages phonetically. Specifically, common consonantal phonemes in the two languages differ in terms of:

1. the feature [spread glottis] on the [Laryngeal] node in the case of voiceless stops. The Laryngeal features which are [voice], [spread glottis], [constricted glottis] were presented as an integral part of the feature geometry tree (see section 2.4.4.6). 'There must be at least 25 msec of voicelessness after release for a stop to be [+s.g.]' in English (Bernhardt & Stemberger, 1998:698). English voiceless stops have long-lag aspirated Voice Onset Time (VOT) in stressed position, whereas voiced stops have short lag unaspirated VOT e.g. /b/→[p]. VOT is defined as the timing between the release of a stop closure and the beginning of vocal-fold vibration (Lisker & Abramson, 1964). Unlike in English (e. g. Yavaş, 2011), Greek voiceless stops are [-spread glottis]. It is widely accepted that Greek voiceless stops are produced as short lag unaspirated VOT (Fourakis, 1986; Kollia, 1993) and word initial voiced stops are prevoiced, i.e. with lead voicing (Botinis, Fourakis & Prinou, 2000). As phonetic transcription is not a reliable measure of VOT differences in production, the present thesis will not attempt an analysis in terms of VOT.

2. the feature [anterior] on the [Coronal] node. The features on the [Coronal] node which are [anterior], [distributed], [strident] were presented as an integral part of the feature geometry tree (see section 2.4.4.6). In English, the [-anterior] feature of alveopalatals /ʃ, ʒ/ is phonemic and contrasts the [+anterior] feature of alveolars /s, z/ in the underlying structure. In Greek, [-anterior] marking palatal articulation is not phonemic but results from an allophonic rule: the alveolar nasal, /n/, and the lateral, /l/, characterized by the [+anterior] are allophonically palatalized to [ɲ] and [ʎ] with the [-anterior] feature, when they precede a sequence of /i/ with any of the other vowels in Greek (/e, a, o, u/) within the same syllable as, for example, in *κούνιες* (swings) /kunies/→[kuɲes] and *μαλλιά* (hair) /malia/→[maʎa]. In English, the clear lateral, /l/, on the [Coronal] node becomes dark [ɫ] word-finally and post-vocalically, thus, obtaining a secondary [Velar] articulation.

3. the feature [back] on the [Dorsal] node. In Greek, the velar plosives /k, g/ and the continuants /x, γ/, characterized by the [+back] feature, are allophonically palatalized to stops [c, ɟ] and fricatives [ç, ʝ] that are [-back], respectively, in the context of following vowels /i, e/ caused by their [+front] feature as, for example, in *κατσίκες* (goats) /katsikes/→[kat͡sices], *φέγγει* (shines) /fegi/→[feɟi], *έχει* (has) /exi/→[eçi] and *γύρω* (around) /γiɾo/→[ʝiɾo]. Furthermore, the palatals [ç, ʝ] have the [-strident] feature.

4. prenasalization; the Ancient Greek nasal+voiceless stop clusters /mp, nt, ŋk/ have evolved to either singleton voiced stops, [b, d, g], in standard Modern Greek or to prenasalized voiced stops, [ᵐb, ⁿd, ᵑg], in Modern Greek dialects (Newton, 1972; Arvaniti & Joseph, 2000). This has led to a controversy regarding the phonological status of voiced stops in Modern Greek (e.g. Arvaniti, 2007) as to whether they are derived consonants from a nasal+voiceless stop cluster whereby the second member takes the [+voice] feature of the first member which assimilates for [place] to the second member (Newton, 1972; Malikouti-

Drachman & Drachman, 1992) or they are independent phonemes (Householder, 1964; Setatos, 1974). A thorough discussion on both positions is given by Malikouti-Drachman (2001b). In the present study, the child's voiced stops are not generally prenesalized; out of thousands of tokens in the span of the longitudinal study less than twenty were prenasalized in the two languages together; the occurrences in the child's English are discussed in chapter 6. As to whether the thousands of voiced stops which are not prenasalized in the child's speech are considered phonemes or not may be of theoretical interest to linguists of Modern Greek but it will not be discussed here further as it is beyond the scope of the present study. For prenasalization in other languages see, among others, Ohala & Ohala (1993).

4. phonotactic restrictions with regard to syllabic structure; in English an obligatory vocalic element is required as its nucleus which results in the allophonic use of /m, n, l, ɹ/ as vocalic consonants [m̩, n̩, l̩, ɹ̩] (e.g. Roca & Johnson, 1999; Gut, 2009). There are no syllabic consonants in Greek.

In total, there are 31 consonantal segments in Greek of which 11 are allophones [^{m}b, ^{n}d, ^{ŋ}g, c, ɟ, ŋ, ɱ, ɲ, ʎ, ç, ʝ] and 32 consonantal segments in English of which eight are allophones [p^{h}, t^{h}, k^{h}, m̩, n̩, ɫ, l̩, ɹ̩]. In a nutshell, Greek has no palato-alveolars and glottals while English has no velar fricatives, alveolar affricates or palatals other than /j/. Further discussion of phonotactic use and examples in the two languages can be found in Mennen & Okalidou (2007) for Greek and Gut (2009) for English, among others.

4.2.2 The input in Greek and English

Maria Sofia's mother (the author) is a native speaker of non-dialectal Modern Greek with a Greek consonantal inventory as described in the previous section that excludes prenasalization as a feature of her speech. She is also a fluent L2 speaker of English with university studies in England and residence experience in England and the U.S. for a total of fifteen years. Although a detailed analysis of the mother's interlanguage (being the primary input source in English) is beyond the focus of this thesis, her interlanguage consonantal inventory is shown in table 4.2. The assessment is done by the author herself, as in Smith (1973).

Table 4.2 Mother's English Consonantal Inventory

Target English	**Transfers**
p, (p$^{h)}$, b, m, (m̩), f, v	
θ, ð, t, (t^{h}), d, s, z, n, (n̩), l, l̩, ɹ, (ɹ̩), ʃ, ʒ, tʃ, ʤ	ɹ → (ɾ)
j	j → (ʝ)
ŋ, ɫ k, (k^{h}), g, w	k, k^{h} → (c); g → (ɟ)
h	h → (x), (ç)

N.B. The parentheses denote irregular use

In the first column of the table, the mother's native-like production of English target consonants are shown without a parenthesis. The parenthesis denotes irregular (meaning sometimes) use, e.g. [p^h]→[p], the rest being native-like. In the second column, the mother's consonantal transfers are shown which are irregular, the rest being native-like.

4.3 Early lexical repertoire in the two languages

A description of the methodology used in the thesis that pertains also to this chapter was given in Chapter 3. Based on information in the Database Log (see §3.5.5), the recordings at 2;7 run to a monthly total of 182 minutes in 41 files. Using CLAN commands, the number of word tokens and utterances were obtained for each file separately because CLAN does not do it for many files collectively. Then, each file's results were entered in Excel and added together to obtain the total tokens and utterances for the month. The same procedure, however, could not be followed to obtain the total word types in the month since the same word may appear in several files. The word types from all the files at 2;7 were entered in one column of an Excel file and then arranged alphabetically. Each word type's total tokens, its correct tokens and its incorrect tokens were entered in different columns of the same row occupied by the word type.

There are a total of 1,473 child utterances in this month's recordings of which 785 are in English and 688 are in Greek. The word tokens to utterance ratio (TUR) in English is 2.02 and in Greek 3.68 which means that at 2;7 the child has longer utterances in Greek than in English. This is a first measure of linguistic competence between the two languages and is identical to the Average Length of Sentence (ALS) introduced by Nice (1925), since at 2;7 Maria Sofia does not produce consecutive sentences in conversation with the author/mother; an utterance coincides with a sentence. Parker & Brorson (2005) compared ALS, which was later termed MLU in words, with the mean length of utterance in morphemes (MLU) proposed by Brown (1973) for 40 language transcripts of 28 typically developing English speaking children between the ages of 3;0 and 3;10. The two measures were found to be perfectly correlated suggesting that, the simpler to calculate ALS may be used instead of MLU. In any case, Maria Sofia's MLU at 2;7 was also calculated resulting in the values 2.3 and 4.5 in English and Greek, respectively. Brown (1973) defined stages in child speech development according to the MLU level in English. Brown's Stage III for ages 2;7-2;10 is characterized by an MLU between 2.5 and 3.0. Maria Sofia's MLU in English is near this category.

Furthermore, a comparison of the word types to word tokens ratio (TTR) in the two languages at 2;7 yields a TTRE (in English) of 0.21 and a TTRG (in Greek) of 0.23, meaning that each word type is produced on average five times during the month in each language. Since the thesis focuses on consonants, words without consonants are now ignored resulting in 2,374 word tokens in Greek with 540 being word types and 1,516 word tokens in English with 317 being word types. In the next sub-section, the child's vocabulary in both languages at 2;7 is presented in detail.

4.3.1 Productive vocabulary

Ingram & Ingram (2001) emphasize the importance of correlating vocabulary size to the level of phonological development and argue that ‘expressive vocabulary is rarely measured because of its inherent difficulty in a portraying a given child’s ability accurately without requiring considerable time and effort’ (275). The tables given in this section catalogue Maria Sofia’s total productive vocabulary at 2;7 in English (table 4.3) and in Greek (table 4.4). The vocabulary includes semantically different word types (including proper names and some onomatopoeia), grammatical word types meaning lexical differentiation due to grammar (e.g. inflections, plurals, diminutives, etc.), as well as, sums of tokens, meaning all instances of word types including repetitions. Tables 4.3 and 4.4 have the following columns: word *Type* (column 1), IPA transcription of *Adult form* (column 2), total *Tokens* per word type (column 3), instances of the child’s whole word *Correct* outputs (column 4), IPA transcriptions of the child’s *Incorrect* outputs, columns 5-14 for English and 5-11 for Greek, marking total instances for each output in parenthesis, e.g. *and* → ə (2). The translation of the Greek words to English as well as some grammatical information on them are presented in Appendix B**.** Primary stress has also been marked in the tables for target words. It is noted that in Greek the stressed syllable is easily identifiable by the stress mark, compulsory in the language’s orthography. However, stress does not concern the present thesis and that is why it is not marked in the outputs.

Table 4.3 The child’s productive vocabulary in English at 2;7

Types	**Adult form**	**Tks**	**Cor**	**I 1**	**I 2**	**I 3**	**I 4**	**I 5**
again	ə'gɛn	6		əd̪eñ	əd̪ɛn	eden	əʤeːn	əɟen əɟe
airplane	'eɹˌpleɪn	1		ɜːpɪn				
all	ɔɫ	1	1					
also	'ɔɫsoʊ	1		oso				
and	ənd	4		ən	ət	ə (2)		
any	'enɪ	4	3	elɪ				
are	ɑ:ɹ	1		ɑ:l				
at	æt	2	2					
auntie	'ænti:	2	1	ɑːtini				
baby	'beɪbi	18	15	b̥eɪb̥ɪ (3)				
back	bæk	3		bæt (3)				
ball	bɔɫ	2	1	bɔ:				
basket	'bæskɪt	1		bastət				
bear	beəɹ	2		beəl	be			
because	bɪ'k^{h}ɔz	2		vʊvɔːs	ɪtɔːz			
bed	bed	3	1	bet^h	bet			
bee	biː	3	3					

beginning	bɪ'gɪnɪŋ	2	1	bɪdinɪn				
behind	bɪ'haɪnd	1		bɪʃaɪnt				
bib	bɪb	1	1					
big	bɪg	19		bɪt (10)	bɪtʰ (2)	bɪd (4)	bɪd̥	bɪ (2)
bike	baɪk	1		baɪ				
biscuit	'bɪskət	2		bɪstət	bɪʦtət			
bit	bɪt	1	1					
bite	baɪt	3	3					
black	blæk	5		bæt (4)	pæt			
blanket	'blæŋkət	8		bæntət (3)	bætət	pandənt	pʰætə (2)	vætət
blue	blu:	15		bu: (15)				
book	bʊk	2		but (2)				
boots	bu:ts	2	2					
both	boʊθ	2		boʊfʦ	boʊʃ			
bowl	boʊɫ	1		boʊ				
box	bɑks	1		bot				
boy	bɔɪ	4	4					
boys	bɔɪz	3	3					
bread	bɹed	2		bet	bed			
breakfast	'bɹekfəst	2		bɛstats (2)				
bricks	bɹɪks	2		bɪts	bɪʧ			
bridge	bɹɪʤ	2		biz	bɪʤ			
broke	bɹoʊk	2		boʊt (2)				
broken	'bɹoʊkn̩	1		votə				
brother	'bɹʌðəɹ	2		bʌlə	bʌɹə			
brought	bɹɔt	2		mɔ:t	bɔ:t			
brown	bɹæʊn	3		baʊn (2)	vaʊn			
bye	baɪ	5	4	ma				
cake	kʰeɪk	1		teɪt				
can	kʰən	1		tʰæn				
candy	'kʰændɪ	1		ʦædi				
car	kʰɑɹ	2		tɑ:l (2)				
carpet	'kʰɑɹpət	8		tʰa:pət (6)	pʰɑ:pət	tʰa:pə		
case	kʰeɪs	1		tɛɪs				
catch	kʰæʧ	2		taks	taʧ			
CD	ˌsi:'di:	1	1					
cereal	'sɪɹiəɫ	3		siliəl (3)				
chocolate	'ʧɒklət	7		ʧɒtət (3)	stɒtət	sɒtət	soteə	sʧɒtə
chocolates	'ʧɒkləts	2		tɒtət	tɒtəts			
chu	ʧu	2	2					
church	ʧəɹʧ	1		tsɛ:ts				
clock	klɒk	1		tɒt				

close	kloʊz	5		toʊz	tʰo:z	ʦo:s (2)	ʧoʊz	
coffee	'kʰɔfi:	5		tʰɒfɪ (3)	tɒfɪ	dɒfɪ		
cold	kʰoʊɫd	1		do:d				
come	kʰəm	33	3	tʌm (16)	tʰʌm (11)	tʌ (2)	dʌm	
coming	'kʰəmɪŋ	1		tʌmɪŋ				
cookie	'kʰʊkɪ	1		tʰuʦɪ				
crown	kɹæʊn	3		taʊn (2)	taʊ			
crying	kɹaɪŋ	2		taɪŋ (2)				
cup	kʰʌp	1		tʰʌp				
daddy	'dædi	12	10	d̪ædɪ	tadɪ			
daddy's	'dædiz	3	2		taziz			
daisies	'deɪzɪz	1		deɪzɪ				
daisy	'deɪzɪ	3	3					
dance	dæns	3	2	danʦ				
dark	dɑɹk	2		da:t (2)				
Diana	daɪ'ænə	1	1					
dog	dɔg	2		dɔt	dɔd̥			
doggy	dɔgi	7		dɔdɪ (6)	dɔdɪt			
dolly	'dɑli	2	2					
don't	doʊnt	8	1	tant	don	dɔt	doʊ	dɔ
								tɛ (2)
door	dɔɹ	3		dɔɫ (2)	dɔ:l			
Dorothy	'dɑɹəθɪ	1		dəɹəs.zɪ				
down	dæʊn	19	16	taʊn	daʊ	da:		
downstairs	dæʊn'steɹz	1		daʊnseəs				
drink	dɹɪŋk	3		dɪ:n	tʰɪ:n	dɪt		
duck	dʌk	1	1					
duckling	'dʌklɪŋ	1		dʌtlɪn				
eat	i:t	8	7	li:t				
egg	eg	1		e:ft				
eight	eɪt	1		neɪt				
Elena	'elənə	1	1					
else	eɫs	1		e:s				
enough	ɪ'nəf	1	1					
eyes	aɪz	1		aɪ				
fall	fɔɫ	1		vɔɫ				
father	'fɑðəɹ	1		fɑvə				
feed	fi:d	1	1					
fell	feɫ	4	1	feə (3)				
find	faɪnd	2		ʃaɪn	ʃaɪd			
fine	faɪn	3	3					
finished	'fɪnɪʃt	2	1	fɪnɪt				

first	fəɹst	1		fɜ:ts				
fit	fɪt	2	2					
fits	fɪts	1		pɪts				
floor	flɔɹ	1		fɔ:l				
flower	'flawəɹ	1		fa:ləɫ				
for	fəɹ	4		ə (2)	fə	ɔ		
forgot	fəɹ'gɑt	1		fəkʰədɒt				
found	fæʊnd	2	2					
from	fɹəm	1		ə				
further	'fəɹðəɹ	1		sevəɹ				
get	get	2		det (2)				
girl	gəɹɫ	5		deɫ (2)	del	ʥeəl	de:	
give	gɪv	5		dɪ (4)	ɟɪ			
glass	glæs	3		dæs	ʤas	ɟæs		
go	goʊ	12		doʊ (10)	dɔ	soʊ		
goats	goʊts	1		dɔʊts				
goes	goʊz	3		dɔuz (3)				
going	goʊɪŋ	1		dɔɪŋ				
good	gʊd	3		dut (2)	idu:t			
green	gɹi:n	1		ti:n				
hands	hændz	1		ʦants				
he	hi:	1	1					
hello	hə'loʊ	3		səloʊ	ʃʌloʊ (2)			
help	'heɫp	3	1	seəp (2)				
here	hɪəɹ	10		sɪə (6)	ʃiəl (2)	ʃiəɹ	ʦɪə	
hiding	'haɪdɪŋ	1		saɪdɪn				
him	hɪm	2		sɪ	ɪm			
his	hiz	3		his	sis	ʃɪz		
hold	hoʊɫd	7		ʃoɫd (2)	ʃo:d (3)	ʃoɫ	soid	
honey	'hənɪ	1		ʃʌnɪ				
horse	hɔɹs	1		ʃɔ:ʃ				
house	hæʊs	6		faʊz	ʃaʊz (3)	saʊs (2)		
hug	hʌg	1		ʃʌd				
icon	'aɪkn̩	1		a:tn̩				
in	ɪn	5	2	i	il	li		
inside	in'saɪd	26		ɪsaɪt (13)	isaɪt̪	ɪsaɪd	i:saɪd̪	ɪsaɪ (9)
								aɪt
is	ɪz	105	68	ɪs (36)	ɪn			
it	ɪt	104	98	its	titi	ti	i (2)	id
jumbo	'ʤəmboʊ	2		ʥabo (2)				
know	noʊ	2	2					
last	læst	1	1					

leave	li:v	2	1	i:v			
legs	legz	1		jets			
let's	lets	13	4	les (6)	lest	nes	ses
lie	laɪ	2	2				
like	laɪk	4		laɪt (3)	naɪk		
lips	lɪps	2	1	ips			
listening	'lɪsənɪŋ	1		isənɪn			
lock	ˈlɑk	2		lot	lo		
long	ˈlɔŋ	1	1				
look	ˈlʊk	1		lʊt			
lose	ˈlu:z	4	4				
lost	ˈlɔst	1	1				
lullaby	'ləlәˌbaɪ	2	1	mjajәbaɪ			
lying	ˈlaɪŋ	1	1				
make	ˈmeɪk	6		meɪt (6)			
mammy	'mæmi	9	8	əɑmi			
mammy's	'mæmiz	1	1				
Manolis (name)	ma'nolis	1	1				
many	'menɪ	2	2				
Maria	mə'ɹiə	4		maia (2)	malia	maɾia	
Maya	'mɑjə	3	2		maʒa		
me	mi:	24	24				
Mickie	'mɪkɪ	2		mɪtɪ (2)			
milk	mɪɫk	5		mɪət (5)			
mine	maɪn	18	17	maɪ			
Minnie	'mɪnɪ	1		mimi			
missed	mɪst	3	1	mɪs (2)			
money	'mʌni	7	7				
more	ˈmɔɹ	6		me:	mɔl (5)		
mountains	'mæʊntənz	1	1				
mouse	mæʊs	3		maʊs (2)	maʊz		
mouth	mæʊθ	1		maʊʃ			
moved	mu:vd	1		mu:zv			
music	'mjuzɪk	1		muzit			
muzzle	'məzl̩	2	1	mʌzə			
my	maɪ	14	13	aɪ			
name	neɪm	2	2				
nice	naɪs	1	1				
Nicholas	'nikələs	1		nitolas			
night	naɪt	1	1				
no	noʊ	64	61	dɔʊ	lɔʊ	ɲɔʊ	
not	nɑt	10	9	ɑt			

now	næʊ	10	10					
o'clock	ə'klɒk	1		ɔtot				
on	ɔn	16	15	no				
one	wʌn	10	2	vʌn (4)	ʊʌn (3)	ʌ		
open	'oʊpn̩	8	8					
or	ɔɹ	1		ɔ:				
other	ʌðəɹ	4		ʌləl (3)	ʌlə			
out	æʊt	3	3					
outside	ˌæʊt'saɪd	1		aʊtsaɪt				
page	pʰeɪʤ	7	3	peɪts (2)	pʰeɪts	beɪʤ		
Papi (name)	'pʰæpɪ	8	8					
Papis (name)	'pʰæpɪs	3	3					
Papi's	'pʰæpɪz	1	1					
pavement	'pʰeɪvmənt	4		peɪvmən	peɪment	peɪmet	peɪemən	
pee	pʰi:	2	2					
pet	pʰet	2	2					
Peter	'pʰi:təɹ	1		pʰɛtel				
pick	pʰɪk	3		pɪt (2)	tʰit			
pictures	'pʰɪkʧəɪz	1		pɪtsaz				
pillow	'pʰɪloʊ	1	1					
Pinocchio	pɪˈnɑkɪə	2		pinotɪo (2)				
play	pleɪ	6		pɛɪ (4)	beɪ	pʰeɪ		
playground	pleɪ'gɹæʊnd	2		peɪdaʊnt	beɪndaʊnt			
please	pli:z	1		piz				
pooh	pʰu:	2	2					
pot	pʰɑt	3	3					
purple	'pʰəɹpl̩	1	1					
push	pʰʊʃ	4	1	pʊs	pʊz	ibʊʃ		
put	pʰʊt	3	2	pʰʊ				
rabbit	'ɹæbət	1		labɪtʰ				
read	ɹi:d	4		vi:d (3)	wi:d̥			
reading	'ɹi:dɪŋ	1		vi:dɪn				
red	ˈɹed	13		ved (4)	ved̥ (3)	vet (3)	vɛd̪	bed̪ ve:
restaurant	'ɹestɹɑnt	2		ɹestant	lestant			
ride	ɹaɪd	2		naɪd (2)				
room	ɹu:m	18		lum (11)	lumi (3)	vu:m	ɾu:m	mʊm lu:
run	ɹʌn	3		vʌn (2)	Lan			
salad	'sæləd	1		sælət̥				
same	seɪm	1	1					
sauce	sɔs	2	1	ʃɔ:s				

say	seɪ	1	1					
school	sku:ɫ	1		stʊl				
see-saw	'si:sɔ	1	1					
she	ʃi:	4	1	si:	ʦi	ɪz		
she's	ʃi:z	1		si:				
shoes	ʃu:z	1	1					
short	ʃɔɹt	1		sɔ:t				
show	ʃoʊ	1	1					
sick	sɪk	1		sit				
sister	'sɪstəɹ	2		sistəl	sɪt.stə			
sisters	'sɪstəɹz	1		sisʦəɹz				
sit	sɪt	12	2	sɪtə	sɪdɪ	sits	si (5)	ti:
								çi:
sleep	sli:p	2		si:ps	si:p			
small	smɔɫ	5	4	smɔʊ				
snail	sneɪɫ	3	1	senɔ:	nelɔʊ			
snot	snɑt	1	1					
sofa	'soʊfə	1	1					
Sofia	soʊ'fi:ə	3	2	fɔfɪa				
Sofia's	soʊ'fi:əz	1		fɔfɪas				
some	səm	1		aɪ				
spaghetti	spə'geti:	1		spatetɪ				
speak	spi:k	1		fpi:t				
spoon	spu:n	6	3	spa:	pu:n	pʰu:		
stay	steɪ	1		tseɪ				
steps	steps	2	1	ste				
stir	stəɹ	1		tsɜl				
story	'stɔɹi:	2		stɔlɪ (2)				
strawberries	'stɹɔˌbeɹi:z	1		tsɔ:belɪz̥				
street	stɹi:t	1		sti:				
stroller	'stɹoʊləɹ	1		tsolos				
suds	sʌdz	1		sʌds				
sunny	'sʌni	1	1					
swings	swɪŋz	1		fin				
table	tʰeɪbl̩	1		teɪbə				
take	tʰeɪk	6	1	teɪt (2)	teɪtʰ	teɪ	deɪ	
talk	tʰɔk	7		tʰɔt (6)	dɔt			
tape	tʰeɪp	2	2					
telephone	'tʰeləˌfoʊn	4		tevəfɔʊn (2)	tʰɛmefɔʊn	əməfɔʊn		
thank	θæŋk	2		sent	ʃɛnt			
that	ðæt	3	1	læt	la			
the	ðə	49	2	tə (4)	ʦe (3)	tʰɑɪ	də	lə (3)

				nə	hu	ə (29)	ɪ (2)	ɔ (2)
there	ðeəɹ	7		ðeə	ðeis	leəl (2)	neə (2)	eə
these	ði:z	1		ði:				
they	ðeɪ	1		i				
this	ðɪs	41	9	ð̥is	tɪs	vɪs	zɪs	lɪs (14)
				ləlis	nɪs (6)	ɲ̃is	jɪs	ɪs (5)
time	tʰaɪm	2	1	tʰaɪ				
Thomais (name)	θoma'is	3		somais (2)	ʃomais			
Thomas	'tʰɑməs	2	2					
through	θɹu:	2		tu (2)				
throw	θɹoʊ	1		ʃɔʊ				
to	tə	10	9	dɔ				
today	tə'deɪ	1	1					
together	tə'geðəɹ	1		tʊʤeləl				
toilet	'tʰɔɪlət	1	1					
tomato	təˈmeɪtoʊ	1		əmeɪtɔ				
too	tʰu:	2	2					
top	tʰɑp	1	1					
Toto (name)	tə'tʰɑ	1	1					
toy	tʰɔɪ	1	1					
toys	tʰɔɪz	2		tʰɔɪs (2)				
train	tɹeɪn	2		teɪn (2)				
tree	tɹi:	1		tʰi:				
TV	'tʰi:ˈvi:	1	1					
up	əp	10	9	pʌp				
upstairs	'əpsteɹz	3		ʌptseəz	ʌpseəz	ʌpʃeəz		
us	əs	1	1					
Venizelo (name)	veni'zelo	1		mɛmizɛlo				
wait	'weɪt	2	1	veɪt				
walk	wɔk	3		vɔ:t (2)	wɔ:ʦ			
wall	wɔɫ	1		vol				
want	wɔnt	10		vont	vɔt (4)	vet	vɔʃ	mɔt
							nɔt	vɔ
water	'wɔtəɹ	1		votəl				
way	weɪ	4		veɪ (3)	ve			
we	wi:	5		si (2)	li (2)	I		
wearing	'weəɹɪŋ	2		veəlɪn	veəlɪ			
wee	wi:	1		vi:				
when	wen	2		veɪ	ven			
where	weəɹ	14	2	vɛ: (8)	bɛ: (2)	ve:ɹ	weə	
white	waɪt	2		vaɪt (2)				
why	waɪ	1		vaɪ				

will	wɪɫ	2		li (2)				
Willie	wɪlɪ	1		vi				
window	'wɪndoʊ	1		vɪndɔʊ				
Winkie	'wɪŋki	2		wɪntɪ	viti			
Winnie	'wɪni	2	2					
with	wɪθ	3		ɪz	ɪ	ɪʃ		
won't	woʊnt	1	1					
yeah	jeə	8	7	ɲe:				
yellow	'jeloʊ	20	3	leloʊ (8)	lelə (7)	eloʊ	vlelɔʊ	
yes	jes	113	61	ðes	ðeʦ	ʃes	zes (7)	ʒes (18)
				ʤes (4)	les (2)	leɪs	nes (3)	ɲex
				ɲes (3)	jeh	jeʃ	jex	jeps
				jez	ces	tɛ:	ɲe	je
				es				
you	ju:	7	2	su	ʃu	ʒu:	u (2)	
your	jɔɹ	2		su:	ʒu			
yours	jʊɹz	2		ʃɔ:s	ʎɔ:			
Zozef (name)	'zoʊzef	1	1					
Total	317	1516	665					

N.B. Tks: tokens, Cor: the child's correct productions, I: the child's incorrect productions

Table 4.4 The child's productive vocabulary in Greek at 2;7

Types	**Adult form**	**Tks**	**Cor**	**I 1**	**I 2**	**I 3**	**I 4**	**I 5**
αγελάδα	aʝe'laða	1		aleʝaʝa				
αγκαλιά	aga'ʎa	7		adʒaʝa (6)	agala			
αγκαλίτσα	aga'liʦa	1		adalitʃa				
άδειο	'aðʝo	2		aʒo (2)				
ακόμα	a'koma	3		apoma (3)				
ακουμπάμε	aku'bame	1		atubame				
αλήθεια	a'liθça	1		aiʃa				
άλλη	'ali	11	7	ai (3)	aɫi			
άλλο	'alo	1	1					
άλλος	'alos	1	1					
αλογάκι	alo'ɣaci	2		alolati	alolaʦi			
Άλπεις	'alpis	2		api	apis			
άμα	'ama	1		ana				
αν	an	1		an				
Αναργύρου	anaɾ'ʝiɾu	1		anaʝius				
ανέβω	a'nevo	1	1					
άνοιξε	'anikse	1		anisʦe				

ανοίξει	a'niksi	1		anitsi				
ανοίξεις	a'niksis	2		anitsis (2)				
ανοίξω	a'nikso	1		anitso				
αντίο	a'dio	3	3					
από	a'po	10	7	po (2)	amo			
αρκουδάκι	aɾku'ðaci	1		akuvaci				
αρχή	aɾ'çi	1		asi				
άσε	'ase	1	1					
άσπρη	'aspɾi	3		aspi (3)				
άσπρο	'aspɾo	1		aspo				
άστη	'asti	2	2					
άστηνε	'astine	1	1					
άστο	'asto	1	1					
αυγό	a'vɣo	1		avo				
αύριο	'avɾio	1		avio				
αυτά	a'fta	2		as̺ta	asta			
αυτή	a'fti	5		as̺tin	ati	esti	asti (2)	
αυτί	a'fti	1		asti				
αυτό	a'fto	15	1	asto (8)	to (3)	naθto	s:to	aʃto
αυτοκίνητο	afto'cinito	1		fafotinito				
αυτός	a'ftos	3	1	astos (2)				
αφήνει	a'fini	4	4					
αφήνεις	a'finis	1	1					
αφήσει	a'fisi	1	1					
αφήσεις	a'fisis	1		afiʃis				
βάζανε	'vazane	1	1					
βάλει	'vali	1	1					
βάλεις	'valis	2	1	vais				
βάλω	'valo	10	8	falo (2)				
βγάλεις	'vɣalis	2		valis	vais			
βγάλω	'vɣalo	1		valo				
βγει	vʝi	1		vi				
βγεις	vʝis	1		vis				
Βενιζέλο	veni'zelo	1		menizelo				
βιβλίο	vi'vlio	1		vivio				
βλέπω	'vlepo	1		vepo				
βόλτα	'volta	1		vota				
βουνά	vu'na	1	1					
βρεις	vɾis	2		vi	vis			
βρήκες	'vɾices	1		vite				
βρούμε	'vɾume	1		vume				
γάλα	'ɣala	2		lala (2)				
γατούλα	ɣa'tula	3		ʝatula	atula	atual		

γαύγισε	'ɣavɟise	1		vavise				
γειά	ɟa	2	2					
γέρος	'ɟeɾos	1		ɟelos				
γη	ɟi	1		li				
γιαγιά	ɟa'ɟa	1		ʒaza				
γιατί	ɟa'ti	22	4	tati (15)	ʒati	kaki	tetati	
γιατρό	ɟa'tɾo	1		ɟato				
γίνουμε	'ɟinume	1		inumesu				
Γιώργος	'ɟorɣos	3		ɟoɣos	ɟoɟos	ɟoʎos		
γλύψει	'ɣlipsi	1		vipsi				
γράμματα	'ɣɾamata	2		lamata	ɟamata			
γραφείο	ɣɾa'fio	1		vafio				
γράψω	'ɣɾapso	2		łapso	lapso			
γυρίσω	ɟi'ɾiso	2		ɟiliso (2)				
γύρω	'ɟiɾo	9		lio (9)				
γω	ɣo	5	2	lo (3)				
δαχτυλίδι	ðaxti'liði	1		ðastilili				
δε	ðe	42	2	ze	e (34)	ʃe	me (2)	ɟa le
δείξω	'ðikso	3		titso	litso (2)			
δεν	ðen	15			e (4)	en (10)	ɟes	
Δημήτρης	ði'mitɾis	2		melitis	mimitis			
διαβάσεις	ðʝa'vasis	4		vavasis (4)				
διαβάσουμε	ðʝa'vasume	1		valasume				
διαβάσω	ðʝa'vaso	1		vavaso				
διάλεξα	ðʝaleksa	1		laletsa				
δικά	ði'ka	2		tita	lita			
δική	ði'ci	2		titi (2)				
δικό	ði'ko	12		tito (6)	ʦito (2)	it^ho	tit^ho	dito (2)
δίνω	'ðino	2	1	lino				
δουλειά	ðu'ʎa	1		ʒuʒa				
δυνατά	ðina'ta	1	1					
δύο	'ðio	2		lio (2)				
δω	ðo	1	1					
δώσε	'ðose	3		vose	lose (2)			
δώσει	'ðosi	4		losi (4)				
δώσεις	'ðosis	1		losis				
δώσω	'ðoso	2		loso (2)				
έβαλα	'evala	2	1	eɣala				
έβαλες	'evales	1	1					
έβγαλα	'evɣala	2		evala (2)				
έγλειψα	'eɣlipsa	1		elipsa				
έγλειψε	'eɣlipse	1		epipse				

εγώ	e'ɣo	16		eo	elo (14)	eʎo		
εδώ	e'ðo	47		elo (38)	lo (3)	eło (2)	mεɲo	eno
							εtʰo	eʎo
έδωσε	'eðose	2	1	elose				
είμαι	'ime	9	9					
είμαστε	'imaste	1		imats				
είναι	'ine	63	60	in (3)				
είπα	'ipa	4	4					
είπε	'ipe	3	3					
είσαι	'ise	1	1					
έκανα	'ekana	2	1	etana				
έκανες	'ekanes	1		etanes				
εκεί	e'ci	7		eti (5)	εtʰi (2)			
εκκλησία	'ekli'sia	1		etisia				
έκλεισα	'eklisa	1		titisa				
έκλεισε	'eklise	2		et͡sise	etise			
έλα	'ela	18	15	tela	eła	ena		
ελίτσες	e'lit͡ses	1	1					
εμείς	e'mis	3	2	mis				
εμένα	e'mena	2	2					
ένα	'ena	16	14	en	nena			
έξω	'ekso	4		etso (4)				
έπαιξες	'epekses	1		epetses				
έπεσαν	'epesan	1	1					
έπεσε	'epese	8	7	epeʃe				
έρχεται	'eɾçete	1		esete				
έρχομαι	'eɾxome	1		ʃome				
εσένα	e'sena	6	6					
εσύ	e'si	10	8	dʒεjusi	zi			
έτρεξα	'etɾeksa	1		eðatsa				
έτρωγα	'etɾoɣa	1		etoʒa				
έτσι	'et͡si	12	11	εtʃi				
ευχαριστώ	efxaɾi'sto	2		efalisto	falisto			
έφαγα	'efaɣa	2	1	efaa				
εφτά	e'fta	1		esta				
έχασε	'exase	1		eʃase				
έχει	'eçi	6		εʃi (2)	esi (4)			
έχεις	'eçis	1		εʃis				
έχω	'exo	5		εʃo (5)				
ζαμπόν	za'bon	1		ʝabon				
ζούσε	'zuse	2	2					
ζώα	'zoa	1		ʒoa				
ζωγραφήσεις	zoɣɾa'fisis	1		ɣafisis				

ζωγραφήσουμε	zoɣɾa'fisume	1		vovafisume				
Ζωή	zo'i	3	1	zoti	ɟoi			
ήθελες	'iθeles	1		iʃeles				
ήμουνα	'imuna	1	1					
ήρθε	'iɾθe	6		ise (2)	iʃe (4)			
ήρθες	'iɾθes	2		iʃes (2)				
ήτανε	'itane	2	2					
θα	θa	49	2	a (17)	ta (9)	fa	ma	ʃa (13)
							me	sa (5)
θάλασσα	'θalasa	1		ʃalaʃa				
θεία	'θia	2		ʃia	çia			
θέλει	'θeli	12		seli (3)	ʃɛli (4)	ʃeni	zli	seni
							tɛi	ʃei
θέλεις	'θelis	1		selis				
θέλω	'θelo	35	4	telo (4)	selo (8)	ʃelo (17)	elo (2)	
θεού	θe'u	1		ʃɛu				
θές	θes	2	1	sɛə				
θυμάσαι	θi'mase	1		simase				
Θωμαίς	θoma'is	26	1	ʃomais (19)	somais (4)	ʦomais	ɟomais	
κάθησε	'kaθise	1		tʰatisɛ				
καθήσει	ka'θisi	1		tatisi				
κάθομαι	'kaθome	1		taʃome				
κάθονται	'kaθode	2		taʃode (2)				
και	ce	63		te (61)	e	ne		
καιρό	ce'ɾo	4		telo	delo	t̪eɾo	ɟelo	
κακός	ka'kos	9		tatʰos (2)	tatos (7)			
καλά	ka'la	5		tala (5)				
καλή	ka'li	1		tali				
καλημέρα	kali'meɾa	1		kaimala				
καναπέ	kana'pe	1		talape				
κάνε	'kane	1		tane				
κάνει	'kani	1		tani				
κάνεις	'kanis	4		tanis (3)	stanis			
κάνουμε	'kanume	2		tanume (2)				
κάνω	'kano	1		tano				
κάπου	'kapu	1		tapu				
καράβι	ka'ɾavi	1		talavi				
καρέκλα	ka'ɾekla	2		taleta (2)				
καρότσι	ka'ɾoʦi	3		taloʦi (2)	dadoti			
καταλαβαίνει	katala'veni	1		talaveni				
κατάφερα	ka'tafeɾa	1		tatafela				
κατεβάσεις	kate'vasis	1		tatevasis				
κατσαρόλα	kaʦa'ɾola	3		tatʃalola (2)	taalola			

κάτσε	'kaʦe	3		taʦe (3)				
κάτσεις	'kaʦis	1		taʦis				
κατσίκες	ka'ʦices	1		taʦites				
κάτσω	'kaʦo	3		ʦaʦo	taʦo (2)			
κάτω	'kato	7		t̪at̪o	tato (5)	tʰato		
κει	ci	4		ti (4)				
κ'εμένα	ce'mena	2		temena (2)				
κεφάλα	ce'fala	1		tefala				
κεφαλάκι	cefa'laci	1		tefalati				
κι'άλλη	'cali	2		tali (2)				
κι'αυτά	ca'fta	1		tasʦa				
κι'ο	co	3		tu (3)				
κιόλας	'colas	2		tolas (2)				
κίτρινα	'citɾina	1		tʰitina				
κίτρινη	'citɾini	1		titini				
κίτρινο	'citɾino	4		titino (4)				
κλείσε	'klise	1		tise				
κλείσετε	'klisete	2		pisete	tisete			
κλείσω	'kliso	1		tʰiso				
κοιμάται	ci'mate	1		pimate				
κοιμηθεί	cimi'θi	13		pimisi (5)	pimiʃi (5)	cimisi	miisi	fipimisi
κοιμηθούμε	cimi'θume	2		pimisume (2)				
κοιμηθώ	cimi'θo	4		pimiso (4)				
κοίτα	'cita	7	2	tʰita (2)	tita (3)			
κόκκινα	'kocina	1		tʰotina				
κολλήσουμε	ko'lisume	1	1					
κοντά	ko'da	3		d̪oda (2)	toda			
κοριτσάκι	koɾi'ʦaci	1		toliʦati				
κουβέρτα	ku'veɾta	2		tuteta	tuveta			
κουζίνα	ku'zina	1		tuzina				
κούκλα	'kukla	1		tuta				
κουκλίτσα	ku'kliʦa	1		tutiʦa				
κούκλες	'kukles	2		tutez (2)				
κουνάς	ku'nas	1		tolas				
κούνιες	'kuɲes	1	1					
κουράζομαι	ku'ɾazome	2		tulazome (2)				
κουτάκι	ku'taci	1		kutati				
κουτάλι	ku'tali	3		ɾuteli	tutali (2)			
κουτί	ku'ti	3		tuti (3)				
κράτα	'kɾata	1		tata				
κρατάς	kɾa'tas	1		tatas				
κρατάω	kɾa'tao	7		tatʰao (3)	atao	tatao (3)		
κρέας	'kɾeas	1		teas				

κρεβάτι	kɾe'vati	4		tevati (4)			
κρεμούλα	kɾe'mula	1		temula			
κρυμμένος	kɾi'menos	1		timelos			
κρύφτηκε	'kɾiftice	1		tisite			
κρυφτούμε	kɾi'ftume	1		titume			
κρύψω	'kɾipso	2		pipso (2)			
κρυώνω	kɾi'ono	1		tiono			
κύκλο	'ciklo	1		tito			
κυρία	ci'ɾia	4		tilia	tilela	tiia	cilia
λαμπάδα	la'baða	2		labala (2)			
λαμπρό	la'bɾo	1		labo			
λέγανε	'leɣane	1		lane			
λέει	'lei	4	4				
λένε	'lene	2	2				
λες	les	1		es			
λέω	'leo	1	1				
λιγάκι	li'ɣaci	1		iati			
λίγη	'liʝi	3	1	liʝiʒi	liʒi		
λίγο	'liɣo	1		lio			
λιοντάρι	ʎo'daɾi	1		lodali			
λουλουδάκια	lulu'ðaca	1		lululata			
λουράκι	lu'ɾaci	1		lulati			
λύκο	'liko	1		lito			
λύκος	'likos	8		litos (8)			
μαγειρεύω	maʝi'ɾevo	1		maievo			
μαγκώσει	ma'gosi	1		madoʦi			
μαγκώσω	ma'goso	1		madoso			
μαζί	ma'zi	12	10	maʒi (2)			
μαθαίνω	ma'θeno	1		maseno			
μακαρόνια	maka'ɾoɲa	2		pataloɲa	mataloɲa		
μακριά	makɾi'a	1		matia			
μαλλιά	ma'ʎa	2	1	mala			
μάλωσε	malose	1	1				
μαλώσεις	ma'losis	1	1				
μαμά	ma'ma	31	29	bama	mamami		
Μανώλη	ma'noli	3		maloli (3)			
Μανώλης	ma'nolis	15	4	malolis (4)	manoli (7)		
μαργαρίτα	maɾɣa'ɾita	2		malalita (2)			
Μαρία	ma'ɾia	7		malia (6)	maia		
μαρμελάδα	maɾme'laða	1		malelaða			
μας	mas	15	15				
μάτι	'mati	1	1				
μάτια	'matça	1		matʃa			

μαύρο	'mavɾo	1		mɒv		
μαύρος	'mavɾos	1		bamos		
μ'αυτό	ma'fto	1		masto		
μ'αφήνει	ma'fini	4	3	afini		
με	me	43	43			
μεγάλες	me'ɣales	1		melales		
μεγάλη	me'ɣali	4	1	melali (3)		
μεγάλο	me'ɣalo	5		melalo (5)		
μεγάλωσα	me'ɣalosa	1		melalosa		
μεγάλωσε	me'ɣalose	2		melalose (2)		
μεγαλώσεις	meɣa'losis	1		melalosis		
μεγαλώσω	meɣa'loso	1		melaloso		
μείνε	'mine	1	1			
μείνεις	'minis	1	1			
μείνουμε	'minume	8	8			
μέλι	'meli	1	1			
μένα	'mena	1	1			
μέρα	'meɾa	2		mela (2)		
μέσα	'mesa	19	17	meʃa	meta	
μέση	'mesi	4	4			
μετά	me'ta	6	6			
μη	mi	16	15	to		
μια	mɲa	6	5	mema		
μία	'mia	3	3			
μικρή	mi'kɾi	3		mitʰi (2)	miti	
μικρό	mi'kɾo	6		mitʰo	mito (5)	
μίλα	'mila	1	1			
μίλησα	'milisa	1	1			
μίλησε	'milise	4	4			
μιλήσεις	mi'lisis	2	2			
μιλήσουμε	mi'lisume	3	1	minisume (2)		
μιλήσω	mi'liso	2	2			
μόνη	'moni	3	3			
μόνο	'mono	2	2			
μου	mu	74	74			
μουσούδα	mu'suða	2		musula (2)		
μπάλα	'bala	6	6			
μπαλόνι	ba'loni	2	1	balolman		
μπαμπά	ba'ba	17	17			
μπαμπάς	ba'bas	10	8	babaç	baba	
μπάνιο	'baɲo	1		paɲo		
μπει	bi	1	1			
μπιστόλα	bi'stola	7	4	s̪tola	mpʰisola	b̥istola

μπλούζα	'bluza	4		buʒɐ	buʤa	buza	puza	
μπογιά	bo'ʝa	1	1					
μπορεί	bo'ɾi	2		boi	boli			
μπορείς	bo'ɾis	2		boi	bolis			
μπορούμε	bo'ɾume	1		boume				
μπορώ	bo'ɾo	9		bolo (7)	polo	b̥oɹo		
μπροστά	bɾo'sta	3		bostami	botsa (2)			
μπω	bo	1	1					
μωβ	mov	1	1					
μωρά	mo'ɾa	1		mola				
μωρό	mo'ɾo	18		molo (18)				
να	na	130	92	a (31)	n	to	ʃa	ta (2)
							ðat	le
ναι	ne:	11	9	ɲe (2)				
Νάσια	'nasça	1		ɲasa				
νάτα	'nata	1	1					
νάτη	'nati	2	2					
νάτην	'natin	1	1					
νάτηνε	'natine	1		naʦine				
νάτος	'natos	3	3					
Ναταλία	nata'lia	1		atalia				
νεράκι	ne'ɾaci	4		nelati (2)	nenati	nelaci		
νερό	ne'ɾo	1		nelo				
Νικόλας	ni'kolas	4	1	nitʰolas	nitʰola	titolas		
νομίζω	no'mizo	1	1					
νούμερα	'numeɾa	2		mumela	nulela			
ξάπλω	'ksaplo	1		tsapo				
ξάπλωσε	'ksaplose	1		tapose				
ξέρεις	'kseɾis	1		tselis				
ξέρω	'kseɾo	7		kselo	ts̪elo	tselo (5)		
ξέχασα	'ksexasa	1		tetasa				
ξέχασες	'ksexases	1		tetases				
οδηγάω	oði'ɣao	1		oiao				
όλες	'oles	1	1					
όλο	'olo	1	1					
όλοι	'oli	9	9					
όμως	'omos	2	2					
όπως	'opos	2	2					
όρεξη	'oɾeksi	1		oletsi				
όρθια	'oɾθia	1		oɹsia				
όταν	'otan	5	4	ota				
ουρά	u'ɾa	1		ua				
ουρανό	uɾa'no	1		ulano				

όχι	'oçi	20	2	oʃi (12)	osi (4)	oʦi	os̺i
οχτώ	o'xto	1		əto			
πάει	'pai	1	1				
παίζαμε	'pezame	1	1				
παίζει	'pezi	2		pezi	tezi		
παίξει	'peksi	1		petsi			
παίξουμε	'peksume	3		petsume	tetsume	pʰetsume	
πάλι	'pali	2	2				
πάμε	'pame	10	10				
πάντα	'pada	1		psada			
πάνω	'pano	8	8				
παπάκι	pa'paci	1		papati			
Πάπη	'papi	4	3	b̥api			
Πάπης	'papis	11	10	bapis			
παπούτσια	pa'puʦça	1		papuʦa			
παππού	pa'pu	2	2				
παρακαλώ	paɾaka'lo	1		patalo			
παραμυθάκι	paɾami'θaci	5		paemisati	pamisati (3)	apamis̺ati	
παραπάνω	paɾa'pano	1		pawapano			
πάρε	'paɾe	4		pale (3)	pʰale		
πάρει	'paɾi	1		pali			
πάρεις	'paɾis	9		palis (7)	pais	bais	
πάρουμε	'paɾume	1		palume			
πάρτα	'paɾta	1		pata			
πάρτηνε	'paɾtine	1		patine			
πάρτο	'paɾto	1		paɹto			
πάρω	'paɾo	6	2	palo (3)	falo		
πάς	pas	2	2				
παστίτσιο	pa'stiʦço	2		paʦiʦo	faʦito		
πάτα	'pata	1		pata			
πατήσεις	'pa'tisis	2	2				
πάω	'pao	5	5				
πειράζει	pi'ɾazi	1		piaz			
πεις	pis	4	4				
πέντε	'pede	2		bede	ped̥		
περάσει	pe'ɾasi	3		pelasi (3)			
περιμένεις	peɾi'menis	2		pelimenis	peimenis		
περιμένουμε	peɾi'menume	1		penenume			
περπατώ	peɾpa'to	1		pepato			
πεταλούδα	peta'luða	1		petalula			
πέταξε	'petakse	1		petatse			
πετάξω	pe'takso	2		petatso (2)			

πεταχτεί	peta'xti	1		petasti		
Πέτρο	'petɾo	1		peto		
πήγα	'piɣa	1		piða		
πηγαίνω	pi'ʝeno	1		pizeno		
πήγαμε	piɣame	1		pijame		
πήγες	'pijes	1		piʒes		
πιάσω	'pçaso	5	2	pʃaso (3)		
πιάτο	'pçato	1		sato		
πιείς	pçis	1		pʃis		
πιο	pço	6	2	pʃo (3)	po	
πιούμε	'pçume	2	1	pʃume		
πίσω	'piso	5	2	piʃo (2)	pi̠so	
πιώ	pço	2	1	pʃo		
ποδαράκια	poða'ɾaca	1		poɹalata		
ποδήλατο	po'ðilato	1		poðiato		
πόδια	'poðʝa	1		poʒa		
ποιό	pço	1	1			
πολλά	po'la	3	3			
πόνεσα	'ponesa	1		poneʃa		
ποπός	po'pos	1	1			
πόρτα	'poɾta	4		pota (4)		
πορτοκαλί	poɾto'kali	1		potali		
που	pu	9	9			
πού	pu	10	10			
πούμε	'pume	1	1			
πράγματα	'pɾaɣmata	1		pamata		
πράσινο	'pɾasino	1		pasino		
πρέπει	'pɾepi	1		pepi		
προκομμένη	pɾoko'meni	1		pokameni		
προκομμένος	pɾoko'menos	4		potomenos (4)		
πρώτα	'pɾota	3		pota (3)		
πώς	pos	2	1	po		
ρθει	ɾθi	8		si (2)	ʃi (6)	
ρθω	ɾθo	2		ʃo (2)		
ρυζάκι	ɾi'zaci	1		izaci		
ρωτάς	ɾo'tas	3		tatas	lodas	lotas
ρωτήσουμε	ɾo'tisume	1		tot^{h}isume		
σαλάτα	sa'lata	5	4	salaka		
σαπούνι	sa'puni	1		ʃapuni		
σας	sas	1	1			
σε	se	4	4			
σελίδα	se'liða	2		selia (2)		

σένα	'sena	2	2					
σηκωθείς	siko'θis	1		sitoʃis				
σηκώσεις	si'kosis	1		sitosi				
σήμερα	'simeɾa	3		simela (3)				
σκαμνί	ska'mni	3		ami	tami (2)			
σκεπάσω	sce'paso	2		tepaso (2)				
σοκολάτα	soko'lata	7		sokolata (6)	ʦatalata			
σου	su	40	40					
Σοφία	so'fia	2		fofia (2)				
σπιτάκι	spi'taci	2		pitati	pitaci			
σπίτι	'spiti	5		piti (5)				
σπρώξεις	'spɾoksis	3		potsis (3)				
Σπυριδούλα	spiɾi'ðula	1		pititula				
στα	sta	2	1	ta				
στ'αγγλικά	stagli'ka	1		tatida				
στη	sti	14	1	ti (4)	ʦi (5)	i (4)		
στην	stin	3		ti (2)	ʦe			
στις	stis	2		tis	s			
στο	sto	38	3	to (9)	o (21)	so (3)	ɣo	ʃo
στόμα	'stoma	1	1					
συ	si	11	11					
σχολείο	sxo'lio	3		ʃolio (2)	solio			
σχολιό	sxo'ʎo	1		ʃojo				
τα	ta	20	18	a (2)				
ταίσεις	ta'isis	2	1	tai:				
τελείωσα	te'liosa	1	1					
τελείωσε	te'liose	4	4					
τελειώσω	te'ʎoso	1	1					
τέσσερα	'teseɾa	2		tesela (2)				
τη	ti	29	26	i (3)				
τηλέφωνο	ti'lefono	3		tiefono (3)				
την	tin	6		ti (6)				
της	tis	19	15	ʦis	ti (3)			
τί	ti	10	10					
τίποτα	'tipota	1	1					
τις	tis	2		ti (2)				
το	to	136	115	o (19)	ʦo	mo		
τον	ton	2	1	to				
τόσο	'toso	1		toʃo				
του	tu	17	17					
τουβλάκια	tu'vlaca	3		tuvata (3)				
τραβήξω	tɾa'vikso	3		tavitso (2)	vitso			
τραπέζι	tɾa'pezi	6		papezi (6)				

τρένο	'treno	3		teno			
τρία	'tria	5		tia (5)			
τρώμε	'trome	2		tome	tʰome		
τρώνε	'trone	1		tʰone			
τρως	tros	1		tos			
τσάι	'ʦai	3	2	sai			
τσάντα	'ʦada	1		ʣada			
τσου	ʦu	2		tʃu (2)			
τσουρέκι	ʦu'reci	2		tʃuluti	tʃuleti		
τώρα	'tora	20	1	tola (16)	tʰola	to	koɹa
φάγαμε	'faɣame	3		falame (3)			
φαγητό	faji'to	1	1				
φάει	'fai	5	5				
φακές	fa'ces	1		fatʰes			
φάμε	'fame	1	1				
φάνε	'fane	1	1				
Φασουλής	fasu'lis	1	1				
φάω	'fao	1	1				
φεγγαράκι	fega'raci	1		fed̪alati			
φέγγε	'feɟe	1		fete			
φέρω	'fero	4		felo (4)			
φίλη	'fili	2	2				
φοβάται	fo'vate	1	1				
φορά	fo'ra	10		fola (10)			
φτάσεις	'ftasis	3	2	taʦis			
φτάσω	'ftaso	1		taʦo			
φτιάξε	'ftçakse	2		taʦe (2)			
φύγει	'fiji	5	3	fiʒ̥i	fiili		
φύγεις	'fijis	2	1	fiʒis			
φύγω	'fiɣo	1		fio			
φυλάξω	fi'lakso	1		filatso			
Φωκίωνα	fo'ciona	1		fotiona			
φωνάζουμε	fo'nazume	1		nazume			
φωνάζω	fo'nazo	1	1				
χαιδέψεις	xai'ðepsis	1		ʦalepsis			
χαιδέψουμε	xai'ðepsume	1		ʃalepsume			
χαιδέψω	xai'ðepso	2		sailepso (2)			
Χάιντι	'xaidi	4		saidi (4)			
χαλάει	xa'lai	1		ʃalazi			
χάλασε	'xalase	2	1	ʃalase			
χαρούμενη	xa'rumeni	1		alumeni			
χαρτάκια	xa'rtaca	1		ʃatata			
χειμώνας	çi'monas	1		ʃimonas			

χεράκι	çe'ɾaci	2		selati (2)		
χέρι	'çeɾi	3		çei	seli (2)	
χέρια	'çeɾja	2		seʒa	seja	
χορέψουμε	xo'ɾepsume	3		ʃolepsume	solepsume	hoepsume
χρώμα	'xɾoma	2		ʃoma (2)		
χτενίσω	xte'niso	1		teniso		
χτύπησα	'xtipisa	1		pipisa		
χωρέσω	xo'ɾeso	1		foleʃo		
χώρο	'xoɾo	1		ʃolo		
ψηλά	psi'la	2	1	ʦila		
ψηλή	psi'li	3	3			
ψιθυρίζω	psiθi'ɾizo	2		piʦiliʣo	piʦilizo	
ψωμάκι	pso'maci	1		psomati		
ωραία	o'ɾea	1		olea		
Total	540	2374	1057			

N.B. Tks: tokens, Cor: the child's correct productions, I: the child's incorrect productions

4.3.2 Whole-word correctness

In table 4.5 below, information is summed on whole-word correctness:

Table 4.5 Types, tokens and whole-word correctness

Whole-word correctness		
	English	**Greek**
Correct / **Types**	127 / **317** = 0.40	181 / **540** = 0.34
Correct / **Tokens**	665 / **1,516** = 0.44	1,057 / **2,374** = 0.45
	0.32	*0.27*

N.B. The numbers in italics denote arithmetic average

Targeted word types and tokens. The child's vocabulary at 2;7 consists of 317 word types in English and 540 word types in Greek, with 1,516 and 2,374 word tokens, respectively. There are 70 function words in English which make up 22% of all word types and 109 function words in Greek, 20% of all word types. Comparing these findings in terms of word types to the vocabulary norms for two-year old (150-300 words) and three-year old (900-1000 words) monolingual English children (e.g. Ingram, 1989a and ref therein; Loraine, 2008), and ignoring sampling effects, it appears that Maria Sofia's vocabulary in English is slightly behind the monolingual standard. Bilingual children are known to reach important milestones within similar age spans to their monolingual peers, including overall rate of vocabulary growth (Pearson, Fernandez, & Oller, 1993). However, when comparing bilingual children's vocabulary to that of monolingual children in each language, the sum of words in both languages rather than per language is compared to that of a monolingual child (e.g. Werker et al., 2009). Thus, Maria Sofia's total of *857* types for both Greek and English in the recorded sessions alone (182 minutes) shows that her vocabulary level is above average compared to the monolinguals'.

Although there are a lot more word types in the child's Greek than in her English, it should be noted that *semantically* different words within each language account for 96% of the English types and 71% of the Greek ones. In other words, the Greek vocabulary appears much richer because of grammatical variance. The child's Greek is more advanced in terms of grammar as a direct corollary of the nature of the language itself being more complex than English. For example, the English definite article, *the*, has twelve (12) translation equivalents in Greek (8 of which are found in the sample of table 4.4) to account for gender, case and number differences. Looking at the general stages of phonological acquisition based on identifiable periods of vocabulary development (e.g. Ingram, 1976b & 1989a; Macken, 1992), it appears that Maria Sofia is in the third intermediate stage of phonological acquisition (the multi-word utterance stage in Ingram, 1989a), or 'the period of greatest phonological development' (Macken & Ferguson, 1987:8), which is also corroborated by her vocabulary counts. Macken (1992) postulated that the third stage begins at 24 months which is two months earlier than MS's first-word combinations in Greek. The child's first word combinations in English are attested at 2;6 which led to the decision of examining her increasing phonological data from recorded sessions at 2;7.

Correct word types and tokens. Quantitative approaches in the acquisition of phonology revealing the extent to which a consonant is adequately proven to be acquired have correctness as their common denominator (e.g. Ingram, 1981c; Stoel-Gammon & Dunn, 1985; Shriberg, Austin, Lewis, McSweeny, & Wilson, 1997). Schmitt, Howard, & Schmitt (1983) suggested that the measure of whole-word accuracy (WWA) would favorably complement other measures such as the proportion of consonants correct (PCC). The WWA measure is used here. Out of the 317 English and 540 Greek word types, 127 and 181 of them respectively are produced correctly. Also, there were a total of 1,516 English and 2,374 Greek tokens out of which 665 and 1,057 of them respectively were produced correctly. At a first glimpse, it is clear that the child at 2;7 already has an estimable command of phonology.

Weighted and arithmetic averages of whole-word correctness. Types and tokens and their correct equivalents in table 4.5 above form part of calculations resulting to whole-word correctness, weighted averages and arithmetic means. The weighted average is given from dividing the correct tokens by their corresponding total tokens. The arithmetic average (or unweighted average) results by calculating the weighted mean for each word type individually and then the sum of these means is divided by the total number of word types. That is, in contrast to the weighted average, the arithmetic average assigns the same weight to all the word types irrespective of the number of targets. When either the number of tokens is the same for all word types or the weighted mean for each word type is the same, the two averages are identical. That's why the two tabulations are identical with regard to the correctness of word types. Both tabulations have been used in the literature (e.g. Ingram, 1981c; Shriberg et al. 1997; Secord & Donohue, 2004). The weighted average of the tokens is 0.44 and 0.45 in English and Greek, respectively, while the arithmetic averages for English (types: 0.40, tokens: 0.32) when compared to those for Greek (types: 0.34, tokens: 0.27) show that the child's whole-word correctness in English is better than in Greek. This may be attributed to the fact that there are more word types in Greek (540) than in English (317). Also, whole-word correctness depends on the complexity of words in each language in terms of the number of syllables and consonant clusters. These will be examined next.

4.3.2.1 Singleton and cluster words

Table 4.6 further breaks down the child's vocabulary in terms of *singleton and cluster words*, whereby, there is at least one consonantal cluster in cluster words and none in singleton words. These results were obtained by separating singleton and cluster words in the Excel file containing all the word types and their correct and incorrect tokens.

Table 4.6 Correctness in singleton and cluster words

	English		**Greek**	
Words	Correct / **Types**	Correct / **Tokens**	Correct / **Types**	Correct / **Tokens**
Singleton	108 / **209** =0.52	635 / **1,232** = 0.52 *0.42*	162 / **356** = 0.46	1,023 / **1,967** = 0.52 *0.38*
Cluster	19 / **108** = 0.18	30 / **284** = 0.11 *0.11*	19 / **184** = 0.10	34 / **407** = 0.08 *0.06*

N.B. The numbers in italics denote arithmetic average

The information here also corroborates that the child's performance in English (both singleton and cluster words) is overall better than in Greek as indicated by the numbers in the table. Here again we note that the 'better' language (English) has less word types in both singleton and cluster words. However, an analysis in terms of monosyllabic and multisyllabic words that follows reveals that the child does not perform better in English independent of the number of word syllables.

4.3.2.2 Monosyllabic and multisyllabic singleton and cluster words

Ingram & Dubasik (2011) and Demuth (2011), among others, have discussed that variable production is also dependent on word length. In table 4.7, the child's whole-word correctness in terms of *monosyllabic words* is presented. These results were obtained by separating the monosyllabic singleton and cluster words from the multisyllabic ones in the created Excel file containing word types, correct and incorrect tokens.

Monosyllabic whole-word correctness is found better in Greek than in English, irrespective of whether the types are singleton or cluster words. This, again, is partly attributed to the fact that there are more monosyllabic word types in English than in Greek containing 27% (56/206) and 65% (37/57) function words, respectively. Moreover, it should be remarked that the English monosyllabic words are in general more complex, in that they involve a larger variety of consonants and consonant clusters than Greek. In coda position (see tables 4.3 and 4.4) the child's Greek only has [-s], [-n], and [-v] in the loanword *μωβ* /mov/, while her English has [-p], [-ps], [-b], [-v], [-vd], [-t], [-ts], [-nt], [-d], [-m], [-n], [-nz], [-nt], [-nd], [-ndz], [-s], [-ʃ], [-st], [-z], [-ʧ], [-ʤ], [-ɫ], [-ɫp] [-ɫd], [-ɫz], [-ɫk], [-ɹ], [-ɹt], [-ɹz], [-ɹst], [-ɹʧ], [-ɹɫ] [-ɹk], [-k], [-ks], [-g], [-gz]; in the Greek language, consonant clusters do not exist in coda position.

Table 4.7 Correctness in monosyllabic singleton and cluster words

	English		**Greek**	
Words	Correct/**Types**	Correct/**Tokens**	Correct/**Types**	Correct/**Tokens**
Monosyllabic all	89 / **206** =0.43	559 / **1,214** = 0.46 *0.33*	38 / **57** = 0.67	559 / **897** = 0.62 *0.51*
Monosyllabic singletons	73 / **138** =0.53	532 / **1,032** = 0.52 *0.41*	31 / **41** = 0.76	545 / **807** = 0.68 *0.63*
Monosyllabic clusters	16 / **68** = 0.24	27 / **182** = 0.15 *0.15*	7 / **16** = 0.44	14 / **90** = 0.16 *0.21*

N.B. The numbers in italics denote arithmetic average

The child's correctness of multisyllabic words is given in table 4.8. We observe that multisyllabic words are produced slightly more correctly in English than in Greek contrary to monosyllabic words. Once more, there are more word types in Greek than in English. However, Greek multisyllabic words with clusters are produced slightly more correctly than their English counterpart, even though there are many more types. This may be attributed to the fact that in the child's English, but not her Greek, there are consonant clusters in coda positions, [-ts], [-st], [-nt], [-nd], [-nz], [-ɹpl̩], [-ɹz], [-ʃt], that most often are not produced correctly, as will be discussed below. English is better than Greek in multisyllabic words because they consist of three times less three-or-more syllable words in English (34/302=11% in tokens, 20/111=18% in types) than in Greek (446/1477=30% in tokens, 246/483=51% in types) and the two-syllable words are produced more correctly than the three-or-more syllable words in both languages. The two syllable words in English are 37% (99/268) correct in tokens and 35% (32/91) correct in types while the three-or-more syllable words are 21% (7/34) correct in tokens and 30% (6/20) correct in types. In Greek, the two-syllable words are 39% (407/1033) correct in tokens and 39% (95/243) correct in types while the three-or-more syllable words are 20% (87/446) correct in tokens and 20% (48/246) correct in types.

Table 4.8 Multisyllabic singleton and cluster words

	English		Greek	
Words	Correct / **Types**	Correct / **Tokens**	Correct / **Types**	Correct / **Tokens**
Multisyllabic all	38 / **111** = 0.34	106 / **302** = 0.35 *0.30*	143 / **483** = 0.30	498 / **1,477** = 0.34 *0.24*
Multisyllabic singletons	35 / **71** = 0.49	103 / **200** = 0.52 *0.44*	131 / **315** = 0.42	478 / **1,160** = 0.41 *0.34*
Multisyllabic clusters	3 / **40** = 0.075	3 / **102** = 0.03 *0.05*	12 / **168** = 0.07	20 / **317** = 0.06 *0.05*

N.B. The numbers in italics denote arithmetic average

Conclusively monosyllabic words are produced much more correctly than multisyllabic words in each language and, since there is a much smaller proportion of monosyllabic word types in Greek (11%=57/540) than in English (65%=206/317), English is better in the whole-word correctness. Furthermore, Greek is more correct in monosyllabic singleton and cluster words because of less complex and fewer word types while English is ahead in multisyllabic words because of fewer three-or-more syllable words.

The difference in the child's speech performance between the two languages as described above is strong evidence of the child's ability to differentiate the two languages. The English and Greek languages, besides being stress timed and syllable timed, respectively, resulting in a larger proportion of consonants to vowels in spoken English than in spoken Greek as is the case for other languages of such nature (e.g. Nespor et al., 2003), have other important differences as well. Greek is more complex grammatically than English in terms of gender, case, number, verb conjugation, etc; moreover, there are different phonotactic restrictions in the two languages: most words in Greek are bisyllabic or multisyllabic (Setatos, 1974) which is not the case in spoken English especially in child speech; there are language specific consonants which were shown in table 4.1a; in Greek, only the consonants *s* and *n* are permitted at word-final position except in loanwords where other consonants are also permitted (Setatos, 1974); the consonant clusters that are permitted in English and Greek may be found among others in Kenstowicz (1994) and PAL (1995), where it may be seen that

Greek, contrary to English, does not permit any word final consonant clusters except in loanwords; other phonotactic rules on singleton consonants and consonant clusters in Greek were given in section 4.1. The aforementioned differences between the two languages are present in Maria Sofia's speech at age 2;7, as seen in the results of this chapter, and they become more pronounced qualitatively and quantitatively, thereafter.

4.4 Early phonetic repertoire in the two languages

This section evaluates the child's level of consonant acquisition at 2;7 in terms of the universal order in the acquisition of phonology (Jakobson, 1941/1968) and of successive feature contrasts (e.g. Ervin & Miller, 1963; Dinnsen, 1992) (see §2.4.4.1). Her substitution patterns are also presented and discussed. The child's phonetic inventory is compared with normative data of monolingual children in each language. This is done qualitatively as well as quantitatively to establish universal and individual variation patterns in this child's acquisition of consonants and to pinpoint differences between the two languages both on a qualitative and a quantitative basis.

Here, Maria Sofia's early consonant inventories in the two languages at 2;7 will be discussed in detail. The full consonant portraits are provided in tables 4.9 and 4.10 for English and Greek, respectively, which are made from the data provided in tables 4.3 and 4.4, respectively. Each portrait lists the full phonetic inventory in the language and shows the child's consonantal use in exact proportions with regard to correctness, deletions, as well as, specific substitutions used by the child. Column A is titled *target* since it lists the target consonants, while Row 1 is titled *realization* since it contains the realized consonants (correct in context, substitutions and deletions) corresponding to each target consonant. Therefore, the proportions in each row add up to 1 shown in column AL. The numbers in bold in the portraits' diagonal are the proportions of correct in context consonant productions. The consonants of both languages are included in each portrait in order to depict transfer/interference instances. That's why, when there is no target, the corresponding cell in the diagonal is empty. Also, the cells that correspond to a zero substitution or deletion are left empty to ease reading of the portraits. However, proportions in the portraits are shown in two decimal places resulting in cells showing zeros when the proportion is smaller than 0.005. A discussion on the contents of the two portraits follows.

Table 4.9. The child's English consonant portrait

[C]//C/	p	b	m	f	v	θ	Ð	t	d	s	z	ts	dz	n	l	ʎ	ɾ	ɹ	ʃ	ʒ	tʃ	dʒ	ɲ	j	c	ɟ	ç	k	g	x	ɫ	ŋ	w	h	vcl	Ø
p	**0.95**	0.03						0.01																												0.01
b	0.03	**0.93**	0.01		0.03																															0.01
m			**0.95**																																0.00	0.05
f	0.02			**0.77**	0.02					0.06									0.04																	0.09
v			0.07		**0.36**																															0.57
θ				0.08		**0.00**		0.17		0.33									0.42																	
ð					0.03		**0.14**	0.05	0.01		0.01	0.03		0.08	0.25			0.01					0.01	0.01										0.01		0.36
t								**0.83**	0.02	0.02		0.01							0.00																	0.12
d								0.22	**0.69**		0.01																									0.09
s				0.01				0.03		**0.87**	0.02	0.01							0.02								0.00			0.01				0.00		0.03
z										0.29	**0.66**			0.01																						0.04
n			0.01						0.00					**0.78**	0.01								0.00													0.19
l			0.01		0.01					0.01				0.01	**0.47**									0.02												0.47
ɹ		0.01			0.10									0.01	0.26		0.01	**0.05**													0.02		0.01			0.55
ʃ										0.21	0.07	0.07							**0.50**																	0.14
tʃ										0.38		0.06									**0.56**															
dʒ											0.09	0.18	0.18									**0.55**														
j							0.01	0.01		0.01	0.04			0.02	0.12	0.01			0.03	0.13		0.03	0.04	**0.52**	0.01											0.03
k	0.01				0.01			0.86	0.02			0.03									0.01							**0.03**								0.03
g								0.21	0.65	0.01			0.03									0.03				0.05			**0.00**							0.03
ɫ															0.17																**0.33**				0.24	0.26
ŋ														0.53																		**0.23**				0.23
w		0.03	0.01		0.57					0.03				0.01	0.07																		**0.15**		0.04	0.08
h				0.02						0.37		0.05							0.46															**0.07**		0.02

Table 4.10. The child's Greek consonant portrait

[C]//C/	p	b	m	f	v	θ	ð	t	d	s	z	ts	dz	n	l	ʎ	ɾ	ɹ	ʃ	ʒ	tʃ	dʒ	ɲ	j	c	ɟ	ç	k	g	x	ɣ	ɫ	w	h	Ø
p	**0.96**	0.01	0.00	0.01				0.01																											0.00
b	0.05	**0.94**																																	0.01
m	0.00	0.00	**0.98**					0.00						0.00	0.01																				0.00
f				**0.69**		0.01				0.20									0.01																0.09
v			0.02	0.03	**0.92**			0.02							0.02																				
θ			0.01	0.01		**0.04**		0.09		0.27	0.01	0.01							0.45					0.01			0.01								0.10
ð			0.02		0.05		**0.05**	0.07	0.01		0.01	0.01		0.01	0.40	0.01			0.01	0.01			0.01	0.02								0.01			0.31
t	0.01		0.00				0.00	**0.85**	0.00	0.02		0.01																0.01			0.00				0.10
d									**1.00**																										
s				0.00				0.02		**0.81**	0.00	0.01							0.02								0.00								0.14
z					0.02						**0.78**		0.02							0.09		0.02		0.04											0.02
ts								0.05		0.02		**0.68**	0.02								0.20														0.02
n			0.00				0.00	0.02		0.00				**0.84**	0.02				0.00				0.01												0.11
l	0.00													0.02	**0.83**									0.00								0.01			0.14
ʎ															0.23	**0.15**				0.08				0.54											
ɾ	0.00							0.01	0.00					0.01	0.46		**0.01**	0.01														0.00	0.00		0.49
ɲ																							**0.90**												0.10
j								0.21			0.03				0.16					0.14				**0.29**				0.01							0.16
c	0.11		0.01					0.82	0.01			0.01		0.01											**0.04**	0.01									0.01
ɟ								1.00																		**0.00**									
ç										0.27		0.02							0.41								**0.16**								0.14
k	0.03							0.90	0.02			0.01					0.00											**0.04**							0.01
g								0.08	0.33													0.50							**0.08**						
x	0.03			0.03				0.05		0.23		0.03							0.38											**0.03**				0.03	0.23
ɣ	0.01				0.05		0.01								0.52	0.03				0.01				0.05							**0.06**				0.25

4.4.1 Consonant correctness

The proportion of in context correct productions of consonants is given by the diagonal cells of tables 4.9 and 4.10 for English and Greek, respectively. However, it is important to also show the number of tokens (targets) for each consonant as well as the number of word types containing the consonant. This was calculated by creating an Excel file for each consonant where each word type occupies a row with the number of targets, correct tokens and substitution tokens, occupying separate cells. This way, both the weighted and the arithmetic averages may be obtained. In table 4.11, the number of consonant targets cumulatively for all the words, the number of word types and the weighted (W) and arithmetic (A) averages of correct productions to targets are listed for each consonant in the two languages to complement the content of the two portraits, tables 4.9 and 4.10.

It is observed that when the consonant's sample size is relatively small (less than 30 targets or less than 10 word types) and its acquisition rate is neither too large (greater than 90%) nor too small (less than 10%), the weighted and arithmetic averages differ significantly (more than 10%); see English /v, ʃ, ʤ, j, ŋ/ (except /ʧ/) and Greek [ʎ]. The performance of consonants with respect to word position is presented in table 4.13 and discussed following it. For all other consonants, except English /s/, the two averages yield similar results. Moreover, there are common consonants in the two languages which are produced in significantly different correct proportions (larger than 10%); see /v, d, z, l/. This will be explained following table 4.13 where consonant errors are analyzed with respect to word positions, singletons and clusters.

In the child's 540 Greek word types with 2,374 tokens, there are 4,551 vowels yielding 50% (4,551/9,172) proportion of vowels (PV). In her 317 English word types with 1,516 tokens, there are 2,262 vowels giving a PV equal to 43% (2,262/5,206). Syllable timed languages (like Greek) have a simpler syllabic structure and longer words than stress timed languages (like English) which have more monosyllabic words and a rich syllabic structure, thus, the proportion of consonants to vowels is larger in stress timed languages (Nespor, Peña & Mehler, 2003). This is also the case in Maria Sofia's speech at 2;7.

Table 4.11 Consonant targets, word types and correct productions

Consonant Targets			Word types		Correct proportions			
Labial	English	Greek	English	Greek	English		Greek	
					W	A	W	A
/p/	121	291	35	109	95%	95%	96%	96%
/b/	156	99	41	19	93%	91%	94%	95%
/m/	203	549	37	118	95%	89%	98%	96%
/f/	47	109	25	50	77%	73%	69%	74%
/v/	14	64	6	38	36%	54%	92%	93%
Coronal								
/θ/	12	184	7	28	0%	0%	4%	2%
/ð/	111	175	11	40	14%	17%	5%	14%
/t/	328	583	81	124	83%	81%	85%	90%
/d/	172	17	44	8	69%	73%	100%	100%
/s/	326	662	71	208	87%	76%	81%	85%
/z/	163	46	34	21	66%	63%	78%	74%
/ʦ/	n/a	41	n/a	17	n/a	n/a	68%	63%
/ʣ/	n/a	0	n/a	0	n/a	n/a	-	-
/n/	311	423	64	99	78%	83%	84%	88%
/l/	144	328	48	124	47%	51%	83%	75%
/ɾ/	n/a	346	n/a	140	n/a	n/a	1%	1%
/ɹ/	196	n/a	71	n/a	5%	6%	n/a	n/a
/ʃ/	14	n/a	7	n/a	50%	61%	n/a	n/a
/ʒ/	0	n/a	0	n/a	-	-	n/a	n/a
/ʧ/	16	n/a	6	n/a	56%	51%	n/a	n/a
/ʤ/	11	n/a	3	n/a	55%	40%	n/a	n/a
Palatal								
[ɲ]	n/a	10	n/a	4	n/a	n/a	90%	96%
[ʎ]	n/a	13	n/a	6	n/a	n/a	15%	25%
/j/	156	n/a	8	n/a	52%	32%	n/a	n/a
[c]	n/a	171	n/a	49	n/a	n/a	4%	5%
[ɟ]	n/a	1	n/a	1	n/a	n/a	0%	0%
[ç]	n/a	63	n/a	22	n/a	n/a	16%	14%
[ʝ]	n/a	76	n/a	30	n/a	n/a	29%	34%
Velar								
/k/	174	239	57	107	3%	3%	4%	6%
/g/	80	12	22	6	0%	0%	8%	2%
[ɫ]	46	n/a	17	n/a	33%	30%	n/a	n/a
/ŋ/	30	n/a	16	n/a	23%	34%	n/a	n/a
/x/	n/a	40	n/a	25	n/a	n/a	3%	2%
/ɣ/	n/a	79	n/a	38	n/a	n/a	6%	4%
/w/	72	n/a	23	n/a	15%	16%	n/a	n/a
Glottal								
/h/	41	n/a	14	n/a	7%	12%	n/a	n/a
N.B. W denotes weighted average, A denotes arithmetic average								

4.4.2 Cumulative consonant correctness and PMLU

Cumulatively for all consonants, the weighted average of correctness is calculated from table 4.11 to be 60% (1755/2944) in English and 62% (2874/4621) in Greek; their arithmetic averages respectively are: 47% in English and 49% in Greek. The proportion of consonants correct (PCC), as defined by Shriberg et al. (1997), that is, computing the correctness proportion of all consonants for each word type and then averaging them arithmetically, yields similar results to the weighted average: 58% (182.37/317) for English and 61% (329.4/540) in Greek. Therefore, Greek is slightly better than English in consonants correctness but not in word correctness, as word length in Greek is larger than in English containing more consonants. It is worth comparing the performance of consonants, common in the two languages: /p, b, m, f, v, t, d, n, s, z, θ, ð, l, k, g/. Their cumulative correctness in English is 68% (1607/2362) lower than the 74% (2786/3781) in Greek.

Ingram & Ingram (2001) and Ingram (2002) introduced the phonological mean length of utterance (PMLU) measure to differentiate performance on word length by counting correct in-context consonants twice and all other produced consonants and vowels once. Maria Sofia's targeted average PMLU is computed as 5.38 in English and 5.81 in Greek showing that Greek words are more difficult to produce. Her performed average PMLU is calculated to be 4.3 and 4.82 in English and Greek, respectively. The phonological word proximity (PWP), which was also defined by the same authors as being equal to performed PMLU divided by targeted PMLU, is about the same in Maria Sofia's two languages; 80% in English and 83% in Greek.

4.4.3 Level of consonant acquisition

In table 4.12 below, the consonants for the two languages are grouped according to the level of acquisition. The level is taken as the in-context correct productions in proportion to the consonant targets, that is, as the weighted average of correctness. Similar to the gradient classification for the acquisition of segments at any certain point in time that was proposed by Ingram (1981c), 'used', 'frequent', 'infrequent' and 'not-used', the following terms are utilized here: 'completely acquired' referring to those segments produced correctly in context at 90% and over; 'very frequent' referring to correct production between 75% and 89%; 'frequent' for segments produced correctly between 50% and 74%; 'not acquired' for those segments produced correctly between 1% and 49%; and 'not-used' for 0% production rate. Previous approaches in phonology have set the 70% (e.g. Ingram et al., 1980) and 75% correct use of a structure in obligatory environments (e.g. Diedrich & Bangert, 1980; Olswang & Bain, 1985; PAL, 1995, Kappa, in press) as criterions of adequate performance. The criterion of 90% correct use of consonants has also been utilized in developmental phonology (e.g. Smit et al., 1990; PAL, 1995). The more rigid criterion of 100% correct use of a structure in obligatory environments was employed by Stemberger (1992b).

Table 4.12 Correct productions of segments at 2;7

	English	Greek
completely acquired: ≥90%	p, b, m	p, b, m, v, d, ɲ
very frequent: 75% - 89%	f, t, s, n	t, s, z, n, l
frequent: 50% - 74%	d, z, ʃ, ʧ, ʤ, j	f, ʦ
not acquired: 1% - 49%	v, ð, l, ɹ, ɫ, ŋ, k, w, h	θ, ð, ɾ, ʎ, c, ç, ʝ, k, g, x, γ
not used in context: 0%	θ, g	ɟ
no targets	ʒ	ʣ

It is noted here that if the acquisition level was defined by the arithmetic average of correct consonant productions instead of the weighted average, English v, l and Greek t, z would move up one category, while English m, f, ʤ, j would move down one category. In what follows a detailed discussion will be made according to the level of acquisition.

4.4.3.1 Completely acquired consonants

The consonants that are ‘completely acquired’ in both languages at 2;7 are the labial stops: /p/, /b/ and /m/. Their presence in this category manifests acquisition of the /Labial, oral:nasal/ contrast as the first requisite opposition in the acquisition of the ‘minimal consonantal system’ (MCS) defined by Jakobson (1941/1968) referring to the onset of speech and the order of phoneme appearance. Maria Sofia’s acquisition level of /p, b, m/ in both English and Greek at 2;7 is similar to that of the respective monolingual children’s average, since normative data in both languages indicate 90% acquisition of /p, b, m/ by age 3;0 (e.g. Smit et al., 1990; PAL, 1995). All normative data references, hereon, are from these two studies unless stated otherwise. In terms of the first maximal binary contrasts i.e. VOICELESS < VOICED and STOP < CONTINUANT (Jakobson, 1941/1968; Dresler, 1998), where the symbol < means *acquired earlier than*, only /b/, that is, [Labial, -continuant +voice] has been acquired in both languages, at 93% in English and 94% in Greek.

‘Typically developing children will often acquire […] place distinctions before any voice distinctions’ (Ingram & Ingram, 2001:276). Here, it is found that the second requisite opposition in the MCS, that between labial and coronal stop, is also completely acquired in Greek /b:d/ but not in English. Greek /d/ is produced correctly in all attempted instances at 100% while in English at about 70%. Additionally, 92% production of Greek /v/ is evidence that the contrast [Labial, +voice +continuant] is also completely acquired in the language, in agreement with the universal order of phonological acquisition, whereby [Labial, -continuant -voice] < [Labial, +voice -continuant] < [Labial, +voice +continuant] (Jakobson, 1941/1968), where the symbol < means *acquired earlier than*. Complete acquisition of Greek /v/, as opposed to about 45% acquisition of English /v/ shows again an advance in the Greek language that parallels that of respective normative data in the two languages. The voiced labial fricative is generally acquired earlier by monolingual Greek children than by monolingual English: between 3;0-3;6 in Greek and after 4;6 in English. The above differences will be clarified below when they are examined in the context of word position and clusters.

Lastly in this category of complete acquisition, the presence of the palatal nasal, [ɲ], in Maria Sofia is one more indication that the Greek language leads the way on the acquisition of unary contrasts in that this nasal articulation, produced laminally rather than apically, is the first [Dorsal, -back] articulation in this category mastered at the 90% production border. This ability to consistently articulate a sound that is behind the alveolar ridge, evidenced in this category only in Greek, validates the implicational law of $\text{FRONT}_p < \text{BACK}_p$ and, more specifically, [Labial] < [Coronal] < [Dorsal] (Jakobson, 1941/1968), where the symbol < means *acquired earlier than*. In the post-Jakobson era, there is no unanimous agreement on a universal [place] markedness hierarchy with a number of other propositions being made in the literature: Dorsal >> Labial >> Coronal (cf. Prince & Smolensky 1993) and Labial, Dorsal >> Coronal (Kiparsky, 1994), where the symbol >> means *more marked than*. Specifically for Greek, a place markedness hierarchy has been proposed by Malikouti-Drachman (2001a): Coronals << Dorsals << Labials, where the symbol << means *less marked*. Overall, there are exceptions based on variation across children with labial or dorsal being the default PoA and fricative being the default MoA (e.g. Bernhardt & Stemberger, 1998). Frequent production of the Greek palatal nasal by Maria Sofia matches previous findings in the literature of early acquisition of Greek palatal allophone [ɲ] by age 2;6 (Thomadaki & Magoula, 1998). At this stage in the analysis, it is claimed that only initial unary and binary oppositions in the MCS, as outlined in §2.4.4.1 (Jakobson, 1941/1968; Ervin & Miller, 1963), have been completely acquired in English and that, despite the slight advance in Greek, the child's phonological system in both languages is still in the beginning of the third intermediate stage of phonological acquisition.

4.4.3.2 Very frequent consonants

The /Labial:Coronal/ contrast with regard to stops in the MCS is established in this category with the production of /t/ at 83% in English and 85% in Greek, showing roughly the same productive distribution in both languages. Normative data in both Greek and English show complete acquisition (≥90%) of /t/ rather late between 3;6-4;0. The coronal stop /t/ is the default (Archangeli, 1984; Bernhardt & Stemberger, 1998) in phonological development and being underspecified for [place], it adopts features spreading from other consonants in the word, as in the case of consonantal harmony (CH) (e.g. Stemberger & Stoel-Gammon, 1991; Fikkert, 2007; Menn, 1978). The /Labial:Coronal/ contrast is extended in this category to include the [+continuant] feature in the case of /s/ in both languages with a precedence of English /s/ at 87% over Greek /s/ at 81%. Interestingly, the arithmetic average of English /s/ drops to 74% while that of Greek /s/ goes up to 85%.

The Greek language's advance in terms of the [Coronal, +continuant] feature is further substantiated by the presence in this category of its voiced alternative, since Greek /z/ is produced correctly at 78% while English /z/ at 66%. This more marked combination of [Coronal, +voice +continuant] in Greek /z/ mirrors the better performance of Greek /v/ in [Labial] as mentioned earlier. Comparison of the acquisition of /z/ in the two languages mirrors in reverse the earlier discussion on /s/ with regard to normative data. At the 90% criterion, monolingual Greek children's /z/ is acquired between 4;0 and 4;6 (PAL, 1995) whereas that of monolingual English well after 5;0 at the 75% criterion (Smit et al., 1990). The difficulty of English /z/ in monolingual phonological development has been discussed in detail by Ingram et al. (1980). Lastly, English /f/ is included in this category at 77% correct production, though Greek /f/ at 69% is not considered to be significantly far behind; when their arithmetic averages are compared they are at the same level. /f/ is acquired by monolingual children in each language between 3;6 and 4;0 at the 90% criterion. In the English language, generally, /f/ is acquired before /s/ (e.g. Templin, 1957; Moskowitz, 1971) although the opposite is also possible (Bernhardt & Stemberger, 1998). Both [f] and [s] have been found in the 50- word inventories of English speaking children (e.g. Ingram, 1981c; Stoel-Gammon, 1985).

Following acquisition of these first contrasts in the 'chain of successive acquisitions' (Jakobson & Halle, 1956:54), the /Coronal, oral:nasal/ contrast, i.e. /t:n/ is also evidenced in this category in both languages, as English /n/ is produced at 78% and Greek /n/ at 84%. These averages, by and large, agree with findings on normative data, whereby the /Coronal, oral:nasal/ contrast is acquired earlier in Greek (by 2;6) than in English (by 3;0) at the 90% criterion. Following the sonorant stops distinction, /m/ < /n/, the nasals < liquids contrast (Jakobson, 1941/1968) is also validated by Maria Sofia's acquisition of Greek /l/ at an 83% lead before English clear /l/ at 46% production. This discrepancy ties in with differences between the languages in normative acquisition data, as Greek /l/ is acquired by 4;0 while English clear /l/ by 5;0 (girls).

4.4.3.3 Frequent consonants

The presence of the nasals < liquids contrast is concurrent with the general sonorants < obstruents contrast. Jakobson & Halle (1956:56) have postulated that continuants and affricates appear in child language after the first liquid, that being predominantly the lateral (e.g. Smith, 1973). Quantitative support of lateral < affricate is evidenced in Maria Sofia's productive distribution of the Greek affricate /ʦ/ at 68% in this category. Magoula (2000) ommits /ʦ/ from the phonetic inventory of Greek children between the ages of 1;5-2;6, but PAL (1995) reports 50% correctness of the voiceless affricate by age 2;6 which is close to the data produced by this child. Overall, normative data testify late acquisition of the voiceless alveolar affricate, that is, by 4;6-5;0 at the 75% criterion and after 6 at the 90% criterion.

Phonological theory with regard to the phonological status of the affricate is controversial. For a comprehensive review and analysis, a summary of which is provided here, see Kappa (1998). Jakobson, Fant & Halle (1951), among others, view affricates as single stop segments, characterized by the feature [strident]. Modern Greek affricates have also been claimed to have unary nature (e.g. Householder, 1964; Malikouti, 1970; Kappa, 1998). Arguments that favor a parallelism between affricates and clusters have also been made (e.g. Newton, 1961; Setatos, 1974; Greenberg, 1978). Overall, there are two levels of representation for an affricate: one on the skeletal tier whereby the affricate has a single node, C, (Clements & Keyser, 1983) and another one, on the melodic tier, whereby the affricate is represented in terms of features. As a contour segment, the representation of the affricate on the melodic tier is one that has two ordered articulations in a sequence of [-cont] followed by [+cont] (Sagey, 1986); the [cont] feature is binary. As a complex segment, the affricate has two unordered features, [-cont] and [+cont] that are single-valued, represented at two different tiers and can either be present or absent (Lombardi, 1990).

To date, research on phonological acquisition with regard to affricates has been similarly controversial. Based on evidence from German and Spanish children, Lleó & Prinz (1997) have claimed that there is a parallelism between the acquisition of affricates and that of clusters which is guided by directionality of syllable structure assignment. On the other hand, Kappa (1998) has shown that this is not the case for Modern Greek: during acquisition of Greek affricates, reduction results on the melodic tier follow an OT markedness proposition that favors the [stop] over the [continuant] in the early stages. It is argued in the study that this is contrary to the known pattern of syllable structure assignment in Greek, that is from right to left (e.g. Drachman, 1990), thus, demonstrating the single-segment nature of Greek affricates. On the same line, Tzakosta & Vis (2009) have shown that Greek affricates, unlike [stop+s] and [s+stop] clusters tend to show a limited degree of decomposition which is the result of different phonological representations.

Although a thorough discussion of this theoretical controversy is beyond the scope of this thesis, Maria Sofia's data provide evidence that is in support of the unary but complex nature of her voiceless affricate, [ʦ], on both the skeletal and the melodic tiers. This evidence comes from her use of [ʦ] as a substitution for /t, s, ð, k/ in her Greek and English and as substitution for /θ/, [c], /x/, [ç] in Greek, as well as /ʃ, h/ in her English, as may be seen in tables 4.9 and 4.10. In any case, the use of affricates as substitutions for single segments has been previously reported in the literature (e.g. Bernhardt & Stemberger, 1998) which suggests that a more universal claim may be made that supports the proposition of affricates as single segments rather than as a sequence of clusters.

Frequent productions of English-specific consonants are evidenced in post-alveolars /ʃ, ʧ, ʤ/ and the palatal glide /j/. Obstruents /ʃ/, /ʧ/ and /ʤ/ are produced at 50%, 56% and 55% respectively. The sonorants < obstruents contrast is also supported with regard to the lateral < fricative/affricate in this child's English as English /l/ has been acquired at the near rate of 46%. Normative data at the lenient 75% criterion report acquisition of /ʃ/ and /ʧ/ by girls as late as age 4;0 and of [ʤ] as late as 4;6. Ingram et al. (1980) report a bladed rather than clearly apical articulation at initial stages in the development of word-initial /s/. Bernhardt & Stemberger (1998) also refer to backing of alveolars, e.g. /s/→[ʃ] as a developmental pattern. As will be shown in the analysis of the consonantal substitutions, the child shows similar patterns of bladed realizations at this stage in her phonological development. If not just in terms of articulatory skill, [Coronal, -anterior] seems contrastive.

The English approximant /j/ at 52% is in this category, although its arithmetic average of 32% would make it drop to the category below where the Greek [ʝ] at 29% (arithmetic average 34%) also belongs. Monolingual normative data show English /j/ to be 90% acquired by age 3;6, whereas acquisition of Greek [ʝ] delays somewhat between ages 3;6-4;0. These two sounds are phonetically largely similar. A parenthesis will be made here to clarify 'largely similar'. Although English /j/ is a phoneme and Greek [ʝ] is an allophone of /γ/ (see §4.2.1), their phonetic substance only differs with respect to [consonantal], meaning that in the case of the approximant there is wider constriction in the oral cavity allowing air to flow uninterruptedly whereas, in the case of consonantal [ʝ] the constriction is narrower creating some turbulence. In essence, their articulatory and acoustic difference is slight and it can only be accounted in terms of intensity of friction. In phonological development, glides are treated as consonantal sounds (e.g. Smith, 1973). Bernhardt & Stemberger (1998) report [ʝ] (and [ʒ]) as one of the substitution patterns of developing /j/. This may be additional proof of the phonetic similarity between /j/ and [ʝ] in development.

4.4.3.4 Consonants that are not acquired

English /l/ and /v/, fall in this category when weighted average is used but when arithmetic average is used they move one category up, still below their performance in Greek as discussed above. The presence of the interdental fricatives in this category of 'not acquired' segments is not surprising as the interdental fricatives are marked sounds and are generally acquired late cross-linguistically (e.g. Ingram et al, 1980; Smit et al., 1990, PAL, 1995; McLeod (2007), although faster in Greek than in English (e.g. Ingram, 2009). Discussions on the acquisition of fricatives in Greek are given by Kappa (2000) and Tzakosta (2001a). Maria Sofia produces English /ð/ at 14% and Greek /ð/ at 5% but the difference between the languages minimizes when the arithmetic averages are considered, again showing better performance in English (17%) than in Greek (14%). Early instances of /ð/ production are reported at 2;3 for Greek (Magoula, 2000), at 2;4 for bilingual English (Leopold, 1949) and 2;10 (Schnitzer & Krasinksi, 1994; 1996) for bilingual Spanish at 1;10 (Schnitzer & Krasinksi, 1996) and 3;2 (Schnitzer & Krasinksi, 1994) also depending on individual variation. Maria Sofia's production of the voiceless interdental fricative, /θ/, behaves differently, produced marginally in Greek at 4% but not attempted in English at all. Magoula (2000) reports no instances of /θ/ production in Greek children by age 2;6. Normative data report age of /θ/ acquisition at the 75% level between ages 3;0-3;6 in Greek and by 5;6 in English.

English /ɹ/ and Greek /ɾ/ at the small proportions of 5% and 1% respectively are also anticipated in this category in both languages based on Dinnsen's (1992) generative model of feature development, whereby liquids are divided in the final stages of development (level 5) into [+lateral] for /l/ and [+central] for the rhotics, the latter being the more marked feature. The English rhotic approximant, /ɹ/, is acquired late by age 6;0 at the 75% criterion and by age 8;0 at the 90% criterion, while the Greek central liquid is acquired between 5;6-6;0 at the 75% criterion and after age 6;0 at the 90% criterion. First instances of /ɾ/ in Greek are reported as early as 2;3-2;6 (Magoula, 2000) which is in agreement with Maria Sofia's low [ɾ] production at 2;7. Finally, among their common segments in this category, the velar stop /k/ in both languages is produced marginally at 3% and 4% in English and Greek, respectively while /g/ only in Greek at 8%; there is no instance of a produced voiced velar stop in English. Maria Sofia's lack of skill in [Dorsal, +back] provides an example of individual variation in this child since normative data report early acquisition of velar stops at the 75% criterion by age 2;6 in Greek and by age 3;0 in English. Schnitzer & Krasinksi (1996) also report early bilingual acquisition of /k/ in both English and Spanish by 1;7 and 1;1, respectively.

Among the remaining dorsal productions included in this category of not acquired consonants, the following can be said per language. The English velar nasal is produced correctly at 23% by Maria Sofia. Normative data show late acquisition for this segment by age 5;6 at the 75% criterion. The dark lateral, despite its velarized articulation, is produced at 33% by Maria Sofia this month, an estimable proportion if one considers that [ɫ] is a marked sound acquired as late as between 6;0 and 7;0 by monolingual English children. On the other hand, normative data report early acquisition of the velar glide by age 3;0, while Maria Sofia shows little progress, producing it correctly at a low 15% during this month. Lastly, the English glottal fricative is produced at a marginal 7%, one more indication of delay in the acquisition of [+back] in this child. In Greek, low productions of velar continuants at 3% for /x/ and 6% for /γ/ match the small productions of the stops in both languages. Though not completely acquired, [Dorsal, +back +continuant] is also contrastive in this child at the age of 2;7.

The Greek palatal stops exhibit an overall comparable performance to that of the velar stops in both languages, with [c] produced at 4% and [ɟ] never produced in context, equivalently to English /g/. Both allophonic palatal fricatives have a better productive distribution than their stop counterparts: [ç] at 16% and [ʝ] at 29% which agrees with previous evidence that the 'terminal' (non-privative articulator node) feature, [+continuant], is sometimes the default exception in development (e.g. Bernhardt & Stemberger, 1998). The Greek palatal lateral [ʎ] also performs better than the stops at 15% production. Greek normative data report both early acquisition of this sound by age 2;6 (Thomadaki & Magoula, 1998) as well as late acquisition i.e. after age 4 at the 75% criterion (PAL, 1995).

Maria Sofia's slow correctness rate of [ʎ] at 2;7 may be part of the more general pattern of difficulty she has with dorsal sounds. Her slow acquisition of [ʎ] is explained by her general lack of articulatory skill in the [Dorsal, +back] feature. Following the 75% criterion in both languages, English /j/ is reported acquired by age 3;6, There is very limited normative data for Greek palatals, as will be shown in table 4.15. Only [c] can be compared for which Maria Sofia is behind the monolingual norm.

Overall, however, and contrary to the [place] markedness divergences discussed above, Maria Sofia's patterns of consonantal acquisition in both languages emphasize the child's adherence to the Front < Back (Jakobson, 1941/1968) contrast. This child's hierarchy of place markedness based on her quantitative productions at 2;7, underlyingly characteristic of her progress in both languages, is: LABIAL < CORONAL < DORSAL [-back] < DORSAL [+back] < GLOTTAL, where the symbol < means *acquired earlier than*. This hierarchy qualitatively agrees strictly with the rudimentary Front < Back distinction advocated in Jakobson (1941/1968) but also establishes it quantitatively.

4.4.3.5 Consonants not used in context

In English /θ/ and /g/ are never produced correctly in context; in Greek they were correct at very low rates. The Greek voiced palatal stop, [ɟ], also falls in this category, although it was produced elsewhere out of context, as a substitute of [c].

4.4.4 Consonant correctness on word position, singletons and clusters

Here, the performance of consonants in different word positions as singletons and in clusters is examined. Table 4.13 below shows each consonant's correctness in both languages in word-initial, word-final and word-medial position, and as singleton and in consonant clusters. It is noted that word-medial position means here any position that is not word-initial or word-final.

Table 4.13 Correctness on word position and clusters

	Initial		**Final**		**Medial**		**Singleton**		**Cluster**	
Labial	**E**	G	**E**	G	**E**	G	**E**	G	**E**	G
/p/	**91%** *52/57*	95% *182/192*	**100%** *19/19*	n/a	**98%** *44/45*	99% *98/99*	**97%** *84/87*	96% *210/219*	**91%** *31/34*	97% *70/72*
/b/	**92%** *119/130*	91% *61/67*	**100%** *1/1*	n/a	**100%** *25/25*	100% *32/32*	**97%** *105/108*	95% *86/91*	**83%** *40/48*	88% *7/8*
/m/	**98%** *113/115*	99% *350/355*	**88%** *53/60*	n/a	**93%** *26/28*	97% *188/194*	**95%** *186/195*	98% *528/538*	**75%** *6/8*	91% *10/11*
/f/	**69%** *20/29*	90% *46/51*	**100%** *2/2*	n/a	**88%** *14/16*	50% *29/58*	**81%** *34/42*	99% *68/69*	**40%** *2/5*	18% *7/40*
/v/	**0%** *0/1*	89% *25/28*	**38%** *3/8*	100% *1/1*	**40%** *2/5*	94% *33/35*	**31%** *4/13*	88% *38/43*	**100%** *1/1*	100% *21/21*

Coronal										
/θ/	**0%** *0/8*	5% *7/130*	**0%** *0/3*	n/a	**0%** *0/1*	0% *0/54*	**0%** *0/9*	4% *7/164*	**0%** *0/3*	0% *0/20*
/ð/	**16%** *16/102*	6% *6/103*	- *0/0*	n/a	**0%** *0/9*	4% *3/72*	**15%** *16/110*	5% *9/165*	**0%** *0/1*	0% *0/10*
/t/	**90%** *44/49*	89% *266/300*	**86%** *201/234*	n/a	**60%** *27/45*	82% *231/283*	**91%** *225/248*	93% *383/414*	**59%** *47/80*	67% *114/169*
/d/	**92%** *67/73*	- *0/0*	**40%** *31/77*	n/a	**91%** *20/22*	100% *17/17*	**71%** *103/145*	100% *17/17*	**56%** *15/27*	- *0/0*
/s/	**77%** *49/64*	54% *87/161*	**90%** *191/212*	89% *222/249*	**86%** *43/50*	91% *230/252*	**90%** *197/218*	91% *444/487*	**80%** *86/108*	54% *95/175*
/z/	**100%** *1/1*	44% *4/9*	**64%** *98/152*	n/a	**90%** *9/10*	86% *32/37*	**67%** *101/150*	78% *36/46*	**54%** *7/13*	- *0/0*
/ʦ/	**n/a**	25% *2/8*	**n/a**	n/a	**n/a**	79% *26/33*	**n/a**	68% *26/38*	**n/a**	67% *2/3*
/ʣ/	**n/a**	- *0/0*	**n/a**	n/a	**n/a**	- *0/0*	**n/a**	- *0/0*	**n/a**	- *0/0*
/n/	**96%** *85/89*	75% *123/163*	**89%** *101/114*	54% *19/35*	**54%** *58/108*	94% *212/225*	**92%** *211/229*	84% *354/420*	**40%** *33/82*	0% *0/3*
/l/	**79%** *30/38*	93% *26/28*	**50%** *2/4*	n/a	**34%** *35/102*	82% *246/300*	**81%** *67/83*	91% *269/295*	**0%** *0/61*	9% *3/33*
/ɾ/	**n/a**	0% *0/15*	**n/a**	n/a	**n/a**	1% *4/331*	**n/a**	2% *4/200*	**n/a**	0% *0/146*
/ɹ/	**2%** *1/44*	n/a	**7%** *5/69*	n/a	**4%** *3/83*	n/a	**6%** *7/126*	n/a	**3%** *2/70*	n/a
/ʃ/	**50%** *4/8*	n/a	**50%** *2/4*	n/a	**50%** *1/2*	n/a	**50%** *6/12*	n/a	**50%** *1/2*	n/a
/ʒ/	**-** *0/0*	n/a	**-** *0/0*	n/a	**-** *0/0*	n/a	**-** *0/0*	n/a	n/a	n/a
/ʧ/	**58%** *7/12*	n/a	**67%** *2/3*	n/a	**0%** *0/1*	n/a	**53%** *8/15*	n/a	**100%** *1/1*	n/a
/ʤ/	**0%** *0/2*	n/a	**67%** *6/9*	n/a	**-** *0/0*	n/a	**55%** *6/11*	n/a	**-** *0/0*	n/a
Palatal										
[ɲ]	**n/a**	- *0/0*	**n/a**	n/a	**n/a**	90% *9/10*	**n/a**	100% *4/4*	**n/a**	83% *5/6*
[ʎ]	**n/a**	0% *0/1*	**n/a**	n/a	**n/a**	17% *2/12*	**n/a**	15% *2/13*	**n/a**	- *0/0*
/j/	**52%** *79/152*	n/a	**n/a**	n/a	**50%** *2/4*	n/a	**52%** *81/155*	n/a	**0%** *0/1*	n/a
[c]	**n/a**	3% *4/121*	**n/a**	n/a	**n/a**	6% *3/50*	**n/a**	4% *7/169*	**n/a**	0% *0/2*
[ɟ]	**n/a**	- *0/0*	**n/a**	n/a	**n/a**	0% *0/1*	**n/a**	0% *0/1*	**n/a**	n/a
[ç]	**n/a**	13% *1/8*	**n/a**	n/a	**n/a**	16% *9/55*	**n/a**	9% *3/35*	**n/a**	25% *7/28*
[ʝ]	**n/a**	30% *13/43*	**n/a**	n/a	**n/a**	27% *9/33*	**n/a**	33% *20/60*	**n/a**	13% *2/16*
Velar										
/k/	**4%** *3/69*	4% *5/120*	**5%** *3/64*	n/a	**0%** *0/41*	3% *4/119*	**5%** *67/120*	5% *7/145*	**0%** *0/54*	2% *2/94*
/g/	**0%** *0/36*	- *0/0*	**0%** *0/23*	n/a	**0%** *0/21*	8% *1/12*	**0%** *0/72*	9% *1/11*	**0%** *0/8*	0% *0/1*
[ɫ]	**n/a**	n/a	**39%** *11/28*	n/a	**22%** *4/18*	n/a	**39%** *9/23*	n/a	**26%** *6/23*	n/a

/ŋ/	**n/a**	n/a	**50%** *7/14*	n/a	**0%** *0/16*	- *0/0*	**50%** *7/14*	n/a	**0%** *0/16*	- *0/0*
/x/	**n/a**	5% *1/22*	**n/a**	n/a	**n/a**	0% *0/18*	**n/a**	4% *1/26*	**n/a**	0% *0/14*
/γ/	**n/a**	12% *2/17*	**n/a**	n/a	**n/a**	5% *3/62*	**n/a**	7% *4/57*	**n/a**	5% *1/22*
/w/	**16%** *11/70*	n/a	**n/a**	n/a	**0%** *0/2*	n/a	**15%** *11/71*	n/a	**0%** *0/1*	n/a
Glottal										
/h/	**8%** *3/40*	n/a	**n/a**	n/a	**0%** *0/1*	n/a	**7%** *3/41*	n/a	**-** *0/0*	n/a

It is shown in table 4.13 that most consonants, as expected, perform as singletons either better or similarly to those in clusters. English /b, m, f, t, d, n, s, z, ð, l, ŋ, w/, [ɫ] and Greek /f, t, n, s, l/, [ɲ], [ʝ] perform considerably better (>10%) as singletons than in clusters, independent of their acquisition level. Conversely, English /v, ʧ/ and Greek /v/ and [ç], seem to perform considerably better (>10%) in clusters than as singletons. However, a closer look reveals that this conclusion is hasty for English /v, ʧ/ as they have only one token in clusters, in the child's speech at 2;7. In adult Greek, [ç] may be either an allophone of /x/ or a surface realization of the underlying front vowel /i/ when /i/ is preceded by a voiceless consonant other than /x/ and followed by another vowel, as is the case with the following targeted words in the child's data: *αλήθεια* /aliθia/, *μάτια* /matia/, *Νάσια* /nasia/, *παπούτσια* /paputsia/, *παστίτσιο* /pastitsio/, *πιάσω* /piaso/, *πιάτο* /piato/, *πιεις* /piis/, *πιο* /pio/, *ποιο* /pio/, *πιω* /pio/ *πιούμε* /piume/, *φτιάξε* /ftiakse/, where the adult surface form is [aliθça], [matça], [nasça], etc., respectively. Excluding these words, the allophone [ç] is produced better as a singleton (9%) than in clusters (0%). On the other hand, there seems to be no explanation why Greek /v/ performs better in clusters than as singleton.

With regard to individual consonant performance by word position, when the sample size is not small and the difference in correct performance is larger than 10% between the two languages, remarks are made as follows.

In English, /f-/ performs worse than /-f-/ (69% vs. 88%) even when clusters are excluded, 69% (18/26) vs. 100% (14/14). In Greek, however, because there are many clusters in medial position (59%=34/58), performance is low relative to initial position and to English medial whose clusters are at 13% (2/16). When clusters are excluded, Greek medial /f/ is performed at 100% (24/24), slightly better than initial (98%=44/45) and as good as English medial. These results show that English /f-/ lags well behind, showing different position-dependent level of acquisition in the two languages and, as is known (e.g. Leopold, 1949), that continuants are more difficult to produce in word-initial position.

English /t/ performs worse in medial position, as the proportion of clusters in medial position (41/45=91%) is much larger than in initial (3/49=6%) or final (36/234=15%) positions and /t/ in cluster is produced correctly at the rates of 55%, 100% and 61% in the three positions, respectively. In Greek, however, the proportion of clusters in medial position is 52% (148/283) much lower than in English, thus, explaining the much better performance in Greek over English, 82% vs. 60%.

English /d/ is performed much better in initial and medial positions (92%) than in final position (40%) due to the pattern of word-final devoicing, agreeing with alignment constraints whereby stops are performed better in word initial than final position. There is no /-d/ in Greek which explains the large difference, 69% vs. 100%, in overall correctness of /d/ between English and Greek.

English /n/, like /t/, performs worse in medial position as the proportion of clusters in medial position (82/108=76%) is much larger than in initial (0%) or final (0%) positions and the correctness in cluster is 40% while as singleton 92%. On the other hand, the child's Greek /n/ is not involved in clusters, with the exception of one word type, /skamni/, and is produced better in medial than in either initial or final position. This is explained by the fact that the proportion of deletions in word final position (15/35=43%) is larger than in initial position (26/163=16%) and much larger than in medial (4/225=2%) position, as deletions dominate errors in /n/ at 11% with /l/ and /t/ following at 2%. In English, /n/ is produced better than in Greek in both word initial and final positions. In initial /n/ position in English, there is only one multisyllabic word, *Nicholas*, which together with the six monosyllabic words, including the function word *not*, are completely acquired (96%). In Greek, however, there are twelve multisyllabic words, 83% correct, and two monosyllabic words that include the function word */na/,* produced at 74% (105/141) correct; the Greek function word, */na/*, (96/130=74%) is less correct than the English, *not*, (9/10=90%) because it is not stressed. These two facts explain why /n/ performs better in English in word initial position. In word final position, /n/ performs better in English, as well. This is attributed to the presence of the Greek function words: */ðen/*, */stin/*, */tin/*, *ton/*, which are produced correctly only at 42% (11/26) because of deletions, a pattern also observed in adults; the remaining Greek final /n/ words are produced (8/9=89%) identically to all the English final /n/ words (101/114=89%). It is also noted that the Greek function word, */an/* is produced at 1/1=100% and the English function words, *in* and *on*, at 2/5=40% and 16/16=100% respectively.

Both in English and Greek, /s/ is produced better in word final than in initial position agreeing with alignment constraints discussed in section 2.4.4.1, whereby [+continuant] attaches to the right edge (e.g. Ferguson, 1978; Kappa, 2000). The earlier realization of /s/ in word final position in Greek is morphologically conditioned, being a marker of gender/case (Kappa, 2000; 2002). The number of clusters in each word position and the correctness of /s/ in them explain the large intralanguage and interlanguage differences in performance. Greek initial /sC/ clusters are produced correctly only at 15% (12/81) while in English at 72% (21/29) which, together with the initial singleton performance of 94% (75/80) and 80% (28/35) in Greek and English, respectively, yield a much better overall rate in English (77%) than in Greek (54%). The singleton /s/ intralanguage comparison between initial and final positions is interesting in itself. In English, the final position performs better, 92% to 80%, while in Greek the comparison seems to be violating the alignment constraint; 89% final vs.

94% initial. However, an examination of the /s/ word types in Greek reveals that two words, /su/ and /si/, form part of a larger phonological word and, thus, do not stand on their own. Excluding these words which are performed at 98% (50/51) from the calculation of initial position results in an 86% (25/29) correct proportion for initial Greek /s/ lower than that (89%) in final position. Comparing English clusters also yields better performance at initial, 72% (21/29), than at final position (24/31=77%). In Greek there are no final /Cs/ clusters.

Greek /z/ is performed much better (86% vs. 44%) in medial than in initial position. English /z/ is performed much better (90% vs. 64%) in medial than final position where devoicing dominates the substitutions at 87% (48/55) and all the clusters exist. Therefore, the large proportions of /-z-/ targets in Greek (80%=37/46) and of /-z/ targets in English (93%=152/163) explain the better overall performance of /z/ in Greek by 12% over English.

/ð/ is produced better in word initial position in both languages though English outperforms Greek (16% vs. 6%). This may be due to the presence of 100% (6/6) monosyllabic /ð-/ words in English (that, the, there, these, they, this) and only 14% (3/21) of them in Greek (/ðe/, (/ðen/, (/ðo/).

Singleton /l-/ is behind in English (79% vs. 93%) and this cannot be explained in terms of word length or word complexity. This lagging is further attested by the presence of substitute [j] only in English (*legs, lullaby*). The disparity between the two languages shows differentiation in their level of acquisition. /-l-/ is well behind in English (34% vs. 82%) but this is attributed to the much larger proportion of clusters in English (60%=61/102) than in Greek (11%=33/300) since /l/ clusters are produced poorly in both languages; 0% in English and 9% in Greek.

Conclusively, among the fifteen (15) common consonants in the two languages, /v, d, z, l/ are performed better by 10% or more in Greek over English, cumulatively for all word positions. For /d, z/, this interlanguage difference is explained in terms of differences in the consonant's proportions in word positions. For /l/, the interlanguage difference exists in both word initial and medial positions. The difference in /-l-/ is attributed to the difference in cluster proportions while the difference in /l-/ cannot be attributed to word length or complexity, as is also the case for /v/ which, however, has limited targets in English. Even though the remaining twelve (12) common consonants do not perform substantially different, <10%, cumulatively for all word positions between the two languages, some of them do perform differently (>10%) in individual word positions; /-f-, n-, -n, s-, ð-/ perform better in English while /f-, -t-, -n-/ perform better in Greek. All these differences, except for /f-/, have been explained in terms of differences in cluster proportions and word length.

4.4.4.1 Cumulative consonant correctness on word position, singletons and clusters

Dependence of consonant correctness on word position is first evaluated by computing the proportion of all correct consonants, cumulatively. Using table 4.13, it yields the following weighted averages for

all consonants

English **initial**: 59% (704/1,189), **final**: 67% (738/1,100), **medial**: 48% (313/655)
Greek **initial**: 62% (1211/1942), **final**: 85% (242/285), **medial**: 59% (1421/2394)

Since for all the positions cumulatively the weighted averages for English (60%) and Greek (62%) but not the arithmetic means, computed and presented in section 4.4.2, were similar to the computed PCC (58% for English and 61% for Greek), only the weighted average was computed for each word position. It is seen that in both languages consonants performance is better in the order of: final position, initial and medial position. Comparing performance between the languages, English lags behind Greek in every position. However, because the proportion of consonants in final position is much higher in English, 37% (1,100/2,944), than in Greek, 6% (285/4,621), while in medial it is lower, 22% (656/2,944) in English vs. 31% (2,394/4,621) in Greek, the end result is a comparable performance in English (60%) and Greek (62%), cumulatively for all three word positions.

Now, only consonants that are common to all positions within the language will be weighed. In the child's Greek, only /v, s, n/ are common. In English, /ð, ʤ, j, w, h, ŋ/, [ɫ] are not common to all positions. Then, using table 4.13, yields the following correct proportion for

common to all positions consonants within the language

English **initial**: 72% (595/823), **final**: 68% (714/1,049), **medial**: 51% (307/605)
Greek **initial**: 67% (235/352), **final**: 85% (242/285), **medial**: 93% (475/512)

The order of correctness between initial and final position has now changed in English because the consonants that are not common have not been acquired and they exist at a large proportion in initial position only; 30% vs. 5% in final and 9% in medial position. In Greek, the order of correctness has changed for the medial position which has now become better than the other two positions since /v, s, n/ have been completely acquired in the medial position. The final position is dominated by /s/ which has been acquired at 89% rate, thus, still performing better than the initial position.

Next, it will be interesting to compare consonants that are common in the two languages by word position; the common consonants are /p, b, m, f, v, t, d, n, s, z, θ, ð, l, k, g/. In initial position, /d/ and /g/ are excluded from the comparison because no such words were targeted by the child in Greek. In word final position only /v, s, n/ are common since no other consonants exist in this position in the child's Greek. In medial position, all the common consonants, independent of word position, in the two languages are present. Using table 4.13, yields the following correct proportion for common consonants between the languages:

common consonants between the two languages

English **initial**: 71% (532/752), **final**: 88% (295/334), **medial**: 57% (303/528)

Greek **initial**: 70% (1,188/1,707), **final**: 85% (242/285), **medial**: 76% (1,356/1,789)

The child performs similarly in word initial and final positions between the two languages but much better in word medial position in Greek, where consonants cannot be followed by a word final consonant creating a cluster, contrary to English. In final position where English /s/ is involved in clusters, the performance is not hindered as /-s/ is produced correctly at 90%.

Last, cumulative consonant performance in singleton and cluster context is calculated. From table 4.13, the weighted average of correct singletons is calculated as 64% (1477/2297) in English and 68% (2528/3727) in Greek while the arithmetic mean is 52% (12.4/24) in English and 51% (12.78/25) in Greek. On the other hand, the weighted average of correct consonants in clusters is 43% (278/647) in English and 39% (346/894) in Greek while the arithmetic mean is 39% (8.57/22) in English and 34% (7.19/21) in Greek. It is seen that consonants perform overall better as singletons than in clusters in both languages, as expected, and that English is better in clusters in agreement with the results of whole word correctness presented and discussed above. The weighted proportion of targeted consonants in clusters is 19% (894/4621) in Greek, less than the 22% (648/2944) in English resulting in a better performance in Greek overall (62% in Greek vs. 60% in English), but not in whole word correctness, as word length in Greek is larger than in English.

4.4.4.2 Comparison with other children

Maria Sofia's performance on word position is compared with that of monolingual English and monolingual Greek children in tables 4.14 and 4.15. Her English is compared to monolingual English children in table 4.14 below.

Table 4.14 Comparison of Maria Sofia's English correctness on word position

	present study		**Olmsted (1971)**	**Prather et al. (1975)**		**Ingram et al. (1980)**	**Smit et al. (1990)**	
	2;7		2;8 >50%	2;8 >75%	3;0 >75%	2;10 >70%	3;0	
Labial	I	F	I	I+F	I+F	I	I	F
/p/	91%	100%		√	√		95%	93% (2)
/b/	92%	100% (1)		√	√		98% (3)	91%
/m/	98%	88%		√	√		91%	89% (2)

/f/	69%	100% (2)	**78%**	√	√	**73%**	86%	82%
/v/	0% (1)	38% (3)				**10%**	41%	64%
Coronal								
/θ/	0%	0% (2)	**40%**				30%	27%
/ð/	16%		**14%**				32%	
/t/	90%	86%		√	√		95%	85% (3)
/d/	92%	40%		√	√		97% (3)	91%
/s/	77%	90%	**55%**		√	**46%**	75% (2)	77% (2)
/z/	100% (1)	64%				**20%**	41%	48% (2)
/n/	96%	89%		√	√		82%	80% (2)
/l/	79%	50% (3)					77%	36%
/ɹ/	2%	7%					25% (2)	45%
/ʃ/	50%	50% (1)	**62%**			**50%**	68% (2)	64%
/ʒ/								
/ʧ/	58%	67% (2)	**50%**			**89%**	66% (2)	64%
/ʤ/	0% (1)	67% (2)	**33%**			**75%**	73%	61% (2)
Palatal								
/j/	52%	n/a		√	√		59%	n/a
Velar								
/k/	4%	5%		√	√		77% (3)	92% (3)
/g/	0%	0%			√		82% (2)	82% (2)
[ɫ]	n/a	39%					n/a	36%
/ŋ/	n/a	50%					n/a	50%
/w/	16%	n/a		√	√		100% (2)	n/a
Glottal								
/h/	8%	n/a	n/a	√	√		98% (2)	n/a

Smit et al.'s data on girls, only, is shown here. Prather et al.'s data show consonant performance on a 75% acquisition criterion. Olmsted's and Ingram et al.'s data do not represent proportion of consonant correctness but proportion of children that have acquired the consonant more than 50% and 70%, respectively, and are shown in the table in bold. Their data involve fricatives and affricates, only. Ingram et al. (1980) used four word types for each consonant. Moreover, the data used in the different studies is dissimilar in terms of word types and tokens. However, a comparison will be made. Whenever there are less than five targeted word types in a consonant's position, the number is shown in parenthesis in the corresponding cell in the table. It may be concluded from table 4.14 that Maria Sofia's labials /p, b, m/, coronals /n, s, l/ and, perhaps, /z/ are performed at a higher level of correctness than monolingual children's of the same age. At a lower level of correctness are her coronals /-d, ɹ/ and, perhaps, /ʃ/, as well as her velars /k, g, w/ and the glottal /h/. No conclusion can be reached for /v, ʤ/ because of insufficient data. The rest of Maria Sofia's consonants are performed at about the same level as her monolingual peers'.

It is remarked that, as /f-/ and /l-/ are the only consonants that *truly* differentiate in Maria Sofia's performance in the two languages, her Greek consonants common to English are compared to English monolingual children's in the same way as her English consonants above, except for /f-/, which is performed better in her Greek than in her English and, thus, better than in the English of monolingual children; her /l-/ is also performed better in her Greek than in her English.

The comparison of Maria Sofia's Greek consonant performance depending on word position to that of monolingual Greek children is made in table 4.15 below where I stands for word initial postion and M for word medial position.

Table 4.15 Comparison of Maria Sofia's Greek correctness on word position

	present study		**PAL (1995)**	
	Maria Sofia at 2;7		# of children 2;6-3;0 with >90% acquisition	
Labial	I	M	I	M
/p/	95% *182/192*	99% *98/99*	75%-90%	75%-90%
/b/	91% *61/67*	100% *32/32*	75%-90% (2)	75%-90% (2)
/m/	99% *350/355*	97% *188/194*	75%-90% (3)	75%-90%
/f/	90% *46/51*	50% *29/58*	50%-75%	50%-75%
/v/	89% *25/28*	94% *33/35*	50%-75%	50%-75%
Coronal				
/θ/	5% *7/130*	0% *0/54*	<50% (3)	<50%
/ð/	6% *6/103*	4% *3/72*	<50%	<50%
/t/	89% *266/300*	82% *231/283*	75%-90% (3)	75%-90%

/d/	-	100% *17/17*	75%-90% (1)	50%-75% (3)
/s/	54% *87/161*	91% *230/252*	<50%	50%-75%
/z/	44% *4/9*	86% *32/37*	50%-75% (2)	50%-75% (3)
/ts/	25% *2/8*	79% *26/33*	<50% (2)	50%-75% (2)
/dz/	-	-	<50% (2)	<50% (2)
/n/	75% *123/163*	94% *212/225*	75%-90% (2)	50%-75%
/l/	93% *26/28*	82% *246/300*	50%-75% (3)	50%-75%
/ɾ/	0% *0/15*	1% *4/331*	<50% (2)	<50%
Palatal				
[ɲ]	-	90% *9/10*	-	75%-90% (1)
[ʎ]	0% *0/1* (1)	17% *2/12*	50%-75% (1)	50%-75% (2)
[c]	3% *4/121*	6% *3/50*	75%-90% (3)	75%-90%
[ɟ]	-	0% *0/1* (1)	-	75%-90% (2)
[ç]	13% *1/8*	16% *9/55*	75%-90% (1)	<50%
[j]	30% *13/43*	27% *9/33*	75%-90% (1)	<50%
Velar				
/k/	4% *5/120*	3% *4/119*	75%-90%	75%-90%
/g/	-	8% *1/12*	-	75%-90% (1)
/x/	5% *1/22*	0% *0/18*	50%-75% (3)	75%-90%
/ɣ/	12% *2/17*	5% *3/62*	75%-90%	50%-75%

It should be noted that PAL's (1995) results are for several children between the ages 2;6-3;0, the number of which is not given, and their data were elicited through picture naming of 101 word types; the number of tokens was not reported. What they reported is the proportion of children between the ages 2;6-3;0 who had acquired each consonant in word-initial and final positions without defining what they mean by 'acquired'. Here, based on the way their data are presented, it is concluded that by 'acquired' they mean a correct proportion of greater than 90%. The number of word types for each consonant position has been also counted here from their data and, whenever it is smaller than four, it has been entered in parenthesis in the corresponding cell of table 4.15. Maria Sofia's number of less than four word types for each consonant position has been also entered in parenthesis in the appropriate cell. Then, from table 4.15, one could only possibly conclude that Maria Sofia's overall performance is similar to that of monolingual Greek children though her [c], [-f-] and velars lag behind, keeping in mind that PAL's children are believed to be older, since exact ages were not given. PAL (1995) provides information on word final acquisition only for /s/, reported to be produced correctly better than 90% for 50%-75% of the children between the ages 2;6-3;0. Therefore, Maria Sofia's production of word final /s/ at 89% is similar to that of monolingual Greek children.

4.5 Maria Sofia's main substitution patterns and deletions

The consonants' main substitution patterns, including deletions, that have a frequency of occurrence equal or larger than 5%, are taken from tables 4.9 and 4.10 for English and Greek, respectively, and are shown in table 4.16, for convenience of analysis and discussion. Common segments between the languages, different ones, as well as, those that are similar in some respect are discussed to reveal common tendencies or differences between the languages. For comparison, when substitutions or deletions are at a proportion of 5% or larger in one language, they are also shown in the other language even if they are at a rate smaller than 5%. Detailed theoretical elaborations on the acquisition of phonemes and feature contrasts has been tackled extensively elsewhere in a number of different theoretical stances (see §2.4.4) and is not the focus here. Nevertheless, the most relevant constraints ranking high in her choice of substitutions are identified here within the perspective of constrained-based nonlinear phonology of Bernhardt & Stemberger (1998), discussed in §2.4.6 of the present thesis. The terminology used below is borrowed from Bernhardt & Stemberger (1998:705-716).

The child's performance in the two languages shows common and different substitution patterns. Common and different patterns will be discussed in relation to common target consonants as well as to similar phonemes between the two languages. Moreover, substitutions for consonants specific to each language will also be discussed. Substitution patterns will be examined in relation to the target's word position.

Table 4.16 Maria Sofia's main substitution patterns and deletions

Target	**Substitutions & Deletions**					**Process**
	Common			**English**	**Greek**	
Labial		**E**	G			
/f/	**[s]** **Ø**	**6%** **9%**	20% 9%			*Apicalization*
/v/	**[m]**	**7%**	2%	**Ø 57%**		*CH nasal*
Coronal						
/θ/	**[ʃ]** **[s]** **[t]** **[f]**	**42%** **33%** **17%** **8%**	45% 27% 9% 1%		Ø 10%	*Laminalization* *Sibilization* *Stopping* *CH labial*
/ð/	**[l]** **[t]** **[n]** **Ø**	**25%** **5%** **8%** **36%**	40% 7% 1% 31%			*Lateralization* *Stopping* *CH coronal* *Nasalization*
/t/	**Ø**	**12%**	10%			
/d/				**[t] 22%** **Ø 9%**		*Devoicing*
/s/	**Ø**	**3%**	14%			
/z/				**[s] 29%**	[ʒ] 9%	*Devoicing* *Laminalization*
/ʦ/				n/a	[ʧ] 20%	*Laminalization*
/n/	**Ø**	**19%**	11%			
/l/	**Ø**	**47%**	14%			
/ɾ/				n/a	[l] 46% Ø 49%	*Lateralization*
/ɹ/				**[l] 26%** **[v] 10%** **Ø 55%**	n/a	*Lateralization* *Labialization*
/ʃ/				**[s] 21%** **[z] 7%** **[ʦ] 7%** **Ø 14%**	n/a	*Apicalization* *ibid/Voicing* *ibid/Affrication*
/ʧ/				**[s] 38%** **[ʦ] 6%**	n/a	*Deaffrication* *Apicalization*
/ʤ/				**[ʦ] 18%** **[dz] 18%** **[z] 9%**	n/a	*Apicalization* *ibid* *Deaffrication*
Palatal						
[ɲ]				n/a	Ø 10%	
[ʎ]					[j] 54% [l] 23% [ʒ] 8%	*Spirantization* *Depalatalization* *Spirantization*
/j/				**[ʒ] 13%**	n/a	*Spirantization*

				[l] 12%		*Lateralization, CH*
[c]				n/a	**[t]** 82% **[p]** 11%	*Fronting* *CH labial*
[ç]				n/a	**[ʃ]** 41% **[s]** 27% **Ø** 14 %	*Fronting* *Apicalization*
[j]				n/a	**[t]** 21% **[l]** 16% **[ʒ]** 14% **Ø** 16 %	*CH coronal* *Lateralization* *Fronting*
Velar						
/k/	**[t]**	**86%**	90%			*Fronting*
/g/	**[d]** **[t]** **[ʤ]**	**65%** **21%** **3%**	33% 8% 50%	**[ɟ] 5%**		*Fronting* *ibid/Devoicing* *Metathesis* *Palatalization* *Affrication*
[ɫ]				**[ə] 22%** **[l] 17%** **Ø 26%**	n/a	*Vocalization* *Develarization*
/ŋ/				**[n] 53%** **Ø 23%**	-	*Fronting*
/x/				n/a	**[ʃ]** 38% **[s]** 23% **[t]** 5% **Ø** 23%	*Laminalization* *Fronting* *CH coronal*
/γ/				n/a	**[l]** 52% **[v]** 5% [j] 5% **Ø** 25%	*Lateralization* *CH labial* *Palatalization*
/w/				**[v] 57%** **[l] 7%** **Ø 8%**	n/a	*Labialization* *CH lateral*
Glottal						
/h/				**[ʃ]: 46%** **[s]: 37%**	n/a	*Laminalization* *Apicalization*

4.5.1 Different substitutions for common consonants between the languages

There appear to be different substitutions for the common consonants /d, z/ between the two languages. In table 4.17, the differences are depicted based on word position.

Table 4.17 Substitutions of /d, z/ on word position

	Initial		Final		Medial	
Pattern	**E**	G	**E**	G	**E**	G
/d/→[t]	**8%** *6/73*	- *0/0*	**39%** *30/77*	n/a	**5%** *1/22*	0% *0/17*
/z/→[s]	**0%** *0/1*	0% *0/9*	**32%** *48/152*	n/a	**0%** *0/10*	0% *0/37*
/z/→[ʒ]	**0%** *0/1*	11% *1/9*	**0%** *0/152*	n/a	**0%** *0/10*	8% *3/37*

Each of the patterns shown in table 4.17 will now be discussed separately.

/d/→[t]. This devoicing pattern exists only in the child's English and mostly in word-final position as in *bed* [betʰ], *behind* [bɪʃaɪnt], *good* [dut], *inside* [isaɪt̪], *playground* [beɪndaʊnt], *salad* [sælət̥]. Examples in word initial position are: *down* [taʊn], *drink* [tʰɪːn], and *daddy* [tadɪ]. /d/ in the child's Greek only occurs in word medial position in which it is produced 100% correctly; there is no word final /d/ in the Greek language. Therefore, even though /d/ is a common target in the two languages, the word position in which it is targeted is largely different, causing the difference in the substitution pattern. Devoicing of /d/ and, especially word final devoicing, is a process found in child English development (e.g. Ingram, 1976b; Major, 1977; Grunwell, 1981b) and is reported to persist until age 3;6 (e.g. Beers, 1995). As [+voice] is a terminal (i.e. secondary, non-privative articulator node) non-default feature on the melodic tier, faithfulness to it appears first in word-initial positions (e.g. Bernhardt & Stemberger, 1998:224), as is the case here. Due to the **Survived/LinkedUpwards(C-Root)** constraints which rank lower than the **Survive(Coronal, -continuant)** which in turn ranks lower than the **Not(+voice)** constraint, yields the insertion of the default [-voice]. The terminology is borrowed from Bernhardt & Stemberger (1998:705-716) where **Survived** means that an element in the underlying representation surfaces in the output, **LinkedUpwards** means that an element must be anchored in time relative to other elements for the purpose of preventing its deletion, and **NOT** means that an element must not appear in the output.

/z/→[s]. This devoicing occurs only in English and at 32% always at word final position. Examples are: *because* [vʊvɔːs], *close* [ʦoːs], *hands* [ʦants], and *toys* [tʰɔɪs]. As in the case of word-final devoicing of English /d/, deletion of the [+voice] leads to insertion of the default /s/ imposed by the constraints mentioned in the preceding paragraph with [-continuant] replaced by [+continuant]. The Greek language disallows word final /z/.

It is common for children in development to devoice word final consonants and, in particular, voiced obstruents (Velten, 1943; Naeser, 1970; Ingram 1974a; B. L. Smith, 1979; Stampe, 1979; Smit, 1993a; Richtsmeier, 2010). The preference for word-final as opposed to word-initial devoicing may be explained by the general principle that markedness occupies phycholinguistically prominent positions (e.g. J. Smith, 2002). A comprehensive review of word final devoicing is given by Richtsmeier (2010). In summary, Stampe (1979) suggests that children devoice word final obstruents in initial stages of development but eventually devoicing disappears. Smit (1993a) finds that devoicing normally occurs in children younger than three years old and that the frequency of occurrence depends on place and manner of articulation of the obstruent, with /z/ being devoiced more frequently than any of /b, d, g, v, ʤ/. Bernhardt & Stemberger (1998) explain coda devoicing as discussed above. Devoicing occurs in adult speech, as well, as shown by Haggard (1978) for word final fricatives and by Flege (1982) for word final /b/. Word final devoicing is also found in the child under investigation in the present thesis at age 2;7, as discussed in this chapter and at subsequent ages, as discussed in chapters 5 and 7.

/z/→[ʒ]. In Greek, the main substitution of /z/ involves its laminalization or backing to the [-anterior] manner of articulation at 11% and 8% for initial and medial word positions, respectively, even though /ʒ/ does not exist in standard Modern Greek. Examples of the pattern are: *ζώα* /zoa/→[ʒoa], *μαζί* /mazi/→[maʒi], *μπλούζα* /bluza/→[buʒa]. There is no final /z/ in the Greek language, so no conclusion can be drawn with respect to laminalization in that position. Remarkably, /z/→[ʒ] is not present in Maria Sofia's English /z/. However, it should be mentioned that Maria Sofia's [ʒ] is not always a clearly articulated post-alveolar fricative, nor is it a clear [Coronal, +voice +sibilant -anterior] articulation. The substitution pattern is considered a universal, explained by the token of /alveolars/→[post-alveolars] (e.g. Bernhardt & Stemberger, 1998). Ingram et al. (1980), among others, has reported blading with regard to word-initial /s/ in the early stages of the sound's development. Magoula (2000) reports /s/→[ʃ] in the phonetic inventory of Greek monolingual children as well. Maria Sofia also blades /s/ in all word positions, but this is done at the low rate of 2% in each language since she has acquired /s/. The laminalization pattern is found present, at high or low rates, as substitution of most fricatives in this child's languages at 2;7 as may be seen in tables 4.7.1 and 4.7.2; in its voiced form it substitutes voiced ones, as is the case of /z/→[ʒ] here, and in its voiceless form, it substitutes voiceless fricatives.

In conclusion, only /z/→[ʒ] exists as a different substitution pattern between the two languages as /d/→[t] and /z/→[s] are different due to the difference in word position of the target between the two languages.

4.5.2 Substitutions for similar phonemes between the two languages

The phonemes in the pairs /j/ and [ʝ], /ɹ/ and /ɾ/, /h/ and (/x/, [ç]), /w/ and /ɣ/, though not common in the two languages, are similar and share the same main substitution patterns as will be discussed below.

/j/ vs. [ʝ]. Table 4.18 shows the substitutions patterns of /j/ and [ʝ] at each word position.

Table 4.18 Substitutions of /j/ and [ʝ] on word position

	Initial		Final		Medial	
Pattern	**E**	G	**E**	G	**E**	G
/j/, [ʝ]→[l]	**13%** *19/152*	23%* *10/43*	**n/a**	n/a	**0%** *0/4*	6% *2/33*
/j/, [ʝ]→[ʒ]	**13%** *20/152*	5%* *2/43*	**n/a**	n/a	**25%** *1/4*	27% *9/33*
[ʝ]→[t]	**n/a**	37%* *16/43*	**n/a**	n/a	**n/a**	0% *0/33*

* arithmetic averages for [ʝ]→[l, ʒ, t] are 20%, 5%, 7%, respectively.

The similarity between the palatal approximate and the palatal fricative has been discussed in section 4.4.3.3 above. Maria Sofia's main substitutions for both phonemes are [ʒ] and [l], the latter sometimes harmonizing with another consonant in the word, as in *yellow* [leloʊ]~[lelə]. Smith (1973) reported that the presence of a lateral triggers assimilation to it, providing his monolingual English son's *yellow* [lɛlu:]~[lɛlo], also as an example. Fricatives as a substitution for glides, as is the case of /j/→[ʒ], is an attested substitution pattern in monolingual phonological development in English (Ingram, 1989c, Bernhardt & Stemberger, 1998). As shown in table 4.1b, /j/, besides being Dorsal[-back], is also Coronal[-anterior]. Therefore, the constraints that govern the substitution pattern /j/→[ʒ] are: **Survived(Coronal, -anterior, +voice)** lower than **NOT(-continuant)**, which eliminates [ʤ]. As far as [ʝ]→[ʒ] is concerned, obstruents have been reported to substitute fricatives at a later stage in phonological development (Ingram et al., 1980). The Greek palatal fricative [ʝ] has a Dorsal[-back] articulation like English /j/ and, further, as Bernhardt & Stemberger (1998) argue, palatal fricatives have both a Dorsal and a Coronal place of articulation which may explain why [ʒ] substitutes both Greek [ʝ] ande English /j/.

Maria Sofia's pattern /j/, [ʝ]→[l] mostly occurs at word initial position while /j/, [ʝ]→[ʒ] in word medial position. It is noted that [ʝ] is found in the present study to substitute many consonantal segments including /z/ as also reported by Magoula (2000). However, the reverse pattern [ʝ]→[ʒ, z] was not reported while here [ʝ]→[z] also appears at the smaller rate of 3%. In English, Maria Sofia's /j/→[z] is present at 4%. Furthermore, there exists the substitution pattern [ʝ]→[t] only at word initial position, on the weighted average of 37%. However, its arithmetic average is 7% as it only occurs in the word *γιατί* [ʝati]→[tati], 16 out of 22 different instances, while there are 10 targeted word types with [ʝ-]. Stopping of fricatives to the [Coronal] is universally common (e.g. Bernhardt & Stemberger, 1998) but, here, the substitution results from an assimilatory process. Velar and labial assimilations are reported to be far more common (e.g. Menn, 1978, Smith 1973; Stemberger & Stoel-Gammon, 1991, etc.), but the coronal assimilation found here is lexically dependent, in that it only occurs in the word [ʝati] (why). In Maria Sofia's English the similar /j/ also becomes [t] but only once in the word *yes* whose productions at different instances involved mainly [ʒ] and [z] as /j/'s substitutions.

/ɹ/ vs. /ɾ/. Table 4.19 depicts the substitution patterns of /ɹ/ and /ɾ/ at each word position.

Table 4.19 Substitutions of /ɹ/ and /ɾ/ on word position

	Initial		Final		Medial	
Pattern	**E**	G	**E**	G	**E**	G
/ɹ, ɾ/→[l]	**41%** *18/44*	13% *2/15*	**33%** *23/69*	n/a	**11%** *9/83*	47% *157/331*
/ɹ/→[v]	**43%** *19/44*	n/a	**0%** *0/69*	n/a	**0%** *0/83*	n/a

The central liquid is [+consonantal] in Greek, the flap /ɾ/, but [-consonantal] in English, the approximant /ɹ/. In both English and Greek, Maria Sofia's rhotics have [l] as the dominant substitution at the rates of 26% and 46%, respectively, cumulatively for all word positions. In English, however, [v] also appears as a main substitute for /ɹ/ at 10% overall and 43% at word initial position where it occurs exclusively. In both English and Greek, the [l] substitution appears in all possible word positions. Examples are, *rabbit* [labɪtʰ] (with the b devoiced), *restaurant* [lestant], *story* [stɔlɪ], *bear* [beəl], *car* [tɑ:l], *sister* [sistəl], *together* [tʊʤeləl], in English and *ρωτάς* /ɾotas/→[lotas]~[lodas], *γέρος* [ʝeɾos]→[ʝelos], *ευχαριστώ* /efxaristo/→[falisto], *κατάφερα* /katafeɾa/→[tatafela]. However, in English it is dominant in initial and final positions. The reason is that, in English, out of 83 /ɹ/ targets in medial position, 66 are involved in clusters where they are deleted all the time. On the other hand, in Greek where /ɾ/ gets deleted in clusters 97% of the times, the proportion of clusters in medial position is not as large as in English, 44% (146/331) vs. 80% (66/83). That's why, in Greek medial position, /ɾ/→[l] is a dominant pattern. The lateral as a substitution for consonantal rhotics is a known process cross-linguistically (e.g. Bernhardt & Stemberger, 1998 and references therein, Magoula, 2000). As /ɹ/ is a glide, it is usually substituted by [w] in both monolingual (e.g. Smith, 1973) and bilingual English development (e.g. Leopold, 1949) keeping faithful to **Survived(Labial, -consonantal)** ranking lower than **Not(Coronal)**. The /ɹ/→[l] pattern is not entirely unusual even in monolingual English (e.g. Smith, 1973), however, less common. Bernhardt & Stemberger (1998:306) also report the non-velarized lateral for /ɹ/ in coda. What is certain is that [-consonantal] is highly marked and not yet contrastive in Maria Sofia's system. As the lateral is the nearest alternative to the sonorous target, the substitution /ɹ/→[l] is governed by the constraints **Survived(Coronal, +sonorant)** ranking lower than **Not(-consonantal)**. The /ɾ/→[l] pattern is common in monolingual Greek development (e.g. PAL, 1995; Magoula, 2000; Stephany, 1997). Within the group of liquids, centrals are acquired after laterals (e.g. Dinsenn, 1992). Therefore, the acquired [l] (at 83% in context) surfaces with the higher constraint **Not(+central)** instead of **Not(-consonantal)** which is the higher constraint governing the same substitution for the English rhotic. The fact that Maria Sofia has an underlying representation for English /ɹ/, that is different to that of Greek /ɾ/, is evidenced in the existence of the /ɹ/→[v] pattern only in English, in word-initial position. The tokens are *read* [viːd]~[wiːd̥], *reading* [viːdɪn], *red* [ved], *room* [vuːm] and *run* [vʌn]. In the last two words both patterns, [l]~[v], are interchanged in her productions at different instances. It is argued that, as **Not(-consonantal)** ranks high at this stage, faithfulness to the alveolar approximant comes through **Survived(Labial)**. [Labial] is the secondary articulation of both the alveolar approximant, [ɹ], and of the velar glide, [w], which usually substitutes monolingual English /ɹ/ (Bernhardt & Stemberger, 1998). The labial voiced fricative, /v/, never appears as a substitution of the Greek rhotic which does not have any secondary articulation.

/h/ vs. /x/, [ç]. Table 4.20 shows the substitution patterns of /h/, /x/ and [ç] at each word position.

Table 4.20 Substitutions of /h/ and /x/, [ç] on word position

	Initial		**Final**		**Medial**	
Pattern	**E**	G	**E**	G	**E**	G
/h, x/→[s]	**38%** *15/40*	32% *7/22*	**n/a**	n/a	**0%** *0/1*	11% *2/18*
/h, x/→[ʃ]	**45%** *18/40*	36% *8/22*	**n/a**	n/a	**100%** *1/1*	39% *7/18*
/x/→[t]	**n/a**	0% *0/22*	**n/a**	n/a	**n/a**	11% *2/18*
[ç]→[s]	**n/a**	75% *6/8*	**n/a**	n/a	**n/a**	20% *11/55*
[ç]→[ʃ]	**n/a**	13% *1/8*	**n/a**	n/a	**n/a**	45% *25/55*

Here the difference between English and Greek targets lies both in the [±consonantal] contrast and in privative articulator node; [Glottal] for /h/ and [Dorsal, ±back] for /x/, [ç]. With the exception of /x/→[t] at only word medial position, all three phonemes share the same substitutions, [s] and its bladed version [ʃ]. Examples in English include: *hello* [sɔloʊ]~[ʃʌloʊ], *help* [seəp], *here* [ʃiəl]~[siə], *hiding* [saɪdɪn], *hold* [ʃoɫ]~[soid], *behind* [bɪʃaɪnt]. In Greek examples for /x/→[s, ʃ] are: *χρώμα* /xɾoma/→[ʃoma], /xoɾepsume/→[ʃolepsume]~[solepsume], *έχω* /exo/→[εʃo], *δαχτυλίδι* /ðaxtiliði/→[ðastilili], while for [ç]→[s, ʃ] are: *χειμώνας* [çimonas]→[ʃimonas], *όχι* [oçi]→[oʃi]~[osi], *έρχεται* [erçete]→[esete], *πιάτο* [pçato]→[sato], *μάτια* [matça]→[matʃa], *πιάσω* [pçaso]→[pʃaso]. For /h/, **Not(Glottal, -consonantal)** ranks higher than **Survived(-voice, +continuant)**. The palatal fricative, [ç], in Greek has the same underlying representation with /x/, being its allophone. Therefore, their common pattern of substitution is not surprising in that fronting of velars and palatals is a widespread phenomenon in development (Jakobson, 1941/1968; Grunwell, 1981b). The usual substitution of /h/ in monolingual English children is deletion (e.g. Smith, 1973; Bernhardt & Stemberger, 1998) but Maria Sofia has a low rate of /h/ deletions at 2%, cumulatively for initial and medial positions. Knowing that [x] transferred to /h/ in the mother's input, it is not clear whether the child has an underlying representation of /h/ that is different than /x/ or whether it is her individual propensity for front articulations that equates /h/ and /x/→[Coronal, sibilant]. Interestingly, the reverse, /s/→[h], has been reported as a substitution pattern both in monolingual English and Portuguese Spanish (Bernhardt & Stemberger, 1998) indicating that if [Glottal, -consonantal] was in the child's system, but say [+sibilant] was not, then that pattern may have also surfaced in Maria Sofia's productions, both as target and substitution. It is noted that [s] is more prevalent in initial than medial position for all three targets. The same is true if [s] and [ʃ] are considered as one phone. Last, the Greek voiceless velar fricative is stopped to the default, /x/→[t], in the same assimilatory process that was discussed for [ɟ]. This solely occurs in the two grammatical forms of a single word type: *ξέχασα* /ksexasa/→[tetasa], *ξέχασες* /ksexases/→[tetases].

/w/ vs. /γ/. In table 4.21, the substitution patterns for /w/ and /γ/ at each word position are shown.

Table 4.21 Substitutions of /w/ and /γ/ on word position

	Initial		**Final**		**Medial**	
Pattern	**E**	G	**E**	G	**E**	G
/w, γ/→[v]	**59%** *41/70*	18% *3/17*	**n/a**	n/a	**0%** *0/2*	2% *1/62*
/w, γ/→[l]	**6%** *4/70*	47% *8/17*	**n/a**	n/a	**50%** *1/2*	53% *33/62*

The two [Velar] phonemes contrast with regard to [consonantal] and the secondary [Labial] articulation of /w/. Although their two main substitutions [v, l] are common, their proportions are different for the two targets because the underlying process is not the same. [v] is produced at 57% and 5% for /w/ and /γ/, respectively, while [l] at 7% and 52%, cumulatively at all word positions. The comparison holds true at each word position as well, except for medial English where there are insufficient tokens, only two. It is noted that the lesser of the two substitutions for each phoneme is a result of assimilation, for example, *flower* [faːlɔɫ], *γαύγισε* [ɣavɟise]→[vavise]. The first is an example of a lateral triggering assimilation (Smith, 1973) while in the second word a labial assimilation occurs which is common in phonological development (e.g. Menn, 1978, Smith 1973; Stemberger & Stoel-Gammon, 1991, etc.). Examples of Maria Sofia's /w/→[v] are: *way* [veɪ], *want* [vont]~[vɔt], *water* [votəl], *window* [vɪndɔʊ]. This pattern of spirantization has been reported in the literature for monolingual English development (e.g. Berhnardt & Stemberger, 1998). As both [-consonantal] and [Velar] are highly marked in this child's productions, the glide is prohibited resulting in the [+consonantal] segment that is faithful to the secondary [Labial] articulation of /w/. Thus, **Survived(Labial, +voice)**, where the default in sonorants [+voice] is also respected, ranks lower than **Not(-consonantal)**. With regard to the /γ/→[l] pattern, one could argue that the same process of assimilation to the [lateral] is responsible, as seen in several tokens: *αλογάκι* /aloɣaci/→[alolati], *γάλα* /ɣala/→[lala], *μεγάλη* /meɣali/→[melali]. However, in Greek the substitution is retained even in the absence of /l/ in the word, as in *γω* /ɣo/→[lo], *εγώ* /eɣo/→[elo], *φάγαμε* /faɣame/→[falame], *γράμματα* /ɣramata/→[lamata]. Liquid replacement of fricatives, though infrequent, has been reported in development (e.g. Ingram et al. 1980; Bernhardt & Stemberger, 1998). This substitution pattern is also found in the phonetic inventories of monolingual Greek children (e.g. Magoula, 2000). Here, the constraint **Not(Velar, -sonorant, +central)** ranks higher than the constraint **Survived(+voice, +continuant)**.

4.5.3 Common substitution patterns across the languages

Common substitution patterns for common consonant targets across the two languages, will now be discussed. Table 4.22 shows the substitution patterns for /f/ and /v/ at each word position for each language.

Table 4.22 Common substitutions for /f/ and /v/ across the languages

	Initial		**Final**		**Medial**	
Pattern	**E**	G	**E**	G	**E**	G
/f/→[s]	**3%** *1/29*	0% *0/51*	**0%** *0/2*	n/a	**13%** *2/16*	38% *22/58*
/v/→[m]	**100%** *1/1*	4% *1/28*	**0%** *0/8*	0% *0/1*	**0%** *0/5*	0% *0/35*

Each of the patterns shown in table 4.22 will now be discussed separately.

/f/→[s]. This is a substitution pattern dominant in Greek at 20% but also found in English at 6%, cumulatively for all word positions. The pattern appears mostly in word medial position. Examples in Greek comprise of: *αυτά* /afta/ [asta], *αυτί* /afti/→[asta], *εφτά*→[esta] and *κρύφτηκε* /kɾiftike/→[tisite], while in English it is found only in *further* [sevəɹ] and in *breakfast* [bɛstats]. It is observed that this pattern of substitution is found only in word types where at least one cluster is present that may involve /f/. Although /f/→[s] is found only in such cluster-containing word types, the reverse is not true, that is, not all /f/ word types containing a cluster are produced with [s] as a substitution. This high ranking of [Coronal] over [Labial] is a less common pattern in development, especially in English (Bernhardt & Stemberger, 1998:291) where acquisition of [f] precedes that of [s] (e.g. Templin, 1957; Moskowitz, 1971).

/v/→[m]. This pattern occurs only in the Greek word/name *Venizelo* /venizelo/ pronounced as [mɛmizɛlo] at 2;7.10 and [menizelo] at 2;7.06 in her English and Greek speech, respectively. In the first case, there is a bi-directional assimilation whereby the coronal, /n/, assimilates to the [Labial] of [v] becoming [m] but retaining [+nasal]. The [+nasal] feature, in turn, spreads to the left and triggers nasal assimilation of [v] →[m]. It is known that [nasal] spreads from right-to-left only (e.g. Ladefoged, 1993). However, in the only other word in English with nasal to the right of /v/ and in the majority of words in Greek, these constraints are not applicable, since /v/ is produced correctly. These words are: *pavement* [peɪvmən], *βάζανε* /vazane/→[vazane], *βουνά* /vuna/→[vuna], *βρούμε* /vɾume/→[vume], *καταλαβαίνει* /katalaveni/→[talaveni].

For a comprehensive review of Consonant Harmony (CH) theory, see Tzakosta (2007), a summary of which is provided here. CH patterns are usually accounted for in terms of place of articulation (e.g. Goad, 1997; Stoel-Gammon & Stemberger, 1994) and manner of articulation (Dinnsen, 1998). The preferred directionality of CH is mostly regressive (right-to-left) (e.g. Bernhardt & Stemberger, 1998) though progressive CH (left-to-right) is also possible. Various place markedness rankings have been reported in the literature for different languages: Dorsal >> Labial >> Coronal for L1 Canadian English, Labial >> Coronal >> Dorsal for L1 Canadian French (Rose, (2000); Labial >> Dorsal >> Coronal for L1 Greek (Kappa, 2001). The symbol >> means *higher ranked than*. Overall, velars and labials are triggers of CH while coronals are the targets. This is explained in terms of underspecification theory in that the default coronals draw the spreading of features from more marked segments (Stoel Gammon & Stemberger, 1994). In a study of nine children acquiring L1 Greek, Tzakosta (2007) has found that CH in L1 Greek exhibits exceptional patterns in that coronals are not targets but triggers of the process. She further argues that consonantal harmonies in L1 Greek are affected not only by place and manner considerations, but also by markedness scales and word stress.

Table 4.23 depicts the substitution patterns for /θ/ at each word position for each language.

Table 4.23 Common substitutions for /θ/ between the languages

	Initial		**Final**		**Medial**	
Pattern	**E**	G	**E**	G	**E**	G
/θ/→[s]	**38%** *3/8*	19% *25/130*	**0%** *0/3*	n/a	**100%** *1/1*	46% *25/54*
/θ/→[ʃ]	**38%** *3/8*	44% *57/130*	**67%** *2/3*	n/a	**0%** *0/1*	46% *25/54*
/θ/→[t]	**25%** *2/8*	11% *14/130*	**0%** *0/3*	n/a	**0%** *0/1*	4% *2/54*
/θ/→[f]	**0%** *0/8*	2% *2/130*	**33%** *1/3*	n/a	**0%** *0/1*	0% *0/54*

Each of the patterns shown in table 4.23 will now be discussed separately.

/θ/→[s]. The apicalization pattern in /θ/→[s], present at 33% in English and 27% in Greek, cumulatively for all word positions, is a common developmental pattern for the voiceless interdental in both languages (e.g. Ingram et al., 1980; PAL, 1995; Bernhardt & Stemberger, 1998). The constraint **Not[-strident]** ranks higher than **Survived(Coronal, -voice +continuant)** in the substitution [s] for /θ/ in the child's productions. Examples are: *Dorothy* [dəɹəs.zɪ], *thank* [sent], *ήρθε* /iɾθe/→[ise], *θυμάσαι* /θimase/→[simase] and *κοιμηθεί* /kimiθi/→[pimisi], παραμυθάκι /paɾamiθaki/→[pamisati]. In Greek, the substitution pattern is more prevalent in medial position while in English there is not enough data to tell.

/θ/→[ʃ]. Laminalization of the voiceless interdental at 42% (English) and 45% (Greek), cumulatively for all word positions, is also strongly present in both languages as a correlate/variant of the /θ/→[s]. This laminalization pattern, present in the substitutions of the child's fricatives in general was discussed earlier (see /z/→[ʒ]). Examples across different positions are: *both* [boʊʃ], *mouth* [maʊʃ], *thank* [ʃɛnt], *throw* [ʃoʊ], *ήθελες* /iθeles/→[iʃeles], *θέλω* /θelo/→[ʃelo]. Cumulatively, /θ/→[s, ʃ] in Greek is more prevalent in medial position than in word initial position, 92% vs. 63%.

/θ/→[t]. Another common substitution process for the voiceless interdental between the two languages is its stopping. In English it occurs only in word initial position and at 25%, *through* [tu]. In Greek, its overall proportion is 9%, e.g. θέλω /θelo/→[telo], being more prevalent in word initial position than in medial position, 11% vs. 4%. Here, the non-default terminal feature [+continuant] is not contrastive, thus, the constraint **Not(+continuant)** ranks higher than **Survived(Coronal, -voice)** resulting in the default for place, manner and laryngeal features, [t]. In this substitution pattern for /θ/ as well as in the two previous patterns, [Coronal] is the highest ranked default for [place], faithful to the target.

/θ/→[f]. Last, to a lesser degree**,** labialization of the voiceless interdental occurs overall at 8% and 1% in English and Greek, respectively, only in the functional words *both* [boʊfts] and *θα* [fa]. It is known that the non-default [Labial] is sometimes preferred in development to the [Coronal] when there is a co-occurrence of the terminal feature [+continuant] (Bernhardt & Stemberger, 1998).

In table 4.24, the substitution patterns for /ð/ at each word position for each language are shown.

Table 4.24 Common substitutions for /ð/ between the languages

	Initial		**Final**		**Medial**	
Pattern	**E**	G	**E**	G	**E**	G
/ð/→[l]	**22%** *22/102*	17% *18/103*	- *0/0*	n/a	**67%** *6/9*	72% *52/72*
/ð/→[t]	**6%** *6/102*	11% *11/103*	- *0/0*	n/a	**0%** *0/9*	3% *2/72*
/ð/→[n]	**9%** *9/102*	0% *0/103*	- *0/0*	n/a	**0%** *0/9*	3% *2/72*

Each of the patterns shown in table 4.24 will now be discussed separately.

/ð/→[l]. The lateralization is the main substitution pattern of the voiced interdental fricative, overall at 25% in English and 40% in Greek. The pattern seems to be more prevalent in medial than in word initial position in both languages. However, a closer examination reveals that the size of this gap is due to the large proportion of function words in word initial /ð/ for which the substitution pattern in question is not as prevalent as in other words. In English, the proportion is at 100% (6/6) while in Greek is at 33% (7/21) with a proportion of tokens at 74% (76/103), yielding arithmetic averages of 37% and 49% for word initial and medial positions in Greek, respectively. Examples of the lateralization pattern in the two languages are: *that* [læt], *this* [lɪs], *other* [ʌlәl], *together* [tʊʤelәl], *δώσει* /ðosi/→[losi], *εδώ* /eðo/→[elo], *μουσούδα* /musuða/→[musula], *χαιδέψω* /xaiðepso/ →[sailepso]. Here, the constraint **Not(-sonorant, +central)** ranks higher than **Survived(Coronal, oral)** forcing [lateral] to surface in both languages. Interestingly, the same constraint is also found in Greek *εδώ* /eðo/→[eʎo]~[eɫo]. The lateralization of /ð/ is largely uncommon in both monolingual English and Greek development. In monolingual English, [d] is the dominant substitution (e.g. McLeod, & Bleile, 2003; McLeod, 2007) which is found at only 1% in Maria Sofia's English and Greek. PAL (1995) and Magoula (2000) only report stopping, apicalization and palatalization of /ð/ for monolingual Greek children, patterns that are also found in Maria Sofia's data, though infrequently. The Rice and Avery (1995) feature geometry model cannot account for this substitution pattern as it does not have a built-in connection between [±continuant] and [±sonorous]. Ingram et al. (1980), however, mention lateralization as a possible, yet infrequent, substitution of the voiced interdental fricative in English in Stage 3. Bernhardt & Stemberger, (1998) argue that liquids 'serve relatively infrequently as substitutions or defaults' (331), in general, but they do acknowledge lateralization of /ð/ as more frequent in Spanish and Greek than in English.

/ð/→[t]. Stopping of /ð/ is present at 5% in English and 7% in Greek, overall. The constraint **Not(+voice, +continuant)** ranks higher than **Survived(Coronal, +anterior)** resulting in [t], the default for place, supralaryngeal and laryngeal features. This pattern is very common in the early stages of monolingual development cross-linguistically, but also in Greek and English (e.g. McLeod & Bleile, 2003; McLeod, 2007). The words *εδώ* /eðo/→[ɛtʰo] and multisyllabic *Σπυριδούλα* /spiɾiðula/→[pititula] are the examples in Greek. In the majority of tokens, however, the coronal default is preferred for different reasons in the two languages. /ð/→[t] in English occurs in function words (*the*, *this*) because they are prosodically weaker; it is known that the less marked choice is preferred in less prominent prosodic positions (e.g. Bernhardt & Stemberger, 1998). On the other hand, the majority of /ð/→[t] in Greek is a result of consonantal harmony (CH), spreading [-voice, -continuant] to the left in the produced word and ranking it higher than the terminal non-defaults [+voice, +continuant] expected in /ð/. Examples include *δείξω* /ðikso/→[titso], *δικό* /ðiko/→[tito], *δικά* /ðika/→[tita]. This explains why the pattern /ð/→[t] is more prevalent in word initial position.

/ð/→[n]. This realization pattern is at 8% in English vs. 1% in the Greek word *εδώ* /eðo/→[eno]. The English words are: *the* [nə], *there* [neə] and *this* [nɪs]. The /fricative/→[nasal] pattern of substitution has been reported in the literature (Bernhardt & Stemberger, 1998). The child's /ð/→[n] pattern is governed by the constraint **Not(oral)** ranking higher than **Survived(Coronal)**.

Ingram et al. (1980) report the following stages in the acquisition of word-initial fricatives in English before the final stage of complete acquisition: Stage 1: deletions; Stage 2: stops; Stage 3: liquids, glides and, subsequently, obstruents. With regard to her interdental fricatives, Maria Sofia is between Stages 2 and 3, though closer to Stage 3, because [t, s, ʃ, l, n] dominate the substitutions not only in word initial position, as reported by Ingram et al. (1980), but in all word positions. As far as the rest of her fricatives are concerned, Maria Sofia is at Stage 3 since her productions involve liquids and obstruents.

In table 4.25, the substitution patterns for /k/ and /g/ at each word position for each language are shown.

Table 4.25 Common substitutions for /k/ and /g/ between the languages

	Initial		**Final**		**Medial**	
Pattern	**E**	G	**E**	G	**E**	G
/k/→[t]	**84%** *58/69*	88% *106/120*	**84%** *54/64*	n/a	**93%** *38/41*	91% *108/119*
/g/→[d]	**83%** *30/36*	- *0/0*	**30%** *7/23*	n/a	**71%** *15/21*	33% *4/12*
/g/→[t]	**3%** *1/36*	- *0/0*	**61%** *14/23*	n/a	**10%** *2/21*	8% *1/12*
/g/→[ʤ]	**3%** *1/36*	- *0/0*	**0%** *0/23*	n/a	**5%** *1/21*	50% *6/12*

Each pattern shown in table 4.25 will now be discussed separately.

/k/→[t]. This is the dominant substitution pattern for /k/ in both languages at 86% in English and 90% in Greek, overall. The proportion of the pattern in each word position is about the same. Examples include: *back* [bæt], *box* [bot], *car* [tɑːl], *cake* [teɪt], *close* [tʰoːz], *come* [tʰʌm], *pictures* [pɪtsaz], *duckling* [dʌtlɪn], *Mickie* [mɪtɪ], *sick* [sit], *talk* [dɔt], *εκκλησία* /eklisia/→[etisia], *κακός* /kakos/→[tatʰos], *κάνεις* /kanis/→[tanis], *ανοίξεις* /aniksis/→ [anitsis], *σκαμνί* /skamni/→[tami], *λύκος* /likos/→[litos], *μακριά* /makɾia/ [matia], etc. Fronting to [Coronal] is known to be a universal in the acquisition of the velar stops prevalent cross-linguistically (e.g. Leopold, 1949; Smith, 1973; Schnitzer & Krasinski, 1994, Magoula, 2000, PAL, 1995). The non-default privative node, [Dorsal], is cancelled permitting default [Coronal] to surface through the constraint **Not(Labial, Dorsal)** ranking higher than **Survived(-voice, -continuant)**.

/g/→[d]. Similarly, /g/ is fronted to [Coronal] at 65% in English and 33% in Greek, overall, with 22 and 6 word types in English and Greek, respectively. However, the proportion at word final position is smaller because of the devoicing of [d]. Examples of /g/→[d] are: *again* [əden], *big* [bɪd], *forgot* [fəkʰədɒt], *get* [det], *give* [dɪ], *glass* [dæs], *hug* [ʃʌd], *αγκαλίτσα* /agaliʦa/→[adalitʃa], *μαγκώσει* /magosi/→[madoʦi], *φεγγαράκι* [fega'ɾaci]→ [fed̪alati].

/g/→[ʤ]. Lenition of /g/ to the voiced affricate is evidenced at 50% in Greek and 3% in English, overall. The lexical dependence of this pattern in Greek is evident in the multiple occurrence at different instances of the word *αγκαλιά* [agaʎa]→[adʒaʝa]. This /g/→[ʤ] pattern is in agreement with faithfulness to [Coronal] found in the /Velar/→[Coronal] pattern elsewhere in the child's two languages but also, universally, in development. However, here the laminalization seems to result from assimilation to [ʝ] in the output, under the assumption that Greek palatals are both [Coronal, -anterior] and [Dorsal, -back], as generally reported for palatals by Bernhardt & Stemberger (1998). The fricative, [ʝ], in the child's output is a substitute of [ʎ] because [lateral] ranks low in the output; it is known that less sonorous outputs are preferred in development (e.g. Bernhardt & Stemberger, 1998). Further proof for this comes from the word *αγκαλίτσα* /agaliʦa/ pronounced [adalitʃa] where the lack of [ʎ]→[ʝ] in the word results in the more dominant /g/→[d] pattern. In English, /g/→[ʤ] is present 1 out of 6 times in the word *again* [əʤeːn] and 1 out 3 times in the word *glass* [ʤas].

/g/→[t]. Fronting and devoicing of /g/ to [t] is evidenced at 21% in English and at 8% in Greek, overall, and mostly in word final position in English as word final /g/ in not allowed in the Greek language. Examples are *big* [bɪtʰ]~[bɪtʰ], *dog* [dɔt] and *egg* [eːft], though there is also a token of word-initial devoicing in *green* [tiːn]. In Greek, devoicing is found in a single word, *στ'αγγλικά* /staglika/→[tatida], instead of *[tadita], where [+voice] is involved in metathesis.

4.5.4 Substitutions for remaining consonants specific to each language

The remaining consonants specific to each language, that is, /ɫ/ in English and /ʦ/, [c, ʎ] in Greek are discussed below since /ɹ/ and /ɾ/, /j/ and [ʝ], /w/ and /ɣ/, /h/ and (/x/, [ç]) were discussed above in relation to each other, respectively.

4.5.4.1 Substitutions for English specific consonants

In table 4.17.1, the substitution patterns of [ɫ] are shown.

Table 4.26 Substitutions for English [ɫ]

Pattern	Initial	Final	Medial
[ɫ]→[ə]	**n/a**	**11%** *3/28*	**39%** *7/18*
[ɫ]→[l]	**n/a**	**29%** *8/28*	**0%** *0/18*

The child's substitution processes with regard to the velarized lateral are at 22% for [ɫ]→[ə] and 17% for [ɫ]→[l], overall. These two patterns are consistent with those found in monolingual and bilingual English development (e.g. Leopold, 1949; Smith, 1973; Bernhardt & Stemberger, 1998 and ref. therein). The first pattern occurs mostly at word medial position in the words *help* [seəp] and *milk* [mɪət] while the second occurs at word final position in the words *cereal* [silɪəl], *girl* [del], *school* [stʊl], *snail* [s̪neəl] and *wall* [vol]. It looks like the first pattern is preferred in clusters while the second is preferred in singletons.

4.5.4.2 Substitutions for Greek specific consonants

Table 4.27 depicts quantitatively the substitution patterns for /ʦ/, [c] and [ʎ].

Table 4.27 Substitutions for Greek /ʦ/, [c], [ʎ]

Pattern	Initial	Final	Medial
/ʦ/→[ʧ]	50% *4/8*	n/a	12% *4/33*
[c]→[t]	78% *94/121*	n/a	92% *46/50*
[c]→[p]	15% *18/121*	n/a	0% *0/50*
[ʎ]→[j]	0% *0/1*	n/a	58% *7/12*
[ʎ]→[l]	100% *1/1*	n/a	17% *2/12*
[ʎ]→[ʒ]	0% *0/1*	n/a	8% *1/12*

The Greek affricate /ʦ/ is laminalized to [ʧ] at 20%, overall, following the same process discussed above for fricatives. The pattern is more prevalent at word initial position than in medial position. Examples in both positions include: *τσουρέκι* [tsuɾeci]→[tʃuleti], *κατσαρόλα* /katsaɾola/→[tatʃalola]. With regard to the palatals [c] and [ʎ], major substitutions enforce depalatalization to the coronal place of articulation, retaining faithfulness to respective laryngeal and supralaryngeal features. Therefore, [c] becomes [t] at 82%, overall, matching the substitution pattern of /k/, which is the underlying representation of this allophone in Greek, e.g. *και* [ce]→[te], *κιόλας* [colas]→[tolas], *κύκλο* [ciklo]→[tito], *λουλουδάκια* [luluðaca]→[lululata]. Also, [ʎ] depalatalizes to [l] at 23%, overall, constrained by **Not(-anterior)** ranking higher than **Survived(Coronal, +lateral)**, under the assumption that [ʎ] is [Coronal, -anterior]. On the other hand, assuming that [ʎ] is [Dorsal, -back], then the substitution [l] for [ʎ] is constrained by **Not(Dorsal)** ranking higher than **Survived(+lateral)** as in *λιοντάρι* [ʎodaɾi]→[lodali], *μαλλιά* [maʎa]→[mala]. Moreover, [c] becomes 15% [p] at word initial position in assimilation to the [Labial] in the word, as discussed above for other consonants. It is only found in grammatical forms of the single word *κοιμάται* [cimate]→[pimate], *κοιμηθώ* [cimiθo]→pimiso, κοιμηθεί [cimiθi]→[pimisi], *κοιμηθούμε* [cimiθume]→[pimisume]. Last, [ʎ] becomes [ʝ] in the words αγκαλιά [agaʎa]→[adʒaʝa] and σχολιό [sxoʎo]→[ʃoʝo] and [ʒ] in the word δουλειά [ðuʎa]→[ʒuʒa]. It has been reported in the literature (e.g. Smith, 1973) that /l/ becomes /j/ during development. Here, also [Dorsal] predominates at the loss of [lateral].

4.5.5 Deletions

Deletions which occur at a rate of 5% or higher per consonant are examined below in both Greek and English. However, when deletion is examined for a consonant in one language, it is also examined for comparison in the other language when it is applicable, even if it is lower than 5%.

4.5.5.1 Labial deletions

In table 4.28, labial deletion is shown for each language, at each word position and in singleton and cluster context.

Table 4.28 Deletions of labials on word position, singletons and clusters

	Initial		**Final**		**Medial**		**Singleton**		**Cluster**	
Labial	**E**	G	**E**	G	**E**	G	**E**	G	**E**	G
/f/ →[Ø]	**14%** *4/29*	10% *5/51*	**0%** *0/2*	n/a	**0%** *0/16*	9% *5/58*	**7%** *3/42*	1% *1/69*	**20%** *1/5*	23% *9/40*
/v/→[Ø]	**0%** *0/1*	0% *0/28*	**63%** *5/8*	0% *0/1*	**60%** *3/5*	0% *0/35*	**62%** *8/13*	0% *0/43*	**0%** *0/1*	0% *0/21*

The deletions of /f/ and /v/ will now be discussed separately.

/f/→[Ø]. English /f/ is deleted at initial word position only, at 14% (9% overall), in the function words *for* [ə]~[ɔ] and *from*→[ə], which constitute weaker syllables of larger phonological words. It is known that faithfulness ranks low in unstressed syllables because they are a weaker prosodic domain (e.g. Grunwell, 1981b; Bernhardt & Stemberger, 1998). In Greek, /f/ deletions occur also at 9% overall, and mostly in cluster contexts, e.g. *αυτό* /afto/→[ato], *κρυφτούμε* /kɾiftume/→[titume], *φτάσεις* /ftasis/→[tat͡sis]. Out of 15 words containing a /fC/ cluster, deletion occurs in 6 of them. However, deletion also occurred in the singleton /f/ multisyllabic word *φωνάζουμε* /fo'nazume/→['nazume] where the entire /fV/ unstressed syllable is deleted.

/v/→[Ø]. English /v/ is deleted at 57%, overall, and only in syllable-final and word-final positions; one /v/ is targeted at word initial position. Out of 2 words with /v/ at word final position, *give* and *leave*, Maria Sofia deletes /v/ only in *give* [dɪ]~[ɟɪ] where there is a consonant, /g/, that has not been acquired (0%). In word medial position there is deletion in *pavement* [peɪment]~[peɪemən] but not in *moved* [muːzv] and *TV* [tivi]. In Greek there is no deletion in 38 word types including the word-final loan word *μωβ* /mov/→[mov], as /v/ has been completely acquired, at 92%.

In conclusion, /f/ gets deleted at word initial English and in /ft/ clusters at word initial and medial position Greek. /v/ gets deleted in syllable final and word final positions in English only, as it has been completely acquired in Greek.

4.5.5.2 Coronal deletions

Table 4.29 depicts quantitatively Maria Sofia's coronal deletions for each language, at each word position and in singleton and cluster context.

Table 4.29 Deletions of coronals on word position, singletons and clusters

	Initial		**Final**		**Medial**		**Singleton**		**Cluster**	
Coronal	E	G	E	G	E	G	E	G	E	G
/θ/→[Ø]	**0%** *0/8*	15% *19/130*	**0%** *0/3*	n/a	**0%** *0/1*	0% *0/54*	**0%** *0/9*	12% *19/164*	**0%** *0/3*	0% *0/20*
/ð/→[Ø]	**39%** *40/102*	48% *49/103*	- *0/0*	n/a	**0%** *0/9*	8% *6/72*	**36%** *40/110*	32% *52/165*	**0%** *0/1*	30% *3/10*
/t/→[Ø]	**4%** *2/49*	8% *25/300*	**12%** *27/234*	n/a	**24%** *11/45*	12% *33/283*	**8%** *19/248*	6% *24/414*	**26%** *21/80*	20% *34/169*
/d/→[Ø]	**0%** *0/73*	- *0/0*	**21%** *16/77*	n/a	**0%** *0/22*	0% *0/17*	**7%** *10/145*	0% *0/17*	**22%** *6/27*	- *0/0*
/s/→[Ø]	**6%** *4/64*	38% *61/161*	**3%** *6/212*	9% *23/249*	**2%** *1/50*	2% *6/252*	**2%** *4/218*	5% *24/487*	**8%** *9/108*	38% *66/175*
/n/→[Ø]	**1%** *1/89*	16% *26/163*	**11%** *12/114*	43% *15/35*	**44%** *47/108*	2% *4/225*	**6%** *13/229*	10% *42/420*	**57%** *47/82*	100% *3/3*
/l/→[Ø]	**8%** *3/38*	7% *2/28*	**50%** *2/4*	n/a	**61%** *62/102*	15% *45/300*	**7%** *6/83*	5% *15/295*	**100%** *61/61*	88% *29/33*
/ɹ/→[Ø]	**0%** *0/44*	n/a	**54%** *37/69*	n/a	**86%** *71/83*	n/a	**31%** *39/126*	n/a	**99%** *69/70*	n/a
/ɾ/→[Ø]	**n/a**	73% *11/15*	**n/a**	n/a	**n/a**	48% *159/331*	**n/a**	14% *28/200*	**n/a**	97% *142/146*
/ʃ/→[Ø]	**13%** *1/8*	n/a	**0%** *0/4*	n/a	**50%** *1/2*	n/a	**8%** *1/12*	n/a	**50%** *1/2*	n/a

The deletions of each coronal will now be discussed separately.

/t/→[Ø]. The overall proportion of /t/ deletions in English is 12%. Examples of word final deletion are: *blanket* [pʰætə], *carpet* [tʰaːpə], *don't* [doʊ]~[don], *sit* [si], *put* [pʰʊ], *street* [sti:], *want* [vɔ], *missed* [mɪs]. Out of 41 word types with word-final /t/, 10 of them have /t/ deleted. Evidence of correct production of word final /t/ in the majority of the remaining instances, e.g. *basket*, *bit*, *biscuit*, *brought*, *eat*, *fit*, *get*, etc. proves that word-final /t/ is acquired. This matches reports of final consonant deletion waning as a simplification process in monolingual English by age 2;6 (e.g. Grunwell, 1981b, Beers, 1995). Furthermore, /t/ deletion in word final position agrees with the findings of Smit (1993a) that all obstruents in final word position may be deleted by monolingual English children in Maria Sofia's age group. In word medial position /t/ deletions are involved in cluster reduction as in *downstairs* [daʊnseəs], *let's* [les] and *upstairs* [ʌpseəz] as target clusters dominate this position at 91% (41/45). Out of 33 word types with /t/ clusters, 8 of them have /t/ deleted. The proportion of /t/ deletions in Greek is at 10%, overall, and explanations are in similar lines to those in English. Deletion in a cluster context is more prevalent as in *αυτοκίνητο* /aftokinito/→[fafotinito], *μπιστόλα* /bistola/→[ᵐpʰisola], *στη* /sti/→[i] and *στο* /sto/→[o]. There are two words that involve a /t/ cluster in a weaker syllable where the entire syllable gets deleted: *τραβήξω* /tɾa'vikso/→['vitso], πορτοκαλί /poɾtoka'li/→[pota'li]. Out of 57 word types with /t/ clusters, 7 of them have /t/ deleted. The remaining Greek /t/ deletions are onset deletions in the function words *τα* /ta/, *τη* /ti/, *το* /to/ as was the case for the English word initial /f/ function words. Overall, /t/ in cluster /st/ dominates deletions in word medial position as is also the case in English.

/d/→[Ø]. This pattern occurs only in English final position at 21% in 4 word types in a cluster context and in 2 word types as a singleton /d/, out of a total 13 cluster word types and 31 singleton word types. The clusters word types are *and* [ən], *find* [ʃaɪn], *hold* [ʃoɫ] and *moved* [muːzv] while the singleton word types are *inside* [ɪsaɪ] and *red* [ve:]. In Greek, /d/ is not allowed in final word position and the child has no targets in a cluster context or in word initial position while it has completely acquired (100%) it in word medial position.

/n/→[Ø]. This pattern is present at 19% in English and at 11% in Greek, overall. In English, deletion is more prevalent in word medial position where all the /n/'s in a cluster context exist. In fact, all the deletions in word medial position are in a cluster context. Examples are: *and* [ət], *auntie* [ɑːtini], *find* [ʃaɪd], *pavement* [peɪmet]. In word final position examples include: *again* [əɟe], *crown* [taʊ], *mine* [maɪ], *one* [ʌ], *spoon* [pʰuː]. In initial word position there is only one occurrence of /n/ deletion in the function word *not* which was targeted 10 times. In Greek, there is only 1 cluster word type, with /n/ being deleted all three times that it was targeted: *σκαμνί* /skamni/→[tami]~[ami]. In word final position, there are in proportion more deletions at 43% where 5 out of 9 word types get deleted, all being function words: *δεν* [e], *όταν* [ota], *στην* [ti], *την* [ti], *τον* [to]. The above /n/ deletions in both languages show that, at 2;7, Maria Sofia simplifies the intended CCV and CVC syllables as CV in her production, which is the universally unmarked syllable pattern in child phonological development (e.g. Ingram, 1989a, Fikkert, 1994). In Greek, /n/ deletions are observed at word initial position of the function word *να*→[α], 25 out 130 times and of the multisyllabic word *Ναταλία* /natalia/→[ata'lia] in the single occurrence that it was targeted, as part of the weaker syllable.

/s/→[Ø]. Deletions of /s/ are evidenced at a substantial proportion only in Greek, at 14%, overall. The reason is that the child substantially deletes her word initial /s/ clusters only in Greek; 67% (56/84) in Greek vs. 13% (4/32) in English. This is because deletions occur mostly in word initial /sk/, /sp/ and /st/ clusters which drop in sonority, the latter mostly in function words which occur only in the child's Greek. Examples are: *spoon* [pʰuː], *σκαμνί* /skamni/→[ami]~[tami], *σπιτάκι* /spitaki/→[pitati], *σπρώξεις* /spɾoksis/→[potsis], *στο* /sto/→[to]. Her English contains several (11/32) word initial /s/ clusters rising in sonority, /sl/, /sm/, /sn/, where only one deletion occurs in the word *snail* [nelɔʊ] which was targeted three times. The reduction of /s/ plus a stop or nasal clusters to the stop or nasal, agrees with normative data of monolingual English children (e.g. Smit, 1993b). Last, in Greek, out of 29 word types with /s/ deletions, 16 of them have it at word final position, e.g. *μπορείς* /boɾis/→[boi], *Νικόλας* /nikolas/→[nitʰola], *ταίσεις* /taisis/→[tai:], *τις* /tis/→[ti]; there are 84 targeted word final /s/ word types. The child's deletion of word final /s/ in Greek further supports normative data reporting it present until age 4;0 in monolingual Greek (PAL, 1995).

/θ/→[Ø]. Deletion of /θ/ is evidenced only in Greek and at 10%, overall, even though /θ/ is produced correctly at a very low rate in each language, 0% in English and 4% in Greek. Deletion occurs only in the unstressed function word *θα* /θα/→[a], 17 times out of 49 times that it is targeted at different instances, and at initial position in the word *θέλω* /θelo/→[elo], 2 out of 35 times. No deletions occur in a cluster context; /θɹ/ in English and [θç] in Greek.

/ð/→[Ø]. Both languages show a considerable number of /ð/ deletions, at 36% in English and 31% in Greek, overall, as /ð/ is produced correctly at a very low rate in both languages. /ð/ deletions are much more prevalent in word initial position, 39% and 48% in English and Greek, respectively. The overwhelming majority of deletions are evidenced in the function words English *the* at 83% (33/40) and Greek *δε* /ðe/ at 91% (48/53). The remaining deletions are found word-initially in the English function words *there, they*, *this* and in Greek *δικό* /ðiko/→[itʰo], *οδηγάω* /oðiγao/→[oiao], where /ð/ is also part of prosodically weaker contexts, that is, unstressed syllables. In Greek only, deletions are also evidenced in the cluster context [ðʝ], e.g. *άδειο* [aðʝo]→[aʒo], *πόδια* [poðʝa]→[poʒa]. One could argue that fusion rather than deletion is the underlying process here whereby the primary nodes [Coronal, +anterior] in /ð/ and [Dorsal] in [ʝ] coalesce into the [Coronal, -anterior] of [ʒ]. However, this is not the case if one assumes that the Greek palatal fricative falls under the [Coronal, -anterior] articulator node. Substitution of the palatal [ʝ] by the palato-alveolar [ʒ] is concluded here as it exists in other contexts as well, at 11% of targeted [ʝ]. As a result, there is no fusion involved here; just /ð/ deletion.

/l/→[Ø]. This is the main pattern of non-correctness of /l/ in both languages occurring at 47% in English and 14% in Greek, overall. Deletions occur mostly in clusters which mostly exist in word medial position. Whenever there is a /Cl/ cluster in English, 61 times, /l/ gets deleted every single time, e.g. *airplane* [ɜːpɪn], *black* [pæt], *chocolates* [tɒtəts], *flower* [faːlɔɫ], *glass* [dæs], *play* [pʰeɪ], *sleep* [siːp], etc. On the other hand, as a singleton consonant, /l/ gets deleted 6 out 83 times, 7%, as in l*eave* [iːv] and *listening* [isənɪn]. In Greek, cluster /l/ deletion in clusters occurs 29 out of 33 times as in *βιβλίο* /vivlio/→[vivio], *γλύψει* /ɣlipsi/→[vipsi], έκλεισα /eklisa/→[titisa], κούκλα /kukla/→[tuta], μπλούζα /bluza/→[buza]. As a singleton in Greek, /l/ gets deleted 11 out of 295 times, 4%. With the exception of a single token in Greek, *αλήθεια* [aliθça]→[aiʃa], the majority of word-initial and word medial deletions are evidenced in unstressed syllables, e.g. *άλλη* /ali/→[ai], *βάλεις* /valis/→[vais], *βγάλεις* /vγalis/→[vais], *γατούλα* /γatula/ [atual], *λιγάκι* /liɣaci/ [iati], *θέλει* /θeli/→[tɛi], *καλημέρα* /kalimeɾa/→[kaimala], *ποδήλατο* /poðilato/→[poðiato], *τηλέφωνο* /tilefono/→ [tiefono]. In English, however, deletions also occur in word-initial stressed syllables, l*eave* [iːv], *lips* [ips], *listening* [isənɪn] and as part of an entire weaker syllable deletion in *Willie* [vi]. These patterns and the higher proportion of deletions in English are commensurate with the general lag in the acquisition of the lateral in the language, discussed in section 4.4.1 above in terms of order of acquisition; /l/ is produced correctly at 47% in English vs. 83% in Greek as analyzed in section 4.4.2 above. Last, the velarized lateral, [ɫ], which does not exist in the Greek language, gets deleted at 26%, overall, in both medial and final word positions at 39% and 18%, respectively, as seen in table 4.18.4 below.

/ɹ/→[Ø]. Deletions of English /ɹ/ are evidenced at 55%, overall, occurring mostly in word medial position at 86%, where all the clusters exist. Out of 49 word types with deletions, 14 word types have /ɹ/ deleted in word-final position as in *bear* [be], *for* [fə], *here* [sɪə] and *other* [ʌlə]. 35 word types have /ɹ/ deleted in medial position in both onset and coda positions, 32 having the deletion in a cluster context as in *bread* [bet], *bridge* [biz], *dark* [daːt], *downstairs* [daʊnseəs], *horse* [ʃɔːʃ], *playground* [beɪndaʊnt], *through* [tu]. The reduction of clusters consisting of an obstruent plus /ɹ/ or /l/ to the less marked member of the cluster has been reported in the literature for monolingual English children until age 5;0 (e.g. Smit, 1993b).

/ɾ/→[Ø]. Deletions of Greek /ɾ/ are at 49%, overall, 84% (142/170) of which are in cluster contexts and word medially in syllable coda positions. Examples include: *αρκουδάκι* [aɾkuðaci]→[akuvaci], *άσπρη* /aspɾi/→[aspi], *γράμματα* /ɣɾamata/→[ɟamata], *έτρωγα* /etɾoɣa/→[etoʒa], *μαρμελάδα* /maɾmelaða/→[malelaða], *μαύρος* /mavɾos/→[bamos], *μπροστά* /bɾosta/→[botsa], *προκομμένη* /pɾokomeni/→[pokameni], *ρθεί* /ɾθi/→[ʃi], *τρώμε* /tɾome/→ [tʰome]. The remaining deletions are found in word medial position of both stressed and unstressed syllables, as in *κυρία* /ki'ɾia/→[tiia], *Μαρία* /ma'ɾia/→[maia], *ουρά* /u'ɾa/→[ua], *παρακαλώ* /paɾaka'lo/→[patalo], *παραμυθάκι* /paɾami'θaki/→[paemisati], *πάρεις* /'paɾis/→ [bais] indicating the overall low level of acquisition for this phoneme. /ɾ/ in the words *ρθω* /ɾθo/ and *ρθεί* /ɾθi/ is in coda position word medially and, thus, the proportions of /ɾ/ deletions at word initial and medial positions become 20% (1/5) and 50%, respectively, making the word medial position the most prevalent deletion position as is the case in the child's English /ɹ/.

Conclusively, pronounced coronal deletions common to the child's two languages target /l/, /n/ and /ð/, the first two of which occur predominantly in cluster context with an obstruent which is less marked. The same is true for the similar coronals, /ɹ/ and /ɾ/, in the two languages. Moreover, deletions of /l/, /n/ in English, and of /ɹ/ and /ɾ/, occur in word medial position within the aforementioned cluster context. The two interdentals, /θ/ in Greek and /ð/, get deleted by and large in singleton context in word initial position. /d/ gets deleted exclusively in word final position where in the Greek language, /d/ is not allowed as target. In both languages /t/ gets deleted in word medial position in /st/ clusters and in word initial and final positions in Greek and English, respectively, both as singleton and in cluster context. Last, /s/ in Greek gets deleted in word initial position in cluster context with a stop, /k, p, t/.

4.5.5.3 Palatal deletions

Table 4.30 shows quantitatively Maria Sofia's palatal deletions for each language, at each word position and in singleton and cluster context.

Table 4.30 Deletions of palatals on word position, singletons and clusters

	Initial		**Final**		**Medial**		**Singleton**		**Cluster**	
Palatal	**E**	G	**E**	G	**E**	G	**E**	G	**E**	G
[ɲ]→[Ø]	**n/a**	- *0/0*	**n/a**	n/a	**n/a**	10% *1/10*	**n/a**	0% *0/4*	**n/a**	17% *1/6*
[ç]→[Ø]	**n/a**	0% *0/8*	**n/a**	n/a	**n/a**	16% *9/55*	**n/a**	0% *0/35*	**n/a**	32% *9/28*
[ʝ]→[Ø]	**n/a**	2% *1/43*	**n/a**	n/a	**n/a**	33% *11/33*	**n/a**	3% *2/60*	**n/a**	63% *10/16*

It is observed that palatal deletion occurs overwhelmingly in cluster context which mostly exists in the child's productions with the palatal in word medial position. The most frequent /ʝ/ deletion occurs in the clusters [vʝ] and [ðʝ], while no [ʝ] deletion occurs in [ɾʝ] where /ɾ/ gets deleted. [ɲ] deletion occurs only in the word *μια* [mɲa]. Deletion of [ç] occurs only in cluster context which only exists with [ç] in word medial position. [ç] gets deleted in the clusters [θç] and [sç], but not in [pç], and in coda position word medially in [ɾç]. The terminal feature [voice] differentiates [ʝ] from [ç] and seems to play a role in their deletion patterns in cluster contexts. Overall, palatals get deleted at word medial position in cluster context with either coronals or labials.

4.5.5.4 Velar deletions

Table 4.31 depicts quantitatively Maria Sofia's velar deletions for each language, at each word position and in singleton and cluster context.

Table 4.31 Deletions of velars on word position, singletons and clusters

	Initial		**Final**		**Medial**		**Singleton**		**Cluster**	
Velar	**E**	G	**E**	G	**E**	G	**E**	G	**E**	G
[ɫ]→[Ø]	**n/a**	n/a	**18%** *5/28*	n/a	**39%** *7/18*	n/a	**17%** *4/23*	n/a	**35%** *8/23*	n/a
/ŋ/→[Ø]	**n/a**	n/a	**7%** *1/14*	n/a	**38%** *6/16*	- *0/0*	**7%** *1/14*	n/a	**38%** *6/16*	- *0/0*
/x/→[Ø]	**n/a**	9% *2/22*	**n/a**	n/a	**n/a**	39% *7/18*	**n/a**	4% *1/26*	**n/a**	57% *8/14*
/γ/→[Ø]	**n/a**	12% *2/17*	**n/a**	n/a	**n/a**	29% *18/62*	**n/a**	12% *7/57*	**n/a**	59% *13/22*
/w/→[Ø]	**7%** *5/70*	n/a	**n/a**	n/a	**50%** *½*	n/a	**7%** *5/71*	n/a	**100%** *1/1*	n/a

It is seen that velar deletion predominates in cluster context which mostly exists with the velar in word medial position in the child's productions. /ŋ/ gets deleted in /ŋk/, [ɫ] in [ɫs] and [ɫd], /w/ in /sw/, /γ/ in /vγ/, /γm/, /γɾ/ and /ɾγ/, and /x/ in /fx/, /sx/, and /xt/. Overall, velars get deleted at word medial position in cluster context with either coronals or labials.

4.5.6 Conclusions on substitutions and deletions

Most substitution processes found in Maria Sofia's Greek and English are in agreement with universal patterns in child phonological development in the two languages. There are, however, five exceptions indicating individual variation in her substitution processes when compared to monolingual norms. These are /ð, ɹ, j/, [ɟ]→[l], the first of which occurs in both languages, and /f/→/s/ in Greek. /ð/ becomes lateral [l] in singleton context 40% and 25% of the times that it is targeted in all contexts over all word positions in Greek and English, respectively, and more prevalently 72% and 67% of the times at word medial position in Greek and English, correspondingly. /ɹ/ becomes [l] 41%, 33% and 11% of the times that it is targeted at word initial, final and medial positions, respectively. Lateralization of /ɹ/ is not preferred at word medial position where it predominantly deletes because it most often occurs in cluster context. It is noted that /ɹ/ also becomes [v] at word initial position, 43% of the times that it is targeted. This substitution pattern specific to her system only, occurs instead of /ɹ/→[w], the norm in monolingual English children, who have acquired /w/ by this age. Maria Sofia only produces /w/ at 16% word-initially and, thus, she uses /w/'s main substitution instead, which is [v] at 59% in this word position. The main substitution of the

Greek rhotic, /ɾ/, is also the lateral [l] and this is the norm for monolingual Greek children, as well. /j/, [ʝ]→[l] is the main substitution pattern word initially at 13% and 23% for /j/ and [ʝ], respectively. Maria Sofia uses spirantization of [ʎ]→[ʝ] at 54%, a process that is common in monolingual Greek children. However, the reverse process, the lateralization of [ʝ] that is present here, has not been reported as a common process in monolinguals. Last, the coronalization of /f/→[s], which is common at word final position in monolingual English, occurs here at 20% and 6% over all word positions in Greek and English, respectively, but more prevalently at word medial position, 38% in Greek and 13% in English in words containing /f/ clusters or other clusters.

There are several differences between Maria Sofia's deletions in English and monolingual children's. It is common in monolingual English children around 2;7 to be still deleting obstruents in word final position. Maria Sofia deletes /v/, /t/ and /d/ in word final position at the rates of 63%, 12% and 21%, respectively. Her other English obstruents are deleted at rates lower than 5%. However, her English /v/ and /t/ are also deleted, prevalently, in word medial position at 60% and 24%, respectively, the latter due to its presence in cluster context. Maria Sofia's English /f/ and /ð/ are deleted only in word initial position at 14% and 39%, respectively, mainly in function words, while her English /θ/ is not deleted at all, even though it is never produced correctly in context.

The only obstruent that is allowed in the Greek language in final word position is /s/ which the child deletes at 9%. Her obstruents in Greek, common to English, delete in other word positions as follows: /ð/, /s/, /θ/, /t/ in word initial position at 48%, 38%, 15%, 8%, respectively, and /t/, /ð/ in word medial position as well at 12% and 8%, respectively. Deletions in Greek word initial /ð/ and /θ/ occur mostly in function words. This explains the difference with the non-existent deletion of English /θ/. Another main difference in obstruent deletions between the two languages is the strong presence of /s/ deletions in Greek word initial position. This occurs mostly in /s/ clusters that drop in sonority which are not prevalent in the child's English.

For the remaining common coronals in the two languages, deletions occur in /l/ and /n/, predominantly in cluster context where the least sonorous member is preserved, as is universally the case for the acquisition of clusters (e.g. Barlow, 2004). The same is true for the similar coronals, /ɹ/ and /ɾ/, in the two languages. Moreover, deletions of /l/, /n/ in English, and of /ɹ/ and /ɾ/, occur mainly in word medial position within the aforementioned cluster context resulting in the simplification of the syllable CCV to CV, as is universally the case for the acquisition of syllables (e.g. Stoel-Gammon & Dunn, 1985). Furthermore, /n, ɹ/ are deleted in word final position simplifying the syllable CVC to CV, as is also universally the case for the acquisition of syllables (e.g. Ingram, 1989a).

Deletions of glides are known to still persist in monolingual English around 2;7. Maria Sofia deletes /w/ at 8% and /j/ at 3%, even though /w/ is produced correctly in context only at 15%. She prefers to substitute /w/ with [v] rather than delete it, in contrast to monolinguals preferring deletion.

Comparing deletions in Maria Sofia's English clusters with monolingual children's, there is a difference in the production of /s/ clustering with a stop or nasal. In monolingual children, these clusters reduce to the stop or nasal. In Maria Sofia, /sk/, /sp/ and /st/, which drop in sonority, reduce to the stop at word initial position but /st/ reduces to /s/ in word medial position. Moreover, her /sn/ and /sm/, which rise in sonority, do not reduce at word initial position, contrary to monolinguals' /sn/ and /sm/ which reduce to the nasal. It is noted that the Greek language does not allow these two clusters in any word position. It is interesting that Maria Sofia at 2;7 adheres to the sonority sequencing principle (see chapter 6) even for /s/, even though the principle does not apply to /s/ in the English language. Above it was mentioned that when /l/ or /ɹ/ are in a cluster with an obstruent which is less marked, they get deleted in Maria Sofia's speech. This agrees with what monolinguals do.

Another pattern in Maria Sofia's cluster reduction is the deletion of palatals and velars in cluster context with either coronals or labials as a result of their level of acquisition; labials and coronals are at a much higher level of acquisition than palatals and velars which assimilate to them in singleton context at a much smaller proportion than systemic substitutions.

There is evidence of phonetic differences in the substitution patterns of common consonants in the child's two languages, though limited. The pattern /z/→[ʒ] occurs only in the child's Greek, 11% at word initial position and 8% at word medial position, even though /ʒ/ does not exist in standard Modern Greek. The other apparent differences are /d/→[t] and /z/→[s] which only occur in English. A closer examination revealed that the first occurs mainly at word final position, 39%, but also at word initial and medial positions, 8% and 5%, respectively, while the second occurs only at word final position, 32%, as there is only one target at word initial position. However, since final /z/ and /d/ are not allowed in the Greek language, the differences /d/→[t] and /z/→[s] between the languages are erased.

There are common substitution patterns for similar consonants between the two languages. In adult second language speech, similarity of consonants between an L1 and an L2 leads to the transfer of the L1 consonant in place of the similar L2 consonant. In Maria Sofia's case, evidence of such transfer as in adult interlanguage (IL), or interference in bilingualism, occurs at proportions smaller than 5%, as may be seen in tables 4.7.1 and 4.7.2 with the exception of English /g/→[ɟ] at 5% in a /ge/ context. Besides the phonemes /j/, [j] which are similar to each other, and /ɹ, ɾ/ which are also similar to each other, all having [l] as their main common substitution pattern, as was mentioned above, /h/ is similar to /x/ and its allophone [ç] with common substitutions [s] and [ʃ]. Also, the similar /w, γ/ share [v, l] in very different proportions, resulting from different processes. /w/ mainly becomes [v] and /γ/ mainly becomes [l] systemically, in accordance with monolingual development, while their smaller proportions result from harmonies.

Last, it is observed that [Coronal] survives as the default place in the child's substitutions in both languages. Next comes [Labial], produced in assimilation processes in both languages, while [Dorsal, ±back] is non-existent in either one. In other words, the ranking that applies to this child's choice of substitutions in both languages with regard to privative articulator nodes, [Coronal] > [Labial] > [Dorsal], agrees with the ranking on the harmonic scale proposed in the literature (Prince & Smolensky, 2004:215). Among terminal features, the following are present in the resulting substitutions: Laryngeal: [±voice]; Air flow: [±continuant], Sonorant: [+nasal] and [+lateral]. [Coronal] articulations do not include [-groove] nor [+central], so the interdentals and rhotics, having a low rate of correctness in context in any case, are excluded from substitutions in both languages. The child's preference for [+groove] in substitutions, opposes the general 'tendency for ungrooved sibilants in the speech of many children' (Bernhardt & Stemeberger, 1998:298) and is a sign of individual preference or idiosyncratic skill.

Overall, there is a common underlying system between the two languages, irrespective of variations in phonetic detail. Labials substitute labials except for /f/, which is substituted by [s], coronals substitute coronals, velars and the glottal except for /w/, which is substituted by /v/.

4.6 Conclusions on the child's two languages at 2;7

Comparison of the child's vocabulary between the two languages reveals that Greek is ahead, but by not much, once grammatical forms of the same word are ignored. Also, a modest gap exists in the phonological mean length of utterance (PMLU), the average length of sentence, and the mean length of utterance (MLU), between the two languages, with English being behind.

With respect to whole word correctness in the context of the number of syllables, singletons and clusters, the analysis shows that the child's English is better in whole word correctness, overall, because of more monosyllabic words. It is also better in multisyllabic singletons because of fewer three- or more-syllable words. Greek is ahead in monosyllabic words because of fewer cluster types in word final position.

Regarding cumulative consonant performance, this decreases in the order of final, initial and medial position, in both languages. Comparing this performance between languages, English lags behind Greek in every position. However, because the proportion of consonants in final position is much higher in English than in Greek, while in medial it is lower, the end result is the child's similar performance in the two languages cumulatively for all word positions.

Comparing cumulatively all the consonants that are common between languages, the child performs similarly in word initial and final positions between the two languages, but much better in word medial position in Greek, where a consonant forming a cluster with a coda consonant is not allowed, contrary to English.

Conclusively, when whole word correctness is compared to cumulative consonant correctness, overall, the child's English is similar to Greek in cumulative consonants correctness but ahead of Greek in whole word correctness because Greek contains longer words.

As far as individual consonant performance at age 2;7 is concerned, Maria Sofia has acquired labials and coronals in both languages, except for /θ, ð, ɹ, ɾ/. She has not acquired palatals or velars in either language except for [ɲ], nor has she acquired the glottal, /h/. Comparing with monolingual norms, despite their limited data at 2;7, the child of the present study is ahead in the level of acquisition of English /p, b, m, s, z, n, l/ and behind in English /-d, k, g, w, h/. In Greek, Maria Sofia is behind in velars and [c], /-f-/ but at a similar acquisition level in the remaining consonants.

It has been shown quantitatively that only the initial unary and binary oppositions of the Minimal Consonantal System (Jakobson, 1941/1968; Ervin & Miller, 1963) have been completely acquired in both languages and that, despite the slight advance in Greek, the child's phonological system in both languages is at the beginning of the third intermediate stage of phonological acquisition. Furthermore, her patterns of consonantal acquisition in both languages emphasize the child's adherence to the universal Front < Back (Jakobson, 1941/1968) contrast and establishes it quantitatively. With the exception of her velars (and palatals) idiosyncratically lagging behind, the child's level at 2;7 is, by and large, in accordance with monolingual norms, and slightly better for some of the sounds in English. Finally, universal phonological processes, such as harmonies, coda devoicing and deletion evidenced in her speech are age appropriate and occurring as in monolingual norms. These provide evidence that her developmental course and milestones at 2;7 are similar to those in monolingual development and irrespective of the disparity in the quality and quantity of input she has received in her two languages.

There appear to be some substantial differences in the proportion of correctness between common consonants in the two languages. Most of these differences, however, dissapear if the comparison is made in the context of word position, singletons and clusters. Only the correct productions of /f-/, /v/ and /l-/ remain substantially different at 69%, 54%, 79% and 90%, 93%, 93% between English and Greek, respectively.

The same is true for substitution and deletion patterns in the two languages. As far as common consonants are concerned, only /z/→[ʒ] remains different in that it occurs only in Greek at 11% in word initial position and at 8% in word medial position, even though /ʒ/ does not exist in the Greek language and it is not targeted in the child's English speech. With regard to similar phonemes, /j/, [ʝ] as well as /ɹ, ɾ/ share [l] as their main substitution pattern and /h, x/, [ç] have [s] and [ʃ] as their main common substitutions. These are the only occurrences in the child's substitutions where one could argue for the presence of transfer or interference between the two languages, but knowing that the child's system is still in development and/or that these substitutions are found present at various degrees in monolingual norms of both languages, a distinction between transfer (dominance of L1 on L2), interference (bi-directionally between L1 and L2) and universals cannot be unambiguously made. On the other hand, although the similar phonemes /w, γ/ share [v, l], they do so in very different proportions that result from different processes. /w/ mainly becomes [v] and /γ/ mainly becomes [l], systemically, in accordance with respective monolingual development, while their smaller proportions result from harmonies.

Overall, substitution patterns are similar in the two languages in that coronals substitute coronals, velars and the glottal, and labials (including labio-velar /w/ becoming [v]) substitute labials except for /f/, which is substituted by [s].

The only difference in singleton deletions between the two languages is /θ/ deletion in Greek, but it only occurs in the function word *θα* /θa/, meaning 'will' in English. Maria Sofia's substitutions, when compared to monolingual norms, show individual variation in the patterns /ð, ɹ, j/, [ʝ]→[l], and /f/→[s] in Greek. The latter exists also in her English but it is common between English monolinguals as well.

Comparing singleton and cluster deletions within and between languages, only Greek /v/ truly performs better in cluster context than as singleton, at 100% and 88%, respectively, even though [ç] also does so when the underlying representation is not /x/ but the vowel /i/, when /i/ is preceded by a voiceless consonant other than /x/ and followed by another vowel.

The differences between the two languages, already outlined above allow argumentation in favor of differentiation of systems. One final contributing factor for differentiation of the systems is evidence of the child's correct production of clusters in one language that violate the phonotactic rules in the other language. Examples are [sm], [sn], [nt] in English which are not allowed in Greek, and [ft] in word initial Greek which is not allowed in English.

The kind of evidence found here is often interpreted to mean that there are two separate phonological systems. However, one would have to disregard all the similarities found present in the development of the two languages in order to speak for complete and distinct separation of the phonological systems. It makes better sense to speak in terms of a differentiation that is context-specific and, in some case child-dependent, rather than separation.

Last, based on the quantitative results and analysis of the data here, it is concluded that English is the child's L2, or weaker language, a finding that agrees with the *ad hoc* interpretations based on experience that were made in §3.4, regarding the status of the languages in the child's bilingualism. It was also shown that a clearer distinction needs to be made between 'separation' and 'differentiation' although both terms are interchangeably used in the literature as if they were synonymous.

CHAPTER 5
DEVELOPMENT OF THE CHILD'S CONSONANTS

This chapter is organized as follows: §5.1 introduces the scope and aims of the chapter, §5.2-5.9 examine the monthly development of individual consonants at different word positions cumulatively for all the words in the child's speech as well as for single words in respect of acquisition level and substitution patterns; the voiceless interdental in both English and Greek in §5.2, the voiced interdental in English in §5.3, the labio-velar approximant /w/, which does not exist in the Greek language in §5.4, the voiced labio-dental fricative in English in §5.5, the English rhotic in §5.6, the voiceless velar stop in English in §5.7, the voiced velar stop in English in §5.8, and the voiceless fricatives /h/ in English and [ç] in Greek in §5.9. In §5.10 the child's developmental substitution patterns are summarized in terms of consonant articulation features and in §5.11 the chapter's conclusions are given.

5.1 Introduction

There are few detailed longitudinal case-studies of individual children's phonological development spanning the course of time over many months or years. The longest and most influential ones are Leopold's (1939-49) study of his first daughter's German-English bilingualism during the first two years of her speech development and Smith's (1973) analysis of his son's monolingual English from age 2;2 to 4;0. Major's (1977) case study in bilingual English-Portuguese spans his daughter's development from 1;7 to 2;8. Schnitzer & Krasinksi (1994, 1996) discuss Spanish-English bilingual phonological development from age 1;1 to 3;9 (first son) and from age 1;6 to 4;6 (second son). Keshavarz & Ingram (2002) examined Farsi-English bilingualism in a male child from age 4 months to 2 years. Brulard & Carr (2003) studied their son's developing phonologies in French-English from 1;8 to 2;6. Details on the findings of these and other monolingual and bilingual case studies were given in chapter 2. There is a lack of longitudinal case studies on the phonological development of bilingual Greek with any other language. Furthermore, there are no longitudinal case studies in the bilingual acquisition of any languages exclusively from L2 input (Place & Hoff, 2011), as is the present study.

Despite the length and breadth of these studies, most of the data was in diary notes and the focus was primarily qualitative. As a result, several research questions remain unanswered, among which are: how does consonant performance compare quantitatively along development between two languages which are grammatically different and have different phonotactic rules; what is the path that the acquisition of consonants follows during development; what is the length of developmental stages; is acquisition of consonants progressing within each stage and in what fashion, linear or nonlinear; are there nonlinearities or discontinuities in the development of consonant substitution patterns and at which stage do they occur; how does the U-shaped pattern of phonological and linguistic development known on a qualitative basis, stand on a quantitative basis. In this chapter, a contribution in answering these questions will be made based on monthly consonant performance cumulatively for all the words in the child's speech as well as for single words.

The chapter deals with Maria Sofia's consonantal development during the entire span of data collection from age 2;7 to 4;0. Based on the level of consonant acquisition in the two languages at 2;7 (chapter 4), the development of the following non-acquired consonants in English is examined in detail: the interdentals /θ, ð/, the rhotic /ɹ/, the velars /k, g/, the labio-velar approximant /w/, the glottal fricative, /h/ and the voiced labio-dental fricative, /v/, for which at age 2;7 there was limited data (6 word types with 14 tokens). The comparison in the developmental paths of the acquisition level and substitution patterns between common or similar consonants in the two languages is exemplified by the comparison of the voiceless interdental in English and Greek and the comparison between the voiceless fricatives /h/ in English and [ç] in Greek. Moreover, the dominant substitutions of /ð/ and /ɹ/ in English are discussed in relation to those of /ð/ and /ɾ/ in Greek, respectively. The comparison between consonants in the two languages looks for evidence of similarity or differentiation between the languages longitudinally, and for clear evidence of transfer from the L1 Greek in L2 English.

As attested in chapter 4, Maria Sofia's English phonology at 2;7 is at the beginning of the third intermediate stage of phonological acquisition, 'the multi-word utterance' stage (Ingram, 1989a), or 'the period of greatest phonological development' (Macken & Ferguson, 1987:8) with Greek slightly leading the way. Acquisition of the phonological system in a language (with the exception of few marked sounds and subject to individual child variation) is known to complete by age 4 (Ingram, 1989a). The volume and intensity of the data collected during the seventeen months of the present study covers, by and large, the span of this third period and will enable the depiction of consonantal paths and the identification of precise stages, if so there be. Because such a graphic depiction is founded on dense data, a quantitative presentation of earlier stages in phonological development may not be possible because child speech during those stages is usually sparse.

The term *stage* may refer to a phase or time period, a point as well as a juncture. With respect to the behavior of a single developing linguistic phenomenon, e.g. consonant correctness, the following four different definitions of *stage* may be related: 'a point on a continuum'; a 'plateau', where there is a halt in development; a 'transition'; and an 'acceleration' as a spurt in linguistic development (Ingram, 1989a). In the identification of stages, some 'cause' should overall be proposed for the definition of a stage; descriptive stages determined by measurements or 'evidence' are the first step for finding explanatory stages (ibid:54-55). Ingram (1989a:32) and Bernhardt & Stemberger (1998:6-7) argue in favor of a clear explanation of the intended meaning where the term *stage* is utilized. Here, any systematic change (progressive or regressive transition) in the level of individual consonant correctness is proposed to be the *cause* instigating the breaking point between stages. *Stage* refers to a distinct phase or time-period of distinct change in acquisition level rather than a point or juncture. Each numerical value of the acquisition level is a point in the continuum and each point where transition occurs is a juncture. Brown's (1973) definition of stages in terms of MLU is similar to the one advocated here.

Additionally, the present chapter will re-evaluate the generic theme of linearity/nonlinearity in phonological development in terms of individual consonant correctness and substitution patterns. Linearity in phonological development refers to interrelated successive steps, as if on a straight line, while nonlinearity involves further complexity that can be multi-planar. In auto-segmental phonology (e.g. Menn 1978; Goldsmith, 1979), a multi-planar evaluation of features adds detail to the structure of the segment and enhances our understanding of underlying representations. Chomsky & Halle's (1968) perspective of rules and representations and constraint-based theories stemming from it, such as optimality theory (e.g. Prince & Smolensky, 2004), are essentially linear in their outlook; they account for output limitations by assuming that the child moves linearly from less marked to more marked outputs, initially limited by universal constraints and, subsequently, through parameter setting. On the other hand, Bernhardt & Stemberger (1998) propose a nonlinear constraints-based theory of phonological development. This thesis focuses on a quantitative, rather than a qualitative presentation of consonantal development and will not elaborate on these further.

Contrary to linear propositions, however, and despite their significant impact, there is overall agreement to date that phonological development is non-linear both in terms of general language acquisition theory and particular phonological theorizing (e.g. Macken, 1992; Bernhardt & Stoel-Gammon, 1994; Fikkert, 1994; Rice & Avery, 1995; Vihman, 1996; Gierut, 1996; Bernhardt & Stemberger, 1998; Wong & Stokes, 2001). From the perspective of chaos theory, Mohanan (1992) has argued that phonological development is not gradual 'knowledge discovery and deduction' but rather a nonlinear, dynamic 'morphogenesis' or form creation. Nonlinearity has further been seen in terms of 'self-organizing systems' (Thelen, 1989) and 'dynamic systems' (e.g. van Geert, 1994; Vihman, De Paolis & Keren-Portnoy, 2008), where the existence of phase shifts includes progression and regression.

This last viewpoint agrees with the U-shaped developmental pattern that has been identified in the literature as a pattern in speech development (e.g. Ingram, 1989a; Stemberger et al. 1999; Stoel-Gammon, 2011) in that it traces behaviors that first appear (progress), then they disappear (regress) and then, apparently, reappear (progress again) over time. Ebbinghaus (1913) was the first to speak of forgetting and learning curves. Bills (1934) elaborated on this with a more detailed description of learning curves, identifying three properties: negative acceleration, plateau, and positive acceleration. Smith (1973) and Schnitzer & Krasinksi (1994) provide evidence of the U-shape in phonological development in first and dual language acquisition. Stoel-Gammon (2011:18) has referred to a repeated U-shaped pattern in phonological development as 'peaks and valleys'. 'Re-construing U-shaped functions', Werker, Hall, & Fais (2004) have talked about an N-pattern in language acquisition whereby the development of phenomena starts out non-adult like and proceeds with progression and then regression again before complete acquisition.

Last, a well-known theme in the development of phonology that is also implied within the themes already discussed is the continuity/discontinuity issue, i.e. is phonological development continuous or discontinuous? Proponents of the continuity hypothesis (e.g. Stampe 1969; Wexler & Culicover, 1980; Chomsky, 1986; Dresher, 1994; Macken, 1995; Fikkert, 2007; Fabiano-Smith & Barlow, 2010) argue that despite variability and intermediate stage grammars, every stage in the acquisition is 'a necessary step in an invariant sequence' (Berhardt & Stemberger, 1998:6). On the other hand, proponents of the discontinuity hypothesis relate clearly defined, non-interrelating steps in the developmental sequence to the presence of distinct maturational advances in the biology of humans (e.g. Jakobson, 1941/1968; Lenneberg, 1967; Waterson, 1971; Ferguson & Farewell, 1975; Vihman, 1992; C. Levelt, 1994). Menn & Matthei (1992:221) bridge the gap between the two by arguing that 'surface discontinuity may be the result of an underlying continuous development'. There is a need for further elaboration of the theories on developmental changes, called by Young-Scholten (2009) 'transition theories'.

Maria Sofia's longitudinal data on consonantal development during the seventeen-month period, presented in the chapter, is examined in the light of these propositions in order to contribute to answering the research questions formulated above.

Moreover, the chapter's results aim to shed light on the issue of child phonological delay as Maria Sofia's acquisition level will be compared to the norm at different ages, to determine whether slow acquisition levels well into the stage of greatest phonological development necessarily imply delayed complete acquisition.

Finally, consonant development on a quantitative basis, as studied in this chapter, aims to provide a perspective on adult L2 speech independent of the L1 since it is known that child speech during acquisition has similarities to adult L2 speech (e.g. Flege & Davidian, 1984). However, longitudinal studies on adult L2 speech are scarce and there is a need to investigate further the effect of the L2 speakers' proficiency level on substitution patterns, longitudinally.

5.2 Development of the voiceless interdental in the two languages

A detailed analysis of the performance of /θ/ in Maria Sofia's two languages at age 2;7 was performed in chapter 4. The voiceless interdental's development during the succeeding sixteen (16) months until age 4;0 is examined here.

5.2.1 Acquisition level of /θ/ in the two languages during development

The targeted /θ/ words in the child's speech and the age of their first production in the two languages are:

English /θ/ target words:

2;7 both, Dorothy, mouth, thank, Thomais (name), through, throw
2;8 bathtub, birthday, something, thirsty, with
2;9 anything, bath, bathroom, clothes, thing, three, threw
2;10 Athens, nothing, teeth, theater, throwing
2;11 things, tooth, underneath
3;0 cloth, path, thought, worth
3;1 everything, Thanasis (name), think, thrown
3;2 Filothei (name), fourth, Parthenon, thermometer, thin
3;3 month
3:4 thick, thirteen, Thursday
3;5 -
3;6 mouths, smooth, smoothie
3;7 forth
3;8 thanks, thunder
3;9 -
3;10 breath
3;11 -

Total: 50 words; /θ/ tokens: 1,281; monthly /θ/ tokens: 12, 13, 87, 77, 46, 62, 105, 69, 63, 81, 70, 113, 80, 178, 142, 40, 43. It is remarked that the word *clothes* is pronounced in adult British English speech as [kləʊðz]. However, since the voiced interdental, /ð/, is also produced as voiceless interdental, /θ/, in American English and exclusively in the child's input (mother's speech), the word *clothes* is included in the /θ/ words.

The child's /θ/ target words in Greek are shown below orthographically in alphabetical order and in IPA transcription of the underlying form. Their IPA transcription as in adult speech, their translation in English and grammar are given in Appendix C.

Greek /θ/ target words:

2;7 αλήθεια /aliθia/, ήθελες /iθeles/, ήρθε /iɾθe/, ήρθες /iɾθes/, θα /θa/, θάλασσα /θalasa/, θα΄ρθεί /θaɾθi/, θα΄ρθώ /θaɾθo/, θεία /θia/, θέλει /θeli/, θέλεις /θelis/, θέλω /θelo/, θεού /θeu/, θες /θes/, θυμάσαι /θimase/, Θωμαΐς /θomais/, κάθησε /kaθise/, καθήσει /kaθisi/, κάθομαι /kaθome/, κάθονται /kaθode/, κοιμηθεί /kimiθi/, κοιμηθούμε /kimiθume/, κοιμηθώ /kimiθo/, μαθαίνω /maθeno/, όρθια /oɾθia/, παραμυθάκι /paɾamiθaki/, σηκωθείς /sikoθis/, ψιθυρίζω /psiθiɾizo/

2;8 έρθεις /eɾθis/, έρθω /eɾθo/, ήθελα /iθela/, ήρθα /iɾθa/, Θανάση /θanasi/, θα'ρθείς /θaɾθis/, θέλετε /θelete/, θέλουμε /θelume/, καθαρές /kaθaɾes/, καθαρίσω /kaθaɾiso/, καθήστε /kaθiste/, κοιμηθείς /kimiθis/, κοιμήθηκε /kimiθike/, κολυμπήθρα /kolibiθɾa/, κουνηθείς /kuniθis/, μάθημα /maθima/, μάθω /maθo/, ντυθώ /diθo/, παραμύθι /paɾamiθi/, σκοτωθώ /skotoθo/

2;9 αγκίθες /agiθes/, άνθρωπος /anθɾopos/, βοήθεια /voiθia/, βοήθησε /voiθise/, βοηθήσεις /voiθisis/, γενέθλια /ɣeneθlia/, ήρθατε /iɾθate/, θα’ρθείτε /θaɾθite/, θα’ρθούμε /θaɾθume/, θα’ρθούνε /θaɾθune/, θά’ρχεσαι /θaɾxese/, θά’ρχεται /θaɾxete/, θάψουμε /θapsume/, θέατρο /θeatɾo/, θέλουνε /θelune/, θεός /θeos/, θέση /θesi/, θήκη /θiki/, θόρυβο /θoɾivo/, θόρυβος /θoɾivos/, θυμωμένος /θimomenos/, καθαρή /kaθaɾi/, καθαρίσεις /kaθaɾisis/, κάθεται /kaθete/, καθήσουμε /kaθisume/, καθήσω /kaθiso/, καθιστά /kaθista/, καθρεφτάκι /kaθɾeftaki/, καλαθάς /kalaθas/, κοιμηθείτε /kimiθite/, κοιμήθηκαν /kimiθikan/, κοιμηθούνε /kimiθune/, λάθος /laθos/, μαθητές /maθites/, να΄ρθείς /naɾθis/, παράθυρα /paɾaθiɾa/, παράθυρο /paɾaθiɾo/, σηκώθηκα /sikoθika/, σηκώθηκες /sikoθikes/, σηκωθώ /sikoθo/, στ’αλήθεια /staliθia/

2;10 Αθήνα /aθina/, άνθρωποι /anθɾopi/, αποκοιμηθούμε /apokimiθume/, ελευθερία /elefθeɾia/, ήρθαμε /iɾθame/, καλάθι /kalaθi/, κοιμηθήκαμε /kimiθikame/, κοιμήθηκες /kimiθikes/, μάθει /maθi/, μάθεις /maθis/, Μαράθι /maɾaθi/, νά΄ρθει /naɾθi/, νά’ρθω /naɾθo/, πεθάνεις /peθanis/, τσουλήθρα /ʦuliθɾa/, χύθηκε /xiθike/

2;11 αποκοιμηθώ /apikimiθo/, έμαθε /emaθe/, έρθει /eɾθi/, ήρθανε /iɾθane/, καθαρίσουμε /kaθaɾisume/, καθαρό /kaθaɾo/, καθόλου /kaθolu/, πλυθείς /pliθis/, προσπάθησε /pɾospaθise/

3;0 θά'μαστε /θamaste/, θ'ανέβει /θanevi/, θυμάμαι /θimame/, καθαρίζεις /kaθaɾizis/, καλαθάκια /kalaθakia/, λερωθούνε /leɾoθune/, ξανάρθω /ksanaɾθo/, σηκωθεί /sikoθi/, Φιλοθέη /filoθei/, χυθεί /xiθi/, κοιμήθηκα /kimiθika/

3;1 βαθιά /vaθia/, βοηθήσει /voiθisi/, δώθε /ðoθe/, θά’ρθετε /θaɾθete/, θα'χεις /θaxis/, θυμόμαστε /θimomaste/, κάθεσαι /kaθese/, παραμύθια /paɾamiθia/, τσακωθούμε /ʦakoθume/

3;2 ανθρωπάκι /anθɾopaki/, γεννηθεί /ɣeniθi/, θερμόμετρο /θeɾmometɾo/, καθαρός /kaθaɾos/, κάθε /kaθe/, κάθισμα /kaθisma/, φοβηθείς /foviθis/, φοβήθηκα /foviθika/, ψηθούνε /psiθune/

3;3 αγκαθάκια /agaθakia/, επίθετο /epiθeto/, θ'αλλάξω /θalakso/, θ'ανάψεις /θanapsis/, θ'ανοίξει /θaniksi/, καθένας /kaθenas/, λαβύρινθος /laviɾinθos/, μάθουνε /maθune/, μπουμπουλήθρες /bubuliθɾes/, ψιθύρησε /psiθiɾise/

3;4 αληθινό /aliθino/, αντίθετα /adiθeta/, βοηθήσετε /voiθisete/, έπαθε /epaθe/, ζεσταθεί /zestaθi/, ζεστάθηκε /zestaθike/, θυμήθηκα /θimiθika/, καθάρισα /kaθaɾisa/, καθόμουνα /kaθomuna/, κουκλοθέατρο /kukloθeatɾo/, μάθουμε /maθume/

3;5 βιβλιοθήκη /vivlioθiki/, βοηθάω /voiθao/, βοήθησες /voiθises/, θά'σαι /θase/, κι'αληθινά /kialiθina/, λερωθείς /leɾoθis/, ξανακοιμηθείτε /ksanakimiθite/, πάθεις /paθis/, χάθηκα /xaθika/

3;6 αληθινά /aliθina/, βοηθάς /voiθas/, δεθήκαμε /ðeθikame/, έμαθα /emaθa/, θάλασσας /θalasas/, θα'χω /θaxo/, πουθενά /puθena/, σωθήκαμε /soθikame/

3;7 Αθήνας /aθinas/, αληθινός /aliθinos/, ανθίσαν /anθisan/, θυμήσεις /θimisis/, παρακολουθείς /paɾakoluθis/, στ'αληθινά /staliθina/

3;8 αισθάνομαι /esθanome/, ‘άνθρωπες’ /anθɾopes/, ανθρώπους /anθɾopus/, βρεθεί /vɾeθi/, κιθάρα /kiθaɾa/, πεθαμένη /peθameni/, σταθεί /staθi/

3;9 ζεστάθηκα /zestaθika/, ηθοποιοί /iθopii/, καθαρίζουμε /kaθaɾizume/, καθρέφτης /kaθɾeftis/, προσπαθήσω /pɾospaθiso/, συναντηθούμε /sinadiθume/

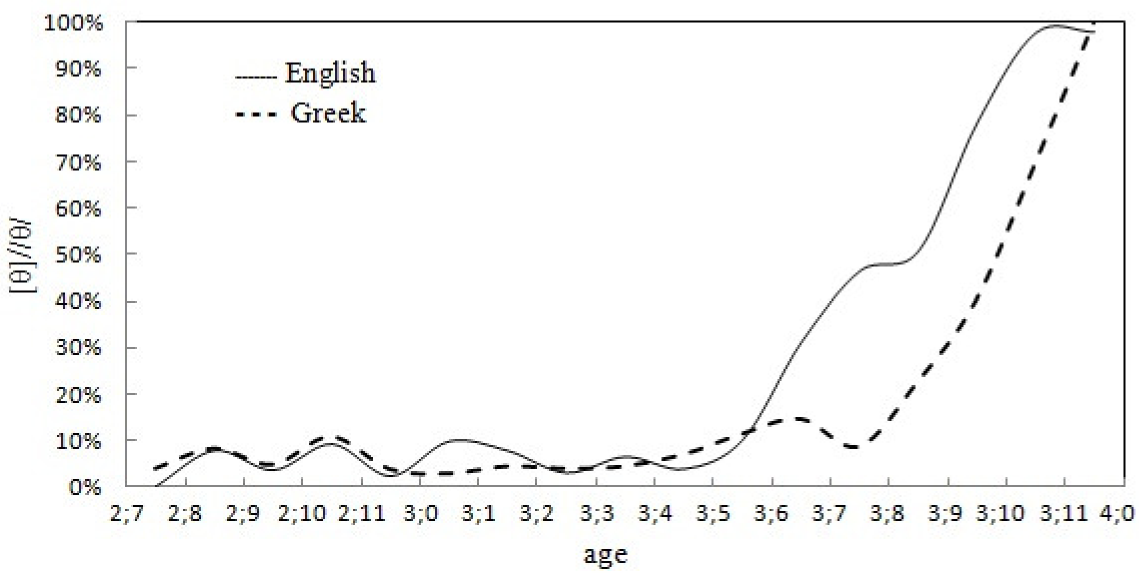
3;10 θέλουν /θelun/, ντυθεί /diθi/, πέθανε /peθane/

3;11 θυμηθείτε /θimiθite/, μεθαύριο /meθavɾio/, ρυθμό /ɾiθmo/

In total, there are 205 word types and 3,800 tokens; The monthly /θ/ tokens: 184, 153, 378, 317, 248, 354, 343, 239, 386, 292, 189, 222, 202, 118, 126, 33, 16.

The productions of targeted /θ/, transcribed in the CHAT files and, according to the methodology discussed in chapter 3, were put together monthly. The acquisition level of /θ/, defined by the proportion of correct realizations to targets, in the two languages is shown longitudinally in figure 5.1.

Figure 5.1. Acquisition level of /θ/ in the two languages during development



The child’s acquistion level of /θ/ while negligible at age 2;7, becomes complete by age 4;0. Based on the acquisition level of /θ/, two main stages in its development may be identified. In the first stage, correctness of /θ/ remains at approximately the same level fluctuating around 5%. That’s why, this stage will be called the *cyclic stage*. In the child’s English this stage is ten months long from age 2;7 to age 3;4, while in the child’s Greek it is three months longer. In the second stage, correctness of /θ/ rises until complete acquisition (>90%). That’s why, this stage will be called the *progressive stage*. In the child’s English, this stage is six months long from age 3;5 to age 3;10, while in the child’s Greek it is one month shorter.

It should be noted that the monthly transition in the acquisition level appears smooth in figure 5.1 as the data are averaged montlhy. If the data were averaged twice a month, this transition would be smooth but the monthly transition would, in general, fluctuate. Fluctuations in child performance during phonological development are known to exist, and they are what Stoel-Gammon (2011) calls ‘peaks and valleys’.

Ingram (1989a) called *plateau* the stage in which there is a halt in linguistic development and *acceleration* the stage where there is a spurt in linguistic development, similar to the terminology used by Bills (1934) for learning in general. These two stages are associated with the cyclic and progressive stages, respectively, identified here in the acquisition level of /θ/.

Ignoring details, the developmental curves of figure 5.1 may be associated with the second and third parts of a U-shape. U-shaped phonological and linguistic development has been discussed previously in the literature (e.g. Smith, 1973; Schnitzer & Krasinksi, 1994; Werker, Hall, & Fais, 2004) but, in the present study, it is the first time that a precise quantitative description is provided both for the depth and length of U; in the case of /θ/ here, they are about 0.95 and twelve (12) months, respectively.

The acquisition level is similar in both languages until age 3;5. At this age, the level in English starts progressing, while the level in Greek remains about the same for two more months, at which time it starts progressing as well. This lag continues for two more months: the level in Greek at 3;8 and 3;9 is the same as the level in English at 3;6 and 3;7, respectively. After that, the lag shortens by one month, that is, the acquistion level in Greek at 3;10 is the same as that in English at 3;9. By age 3;11, the acquisition levels in the two languages become similar.

The reduction in the lagging behind of /θ/ between the two languages is due to the slowing down of the acquisition rate in English at 3;8. This slowing down can be explained by the performance of /θ/ in different word positions. At 3;8, as will be shown in the section that follows, word final and word medial /θ/ slow down much more than word initial /θ/, which performs better than them, therafter. On the other hand, this does not happen in the child’s Greek as word final /θ/ is not allowed in the Greek language and word medial /θ/, although slowing down at 3;8, performs better than word initial /θ/ during the whole progressive stage.

As a result, in the progressive stage, the acquisition level in English follows a double S-curve while in Greek a single S-curve. The S-curve, also known as the logistic curve, was first reported by Verhulst (1838) to describe population growth but it also models general learning (Bills, 1934). The double S-curve is known to model physiological growth in humans (e.g. El Lozy, 1978).

The difference in the acquisition level of /θ/ between the two languages, from age 3;6 to age 3;10, may be attributed to the occurrence of more word types in Greek which are also more complex than English words, as seen in the list of words given above for both languages. However, this difference becomes smaller, though still substantial for the first four months, 3;6, 3;7, 3;8 and 3;9, when the Greek function word *θα* (*will*) is excluded from calculating the acquisition level, because it is very frequent and has a low performance.

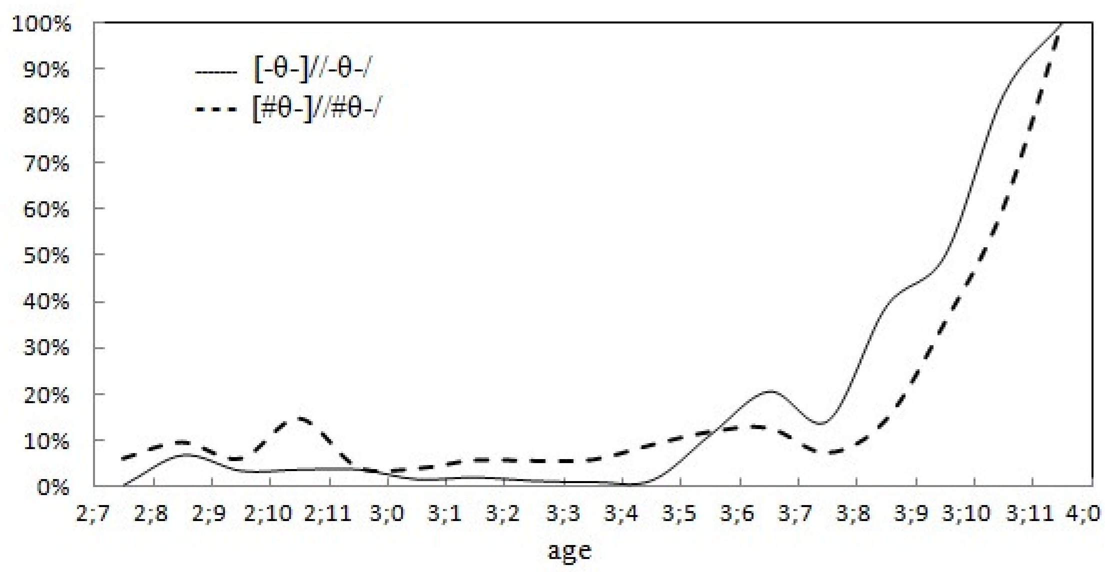
Between the ages 3;6-3;10, the acquisition level of /θ/ in the word *θα* is 10% (11/114), 5% (6/111), 18% (10/57), 29% (18/62), 25% (3/12), while the acquisition level of /θ/ cumulatively in the remaining Greek words is 20% (22/108), 13% (12/91), 28% (17/61), 50% (32/64) and 95% (20/21) as compared to the level in English which is 31%, 46%, 51%, 78%, 98%, respectively. Therefore, excluding /θa/ results in /θ/ being completely acquired in Greek by 3;10, just as in English, even though it had lagged behind it during the progressive stage.

Last, at 3;11 when complete acquisition has been achieved in both languages, the child's /θ/ words in the data are: *anything* (1), *both* (4), *clothes* (4), *mouth* (1), *something* (4), *thankyou* (1), *theater* (2), *thing* (4), *things* (8), *think* (3), *thought* (1), *three* (5), *throw* (4), *underneath*, in English, and *άνθρωποι* (1), *θα* (5), *θάλασσα* (1), *θέλω* (1), *ρθώ* (1), *ρθεί* (1), *θυμηθείτε* (2), *κάθε* (1), *μεθαύριο* (1), *παραμύθι* (1), *ρυθμό* (1), in Greek. With the exception of one deletion in the word *clothes*, /θ/ was correctly produced in all other instances in both languages.

5.2.1.1 Dependence of the acquisition level on word position

The dependence of the acquisition level of /θ/ on word position is examined here for both languages. For Greek, the dependence on word intitial and word medial positions is shown in figure 5.2, as there is no word final /θ/ in the Greek language.

Figure 5.2. Dependence of the acquisition level of /θ/ on word position in Greek

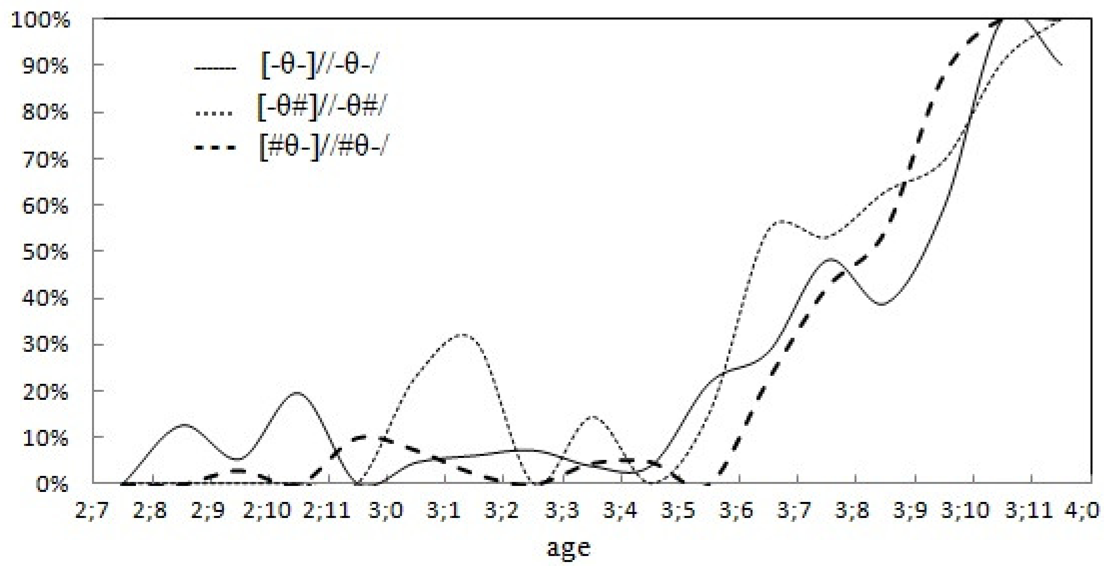


During the cyclic stage, word initial /θ/ has a slightly higher level of acquisition. During the progressive stage, though, it is the word medial /θ/ that has a substantially higher level of acquisition. The Greek medial /θ/ follows a clear double S-curve in its acquisition progress.

If the function word *θα* is excluded from the calculation, word initial /θ/ is at a similar level of acquisition as word medial /θ/ from age 3;9 onwards but, still, lower at 3;7 and 3;8.

The dependence of the acquisition level of /θ/ on word position in English is shown in figure 5.3.

Figure 5.3. Dependence of the acquisition level of /θ/ on word position in English



Word final /θ/ has, overall, a higher level of acquisition in the second part of the cyclic stage and in the first part of the progressive stage than the other two word positions of /θ/. At 3;7 and 3;8, however, its rate of growth slows down substantially so that its level of acquisition becomes comparable to that of word initial at 3;8 and even lower than it, thereafter. This violates the word alignment constraint whereby continuants align to the right edge of the word (e.g. Ferguson, 1978). Therefore, Maria Sofia's acquisition of /θ/ shows nonlinear dependence on the word alignment constraint, longitudinally; word final /θ/ is not permitted in the Greek language. Word medial /θ/ also slows down at 3;8 resulting, thereafter, in a lower acquisition level than word initial /θ/. It will, therefore, be interesting to examine the dependence of the acquisition level on word types near complete acquisition.

At 3;9, the child's acquisition level of /θ/ in each target word is:

bath 100% (1/1)	bathroom 100% (3/3)	birthday 100% (1/1)	both 44% (4/9)
clothes 67% (2/3)	everything 100% (2/2)	Filothei 0 (0/2)	forth 100% (2/2)
mouth 67% (2/3)	nothing 80% (4/5)	path 100% (3/3)	smooth 100% (3/3)
smoothie 100% (7/7)	something 15% (2/13)	thank 100% (1/1)	theater 100% (7/7)
thin 100% (2/2)	things 86% (6/7)	think 86% (6/7)	thirsty 100% (1/1)
three 76% (16/21)	threw 100% (16/16)	throw 90% (18/20)	thunder 100% (1/1)
underneath 0% (0/2)			

The arithmetic average of the acquisition of /θ/ in the 25 word types shown above is 81%, very close to the weighted average plotted in figure 5.1, which is 78%. The arithmetic average of the acquisition of word initial /θ/ is 94% while that of word final /θ/ is 73% which shows that the word alignment constraint is violated, whether the averaging is weighted or not. If word final /θ/ words are excluded in English, as these are not allowed in the Greek language, the acquisition level for the remaining words becomes slightly higher at 84% and 80% for arithmetic and weighted average, respectively.

At 3;9, the child has difficulties with compound words when /θ/ is in the initial position of the second word and they have a consonant in the initial position of the first word as in *something*, *nothing*, and *Filothei* but she has no problems when /θ/ is in the final position of the first word as in *bathroom* and *birthday* or when /θ/ is in final position of single words that do not contain a diphthong as in *bath*, *forth*, *path*, *smooth*. Moreover, there are difficulties with compound words when /θ/ is in the final position of the second word as in *underneath* or when /θ/ is in final position of single words that contain a diphthong as in *both*, *mouth*. Last, there seem to be occasional difficulties with word initial /θ/ when it is involved in a consonant cluster as in *three* or when there is another consonant cluster in the word as in *things*, *think*. Overall, near complete acquisition the child performs better with word initial /θ/ than word final /θ/ contrary to her earlier perfomance which was in agreement with word alingment constraints whereby continuants align to the right edge of the word.

Another point of interest is to look into whether big changes in the acquisition level during the cyclic stage result from averaging different words in the corresponding ages. For example, word final /θ/ is considered in more detail at ages 3;1 and 3;2 at which its level of acquisition calculated as weighted average is substantially different at 31% and 0%, respectively. The child's words and the acquisition level of word final /θ/ in them are at 3;1: *bath* 100% (1/1), *both* 0% (0/1), *cloth* 0% (0/2), *mouth* 40% (2/5), *teeth* 25% (1/4), while at 3;2 they are: *bath* 0% (0/3), *both* 0% (0/2), *mouth* (0/2), *teeth* 0% (0/1). The level of acquisition caclulated as the arithmetic average of all the words is 33% and 0% at 3;1 and 3;2, respectively, similar to their weighted averages of 31% and 0%, correspondingly. Next, only the same words are considered at the two ages: *bath*, *both*, *mouth* and *teeth*. The resulting level of acquisition is 36% and 0% based on the weighted average and 41% and 0% based on the arithmetic average. Therefore, substantial change in the acquisition level during phonological development is an inherent characteristic of the child's performance and not the result of data manipulation. This will be generalized in the section that follows where the same words are tracked along the whole span of the child's development.

Comparing Maria Sofia's acquisition level of initial /θ/ between her two languages, it is less than 12% in both languages until age 3;5 and remains there in Greek for two more months. Her level in English during the progressive period at ages 3;6, 3;7, 3;8, 3;9, 3;10; 3;11, respectively, is: 22%, 42%, 54%, 89%, 100%, 100%. The level in Greek at the same ages, respectively, is much lower than in English: 13%, 7%, 14%, 35%, 55%, 100%. If the function word *θα* is excluded from the calculation, the acquisition level of word initial /θ/ in Greek becomes: 20%, 12%, 5%, 50%, 100%, 100%, still well below the level in English at ages 3;8 and 3;9. In order to see if this difference can be explained, the child's /θ/ target words in Greek at 3;9 are also examined. These words are given below orthographically in alphabetical order and in IPA transcription of the underlying form. Their IPA transcription as in adult speech, their translation in English and grammar are given in Appendix C. At 3;9, the child's acquisition level of /θ/ in each target word in Greek is:

αλήθεια 100% (2/2)	αληθινό 100% (1/1)	ανθρωπάκι 100% (1/1)	άνθρωπος 100% (1/1)
/aliθia/	/aliθino/	/anθɾopaki/	/anθɾopos/
βαθιά 100% (3/3)	έμαθε 100% (1/1)	ζεστάθηκα 0% (0/1)	ήθελα 50% (1/2)
/vaθia/	/emaθe/	/zestaθika/	/iθela/
ήθελε 0% (0/1)	ηθοποιοί 100% (1/1)	ήρθε 0% (0/4)	θα 29% (18/62)
/iθele/	/iθopii/	/iɾθe/	/θa/
θάλασσα 100% (5/5)	θέατρο 100% (1/1)	θέλει 0% (0/1)	θέλεις 33% (1/3)
/θalasa/	/θeatɾo/	/θeli/	/θelis/
θέλουνε 0% (0/1)	θέλω 10% (1/10)	θέση 100% (1/1)	θυμάμαι 50% (1/2)
/θelune/	/θelo/	/θesi/	/θimame/
θυμάσαι 100% (2/2)	καθαρή 100% (1/1)	καθαρίζουμε 0% (0/1)	κάθε 0% (0/1)
/θimase/	/kaθaɾi/	/kaθaɾizume/	/kaθe/
καθόλου 0% (0/2)	καθρέφτης 50% (1/2)	κολυμπήθρα 100% (1/1)	μάθεις 100% (1/1)
/kaθolu/	/kaθɾeftis/	/kolibiθɾa/	/maθis/
μπουμπουλήθρες0%(0/1)	ξανάρθω100%(1/1)	παράθυρο100%(1/1)	προσπαθήσω0% (1/1)
/bubuliθɾes/	/ksanaɾθo/	/paɾaθiɾo/	/pɾospaθiso/
ρθεί 0% (0/3)	συναντηθούμε 100% (1/1)	τσουλήθρα 50% (1/2)	Φιλοθέη 0% (0/1)
/ɾθi/	/sinadiθume/	/ʦuliθɾa/	/filoθei/

There are 36 word types and 126 tokens out of which 62 tokens are for the function word *θα*. The acquisition level calculated in arithmetic average for all the words is 55%, close to the weighted average of 50%, but higher because the word *θα* whose tokens are many (49%) and the acquisition level low (29%), is weighed less. The level in Greek is well below the level in English without the word final /θ/ words whose level is 84% and 80% calculated on arithmetic and weighted average, respectively. The word initial arithmetic average in Greek is 52% well below that in English which is 94%, as was also the case for the weighted average, 35% in Greek vs. 89% in English.

It is observed that there are basically two patterns that persist in Maria Sofia's errors of /θ/ in Greek near complete acquistion at 3;9. One is when /θ/ clusters with the rhotic which is also the case in English, and the other is in the word *θέλω* /θelo/ and its grammatical forms *ήθελα* /iθela/, *ήθελε* /iθele/, *θέλει* /θeli/, *θέλεις* /θelis/, *θέλουνε* /θelune/. If these grammatical forms are considered as one word type in calculating the arithmetic average of the acquisition level in Greek, the result is 63% cumulatively for all the words without word final /θ/ and 70% for word initial /θ/. It is higher than before but, still, well below the level in English which is 84% and 94% for words without word final /θ/ and only words with word initial /θ/, respectively.

Conclusively, the comparison of a consonant's acquisition level across two languages is not straightforward during phonological development because there is language differentiation at many levels as demonstrated above. Even if the words selected for comparison are equivalent in terms of length, consonants' content, clusters, and consonant word position, which would be extremely difficult if not impossible to accomplish, additionally there are individual words whose production is frozen along the development of the language, as demonstrated above. In spite of language differentiation, excluding *θα* resulted in /θ/ being completely acquired (>90%) in Greek at 3;10, the same age as it is completely acquired in English.

That said, Maria Sofia's acquisition level of /θ/ during development is now compared to monolingual English and Greek children's level. The norms established in Smit et al. (1990) for monolingual English females at ages 3;0, 3;6 and 4;0 are, respectively: 30%, 50% and 59% for word initial /θ/ and 27%, 54% and 59% for word final /θ/, showing basically no difference in the performance between the two word-edge positions. Maria Sofia's acquisition level at ages 3;0, 3;6 and 3;11 is, respectively: 7%, 22%, 100% for word initial /θ/ and 23%, 55%, 100% for word final /θ/. As described in detail above, for the longest part of of development, Maria Sofia's word final /θ/ performs considerably better than word initial /θ/ in agreement to word alignment constraints and contrary to the aforementioned norms in which there is basically no difference. Moreover, Maria Sofia's level of word initial /θ/, while much lower than the norm at 3;0 and 3;6, is much higher than the norm by age 3;11 at which Maria Sofia is at 100% while the norm is 59% at age 4;0. At the right edge of the word, Maria Sofia is at the same level with the norm at 3;0 and 3;6 but again reaches 100% by age 3;11 while the norm is 59% at age 4;0. This means that Maria Sofia has acquired /θ/ in English much earlier than monolingual English children.

Comparison with monolingual Greek children's norm is not as meaningful because PAL's (1995) data, which is the only norm in the literature for Maria Sofia's age span, is based on the proportion of children who have 'acquired' consonants without specifying what acquired means. Anyhow, their norm gives that 50% to 75% of the children have acquired word initial /θ/ between ages 3;0-4,0, without giving the exact ages of children in terms of months. If we take this to mean acquisition level, Maria Sofia's level is below it from age 3;0 to age 3;8, similar to it at 3;9, and above it at 3;10 and 3;11.

5.2.2 Substitutions of /θ/ in the two languages during development

Some English /θ/ words that occurred frequently in the child's speech and their realizations during the span of the longitudinal study are given here:

mouth [maʊθ] (target word)

2;7 maʊʃ

2;8 maʊʃ

2;9 maʊs (4), maʊʃ (3), maʊfs, mat

2;10 maʊs (5)

2;11 maʊs (2), maʊʃ

3;1 maʊθ (2), maʊs (2), maʊt

3;2 maʊ, maʊf

3;3 maʊθ (2), maʊɸ, maːʊf

3;4 maʊs (2), maʊf

3;5 maʊθ, maʊ, maʊs

3;6 maʊθ (4), maʊ (3)

3;7 maʊθ (3), maʊ, maʊs

3;8 maʊθ, maʊt

3;9 maʊθ (2), maʊs

3;10 maʊθ (2), waʊθ

3;11 maʊθ

underneath [ʌndɚniːθ] (target word)

2;11 ʌndəɹ/niːs , ʌndəl/niː (2)

3;0 ʌdəniːθ, ʌndəniːs, ʌdəniːfs

3;3 ʌndəniːt̡ ʌndəziːs, ʌdəniːs (3), ʌndəniːs

3;4 ʌdəniː, ʌndəɹniːs, ədəniːs, ʌndəniːs

3;5 ʌndəniːs (3), ʌdəniːz, ʌndəniː, ʌdəniːs (2), ʌdə

3;6 ʌndəniːs (2), ʌndəniːθ (3), ʌndəniːx

3;7 ʌndəniːs

3;8 ʌndəniːθ (3), ʌdəniːθ (2), ʌndəniːs (4), ʌdəniː (2), ʌdəniːs (2) , ʌndəniː

3;9 ʌndeɹniːs (2)

3;10 ʌdeniː

3;11 ʌndəniːθ

things [θɪŋz] (target word)

2;11 ʦɪns

3;0 siːnts

3;1 sɪnts (2), sɪns

3;2 sɪnts

3;3 siːnts (2), siːn , siːns

3;4 sɪnts, siːnts (2), siːns, sɪns

3;5 sɪns (3)

3;6 sɪns, sɪnts, θɪnts (2)

3;7 sɪns

3;8 θɪnts(4), θɪns, θɪŋgs, θɪŋs, θɪŋ, θɪ (2)
3;9 sɪns, θiːs, θɪŋs (2), θiː, θiːŋ, θiːŋz
3;11 θɪŋs (8), θiːŋz

throw [θɹoʊ] (target word)
2;7 ʃɔʊ
2;8 ʃɔʊ
2;9 fɔ, ʃɔʊ
2;10 ʃɔʊ (2), tɔʊ, sɔːʊ, sɔː
3;0 ʃɔʊ (2), sɔː (2), tɔs
3;1 ʃɔʊ, tɔʊ, sɔː (2), taɪ, sɔʊ
3;2 sɔʊ (3), lɔː, stɔ, sɔəʊ
3;6 sɔʊ (2), snɔm, tlɔʊ
3;7 sɾɔʊ, θɾɔʊ (2)
3;8 θɾɔʊ (15), sɾɔː, θtɔʊ, θɾoː (3), tɾɔʊ, θɔʊ, tɾɔː
3;9 θɾɔʊ (11), θɾəʊ (2), tɾɔʊ, tlɔː, θɾɔ (2), θɔɾ, θɾɔː (2)
3;10 θɾɔʊ (4), θɹɔʊ (2)
3;11 θɾɔʊ (4), θɾɔː (3)

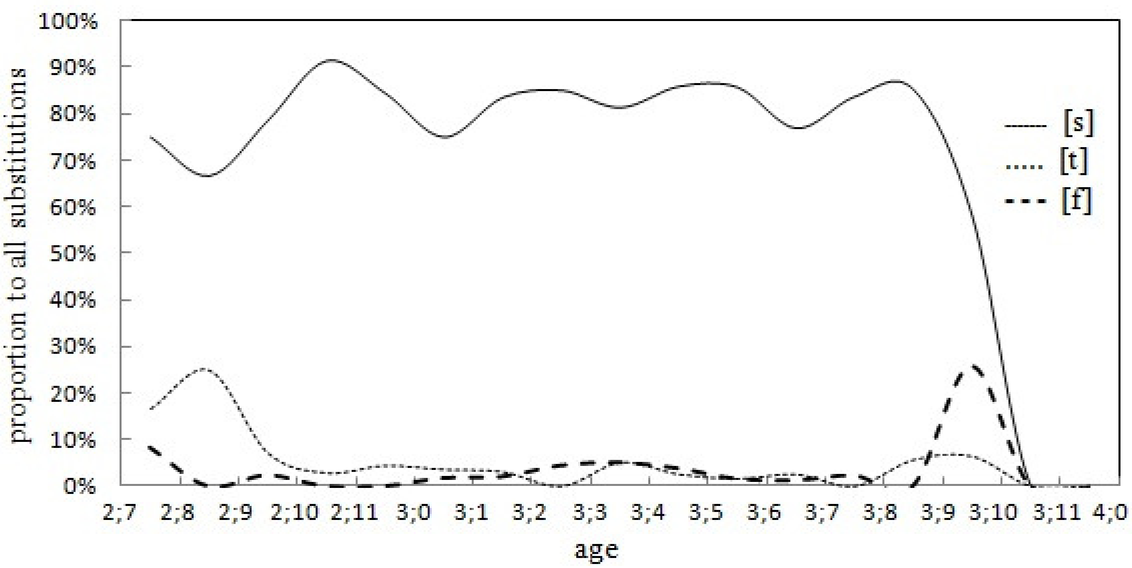
something [sʌmθɪŋ] (target word)
2;8 ʦʌmsɪŋ, sʌmsɪ, sʌmθɪ,
2;9 saː, tʌmʦɪn
2;10 sʌmʃɪŋ
2;11 sʌmsɪŋ (2), ʦʌmsɪ, sʌmsɪ (2), ʦʌmʦɪn
3;0 sʌmsɪŋ, sʌmsɪ
3;1 sʌmʃɪŋ (2), sʌmsɪŋ (6), sʌmsɪn (3), sʌmsɪ (10), sʌsθɪ, sʌmsə, sʌms, sʌmθɪ, sʌm, sʌmz, sʌmθɪn
3;2 sʌmsɪn (3), sʌmsɪŋ, sʌmsɪ (3)
3;3 sʌmsɪn (10), sʌmʦɪ, sʌmsɪ, saːnsɪn, ʌmsɪ
3;4 sʌmsɪn (8), sʌmsɪŋ, sʌmsɪ^{n}, sʌmsɪ (3), saːmsiː, sʌmθɪ , ʦʌmsɪn
3;5 sʌmθɪ, sʌmsɪŋ, sʌmsɪn (2)
3;6 sʌmsɪn (3), sʌmθɪn
3;7 sʌmsɪ (2), sʌmθɪ, sʌmsɪn (3), sʌmsɪŋ (2), sɑːmsɪ
3;8 sʌmsɪ (9), sʌmsɪn (13), sʌmθɪn (2), sʌmsɪŋ (3), sʌmçɪn, sʌmθɪ
3;9 sʌmsɪn (6), sʌmsɪ (3), sʌmθɪŋ (2), sʌmsɪŋ (2)
3;10 sʌmθɪ, sʌmθɪŋ (5)
3;11 sʌmθɪŋ (9), sʌθɪŋ, sʌmθɪ (3), ʦʌmθɪ

It is observed that /θ/ is substituted by [s, ʃ, t, ʦ, f, x, Ø]. The Greek allophone of /x/, [ç] is the only other substitution that occurred in all 50 English word types and 1,281 tokens. Besides all these substitutions, the child also used [n] in Greek but only in the function word *θα* /θa/ (meaning *will* in English). In small proportion, this was done in anticipation of /n/ in a word that followed *θα* but mainly, as the author believes, priming /n/ from the word *να* (meaning *to* in English) in her mind, confusing the infinitive *to* with the modal auxiliary *will*.

Tracking the above five words during development shows that, in general, each word is produced with more than one substitution and that its level of acquisition goes through a cyclic stage before complete acquisition. Cumulatively, these five words give an acquisition level whose arithmetic average from 2;7 to 3;11 is: 0%, 7%, 0%, 0%, 0%, 10%, 0%, 19%, 2%, 13%, 30%, 28%, 28%, 57%, 52%, 67%, 100%. Clearly, there is a cyclic stage and a progressive stage which coincide with the stages that resulted cumulatively for all the words and are shown in figure 5.1.

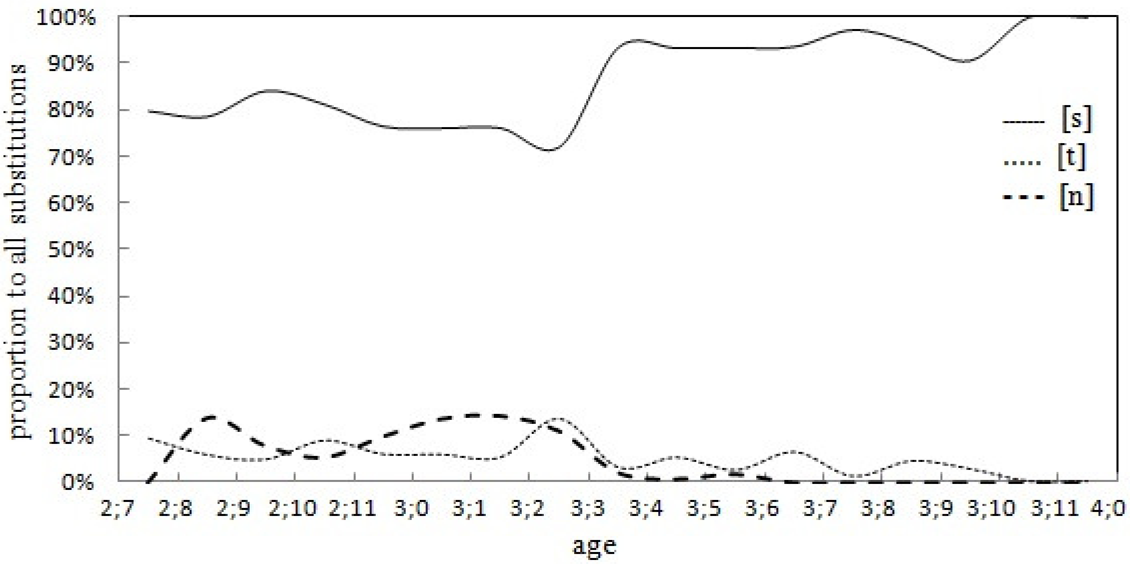
The main substitutions of /θ/ in proportion to all its substitutions are shown in figures 5.4 and 5.5, for English and Greek, respectively, for all /θ/ words during development (as given in section 5.2.1).

Figure 5.4. Substitutions of /θ/ in English during development



In these figures, [s] was calculated together with its variant [ʃ] and [t] together with its variant [ʦ]. A discussion on whether the affricate [ʦ] is a phoneme or a cluster which may be found in Drachman (1990), Lleó & Prinz (1997), Kappa (1998) and Tzakosta & Vis (2009) was also given in chapter 4 and will not be repeated here. However, the production of [ʦ] in place of /θ/ and of other consonants such as /h/ and [ç], presented below, is evidence of the unary status of /ʦ/. The remaining substitutions, mentioned above, are not shown in the figures because their proportion to all substitutions is smaller than 4% at any age during development. Exceptions to these are 6% [x] in English at 3;6 and 4% [f] in Greek at 3;9 but they are also not shown in the figure. Specifically, there are 5 tokens of [x] at 3;6 in the words *think*, *through* (3) and *underneath*. The only other token of [x] is at 3;4 in the word *bathtub*. [x] in the child's Greek is extremely rare with three tokens in total in the words *ήρθα* /iɾθa/, *καθόλου* /kaθolu/, *λάθος* /laθos/, while its allophone [ç], which is also rare, has 39 tokens in total in the verb *θέλω* /θelo/ and its grammatical forms *θέλει* /θeli/, *θέλεις* /θelis/, *θες* /θes/, *ήθελα* /iθela/, *θέλετε* /θelete/, and in the verb *ήρθε* /iɾθe/ and its grammatical forms *ήρθες* /iɾθes/, *ήρθαμε* /iɾθame/. It is remarked that the substitutions [x] and [ç] in these words appear alongside the main substitutions.

Figure 5.5. Substitutions of /θ/ in Greek during development



The substitutions [s, t, f] were reported by Smit (1993a) as the main substitutions of monolingual English children and by Kappa (2000) for a monolingual Greek child, while only [s, t] were reported by Magoula (2000) for monolingual Greek children. Smit's quantitative data for /θ/ includes only two words with word initial /θ/ as a singleton, that is, *thumb* and *thunder*, and one word with word final /θ/, *teeth*. Further, the children were in two age groups, 2;0-3;0 and 3;6-5;0, without a detailed breakdown of the age in months. On the other hand, Magoula's data is only qualitative and for children younger than Maria Sofia's age in the present study. The pattern of /θ/ becoming sibilant [s] or stop [t] has been extensively discussed in the literature (e.g. Ingram et al, 1980; Bernhardt & Stemberger, 1998), while also the similarity of [θ] to the sound [f] has been established acoustically (e.g. Wester, Gilbers, & Lowie, 2007), following Tabain's (1998) results that native speakers perceive [θ] as [f], and vice versa, at 28%.

Here, it is observed that [s] together with its variant [ʃ] is the dominant substitution by far in both languages, during the whole span of development. The frequency of occurrence is independent of word position. However, at 3;10 and 3;11, there appears to be a differentiation in the proportion of [s] between the two languages. This is because Maria Sofia still occasionally deletes /θ/ in the words *clothes* and *underneath*, whose /θ/ position at the word's right edge as a singleton or in cluster is not permitted in the Greek language.

[t] and its variant [ʦ] also occur in all possible word positions in both languages. During development in English, they occur in the following /θ/ words: *Athens*, *bath*, *bathtub*, *clothes*, *path*, *something*, *thank you*, *thing(s)*, *thirsty*, *Thomais*, *three*, *through*, *throw*, *underneath* and *with*. The proportion of [t, ʦ] to all substitutions is higher at 2;7 and 2;8 because out of 12 targeted /θ/ and 12 substitutions at 2;7, there are 2 [t] in two instances of the word *through* and out of 13 targets and 12 substitutions at 2;8, there are 3 [ʦ] in the words *bathtub*, *thank you* and *thirsty*. In Greek, during development, /θ/ becomes [t, ʦ] more frequently in the words *θα* /θa/, *θέλω* /θelo/ and its grammatical forms *θέλεις* /θelis/, *θες* /θes/, *θέλει* /θeli/, *θέλουμε* /θelume/, *θέλουνε* /θelune/, *θέλετε* /θelete/, *ήθελα* /iθela/, *ρθεί* /ɾθi/ and its grammatical forms *ρθείς* /ɾθis/, *ρθώ* /ɾθo/, *ήρθα* /iɾθa/, *ήρθε* /iɾθe/, and less frequently in the words: *αισθάνομαι* /esθanome/, *ανθρωπάκι* /anθɾopaki/, *βαθιά* /vaθia/, *γενέθλια* /ɣeneθlia/, *ελευθερία* /elefθeɾia/, *ζεσταθούμε* /zestaθume/, *θάλασσα* /θalasa/, *θέση* /θesi/, *Θεσσαλονίκη* /θesaloniki/, *θυμάμαι* /θimame/, *θυμάσαι* /θimase/, *Θωμαίς* /θomais/, *καθάρισα* /kaθaɾisa/, *κάθεσαι* /kaθese/, *καθήσει(ς)* /kaθisi(s)/, *καθήσω* /kaθiso/, *καθιστά* /kaθista/, *κάθομαι* /kaθome/, *κοιμηθείτε* /kimiθite/, *κουνηθείς* /kuniθis/, *μάθεις* /maθis/, *παραμυθάκι* /paɾamiθaki/, *πλυθείς* /pliθis/, *τσουλήθρα* /ʦuliθɾa/, *χυθεί* /xiθi/, *ψιθυρίζω* /psiθiɾizo/.

It should be noted that [s] occurs more frequently in the same words that [t, ʦ] also occur more frequently. However, the proportion of [s] substitutions in these and other words is much larger than that of [t, ʦ] resulting to the dominance of [s] substitution depicted in figures 5.4 and 5.5 above.

Near complete acquisition at 3;9, for the first time during development, the substitution [f] in English becomes significant in proportion to all other substitutions at 25%. It is at this same age that [f] occurs most frequently in Greek as well, at 4%. All the child's /θ/ words together with their targeted and correct tokens at 3;9 for both languages were given above. The words with [f] substitutions at 3;9 are: *both* (4), *Filothei* (1), *nothing* (1), *three* (1) in English, and *θυμάμαι* /θimame/ (1), *καθρέφτης* /kaθɾeftis/ (1), *Φιλοθέη* /filoθei/ (1) in Greek. It is noticed that in most cases [f] is the result of assimilation since the word *both* in all four instances was produced preceding *of us*. During the previous months in development, [f] substitutions were in the words: *both* (7), *cloth* (1), *month* (1), *mouth* (4), *throw* (1), *everything* (1), *Filothei* (1), *something* (1) in English, and *θα* /θa/ (2), *θέλω* /θelo/ (1), *θόρυβο* /θoɾivo/ (2), *καθρεφτάκι* /kaθɾeftaki/ (2), *Φιλοθέη* /filoθei/ (6) in Greek. Therefore, assimilation persists near complete acquisition when substitutions decrease.

5.2.3 Deletions of /θ/ in the two languages during development

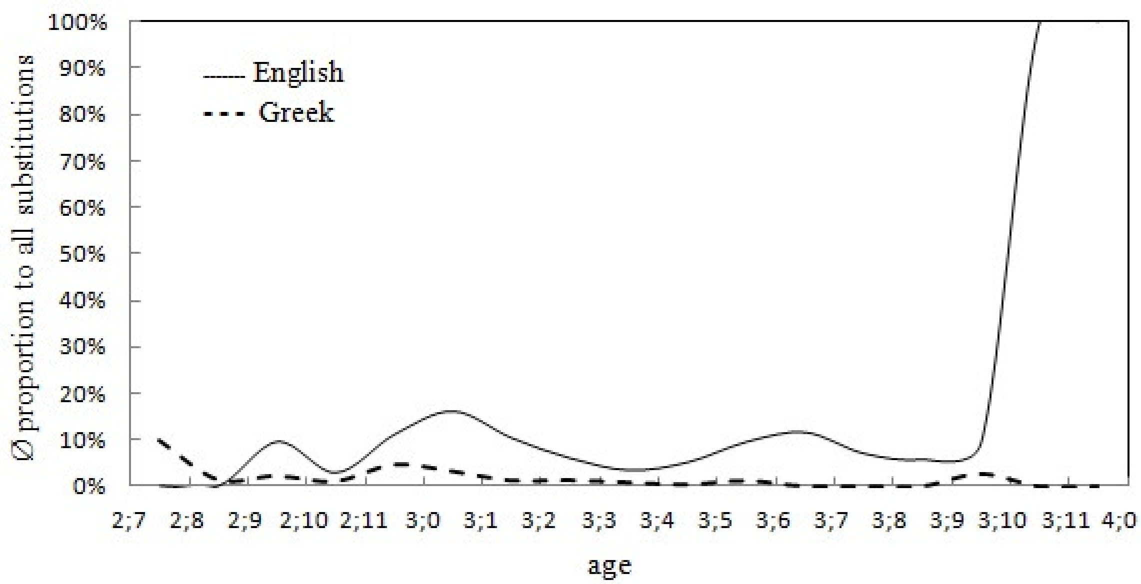
In the child's English, deletions of /θ/ during development are in the target words: 2;7: -, 2;8: -, 2;9: *anything*, *birthday*, *clothes*, *something*, 2;10: *birthday*, *clothes*, 2;11: *bathtub*, *clothes underneath*, 3;0: *clothes*, 3;1: *cloth*, *clothes*, 3;2: *bathtub*, *mouth*, *Parthenon*, *throw*, 3;3: *clothes*, 3;4: *clothes*, *underneath*, 3;5: *clothes*, *mouth*, *underneath*, 3;6: *bath*, *clothes*, *mouth*, 3;7: *both*, *mouth*, 3;8: *both*, *clothes*, *underneath*, 3;9: *both*, *something*, *underneath*, 3;10:

underneath, 3;11: *clothes*. Deletions occur in word final position, in /θs/ and /θr, rθ/ clusters, and in compound words.

In Greek, the deletions of /θ/ are in the target words: 2;7: *θα* /θa/, *θέλω* /θelo/, 2;8: *θα* /θa/, *θέλω* /θelo/, 2;9: *βοηθήσεις* /voiθisis/, *θα* /θa/, *θέλω* /θelo/, *Θωμαίς* /θomais/, 2;10: *θα* /θa/, *θέλω* /θelo/, 2;11: *θα* /θa/, *Θανάσης* /θanasis/, *θέλω* /θelo/, *θέλει* /θeli/, 3;0: *θα* /θa/, *θέλω* /θelo/, 3;1: *θα* /θa/, *βοηθήσει* /voiθisi/, 3;2: *θα* /θa/, *θέλω* /θelo/, *ρθεί* /ɾθi/, 3;3: *θα* /θa/, 3;4: *ζεσταθεί* /zestaθi/, 3;5: *θα* /θa/, 3;6: -, 3;7: -, 3;8: -, 3;9: *θα* /θa/, *θέλεις* /θelis/, 3;10: -, 3;11: -. Contrary to English, deletions in Greek occur mainly in word initial singleton position. At 3;9, near complete acquisition, deletions persist in both languages.

The proportion of /θ/ deletions to all substitutions during development is shown in figure 5.6 for both English and Greek. The level of deletions is below 20% in both languages all along development. However, at 3;11, as there is only one substitution for English /θ/ and it is a word final deletion, the deletion curve for English shoots up to the level of 100%. There are more deletions in English than in Greek of two reasons. First, word final /θ/ is not permitted in the Greek language where deletions occur more frequently and, second, the child applies a different rule across the two languages when deleting /θ/, as just discussed.

Figure 5.6. Deletions of /θ/ during development



5.2.4 Conclusions

Two stages of development are identified in the child's acquisition level of /θ/, the cyclic and the progressive. In the cyclic stage which is ten and twelve months long in English and Greek, respectively, the acquisition level fluctuates around 5%. The progressive stage lasts seven months in English and six months in Greek. In Greek, however, if the modal auxiliary *θα* (will) is excluded, complete acquisition is reached one month earlier. Therefore, overall, there is a plateau stage and a relatively sharply rising progressive stage which define the length and depth of a U-shaped pattern reported on a qualitative basis earlier in the literature for general phonological and linguistic development.

The slowing down of the progression in English is attributed mainly to the slowing down of the acquisition level of word final /θ/ which, near complete acquisition, becomes lower than the acquisition level of word initial /θ/, contrary to earlier perfomance. Thus, near complete acquisition, the word alignment constraint whereby continuants align to the right edge of the word is violated. The cause of this non-linearity in development is the child's persistence to err in words with a diphthong, such as *both*, *mouth* and compound words as *underneath*. On the other hand, the Greek language does not allow word final /θ/.

Near complete acquisition, there is some differentiation in the kind of errors the child makes in the two languages. In English, besides the word final errors mentioned, the child has difficulties with compound words that have /θ/ in syllable initial position as in *something*, *nothing* and, occasionally, with /θɹ/ clusters. In Greek, however, the more frequent errors occur in words with the /θɾ/ cluster and the /ɾ.θ/ heterosyllabic sequence, in the verb *θέλω* /θelo/ (*want*) and its grammatical variations, and in the modal auxiliary *θα* /θa/ (*will*).

Non-linearity is also observed in the child's substitution patterns near complete acquisition. [f]'s frequency of occurrence as a substitution of /θ/ sharply increases in both languages due to the persistence of assimilation while the other main substitutions [s, ʃ, t, ʦ] reduce.

During the whole span of development, [s] together with its variant [ʃ] is the predominant substitution in both languages at about 80% in proportion to all other substitutions including deletions. Rare substitutions are [x] in English as in the word *through* and its allophone [ç] in Greek in the verbs *θέλω* /θelo/ (*want*), *ήρθε* /iɾθe/ (*came*) and in their grammatical variations. In these words and in their phonologically similar words, the main substitutions also occur, with [s] being predominant.

The same is true for the Greek modal auxiliary *θα* /θa/ (*will*) which is the only word, when both languages are compared, where /θ/ is substituted by [n]. This occurs in some cases by anticipation and in the remaining instances, as the author believes, by priming it with the infinitive *να* /na/ (*to*) in her mind.

At 3;9, substitutions persist for /θ/ in words that have the lateral to the right of /θ/ as in /θelo/ and /kaθolu/ but not to the left of /θ/ as in /aliθia/ and /kolibiθɾa/ in which /θ/ is produced correctly. This preferred directionality may be observed in other children's data with regard to regressive consonant harmony, in general, that includes assimilation to the lateral, as discussed in §4.5.3.

Last, the two languages differentiate in their deletion patterns. In English, deletions occur in word final position, in /θs/ and /θɹ, ɹθ/ clusters, and in compound words. In Greek, they occur mainly in singleton word initial position. Near complete acquisition, deletions persist in both languages as, also, assimilations do.

Comparison of Maria Sofia's acquisition of /θ/ with monolingual children reveals that she acquires it completely, much earlier than English or Greek monolinguals. However, during her cyclic stage, her acquisition level in word initial position is well below the monolingual English norm and below the monolingual Greek norm while in word final position it is similar to the monolingual English norm. Maria Sofia progressed much faster than the norm in the last stage of development even though she was well behind in previous stages. This shows that parents and speech pathologists should not rush to judgments as to whether a child is phonologically delayed or not.

The results presented here, besides their interest in child speech development, also provide a perspective on adult L2 speech acquisition where, while it is known that [s, t, f] are the main substitutions for /θ/ independent of the speakers' L1 language (e.g. Brannen, 2002, Weinberger, 2013), the effect of the proficiency level of L2 speakers on substitution patterns, longitudinally, is not known and needs to be investigated.

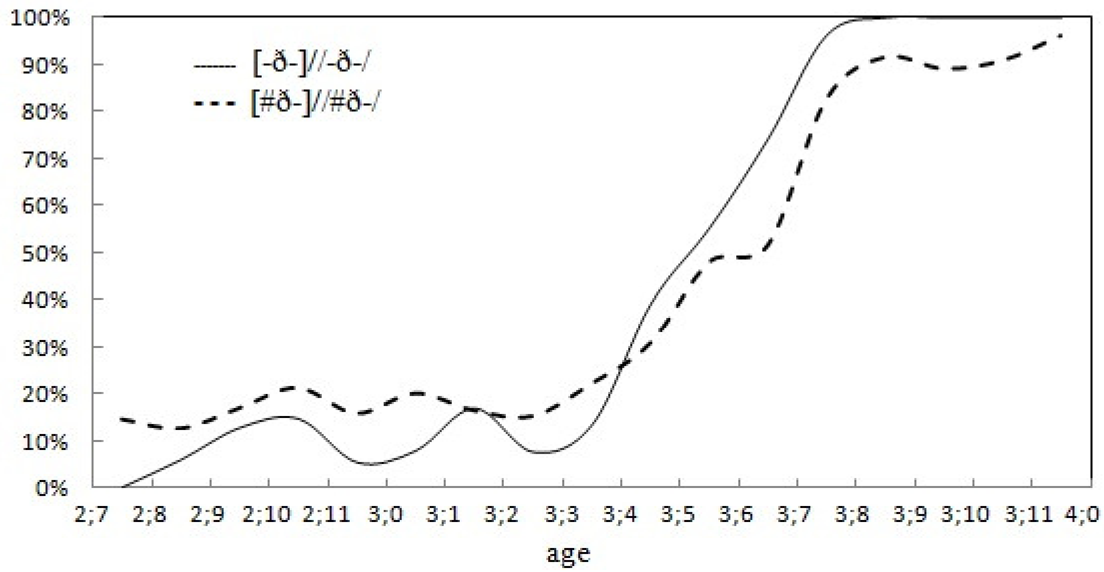
5.3 Development of the voiced interdental in English

The targeted /ð/ words in the child's English speech and the age of their first production are:

2;7	brother, father, further, other, that, the, there, these, they, this, together
2;8	another, bothers, them, then
2;9	bothering, mother, there's, those
2;10	bother, either, that's
2;11	-
3;0	others
3;1	-
3;2	-
3;3	-
3;4	lather, themselves
3;5	without
3;6	than
3;7	-
3;8	theirselves (themselves)
3;9	though
3;10	neither
3;11	breathe

There are 31 targeted word types for a total of 11,432 tokens. The monthly tokens of word initial /ð/ are: 102, 204, 639, 790, 502, 569, 1049, 748, 579, 823, 570, 666, 639, 908, 1069, 406, 417 for a total of 10680 tokens from age 2;7 to 3;11. The monthly tokens of word medial /ð/ are: 9, 17, 71, 48, 57, 90, 107, 40, 45, 64, 29, 31, 27, 56, 35, 9, 17 for a total of 752 tokens. Correctly produced /ð/'s were counted monthly for each word position and the acquisition level was computed as the proportion of correct productions to targets. The result is shown in figure 5.7.

Figure 5.7. The acquisition level of word initial and word medial /ð/ in development



The cyclic stage for both word positions lasts until age 3;2, thus, it is two months shorter than that of the voiceless interdental, /θ/. During this stage, the acquisition level of word initial /ð/ is above the word medial level, both being below 20%. The progressive stage starts at 3;3, with the word medial level progressing at a steeper rate. Starting at age 3;4, it surpasses the word initial level. The word initial delay is attributed to the presence of function words and mostly to the most frequent word in English, the article *the*, which is also the most frequent word in Maria Sofia's speech. The 90% acquisition level is reached at ages 3;7 and 3;8 for word medial and word initial /ð/, respectively.

It is interesting that the drastic slowing down of word initial progress occurs at age 3;6, three months after the start of the progressive stage, creating a second S-shaped curve in the developmental path of the acquisition level. It was also three months into the progressive stage that the same occurred for the other interdental, /θ/. Moreover, the progressive stage for both interdentals is six months long.

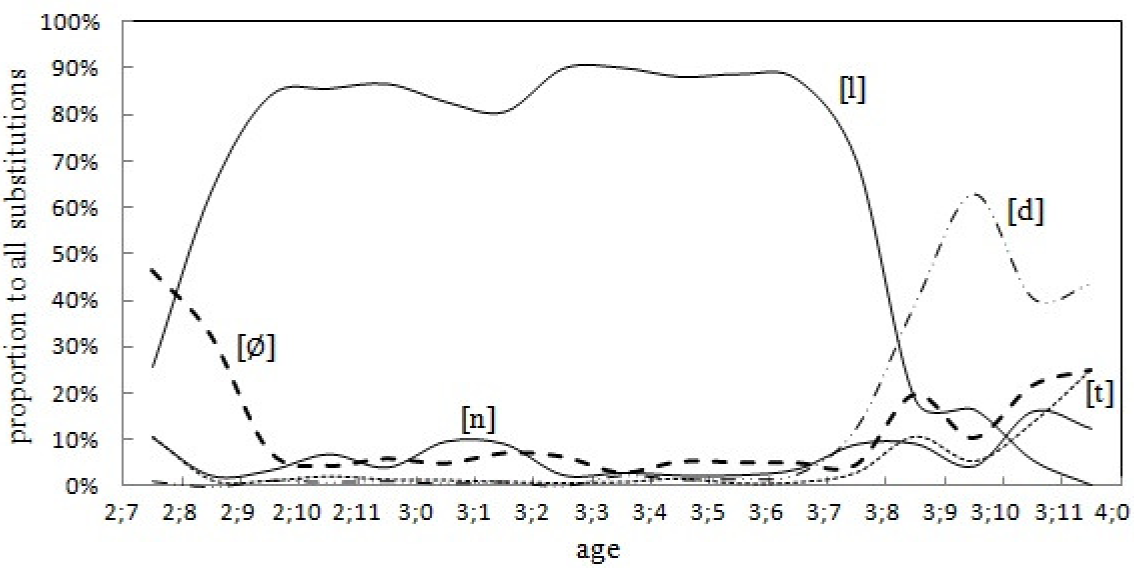
The word initial acquisition level's norm for monolingual English females which is higher than for males is 32%, 58%, and 76% at ages 3;0, 3;6 and 4;0, respectively (Smit et al., 1990). Maria Sofia's acquisition level is slightly below the norm at ages 3;0 and 3;6 and well above the norm near 4;0 as was the case for the voiceless interdental, /θ/.

The developmental substitutions for /ð/ will now be examined separately for each word position.

5.3.1 The substitutions of word initial /ð/ in development

Occurrences of each substitution for word initial /ð/ are counted monthly and computed in proportion to the occurrences of all substitutions including deletions. The results for substitutions, whose level is at least 10% at any age during development, are depicted in figure 5.8.

Figure 5.8. Substitutions of word initial /ð/ in development



During most part of phonological development, the dominant substitution is [l]. Early on, at age 2;7, when the acquisition level of word initial /ð/ is below 20%, deletions are more frequent than [l]. Later, starting at 3;8 when the acquisition level is near 90%, [d] together with its devoiced articulation [t] become predominant while [l] becomes extinct.

It is interesting that [d] which rarely occurs during most part of phonological development becomes, near complete acquisition, much more frequent than [l], the predominant substitution until then. Articulatory maturation does not explain this sudden alteration in the substitutions near complete acquisition, since /t, d/ are phonetically available to the child from the beginning. This phenomenon occurs in the child's development of other consonants, as well, as was the case for the voiceless interdental, /θ/, studied in section 5.2. Such a non-linearity in substitution patterns during development is not accounted for by generative theory and theories stemming from it e.g. OT (e.g. Prince & Smolensky, 2004) which suppose that child starts off with unmarked forms to linearly proceed towards skillfulness and adult production by acquiring higher ordered constraints. When detailed data from other children's development becomes available, it will be determined whether this kind of non-linearity is a universal phenomenon in child phonological development. The author believes that it is universal.

Besides [n], whose proportion to all substitutions is lower than 15% at any age during development, there are other substitutions for word initial /ð/ that occur at a proportion lower than 3% at any age. These are: [v], [j], [r], [z] in order of frequency of occurrence.

The development of word initial /ð/ is exemplified by its development in the word *this*, the second most frequent /ð/ word in Maria Sofia's speech following article *the*, as follows:

Target:	**/ð/** in **this**	**[ð]** productions	**substitutions**
2;7	41	10 (24%)	15[l], 1[t], 7 [n], 1[v], 1[j], 1[z], 5[Ø]
2;8	34	5 (15%)	24[l], 1[n], 1[z], 3[Ø]
2;9	124	28 (23%)	71[l], 4[d], 2[t], 6[n], 1[v], 4[j], 1[z], 7[Ø]
2;10	138	40 (29%)	81[l], 3[d], 4[t], 4[n], 6[Ø]
2;11	124	29 (23%)	81[l], 1[d], 2[t], 1[v], 3[j], 7[Ø]
3;0	127	25 (20%)	77[l], 3[d], 3[t], 9[n], 2[v], 1[ɹ], 7[Ø]
3;1	312	47 (15%)	205[l], 3[d], 1[t], 27[n], 6[v], 2[j], 21[Ø]
3;2	261	54 (21%)	178[l], 1[d], 2[t], 6[n], 1[v], 2[ɾ], 17[Ø]
3;3	138	33 (24%)	86[l], 4[d], 2[t], 5[n], 1[v], 3[j], 1[z], 1[ɾ], 2[Ø]
3;4	221	107 (48%)	86[l], 9[d], 3[t], 1[n], 2[v], 1[z], 1[ɾ], 11[Ø]
3;5	129	107 (83%)	13[l], 2[d], 1[t], 1[n], 1[θ], 4[Ø]
3;6	118	114 (97%)	1[d], 1[n], 2[Ø]
3;7	119	112 (94%)	1[l], 3[d], 1[t], 1[p], 1[Ø]
3;8	157	145 (92%)	4[d], 4[t], 1[n], 1[ɾ], 2[Ø]
3;9	186	162 (87%)	3[l], 15[d], 1[n], 5[Ø]
3;10	43	37 (86%)	3[d], 2[t], 1[Ø]
3;11	76	70 (92%)	5[d], 1[t]

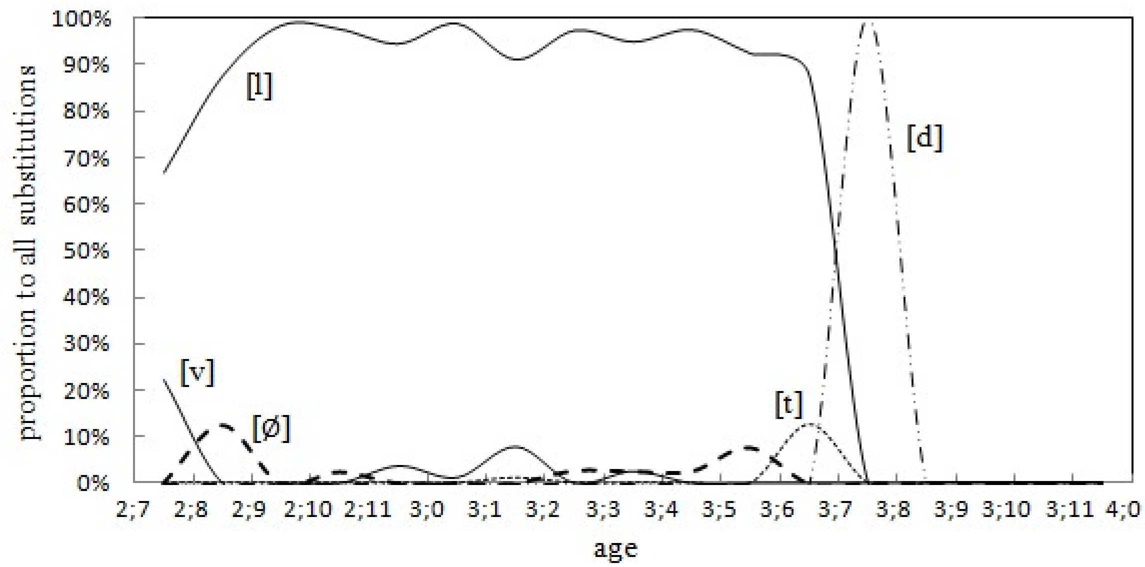
The acquisition level of /ð/ in the word *this* is in a cyclic stage until age 3;2 matching the cyclic stage length for all words, cumulatively. However, its progressive stage is three (3) months long, two months shorter than in all words cumulatively. This word initial delay in reaching complete acquisition is attributed to the progression of the article *the*. In the cyclic stage, [l] dominates the substitutions followed by [n] and deletions. In the first part of the progressive stage at ages 3;3, 3;4 and 3;5, [l] is still dominant followed by [d, t] and deletions. Near complete acquisition, starting at 3;6, [d, t] become dominant followed by deletions, while [l] is becoming extinct.

The norm for monolingual English children is to substitute word initial /ð/ predominantly with [d] all along development at 50%-80% in ages 2;0-3;0 and 30%-50% in ages 3;6-4;0, in proportion to targets (Smit, 1993a). The substitutions [b, j, v, Ø, z] occur at a frequency lower than 5% in proportion to all targets and in this order of frequency, respectively. Maria Sofia's use of [l] as the predominant substitution of /ð/, for the most part of development, is idiosyncratic. However, it has been reported to occur occasionally in other children as well (e. g. Ingram et al. 1980, Bernhardt & Stemberger, 1998).

5.3.2 The substitutions of word medial /ð/ in development

The substitutions of word medial /ð/ whose frequency of occurrence in proportion to all substitutions is 10% or higher at any age are shown during development in figure 5.9.

Figure 5.9. Substitutions of word medial /ð/ in development



[l] is the predominant substitution until age 3;6 as was the case for word initial /ð/. However, in contrast to word initial /ð/, deletions are negligible at 2;7 and [v] occurs at a frequency of 22%, much higher than word initial's 3% at any age. At 2;7, there are two occurrences of [v] out of two targets in the words *father* and *further*. In *father*, [v] re-occurs at ages 2;11, 3;0, 3;1 and 3;3. The only other [v] occurs in the word *brother* at age 3;1.

There is only one occurrence of [d] in word medial position during the whole development, in contrast to word initial position where [d] is more frequent. It is in the word *another* at age 3;7, when there is only one substitution cumulatively in all the words. At 3;6, its devoiced articulation also occurs once in the same word, while overall it only occurs once more at 3;1 in the compound word's constituent word, *other*. Deletions occur in the word *another* at 2;8 and 3;3*,* in the word *either* at 2;10, 3;2 and 3;4, and in the word *other* at 3;5.

There are other substitutions that are rare. [n] occurs once in the word *another* at 2;11 in contrast to word initial position where [n] is more frequent, and [ɾ] occurs once in the word *brother* at 2;7. Both substitutions apparently occur in assimilation.

The development of word medial /ð/ is exemplified by its development in the compound word *another* as follows:

Target: **/ð/** in **another**		**[ð] productions**	**substitutions**
2;7	-	-	-
2;8	6	0 (0%)	5[l], 1[Ø]

2;9	10	2 (20%)	7[l], 1[j]
2;10	5	2 (40%)	2[l], 1[Ø]
2;11	31	2 (6%)	28[l], 1[n]
3;0	17	2 (12%)	15[l]
3;1	16	2 (13%)	14[l]
3;2	9	0 (0%)	9[l]
3;3	20	0 (0%)	19[l], 1[ɾ]
3;4	12	6 (50%)	6[l]
3;5	15	7 (47%)	7[l], 1[Ø]
3;6	3	2 (67%)	1[l]
3;7	2	1 (50%)	1[d]
3;8	17	17 (100%)	-
3;9	3	3 (100%)	-
3;10	2	2 (100%)	-
3;11	5	5 (100%)	-

The acquisition level of /ð/ in the word *another* is in a cyclic stage until age 3;2, matching the cyclic stage length of all words, cumulatively. The progressive stage lasts about five (5) months reaching complete acquisition at about 3;8, the same age with all words, cumulatively. The acquisition level for four months in this stage remains at about 50%, creating a double S-shaped progression curve. Throughout development, [l] dominates the substitutions of word medial /ð/ as it did for all words, cumulatively. At 3;7, near complete acquisition, [d] occurs for the first and last time, while [l] becomes extinct thereafter.

5.3.3 Conclusions

The voiced interdental, /ð/, in Maria Sofia's English is acquired completely at 3;8, about the same age as the voiceless interdental, /θ/. The acquisition level of /ð/ is below 20% during the cyclic stage which lasts until age 3;2, two months earlier than the cyclic stage of /θ/ whose acquisition level is below 10%. The progress of word initial /ð/ slows down by one month due to the article *the*, the most frequent word in the English language and in the child's speech, resulting in a double S-shaped curve of progression. Maria Sofia's acquisition level is slightly below monolingual English children's norm during the cyclic stage but well above it after age 3;7.

The dominant substitution for /ð/ is [l] for the most part of the child's phonological development, except near complete acquisition when primarily [d] and secondarily [t] take over. Other substitutions at 10% or higher, in proportion to all substitutions, are deletions and [n] for word initial /ð/ and deletions and [v] for word medial /ð/. The norm for monolingual English children is [d], while [l] occurs occasionally.

5.4 Development of the labio-velar approximant

The development of word initial /w/ will be examined. The corresponding targeted words in the child's English speech and the age of their first production are:

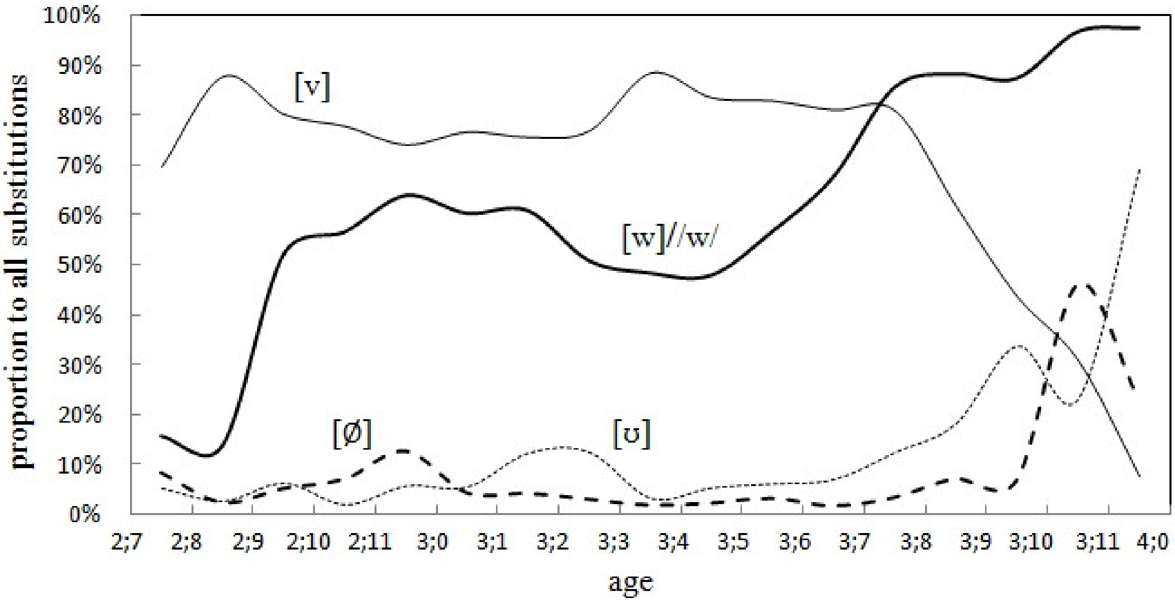
2;7:	one, wait, walk, wall, want, water, way, we, wearing, wee, when, where, white, why, will, Willie, window, Winkie, Winnie, with, won't
2;8	ones, warm, wash, watch, what, which, wide, windows, wolf
2;9	wake, wanted, went, wet, wheels, where, while, wind, work
2;10	waiting, wants, washed, watching, watermelon, weak, well, wipe, wonderful
2;11	water, waves, wheel, word, would
3;0	wagging, wagons, walks, wow, woke, working, worth
3;1	walking, wardrobe, washing, web, windy, winter, wiping, women, worker, workers
3;2	wagon, wave, week, weeks, whiskers, wings
3;3;	was, worm
3;4	warmed, Wednesday, were, whisker, whispering, win, wine, wish, wolves, wore, worry
3;6	weekend, welcome, whisper, without, wonder
3;7	waiting, Walrus, wetting, what's, whenever, wider, wind (to)
3;8	waking, warmer, wasn't, wiped
3;9	wished, wizard, wolfie
3;10	wedding, wicked, wild, wins
3;11	-

There are 112 word types with 10,868 tokens. The monthly tokens are: 70, 139, 510, 513, 498, 567, 945, 777, 691, 965, 692, 854, 787, 1170, 796, 390, 504. The development of the acquisition level is shown in bold solid line in figure 5.10. At 2;7 and 2;8, the level is lower than 20%. The cyclic stage is between 2;9 and 3;5 where the acquisition level fluctuates about 55%. Starting at 3;6, it surpasses the 65% level while between 3;7 and 3;9 it is stationary just below the 90% level. At 3;10, /w/ is acquired completely at 97%.

Monolingual English children have completely acquired word initial /w/ by age 3;0 (Smit et al., 1990), that is, at least nine months earlier than Maria Sofia. As shown in chapter 4, the child idiosyncratically delays in the acquisition of velar place. Furthermore, the velar glide, /w/, does not exist in the Greek language and the child's input was entirely from the Greek mother's L2 English. These may explain the child's delay.

The developmental substitutions of word initial /w/ whose frequency of occurrence in proportion to all substitutions is 10% or higher at any age are also shown in figure 5.10.

Figure 5.10. The development of word initial /w/



The dominant substitution during development is [v] except near complete acquisition when deletions and the vowel [ʊ] take over. The substitution [v] for /w/ is not surprising as they share [Labial] place of articulation. Maria Sofia acquires [v] (see following section 5.5) earlier than [w] contrary to monolingual English norms (Smit et al., 1990). The labio-velar approximant is characterized by the [-consonantal] feature which does not exist in standard Modern Greek and it is, therefore, a marked sound for Maria Sofia whose L2 input for the labio-velar approximant is in an exogenous environment. Moreover, Maria Sofia's overall pattern of consonant acquisition shows a delay in the realization of [Dorsal, +back] sounds where [w] belongs. [v] occurs in all the words and, after age 3;6, it persists in the monosyllabic words *wall*, *was*, *we*, *where*, *will*, *with*. Deletions mostly occur in monosyllabic words and, near complete acquisition, they persist in the words *one*, *want*, *why*, *wolf*. [ʊ] only occurs in the word *one*.

The development of /w/ in the word *window* is given as an example:

Target: **/w/** in **window**		**[w] productions**	**substitutions**
2;7	1	0 (0%)	1[v]
2;8	1	0 (0%)	1[v]
2;9	2	0 (20%)	2[v]
2;10	-	-	-
2;11	3	0 (0%)	3[v]
3;0	2	0 (0%)	2[v]
3;1	1	1 (100%)	-
3;2	7	0 (0%)	7[v]

3;3	-	-	-
3;4	2	0 (0%)	2[v]
3;5	3	0 (0%)	3[v]
3;6	11	6 (55%)	5[v]
3;7	2	2 (100%)	-
3;8	5	5 (100%)	-
3;9	1	1 (100%)	-
3;10	1	1 (100%)	-
3;11	-	-	-

Until age 3;6, [v] dominates while at 3;6, [v] and [w] are about as frequent. Starting at 3;7, [w] is completely acquired in the word *window*. Therefore, the developmental pattern of a phoneme in a specific word does not give the complete picture of the phoneme's development in a child's speech, as it has just been demonstrated.

There are other substitutions of /w/ that occur at a frequency of 7% or less in proportion to all substitutions. In order of frequency of occurrence, these are: [l, f, m, r, g]. [l] occurs more frequently in the word *wolf*, apparently in assimilation to /l/ in the word. [l, m, r, g] have been reported as rare substitutions for monolingual English children as well (Smit, 1993a), where the norm is occasional deletion of /w/ as it is completely acquired before age 3;0 (Smit et al., 1990).

5.4.1 Conclusions

The acquisition level of word initial /w/ goes through three stages of development. In the first stage, ages 2;7 and 2;8, it is lower than 20%. In the second stage, ages 2;9 to 3;5, the acquisition level fluctuates around 55%. In the third stage, it surpasses the 65% level at 3;6, it increases to just below 90% from 3;7 to 3;9 and, finally, it is completely acquired at 3;10. Maria Sofia's complete acquisition of /w/ is delayed by at least nine months compared to the monolingual English children's norm.

The dominant developmental substitution is the labio-dental [v], as it shares the place labial with the labio-velar [w]. As will be seen in section 5.5 that follows, Maria Sofia acquires [v] earlier than [w] contrary to monolingual English norms. The labio-velar approximant does not exist in standard Modern Greek and it is, therefore, a marked sound for Maria Sofia whose L2 input for the labio-velar approximant is in an exogenous environment. Furthermore, the child's overall pattern of consonant acquisition shows a delay in the realization of [Dorsal, +back] sounds where [w] belongs.

Until age 3;8, deletions and vowel [ʊ] occur at a frequency of less than 20% in proportion to all substitutions. However, starting at 3;9 near complete acquisition, they become more frequent becoming the dominant substitutions taking over when [v] becomes extinct. This occurs in monosyllabic words and more frequently in the word *one*. Monolingual children's substitutions are dominated by deletions as /w/ is acquired early, before age 3;0.

5.5 Development of the voiced labio-dental fricative in English

A detailed analysis of Maria Sofia's performance of /v/ in both languages at age 2;7 was examined in chapter 4. The voiced labio-dental fricative's development in English during the succeeding sixteen months until age 4;0 is investigated here.

The targeted English /v/ words in the child's speech and the age of their first production are:

2;7	give, leave, moved, pavement, TV, Venizelo
2;8	cover, DVD, everywhere, gave, have, olives, vase, very
2;9	cave, clever, five, heavy, living, love, loves, of, over, save, seven, vanilla, village
2;10	bravo, covered, dive, drive, drives, every, live, shovel,
2;11	beehive, driver, move, Stavros, waves
3;0	uncover, having, olive, everybody
3;1	curvy, everything, favorite, moving, Venus
3;2	behave, duvet, fever
3;3	evening, giving, ourselves, seventy, wave
3;4	above, believe, covers, driving, dwarves, eleven, eventually, gloves, lives, never, seventeen, themselves, twelve, wolves
3;5	carnival, even, lovely, remove, serve, serving, solving, vegetables
3;6	ever, everyone, hovering, lavender, leaving
3;7	vacuum, valley, whenever
3;8	curving, DVDs, everyday, haven't, invite, leaves, loving, river, view, whatever, wherever
3;9	dived (dove), dove, drived (drove), elves, gravel, I've, loved, movie, removed, saliva, villa
3;10	expensive, lived, negative, starving
3;11	elevator, saved

In total, there are 115 /v/ word types. Word initial /v/ and word final /v/ realizations will now be examined.

5.5.1 The development of word initial /v/

The monthly targeted /#v-/ words in the child's speech are:

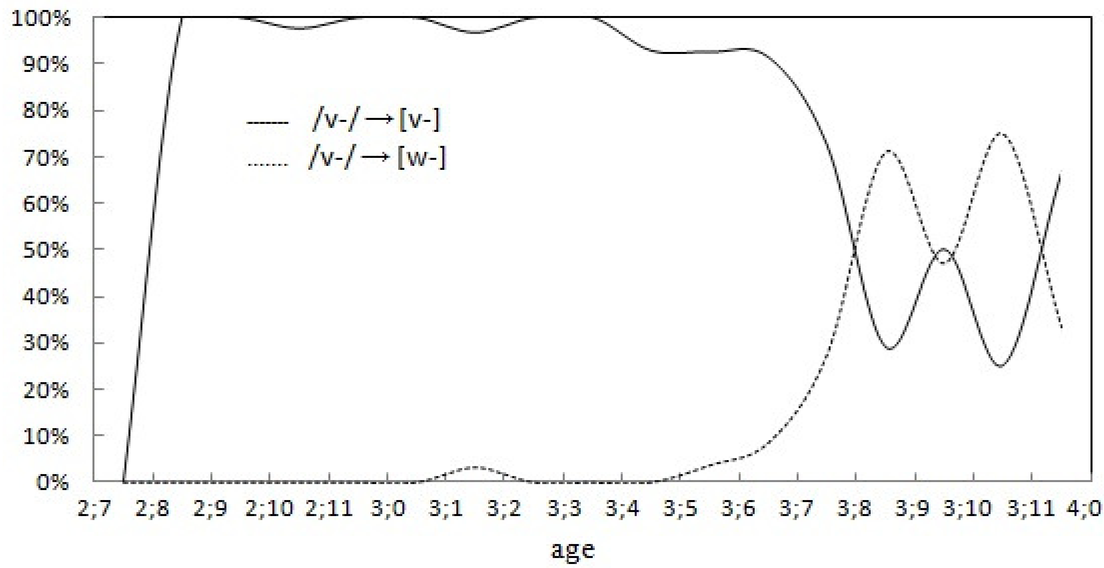
2;7: Venizelo
2;8 vase, Venizelo, very
2;9 vanilla, Venizelo, very, village
2;10 vanilla, very, village
2;11 very
3;0 very
3;1 venus, very, village
3;2 very
3;3 very
3;4 Venizelo, very, village
3;5 vegetables, very
3;6 vase, very
3;7 vacuum, valley, very
3;8 very, view
3;9 very, view, villa
3;10 very
3;11 vase, vegetables, very

There are 11 word types for a total of 377 tokens. The monthly tokens are: 1, 4, 12, 43, 21, 1, 31, 36, 24, 14, 27, 35, 29, 38, 34, 12, 15. The word *very* is by far the most frequent overall as well as, monthly, except at 2;7 and 2;8, and is the only word in which /v/ is not acquired by 3;11. However, /v/ is completely acquired in this word from 2;8 to 3;3, when there is no error in 159 targets. From age 3;4, the child starts substituting /v/ in the word *very* in the following rates: 3;4: 1 deletion out of 12 targets, 3;5: 1 [w] and 1 [f] out of 26 targets, 3;6: 3 [w] out 30 targets, 3;7: 8 [w] out of 27 targets, 3;8: 27 [w] out of 37 targets, 3;9: 16 [w] and 1 [f] out of 32 targets, 3;10: 9 [w] out 12 targets, 3;11: 5 [w] out of 10 targets. The frequent substitution of /v/ by [w] from age 3;6 is attributed to /w/'s progress in its acquisition level (>60%) starting at this age and the fact that [v] is the predominant substitution of /w/. Therefore, the child overgeneralizes the use of [w] in the context of /v/.

In contrast, word initial /v/ is acquired early in all other words in the child's speech, having only the following /v/ errors: 2;7: [m] in *Venizelo* once out of 1 target, 2;10: [l] in *village* once out of 1 target, 3;1: [w] in *village* once out of 2 targets.

The development of the acquisition level of /#v-/ and the corresponding level of its predominant substitution, [w], are shown in figure 5.11. At 2;7, the acquisition level appears negligible since there was only one word in the data whose /v/ was assimilated to [m], a substitution that never occurred afterwards for /v/ at word initial position. It is further remarked that regression in the acquisition level of /v/ after 3;6, besides coinciding with progression in the acquisition level of /w/, also coincides with progression in the acquisition level of the child's other consonants, as was the case for /θ/. Furthermore, the frequent occurrence of previously infrequent substitutions, near the end of phonological development, is common to several consonants as was the case for /θ/ being substituted by /f/.

Figure 5.11. The development of word initial /v/



The norm established by Smit et al. (1990) for monolingual English children for the acquisition level of word initial /v/ is (41%, 52%), (62%, 66%), (78%, 76%) for females, the first in parenthesis, and males at ages 3;0, 3;6 and 4;0, respectively. Maria Sofia's level is well above the norm at ages 3;0 and 3;6 while near 4;0, because of the substitution of [w] in the word *very* her level for the three recorded words *vase*, *vegetables* and *very* is below the norm.

As for substitutions, between ages 2;0-3;6, [b] is the norm's predominant substitution for /v/ in the word *van* with [f], [w] following at levels below 15% and 5%, respectively. Maria Sofia, however, did not substitute [b] for /v/ at any word position because, overall, her substitution pattern for consonants is to adhere to the [+continuant] feature as was the case for [s] substituting /θ/, which was discussed in section 5.2, and for other consonants which will be discussed in the sections that follow.

5.5.2 The development of word final /v/

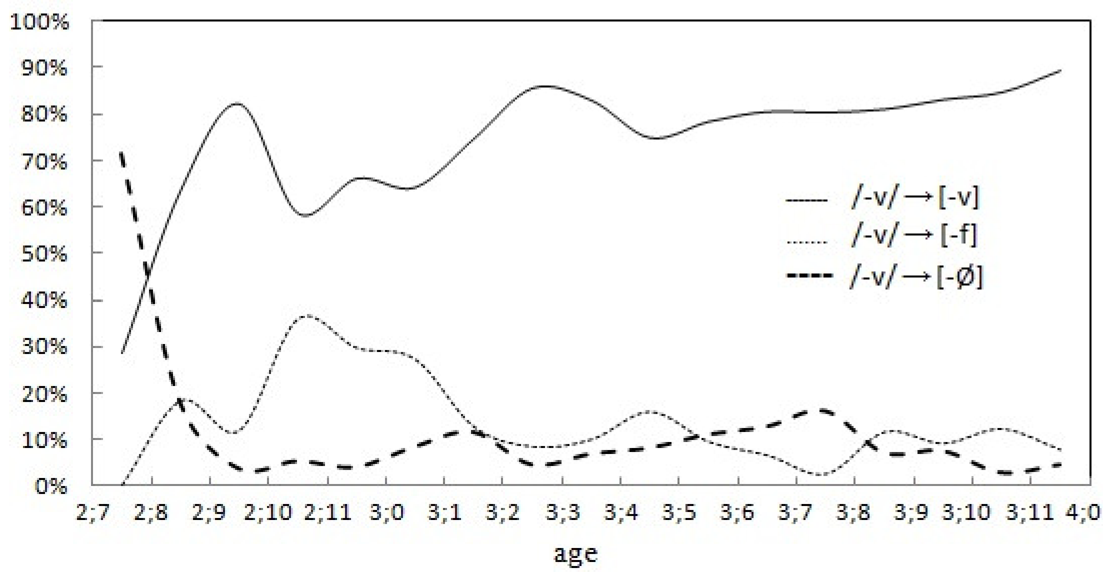
The monthly targeted /-v#/ words in the child's speech are:

2;7 give, leave
2;8 give, have, leave
2;9 cave, five, give, have, leave, of, save
2;10 drive, five, give, have, leave, love, of, save

2;11	beehive, five, give, have, leave, move, of
3;0	five, gave, give, have, leave, move, of, olive
3;1	five, give, have, leave, move, of, save
3;2	behave, give, have, love, move, of
3;3	drive, five, give, have, of
3;4	above, drive, five, gave, give, have, leave, move, of, olive, twelve
3;5	drive, five, gave, give, have, move, of, remove
3;6	beehive, drive, give, have, move, of, twelve
3;7	five, gave, give, have, leave, move, of, remove, solve
3;8	five, give, have, leave, of, twelve
3;9	believe, cave, dive, dove, five, give, have, I've, leave, love, move, of, solve
3;10	dive, expensive, give, have, move, negative, of
3;11	give, have, leave, move, of

There are 27 word types for a total of 1,695 tokens. The monthly tokens are: 7, 11, 51, 109, 71, 70, 121, 84, 71, 120, 105, 125, 124, 218, 233, 67, 108. The more frequent words are: 532 *have*, 325 *of*, 295 *give*, 130 *leave*, 96 *five*, 66 *love*, 49 *save*, 37 *move*, *20 gave*, 20 *solve*, 14 *believe*, 13 *dive,* 13 *drive*. The development of the acquisition level of /-v#/ and the corresponding level of its dominant substitutions are depicted in figure 5.12.

Figure 5.12. The development of word final /v/



The acquisition level is above 60% except at age 2;7, when it is below 60%. Starting at age 3;2, the acquisition level surpasses 80%. The level is lexically dependent, as shown next. The lexical dependency of phonological patterns, in general, is known in child speech development (e.g. Stoel-Gammon, 2011). The acquisition level of words in order of their frequency of occurrence is: *have* (84%), *of* (73%), *give* (69%), *leave* (86%), *five* (68%), *love* (95%), *save* (84%), *move* (73%), *gave* (90%), *solve* (95%), *believe* (93%), *dive* (92%), *drive* (38%), *twelve* (22%), *cave* (63%), *olive* (43%), *beehive* (50%). The child has more difficulties with words that either contain consonant singletons or consonant clusters besides /v/ that have not been acquired as in *cave*, *give*, *drive*, *twelve* or are multisyllabic as *beehive*, *olive*. This explains why the acquisition level at 2;7 is so much lower at 29%, when the only words are *give* and *leave* whose acquisition level is 0% (5/5) and 100% (2/2), respectively.

The monolingual English norm given by Smit et al. (1990) is (64%, 56%), (54%, 66%), (86%, 72%) for females, the first in parenthesis, and males at ages 3;0, 3;6 and 4;0, respectively. Maria Sofia's acquisition level is similar to the females norm at 3;0 and above both the females and males norm at 3;6 and near 4;0.

There are two main substitutions for /v/ at word final position, [f] and deletions, in contrast to the word initial's predominant substitution [w]. These substitutions are lexically dependent as was the case for word initial position [w]. There are words in which deletions are preferred and words where devoicing in [f] is preferred. The proportion of deletions to all substitutions is dominant in the following words: *beehive* (100%), *save* (100%), *give* (93%), *have* (86%), *olive* (75%). [f] is dominant in the following words where its proportion to all substitutions is also given: *gave* (100%), *of* (93%), *twelve* (86%), *move* (80%), *leave* (72%), *five* (71%). In the words *cave* and *drive*, [f] and deletions are at 50% each. As indicated by these results, specific words in general have different substitutions during development. This is exemplified by the child's productions of the words *drive* and *move* during development, which are:

drive [dɹaɪv] (target word)
2;10 daɪ
3;3 da:ɪv, da:v, daɪf, da:ɪf, da:ɪ
3;4 dɾaɪ
3;5 daɪv, daɪf, vdlaɪ
3;6 laɪv, tlaɪv, dlaɪf

move [mu:v] (target word)
2;11 mu:f (2), vu:
3;0 nu:f
3;1 mu:v, mʊv
3;2 mu:v (2), mʊv
3;4 mu:v (3), mu:f, vu:f, mu:
3;5 mu:v, mu:f, mu:fs
3;6 mu:v (7), mʊv
3;7 mu:v
3;9 mu:v (5), mʊv (2), mu:f

3;10 mu:v
3;11 mu:v

It is noted that deletions are more prevalent in early development and that the deleted word final /v/ is sometimes involved in metathesis, i.e., it is produced at word initial position instead.

There are two other substitutions for word final /v/ which are, however, rare, [m, d], and are attributed to **anticipation**, that is, assimilating /v/ to a consonant in a word that follows in the child's speech:

3;1: *leave them* → li:m mem
3;2: *have some candy* → tʌm sʌm tʰɑndɪ
3;4: *half of … them* → sa:f ɔm … ðem
3;5: *give me give me I am cold* → dɪd mɪ dɪv ɪ aɪ æm tɔ:ʊd
3;8: *seven you mean*→ semə ju mi:n

In most of these cases /v/ anticipates its partly homorganic nasal /m/ in nasal harmony. The [+nasal] feature spreads to the left and triggers nasal assimilation of [v]→[m]; it is known that [nasal] spreads from right-to-left in consonant harmony within the word (e.g. Ladefoged, 1993). Here, the phenomenon is observed across words.

Smit (1993a) found that, for the word *glove*, the monolingual English norm between ages 2;0-4;0 is to substitute /v/ by [b] at 15%-30% and by [f] and deletions at 5%-15%. Maria Sofia did not substitute [b] for /v/ at any word position but her [f] and deletions match the norm.

5.5.3 Conclusions

The developmental patterns of the child's voiced labio-dental fricative, /v/, are, in general, lexically dependent. However, for all words it is acquired early with its acquisition level, starting at age 2;8, being above 90% and 60% at word initial and word final positions, respectively, well above the monolingual English norm.

Starting at 3;6, there is regression in the acquisition level of word initial /v/ due to the substitution by [w] only in the word *very*, in which /v/ was produced correctly until then. As [v] is the predominant substitution of /w/, whose acquisition at 3;6 starts progressing beyond the 60% level, the child overgeneralizes the use of [w] in the context of /v/ in the most frequent /v/ word in her speech. Regression of /v/ also coincides with progression in the acquisition level of the consonants that the child did not acquire early. Moreover, the frequent occurrence of previously infrequent substitutions, near the end of phonological development, is common to several consonants as was the case for /θ/ being substituted by /f/.

Starting at age 3;2, word final /v/ surpasses the 80% acquisition level because deletions are no longer frequent. The child has difficulties with words that either contain consonant singletons or consonant clusters, besides /v/, that have not been acquired early as in *cave*, *give*, *drive*, *twelve* or are multisyllabic as *beehive*, *olive*. The main substitutions for /v/ at word final position are [f] and deletions, in contrast to word initial position. However, they are lexically dependent as was also the case for [w] at word initial /v/. For example, [f] is preferred in the words *move* and *twelve* at 80% and 86%, respectively, in proportion to all their substitutions while deletions are preferred in the words *give* and *save* at 93% and 100%, respectively.

There are also rare substitutions in both word positions. At word initial position, these are [m, l] which occur in assimilation as in the words *Venizelo* and *village* while at word final position they are [m, d] which occur in anticipation as in *have some* and *give me I am cold*. [m] substitutes /v/ in nasal harmony spreading from a word that follows. The [nasal] feature spreading from right-to-left in consonant harmony is known to occur within the word (e.g. Ladefoged, 1993) and is observed across words.

5.6 Development of the English rhotic

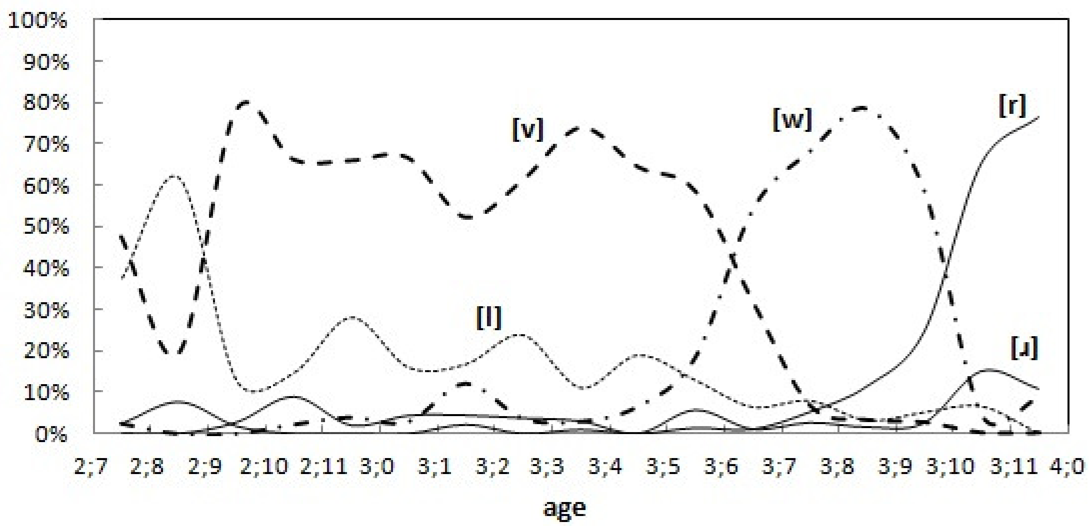
The development of the child's English rhotic, /ɹ/, will be examined here. As the word medial (syllable final) and word final rhotic was sometimes omitted in the child's input (mother's speech), only word initial /ɹ/ will be studied. The English word-initial /ɹ/ words in the child's speech and the age of their first production are:

2;7:	rabbit, read, reading, red, restaurant, ride, room, run
2;8	rain, raining, reach, ready, repeat, write
2;9	race, real, refrigerator, remember, rice, riding, ring, ringing, rock, running
2;10	rest, roof, round, wrapper
2;11	recorder, remind
3;0	rail, rang, reindeer, rested, rose, rub
3;1	read (past tense), rinse, roller, roses, row
3;2	'reds', rooms, rosy, writing
3;3	rails, really, replace
3;4	rainbow, ridden, rollers
3;5	reached, remove, robber
3;6	raincoat, rapping, recognize, remembered, resting, road, runs
3;7	-
3;8	racing, rake, reality, rings, risen, river, rolling
3;9	racket, realize, regular, removed, repeating, return, rocks, 'rinser', rinsing, roll, rusty, wrap, wrapped, written
3;10	rental, roads, rule

3;11 rolled

There are 85 word types for a total of 1,397 tokens. The monthly tokens are: 44, 24, 110, 90, 49, 69, 90, 80, 100, 90, 70, 94, 76, 192, 118, 46, 55. The development of the acquisition level of word initial /ɹ/ and the corresponding level of its main substitutions are shown in figure 5.13.

Figure 5.13. The development of word initial /ɹ/



Word initial /ɹ/ is realized mainly as [v, w, l, ɹ, ɾ]. The English and Greek rhotics are in solid lines, [l] is in dotted line, [v] is in dashed line and [w] is in dash-dotted line. The acquisition level is in a plateau/cyclic stage until about age 3;7 when it progresses mainly to the Greek rhotic. The child transfers her rhotic from L1 Greek when it is in the progressive stage in the L1. The acquisition level for monolingual English children is at about 25%, 50% and 60% at age 3;0, 3;6 and 4;0, respectively (Smit et al., 1990). Clearly Maria Sofia's level is well below that and this is not surprising given that there is ambiguity in her input (mother's speech) between the sounds [ɹ] and [ɾ] as is the case for the English speech of most Greek adults since the sound [ɹ] does not exist in the Greek language.

The main substitutions of /ɹ/ are [v, w, l]. It should be noted that, during development, the child's Greek rhotic is not substituted by [v] or [w] but only by [l]. This is explained by the fact that the English rhotic has a secondary labial articulation (e.g. Bernhardt and Stemberger 1998) while the Greek rhotic does not have a secondary articulation. In monolingual English children (e.g. Smit 1993a), word initial /ɹ/'s predominant substitution is [w] with [l] being rare. [w] substitutes /ɹ/ as they are both approximates and English children acquire /w/ early, before age 3;0. However, Maria Sofia does not acquire [w] at a high level (greater than 60%) until after age 3;6, that's why she uses [v], the substitution of [w], until this age. At 3;9, the English rhotic is produced as Greek or English rhotic at 50%, equally sharing productions with [w]. By 3;11, however, [w] is rare with the Greek rhotic predominating.

In the first two months, cumulatively for all the words, [l] competes with [v] for dominance, while [l] subsides thereafter. Maria Sofia chooses between [v] and [l] depending on the word she uses and the developmental stage she is at. This is exemplified by her realizations of /ɹ/ in the frequently occurring words *read*, *rest* and *room*, which are:

Target **/ɹ/** in:	**read**	**rest**	**room**
2;7	3[v], 1[w]	-	1[ɾ], 1[v], 15[l], 1[w]
2;8	1[ɾ], 1[v], 1[l]	-	8[l]
2;9	33[v], 1[l], 2[Ø]	-	6[l]
2;10	2[ɹ], 4[v], 1[l]	2[v]	11[l], 1[w]
2;11	-	1[v]	1[v], 6[l], 1[w]
3;0	2[ɹ], 7[v], 1[l]	2[v]	2[l]
3;1	18[v], 1[w]	1[v], 1[l], 1[n]	1[ɹ], 7[l], 2[w], 1[Ø]
3;2	1[ɹ], 17[v], 1[l]	-	2[ɹ], 2[v], 11[l], 2[w], 1[Ø]
3;3	2[ɹ], 29[v], 1[l], 1[w], 1[Ø]	1[v], 1[l]	1[ɹ], 2[v], 1[l], 1[w], 1[ð], 1[m], 1[Ø]
3;4	8[v], 1[w]	1[v], 2[l]	3[v], 2[l], 1[w], 2[ð], 1[t]
3;5	3[v], 2[w]	3[v], 2[l]	1[v], 1[w]
3;6	10[v], 4[w]	2[v], 1[w]	1[l], 6[w]
3;7	1[v], 5[w]	1[v], 1[l], 4[w]	1[ɹ], 1[ɾ], 2[l], 9[w]
3;8	1[ɹ], 1[ɾ], 2[v], 1[l], 28[w], 1[Ø]	1[w]	1[ɹ], 6[ɾ], 1[l], 8[w]
3;9	1[ɹ], 7[w]	2[ɾ], 2[w]	2[ɾ], 2[w]
3;10	1[ɾ]	1[ɾ]	1[ɾ]
3;11	-	1[ɹ], 4 [ɾ]	3[ɾ]

Starting at around 3;5, Maria Sofia prefers [v] or [w] over [l] independent of the word. At a younger age, the choice between [v] and [l] is lexically dependent: [v] is preferred in the word *read*, [l] is preferred in the word *room*, while there is no preference between [v] and [l] in the word *rest*.

Besides the main substitutions, there are substitutions for word initial /ɹ/ that are rare as [ð, t, m]. These substitutions are mostly attributed either to assimilation as is the case for [m] in *room* or to priming (perseverating) a consonant in a preceding word in the utterance as is the case for [ð, t] in the utterances *this is my r[ð]oom*, *there is my r[ð]oom*, *c[t]ome to your r[t]oom*.

5.6.1 Conclusions

The child's acquisition level of word initial /ɹ/ by age 4;0 is well below the 60% level of the monolingual English norm. However, at age 3;9 she produces English /ɹ/ as the Greek rhotic, [ɾ], 50% of the targeted /ɹ/'s and, by age 4;0, 75%, when the Greek rhotic is acquired, which is evidence of transfer from the L1 to the L2. The transfer may be attributed to the ambiguity between the English and Greek rhotics in the child's input, the similarity between the two sounds, and the non-existence of the English rhotic in the child's L1 Greek. The two sounds are not usually differentiated in Greek adult L2 English speech, either, based on the author's observations including her own speech.

The developmental substitution patterns are lexically dependent in the early stage of development until about age 3;5 but independent thereafter. The main substitutions are [v, w, l] with [l] becoming infrequent, less than 10% of the targeted /ɹ/'s, starting at age 3;5. Starting at this age, [w] becomes more frequent than [l] and, after age 3;6, even more frequent than [v], the predominant substitution until then.

Monolingual English children substitute /ɹ/ predominantly by [w] as both have a secondary labial articulation, they are approximants, and /w/ is acquired before age 2;7. Maria Sofia uses [v], her substitution for [w], until age 3;6, when she feels comfortable using [w], whose acquisition level is at 60%.

The child's Greek rhotic, however, is not substituted by [v] or [w] but only by [l] as it does not have a secondary labial articulation. This is evidence of differentiation between the two phonological systems by age 2;7. Furthermore, when the Greek rhotic starts progressing, it also becomes more frequent as a substitute of the English rhotic taking the place of [l]. These together with the facts that monolingual English children substitute /ɹ/ by [w] while Greek monolingual children substitute /ɾ/ by [l], lead to the conclusion that [l] is Maria Sofia's developmental transfer for /ɹ/.

There are rare substitutions for /ɹ/, as well: [ð, t, m]. These substitutions are attributed to either assimilation within the word of the targeted /ɹ/ or priming another consonant in a preceding word in the utterance.

5.7 Development of the voiceless velar stop

The development of the child's voiceless velar stop, /k/, in English will be examined here, at word initial and word final positions. Because of the large amount of /k/ words in the data, /k/ words were counted only in the first week of each month between 2;8 and 3;9. At 2;7, 3;10 and 3;11, /k/ words were counted in the whole month. The word-initial /k/ words in the child's English speech and the age of their first production are:

2;7: cake, candy, car, carpet, case, catch, clock, close, coffee, cold, come, coming, cookie, crown, crying, cup
2;8 came, control
2;9 Clara, clogs, closed, clothes, cook, cooking, cry
2;10 clips, closer
2;11 clean
3;0 crunchy
3;1 class, climb, colors, computer, correct, crazy, cream, creased, cross, cute, kitty

3;2 collapsed, kick
3;3 clown, cooked, cradle, quacks
3;4 Christmas, collapse
3;5 connect, crayon
3;6 continue, quarrelsome, queen,
3;7 clap, cleaned, crappy, cucumber
3;8 clutch, crocodile, kicking
3;9 cafeteria, climbing, clouds, collapsing, crack, cried
3;10 confetti, crocodiles
3;11 casket, cockpit, container, cooker, cracks, cupid, cure, keep

There are 76 word types with 1,357 word-initial /k/ tokens. The monthly tokens are: 69, 10, 48, 63, 32, 15, 108, 53, 71, 97, 69, 69, 84, 143, 138, 131, 157.

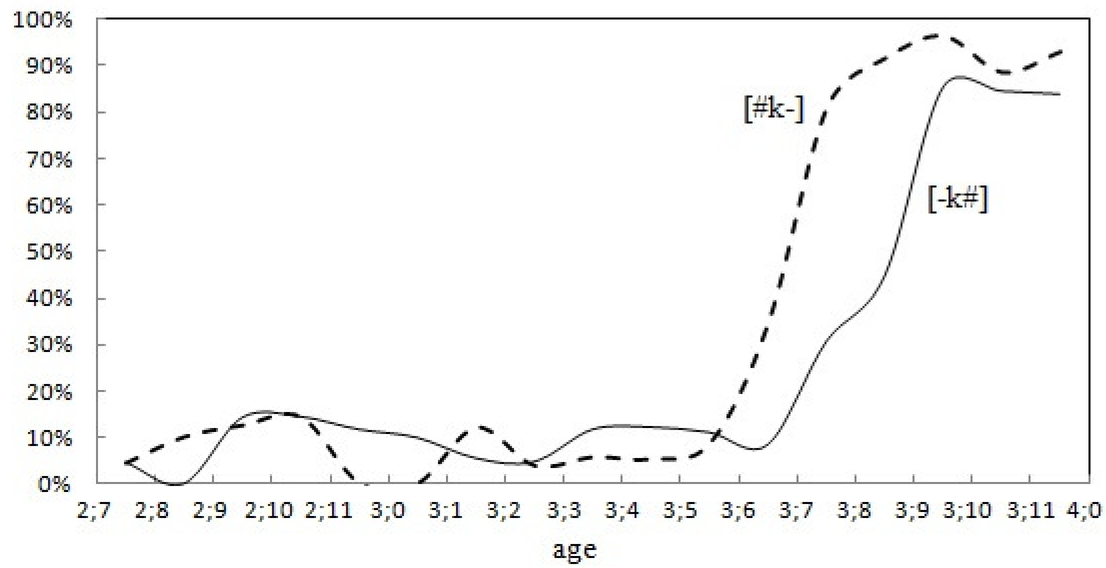
The word-final /k/ words in the child's English speech and the age of their first production are:

2;7 back, bike, black, book, broke, cake, clock, dark, drink, duck, like, lock, look, make, milk, music, o'clock, pick, sick, speak, take, talk, thank, walk
2;8 -
2;9 cook, drank, mistake, stick, took, wake
2;10 fork, Greek, knock, neck
2;11 lick, mask, trunk
3;0 -
3;1 brick, Eric, Jack, pink, quick, sock, work
3;2 kick, park, silk, snack
3;3 break, week
3;4 ask, fake, thick, think
3;5 -
3;6 headache, ink
3;7 -
3;8 block, cheek, rake
3;9 crack, magic, nick, sink, speck,
3;10 hammock, picnic, suck
3;11 pack, peacock, stomach, stuck

There are 71 word types with 1,326 word-final /k/ tokens. The monthly tokens are: 64, 15, 77, 62, 51, 10, 108, 63, 51, 98, 54, 59, 88, 141, 117, 124, 144.

The monthly development of the acquisition level of /k/ at word initial and word final positions is shown in figure 5.14. The progressive stage for the acquisition level of word initial /k/ starts at 3;5, one month earlier than the word final /k/, and is about four months long for both positions. During the cyclic stage the acquisition level is about 10% at both positions, while during the progressive stage the word final /k/'s level lags behind by one month. Near complete acquisition starting at age 3;9, there is a slowing down in progress, possibly due to interference with the L1 Greek at both word positions and the persistence of deletions at word final position, as will be seen below.

Figure 5.14. The acquisition level of /k/ in development

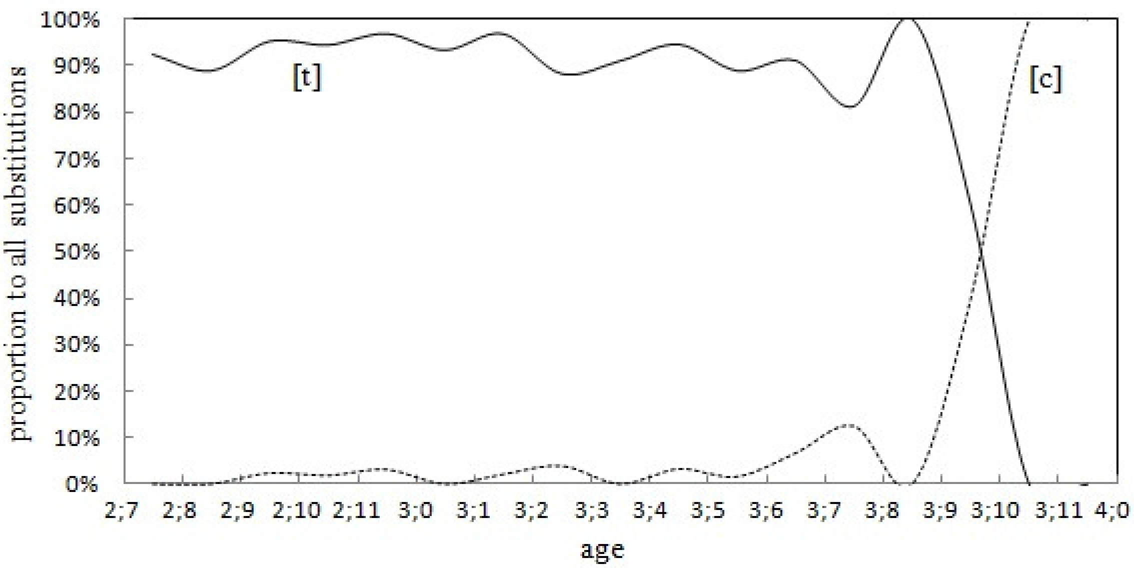


The norm for monolingual English children's acquisition level for word initial /k/ is (77%, 76%), (92%, 89%), (100%, 90%) for (females, males) at ages 3;0, 3;6 and 4;0, respectively (Smit et al., 1990). This norm was computed for only three words, *cake, cat,* and *cup*. Maria Sofia's acquisition level for word initial /k/ is well below the norm at 3;0 and 3;6 and comparable to the norm by age 4;0. The norm for word final /k/ is (92%, 97%), (94%, 92%), (99%, 97%) for (females, males) at ages 3;0, 3;6 and 4;0, respectively (Smit et al., 1990). This norm was computed for the words, *cake, duck* and *sock.* Maria Sofia's acquisition level for word final /k/ is well below the norm at 3;0 and 3;6 and comparable to the norm by age 4;0, as is the case for word initial /k/.

5.7.1 The substitutions of word initial /k/ in development

Each substitution's occurrences for word initial /k/ are counted monthly and computed in proportion to the occurrences of all substitutions including deletions. The substitutions whose level is at least 10% at any age during development, are shown in figure 5.15. The main substitution of the voiceless velar stop, /k/, is the voiceless alveolar stop, [t]. Near complete acquisition when [t]'s frequency decreases, interference with the child's L1 Greek persists; /k/ is being produced as its allophone [c] when it precedes front vowels /i, e/. This palatalization process always happens in the Greek language and it is known to transfer in the L2 English of adult Greeks (Babatsouli & Kappa, 2011). English words in which this occurs in the child's speech are: *came*, *case, keep, kitty,* etc. Other substitutions of word initial /k/ that are rare in the child's speech are [ʦ, d, g].

Figure 5.15. Substitutions of word initial /k/ in development



The development of word initial /k/ is exemplified by its development in the word *came* for the whole month, as follows:

came [keɪm] (target word)

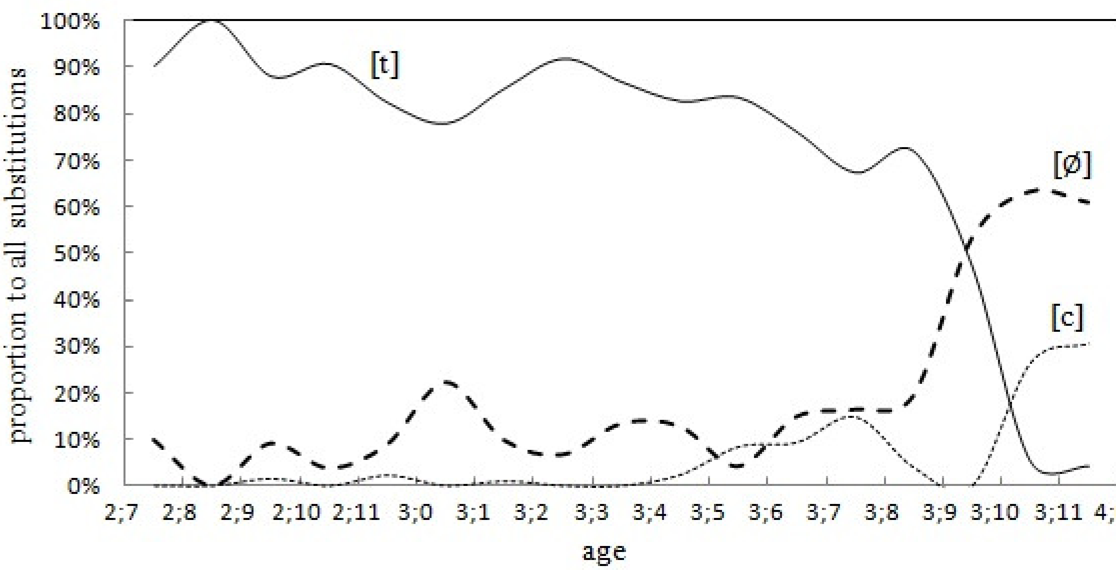
2;8 tʰem
2;9 teɪm, deɪm, steɪm
2;10 tʰeɪm
2;11 -
3;0 tʰeɪm
3;1 ʦeɪm
3;2 tʰeɪm, teɪm
3;3 -
3;4 tʰeɪ, ceɪm (3)
3;5 ceɪm (2)
3;6 kʰeɪm, ceɪm (2), ceɪ
3;7 kʰeɪm (3), ceɪm
3;8 keɪm (2)
3;9 keɪm (5), kʰeɪm (3), keɪp, ke:m, ceɪm (3)
3;10 kʰeɪm, ceɪm
3;11 kʰeɪm (2)

The norm for monolingual English children is to substitute word initial /k/ mainly by [t] (Smit, 1993a) as Maria Sofia does, even though their acquisition level is higher than 80% between ages 3;0 and 4;0. Rare substitutions include [ʦ, d, g] as in Maria Sofia's speech.

5.7.2 The substitutions of word final /k/ in development

Substitutions of word final /k/ whose proportion to all substitutions is at least 10% at any stage during development are shown in figure 5.16.

Figure 5.16. Substitutions of word final /k/ in development



Word final /k/ is substituted mainly by [t] except near complete acquisition when [c] transfers from the child's L1 Greek, as is the case for word initial /k/. At word final position, the presence of [c] denotes transfer of the Greek palatalization rule, whereby the [Dorsal, +back] /k/, is allophonically palatalized to the [Dorsal, -back] stop [c], in the context of following /i/ that is characterized by the [+front] feature (see section 4.2.1). This happens in, for example, *like it* and *make it* where the verbs and post-lexical clitic pronoun *it* form a phonological word and, thus, the word final coda /k/ of the verb becomes word medial syllable onset, i.e. /laɪk ɪt/→[laɪ.cɪt], /meɪk ɪt/→[meɪ.cɪt]. In contrast to the child's performance at word initial position, deletions are much more frequent at word final /k/ all along development, persisting near complete acquisition when [t] dies out. Other substitutions of word final /k/ that are rare in the child's speech are [ʦ, d, g], as is the case for word initial position.

The development of word final /k/ is exemplified by its development in the word *like* as follows:

like [laɪk] (target word)
2;7 laɪk, laɪt (3)

2;8	laɪk, laɪt (3), laɪtʰ, laɪ, laɪc
2;9	laɪk (2), laɪt (11), laɪtʰ (2), laɪ (2), laɪc (2)
2;10	laɪk (3), laɪkʰ, laɪt (7), laɪtʰ (2), lɑ:t, laɪc
2;11	laɪk (2), laɪt (6), laɪtʰ (3), aɪt, laɪc
3;0	laɪk (1), laɪkʰ, laɪt (5), laɪtʰ (1), laɪʦ (2), laɪ
3;1	laɪk (2), aɪk, laɪt (10), laɪtʰ (4), naɪt, tlaɪt , taɪt, laɪʦ
3;2	laɪk (9), taɪk, laɪt (5), ðaɪt, laɪtʰ, laɪ
3;3	laɪk (4), laɪt (5), laɪtʰ, la:d
3;4	laɪk (9), laɪt (5), aɪtʰ, aɪk, daɪt, ðaɪt
3;5	laɪk (3), laɪt (3), laɪtʰ (2), laɪx, laɪc
3;6	laɪk, laɪt (4), laɪc
3;7	laɪk, laɪt, laɪc (3)
3;8	laɪk (10), laɪt (7), laɪc, klat, laɪd, laɪ (3)
3;9	laɪk (6), laɪc, laɪt, laɪ
3;10	laɪk (10), laɪ
3;11	laɪk (16), laɪ, laɪc

The norm for monolingual English children is to substitute word final /k/ by [t] and deletions (Smit, 1993a) as Maria Sofia does near complete acquisition, excluding the L1 transfer, when her acquisition level matches that of the norm.

5.7.3 Conclusions

The acquisition level of /k/ follows two stages of development, the cyclic and the progressive. During the cyclic stage the acquisition level is about 10% at both word positions, initial and final, while during the progressive stage the word final /k/'s level lags behind by one month. The progressive stage for word initial /k/ starts at 3;5, one month earlier than the word final /k/ and is about four months long for both positions.

Near complete acquisition starting at age 3;9, there is a slowing down in progress due to interference with the L1 Greek at both word positions and the persistence of deletions at word final position. Maria Sofia's acquisition level of /k/ is well below monolingual English children's at ages 3;0 and 3;6 but comparable to it by age 4;0. The norm for monolingual Greek children is to completely acquire /k/ in word initial position before age 2;6 (PAL, 1995); word final /k/ is not permitted in the Greek language.

The child's substitutions for /k/ by and large match those of monolingual English. The main substitution is [t], independent of word position, while at word final position deletions occur but much less frequently than [t]. Near complete acquisition, Maria Sofia differs from the monolingual norm in that she transfers [c] from her L1 Greek when /k/ precedes the front vowels /i, e/ more often at word initial position but also at word final position in connected speech. Moreover, her deletions persist at word final position when [t] dies out. Rare substitutions are [ʦ, d, g].

5.8 Development of the voiced velar stop

The development of the child's voiced velar stop, /g/, in English will be studied here, at word initial and word final positions. The word initial /g/ words in the child's English speech and the age of their first production are:

2;7 get, girl, give, glass, go, goats, goes, going, good, green
2;8 game, garden, gate, glasses, grasshopper
2;9 ghost, gift, girlies, girls, glue, gone, got, grandpa, granny, Greece, greedy, grey, grow
2;10 girlie, goofy, grass, Greek
2;11 garage, grapes, ground, grown, guess
3;0 gave, growling
3;1 gee, geese, getting, gold, goose, grab, greasy, great
3;2 games, gown, growl
3;3 gifts, glide
3;4 guitar
3;5 giggle, gorilla, growing
3;6 golden, goody, grain
3;7 gonna, growed (grew)
3;8 -
3;9 gravel
3;10 grandparent
3;11 grated

There are 64 word types with 2,816 word-initial /g/ tokens. The monthly tokens are: 36, 49, 130, 231, 192, 183, 281, 185, 195, 226, 187, 237, 169, 222, 146, 74, 73.

The word-final /g/ words in the child's English speech and the age of their first production are:

2;7: big, dog, egg, hug
2;8: bag, frog
2;9: leg
2;10: -
2;11: -
3;0: peg
3;1: flag
3;2: -

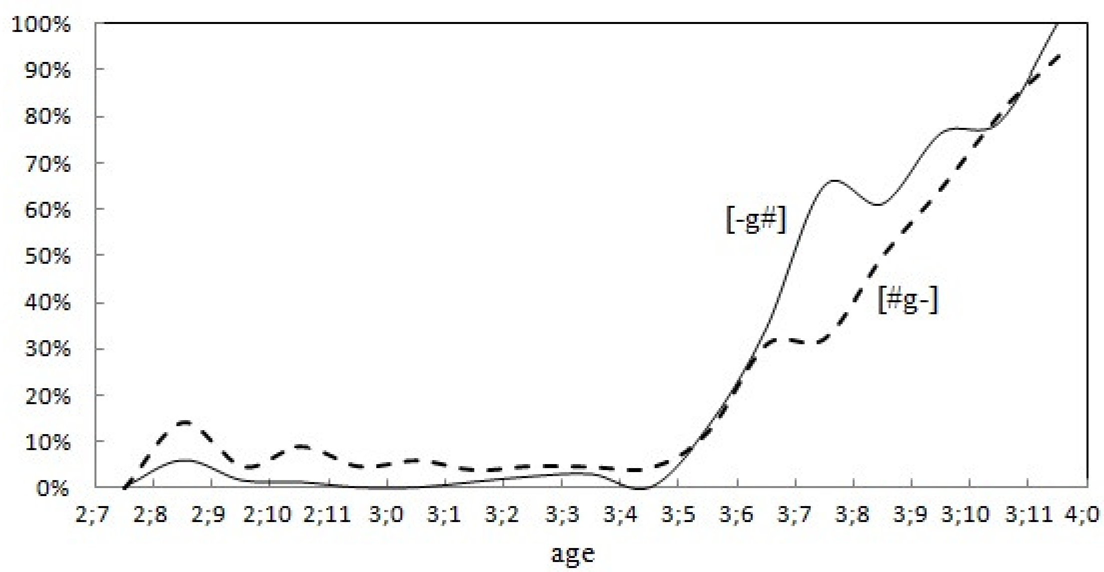
3;3: -
3;4: pig
3;5: -
3;6: -
3;7: -
3;8: drag
3;9: -
3;10: beg
3;11: -

There are 12 word types with 834 word final /g/ tokens. The monthly tokens are: 23, 17, 65, 84, 77, 55, 81, 82, 69, 33, 23, 38, 46, 62, 47, 19, 13.

The monthly development of the acquisition level of /g/ at word initial and word final positions, is shown in figure 5.17.

For both word positions, the cyclic and progressive stages have the same length. The cyclic stage is ten months long while the progressive stage is seven months long. During the cyclic stage, word initial /g/ is at a slightly higher acquisition level, none exceeding 15%. During the progressive stage, word final /g/'s acquisition level becomes higher due to the slowing down of word initial /g/'s acquisition level at age 3;7. This contrasts the performance of the voiceless velar stop /k/, whose acquisition level at word final position is lower than at word initial position during the progressive stage. Complete acquisition of the voiced /g/ is reached two months after the acquisition of voiceless /k/ in both word positions.

Figure 5.17. The acquisition level of /g/ in development



The norm for monolingual English children's acquisition level for word initial /g/ is (82%, 80%), (92%, 88%), (100%, 93%) for (females, males) at ages 3;0, 3;6 and 4;0, respectively (Smit et al., 1990). Keeping in mind that this norm was computed for only two words, *goat* and *gun*, Maria Sofia's acquisition level for word initial /g/ is well below the norm at 3;0 and 3;6 and comparable to the norm by age 4;0.

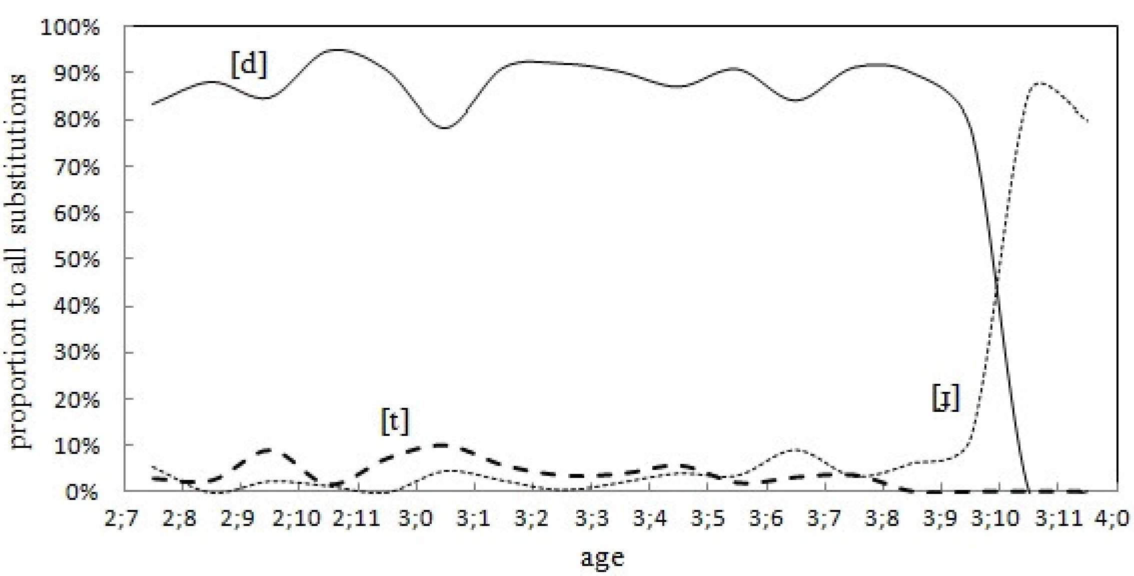
The norm for word final /g/ is (82%, 90%), (88%, 88%), (96%, 93%) for (females, males) at ages 3;0, 3;6 and 4;0, respectively (Smit et al., 1990). This norm was computed for only two words, *dog* and *bag*. Maria Sofia's acquisition level for word final /g/ is well below the norm at 3;0 and 3;6 and comparable to the norm by age 4;0, as is the case for word initial /g/.

5.8.1 The substitutions of word initial /g/ in development

The occurrences of each substitution for word initial /g/ are counted monthly and computed in proportion to the occurrences of all substitutions including deletions. The results for substitutions whose level is at least 10% at any age during development are shown in figure 5.18.

The voiced velar stop, /g/, is overwhelmingly substituted by the alveolar voiced stop [d] and much less frequently by [t], the devoicing of [d]. Near complete acquisition, interference with the child's L1 Greek persists; /g/ is being produced as its allophone [ɟ] when it precedes front vowels /i, e/. This palatalization process always happens in the Greek language and it is known to transfer in the L2 English of adult Greeks (Babatsouli & Kappa, 2011). English words in which this occurs in the child's speech are: *game*, *gate*, *get*, *gift*, *girl, give*, *guess*. Other substitutions of word initial /g/ that are rare in the child's speech are [ʤ, ʣ, k, c, b, ʝ] and deletions.

Figure 5.18. Substitutions of word initial /g/ in development



The development of word initial /g/ is exemplified by its development in the word *game* as follows:

game [geɪm] (target word)

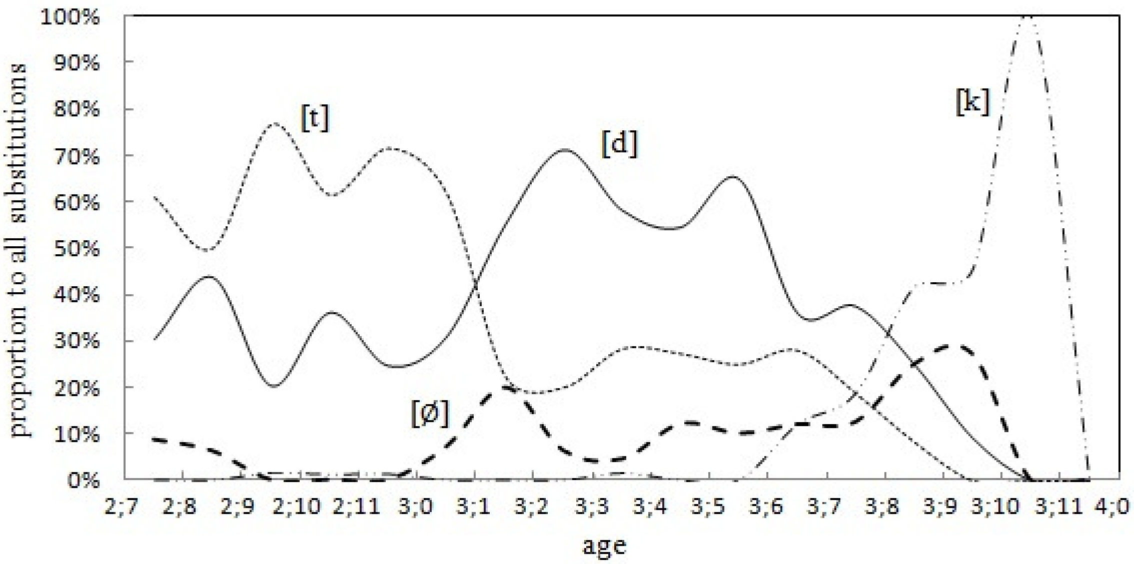
2;8 deɪm
2;9 ɟeɪm
2;10 deɪm
2;11 -
3;0 ɟeɪm, ʣeɪm
3;1 -
3;2 game, ɟeɪm, deɪm, ʣeɪm, ʤeɪm
3;3 geɪm, deɪm
3;4 ce
3;5 geɪm
3;6 geɪm
3;7 geɪm
3;8 geɪm
3;9 geɪm (3), ge
3;10 geɪm, geɪ, ɟeɪm, ɟeɪ
3;11 geɪm (11), geɪ, ge, ɟeɪ

The norm for monolingual English children is to substitute word initial /g/ mainly by [d] (Smit, 1993a) as Maria Sofia does, even though their acquisition level is higher than 80% between ages 3;0 and 4;0. Rare substitutions include [ʤ, k, b] as in Maria Sofia's speech.

5.8.2 The substitutions of word final /g/ in development

Substitutions of word final /g/, whose proportion to all substitutions is at least 10%, are shown in figure 5.19. In the first part of the cyclic stage, Maria Sofia substitutes word final /g/ more by the voiceless alveolar stop [t] than the voiced alveolar stop [d], which she finds difficult to produce at word initial position. Starting at age 3;1, [d] becomes the child's dominant substitution until age 3;8 when its acquisition level slows down. Starting at 3;8 and until complete acquisition, [k] becomes the dominant substitution. Maria Sofia does not frequently use the voiceless velar stop [k] in place of its voiced counterpart, /g/, until late in development, because it is also delayed in its acquisition as was seen in section 5.7. Deletions are much more frequent at word final position than at word initial position, persisting until complete acquisition.

Figure 5.19. Substitutions of word final /g/ in development



The development of word final /g/ is exemplified by its development in the word *bag* as follows:

bag [bæg] (target word)

2;7 -
2;8 bad (3), bat (2), ba
2;9 bad (3), bat (7), bak
2;10 bad (2), bat (7)
2;11 bat (5)
3;0 bad, bat (3)
3;1 bad, bat, ba (2)
3;2 bad (2)
3;3 bad (3), bat (4)
3;4 bad, bat (3)
3;5 bad (2), bat (2)
3;6 bag (2), bad, bat (2),
3;7 bag (4)
3;8 -
3;9 bag, bak
3;10 bag (5), bak (2)
3;11 bag (8)

The norm for monolingual English children is to substitute word final /g/ mainly by [k] (Smit, 1993a) as Maria Sofia does near complete acquisition, when her acquisition level matches that of the norm. Occasional substitutions include deletions and [d], with [t] being rare, as is the case in Maria Sofia's speech near complete acquisition.

5.8.3 Conclusions

The acquisition level of /g/ goes through two stages of development as well. In the cyclic stage which lasts until age 3;4, it is lower than 15% at word initial position and even lower at word final position. During the progressive stage and starting at age 3;7, the acquisition level becomes higher at word final position than at word initial position. Complete acquisition is reached by 3;11, two months after the voiceless velar /k/. Maria Sofia's acquisition level of /g/ is well below monolingual English children's at ages 3;0 and 3;6 but comparable to it by age 4;0. In the Greek language, word final /g/ is not permitted and PAL (1995) does not provide a norm for word initial /g/ in monolingual Greek children.

Near complete acquisition, the child's substitutions for /g/ match those of monolingual children except her word initial [ɟ], the allophone of /g/, which transfers from her L1 Greek when /g/ precedes the front vowels /i, e/. At word initial position, Maria Sofia's main substitution all along development is [d] except near complete acquisition, when [ɟ] persists. This is in correspondence to the voiceless [t], the main substitution of word-initial voiceless /k/ all along development except near complete acquisition, when [c] which is the allophone of /k/ and the devoicing of [ɟ] transfers from L1 Greek.

At word final position the child's main substitutions during development are [t, d] except near complete acquisition, when [k] which is also acquired late, occurs more frequently. Until age 3;0, [t] is more frequent than its voiced counterpart [d] which is harder to produce at word final position. Starting at age 3;1 and until complete acquisition, the voiced alveolar stop [d] is more frequent in substituting the voiced velar stop /g/ as is the case for word initial position.

Deletions occur more frequently at word final position at 30% or less in proportion to all substitutions, persisting until complete acquisition, as is the case for the voiceless velar /k/.

5.9 Development of the voiceless fricatives /h/ in English and [ç] in Greek

The development of the glottal fricative /h/ in English is studied in this section as it is one of the consonants that the child has difficulty in acquiring. [ç], the voiceless palatal fricative in Greek, is also studied in order to compare their development and determine whether there is interference between the child's two languages, as it is known (Babatsouli & Kappa, 2011) that Greek adults transfer [ç] in place of /h/ in their L2 English when /h/ precedes the vowels /e, i/. Transfer takes place in adult speech because [h] does not exist in Greek.

5.9.1 Development of the glottal fricative /h/

The development of the glottal fricative, /h/, will be examined exclusively in the child's English, as it does not exist in the Greek language. The targeted /h/ words in Maria Sofia's speech and the age of their first production are:

2;7	behind, hands, he, hello, help, here, hiding, him, his, hold, honey, horse, house, hug
2;8	grasshopper, Haidi, Haidi's, hair, hand, happy, hat, have, hide, high, home, hot, hungry, hurt, who
2;9	hang, hard, head, heart, heavy, her, himself, hippo, hole, houses, hurry, hush
2;10	had, has, helicopter, helping, holding, huge, hurts, townhouse, whose
2;11	beehive, hair-band, ham, how, husband
3;0	ahead, downhill, hairdresser's, half, hamper, having, hid, hop, hurting, uphill
3;1	aha, hadn't, hairbrush, haircut, heard, higher, horrid
3;2	forehead, hairdresser, hall, hen, hers, holder, hopping, horsie
3;3	hats, hugs
3;4	hairs, harder, hidden, hood, hoop, hula
3;5	handle, heat, hope, perhaps
3;6	ha, hairclip, hairy, hamster, Hansel, happened, headache, hiccup, himself, hisself, houses, hovering
3;7	happen, helper, hill, holes, hospital, hurray
3;8	hanging, happens, haven't, hilarious, hitting, horses, hundreds
3;9	harm, heads, Hispanics, hoops, hotel
3;10	sunhat, hammock
3;11	hey

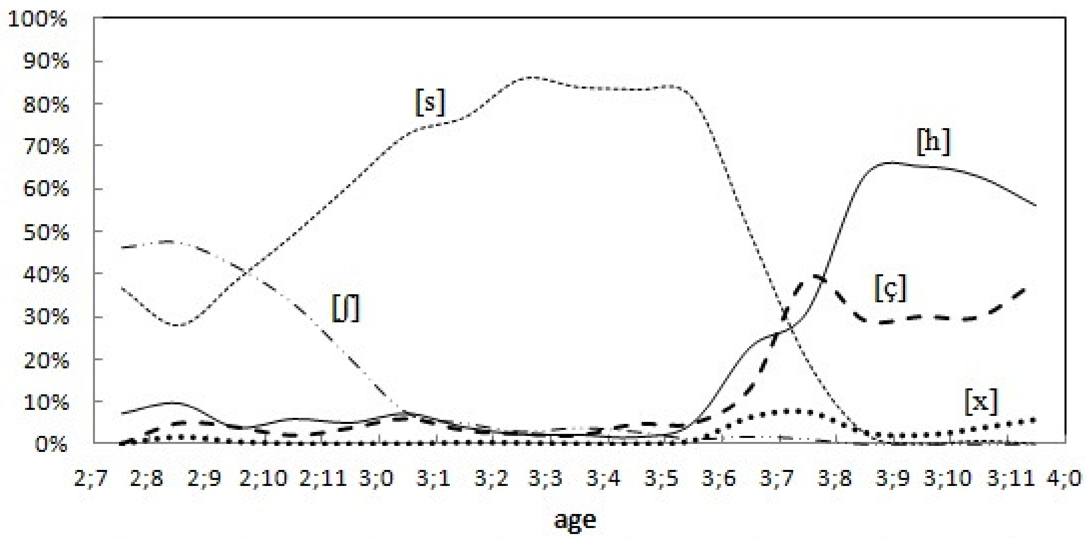
In total, there are 125 word types with 5,456 tokens. The monthly (types, tokens) are: (14, 41), (23, 61), (37, 198), (39, 346), (34, 213), (41, 301), (48, 559), (38, 410), (38, 335), (37, 443), (46, 410), (53, 385), (46, 330), (56, 519), (65, 593), (29, 137), (33, 175).

The development of /h/, cumulatively for all the words, in respect of both its acquisition level and its substitutions is shown in figure 5.20. The acquisition level of /h/ is lower than 10% during its cyclic stage of development until age 3;5. At 3;5, the acquisition level of /h/ starts progressing reaching its highest level of 65% at age 3;8, staying at about this level thereafter. The developmental path in the progressive stage is a double S-curve as was the case for most of the child's consonants. Monolingual English children's acquisition level is greater than 90% before age 3;0 (Smit et al., 1990), placing Maria Sofia well below the monolingual norm during all stages in development.

In the cyclic stage, the child's dominant substitution for /h/ is [s], with its variant [ʃ] occurring frequently till age 3;0. In the progressive stage, [s] regresses while [ç] which was negligible during the cyclic stage progresses becoming the dominant substitution. [ç] occurs only when the child targets /h/ followed by /e/ or /i/. Also, [x] starts occurring at low frequencies during the progressive stage for targeted words in which /h/ is not followed by /e/

or /i/. [ç], the voiceless palatal fricative, is the allophone of /x/, the voiceless velar fricative, in Greek and it always occurs in adult Greek speech whenever /x/ is followed by /e/ or /i/. This means that the child frequently transfers [ç] from her L1 Greek when /h/ is followed by /e/ or /i/ in in her targeted English words.

Figure 5.20. The realizations of /h/ during development



The developmental substitution pattern of /h/ is exemplified by the development of /h/ in the words *help* and *house* as follows:

help [heɫp] (target word)

2;8 sɛːp, ʃep, ʃeːp, hep
2;9 peɪt, seːəp, ʃeːəp, çeːəp, heːp, ʃeːp
2;10 seəp (3), zeːp, zeːpʰ, ʃeːp, ʦeəp, seət
2;11 heːp, seːp (4), seəp (3)
3;0 heːp, seəp (2)
3;1 seːʊp, seəp, feəp, semp
3;2 seəp
3;3 seəp (10), seəpʰ (2), seə (2), zɛːpʰ, seːp
3;4 heːps, seəp, seːəp (2) , sɛːp (4),
3;5 seəp (10), seəpʰ (7), seə (3), sep, teəp, heəp, eəp, ðeəp
3;6 seəp, sɛːp (2), sep (3), θeːp
3;7 seəp, seːp (6), çeəp (5), çeːp (3), çeə
3;8 heɫp, seəp, çeəp (9), çeəpʰ, çeə(3), çɛː, teəp
3;9 heɫ, çeəp (5), çeːɫp (2)
3;10 heɫp, çeːɫp, çeːɫ
3;11 heɫ, çeːɫp (4), çeːɫ (2)

house [haʊs] (target word)

2;8 ʃaʊz
2;9 saʊs (3), ʃaʊs (17), ʃaʊ, faʊs, xaʊs
2;10 haʊs (2), saʊs (11), ʃaʊs (36), ʃaʊ (4), saʊθ, saɔs, taʊs
2;11 ʃaʊs (6), saʊs (5), sɒːs, taʊs ,
3;0 haɔs, saʊs (8), saʊ, ʃaʊs, ʦaʊs
3;1 saʊs (17), saʊ (5), ʃaʊs (3), xaʊs
3;2 saʊs (18), saʊ, ʃaʊs (4)
3;3 saʊs, saʊt, ʦaʊʦ,
3;4 saʊs (6), saːs, saʊʃ, sɑːʊ, saʊzɪ
3;5 haʊs, saʊs (5)
3;6 haʊs (15), haʊ, saʊs (2), xaʊs (10), xaʊd
3;7 haʊs (8), haʊ, xaʊs (4), xa
3;8 haʊs (40), haʊ (2), xaʊs, xaʊ, kaʊs
3;9 haʊs (29), xaʊs (3)
3;10 haʊs (9), haʊɪ
3;11 haʊs (8), xaʊs (2)

For both words the dominant substitution is [s] and its variant [ʃ] during the cyclic stage as was the case for the cumulative performance in all the words. In the progressive stage after age 3;5, the child finds it easier to produce /h/ correctly when it is not followed by /e/ or /i/, as in *house*, resulting to the persistence of [ç] as a substitution for /h/ as in *help*. The reason that the acquisition level of /h/, cumulatively for all the words, does not advance beyond the 65% level is that words in which /h/ is followed by /e/ or /i/ are more frequent in the child's speech and transfer takes place from the L1.

The monolingual English norm is to delete /h/ whenever it is not produced correctly. Rare substitutions are [j, t, d, f]. Undoubtedly, Maria Sofia's substitution pattern for /h/ is different from the monolingual norm. It will, therefore, be of interest to compare the realizations of [ç] in the child's Greek during development, in order to see if there is a relationship between them and the developmental realizations of /h/ as evidence of transfer, as the author believes, or universality in the substitutions for /h/ and [ç] across the two languages.

5.9.2 Development of the voiceless palatal fricative [ç]

The targeted [ç] words in Maria Sofia's speech, their IPA transcriptions of the underlying form and the age of their first production are given below. Their IPA transcription as in adult speech, their translation in English and grammar are given in Appendix D.

2;7 αλήθεια /aliθia/, αρχή /aɾxi/, έρχεται /eɾxete/, έχει /exi/, έχεις /exis/, μάτια /matia/, Νάσια /nasia/, όχι /oxi/, παπούτσια /papoutsia/, παστίτσιο /pastitsio/, πιάσω /piaso/, πιάτο /piato/, πιείς /piis/, πιο /pio/, πιούμε /pioume/, πιώ /pio/, ποιό /pio/, φτιάξε /ftiakse/, χειμώνας /ximonas/, χεράκι /xeɾaki/, χέρι /xeɾi/, χέρια /xeɾia/

2;8: αρχίσετε /aɾxisete/, έπιασα /epiasa/, είχε /ixe/, ήπια /ipia/, ήπιες /ipies/, ήσυχη /isixi/, πιάσεις /piasis/, πιάσου /piasou/, πιες /pies/, ποιός /pios/, σπίτια /spitia/, τρέχει /tɾexi/, τρέχεις /tɾexis/, φτιάξεις /ftiaksis/, φτιάξω /ftiakso/, χερούλια /xeɾulia/, χύθηκε /xiθike/

2;9 βραχεί /vɾaxi/, βρέχει /vɾexi/, έφτιαξα /eftiaksa/, έχετε /exete/, ζητιάνος /zitianos/, ησυχία /isixia/, θά'ρχεται /θaɾxete/, ίσια /isia/, κάποιο /kapio/, κάποιος /kapios/, μαχαίρι /maxeɾi/, νά'χει /naxi/, πιάνετε /pianete/, πιάνει /piani/, πιάστηνε /piastine/, πιάστο /piasto/, ποιά /pia/, ποιανού /pianou/, πρόσεχε /pɾosexe/, σ'έπιασα /sepiasa/, σκαλοπάτια /skalopatia/, στ'αλήθεια /staliθia/, τέτοιο /tetio/, φτιάξαμε /ftiaksame/, φτιάξουμε /ftiaksoume/, φτιάχνω /ftiaxno/, φωτιά /fotia/, χεράκια /xeɾakia/, χύθηκαν /xiθikan/, χυμό /ximo/

2;10 άρχισε /aɾxise/, βουτιά /voutia/, βουτιές /vouties/, είχες /ixes/, κατάπια /katapia/, όποιος /opios/, πιάτα /piata/, πιεί /pii/, προσέχεις /pɾosexis/, τό'πια /topia/, χερούλι /xeɾouli/, χύσεις /xisis/

2;11 αρχίσει /aɾxisi/, βατράχι /vatraxi/, βραχιολάκι /vɾaxiolaki/, βραχιόλι /vraxioli/, έρχεσαι /eɾxese/, κι'έρχεται /kierxete/, κοχύλι /koxili/, όποιο /opio/, πάπια /papia/, χαρτιά /xartia/, χυμός /ximos/

3;0 αρχίσεις /aɾxisis/, βρέχεται /vrexete/, βροχή /vɾoxi/, ζωγραφιά /zoγɾafia/, κάποιον /kapion/, μαχαιράκι /maxeraki/, νύχια /nixia/, πιάνεις /pianis/, πιάνω /piano/, πιάσε /piase/, τέτοια /tetia/, τέτοιοι /tetii/, φτιάχνεις /ftiaxnis/, χειμώνα /ximona/, χυθεί /xiθi/, ψευτιές /psefties/

3;1 βαθιά /vaθia/, έπιασε /epiase/, έπιασες /epiases/, έρχεστε /eɾxeste/, θά'χεις /θaxis/, μαχαίρια /maxeɾia/, παραμύθια /paɾamiθia/, πιάσαμε /piasame/, πιάσει /piasi/, πιάσουμε /piasoume/, πιατάκι /piataki/, πλατιά /platia/, προσέχει /pɾosexi/, συννεφιά /sinefia/, τρίχες /tɾixes/, χαιρετάει /xeɾetai/, χαιρόμαστε /xeɾomaste/, χειμώνιασε /ximoniase/, Χιονάτη /xionati/

3;2 πάπιες /papies/, τ'αυτιά /taftia/, το'φτιαξα /toftiaksa/

3;3 αυτιά /aftia/, έφτιαξε /eftiakse/, κάποιες /kapies/, κορίτσια /koritsia/, ποιον /pion/, τύχη /tixi/, χιόνια /xionia/

3;4 αρχίσουμε /aɾxisoume/, βράχηκες /vɾaxikes/, ευτυχισμένη /eftixismeni/, κάποια /kapia/, πιείτε /piite/, συνεχίσεις /sinexisis/, σχέδιο /sxeðio/, τρέχε /tɾexe/, φτιάχνει /ftiaxni/, χελιδόνι /xeliðoni/

3;5 νύχι /nixi/

3;6 έφτιαξες /eftiakses/, συνέχεια /sinexia/, χιόνι /xioni/

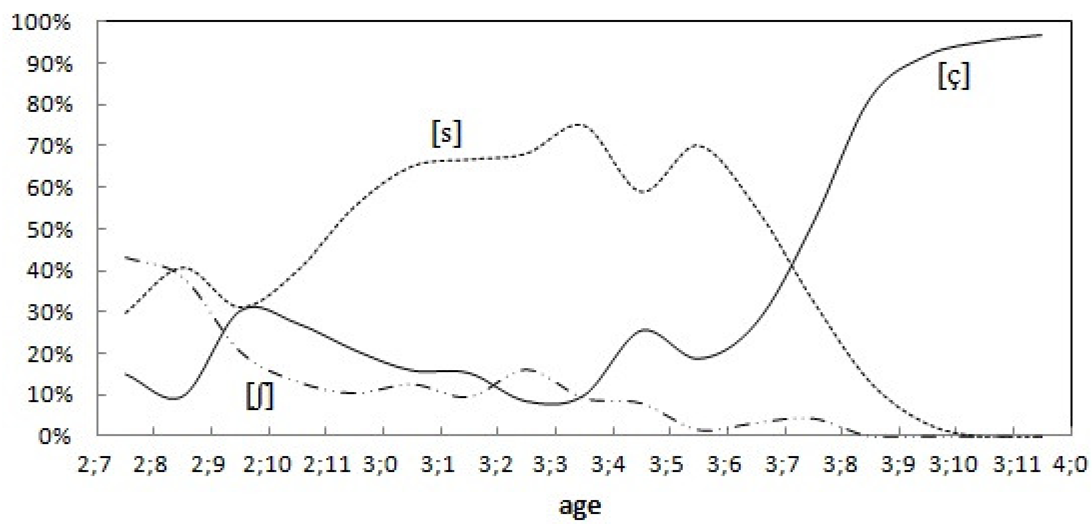
3;7 έβρεχε /evrexe/, έχυσα /exisa/, όποιοι /opii/, όποιον /opion/, πρόσεχες /prosexes/, τυχερή /tixeɾi/, φτιάχνουμε /ftiaxnoume/

3;8 ανοιξιάτικα, μονοπάτια, τέτοιες, χειμωνιάτικα
3;9 πιάνουμε, συνεχίσεις
3;10 κάποιου, σχεδιάσω
3;11 -

The phonetic transcription of these words as in targeted speech, their translation in English and a key to grammar acronyms, are given in Appendix D. In total, there are 164 word types with 2,376 tokens. The monthly (types, tokens) are: (22, 60), (28, 83), (50, 389), (42, 249), (34, 144), (47, 308), (56, 242), (30, 142), (34, 173), (42, 137), (22, 64), (21, 92), (33, 115), (24, 60), (27, 63), (15, 22), (17, 33).

The realizations of [ç] in the child's Greek during development are shown in figure 5.21.

Figure 5.21. The realizations of [ç] during development



The cyclic and progressive stages of the acquisition level of target [ç] coincide with those of /h/ and its substitution [ç]. When the acquisition level of [ç] progresses in Greek, [ç] becomes more frequent in English as a substitution for /h/, transferring from the child's L1. Maria Sofia's age of acquisition of [ç] is about the same as monolingual Greek children's (Pal, 1995). Moreover, not only the dominant substitution for [ç] is [s] and its variant [ʃ] as is the case for /h/, but also [s]'s frequencies of occurrence for [ç] and /h/ coincide during the whole development.

This leads the author to conclude that [ç] not only transfers after its acquisition as a substitute for /h/, but it also transfers before its acquisition by its developmental substitutions. Furthermore, this is evidence for generalizing the definition of transfer and interference in child bilingualism which, up to now, only involves segments that are produced as targeted in one of the two languages.

5.9.3 Conclusions

The child's acquisition level of /h/ shows two stages in development, as was the case for her other consonants. In the cyclic stage which lasts till age 3;5, the acquisition level is lower than 10%, well below the monolingual English norm. The acquisition level progresses till age 3;8 reaching 65%. Complete acquisition is not reached because [ç] is transferred from L1 Greek when /h/ is followed by /e/ or /i/, as is the case for Greek adults' L2 English speech.

During the cyclic stage, the dominant substitutions for /h/ are [s] and its variant [ʃ], while during progression the frequency of their occurrence decreases substantially at the same time that the frequency of occurrence of the substitution [ç] increases substantially.

Examination of the development of [ç] in the child's Greek speech reveals that there is evidence for developmental transfer, that is, [ç]'s main substitutions which are [s] and its variant [ʃ] follow exactly the same path of developmental frequency of occurrence for both /h/ and [ç]. When [ç] is acquired at age 3;8, it transfers into English /h/ becoming its dominant substitution, thereafter.

Even if the developmental substitutions are considered universal for the two consonants, /h/ and [ç], across the two languages, the results presented here show, for the first time in the literature, the frequency of a consonant's ([ç]) transfer from the L1 (Greek) to the L2 (English) as it is being acquired in the L1.

5.10 The child's substitution patterns during development

The child's main developmental substitutions of the consonants that were not completely acquired by 2;7, are shown in table 5.1. The targeted consonants are shown in rows and their main substitutions are shown in columns in the corresponding rows. The two phases of different substitution patterns that were found in the preceding sections of this chapter, one for most of development except near complete acquisition and another near complete acquisition, are indicated in the table by x and circle, respectively. When the substitution occurs in both phases, it is marked as circled x. Substitutions occurring only at word initial position are indicated by a minus sign following x or the circle and substitutions occurring only at word final position are indicated by a minus sign preceding x or the circle. The absence of minus sign implies that the substitution occurs in all word positions.

The child's main substitutions patterns during development overall adhere to the coronal place of articulation. Exceptions are the labio-dental /v/ and the labio-velar /w/ which adhere to labial place and the voiceless interdental fricative, /θ/, which is substituted by [f] near complete acquisition. Maria Sofia's substitution patterns are in agreement with Prince & Smolensky's (1993) universal place markedness hierarchy whereby [Dorsal] is more marked than [Labial] which in turn is more marked than [Coronal]. The coronals /θ, ð, d, z, ʃ, ʧ, ʤ/ retain their place of articulation while the palatal glide, the velars /ŋ, ɫ, k, g/ and the glottal fricative become coronals as well. The voiced labio-dental /v/ is substituted by the voiceless labio-dental [f] in development and by labio-velar [w] near complete acquisition. All along development [v] substitutes /w/. The velar glide is only substituted by labial /v/ adhering to its secondary place of articulation. The English rhotic is substituted by coronal [l] and labials [v, w], retaining both its primary and secondary places of articulation, unlike /w/ which is substituted by [v], adhering to its labial place of articulation.

Table 5.1. Maria Sofia's developmental substitution patterns

[C]//C/	f	v	t	d	s	z	ʦ	ʣ	n	l	ɾ	ʒ	ʧ	ʤ	c	ɟ	ç	k	w	ə	ʊ	ø
v	-⊗																		O-			-⊗
θ	O		⊗		⊗																	-⊗
ð			O-	O-						x-												⊗-
d			-⊗																			-⊗
z					-⊗																	-x
ɹ		x-								x-	O-								O-			
ʃ					⊗																	
ʧ					x		⊗															
ʤ							-⊗	x-					-⊗									
j						x-		x-				x-		x-			O-					
ŋ									⊗													-⊗
ɫ										x										⊗		⊗
k			x												O							-⊗
g			-x	x												O-		-O				-⊗
w		x-																			O-	O-
h					x-												O-					

N.B. x: in development except near complete acquisition, in circle: near complete acquisition

Moreover, the child's substitution patterns remain faithful to the [±continuant] feature of the targeted consonant. Consequently, the non-acquired stops in velar place are substituted by stops and the non-acquired fricatives, including the glottal fricative, employ continuants as their predominant substitutions. Similarly, the post-alveolar affricate /ʧ/ and the palatal glide /j/ are substituted by [s] and [z, ʒ, ç], respectively, rather than by stops when they are not affricated to [ʦ] and [ʣ, ʤ], respectively. As seen in chapter 4, the child has already acquired the default fricative, /s/, at the age of 2;7, which marks her advance in the acquisition of [+continuant] when compared to monolingual standards and is indicative of her preference for non-stop substitutions subsequently during the development of her speech.

This is especially true in the choice of substitutions for the interdental fricatives, /θ/ and /ð/ being [s] and [l] respectively, rather than [t] and [d] most commonly observed in monolingual norms. It would make more sense if the child substituted /ð/ with the voiced alveolar fricative, [z], a pattern evident in the development of /ð/ in her Greek, only, and similar to the pattern for /θ/ in both languages. Her preference for the lateral substitution of /ð/, whereby [+continuant] is inherently present, is an example of individual variation in this child. She opts for the sonorous lateral rather than the stronger alveolar stop, preserving the higher sonority of the targeted interdental fricative when compared to the stops.

It is further noted that both voicing and deletion patterns are affected depending on the consonant's position in the word. Word final devoicing is present from beginning to end in the child's development of /-v/→[f] and /-ʤ/→[ʦ, tʃ] and the same is true for /-g/ being devoiced to the alveolar [t] during development and to [k], near complete acquisition, following acquisition of /k/. This is in line with the universal pattern of word final devoicing still present in monolingual phonological development by age 4;0 (e.g. Beers, 1995). Similarly, word final deletions persist till the end for the stops /d, ŋ, k, g/, the lateral, [ɫ] and the fricatives /v, θ/ with the exception of /-z/ that is no longer deleted near complete acquisition.

The child's substitution patterns are nonlinear in development in that they generally go through two phases. The first phase coincides with the cyclic stage and, for most consonants, goes past it, approaching complete acquisition. The discontinuity occurs near complete acquisition where the substitution patterns enter their second phase.

For the interdentals, the nonlinearity in substitution patterns is not the result of articulation maturation or language interference with the child's other language in bilingualism. In the second phase, [d] substitutes /ð/ taking over from [l], the overwhelmingly dominant substitution in the first phase, and [f] substitutes /θ/ taking over from [t]. The nonlinearity in the substitution patterns of the interdentals cannot be explained by markedness theories such as optimality theory.

However, the occurrence of [w] as a substitute of /ɹ, v/ for the first time in the second phase at 3;6, is the result of articulation maturation as the acquisition level of /w/ passes the 60% level, entering its progressive stage.

The discontinuity in the substitution patterns of the velars /k, g/ and the glottal fricative, /h/, is both the result of articulation maturation in the child's other language and interference between the two languages. Near complete acquisition, [c] transfers from the L1 Greek and takes over from [t] as the main substitution of /k/, [ɟ] transfers from the L1 Greek and takes over from [d, t] as the main substitution of /g/, and /x/, [ç] also transfer from the L1 Greek and take over from [s] as the main substitutions of /h/.

The presence of word-final deletions in Maria Sofia's speech until age 4;0 disagrees with the monolingual English norm (e.g. Grunwell, 1981b) where deletions wane by age 3;0. The child's persistence for deletions may be attributed either to her bilingual status as there are no word final consonants in Greek except for /s, n/ or to her idiosyncratic development in English.

Assimilations to the labials /p, f, v/ and to the coronals /t, d, n, ɹ, l/, a pattern observed in the child's languages at 2;7, persist near complete acquisition. Moreover, near complete acquisition, assimilations to the velar /k/ occur, which although common universally in phonological development (e.g. Menn, 1978; Smith 1973; Stemberger & Stoel-Gammon, 1991), were non-existent earlier in the child's speech as a result of her low acquisition level of velars. Examples near complete acquisition are:

3;10 *have* [**f**æf], *plaster* [plæs**p**əɹ], *real* [ɾiː**ɹ**]
and that's that [ə **n**æts ðæt]
its night now and that's our bedroom [ɪts naɪtʰ naʊ ə **n**æts aʊəɹ bedɾum]
this one will sleep [ðɪs wʌ**ɫ** wɪɫ sliːp]

3;11 *don't knock it down* [dɒŋ**k** nɒk ɪt daʊn]
I like it I love it [aɪ laɪ**v** ɪ aɪ lʌv]
outside it, that I will go [aʊtsaɪd ɪ**d** **d**æ aɪ wʊɫ gɔ]
I don't remember [aɪ dɒn **n**ɪmembə]
this thing that we tear [ðɪs θɪŋ **t**æt wɪ tʰeəɹ]

Assimilations occur within the word, at word boundaries, and outside the word in the whole utterance, either in priming or in anticipation.

5.11 Conclusions

The child's development of consonants in English whose acquisition level is lower than 50% by age 2;7 was examined in detail. These are the interdentals, /θ, ð/, the velars /k, g/, the rhotic, /ɹ/, and the glottal fricative, /h/. The development of /v, w/ was also investigated in detail, even though their acquisition level was generally higher than 50% during the span of the study. Furthermore, the development of the voiceless interdental fricative in English and Greek was compared, as was the development of the voiceless fricatives /h/ in English and [ç] in Greek.

Two stages in development are identified between ages 2;7 and 4;0; the cyclic and the progressive. In the cyclic stage, a consonant's acquisition level repeatedly increases and decreases but overall remains constant. In the progressive stage, it increases until complete acquisition following a single or double S-shaped curve. The length of the cyclic stage and the acquisition level in it, correspond to the well known U-shaped model of phonological and linguistic development that has been advocated in the literature on a qualitative basis.

Progress in the acquisition level starts between ages 3;4 and 3;6 for all consonants in development. Substantial increases in the acquisition level of consonants coincide with a substantial increase in the average length of sentence, that is, the words per utterance ratio. The acquisition levels of voiced consonants start progressing earlier than those of the voiceless consonants. Specifically, the acquisition levels of word initial /ð/ and word final /g/ start progressing earlier than those of word initial /θ/ and word final /k/, respectively, while the acquisition levels of word initial /k, g/ start progressing at about the same age.

The progressive stage lasts about five months until complete acquisition when the acquisition level is higher than 90%. Word initial /ð/ is completely acquired earlier than word initial /θ/ in contrast to word initial /g/ which is completely acquired later than word initial /k/. Voiced /v/ is acquired earlier in word initial position, which has been claimed to be perceptually more prominent (e.g. Fikkert, 2007) than other word positions, in agreement with the general principle that markedness occupies psycholinguistically prominent positions (J. Smith, 2002). Except near complete acquisition, word final /θ/'s acquisition level is higher than word initial /θ/'s, in agreement with the word alignment constraint whereby continuants align to the right edge of the word and stops align to the left. In line with this contraint, word initial /k/ is acquired earlier than word final /k/. In contrast, word initial /g/ is acquired later than word final /g/ due to the fact that the child's word final /g/ is not involved in clusters and is involved only in few monosyllabic words.

By age 3;11, the rhotic and the glottal fricative only reach a level of acquisition of 15% and 60%, respectively, because of frequent transfer from the child's L1 Greek. The Greek rhotic is produced in place of the English rhotic and the Greek /x/ together with its allophone [ç] are produced in place of the glottal fricative, as is the case in the L2 English speech of Greek adults. The voiced interdental, /ð/, is completely acquired earlier than the voiceless interdental, /θ/, in line with its earlier start for progress while the voiced dorsal stop, /g/, is completely acquired later than the voicelss dorsal stop, /k/, contrary to its earlier start for progress.

Comparing Maria Sofia's performance with that of monolingual English children shows that her /k, g, w/ are behind but catch up by 3;11, her interdentals are behind during the cyclic stage but ahead starting at 3;7, while her /v/ is ahead all along. Greek children completely acquire word initial /k/ much earlier than Maria Sofia but acquire word initial interdentals later. There is no Greek norm available for word initial /g/. Last, Maria Sofia's English rhotic and glottal fricative are behind the English norm and do not catch up by age 4;0, because of trasfer from her L1 Greek.

During the cyclic stage, the child's acquisition level of word initial /θ/ is well below the monolingual English norm and below the monolingual Greek norm while that of word final position is similar to the monolingual English norm. However, Maria Sofia's progress is much faster than the norms, completely acquiring the voiceless interdental fricative earlier than the norms in both languages. This implies that parents and speech pathologists should not rush to judgments as to whether a child is phonologically delayed or not.

The comparison of a consonant's acquisition level across the two languages is not straightforward during phonological development as there is language differentiation at many levels as was demonstrated for the development of the voiceless interdental. Even if the words selected for comparison are equivalent in terms of length, consonants' proportion, types of clusters, and the consonants' word position, which would be extremely difficult if not impossible to accomplish, additionally there are individual words whose production is frozen in the language.

The child's main substitutions patterns overall adhere to the coronal place of articulation. Coronals remain coronal while the palatal glide, velars and the glottal fricative also become coronals. Unlike these, /θ/ near complete acquisition becomes labial, [f], and labials in either primary or secondary place of articulation, /v/ and /w/, remain labials [f, w] and [v], respectively, during development. Among these, targeted consonants with a double articulation behave differently, thus, /w/ adheres to its labial place of articulation persisting in [v], while /ɹ/ retains both places of articulations in [l] and [v, w]. Maria Sofia's substitution patterns are in agreement with Prince & Smolensky's (1993) universal place markedness hierarchy whereby [Dorsal] is more marked than [Labial] which in turn is more marked than [Coronal].

Moreover, dominant substitution patterns adhere to the manner of articulation of the targeted consonant with regard to the [continuant] feature in that stops are substituted by stops and fricatives employ continuants as their predominant substitutions. This is especially true for the voiced labio-dental fricative and for the voiced interdental fricative, unlike the monolingual norm in either language, English or Greek. A preference for continuant substitutions is also observed for the affricate /ʧ/ and the palatal glide, /j/, substituted by [s] and [z, ʒ, ç] respectively, rather than by stops, when they are not affricated. Lastly, [s], the dominant substitution of [ç] in the child's Greek, transfers as the dominant substitution for /h/, while the norm in monolingual English is deletion. These are in agreement with the child's patterns at 2;7 showing early acquisition of [continuant] in /s/, unlike monolingual norms, and indicative of her preference, overall, for continuants and more sonorous substitutions over stops during the development.

There is nonlinearity in the substitution patterns during development in that two phases are observed. The first phase coincides with the cyclic stage and supersedes it in most cases as it approaches complete acquisition when the discontinuity in the substitution patterns occurs. With respect to the interdental fricatives, the nonlinearity in the substitution patterns cannot be explained developmentally by markedness theories, such as optimality theory, since it does not result from articulatory maturation, as in the case of /v/. The sudden alteration from [l] to [t, d] for /ð/ and from [s] to [f] for /θ/ is not accounted for in terms of linearly acquired markedness constraints since [t, d] and [f] were phonetically available to the child from the beginning.

The change in the substitution patterns of the velars /k, g/ and the glottal fricative, /h/, is both the result of articulation maturation in the child's other language and interference between the two languages. Near complete acquisition, [c] transfers from the L1 Greek and takes over from [t] as the main substitution of /k/, [ɟ] transfers from the L1 Greek and takes over from [d, t] as the main substitution of /g/, and /x/, [ç] also transfer from the L1 Greek and take over from [s] as the main substitutions of /h/.

The proportion of a substitution is generally word-position dependent as well as lexically dependent. At 3;9, substitutions persist for /θ/ in words that have the lateral to the right of /θ/ as in /θelo/ and /kaθolu/ but not to the left of /θ/ as in /aliθia/ and /kolibiθɾa/ in which /θ/ is produced correctly. This preferred directionality may be observed in other children's data with regard to regressive consonant harmony, in general, that includes assimilation to the lateral, as discussed in §4.5.3. Moreover, there are substitutions that occur exclusively in words that are frequent in the child's speech as, for example, [w] in *very* and [n] in *the* and *this*.

Maria Sofia's main substitutions, by and large, match those of the monolingual English norm except her [l] for /ð, ɹ/, [s] for /h/, [v] for /w/ and her transfers. In monolingual English and Greek norms [d, t] substitute /ð/, that is, the less marked [-continuant] feature is preferred in the substitutions, in contrast to Maria Sofia's preference in the continuant feature of the lateral articulation, whereby the airstream is permitted to proceed along the sides of the tongue. The monolingual Greek norm, whereby [l] substitutes the Greek rhotic, matches Maria Sofia's substitution for both the English and the Greek rhotics. /h, w/ do not exist in the Greek language.

Assimilations persevere until age 3;11 occurring within the word, in word boundaries, and outside the word in the whole utterance, either in priming or in anticipation. Partly like the norm of labial and velar assimilations, the child's assimilations are to the labial and coronal place of articulation during most of the development, while velar assimilations also occur near complete acquisition following the acquisition of [Velar]. For example /v/ assimilates, in anticipation, to its partly homorganic nasal /m/ contained in another word that follows in the utterance; [nasal] spreading from right-to-left in consonant harmony within a word has been known to occur (e.g. Ladefoged, 1993). Similarly, word-final deletions persist in the child's speech till age 3;11 in disagreement with the monolingual English norm where deletions wane by age 3;0, but in agreement with the monolingual Greek norm where deletions persevere till age 4;6.

The child's below the norm acquisition level of some consonants during her cyclic stage of development, before age 3;6, and above the norm during her progressive stage before age 3;11, dictates that parent and speech pathologists should not rush to judgments as to the whether a child is phonologically delayed or not.

As there are quantitative changes in the substitution patterns during development, the results of this chapter also provide a perspective on adult L2 speech independent of the L1 where, on the one hand, substitutions are known to match children's developmental substitutions but, on the other hand, the longitudinal effect of the proficiency level needs further investigation.

Last, the frequency of a segment's transfer from the L1 to the L2, as was shown for Greek [ç] substituting English /h/, during the segment's acquisition in L1, sets a precedent in developmental transfer. Moreover, [ç] not only transfers as such, but it also transfers before its acquisition by its developmental substitutions. This is evidence for generalizing the definition of transfer and interference in child bilingualism which, up to now, only involves segments that are produced as targeted in one of the two languages.

CHAPTER 6
CREATION OF CONSONANT SEQUENCES/CLUSTERS BY EPENTHESIS

This chapter is organized as follows: section §6.1 introduces the scope and research questions relevant to the topic of consonant sequence/cluster creation by epenthesis. §6.2 presents all the words to which a consonant is added in word-initial position to create a consonant sequence/cluster. §6.2.1 provides an examination of the created sequences/clusters that occur in more words than one in terms of the nature of the epenthetic consonant, the target consonant and its realization, the relationship between consonants in the created sequence/cluster, and the influence of the phonological environment outside the sequence/cluster, in the word, whole utterance, and previous child's and adult interlocutor's utterances. §6.3 gives a classification of all created sequences/clusters in terms of the aforementioned contexts, independent of whether they occurred in one or more words, and the dependence of epenthesis on age is discussed. Last, §6.4 presents the chapter's conclusions.

6.1 Introduction

There are errors in child speech that are noticeable only after a thorough analysis of the data. Ervin & Miller (1963) reported that, even though it is not uncommon for substitutions in child speech to come from adult interlocutor productions not relating to the child's targeted segments, this is usually not noticed by parents. There are sound errors that, while salient, their systematicity becomes apparent only after close examination of the data. Ingram (1974b) found that for two children of ages 1;5 and 1;9, the processes of assimilation, metathesis and deletion which at first appeared inconsistent, conspire towards a strategy for fronting. For example, Philip (1;9) produces [naŋi] for *candy*, [baki] for *coffee* in English and Fernande (1;5) produces [dā] for *garde* in French. Leonard (1985) reported that a phonologically disordered child at 4;8 produces velar stops in initial position of words whose adult forms contained word final [d], as [gæ] for *dad* and [gʌdᵊ] for *mud*.

In the present chapter, such is the case in the child's production of consonant sequences/clusters by epenthesis, that is, consonant sequences/clusters that are created by adding a consonant next to a targeted consonant which is produced either as targeted or substituted. For example, Maria Sofia produces *know* as [tnɔʊ], *letter* as [kletəɹ], *half* as [psaːf], *they* as [tle], *pet* as [mpet] and *two* as [ntu:]. The compound term *sequence/cluster* is used here to include both the commonly called 'consonant cluster' and 'consonant sequence' such as a pre-nasalized consonant. Hereby, such consonant sequences/clusters will be referred to simply as consonant clusters. These consonant clusters were not noticed by the author when they occurred during the child's interactions with her but only during data transcription. Also, their systematic patterns were not identified until the data was analyzed in detail.

Consonant clusters produced by epenthesis have been reported in the literature for both normal and phonologically disordered children, though not as often as other errors (e.g. Leonard, 1985; Stemberger, 1989). Edwards & Bernhardt (1973) observed the epenthesis of [n] before [d, t] which were targeted in two phonologically disordered children at ages 4;4 and 5;3 e.g. *bird* [bɜnd], *red* [pf^{w}ɪ^{n}t], *station* [t^{h}jent^{h}ɪn] and *Christina* [t^{h}ə^{n}t^{h}ɪn]. In Smith's (1973) data of his normally developing child, some epenthetic clusters may be noticed as in *neck* [n̥gek] and *come* [gʌmd, kʌmd]. Word initial [m] epenthesis was observed by Ingram (1976b) in Hinckley's (1915) data of a phonologically disordered child of age 6;0: *book* [mbʊ], *chair* [mnæ], *cow* [mtæw]. Fey & Gandour (1982) reported *stub* [dabm̩], *bad* [bædn̩], *big* [bɪgn̩] as the productions of a normally developing child, whereby, the syllabic nasals were added at word final position following a voiced stop. Epenthetic clusters also exist in the data given by Smit (1993a) in the Iowa-Nebraska articulation norms project: /-b, d-, n/→[nd], /l-/ →[bl, fl, gl], /b-/→[db, mb, br], /-f, -t/→[ft], /t-/→[ps], /h-/→[hj], /j-/→[wj], /r-/→[br], /f-/ →[fw, bw], /v-/→[bf], /θ-/→[fs, fl], /-θ/→[tθ, fp], /s-/→[st], /-s/→[ts, sf] and by Vihman (1996) for individual normal children: *clean* [t^{h}ind] for 16-month Alice, and *ball* [bβuʔ] for 13-month old Deborah.

Examples of cluster production by epenthesis may also be observed in the developmental speech data given by several authors for other languages, although these clusters were not reported by the authors in the light of epenthesis: in Italian *bicicleta* (bicycle) [bleblɛka] for 2-year old Laura (Lleó 1990), in Swedish *bok* (book) [bβʊ] for 11-month old Hanna and *blomma* (flower) [bɔmbə] for 10-month old Lina (Vihman, 1996), in French *assis* (sat) [ætçɛ] for 14-month old Charles (Vihman, 1996), and in Polish *krab* (crab) /krap/ [ɲap:ka], *tukan* (toucan) /tukan/ [ɲ:kaɲk], *dywan* (carpet) /dɨvan/ [diɲda] for Grzenio at age 1;5-1;9 (Szreder, 2011).

Stemberger (1989) found 39 occurrences where clusters were created by consonant epenthesis in his two normal daughters' phonological development. In only 2 of these clusters addition occurred before the targeted consonant: *ready* → bready, *toilet* → stoilet. This led Stemberger (1989) to conclude that, like adults (Stemberger & Treiman, 1986), children prefer to add the consonant after the targeted consonant. For example, [w] is added after [ʤ] in *join* and after [d] in *door*. Furthermore, Stemberger (1989) only found 7 of these 39 clusters not to exist in the English language which led him to conclude that this is another child pattern similar to that of adults (Stemberger, 1983); that is, phonotactic violations in consonant clusters which are created by epenthesis occur at a low rate. Stemberger (1989) also examined the whole utterance in which words with epenthetic clusters occurred and found that whenever consonants from other words interfere, they do so by shifting (metathesis), anticipation or perseveration (priming). The latter two processes meaning, respectively, that the epenthetic consonant interferes with a consonant from another word that either follows in the sentence/utterance or precedes in the same or earlier sentences (e.g. Stemberger 1989, Huttenlocher, Vasilyeva, & Shimpi, 2004). Examples are BOCK the DLOOR [dwo:] in *block the door* and BREE in *Let's both of us be the bridge keeper*.

Stemberger (1989) further reported that in the two word initial epentheses that occurred in his data, perseveration was the cause: BREADY in *Supper's just about ready* and STOILET in *I want to sit on the toilet.*

The clusters created by consonant epenthesis in child speech that have been reported in the literature are, therefore, limited in number. Additionally, except in Stemberger (1989), words in which epenthetic clusters occur were not put in context in terms of whole sentences or preceding child or adult interlocutor sentences, where applicable. For this reason, a comprehensive examination and analysis of this phenomenon in child speech has not been possible up to date. As a result, phonological patterns and processes have not been identified as a whole and, where they have, it is questionable whether they are universal.

In the present study, word initial consonant epenthesis next to a produced targeted consonant, resulting in word initial consonant clusters, will be examined in detail. 117 such occurrences were found in Maria Sofia's English speech from age 2;7 to age 3;8 out of a total 205 created clusters with the epenthesis in all word positions. Additionally, there were 16 word initial clusters with the epenthetic consonant in second position. Thus the data of the present study disagrees with Stemberger's (1989) conclusion that children add the consonant much more often in second position as adults do. Consonant clusters created by epenthesis were found in the child's Greek as well and, occasionally, after age 3;8 in both languages but they will not be dealt with here.

In connected child speech, word initial consonants at word boundaries may be interfered by word final consonants of the preceding word (e.g. Speake, Howard, & Vance, 2011). Here, this interference effect is filtered, *ab initio*, by only selecting words at the beginning of sentences. This guarantees that the remaining 83 tokens of created consonant clusters which will be examined are truly utterance onset. Thus, the number of tokens available for analysis in the present study is larger than the number which is found by the author in the literature, collectively for several children. Sufficient data, as is the case here, will facilitate pattern and process identification in the phenomenon of cluster creation by consonant epenthesis.

Specifically, it will be of interest to investigate quantitatively the relationship between: the epenthetic consonant and its adjacent consonant in the cluster; the word initial targeted consonant and its production in cluster second position; the epenthetic consonant and consonants that are produced in words that either follow in the sentence or precede in earlier sentences in the child's or adult interlocutor's speech.

Moreover, it will be interesting to investigate the relationship between the two cluster consonants with respect to known phonotactic rules that apply to onset clusters in the English language and, where relevant, in Greek; in general, the consonants must rise in sonority and not be homorganic (e.g. Kenstowicz, 1994). The rate at which Maria Sofia's phonotactic violations occur will be compared with the low rates reported for adults and for two children by Stemberger (1989). Last, it will be of interest to find out whether the consonants' sonority distance in cluster creation is large, in line with the sonority distance of targeted clusters which children find easier to produce (e.g. Barlow, 2004).

6.2 Words and their initial epenthetic consonant clusters

The produced words containing a consonant cluster created by word initial consonant epenthesis in Maria Sofia’s English speech from age 2;7 to age 3;8, are listed in table 6.1 together with their corresponding targeted words. The age at which productions occurred is also shown.

Table 6.1. Words and their epenthetic consonant clusters

word	tks	P1	P2	P3	P4	P5	P6	P7	P8
balls	1	**zb**ɔːz 3;0							
ceiling	1	**ps**iːlɪn 3;2							
chocolate	1	**stʃ**ɒtə 2;7							
cover	1	**n**tʌvəl 3;5							
drive	1	**vd**laɪ 3;5							
gorilla	1	**nd**ɒɾi 3;5							
green	1	**ŋg**ɾi 3;6							
guess	1	**ŋg**es 3;8							
half	1	**p**saːf 3;5							
have	1	**sx**æv 3;6							
hello	1	**ps**əlɔʊ 2;9							
here	3	**ps**ɪə, **ps**ɪəɹ 3;2, 3;4	**sç**ɪəɹ 3;4						
just	1	**zdz**ʌst 3;0							
know	1	**tn**ɔʊ 3;5							
letter	1	**kl**etəɹ 3;6							
like	2	**kl**æt	**dl**aɪ						

		3;3	3;3			
lullaby	1	**mɲ**ajəbaɪ				
		2;7				
no	4	**sn**'ɔʊ	**fn**ɔʊ			
		3;3, 3;6, 3;7	3;6			
path	1	**mp**aːs				
		3;4				
pet	1	**mp**et				
		3;4				
put	1	**b/p**ʊt				
		3;3				
rain	1	**gɹ**əɪn				
		3;6				
read	2	**sv**ːiːt, **sv**iːd				
		3;2, 3;3				
see	1	**fs**i				
		2;11				
sip	1	**ps**ɪp				
		2;11				
tell	3	**st**eɫ				
		3;2 (2), 3;4				
that	3	**sl**æt	**tð**æt^h	**nd**æt		
		3;6	3;6	3;6		
the	1	**m**le				
		3;4				
there	3	**mp**eəɫ	**dl**eə	**zdz**eə		
		2;10	3;0	3;5		
these	1	**dð**iːz				
		3;4				
they	1	**tl**e				
		3;3				
this	5	**lʒ**es	**bl**ɪs	**ld**ɪs	**dð**ɪs	**nð**ɪs
		2;9	2;11	3;4	3;5	3;5
Thomais	1	**ps**omais				
		2;10				
three	1	**st**li				
		3;4				
tonight	1	**st**ʊnaɪt				
		3;6				
touch	1	**nt**ʌtʃ				
		3;1				

two	1	**nt**uː							
		3;2							
very	1	**bv**eɾɪ							
		3;6							
Wednesday	1	**vw**enzdeɪ							
		3;7							
who	1	**sx**u							
		3;2							
why	2	**tv**aɪ	**mv**aɪ						
		3;0	3;3						
yeah	1	**nj**ɛː							
		3;3							
yellow	1	**vl**elɔʊ							
		2;7							
yes	14	**nj**es	**dj**es	**d/z**es	**ndz**es	**nd**es	**sj**es	**d/dz**es	**ŋɟ**es
		2;9, 3;3, 3;4, 3;5, 3;6, 3;7	2;10	2;10	3;2, 3;5	3;3	3;5	3;6	3;6
you	5	**sl**u	**sj**u	**tɲ**u	**dɟ**u	**d/z**u			
		2;8	2;9	2;11	3;0	3;6			
your	1	**t**jɔː							
		3;8							
yuppee	2	**zɟ**ʊpi	**pɾ**uːpɪ						
		3;3	3;6						
Total: 47	**83**	**47**							

N.B. tks: tokens, Pn: Production n, slash: parting of the cluster consonant sounds

The word initial consonant epenthesis occurred in 47 target word types for a total of 83 tokens. By chance, the produced epenthetic cluster types are also 47. On the one hand, there are target words with more than one cluster-type production and on the other hand, there are cluster types that are produced more than once for the same or different target words at different instances. The words with several cluster-type productions are: *yes* with 8, *you* and *this* with 5, *that* and *there* with 3, and *here*, *like*, *no*, *why* and *yuppee* with 2. The remaining 37 words are produced with one cluster type. The words produced with the same cluster more than once are: *here* (2), *no* (3), *read* (2), *tell* (3) and *yes* (6 nj, 2 nʤ).

It is remarked that in English there is no pre-nasalization and that a sequence nasal + stop, which is not permitted as onset, is considered a cluster (e.g. Kenstowicz, 1994). In Modern Greek this sequence is not permitted as cluster (PAL, 1995), although it was permitted in Ancient Greek; nowadays it is only found in dialects as a pre-nasalized voiced stop where considerable variation in its production occurs (Arvaniti & Joseph, 2000). In Maria Sofia's English speech the sequence nasal + stop occurs in her epenthetic clusters [nt], [nd], [ŋg],

[mp], [nʣ], [ŋɟ], which will be considered as such in the analysis that follows. Similar word initial epenthetic clustering has occurred in monolingual English children as, for example, *book* [mbʊ] and *cow* [mtæw] in a phonologically disordered child at 6;0 (Ingram, 1976b), [mb] in *bag*, *bed* and [nd] in *dog*, *duck* in normally developing children at ages 2;0 - 4;0 in the Iowa-Nebraska articulation project (Smith, 1973).

6.2.1 Words with the same initial epenthetic clusters

Special attention is paid here to the words produced with the same epenthetic cluster, as occurrence in more than one word-type is significant in pointing out patterns that are lexically independent. These words and their common epenthetic clusters are:

ceiling, *half*, *hello*, *here* (2), *sip*, *Thomais*: /s/, /h/, /θ/→[ps]
cover, *touch*, *two*: /k/, /t/→[nt]
gorilla, *that*, *yes*: /g/, /ð/, /j/→[nd]
green, *guess*: /g/→[ŋg]
have, *who*: /h/→[sx]
just, *there*: /ʤ/, /ð/→[zʣ]
letter, *like*: /l/→[kl]
like, *there*: /l/, /ð/→[dl]
path, *pet*, *there*: /p/, /ð/→[mp]
tell (3), *three*, *tonight*: /t/, /θ/→[st]
that, *you*: /ð/, /j/→[sl]
these, *this*: /ð/→[dð]
yeah, *yes* (6): /j/→[nj]
yes, *you*: /j/→[dj]
yes, *you*: /j/→[d/z]
yes, *you*: /j/→[sj]

There are 16 types and 48 tokens. It is observed that, most of the time, in 35 out of 48 cases, epenthesis occurs when the targeted consonant has either not been acquired as is the case for /θ, ð, k, g, h/ or marginally acquired as for /j, ʤ /: 15/j/, 7/ð/, 6 /h/, 3/g/, 2/θ/, 1/ʤ/, 1/k/. The acquisition level of these consonants is known from chapters 4 and 5, and is further attested here by their substitution within the produced cluster, in second position. The substitution patterns here are in agreement with those occurring in singleton and contextual cluster production. In the remaining few instances, the targeted consonants are the coronals /t, s, l/ and the labial /p/ which have been acquired and are not substituted. Along the same line, epenthetic consonants are overwhelmingly, 44 out of 48, those that the child has acquired, the coronals [s, z, d, n] and the labials [p, m]: 13[n], 11[s], 8[d], 7[p], 3[m], 2[z].

It is further observed that in 9 out of 16 epenthetic cluster types, 28 out of 48 tokens, neither of the cluster consonants is a substitute of the other: [ps], [nt], [nd], [ŋg], [kl], [dl], [st], [sl], [d/z]. A close examination of the phonological environment in which these clusters occur, that is, **word**, **sentence**, **preceding child** or **adult interlocutor sentence**, reveals that in 7 out of 9 cluster types, 15 out of 28 tokens, the epenthetic consonant is clearly affected by it.

First, the epenthetic consonant is affected by other consonants in the word it occurred in: *sip* [psɪp] in anticipation of final /p/ in the word, *green* [ŋgɾi] and *like* [klæt] by metathesis.

Second, the epenthetic consonant is produced by **anticipating** a consonant that is produced either as a target or a substitute in another word later in the sentence: *like you* [dlaɪ ʤu]; *tell him to sit* [steɫ sɪm tu sɪt], *tell her* [steɫ sen], *tonight I need to wear my slippers* [stʊnaɪt aɪ ni:t tʊ veəl maɪ sli:pɛs].

Last, the epenthetic consonant interferes with a consonant that was produced in a preceding sentence/utterance by **priming** (perseverating) it: *ceiling* [psiːlɪn] priming [p] from *πύργος* (tower) /piɾɣos/ [pilos], *half* [psaːf] priming [p] from *help me* [seəp mi], *hello* [psəlɔʊ] priming [p] from *πάμε* (let's go) /pame/→[pami]; *touch* [ntʌtʃ] priming [n] from *don't* [don], *cover* [ntʌvəl] priming [n] from *don't* [don]; *gorilla* [ndɒɾi] priming [n] from *no* [noʊ]; *guess* [ŋges] priming from *ναι* (yes) /ne/→[ne]; and *letter* [kletəɹ] priming [k] from her *clever* [tevə] and the interlocutor's *clever* [klevɚ]. The targeted adult speech is in slashes.

Now, those productions will be given in which any of these three processes are evident when either of the cluster consonants is a substitute of the other: *I have* [aɪ sxæv] priming [s] from the interlocutor's *hens* [hens]; *just these* [zʤʌst li:s] anticipating /s/ in the same word; *path* [mpaːs] priming from interlocutor's *bath* [bæθ], *pet me* [mpet mi] anticipating /m/ from the word that followed; *yes* [njes] priming [n] from the interlocutor's *now* [naʊ]; *you to say* [dju tʊ se] anticipating /t/ from the word that followed.

In the majority of the child's epenthetic clusters, the consonants have a sonority distance larger than 1 in the sonority hierarchy: stops, fricatives, nasals, liquids, glides. These are: [nt], [nd], [ŋg], [kl], [dl], [sl], [mp], [nj], [dj], [sj], for a total of 10 out of 16 types and 28 out of 48 tokens. In these, the permitted clusters in English are [kl], [sl], [nj], [dj], [sj] whose members have a sonority distance larger than 2 except for [nj]. Therefore, the child prefers large sonority distance between the consonants in her epenthetic clusters which goes along with the fact that children find it easier to produce contextual clusters with a large sonority distance and, thus, acquire them earlier than clusters with a small sonority distance (e.g. Barlow, 2004).

Moreover, it is known that in contextual cluster reduction in child speech development, the least sonorous consonant survives most often and, specifically, obstruent + sonorant clusters are reduced to the least sonorous constituent of the cluster (e.g Chin & Dinnsen, 1992; Smit, 1993b; Fikkert, 1994; Lleó & Prinz, 1996; Dinnsen & Barlow, 1998; Gnanadesikan, 1996; Barlow 2004; Kappa, in press). In this chapter, focus is on word initial clusters. Examples of reduction in word initial clusters in English are: *play* [peɪ] and *true* [tu] in the Iowa-Nebraska articulation norms project (Smit, 1993b), *please* [piz] and *draw* [dɒ] (Gnanadesikan, 1996) and *pray* [peɪ], *throwing* [fowin], *blow* [bo], climb [gaɪm], *fly* [faɪ] and *queen* [kin] (Barlow 2004). In Greek, Maria Sofia's other language, examples of word initial cluster reduction in other children are: *πλένω* (I am washing) /pleno/ [peno], *κλαίω* (I am crying) /kleo/ [ceo] and *σπίτι* (house) /spiti/ [piti] (Kappa, in press, and references therein). Several examples of cluster reduction across different languages are also given in Kappa (in press).

In the present chapter, the epenthetic consonant in the cluster is both less and more sonorous than the consonant next to which it is produced, the latter (except [s-]) violating the universal **sonority sequencing principle** (Selkirk, 1984; Clements, 1990). According to this principle, in onset clusters, the first consonant must be less sonorous than the second. /s-/ is exempted from this principle. The child's created clusters that violate this principle are: [nt], [nd], [ŋg], [zʤ], [mp], for a total of 5 out of 12 types and 13 out of 37 tokens having excluded /s-/ clusters. However, 5 out of 5 cluster types and 8 out of 13 tokens have their epenthetic consonant influenced by the three environmental processes, as described above.

Onset clusters in the English language rise in sonority but not all clusters that rise in sonority are permitted, as is the case with /t, d, θ/ not allowed to cluster with /l/ in second place. These and other onset clusters that are not permissible in the language obey the **homorganic** rule, that is, onset clusters cannot have their consonants in the same place of articulation. Exceptions include, but are not limited to, /s-/ and /ɹ/ which may be preceded by /t, d, θ/. The full table of permissible onset clusters in English is given by Kenstowicz (1994). In the Greek language, the homorganic rule also applies with the exception of /s-/ and /l, n/ and /ɾ/ not obeying the homorganic rule when they succeed /θ/ and /t, d, θ, ð/ in the cluster, respectively. Discussion and a list of onset clusters in Greek may be found in Setatos (1974), Malikouti-Drachman (1984) and PAL (1995).

The child's created clusters which violate the homorganic rule are: [nt], [nd], [ŋg], [zʤ], [dl], [mp], [dð], [d/z], for a total of 8 out of 12 types and 19 out of 37 tokens having excluded /s-/ clusters. However, except for [dð] and [d/z], the remaining 6 out of 8 types and 9 out of 19 tokens had their epenthetic consonant influenced by the three environmental processes, as described above. It is remarked that the child's created clusters which violate the sonority sequencing principle also violate the homorganic rule; the reverse not being true for all cases.

With respect to /s-/ clusters which are exempted from the sonority and homorganic rules, the created [st], [sl], [sj] are permitted in the English language while [sx] is not. This cluster, however, is permitted in Greek, the child's other language. The same holds true for the child's [ps]. It is noted here that [sx] and [ps] are part of the child's speech in Greek which is an indication of interference between the two languages. However, most of the time, the epenthetic consonant in both of them was influenced by the phonological environment, as described above. In addition, even though the created [nj] is permitted in English, it is not permitted in American English. This is noted because [nj] does not exist in the mother's English speech and it is interesting, therefore that the child uses it in the production of epenthetic clusters. The child's remaining types, [dj] and [kl], are permitted in the English language but they had their epenthetic consonant also influenced by the phonological environment, as described above.

In conclusion, word initial consonant clusters created by epenthesis that occur in more words than one, in their majority, violate the sonority sequencing principle or the homorganic rule. The rate of Maria Sofia's phonotactic violations is large in contrast to the low rates in adults and in Stemberger's (1989) two children. In these violations, the epenthetic consonant is mostly influenced by the phonological environment, as is also the case for those clusters created by the child that are permitted in the English or Greek language. The consonants sonority distance is large, in line with the sonority distance of targeted clusters which children find easier to produce. In most cases, the targeted consonant has not been acquired and is produced either as targeted or by its substitutions, while the epenthetic consonant has been acquired. In most created consonant clusters, neither member is a substitute of the other.

6.3 Classification of the child's word initial epenthetic clusters

In this section, all the epenthetic clusters will be presented cumulatively, independent of whether they occur in one or more word types. They are shown in table 6.2. Word initial epenthetic consonants, [C_1], are shown in rows, while consonants in second cluster position, [C_2], are shown in columns. Therefore, cells in the table represent clusters. Empty are left the cells whose corresponding clusters are not created by Maria Sofia in epenthesis. The number of tokens of each created cluster-type is shown in the corresponding cell. Next to this number inside the same cell are written the tokens and types of the respective targeted consonants when it is substituted; when there is only 1 token, only the consonant type is written. In bold are the produced clusters that are permitted in the English language, while in circle are those that are permitted in the Greek language. Therefore, bold in circle are permitted in both languages, bold without circle are permitted only in English, without bold and without circle are not permitted either in English or in Greek, and in circle without bold are permitted in Greek but not in English. For brevity, [r] in the table represents either English [ɹ] or Greek [ɾ].

There are 47 word initial cluster types created by epenthesis for a total of 83 tokens, of which 16 types and 48 tokens occur in more words than one. They are created by 14 different epenthetic consonants and 21 different consonants in cluster second position. The latter are produced by targeting 18 different consonants. It is observed that, most often, neither consonant in the created cluster is a substitute of the other. Specifically, there are 17 out of 47 cluster types and 30 out of 83 whose one consonant is a substitute of the other consonant: 7[nj], 3[mp], 2[dð], 2[dj], 2[sj], 2[sx], 2[zʥ], 1[d/ʥ], 1[zj], 1[stʃ], 1[sç], [1tj], 1[tð], 1[b/p], 1[bv], 1[fs], 1[vw]. The first 7 of these types for a total of 20 tokens occur in more than one word and they were discussed separately in the preceding section. It is noted that no cluster type that occurs more than once is limited to a single word.

Table 6.2. Consonant clusters created by epenthesis

[C$_2$]/[C$_1$]	p	b	v	ð	t	d	s	z	ʤ	n	l	r	ʒ	tʃ	ɲ	j	ɟ	ç	g	x	w	total
p							⑦ *4h, 1θ*					❶ *j*										8
b	1		1								❶ *ð*											3
m	3 *1ð*		1 *w*								1 *ð*				① *l*							6
f							1			1												2
v						1					① *j*										1	3
t			1 *w*	1						1	1 *ð*				1 *j*	**1**						6
d				2				2 *2j*	1 *j*		2 *1ð*					**2**						9
s			2 *2r*		❺ *1θ*					**3**	**2** *1ð, 1j*			1		**2**		① *h*		② *2h*		18
z		1							2 *1ð, 1dʒ*							1						4
n				1	3 *1k*	3 *1ð, 1j, 1g*			2 *2j*							**7**						16
l						1 *ð*							1 *ð*									2
k											❷											2
g												❶										1
ŋ																	1 *j*		2			3
total	4 *1ð*	1	5 *2w, 2r*	4	8 *1θ, 1k*	5 *2ð, 1j, 1g*	8 *4h, 1θ*	2 *2j*	5 *3j, 1ð, 1dʒ*	5	10 *5ð, 2j*	2 *1j*	1 *ð*	1	2 *l, j*	13	1 *j*	1 *h*	2	2 *2h*	1	83

N.B. in bold: onset clusters permitted in English, in circle: onset clusters permitted in Greek

The relationship between targeted consonants and their realizations which occur in cluster second position will be discussed separately below, following table 6.3.

More frequently, the epenthetic consonants are: 18[s], 16[n], 9[d], 8[p], 6[m], 6[t], 3[b], 3[v], 3[ŋ], all of which have been completely acquired by the child. In total, coronals are added 58 times, labials 22 times and velars 3 times, even though the last place of articulation has not been acquired. The more frequently added consonants in all clusters coincide with the more frequently added consonants in clusters that occur in more words than one. More frequently in cluster second position, occur: 13[j], 10[l], 8[s], 8[t], 5[d], 5[v], 4[p], 4[ð], even though the first has been acquired marginally, and the last has not been acquired. Their frequency of occurrence depends on the targeted consonant as they are its realizations. More on this will be discussed following table 6.3. Common in the two categories, though not in the same frequency, are: [s], [t], [d], [p], [v], all of which have been acquired.

Altogether, there are 11 out of 47 cluster types that are permitted in English, for a total of 27 out of 83 tokens. These are: 5[st], 3[sn], 1[bl], 2[sl], 2[kl], 1[pr], 1[gr], 1[tj], 2[dj], 2[sj], 7[nj]. The majority of them, [st], [sl], [sj], [nj], [dj], [kl], occur in more words than one. Even if the clusters created by the child in her English speech which are permitted only in the Greek language, 7[ps], 1[vl], 1[mɲ], 1[sç], 2[sx], are included ([ps], [sx] occurring in more words than one), the permitted clusters are still below the rate of 50%. This contrasts the rates in adult speech and in Stemberger's two monolingual English daughters' speech which are above 80% (Stemberger, 1983, 1989). On the other hand, the frequent epenthesis of [s] in word initial position to create a cluster agrees with the pattern observed by Stemberger in his children.

It is of interest to look at the sonority distance between the consonants in the created cluster since in child speech development clusters with a large distance are easier to produce (e.g. Barlow, 2004). The sonority distance is discussed in the literature in connection with permitted clusters in the language (e.g. Selkirk, 1984; Clements, 1990; Barlow, 2004). Maria Sofia's created clusters are a mix of permitted and not permitted clusters in English, as discussed above. Some of her non-permitted clusters violate the sonority sequencing principle. Even for these clusters, it will be of interest to see whether the child shows preference in creating the ones that have a large *gap* in the sonority scale between the cluster consonants. Therefore, the term *sonority distance* will be used in a general sense, also applied to include word initial created clusters whose consonants fall in sonority.

The child's created clusters whose consonants have a sonority distance larger than 1 are: 1[bl], 2[sl], 2[kl], 1[pr], 1[gr], 1[tj], 2[dj], 2[sj], 7[nj], 3[mp], 1[vl], 1[vw], 1[tn], 1[tɲ], 1[tl], 3[nt], 2[dl], 1[zj], 3[nd], 2[ɲg], 1[ɲɟ], 1[ld], 1[lʒ], for a total of 23 out of 47 types and 41 out of 83 tokens, that is, approximately 50%. However, the first 9 cluster types are the great majority, 9 out of 11 types and 19 out of 27 tokens, in Maria Sofia's created clusters that are permitted in the English language. This means that the child strongly prefers large sonority distance when she creates clusters that are permitted in English. On the other hand, she does not prefer it in clusters that are not permitted; 14 out of 36 types and 22 out of 56 tokens have

0 or 1 sonority distance. The clusters which violate the sonority sequencing principle (Selkirk, 1984; Clements, 1990) are: 1[b/p], 3[mp], 1[mv], 2[zʤ], 1[nð], 3[nt], 3[nd], 2[nʤ], 1[ld], 1[lʒ], 2[ŋg], 1[mɲ], 1[fs], 1[vd], 1[zb], 1[ŋɟ], for a total 16/41 types and 25/65 tokens, having excluded the /s-/ clusters. From them, [mp], [nt], [nd], [ŋg], [ŋɟ], [ld], [lʒ], for a total 7 out of 16 types and 14 out of 25 tokens, have a sonority distance larger than 1, where the term *sonority distance* is used in the general sense as discussed above; the child has no preference in the sonority distance when she violates the sonority sequencing principle.

In general, onset clusters are not homorganic in the English and Greek language. The child's clusters that violate this rule are: her first 11 cluster types and 20 tokens that violate the sonority sequencing principle plus 1[bv], 1[vw], 1[tð], 1[tn], 1[tl], 2[dð], 2[d/z], 1[d/ʤ], 2[dl], for a total of 20 out of 41 types and 32 out of 65 tokens. As a result, the child violates the homorganic rule in the same rate as she does not.

6.3.1 Consonants in cluster second position and their targets

The relationship between word initial targeted consonants and their realizations, which occur in cluster second position, is depicted in table 6.3.

Table 6.3. Word initial targeted consonants and their realizations in second-cluster position

[C₂]//C₂/	p	b	v	ð	t	d	s	z	ʤ	n	l	r	ʒ	tʃ	ɲ	j	ɟ	ç	g	x	w	total
p	**3**																					3
b		**1**																				1
v			**1**																			1
θ					**1**		**1**															2
ð	1			**4**		**2**			1		**5**		1									14
t					**6**																	6
d						**1**																1
s							**3**															3
n										**5**												5
l											**3**				1							4
r			**2**									**1**										3
tʃ														**1**								1
dʒ									**1**													1
j						**1**		**2**	**3**		**2**	1			**1**	**13**	**1**					24
k					**1**																	1
g						**1**													**2**			3
w			**2**																		**1**	3
h							**4**											**1**		**2**		7
total	4	1	5	4	8	5	8	2	5	5	10	2	1	1	2	13	1	1	2	2	1	83

N.B. in bold: target realizations also when there is no epenthesis

The word initial targeted consonants which are realized in cluster second position, /C_2/, are shown in rows while their realizations, [C_2], are shown in columns. In bold are marked those target realizations that also occur in the child's speech in non-epenthetic contexts. For brevity, /r/ represents English /ɹ/ and [r] represents either English [ɹ] or Greek [ɾ]. Examples are: the targeted word *read* produced as [svi:d] where [v] substituted /ɹ/, shown in the cell that corresponds to row r and column v, and the targeted word *hello* produced as [psəlɔʊ] where [s] substituted /h/, shown in the cell that corresponds to row h and column s.

It is observed that in their great majority, targeted consonants are either produced as targeted or as their substitutions, 42 out of 47 types and 78 out of 83 tokens. Exceptions are the clusters [ðp], [ðʤ], [ðʒ], [lɲ], [jr] which also violate phonotactics in the English (and Greek) language. Targeted consonants that have not been acquired, /θ, ð, ɹ, k, g, w, h/ are mostly substituted, 25 out of 33; those that have been acquired, /p, b, v, t, d, s, n, l/ are produced overwhelmingly as targeted, 23 out of 24; and marginally acquired consonants, /j, dʒ, tʃ/, have no preference, 14 correct vs. 12 substitutions. These realization patterns are in line with realization patterns in non-epenthetic contexts in the child's speech.

The consonants that are targeted more frequently are: 24/j/, 14/ð/, 7/h/, 6/t/, 5/n/, 4/l/. In total, consonants that have not been acquired are targeted 34 times, the marginally acquired /j/ is targeted 24 times, and consonants that have been acquired are targeted 25 times.

6.3.2 Interference of the cluster with the phonological environment

Here, the interference of consonants outside the cluster with the epenthetic consonant is investigated. All the created clusters were examined in their wide phonological environment, that is, word, sentence, previous child's or adult interlocutor's sentences. The clusters whose epenthetic consonant interferes with a consonant outside the cluster are depicted in table 6.4, where interference patterns are also shown.

The epenthetic consonants are listed in rows while the consonants in cluster second position are listed in columns. Therefore, the cells in the table represent clusters. For example, the targeted word *why* was produced as [tvaɪ]. The epenthetic cluster [tv] is shown in the cell that corresponds to row t and column v. The targeted word *rain* was produced as [gɹəɪn]. The epenthetic cluster [gɹ] is shown in the cell that corresponds to row g and column r. The interference pattern associated with the cluster's epenthetic consonant is marked for each cluster in the corresponding cell: A stands for anticipation of a consonant in another word that follows in the child's sentence/utterance, P denotes priming a consonant in the child's preceding sentence, and M represents metathesis. More details on the patterns are also marked: when anticipation occurs within the word of the created cluster, the letter W is included; (S) denotes interference with a consonant that substitutes a target; (I) represents interference with a consonant in an adult interlocutor's earlier sentence. Last, in bold are shown the clusters whose consonant in second position substitutes the target.

Table 6.4. Interference of the epenthetic cluster with phonological environment

[C$_2$]/[C$_1$]	p	b	v	ð	t	d	s	dz	n	l	r	ɲ	j	ç	g	x	total
p							A(W), **3P**				**A(W)**						5
b	A		P														2
m	A, P(I)		**A**									**A(W,S)**					4
v						M											1
t			**A**	A(W)					P	**A(S)**		**A(S)**	A(S)				6
d										A(S)			A(S)				2
s					3A(S)				P(S)					A(S)		P(I)	6
z		A(W)						**A(W)**									2
n					P, **P**	**P**							P(I)				4
l						**A**											1
k										M, P							2
g											P(I,S)						1
ŋ															M, P		2
total	3	1	3	1	5	3	4	1	2	4	2	2	3	1	2	1	38

N.B. A: anticipation, (W): within the word, (S): with substitute, P: priming, (I): with interlocutor, in bold: /C$_2$/ substituted

There are 29 out of 47 cluster-types with 38 out of 83 tokens created whose epenthetic consonant interferes with a consonant outside the cluster. 12/29 of these cluster-types with 17/38 tokens occur in more words than one. About 1 out of 3 of them, 11 out of 29 types with 13 out of 38 tokens, have their target consonant substituted. 17 cluster-types with 20 tokens are created by anticipation, 12 cluster-types with 15 tokens are created by priming, and 3 cluster-types with 3 tokens are created by metathesis. 6 cluster types with 1 token each are created by anticipation within the word.

The clusters [ps], [mp], [kl], [ŋg] are involved in more than one interference patterns: [mp] and [ps] are involved in anticipation and priming, while [kl] and [ŋg] are involved in priming and metathesis. Besides these 4 clusters there are 2 more which are interfered with more than once: 3[st], 2[nt]. In order of frequency of occurrence the clusters that are interfered with more than once are: 4[ps], 3[st], 2[kl], 2[mp], 2[nt], 2[ŋg]. The first cluster is permitted in the Greek language but not in English, the second and third ones are permitted in both languages while the last three clusters are not permitted in either language.

The epenthetic consonants that are interfered with more often are: 6[s], 6[t], 5[p], 4[m], 4[n]. The first four are added in anticipation and priming while [n] is added only in priming. Out of these five more frequently added consonants in interference, four of them, 4[s], 4[p], 2[m] and 4[n] occur in more words than one. The phonological environment of their interference patterns was given in section 6.2.1 above. Examples of the remaining epenthetic occurrences together with the phonological environment of their interference patterns are:

priming: *no* [**s**nɔʊ] ← [**s**elo agaɟa] /θelo agaʎa/ (in slashes adult form)
anticipation: *why you not need it* [**t**vaɪ ju no**t** ni:**t** **it**]
they look ... [**t**le lu:**t**^{h} ...]

Other interference examples are:

priming: *rain* [**g**ɹəɪn] ← *raincoat* (interlocutor)
very [**b**verɪ] ← [ɪvəl **b**ʊc^{h}] *even bigger*
anticipation: *this kid will* [ldɪs ʦɪt wʊɫ]

Additionally, there is an interesting occurrence of [t] epenthesis in the word *know*. Maria Sofia said [**t**nɔʊ] in a single-word sentence and when she was asked by the interlocutor/author what she meant, she replied: 'I don't know'. This is a demonstration that priming also occurs with consonants in the child's **mind** which are not, however, produced. The author believes that such is also the case with some of her [s] and [n] epentheses in the targeted words *two*, *yes*, *no* which are produced as [ntu:], [njes], [snɔʊ] priming the epenthetic consonants respectively in the words *one*, *no* (or /ne/ meaning *yes* in Greek), *yes* that are in the child's mind but are not produced.

The relationship between cluster consonants is not affected by the phonological environment outside the cluster. In only 10 out of 29 cluster types and 11 out of 38 tokens either of the cluster consonants is a substitute of the other, which is about 1/3, the same rate for all created clusters.

Next, it will be determined how many interfered clusters are permitted in the English language and this will be compared with all the clusters that are created, whether they are interfered with or not. The interfered clusters that are permitted in English are: 1[pr], 1[tj], 1[dj], 1[nj], 3[st], 1[sn], 2[kl], 1[gr] for a total of 8 out of 29 types and 11 out of 38 tokens. Even if the clusters permitted in Greek are included, i.e. 4[ps], 1[mŋ], 1[sç], 1[sx], the rate at which the interfered clusters are permitted is well below 50% in types and below 50% in tokens. This is in line with the rate at which all created clusters are permitted in English (and Greek) which is discussed above following table 6.2.

Last, the consonants' sonority distance in the interfered clusters will be examined and compared with that in all clusters, whether they are interfered with or not. In the interfered clusters that are permitted in the English language the sonority distance is large, that is, on average 3. This is in line with the sonority distance in all the child's created clusters that are permitted in the English language. On the other hand, the sonority distance in the interfered clusters that are not permitted in English is small, that is, on average 1 in line with the sonority distance in all created clusters that are not permitted in English.

6.3.3 Relationship between consonants in the created clusters

In this section, the relationship between the two consonants in the created clusters in respect of articulation features is examined as a whole. In table 6.5, this relationship is shown in terms of voicing, place and manner. When both consonants in the cluster are either voiced or voiceless they are marked V. When they have the same place of articulation they are marked

P and when they have the same manner of articulation they are marked M. When the phonological environment outside the cluster interferes at least once with the epenthetic consonant, V, P, M are in bold.

Table 6.5. Relationship between consonants in the created clusters

[C_2]/[C_1]	p	b	v	ð	t	d	s	z	ʤ	n	l	r	ʒ	ʧ	ɲ	j	ɟ	ç	g	x	w	total
p							7 **V**					**1**										8
b	**PM**		**VP**								V											3
m	3 **P**		**VP**								V				**V**							6
f							VM			1												2
v						**V**					V										VP	3
t			**1**	**P**						**P**	**P**				**1**	**1**						6
d				2 VP				2 VP	VP		2 **VP**					2 **V**						9
s			2 M		5 **VP**					3 **P**	2 P			V		2		**VM**		2 **VM**		18
z		**V**							2 **VP**							V						4
n				VP	3 **P**	3 **VP**			2 VP							7 **V**						16
l						**VP**							V									2
k											**2**											2
g												**V**										1
ŋ																	V		2 **VP**			3
total	4	1	5	4	8	5	8	2	5	5	10	2	1	1	2	13	1	1	2	2	1	83

N.B. V: same voice, P: same place, M: same manner, in bold: interference of epenthetic cluster with phonological environment

The following patterns are observed:

Epenthetic labiodentals, [f], [v], interfere less with the phonological environment outside the cluster than the rest of the epenthetic consonants, 0/2 and 1/3, respectively. At the other extreme, epenthetic [t] interferes all the time with it.

In 66% (31 out of 47) of the cluster types, both consonants are either voiced or voiceless with all epenthetic consonants being involved at least once, except for [t, k], and all consonants in second cluster position being also involved at least once, except for [p, n]. However, when [t, p, n] switch place in the cluster they do allow some of their neighboring consonants to have the same voicing as them. In 52% (16 out of 31) of these cluster types, the epenthetic cluster interferes with the phonological environment outside the cluster at least once.

The clusters [zb], [vd], [ld], [nd], [ŋg], which interfere with the phonological environment 67% of their cumulative occurrences, belong to this category; the last two are the only clusters in this category that occur more than once. In these clusters and in [ŋɟ], the voiced plosive is preceded by another voiced consonant. Moreover, in the clusters [b/p, mp, nt], the voiceless plosives [p, t] are preceded by voiced consonants which interfere with the phonological environment outside the cluster at least once and 67% of their cumulative occurrences. In non-English adult speech, there are occurrences where these consonant sequences are produced as one pre-voiced or exaggerated, pre-voiced segment (e.g. van Alphen & Smits, 2004).

The sequence nasal + stop at word initial position in the child's English speech, which is not permitted as onset in English, is considered a cluster. These word initial epenthetic clusters are known to have occurred in monolingual English children as well, as for example, [mb] in *bag*, *bed* and [nd] in *dog*, *duck* in the Iowa-Nebraska norms project (Smit, 1993a). In Modern Greek, however, where this sequence is not permitted as cluster either, it is produced in dialects as a pre-nasalized voiced stop with considerable variation in its production (Arvaniti & Joseph, 2000).

In 45% (14 out of 31) of the cluster types whose consonants are both either voiced or voiceless, this is the only common articulation feature. All the epenthetic consonants belong to this category with at least one cluster type, except for [f], and of course [t, k]. Furthermore, in 45% (14 out of 31) of them, the consonants share the same place of articulation as well.

As far as the manner of articulation is concerned, the sonority distance between the cluster consonants and violations of the sonority sequencing principle were discussed in sections 6.2 and 6.3 above. Here, it is further noted that in only 5 out 47 created cluster types the consonants have the same manner of articulation and in 3 of them, [sv, sx, sç] the phonological environment outside the cluster interferes with the epenthetic consonant. The other 2 are [b/p] and [fs]. [sv] is the only cluster type in this category whose consonants have manner as the only common articulation feature.

47% (22 out of 47) of the created cluster types have their consonants share the same place of articulation. Violations of the homorganic principle were discussed in sections 6.2 and 6.3 above. In 68% (15 out of 22), the phonological environment outside the cluster interferes with the epenthetic consonant. In 32% (7 out of 22), the cluster consonants have place as the only common articulation feature between them.

As consonants in second cluster position, the rhotic, [r], all the post-alveolars that occur, [ʒ, ʧ], all the palatals that occur, [ɲ, j, ɟ, ç], and the velar [x] but not [g], do not share the same place of articulation with the epenthetic consonant. When [g] is added, however, its neighbouring consonant, r, is not homorganic, either. The other consonants, except [g], do not occur in epenthetic position as they have not, overall, been acquired by the child.

Last, in 83% (39 out of 47) of the created cluster types, both consonants are either voiced or voiceless and/or homorganic.

6.3.4 Age dependency of created clusters

In this section, the dependence of the frequency of occurrences of created clusters on age is discussed. The created clusters classified monthly are as follows:

2;7: stʃ, mɲ, vl
2;8: sl
2;9: ps, lʒ, nj, sj
2;10: mp, ps, dj, d/z

2;11: fs, ps, bl, tɲ,
3;0: zb, zʥ, dl, tv, dj
3;1: nt
3;2: 2ps, sv, 2st, nt, sx, nd
3;3: kl, dl, sn, b/p, sv, tl, mv, 2nj, nd, zj
3;4: ps, sç, 2mp, 2st, ml, dð, ld, nj
3;5: nt, vd, nd, ps, tn, zʥ, dð, nð, nj, nʥ, sj
3;6: ŋg, sx, kl, sn, fn, gr, sl, tð, nd, st, bv, nj, d/ʥ, ŋɟ, d/z, pr
3;7: sn, vw, nj
3;8: ŋg, tj

It is observed that the frequency of occurrences depends on the child's age. Three stages may be identified: 2;7-3;1 where the monthly average is 3.1, 3;2-3;6 where the monthly average is 11.2, and 3;7-3;8 where the monthly is 2.5. It will be interesting to examine whether the frequency of occurrence of erroneous (created) clusters is correlated with the frequency of word production and/or the sentence length.

The monthly word frequency and words per utterance are:

age	**words**	**words/utterance**
2;7	1,589	2.0
2;8	2,472	3.2
2;9	7,588	2.9
2;10	9,079	3.4
2;11	5,869	3.7
3;0	6,921	3.5
3;1	11,117	3.7
3;2	7,635	4.6
3;3	6,985	4.3
3;4	9,023	4.7
3;5	7,053	4.6
3;6	8,908	4.4
3;7	8,336	4.8
3;8	11,740	5.8

Comparing similar word frequencies between ages with respective frequencies in created clusters in the first two stages identified above, it is seen that: ages 2;10 and 3;4 have about nine thousand words but their frequency of created clusters is totally different, 4 vs.10; ages 2;9 and 3;2 have about 7,600 words but their frequency of created clusters is 4 and 8, respectively; ages 3;0 and 3;3 have about 6,950 words but their frequency of cluster production is 5 and 11, respectively. Therefore, the frequency of occurrences of consonant clusters created by epenthesis is independent of the number of words produced but very much age dependent.

On the other hand, it is observed that all ages in the second stage have both larger word to utterance ratios and more created clusters than all ages in the first stage. The average word to utterance ratio in the first stage is 3.2 while in the second stage is 4.5, that is, larger than one word per utterance compared to the first stage. Therefore, in the first two stages the frequency with which clusters are created by epenthesis is overall dependent on the number of words per utterance.

However, in the third stage, even though the child produces more words per utterance the frequency of occurrences of created clusters is low. This is so, because the child is in her final stage of phonological development where the frequency of errors is decreasing, not only for clusters created by epenthesis but also for other errors in her speech as it was seen in chapter 5.

6.4 Conclusions

Consonant sequence/cluster creation by epenthesis is a phenomenon occurring in normal and phonologically disordered children as well as in adults, cross-linguistically. In identifying phonological patterns and processes in the phenomenon, Maria Sofia's creation of 47 consonant clusters with 83 tokens in English by sentence/utterance-initial epenthesis between the ages 2;7-3;8 was examined. This class of clusters was examined separately from general word-initial epenthesis to eliminate word boundary effects in their creation.

Analysis of the data in respect of the epenthetic consonant, the target consonant and its realization, and the phonological environment outside the sequence/cluster (word, whole utterance, and previous child's and adult interlocutor's utterances) reveals the following phonological patterns and processes:

Ninety per cent (90%) of the epenthetic consonants had been acquired by the child when data collection began. These are the labials /p, b, m, f, v/ and the coronals /t, d, s, z, n, l/ in contrast to the velars /k, g, ŋ/ which had not been completely acquired during the period of data collection. More frequent are the consonants [s, n, d, p, m, t] in this order, which account for 3/4 of the additions. On the one hand, [s, n, d] are rarely affected by the phonological environment outside the cluster (less than 1/3 occurrences) while, on the other hand, the minimal consonantal system [p, m, t] is often affected by it (more than 2/3 of the occurrences).

Two thirds (2/3) of the consonants produced in second position in the cluster, [p, b, v, t, d, s, z, ʥ, n, l, ɲ], had been acquired by the start of data collection while the rest of the consonants in equal proportion, had been either marginally acquired, [j, ʒ , tʃ], or not acquired, [ð, r, ɹ, ç, g, x, w], during the period of data collection. More frequent are the consonants [j, l, s, t, n, d, ʥ, v] in this order, which account for 70% of the productions in cluster second position. Their frequency is target dependent as they occur in place of targets.

Ninety per cent (90%) of the targeted consonants are either produced as targeted or by substitutions that also occur in the child's speech when they are not added to. The remaining 10% are in clusters that are not permitted in the English (or Greek) language. The substitution rate depends on the acquisition level of the target and, overwhelmingly, is not affected by the phonological environment. The correct rate of production is 1/4 for those that have not been acquired, /θ, ð, ɹ, k, g, w, h/, 1/2 of the marginally acquired, /j, dʒ, tʃ/, and 96% of the completely acquired, /p, b, v, t, d, s, n, l/. More frequently /j/, /ð/, /h/, /t/, /n/, /l/ are targeted, in this order, which account for 70% of the targets. In total, consonants that have not been acquired are targeted 32 times, marginally acquired 26 times, and consonants that have been acquired are targeted 25 times.

In 2/3 of the occurrences, the epenthetic consonant is not a substitute of its cluster neighbor or its neighbor's targeted consonant. The rate remains the same when epenthesis is affected by the phonological environment outside the cluster.

Only 1/3 of the cluster-types with 50% of the tokens are permitted in English or Greek, the child's other language. The rate remains the same when epenthesis is affected by the phonological environment outside the cluster. The rate of permitted clusters contrasts that of monolingual English adults and Stemberger's (1989) two daughters which is above 80% in tokens.

The sonority distance between cluster consonants is large, on average 3, when the created cluster is permitted in English, while it is small, on average 1, when it is not permitted. This finding remains unaffected when epenthesis is influenced by the phonological environment outside the cluster. Maria Sofia's large sonority distance between the consonants in her created clusters that are permitted in the English language is in line with that in monolingual English children's targeted clusters during phonological development (e.g. Barlow, 2004).

The epenthetic consonant is influenced by the phonological environment outside the cluster in 62% of the cluster types and 46% of the cluster tokens. Three different processes are involved: anticipation of a consonant within the sentence at 53% of all occurrences, priming a consonant in previous child or adult interlocutor's sentences at 39%, and metathesis of a consonant from the epenthetic word at 8%. In only 1/4 of the occurrences, epenthesis is influenced by the word in which it occurs; in 2/3 of the occurrences by anticipation and in 1/3 by metathesis.

In 66% (31 out of 47) of the cluster types both consonants are either voiced or voiceless. In 45% (14 out of 31) of them, this is the only common articulation feature between the consonants and, in the same proportion, the consonants are homorganic as well.

There is an overall similarity in the phonological patterns and processes when the data on consonant cluster creation by epenthesis is analyzed separately for clusters that occur in more words than one. This establishes lexical independence of the phenomenon of consonant cluster creation by epenthesis.

Three stages of development may be identified according to the frequency of occurrences of clusters created by epenthesis. In the first stage between ages 2;7 and 3;1 the average frequency is 3.1, in the second stage between ages 3;2 and 3;6 the average frequency is 11.2 while in the third stage between ages 3;7-3;8 the average frequency is 2.5. The stages of word per utterance ratio match these stages: 3.2 in the first stage, 4.5 in the second stage and 5.3 in the third stage. The child creates more clusters in the second stage as there are more words per utterance. However, in the third stage where fewer errors occur overall in the child's speech, even though there are more words per utterance, fewer clusters are created by consonant epenthesis.

The evidence presented in this chapter implies that the child, through the process of erroneous epenthesis, practices her singleton consonants in the context of consonant sequences/clusters during phonological development. The findings here may contribute in evaluating child speech in development and in helping phonologically delayed children to improve.

CHAPTER 7
SUMMARY AND CONCLUSIONS

In this dissertation, the phonological development of a female child's L2 English in bilingualism was examined. The study was based on digital recordings of the child's speech during daily interactions with the author, the child's mother, from age 2;7 to age 4;0. English is the interlocutor's second language and Greek, the child's other language, is the interlocutor's native language. The child was born and raised in Chania, Greece from birth till the end of the study. The child's input in English came exclusively from the author from age 1;0 to age 3;5, when the child started participating in an English speaking playgroup four hours weekly. Her Greek input came mainly from the child's father who is native Greek until she started attending day care in Greek five days a week at age 2;0.

The present study employs a multifaceted perspective that includes: a narrative account by the author/participant with illustrations and vignettes as evidence of the child's linguistic behavior and experience in language learning and use which is a recognized practice in qualitative research (e.g. Merriam, 1998); a theoretical interpretation of the child's qualitative speech data; and an interpretation of the child's quantitative speech data. Such a utilization of mixed methodologies (Duff, 2012) is in line with current trends in language research methodology that combines a 'soft' approach that is 'qualitative and interpretive in nature' and an approach that is 'hard science-like and mathematical … characterized by the use of different ways of quantifying data' (De Bot, 2011:127).

The child's speech in English and Greek was orthographically and IPA phonetically transcribed by the author and entered by the author in a CLAN (MacWhinney, 2000) database, where it was also coded in order to enable easy access to the recordings and make feasible tens of thousands of computations. The focus of the dissertation was on the development of consonants, their acquisition level and substitution patterns, even though reference was also made to the child's vocabulary size and length of sentences.

This dissertation sets a precedent in naturalistically acquiring a language in bilingualism through second language exposure in an exogenous environment. A distinction has been made in the literature between conscious learning involving active metacognitive processes that relate a learned system to an acquired one (e.g. Krashen, 1987; Reber, 1993) and unconscious acquisition of language through naturalistic exposure whereby both implicit and explicit learning occurs focusing on semantic and functional aspects of the language, respectively (Krashen, 1987; Weinert, 2009). During acquisition, the learner focuses on meaning rather than on monitoring grammar in an active and conscious manner. Although the child in this study was actively aware of the two languages present in her environment (§3.4.2), she was not actively conscious of acquiring any particular grammar but rather focusing on meaning during her naturalistic interactions with those in her environment, something that is true for both her L1 and L2.

Evidence of this comes from the fact that despite her ability to translate between the languages (§3.4.4), her productive vocabulary (see, for example, tables 4.3 for English and 4.4 for Greek in §4.3.1) is grounded on the principle of mutual exclusivity, that is, new words refer to new referents (e.g. Markman, Wasow, & Hansen, 2003) and further supports the 'competition model' (e.g. Bates & MacWhinney, 1987) which postulates that the bilingual child learns individual words independently rather than through a translation route whereby the L2 word is added as a subsequent token of the L1 referent-token. In short, the distinction between *naturalistic acquisition*, on one hand, and *learning based on metacognitive processes of analysis*, on the other hand, only makes sense for individuals that have passed the 'critical period' (Penfield & Roberts, 1959; Lenneberg (1967) in language acquisition and are, thus, expected to already have linguistic knowledge and experience as well as metacognitive skills, but does not apply to ordinary infants and toddlers whose metalinguistic ability, at least with regard to phonemic contrasts (e.g. Gierut, 1996), is insufficient.

Acquisition of a second language in the circumstances described in this study (see §3.4) makes a vivid illustration in support of the logical problem of acquisition, or Plato's problem (see §2.1.3), whereby there is prompt acquisition of language (or phonology, in particular) in spite of limited input. The author was the sole source of English input to the child since her first birthday to age 3;5 (§3.4.1-3); the author/mother's interlanguage and the transfers found in her English consonantal inventory were shown in section §4.2. Nevertheless, the maternal scaffolding that enabled acquisition of the second language has been in agreement with general parental practices found during acquisition of a first language, such as the employment of 'motherese' (Newport, 1976), positive and negative input (Marcus, 1993), as well as, with those employed in dual language acquisition, such as the 'Grammont rule' (Ronjat, 1913) (§3.4).

The child's first data at the age of 2;7, presented in chapter 3, have adequately demonstrated the child's linguistic performance in both languages in terms of: word tokens-to-utterance ratio (TUR) with the L1 leading the way; lexical repertoires with a total of 857 word types in both languages that exceeds the number in the English monolingual norm; an MLU in English that is near Brown's Stage III for ages 2;7-2;10; and detailed phonetic inventories per language that are largely comparable to those found in the respective monolingual acquisition. Already at 2;7, the child has an estimable command of phonology: out of the 317 English and 540 Greek word types, 127 and 181 of them respectively are produced correctly. Also, there were a total of 1,516 English and 2,374 Greek word tokens out of which 665 and 1,057 of them respectively were produced correctly.

The analysis of the data longitudinally also demonstrates, by and large, the child's increasing skill both in terms of ease in language use and articulatory maturity. When calculating TURs for the 17-month period covered by the study, it is found that there is a considerable increase in these ratios over the length of the study. At age 2;8, the child has 2.02 tokens per utterance in English and 3.68 in Greek while at age 4;0 she has 6.77 in English and 6.50 in Greek (see §3.5.5 and Appendix A). This means that by the end of the study the child uses English with the same ease as Greek. It is seen that language is naturalistically acquired in bilingualism through second language exposure in an exogenous environment because, for language acquisition to occur, input like an ‘originating force’ acts like a stimulus that produces a response (Skinner, 1938:51).

We know, however, that it is both environment and genetics that interact to produce and process language (Skinner, 1938; Piattelli-Palmarini, 1980; Chomsky, 1981; Locke, 1990; Chomsky, 2007). The assumed automaticity in language acquisition involves innateness, i.e. a component of linguistic knowledge in the human mind’s genetic make-up, what Chomsky (1966) calls the ‘mental organ’ or, in strict linguistic terms, ‘universal grammar’ (UG). This human faculty constrains many aspects of language enabling universal characteristics cross-linguistically. The present study provides further support of innateness in language acquisition by demonstrating that the presence of environmental stimulation, even in less ordinary circumstances, does produce ordinary results. This has been shown both in terms of linguistic behavior as qualitative evidence, as well as in strictly linguistic terms. As shown in section §3.4, the child exhibits linguistic behavior that is similar to that of other monolingual and bilingual children, such as a period of silence; adherence to universal milestones regarding the onset of speech for monolingual and bilingual children; language choice and preference in bilingualism based on reference group; interference; code-switching and a tendency to lapse to dilingualism further supporting claims that bilingualism is a state in flux and that there is a ‘principle’ of ‘complementarity’ (Grosjean, 1989), whereby the languages in bilingualism are acquired for different purposes, with different people and in different situations.

Proof of innateness and thus universality in the child’s acquisition of English is found equally strong in the quantitative aspects of the data: her MLU in English is near Brown’s Stage III for ages 2;7-2;10 (§4.3). Her cumulative (for both languages) vocabulary count in the first month of the study also provides evidence of universality in bilingual language acquisition (§4.3.1). A comparison of Maria Sofia’s languages at 2;7 in terms of the proportion of consonants to vowels provides evidence for a pattern universally found cross-linguistically (e.g. Nespor, Peña & Mehler, 2003), whereby the proportion of consonants to vowels in stress timed languages (like English) is larger than that in syllable timed languages (like Greek). Additionally, the child’s pattern of cluster creation by consonant epenthesis, discussed in chapter 6, sheds light into a phenomenon observed in the developmental speech data of other normal or phonologically disordered children – also a sign of universality.

Additionally, there is proof of universality of principles and patterns in the development of consonantal sounds, i.e. in terms of acquisition stages and milestones, the order of phoneme appearance, substitution patterns, alignment constraints and in terms of implicational hierarchies. Specifically, with the exception of /h/ and /ɹ/ in English and [ʎ] in Greek, the child has acquired the full consonantal inventory in both languages by age 4;0 - an age milestone found to apply universally, with few exceptions subject to markedness and individual child variation (Ingram, 1989a).

Compared to monolingual norms, Maria Sofia's individual consonant performance at age 2;7 is ahead in the level of acquisition of English /p, b, m, s, z, n, l/ and behind in English /-d, ɹ, k, g, w, h/. It has also been shown that the child's phonological systems are at the beginning of the third intermediate stage of phonological acquisition. With the exception of her velars (and palatals) lagging behind, the child's level at 2;7 is, by and large, in accordance with monolingual norms, and slightly better for some of the sounds in English. This child's hierarchy of place markedness based on her quantitative productions, underlyingly characteristic of her progress in both languages, is: LABIAL < CORONAL < DORSAL [-back] < DORSAL [+back] < GLOTTAL. This pattern of consonantal acquisition emphasizes the child's adherence to the universal Front < Back (Jakobson, 1941/1968) contrast both during the first month of the study as well as longitudinally until age 4:0. Her delay in the acquisition of [back] sounds, i.e. the velars and the glottal fricative, contrasts with English monolingual norms but matches Jakobson's universal whereby sounds articulated in the back of the oral cavity will be acquired following acquisition of more anterior sounds. This is established here quantitatively and is in spite of other propositions that have been made in the literature (see §4.4.3.1) in the post-Jakobson era with regard to a universal [place] markedness hierarchy.

The child's data provide further support for universals with regard to first maximal binary contrasts i.e. VOICELESS < VOICED and STOP < CONTINUANT (Jakobson, 1941/1968; Dresler, 1998), since [Labial, -continuant +voice] has been acquired at age 2;7 in both languages, 93% in English and 94% in Greek. Also, the data support Dinnsen's (1992) generative model of feature development, whereby liquids are divided in the final stages of development into [+lateral] for /l/ and [+central] for the rhotics, the latter being the more marked feature. Additionally, universal alignment constraints, whereby [-continuant] attaches to the left edge and [+continuant] attaches to the right edge (e.g. Ferguson, 1978, Kappa, 2000), apply to the child's production of consonants as, for instance, English /d/ performing much better in word initial position (92%) than in word final position (40%) and /s/ performing better in word final position, 90% in English and 89% in Greek, than in word initial position, 77% in English and 54% in Greek.

Universality in her acquisition of both languages, and especially of English, is additionally evidenced in the substitutions of developing consonants and in the deletion patterns. The data show that common consonant targets across the two languages exhibit common substitution patterns, the distinct majority of which are the monolingual norms in developmental patterns in each language, such as /θ/→[s, ʃ, t, f], /ð/→[d, t, n], /k/→[t], /g/→[t, d, ʤ]. Less common substitutions may or may not be attributed to interference between the two languages in bilingualism. On the one hand, [l] is the dominant substitution for /ð/ in both languages contrary to the monolingual substitution norm [d, t], in both languages. On the other hand, [l] being the dominant substitution for both the English rhotic and the Greek rhotic is the monolingual Greek norm but not the monolingual English norm, [w]. Also, [s] for English /f/, one of the child's dominant substitutions, is not the monolingual

English norm. These, nonetheless, have been reported in the literature of monolingual development as either relatively infrequent universal substitutions or as language-specific universals (e.g. Ingram et al., 1980; PAL, 1995; Bernhardt & Stemberger, 1998).

Further evidence of universality in the child's substitutions is found when they are compared to adult L2 speech from different L1s. For example, [l] which is the child's dominant substitution for /ð/ and /ɹ/ in contrast to English monolingual norms is attested in adult L2 English speech from L1 Chinese and Japanese. Also, the child's developmental substitutions for /θ/ in both English and Greek, [s, f, t], match substitutions of adult L2 English speech from different L1s, such as Dutch and French (Brannen, 2002; Weinberger, 2013). This provides a perspective on developmental adult L2 speech, in general, where the effect of the proficiency level of L2 speakers on substitution patterns, longitudinally, is not known and needs to be investigated.

The child's substitution patterns with regard to both common and different consonant targets in the two languages abide to universal phonological processes like: fronting, e.g. /j/, [ʝ]→[ʒ], [ɫ]→[l], /k/→[t], /g/→[d]; stopping of fricatives, e.g. [ʝ]→[t], /θ, ð/→[t]; word-final devoicing, e.g. /d/→[t], /z/→[s]; laminalization of alveolars, e.g. /s/→[ʃ], /z/→[ʒ], /θ/→[ʃ]; spirantization, e.g. /w/→[v]; as language-specific universals, i.e. /ɹ, ɾ/→[l]; (e.g. Velten, 1943; Ingram 1974a, Stampe, 1979; Ingram et al., 1980, 1989; Smit, 1993a; Bernhardt & Stemberger, 1998; Magoula, (2000); vocalization, e.g. [ɫ]→[ə] (e.g. Leopold, 1949; Smith, 1973) and, lastly, consonantal harmony, CH, as in /j/, [ʝ]→[l], /v/→[m], etc. (e.g. Smith, 1973; Menn, 1978, Stemberger & Stoel-Gammon, 1991, etc.).

With regard to CH, various place markedness rankings have been reported in the literature for different languages, but this child's data show evidence of universality in terms of preferred directionality in lateral and nasal assimilation (e.g. Ladefoged, 1993), as in *yellow* [leloʊ] in Maria Sofia's speech. Deletions of consonants in both languages are also subject to universal rules and patterns as, for example, faithfulness ranking low in word- and syllable-final positions, in weaker syllables of larger phonological words such as function words, in unstressed syllables (e.g. Grunwell, 1981b; Bernhardt & Stemberger, 1998) and in cluster contexts. This is the case for /f, v, t, d, θ, ð, n, l, ɹ, w/→[Ø] in the child's data. Lastly, universal phonological processes, such as harmonies, coda devoicing and deletion evidenced in the child's speech are age appropriate and occurring as in monolingual norms.

The child's substitution patterns are in agreement with Prince & Smolensky's (1993) universal place markedness hierarchy whereby [Dorsal] is more marked than [Labial] which in turn is more marked than [Coronal]. Her overall substitution patterns adhere to the coronal place of articulation. Exceptions are /v/ and /w/ which adhere to labial place and /θ/ which is substituted by [f] near complete acquisition. Coronals /θ, ð, d, z, ʃ, ʧ, ʤ/ retain place of articulation while the palatal approximant, /j/, velars, /ŋ, ɫ, k, g/ and the glottal, /h/, become coronals as well. During development /v/ is substituted by [f], while near complete acquisition by [w]. All along development, [v] is the only substitute of /w/, adhering to the target's secondary place of articulation. The English rhotic is substituted by coronal [l] and labials [v, w], retaining both its primary and secondary places of articulation, unlike /w/ which is substituted by [v], adhering to its labial place of articulation.

The child's frequency of substitutions is generally lexically dependent as well as word-position dependent. For example, at 3;9, substitutions persist for /θ/ in words that have the lateral to the right of /θ/ as in /θelo/ and /kaθolu/ but not to the left of /θ/ as in /aliθia/→Adult [aliθça] and in /kolibiθɾa/, in which /θ/ is produced correctly even though it occurs in a consonant cluster. This preferred directionality may be observed in other children's data with regard to regressive consonant harmony, in general, that includes assimilation to the lateral. Moreover, there are substitutions that occur exclusively in words that are frequent in the child's speech as, for example, [w] in *very* and [n] in *the* and *this* in English, and [n] in *θα* in Greek, meaning the auxiliary *will* in English.

For the first time in the literature, this study created a multi-dimensional yardstick for comparing a child's speech performance across two languages given their differences in word length, word complexity, grammatical forms and in phonotactic rules which permit different consonants, common consonants in different word positions and different consonant clusters. The comparison determines on a quantitative basis the stronger language in bilingualism and the degree of differentiation/separation of the two languages.

The qualitative interpretations made by the author through emic narrative in (§3.4) that English at age 2;7 is the L2 language in the child's bilingualism is supported by the quantitative analysis of the data. Vocabulary size, average length of sentences (ALS), mean length of utterance (MLU) and phonological mean length of utterance (PMLU) are lower in English. However, comparing whole word correctness, cumulative consonant correctness or individual consonant correctness across two languages is not straightforward as there is language differentiation at many levels: word syllables, consonant proportion, consonant singletons, consonant clusters, and consonant word position which is evidence of two phonological systems in the child's bilingualism.

The child's English is better in whole word correctness, overall, because English has more monosyllabic words than Greek. English is also better in multisyllabic singletons because it has less three- or more-syllable words than Greek. The child performs better in Greek monosyllabic words because they have fewer consonant clusters in word final position.

Regarding cumulative consonant performance, word final, word initial and word medial positions rank in this order in both languages. Comparing performance between the two languages, Greek is better in every word position. However, because the proportion of consonants in final position is much higher in English than in Greek, while in medial it is lower, the end result is the child's similar performance in the two languages, cumulatively, in all word positions.

Comparing cumulative consonant performance between the two languages only for consonants that are common in the languages, it was found to be similar in word initial and word final positions but much better in Greek in word medial position, where consonants cannot be followed by a word final consonant creating a cluster, contrary to English.

Individual consonant performance at age 2;7 shows that the child has acquired labials and coronals in both languages except for /θ, ð, ɹ, ɾ/. She has not acquired palatals or velars in either language except for [ɲ], nor has she acquired the glottal fricative, /h/. Comparing with monolingual norms, the child is ahead in the level of acquisition of /p, b, m, s, z, n, l/ in English and behind in /-d, k, g, w, h/. In Greek, the child is behind in velars and [c], /-f-/ but at a similar acquisition level in the remaining consonants.

Comparing the acquisition and substitution patterns of individual consonants between the two languages at 2;7, there appear to be some substantial differences. Most of these differences, however, disappear if the comparison takes into account consonant word position, consonant singletons and consonant clusters.

Only the acquisition levels of /f-/, /v/ and /l-/ remain substantially different between English and Greek with Greek being higher, as well as the substitution /z/→[ʒ], which occurs only in Greek even though /ʒ/ does not exist in the Greek language and it is not targeted in the child's English speech. With regard to similar phonemes, /j/, [ʝ] as well as /ɹ, ɾ/ share [l] as their main substitution pattern and /h, x/, [ç] have [s] and [ʃ] as their main common substitutions. On the other hand, although the similar phonemes /w, γ/ share [v, l], they do so in very different proportions that result from different phonological processes. /w/ mainly becomes [v] and /γ/ mainly becomes [l], systemically, in accordance with monolingual development, while their smaller proportions result from assimilations. The only difference in singleton deletions between the two languages is /θ/ deletion in Greek, but it only occurs in the function word *θα* /θa/, meaning *will* in English.

At 2;7, substitution patterns are by and large similar in the two languages in that labials substitute labials except for /f/, which is substituted by [s], and coronals substitute coronals, velars and the glottal, except /w/, which is substituted by [v] being faithful to its secondary articulation. When compared to monolingual norms, the child's substitutions at 2;7 show individual variations in the patterns /ð, ɹ, j/, [ʝ] → [l] and /f/→[s] in Greek. The latter exists also in her English but it is not common between English monolinguals.

Evidence of differentiation between the child's two phonological systems also comes from the production of word final consonants in English that are not permitted at word final position in the Greek language. The consonants and their proportion of correct productions at word final position in English are: p, b, f 100%; m 88%; v 38%; t 86%; d 40%; z 64%; ʧ, ʤ 67%; ʃ, l, ŋ 50%; ɹ 7%; k 5%. Besides correctly producing these consonants at word final position, the child also tries to produce them unsuccessfully by substituting them with consonants other than s or n which are permitted at word final position in the Greek language. The proportions of these substitutions to targets, not including deletions, are: d 39%, ɹ 33%, k 84%, g 91% which also shows that the child differentiates the phonological systems of the two languages.

Further evidence that the child differentiates/separates the phonological systems of the two languages at age 2;7 comes from her production of consonant clusters that are language specific, that is, consonant clusters which are permitted in one language but are phonotacticly restricted in the other language. These consonant clusters in English are: sm, sn, nt independent of word position and st, ts, nt, nd, nz, nts, ld, ps, ɹz at word final position. In

Greek, the consonant clusters that the child produces that are not permissible in English are ps and ft at word initial position.

For the first time in the literature, the present dissertation establishes the developmental path of individual consonants both in terms of their acquisition level and substitution patterns. This is done by examining the child's average monthly performance in individual words as well as cumulatively in all the words containing the consonant. Two stages in development were identified between ages 2;7 and 4;0; the cyclic and the progressive. In the cyclic stage, a consonant's acquisition level repeatedly increases and decreases but overall remains constant. In the progressive stage, it increases until complete acquisition following a single or double S-shaped curve, a curve that also describes other growth phenomena in human biology.

Overall, the cyclic stage represents a plateau in the acquisition level of consonants during development whose length and depth may be associated with the length and depth of the well known U-shaped model of phonological and linguistic development that has been discussed qualitatively in the literature. However, even though the quantitative results of the present thesis support progression in a U-shape development of a consonant's acquisition level, they do not provide evidence of regression, comparable to the height of progression. It cannot be known whether regression would have occurred at earlier stages in the child's development; such evidence has not been given quantitatively in the literature for any child.

Progress in the acquisition level starts between ages 3;4 and 3;6 for all consonants in development. Substantial increases in the acquisition level of consonants coincide with a substantial increase in the average length of sentence, that is, the words per utterance ratio. The acquisition levels of voiced consonants start progressing earlier than those of the voiceless consonants. Specifically, the acquisition levels of word initial /ð/ and word final /g/ start progressing earlier than those of word initial /θ/ and word final /k/, respectively, while the acquisition levels of word initial /k, g/ start progressing at about the same age.

The progressive stage lasts about five months until complete acquisition, when the acquisition level is 90% or higher. Word initial /ð/ is completely acquired earlier than word initial /θ/ in contrast to word initial /g/ which is completely acquired later than word initial /k/. The dependence of a consonant's acquisition on its word position was also determined. Voiced /v/ is acquired earlier in word initial position, which has been claimed to be perceptually more prominent than other word positions, in agreement with the general principle that markedness occupies psycholinguistically prominent positions. Except near complete acquisition, word final /θ/'s acquisition level is higher than word initial /θ/'s, in agreement with the word alignment constraint whereby continuants align to the right edge of the word and stops align to the left. In line with this contraint, word initial /k/ is acquired earlier than word final /k/. In contrast, word initial /g/ is acquired later than word final /g/ due to the fact that the child's word final /g/ is not involved in clusters and is involved only in few monosyllabic words.

The comparison of a consonant's acquisition level across two languages during phonological development, whether in bilingualism or not, is not straightforward. There is language differentiation at many levels as was demonstrated for the development of the child's voiceless interdental in English and Greek. Even if the words selected for comparison are equivalent in terms of length, consonants' proportion, types of clusters, and the consonants' word position, which would be extremely difficult to accomplish, there are additionally individual words whose production is frozen in the language. However, consonant performance on a cumulative basis across a large number of words in each language, as was done in the present study, gives a fair evaluation of the acquisition level in each language.

The child's acquisition level of consonants during development compares well with the monolingual English norm. She is ahead in the acquisition of /p, b, m, v, s, z, n, l/, behind in /k, g, w/ till 3;11, and ahead in the acquisition of the interdentals starting at 3;7, but not before then; her word initial interdentals compare well to the monolingual Greek norm. The rest of the consonants are acquired at about the same age. However, the rhotic and the glottal fricative only reach a level of acquisition of 15% and 60%, respectively, because of frequent transfer of the Greek rhotic in place of the English rhotic and of the Greek [x, ç] in place of the English /h/, partly due to ambiguity in the input from the mother's L2 English. Compared to the monolingual Greek norm, Maria Sofia's /s/, word initial /z/, word initial /v/, word initial /l/ are acquired earlier, while word initial velar /k/ and word initial palatal [ç] are acquired later; a Greek norm is not available for the acquisition of word initial /g/. The rest of the consonants are acquired at about the same age.

One could question whether the results reported in the present study in reference to word position are valid since it is known that word boundary effects play a role in the production of segments at word-initial and word-final positions in running speech. However, the data considered was of such large size that the effect of the phonological environment outside the word does not substantially change the word-initial or word-final quantitative results. Exceptions are function words which were dealt with separately in the analysis, whenever they had consistently singular performance compared to words containing the same consonant as them.

The frequency of a segment's transfer from an L1 to an L2, as was shown for L1 Greek [ç] substituting L2 English /h/ during the segment's acquisition in the L1, sets a precedent in *developmental transfer*. During its development, [ç] transfers as such but it also transfers its substitutions [s, ʃ]. This is evidence for generalizing the definition of transfer and interference in child bilingualism which, up to now, only involves segments produced as targeted in one of the two languages.

The child's main substitution patterns during development overall adhere to the coronal place of articulation. Exceptions are labials, either in primary or secondary articulation, which are substituted by labials, either in primary or secondary place of articulation, and the coronal /θ/ which is substituted by [f] near complete acquisition. The English rhotic is substituted by the coronal [l] and labials [v, w] retaining both its primary and secondary places of articulation, unlike /w/ substituted by [v] only adhering to its secondary labial place of articulation. The substitution patterns, in agreement with Prince & Smolensky's (1993) universal place markedness hierarchy, also remain faithful to the manner of articulation of the targeted consonant: stops remain stops and continuants by and large remain continuants. This is exemplified by the substitutions of the interdental fricatives, /θ/ and /ð/, which are mainly [s] and [l], respectively, during most of the development rather than [t] and [d], most commonly observed in monolingual norms.

In the present thesis, for the first time in the literature, individual substitutions are measured in relation to all substitutions and not to the targets. This enables identification of substitution patterns even near complete acquisition where substitutions are few and would, otherwise, go unnoticed. It was found that the child's substitution patterns generally go through two phases during development. The first phase coincides with the cyclic stage and, for most consonants, goes past it approaching complete acquisition when the pattern discontinuity occurs. However, it is only the discontinuity in the substitution patterns of the interdentals that is found not to be the result of articulation maturation or language interference with the child's other language. In the second phase, [d] substitutes /ð/ taking over from [l], the overwhelmingly dominant substitution in the first phase, and [f] substitutes /θ/ taking over from [t]. The discontinuity in the substitution patterns of the interdentals cannot be explained by markedness theories, such as optimality theory, that views development proceeding linearly from the less marked to the more marked through the promotion and demotion of constraints.

In contrast, the discontinuity in the substitution patterns of /ɹ, v/, [w] occurring for the first time at 3;6, is the result of articulation maturation of /w/. Moreover, the discontinuity in the substitution patterns of the velars /k, g/ and the glottal fricative, /h/, is both the result of articulation maturation in the child's other language and interference between the two languages. Near complete acquisition, [c] transfers from L1 Greek and takes over from [t] as the main substitution of /k/, [ɟ] transfers from L1 Greek and takes over from [d, t] as the main substitution of /g/, and /x/, [ç] also transfer from L1 Greek and take over from [s] as the main substitutions of /h/. Therefore, the development of consonants is nonlinear in both their acquisition level and their substitution patterns.

Assimilations persist till age 3;11, occurring within the word, in word boundaries, and outside the word in the whole utterance, either in priming or in anticipation. During most of the development, the child's assimilations are to the labial and coronal place of articulation, contrasting partly the English norm in the literature where labials and velars trigger assimilations, though in Greek a preference for assimilation to coronals has been reported. The child's labial assimilations are exemplified by /v/ assimilating, in anticipation, to its partly homorganic nasal /m/ contained in another word that follows in the utterance; [nasal] spreading from right-to-left in consonant harmony within a word has been known to occur.

Near complete acquisition, the child's velars also trigger assimilations following their acquisition.

Word-final deletions also persist in the child's speech till age 3;11 in disagreement with the monolingual English norm where deletions wane by age 3;0 but matching the age of the Greek norm whereby word final deletions persist till 4;6.

The creation of consonant sequences/clusters by epenthesis at word/utterance initial position was also examined in the child's English speech, a phenomenon occurring in normal and phonologically disordered children as well as in adults, cross-linguistically. However, it has been scarcely reported in the literature for child speech development and has not been analyzed or understood. The compound term sequences/clusters, simply referred to as consonant clusters here, includes both the commonly called 'consonant clusters' and 'consonant sequences', such as pre-nasalized consonants.

A detailed quantitative and qualitative analysis reveals that the child's creation of consonant clusters by epenthesis is lexically independent and that most of them occur between 3;2 and 3;6 during the cyclic stage. Reduction in their frequency of occurrence coincides with a substantial increase in the child's overall phonological progress including the acquisition level of consonants and the average length of sentences.

The great majority of the epenthetic consonants have been completely acquired by the child. The minimal consonantal system [p, m, t] which was completely acquired by age 2;7, in two thirds of the occurrences in epenthesis, is affected in assimilation by the phonological environment outside the consonant cluster, within the word, the utterance, or in the child's or interlocutor's previous utterance.

The targeted consonants which in their great majority are either completely acquired, or marginally acquired, are produced in the cluster's second position as when they are not added to. In two thirds of the occurrences, the epenthetic consonant is not a substitute of its cluster neighbor or its neighbor's targeted consonant. The rate remains the same when epenthesis is affected by the phonological environment outside the cluster.

Only one third of the cluster types and fifty per cent of the cluster tokens are permitted in English or Greek, the child's other language. The sonority distance between cluster consonants is large, on average three, when the created cluster is permitted in English, while it is small, on average one, when it is not permitted. This finding remains unaffected when epenthesis is influenced by the phonological environment outside the cluster. The child's large sonority distance between the consonants in her created clusters that are permitted in the English language is in line with that in monolingual English children's targeted clusters during phonological development.

In only twenty five per cent of the created clusters, the epenthetic consonant is influenced by another consonant within the word in which it occurs; in two thirds of them by anticipation and in one third by metathesis. In about half of the created clusters, the epenthetic consonant is assimilated to a consonant outside the cluster; fifty per cent of the times in anticipation to another consonant in the utterance and forty per cent of the times in priming another consonant in the child's or interlocutor's previous utterance.

In two thirds of the created clusters, the two consonants in the cluster have the same voicing, either voiced or voiceless. In about half of the created clusters, this is the only common articulation feature between the consonants and in the other half they are homorganic as well.

Through the process of erroneous epenthesis, the child practices her singleton consonants in the context of consonant clusters during phonological development. Although the frequency of occurrence of the phenomenon is low, which explains why it is not usually discussed in the literature, it is a developmental norm that needs further investigation in other children.

Next, the ardently discussed issue in the field of phonological development of whether a child (or learner in general) acquires phonetics or phonology will be dealt with in relation to Maria Sofia's bilingual phonological development. Under the innateness assumption, children gradually acquire a system of phonemic and phonetic contrasts that is known to have universal application cross-linguistically. The two-lexicon model in child phonology accounts for development of phonology on many levels, i.e. input and output representations and articulatory maturation (Ingram, 1974a; Macken, 1992), agreeing with the generative viewpoint that, what is acquired, is abstract phonology through universal grammar (UG) from the beginning. A consideration of phonology (theorizing) relies on a consideration of phonetics (evidence) and the two are inter-related (Bernhardt & Stemberger, 1998). However, neither the presence of phonology in the absence of phonetics nor the exact level of phonological competence in the presence of phonetics is easily determinable by looking at the interface between phonology and phonetics alone.

It is equally valid to recast the question in terms of order of acquisition: 'which one leads the way in acquisition: phonology or phonetics?' We know that both are present early on in life. Even within the first year, children exhibit an array of phonetic realizations, including productions that do not exist in the phonetic inventory of the language(s) they are exposed. These short-lived articulatory gestures are mechanical productions void of any abstract grammatical substance. Infants are also known to have categorical perception and to be able to discriminate prosodic differences and sound contrasts in speech early on, eventually becoming more sensitive to the distributions and statistics of the specific language(s) they are exposed to. Whether, though, the two interact very early on in life or, if they do, at which point this begins has not been determined in the literature. Answering this question entails research in infant neuro-linguistics, similar to work done on 'the language learning brain' (Beretta, 2009) with respect to adult L2.

Children's ability to put phonetics and phonology together in order to produce *adult* speech is concomitant with their general physiological growth, including neurological foundations, brain maturity, categorical perception, as well as, articulatory and acoustic skill. What the child acquires is *language*. In other words, both phonology and phonetics are being acquired together with other aspects of language, like vocabulary, morphology and syntax. Because language itself is a system of many parts and each module is in charge of specific facets of the system (Bernhardt & Stemberger, 1998), a multi-planar viewpoint is necessitated. Based on the input a child receives, what is being gradually acquired is *aptitude* in all aspects involved in language production, which, of course, includes ability to comprehend speech, make phonemic distinctions and articulate them.

These points are believed to hold for Maria Sofia as well, in light of the evidence present during her bilingual acquisition of English and Greek. Evidence of 'passive control' of phonological features (Ervin & Miller, 1963), whereby the child is able to hear phonetic contrasts but not produce them, shows that at least certain aspects of phonological awareness precedes articulatory skill. Proof of this in Maria Sofia's data comes, among other instances, from the following dialogue between author/interlocutor and child participant (2;12.24 WS310279):

Author/interlocutor:	how about some grapes?
Child participant:	yes, I want some [deɪps].
Author/interlocutor:	ok, I'll go bring some *dapes*.
Child participant:	not *dapes*, mammy! [deɪps]!

The ability to hear the phonological contrast provides proof of the child's phonological competence, however limited or indeterminable, in ascertaining that the interlocutor's *dapes* is not the same as *grapes.* The same is found to be true in at least 24 instances of the child's English developmental productions being homonymic (others are also found in Greek), whereby she uses the same production token for different targeted words. Examples include: [vet] for *red & wet*, [bɛdɪ] for *birdie & beddy*, [su:z] for *whose & shoes*, [tʰaʊn] for *down & town*, [fʌn] for *one & fun*, [wʌn] for *run & one*, [steas] for *squares & stairs*, [lʌɸ] for *love & laugh*.

The qualitative and quantitative analysis of Maria Sofia's bilingual speech data also points towards the presence of phonology in the phonetics of her acquisition. This has been exemplified in terms of: the presence of phonological universals; the order of phonemic and phonetic acquisition; the variability of substitutions in both languages based on well-known phonological processes; the agreement to monolingual norms and milestones (e.g. acquisition of most consonants by age 4;0); and the presence of stages in her longitudinal development as proof of the simultaneous interplay of phonetics and phonemics in progress.

Given the special circumstances in this child's acquisition of English in bilingualism, it is also pertinent to ask whether the child acquires English phonetics and phonology. That the child acquires a differentiated phonological system per language was shown in the multi-faceted analysis of chapter 4 in terms of several factors at play, such as the length of the word, the presence of singletons and clusters, lexical dependence, the prosodic position as well as morphological and phonotactic considerations. Her delay in the acquisition of English

/ɹ/ and /h/, however, may be misinterpreted to mean inability to completely acquire these sounds phonemically or phonetically, or both. However, both the child's phonetic and phonemic skill with regard to these sounds is demonstrated by their presence per se in her English phonetic inventory, by the presence of the monolingual norm in their substitutions e.g. Maria Sofia's /ɹ/→[w], as well as, by instances of produced interference in her L1 Greek, i.e. /ɾ/→[w], /x/→[h] during the span of the development. Examples of interference in Greek are: *ξέρεις* /kseɾis/→[tseɹis], *πάρω* /paɾo/→[pawo], *χεράκι* Adult [çeɾaci]→[seɹatsi], *μέρα* /meɾa/→[mewa] and *χώμα* /xoma/→[homa], *προσέχω* /pɾosexo/→[poseho], *χάρτης* /xaɾtis/→[hatis], *έχω* /exo/→[eho]).

The delay in the acquisition of /ɹ, h/ may be accounted for by the ambiguity in the maternal input being undermined in terms of quality and quantity delaying the path of their development; this is in agreement with Cognitive Theory, whereby levels of representation in the child's lexicon have been discussed in terms of single and double lexicons, overall postulating that children have adult-like underlying representations (URs) in their lexicons (Smith, 1973; Ingram, 1974a; Kiparsky & Menn, 1977; Stampe, 1979; Macken, 1980b). Proof comes from the fact that by age 5;0, Maria Sofia produces /h/ correctly with no instances of transfer, following exposure to some native input as well as reading instruction for about a year. However, her production of /ɹ/ to the present day (age 7;1) still oscillates between [ɾ] and [ɹ], both produced randomly as well as on discretion. /ɹ/ being a marked consonant even in monolingual English development (not fully acquired before age 8 by some children) is either still in development in Maria Sofia's English speech or simply fossilized at a state of being partly used. Evidence of a separate underlying representation for /ɹ/, rather than free allophony whereby /ɹ/→[ɹ, ɾ], comes from Maria Sofia's occasional use of /ɾ/→[ɹ] in her Greek; this use is not a sign of interference between her two languages because, on all occasions, it is done purposefully and the child has classified her production of it as being English.

Moreover, it is of interest to mention that the non-acquisition of skill in phonology alongside phonetics may be the result of the child's erroneous underlying representation, as is the case of [ʎ] in her Greek - an independent phonemic misinterpretation that would have occurred even if the child was not bilingual. [ʎ] is produced in her Greek speech at a very low rate (about 15%), is mostly always substituted by [j] and is fully acquired at about age 6;0. For instance, *μαλλιά* (hair) /malia/→ Adult [maʎa] is developmentally produced by the child as [maja]; Adult [ʎ] → Child [j] is a developmental norm in monolingual Greek. Complete acquisition of [ʎ] coincides with the beginning of her formal education in Greek, whereby familiarization with Greek orthography leads to the realization that the key constraint in producing [ʎ] lies in [+lateral]. Once [lateral] becomes contrastive for Maria Sofia in this context with the aid of orthography, she asks: 'Does this mean we also say [ʎaʎa]? [ʎaʎa] refers to targeted *γιαγιά* (granny) /ɣiaɣia/→ Adult [jaja]→Maria Sofia's [ʎaʎa]. Her overgeneralization of the newly acquired contrast to apply in the case of the substitution [j] she was using for [ʎ] implies her original erroneous representation of /li/→

Adult [ʎ] → Maria Sofia's [j], which did not involve [+lateral]. Once the phonological contrast is made, articulatory skill in producing [ʎ] followed automatically. The kind of evidence shown here with regard to the production of English /h/ and Greek [ʎ] shows that metacognitive ability, as in instructional learning, facilitates phonological skill. Habit and articulatory ease as a result of articulatory practice in the production of sounds may also play an important role in correctly producing them.

This kind of evidence inspires an optimistic outlook on successful ultimate attainment in adult L2 speech given that both perceptual and articulatory constraints are dealt with; this could well be the result of conscious learning, as in formal instruction.

The present study has not only shown qualitatively that the child has differentiated/separated her two languages by age 2;7, but it has also shown the degree of differentiation/separation of the two languages. The child's average length of sentence and the mean length of utterance are well below in English: 2.0 and 2.3 in English vs. 3.7 and 4.5 in Greek, as Greek is a morphologically richer language and this is reflected in the child's speech as well. The proportion of consonants to vowels is 1.30 in English and 1.02 in Greek reflecting the fact that English is a stress timed language while Greek is a syllable timed language thus containing a larger proportion of spoken consonants than vowels. The Greek language has mostly bisyllabic and multisyllabic words and this is also differentiated in the child's speech at 2;7, where the proportion of monosyllabic words to all words is 80% in English but only 38% in Greek. The production of a large number of consonants at word final position in English which are phonotacticly restricted in Greek, as Greek permits only s and n at word final position, is further evidence of the child's differentiation of the two phonological systems. This evidence also includes the production of language specific consonant clusters: sm, sn, nt, st#, ts#, nd#, nz#, ld#, ps#, ɹz# in English and #ps, #ft in Greek.

Based on all these, it is concluded that it is more sensible to speak in terms of differentiation of languages that is context-specific and, in some cases, child-dependent rather than complete separation of the systems in bilingualism. The kind of evidence found in the present study for differences in the development of consonants common to the child's two languages and for her ability to produce consonants specific to each language is often interpreted to mean that there are two separate phonological systems. However, because on the one hand the quantitative differences are mainly attributed to language differentiation and, on the other hand, the acquisition level of the L2 language specific sounds is affected to a large degree by transfer of similar sounds of the L1, as is the case in adult L2, the author believes that it is more appropriate to speak in terms of *differentiation* rather than *separation* of the phonological systems.

This dissertation shows that the weaker language in bilingualism, one that is acquired through primarily non-native input in exogenous environment, does not inevitably develop more slowly than the stronger one, nor is the presence of transfer and interference patterns shown to be so dominant that they exceed what would normally be expected in other cases of child or adult bilingualism. There is evidence that her bilingual first language acquisition has been to the child's advantage rather than to her detriment with regard to overall linguistic attainment, including faster than the norms acquisition of marked consonants. Conclusively, the development of this child's consonants in L2 English, the weaker language, alongside her L1 Greek has shown that universals and developmental milestones in bilingualism are not adversely affected by the status of the language in the bilingualism, nor are they impaired in any substantial way by primary exposure to non-native input.

The findings of the present study, besides their general interest in child phonological development in monolingualism or bilingualism, may contribute in evaluating child speech in development as far as the acquisition of consonants is concerned. A child's consonants whose acquisition levels are well below the norm until a certain age may show a faster progress later on, resulting in a complete acquisition earlier than the norm. Such was the case for Maria Sofia's interdentals and especially for her word initial voiceless interdental fricative whose acquisition level was well below the monolingual English and Greek norms until age 3;6 but above them before age 3;11. For this reason, parents and speech pathologists should not rush to judging whether a child is phonologically delayed.

Maria Sofia's creation of consonant clusters by epenthesis may have implications for treatment of children with phonological delay or disorders. For clusters that are not permitted in the language, the sonority distance between the consonants was small. Speech pathologists employ small-sonority-distance consonant clusters that are permitted in the language as a strategy to enhance production of consonant clusters of larger sonority distance (Barlow, 2004). Perhaps, small-sonority-distance consonant clusters that are not permitted in the language could also be tried as part of this strategy.

The results of this dissertation point to the need for future research. The author plans to investigate consonant correctness and substitutions in relation to adjacent vowels and consonants in the wider phonological environment across words in the same utterance and in preceding utterances. An examination of the effect of the interlocutor's preceding utterances on the child's production may show priming and errors that are not phonemically instigated, similar to those determined in the child's created consonant sequences by epenthesis. The development of consonantal clusters in each language and across the two languages will also be of interest. An acoustic analysis of VOT in the child's English, its appearance in her Greek speech and how it compares to monolingual English norms is deemed essential.

The presence of English interference in the child's Greek will need to be shown in detail and investigated both quantitatively and qualitatively. A detailed assessment of transfers and interference may shed more light into their exact nature and help define them with more precision. A comparison of the child's Greek/English developmental transfers with Greek adult L2 English developmental substitution patterns, as well as, cross-linguistically may lead to viewing transfer as a more universal tendency cross-linguistically. All of these issues may be tackled in the child's data in terms of phonology, morphology, syntax and semantics.

Code-switching in the child's data and its effect, if any, on production or on the path of development may help investigate further this universal phenomenon in bilingualism.

In addition, it will be interesting to obtain longitudinal data, on a quantitative basis, for other monolingual and bilingual children in order to establish norms for the length and depth of the cyclic stage and the length of the progressive stage during consonant development, as well as to identify possible discontinuities in substitution patterns, especially near complete acquisition. More studies on the degree of differentiation of the phonological systems in bilingualism comparing performance on a multi-dimensional scale, as was done here, will ascertain norms and differences during the acquisition of different combinations of languages in bilingualism which, in turn, will enable a more in-depth comparison of first and dual language acquisition. Additional studies of bilingual Greek/English or Greek/another language will permit further comparison of this child's data in terms of universals, interference, transfer and individual variation patterns that may establish general regularities.

The global patterns of second language use that crafted Maria Sofia's bilingualism are bound to re-surface with more bilinguals in similar circumstances. *Surface* is used because the lack of such research does not preclude their existence in life. Further, there is anecdotal but clear indication of parents' enthusiasm in fostering their L2 early on in their children's lives. A requirement for absolute proficiency is not necessarily a deterring factor for engaging in this. The study of bilingual children acquiring a weaker language within the 'interlanguage ambiguity hypothesis' (Paradis, 2000) framework will further verify the presence of universals and developmental transfers in such contexts and will facilitate their in-depth analysis and establish bilingual norms.

Last, there is a general need for speech performance comparison across languages on a quantitative basis in first language, second language and bilingual acquisition. The methodology employed and the results obtained in the present study may serve as a guide for future investigations in these areas.

8. LIST OF REFERENCES

Abutalebhi, J., Cappa, S., & Perani, D. (2005). What can functional neuroimaging tell us about the bilingual brain? In J. Kroll & A. De Groot (Eds.), *Handbook of bilingualism: Psycholinguistic perspectives* (pp. 497–515). Oxford: Oxford University Press.

Adler, P. A., & Adler, P. (1994). Observational techniques. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 377-392). Thousand Oaks, CA: Sage.

Aier, D. J. (2005). *Crosslinguistic comparison of negative evidence in English, Hindi and Tamil.* Unpublished doctoral dissertation. Arizona State University, USA.

Altmann, G. T. M. (1990). Lexical statistics and cognitive models of speech processing. In G. T. Altmann (Ed.), *Cognitive models of speech processing: Psycholinguistic and computation perspectives* (pp. 211-235). Cambridge, Mass.: MIT Press.

Anderson, S. R., & Lightfoot, D. (2000). The human language faculty as an organ. *Annual Review of Physiology*, *62*, 697-722.

Antoniou, M., Best, C. T., Tyler, M. D., & Kroos, C. (2010). Language context elicits native-like stop voicing in early bilinguals' productions in both L1 and L2. *Journal of Phonetics*, *38*, 640–653.

Archangeli, D. (1984). *Underspecification in Yawelmani phonology and morphology*. Doctoral dissertation: MIT. New York: Graland Press.

Archangeli, D., & Pulleyblank, D. (1994). *Grounded phonology*. Cambridge: MA: MIT Press.

Archibald, J. (1998). *Second language phonology.* Language Acquisition & Language Disorders 17. Amsterdam: John Benjamins.

Ard, J. (1989). A constructivist perspective on non-native phonology. In S. M. Gass & J. Schachter (Eds.), *Linguistic perspectives on second language acquisition* (pp. 243-259). Cambridge: Cambridge University Press.

Arlt, P. B., & Goodban, M. J. (1976). A comparative study of articulation acquisition as based on a study of 240 normals, aged three to six. *Language, Speech, and Hearing Services in Schools, 7,* 173-180.

Arvaniti, A. (2007). Greek phonetics: The state of the art. *Journal of Greek Linguistics*, *8*, 97-208.

Arvaniti, A., & Joseph, B. (2000). Variation in nasal stop prenasalization in Greek. *Glossologia*, *11-12*, 113-166.

Auer, P., & Wei, L. (Eds.) (2007). *Handbook of multilingualism and multilingual communication*. Berlin/New York: Mouton de Gruyter.

Augustine, S. (1952). *The Confessions* (Vol. 18). Chicago: Encyclopedia Britannica.

Babatsouli, E., & Kappa, I. (2011). Transfer of Greek palatals in L2 English. In M. Wrembel, M. Kul, & K. Dziubalska-Kołaczyk (Eds.), *Achievements and perspectives in the acquisition of second language speech: New Sounds 2010* (pp. 27-42). Frankfurt: Peter Lang.

Baetens Beardsmore, H. (1982). *Bilingualism: Basic principles*. Clevedon: Multilingual Matters.

Balas, A. (2009). Why can Poles perceive sprite but not coca cola? A natural phonological account. In P. Boersma & S. Hamann (Eds.), *Phonology in perception*. Berlin/New York: Mouton de Gruyter.

Baltazani, M., & Topintzi, N. (2010). The phonology and phonetics of glides in North-Western Greek dialects. In A. Ralli, B. Joseph, M. Janse, & A. Karasimos (Eds.), *Proceedings of the 4th International Conference on Modern Greek Dialects and Linguistic Theory* (pp. 54-68).

Baltazani, M., & Topintzi, N. (2013). On some phonetic and phonological properties of the Greek glide. In Z. Gavriilidou, A. Efthymiou, E. Thomadaki, & P. Kambakis-Vougiouklis (Eds.), *Proceedings of the 10th International Conference on Greek Linguistics* (pp. 153-166).

Barlow, J. A. (2004). Consonant clusters in phonological acquisition: Application to assessment and treatment. *California Speech-Language-Hearing Association Magazine*, *Summer*, 10-13.

Barnard, R., & Torres-Guzman, M. E. (2009). *Creating classroom communities of learning: International case studies and perspectives*. Clevedon: Multilingual Matters Limited.

Bates, E. (1976). *Language and context: The acquisition of pragmatics*. New York, NY: Academic Press.

Bates, E., Dale, P., & Thal, D. (1995). Individual differences and their implications for theories of language development. In P. Fletcher & B. MacWhinney (Eds.), *The handbook of child language* (pp. 96-151). Oxford: Blackwell.

Bates, E., & MacWhinney, B. (1987). Competition, variation, and language learning. In B. MacWhinney (Ed.), *Mechanisms of language acquisition* (pp. 157-194). Hillsdale, NJ: Lawrence Erlbaum.

Beckman, M., Munson, B. & Edwards, J. (2007). Vocabulary growth and the developmental expansion of types of phonological knowledge. In J. Cole & J. Hualde (Eds.), *Laboratory phonology 9* (pp. 241-264). New York: Mouton de Gruyter.

Beers, M. (1995). *The phonology of normally developing and language impaired children.* IFOTT dissertation series, No 20. University of Amsterdam.

Beretta, A. (2009). The language learning brain. In C. Doughty & M.H. Long (Eds.), *Handbook of second language learning* (pp. 65-80). Oxford: Blackwell.

Bernhardt, B., & Stemberger, J. (1998). *Handbook of phonological development: From a nonlinear constraints-based perspective*. San Diego: Academic Press.

Bernhardt, B., & Stemberger, J. (2008). Constraints-based nonlinear phonological theories: Application and implications. In: M. J. Ball, M. R. Perkins, Nicole Müller, & S. Howard (Eds.), *The handbook of clinical linguistics* (pp. 423-450). Oxford: Blackwell.

Bernhardt, B., & Stoel-Gammon, C. (1994). Nonlinear phonology: Introduction and clinical application. *Journal of Speech and Hearing Research*, *37*, 123-143.

Bertoncini, J. R., Bijeljac-Babic, R., Blumstein, S. E., & Mehler, J. (1987). Discrimination in neonates of very short CV's. *Journal of the Acoustical Society of America*, *82*, 31-37.

Best, C. T. (1994). The emergence of language-specific phonemic influences in infant speech perception. In J. Goodman & H. Nusbaum (Eds.), *The development of speech perception: The transition from speech sounds to spoken words* (pp. 167-224). Cambridge, MA: MIT Press.

Best, C. T. (1995). A direct realist view of cross-language speech perception. In: W. Strange (Ed.), *Speech perception and linguistic experience: Issues in cross-language research* (pp. 171-204). Timonium, MD: York Press.

Best, C. T., & Strange, W. (1992). Effects of phonological and phonetic factors on cross-language perception of approximants. *Journal of Phonetics*, *20 (3)*, 305-330.

Bhatia, T. K. (2006). Introduction to part I. In T. Bhatia & W. Ritchie (Eds.), *The handbook of bilingualism* (pp. 5-7). Malden, MA: Blackwell.

Bhatia, T. K., & Ritchie, W. C. (2006). The bilingual child: some issues and perspectives. In W. C. Ritchie & T. K. Bhatia (Eds.), *Handbook of child language acquisition* (pp. 569-643). San Diego: Academic Press.

Bickerton, D. (1984). The language bioprogram hypothesis. *The Behavioural and Brain Sciences*, 7, 173-188.

Bills, A. G. (1934). *General Experimental Psychology*. Longmans Psychology Series (pp. 192-215). New York, NY: Longmans, Green and Co.

Birdsong, D. (1992). Ultimate attainment in second language acquisition. *Language*, *68*, 706-755.

Birdsong, D. (Ed.) (1999). *Second language acquisition and the critical period hypothesis*. Routledge: Taylor & Francis.

Black, B., & Uhde, T.W. (1995). Psychiatric characteristics of children with selective mutism. *Journal of the American Academy of Child and Adolescent Psychiatry*, *34,* 847-856.

Blevins, J. (2007). Interpreting misperception: Beauty is in the ear of the beholder. In M. Solem, P. Bedor, & M. Ohala (Eds.), *Experimental Approaches to Phonology*. (pp. 144-154). Oxford: Oxford University Press.

Bley-Vroman, R. (1989). What is the logical problem of foreign language learning? In S. Gass & J. Schachter (Eds.), *Linguistic perspectives on second language acquisition* (pp. 41-68). New York: City University Press.

Bloch, B. (1950). Studies in colloquial Japanese IV: Phonemics. *Language*, *26*, 113-135.

Bloomfield, L. (1933). *Language*. New York: Holt.

Boersma, P. (1997). *How we learn variation, optionality and probability*. Rutgers Optimality Archives, *ROA # 221*, http://roa.rutgers.edu.

Boersma, P. (2009). Cue constraints and their interactions in phonological perception and production. In P. Boersma & S. Hamann (Eds.), *Phonology in Perception* (pp. 55-95). Berlin/New York: Mouton de Gruyter.

Boersma, P., & Weenink, D. (2001). Praat, a system for doing phonetics by computer. *Glot International*, *5 (9/10)*, 341-345.

Bohannon, J, N., & Stanowicz, L. (1988). The issue of negative evidence: adult responses to children's errors. *Developmental Psychology*, *24 (5)*, 684-689.

Botinis, A., Fourakis, M., Prinou, I. (2000). Acoustic structure of the Greek stop consonants. *Glossologia*, *11/12*, 167-200.

Braine, M. D. S. (1971). On two types of models on the internalization of grammars. In D. I. Slobin (Ed.), *The ontogenesis of grammar: A theoretical symposium* (pp. 153-186). New York: Academic Press.

Brainerd, C. J. (1978). *Piaget's theory of intelligence*. New Jersey: Prentice Hall, Inc.

Brannen, K. (2002). The role of perception in differential substitution. *Canadian Journal of Linguistics - Revue Canadienne de Linguistique*, *47*, 1-20.

Brière, E. J. (1968). *A Psycholinguisitc study of phonological interference*. The Hague/Paris: Muton.

Broca P. (1865). Sur le siège de la faculté du langage articulé. *Bulletin de la Soci*été *d' Anthropologie*, *11,* 337-393.

Brooks, P. J., & Mac Whinney., B. (2000). Phonological priming in children's picture naming. *Journal of Child Language*, *27*, 335-366.

Brown, C. (2000). The interrelation between speech perception and phonological acquisition from infant to adult. In J. Archibald (Ed.), *Second language acquisition and linguistic theory* (pp. 4-63). Malden, MA: Blackwell.

Brown, R. (1958/1970). How shall a thing be called? *Psychological Review, 65, 14-21*. Reprinted in R. Brown (Ed.), (1970), *Psycholinguistics: Selected papers by Roger Brown* (pp. 3-15), New York: The Free Press.

Brown, R. (1973). *A first language: The early stages*. Cambridge, MA: Harvard University Press.

Brown R. (2004). The study of Adam, Eve and Sarah. In B. C. Lust & C. Foley (Eds.), *First language acquisition: The essential readings* (pp. 335-343). Malden, MA: Blackwell.

Brown, R., & Hanlon, C. (1970). Derivational complexity and order of acquisition in child speech. In J. R. Hayes (Ed.), *Cognition and the development of language*. New York: Wiley.

Brulard, I., & Carr, P. (2003). French-English bilingual acquisition of phonology: One production system or two? *International Journal of Bilingualism*, *7,* 177-202.

Bruner, J. S. (1983). *Child talk: Learning to use language*. New York: Norton.

Brysbaert, M. (1998). Word recognition in bilinguals: Evidence against the existence of two separate lexicons. *Psychologic Belgica*, *38,* 163-175.

Bunta, F., Davidovich, I., & Ingram, D. (2006). The relationship between the phonological complexity of a bilingual child's words and those of the target languages. *International Journal of Bilingualism*, *10 (1)*, 71-88.

Bunta, F., Fabiano-Smith, L., Goldstein, B. A., & Ingram, D. (2009). Phonological whole-word measures in three-year-old bilingual children and their age-matched monolingual peers. *Clinical Linguistics and Phonetics*, *23,* 156-175.

Burling, R. (1959/1978). Language development of a Garo and English child. *Word*, *15*, 45-68. Reprinted in E. M. Hatch (Ed.) (1978). *Second Language* Acquisition (pp. 54-75). Rowley, MA: Newbury House.

Burquest, D. A. (2006). *Phonological analysis: A functional approach*. Dallas, TX: SIL International.

Burrows, L., & Goldstein, B.A. (2010). Whole word measures in bilingual children with speech sound disorders. *Clinical Linguistics and Phonetics*, *24*, 357-368.

Cairns, C. (1969). Markedness, neutralization and universal redundancy rules. *Language*, *45*, 863-885.

Carey, S. (1978). The child as word learner. In M. Halle, J. Breasnan, & G. A. Miller (Eds.), *Linguistic theory and psychological reality* (pp. 264-293). Cambridge, MA: MIT Press.

Cazden, C. (1968). The acquisition of noun and verb inflections. *Child Development¸ 39*, 433-444.

Cazden, C. (1983). Adult assistance to language development: Scaffolds, models and direct instruction. In R. P. Parker & F. A. Davis (Eds.), *Developing literacy: Young children's use of language* (pp. 3-18). Newark, DE: International Reading Association.

Celce-Murcia, M. (1978). The simultaneous acquisition of English and French in a two-year-old child. In E. Hatch (Ed.), *Second language acquisition: A book of readings* (pp. 38-53). Rowley, MA: Newbury House Publishers.

Chapelle, C., & Duff, P. (Eds.) (2003). Some guidelines for conducting quantitative and qualitative research in TESOL. *TESOL Quarterly*, *37*, 157-178.
Chee, M. W. L., Tan, E. W. L., & Thiel, T. (1999). Mandarin and English single word processing with functional magnetic resonance imaging. *Journal of Neuroscience*, *19*, 3050-3056.
Chin, S. B., & Dinnsen, D. A. (1992). Consonant clusters in disordered speech: Constraints and correspondence patterns. *Journal of Child Language*, *19*, 259-285.
Chomsky, N. (1959). Review of Skinner's verbal behavior. *Language*, *35*, 26-58.
Chomsky, N. (1965). *Aspects of the theory of syntax*. Cambridge, MA: MIT Press.
Chomsky, N. (1966). *Cartesian linguistics: A chapter in the history of rationalist thought*. New York: Harper & Row.
Chomsky, N. (1980). *Rules and representations*. Cambridge, MA: MIT Press.
Chomsky, N. (1981). *Lectures on government and binding*. Dordrecht, The Netherlands: Foris.
Chomsky, N. (1986). *Knowledge of language: Its nature, origins, and use.* New York: Praeger.
Chomsky, N. (2007). Approaching UG from below. In S. Uli & H. M. Gärtner (Eds.), *Interfaces + Recursion = Language?* (pp. 1-29). New York: Mouton de Gruyter.
Chomsky, N., & Halle, M. (1968). *The sound pattern of English*. New York: Harper & Row.
Clements, G. N. (1985). The geometry of phonological features. *Phonology Yearbook*, *2*, 2225-2252.
Clements, G. N. (1988). Towards a substantive theory of feature specifications. *Proceedings of NELS 18* (pp. 79-93). Amherst, MA: GLSA.
Clements, G. N. (1990). The role of the sonority cycle in core syllabification. In J. Kingston & M. E. Beckman (Eds.), *Papers in laboratory phonology I: Between the grammar and physics of speech* (pp. 283-333). New York: Cambridge University Press.
Clements, G. N., & Keyser, S. J. (1983). *CV phonology: A generative theory of the syllable*. Cambridge, MA: MIT Press.
Comeau, L., Genesee, F., & Mendelson, M. (2007). Bilingual children's repairs of breakdowns in communication. *Journal of Child Language, 34*, 159-174.
Cook, V. (1992). Evidence for multi-competence. *Language Learning*, *42 (4)*, 557-591.
Cook, V. (1997). Monolingual bias in second language acquisition research. *Revista Canaria de Estudios Ingleses*, *34*, 35-50.
Crystal, D. (1974). Review of R. Brown, 'A first language'. *Journal of Child Language*, *1*, 289-334.
Crystal, D. (1995). *The Cambridge encyclopedia of the English language* (2nd edition). Cambridge: Cambridge University Press.
Crystal, D. (2003). *A dictionary of linguistics and phonetics* (5th edition). Oxford: Blackwell.
Crystal, D. (2012). In conversation with David Crystal (special session). Presentation at the *14th Meeting of the International Clinical Phonetics and Linguistics Association*, June 2012, Cork, Ireland.
Curtiss, S. (1977). *Genie: a psychological study of a modern-day 'wild child.'* New York: Academic Press.
Cutler, A. (1994). Segmentation problems, rhythmic solutions. *Lingua*, *9,* 81-104.
Darwin, C. (1877). A biographical sketch of an infant. *Mind*, *2*, 292-294.

De Bot, K. (1992). A bilingual production model: Levelt's 'speaking' model adapted. *Applied Linguistics*, *13*, 1-24.
De Bot, K. (2011). Epilogue. In M. Verspoor, K. De Bot, & W. Lowie (Eds.), *A dynamic approach to second language development* (pp. 123-127). Amsterdam/Philadelphia: John Benjamins.
De Bot, K., Lowie, W., Verspoor, M. (2006). *Second language acquisition: An advanced resource book*. London/New York: Routledge.
De Casper, A. J., & Fifer, W. P. (1980). Of human bonding: newborns prefer their mothers' voices. *Science*, *208*, 1174-1176.
De Houwer, A. (1995). Bilingual language acquisition. In P. Fletcher & B. MacWhinney (Eds.), *The handbook of child language* (pp. 219-250). Oxford: Blackwell.
De Houwer, A. (2002). Comparing monolingual and bilingual acquisition. *Alkalmazott Nyelvtudomány*, *2 (1),* 5-19.
De Houwer, A. (2007). Parental language input patterns and children's bilingual use. *Applied Psycholinguistics*, *28*, 411-424.
De Houwer, A. (2009). *Bilingual first language acquisition.* Clevedon, England: Multilingual Matters.
De Houwer, A., & Bornstein, M. (2003). Balancing on the tightrope: Language use patterns in bilingual families with young children. Presentation at the *4th International Symposium on bilingualism*. May 2003, Tempe, AZ.
De Keyser, R., & Larson-Hall, J. (2005). What does the critical period really mean? In: J. Kroll & A. De Groot (Eds.), *Handbook of bilingualism: Psycholinguistic perspectives* (pp. 88-108). Oxford: Oxford University Press.
De Lange, C. (2012). Bilingual brain boost: two tongues, two minds. *New Scientist*, *2863*. Online: http://www.newscientist.com/article/mg21428631.800-bilingual-brain-boost-two-tongues-two-minds.html.
Demuth, K. (1997). Variation in acquisition: an optimal approach. In S. Davis (Ed.), *Optimality viewpoints* (pp. 77-88). Bloomington: Indiana University Linguistics Club.
Demuth, K. (2011). Interactions between lexical and phonological development: Crosslinguistic and contextual considerations - A commentary on Stoel-Gammon's 'Relationships between lexical and phonological development in young children'. *Journal of Child Language*, *38*, 69-74.
Denzin, N. K. (1970). *The Research act in sociology.* Chicago: Aldine.
De Saussure, F. (2006). On the dual essence of language. In S. Bouquet & R. Engler (Eds.), *Writings in general linguistics* (pp. 3-60). Oxford: Oxford University Press.
Deuchar, M., & Clark, A. (1996). Early bilingual acquisition of the voicing contrast in English and Spanish. *Journal of Phonetics*, *24*, 351-365.
Deuchar, M., & Quay, S. (2000). *Bilingual acquisition: Theoretical implications of a case study*. Oxford: Oxford University Press.
De Weck, G., Salazar Orvig, A., Da Silva, C., Rahmati, S., & Rezzonico, S. (2012). Maternal scaffolding strategies and setting variations: comparison of SLI and typically developing mother-child dyads. Presentation at the *14th Meeting of the International Clinical Phonetics and Linguistics Association*, June 2012, Cork, Ireland.
Diedrich, W., & Bangert, J. (1980). *Articulation learning*. Houston, TX: College Hill Press.

Dinnsen, D. A. (1992). Variation in developing and fully developed phonologies. In C. A. Ferguson, L. Menn, & C. Stoel-Gammon (Eds.), *Phonological development: Models, research, implications* (pp. 191-210). MD: York Press.

Dinnsen, D. A. (1998). On the organization and specification of manner features. *Journal of Linguistics*, *34*, 1-25.

Dinnsen, D. A., & Barlow, J. A. (1998). On the characterization of a chain shift in normal and delayed phonological acquisition. *Journal of Child Language*, *25*, 61-94.

Dinnsen, D. A., Barlow, J. A., & Morrisette, J. A. (1997). Long-distance place assimilation with an interacting error pattern in phonological acquisition. *Clinical Linguistics and Phonetics*, *11 (4)*, 319-338.

Dodd, B., Holm, A., Crosbie, S., & Bloomfield, J. (2006). English phonology: Acquisition and disorder. In Z. Hua & B. Dodd (Eds.), *Phonological development and disorders: A multilingual perspective* (pp. 25-54). Clevedon, England: Multilingual Matters.

Dodd, B., Holm, A., Hua, Z., & Crosbie, S. (2003). Phonological development: A normative study of British speaking children. *Clinical Linguistics and Phonetics*, *17 (8)*, 617-643.

Dollaghan, C. (1985). "Child meets word: "Fast mapping" in preschool children". *Journal of Speech and Hearing Research*, *28* (3), 449-454.

Donegan, P. J., & Stampe, D. (1979). The study of natural phonology. In D. A. Dinnsen (Ed.), *Current approaches to phonological theory* (pp. 126-173). Bloomington, IN: Indiana University Press.

Doughty, C. J., & Long, M. H. (Eds.) (2003). *The handbook of second language acquisition*. Oxford: Blackwell Publishing.

Drachman, G. (1975). Generative phonology and child language acquisition. In W. U. Dressler & F. V. Mares (Eds.), *Phonologica 1972* (pp. 235-251). Munchen: Finck.

Drachman, G. (1978). Child language and language change: conjecture and some refutations. In J. Fisiak (Ed.), *Recent developments in historical phonology* (pp. 123–144). The Hague: Mouton.

Drachman, G. (1990). A remark on Greek clusters. In J. Mascaro, & M. Nespor (Eds.), *Grammar in progress, glow essays for Henk v. Riemsdijk*.

Drachman, G., & Malikouti-Drachman, A. (1972). Studies in the acquisition of Greek as a native language: II. Sporadic processes in phonology. Presentation at the *Child Language Research Forum*, Stanford University, USA.

Drachman, G., & Malikouti-Drachman, A. (1973). Studies in the acquisition of Greek as a native language: I. Some preliminary findings on phonology. *Ohio State University Working Papers in Linguistics*, *15*, 99-114.

Dresher, E. (1994). *Child phonology, learnability, and phonological theory*. Unpublished manuscript, University of Toronto.

Dresher, B. E. & Kaye, J. D. (1990). A computational learning model for metrical phonology. *Cognition*, *34*, 137-195.

Dressler, C. (1998). Child phonology, learnerability and phonological theory. In C. W. Ritchie & T. K. Bhatia (Eds.), *Handbook of child language acquisition* (pp. 299-346). Amsterdam: Elsevier Science and Technology Books.

Duff, P. A. (2008). *Case study research in applied linguistics*. New York: Routledge.

Duff, P. A. (2012). Triangulating theories, methods, and perspectives in SLA research (plenary talk). *Second Language Research Forum*: *Building Bridges between Disciplines*, October 2012, Pittsburgh, USA.

Ebbinghaus, H. (1913). *A contribution to experimental psychology*. New York: Teachers College Press.
Echols, C. (1993). A perceptually-based model of children's earliest productions. *Cognition*, *46*, 245-296.
Eckman, F. R. (1984). Universal typologies and interlanguage. In W. Rutherford (Ed.), *Language universals and second language acquisition* (pp. 79-105). Amsterdam: John Benjamins.
Edwards, J. (2006). Foundations of bilingualism. In T. Bhatia & W. Ritchie (Eds.), *The handbook of bilingualism* (pp. 5-29). Oxford: Blackwell.
Edwards J. G. H., & Munson, B. (in press). Transcribing the speech of multilingual children with speech and sound disorders. In S. Macleod & B. Goldstein (Eds.), *Multilingual aspects of speech sounds disorders in children.* Bristol: Multilingual Matters.
Edwards, J. G. H., & Beckman, M. E. (2008). Methodological questions in studying consonant acquisition. *Clinical Linguistics and Phonetics*, *22 (12)*, 937-956.
Edwards, J. G. H., Beckman, M., Magoula, E., Nikolaidis, E., & Tserdanelis, G. (2004). Acquisition of lingual obstruents in Greek. *Proceedings of the 6th International Conference on Greek Linguistics (ICGL 2003).*
Edwards, M., & Bernhardt, B. (1973). *Phonological analyses of the speech of four children with language disorders.* Unpublished manuscript, Stanford University.
Edwards, J. G. H., & Zampini, M. L. (Eds.) (2008). *Phonology and second language acquisition*. Philadelphia: John Benjamins.
Eimas, P. D. (1974) Auditory and linguistic processing of cues for place of articulation by infants. *Perception and Psychophysics*, *16*, 513-521.
Eimas, P. D., & Miller, J. L. (1980). Discrimination of the information for manner of articulation. *Infant Behaviour and Development*, *3*, 367-375.
Ellingson, L. (2009). *Engaging crystallization in qualitative research: an introduction*. Thousand Oaks: CA, Sage.
Ellis, N. (1994). *Implicit and explicit learning of languages*. New York: Academic Press.
Ellis, N. (2002). Frequency effects in language processing: A review with implications of implicit and explicit theories of language acquisition. *Studies in Second Language Acquisition*, *24*, 143–188.
Ellis, R. (2008). *The study of second language acquisition*. Oxford: Oxford University Press.
El Lozy, M. (1978). A critical analysis of the double and triple logistic growth curves. *Annals of Human Biology, 5,* 389-394.
Ervin, S. M., & Miller, W. R. (1963). Language development. In *Child Psychology*, *NSSEY*, (pp. 108-143). Chicago: Chicago University Press.
Ervin-Tripp, S. M. (1987). Some issues in relating first and second language learning. In H. Blanc, M. Le Douaron, & D. Veronique (Eds.), *S'approprier une langue étrangère* (pp. 276-282). Paris: Didier Erudition.
Erwin, S., & Osgood, C. (1954). Second language learning and bilingualism. *Journal of Abnormal and Social Psychology*, *49*, 139-146.
Fabiano-Smith, L., & Barlow, J. (2010). Interaction in bilingual phonological acquisition: evidence from phonetic inventories. *The International Journal of Bilingual Education and Bilingualism*, *13 (1)*, 81-97.

Fabiano-Smith, L., & Goldstein, B. A. (2010). Phonological acquisition in bilingual Spanish-English speaking children. *Journal of Speech, Language, and Hearing Research*, *53,* 160-178.

Fantini, A. F. (1985). *The Language acquisition of a bilingual child.* Clevedon: Multilingual Matters.

Ferguson, C. A. (1978). Fricatives in child language acquisition. In V. Honsa & M. J. Hardman-de Bautista (Eds.), *Papers on linguistics and child language* (pp. 93-115). The Hague: Mouton.

Ferguson, C., & Farewell, C. (1975). Words and sounds in early language acquisition: Initial consonants in the first fifty words. *Language*, *51*, 419-439.

Fey, M., & Gandour, J. (1982). Rule discovery in phonological acquisition. *Journal of Child Language, 9,* 71-82.

Fikkert, P. (1994). *On the acquisition of prosodic structure*. HIL Dissertation 6. Dordrect: ICG Printing.

Fikkert, P. (2007). Acquiring phonology. In P. de Lacy (Ed.), *Handbook of phonological theory* (pp. 537-554). Cambridge, MA: Cambridge University Press.

Fishman, J. A. (1965). Who speaks what language to whom and when? *La Linguistique*, *2*, 67-88.

Flege, J. E. (1982). English speakers learn to suppress stop devoicing. In R. A. Chametzky, R. Hirzel, & K. Tuite (Eds.), *Papers from the Eighteenth Regional Meeting of the Chicago Linguistic Society* (pp. 111-122).

Flege, J. E. (1991). Perception and production: The relevance of phonetic input to L2 phonological learning. In T. Huemner & C. A. Ferguson (Eds.), *Cross currents in second language acquisition and linguistic theories* (pp. 249-269). Amsterdam/Philadelphia: John Benjamins.

Flege, J. E. (1995). Second language speech learning: Theory, findings and problems. In W. Strange (Ed.), *Speech perception and linguistic experience: Theoretical and methodological issues* (pp. 233-277). Timonium, MD: York Press.

Flege, J. E., & Davidian, R. (1984). Transfer and developmental processes in adult foreign language speech production. *Applied Linguistics*, *5*, 323-347.

Forster, K. I. (1976). Accessing the mental lexicon. In F. Wales & E. Walker (Eds.), *New approaches to languages mechanisms* (pp. 257-287). Amsterdam: North Holland.

Fourakis, M. (1986). An acoustic study of the effects of tempo and stress on segmental intervals in modern Greek. *Phonetica*, *43*, 172–188.

Freedman, S. E., & Barlow, J. A. (2012). Using whole-word production measures to determine the influence of phonotactic probability and neighborhood density on bilingual speech production. *International Journal of Bilingualism*, *16 (4)*, 369-387.

Friedrick, O., Ludtke, M., & Mehrtens Calvin, R. (1983). What do Babies know? *Time*, *122 (7).* Online: http:www.time.com/time/magazine/article/0,9171,949745-1,00.html.

Fries, C. C. (1945). *Teaching and learning English as a foreign language*. Ann Arbor, MI: Michigan University Press.

Fulop, S., & Golston, C. (2012). If segments are real what are they? Presentation at the *CUNY Conference on the Segment*, January 2012, New York, NY.

Gass, S. M., & Selinker, L. (Eds.) (1983). *Language transfer in language learning*. Cambridge, MA: Newbury House.

Gass, S. M., & Selinker, L. (2008). *Second language acquisition: An introductory course.* New York: Routledge.

Genesee, F. (1989). Early bilingual development: One language or two? *Journal of Child Language*, *6*, 161-179.

Genesee, F. (2009). Early childhood bilingualism: Perils and possibilities. *Journal of Applied Research on Learning, 2 (2)*, 1-21.

Genesee, F., Boivin, I. & Nikoladis, E. (1996). Talking with strangers: A study of children's communicative competence. *Applied Psycholinguistics*, *17*, 427-442.

Genesee, F., Paradis J., & Crago, M. (2008). *Dual language development & disorders: A handbook on bilingualism & second language learning*. Baltimore: Paul Brookes.

Gerschwind, N. (2004). Language and the brain. In B. C. Lust & C. Foley (Eds.), *First language acquisition: The essential readings* (pp. 108-122). Oxford: Blackwell Publishers.

Gierut, J. A. (1996). Featural categories in English phonemic acquisition. In B. Bernhardt, D. Ingram, & J. Gilbert (Eds.), *Proceedings of the UBC International Conference on Phonological Acquisition* (pp. 42-52). Somerville, MA: Cascadilla Press.

Gildersleeve-Neumann, C. E., Kester, E. S., Davis, B.L., & Peña, E. D. (2008). English speech sound development in preschool-aged children from bilingual English-Spanish environments. *Language, Speech, and Hearing Services in Schools*, *39*, 314-328.

Gleitman, L. R. (1981). Maturational determinants of language growth. *Cognition*, *10*, 103-114.

Gnanadesikan, A. E. (1996). Child phonology in optimality theory: Ranking markedness and faithfulness constraints. In A. Stringfellow, D. Cahana-Amitay, E. Hughes, & A. Zukowski (Eds.), *Proceedings of the 20th Annual Boston University Conference on Language Development* (Vol. 1, pp. 237-248). Sommerville, MA: Cascadilla Press.

Gnanadesikan, A. E. (2004.) Markedness and faithfulness constraints in child phonology. In R. Kager, J., Pater, & W. Zonneveld (Eds.), *Constraints in phonological acquisition* (pp. 73-108). Cambridge: Cambridge University Press.

Goad, H. (1997). Consonant harmony in child language: An optimality theoretic account. In S. J. Hannahs, & M. Young-Scholten (Eds.), Focus on Phonological Acquisition (pp. 113-142). Amsterdam: John Benjamins.

Goad, H., & Ingram, D. (1987). Individual variation and its relevance to a theory of phonological acquisition. *Journal of Child Language*, *14*, 419-432.

Goldsmith, J. A. (1979). The aims of autosegmental phonology. In D. A. Dinnsen (Ed.), *Current approaches to phonological theory* (pp. 202-222). Bloomington: Indiana University Press.

Goodluck, H. (1991). *Language acquisition: A linguistic introduction*. Oxford: Blackwell Publishers.

Grainger, J., & Dijkstra, A. (1992). On the representation and use of information in

bilinguals. In R. J. Harris (Eds.), *Cognitive processing in bilinguals* (pp. 207-220). Amsterdam: Elsevier Science.
Grainger, J., & Jacobs, A. M. (1994). A dual read-out model of word-context effects in letter perception: further investigations of the word superiority effect. *Journal of Experimental Psychology: Human Perception and Performance*, *20*, 1158-1176.
Green, D. W. (1986). Control, activation, and resource. *Brain and Language*, *27*, 210-223.
Greenberg, J. H. (1963). Some universals of grammar with particular reference to the order of meaningful elements. In J. H. Greenberg (Ed.), *Universals of language* (pp. 73-113). London: MIT Press.
Greenberg, J. H. (1978). Some generalizations concerning initial and final consonant clusters. In J. H. Greenberg, C. Ferguson, & E. A. Moravcsik (Eds.), *Universals of human language* (Vol. 2, pp. 243-279). Stanford, CA: Stanford University Press.
Gregg, K. R. (1989). Second language theory: The case for a generative perspective. In S. M. Gass & J. Schachter (Eds.), *Linguistic perspectives on second language acquisition* (pp. 15-40). Cambridge: Cambridge University Press.
Gregg, K. R. (1994). Second language acquisition: History and theory. *Encyclopaedia of language and linguistics* (pp. 3720-6). (2nd edition). Oxford: Pergamon.
Gropen, J., Pinker, S., Hollander, M., Goldberg, R., & Wilson, R. (1989). The learnerability and acquisition of the dative alternation. *Language*, *65*, 203-257.
Grosjean, F. (1985). The bilingual as a competent but specific speaker-hearer. *Journal of Multilingual and Multicultural Development, 4 (6)*, 467-477.
Grosjean, F. (1989). Neurolinguists, beware! The bilingual is not two monolinguals in one person. *Brain and Language*, *36*, 3-15.
Grosjean, F. (1992) Another view of bilingualism. In R. J. Harris (Ed.), *Cognitive processing in bilinguals* (pp. 51-62). Amsterdam: Elsevier Science Publishers.
Grosjean, F. (1997). The bilingual individual. *Interpreting*, *2*, 163-187.
Grosjean, F. (2001). The bilingual's language modes. In J. Nicol (Ed.), *One mind, two languages: Bilingual language processing* (pp. 1-22). Oxford: Blackwell.
Grosjean, F. (2008). *Studying bilinguals,* Oxford: Oxford University Press.
Grosjean, F. (2012). An attempt to isolate and then differentiate transfer and interference. *International Journal of Bilingualism*, *16 (1)*, 11-21.
Grosjean, F., & Li, P. (2013). *The psycholinguistics of bilingualism*. Malden MA & Oxford: Willey Blackwell.
Grunwell, P. (1981a). *The nature of phonological disability in children*. London: Academic Press.
Grunwell, P. (1981b). The development of phonology. *First Language, 3*, 161-191.
Gut, U. (2000a). *Bilingual acquisition of intonation: A study of children speaking German and English*. Tübingen: Niemeyer.
Gut, U. (2000b). Cross-linguistic structure in the acquisition of intonational phonology by German-English bilingual children. In S. Döpke, S. (Ed.), *Cross-linguistic structures in simultaneous language acquisition* (pp. 201-225). Amsterdam: John Benjamins.
Gut, U., & Bayerl, P. S. (2004). Measuring the reliability of manual annotation of speech corpora. In B. Bell & I. Marlien (Eds.), *Proceedings of speech prosody* (pp. 565-568). Nara, Japan.
Gut, U. (2007). Foreign accent. In C. Müller (Ed.), *Speaker classification* (pp. 75-87). Berlin: Springer.

Gut, U. (2009). *Introduction to English phonetics and phonology*. Frankfurt: Peter Lang.
Gut, U. (2011). Personal communication.
Haggard, M. (1978). The devoicing of voiced fricatives. *Journal of Phonetics*, *6*, 95-102.
Hakuta, K. (1976). A case study of a Japanese child learning English as a second language. *Language Learning*, *26 (2)*, 321-351.
Hakuta, K. (1986). *Mirror of language: The debate on bilingualism*. New York: Harper Collins.
Halliday, M. A. K. (1979). One child's protolanguage. In: M. Bullowa (Ed.), *Before speech: the beginnings of interpersonal communication* (pp. 179-190). Cambridge: Cambridge University Press.
Hamers, J. F., & Blanc, M. H. A. (1983). *Bilinguality and bilingualism*. Cambridge: Cambridge University Press.
Hancin-Bhatt, B., & Govindjee, A. (1999). A computational model of feature competition in L2 transfer. In P. Broeder & J. Murre (Eds.), *Language and thought in development: Cross-linguistic studies* (pp. 145-161). Gunter Narr: Tuebingen.
Hannahs, S. J., & Young-Scholten, M. (Eds.) (1997). *Focus on phonological acquisition.* Philadelphia: John Benjamins.
Hatch, E. (Ed.) (1978). *Second language acquisition*. Rowley, MA: Newbury House.
Haugen, E. (1953). *The Norwegian language in America*. Philadelphia: University of Pennsylvania Press**.**
Hesse-Biber, & S. N., Leavy, P (2006). *The practice of qualitative research*. Thousand Oaks, CA: Sage.
Hinckley, A. (1915). A case of retarded speech development. *Pediatric Seminary*, *22*, 121-146.
Hoff, E. (2006). How social contexts support and shape language development. *Developmental Review*, *26*, 55-88.
Hoff, E., Core, C., Place, S., Rumiche, R., Señor, M., & Parra, M. (2011). Dual language exposure and early bilingual development. *Journal of Child Language*, *39*, 1-27.
Hohenberger, A., & Peltzer-Karpf, A. (2009). Language learning from the perspective of nonlinear dynamic systems. *Linguistics*, *47 (2)*, 481-511.
Holm, A., & Dodd, B. (1999). A longitudinal study of the phonological development of two Cantonese-English bilingual children. *Applied Psycholinguistics*, *20*, 349-376.
Holton, D., Mackridge, P., & Philippaki-Warburton, I. (1998). *Grammar of Greek language*. Athens: Patakis (in Greek).
Hornstein, N., & Lightfoot, D. (1981). *Explanation in linguistics: The logical problem of language acquisition*. London: Longman.
Householder, F. W. (1964). Three dreams of Modern Greek phonology. In R. Austerlitz (Ed.), *Papers in Memory of George C. Papageotes* (pp. 17-27). Supplement to Word 20:3.
Hua, Z., & Dodd, B. (2006). A multilingual perspective on phonological development and disorders. In Z. Hua & B. Dodd (Eds.), *Phonological development and disorders: A multilingual perspective* (pp. 1-13). Clevedon, England: Multilingual Matters.
Huerta, A. (1977). *The acquisition of bilingualism: A code-switching approach*. Austin: University of Texas.
Huttenlocher, J., Vasilyeva, & M., Shimpi, P. (2004). Syntactic priming in young children. *Journal of Memory and Language*, *50*, 182-195.

Ingram, D. (1974a). Phonological rules in young children. *Journal of Child Language*, *1,* 49-64.
Ingram, D. (1974b). Fronting in child phonology. *Journal of Child Language*, *1,* 233-241.
Ingram, D. (1975). If and when transformations are acquired by children. In D. Dato (Ed.), *Developmental psycholinguistics: Theory and applications* (pp. 99-127) Georgetown University Roundtable on Languages and Linguistics.
Ingram, D. (1976a). *Phonological disability in children*. London: Edward Arnold.
Ingram, D. (1976b). Phonological analysis of a child. *Glossa*, *5 (1),* 1-19.
Ingram, D. (1979). Phonological patterns in the speech of young children. In P. Fletcher & M. Garman (Eds.), *Language acquisition* (pp. 133-148). Cambridge: Cambridge University Press.
Ingram, D. (1981a). On variant patterns of language acquisition. Presentation at the *Biannial Meeting for the Society of Research on Child Development*. Boston, MA.
Ingram, D. (1981b). The emerging phonological system of an Italian-English bilingual child. *Journal of Italian Linguistics*, *2*, 95-113.
Ingram, D. (1981c). *Procedures for the phonological analysis of children's language*. Baltimore, MD: University Park Press.
Ingram, D. (1988a). Jakobson revisited: Some evidence from the acquisition of Polish, *Lingua*, *75*, 55-82.
Ingram, D. (1988b). The acquisition of word-initial [v]. *Language and Speech*, *31*, 77-85.
Ingram, D. (1989a). *First language acquisition: Method, description and explanation.* Cambridge: Cambridge University Press.
Ingram, D. (1989b). Underspecification theory and phonological acquisition. Unpublished manuscript. University of British Columbia, CA.
Ingram, D. (1989c). *Phonological disability in children*. London: Cole & Whurr and San Diego, CA: Singular Publishing Group.
Ingram, D. (1991). Toward a theory of phonological acquisition. In J. Miller (Ed.), *Research on child language disorders: A decade of progress* (pp.55-72). Austin, TX: Pro-Ed.
Ingram, D. (1992). Early phonological acquisition: A crosslinguistic perspective. In C. A. Ferguson, L. Menn, & C. Stoel-Gammon (Eds.), *Phonological development: Models, research, implications* (pp. 147-158). Timonium MD: York Press.
Ingram D. (2002). The measurement of whole-word production. *Journal of Child Language*, *29,* 713-733.
Ingram, D. (2009). Cross-linguistic phonological acquisition. In M. J. Ball, M. R. Perkins, N. Müller, & S. Howard (Eds.), *The handbook of clinical linguistics* (pp. 626-640). Oxford, UK: Blackwell Publisher Ltd.
Ingram, D. (2012). Personal communication.
Ingram, D., Christensen, L., Veach, S., & Webster, B. (1980). The acquisition of word-initial fricatives and affricates in English by children between 2 and 6 years. In G. H. Yeni-Komshian, J. F. Kavanaugh, & C. A. Ferguson, *Child phonology, Vol. I: Production* (pp. 169-192). New York: Academic Press.
Ingram, D., & Dubasik, V. L, (2011). Multidimensional assessment of phonological similarity within and between children. *Clinical Linguistics and Phonetics*, *25*, 962-967.
Ingram, D., Dubasik, V., Liceras, J. M., & Fernández Fuertes, R. (2010). Early phonological acquisition in a set of English-Spanish bilingual twins. In P. Leow & C. Sanz (Eds.), *Implicit and explicit conditions, processes, and knowledge in SLA & bilingualism*

(pp. 195-205). Proceedings of the Georgetown University Roundtable on Languages and Linguistics 2009. Washington: Georgetown University Press.

Ingram, D., & Ingram K. (2001). A whole-word approach to phonological analysis and intervention. *Language, Speech and Hearing Services in Schools*, *32*, 271-283.

Ioup, G. (2008). Exploring the role of age in the acquisition of second language phonology. In J. G. H.Edwards & M. L. Zampini (Eds.), *Phonology and second language acquisition* (pp. 41-62). Philadelphia: John Benjamins.

Ioup, G., & Weinberger, S.H. (1987). *Interlanguage phonology: The acquisition of second language sound system.* Cambridge, Mass.: Newbury House.

Irwin, M. V., & Wong, S. P. (1983). *Phonological development of children 18 to 72 months*. Carbondale, IL: Southern Illinois University Press.

Itô, J. Mester, A., & Padgett, J. (1995). Licensing and underspecification in optimality theory. *Linguistic Inquiry*, *26*, 571-614.

Itoh, H., & Hatch, E. (1978). Second langauge acquisition: A case study. In E. Hatch (Ed.), *Second language acquisition* (pp. 76-88). Rowley, MA: Newbury House.

Jakobson, R. (1941/1968). *Child language, phonological universals and aphasia*. (Keiler, A. Trans.). The Hague: Mouton. Original work published in 1941 as *Kindersprache, aphasie und allgemeine Lautgesetze*.

Jakobson, R. (2004). The sound laws of child language and their place in general phonology. In B. C. Lust & C. Foley (Eds.), *First language acquisition: The essential readings* (pp. 285-296). Oxford: Blackwell Publishers.

Jakobson, R., Fant, G., & Halle, M. (1951). *Preliminaries to speech analysis. The distinctive features and their correlates*. Cambridge, MA: MIT Press.

Jakobson, R., & Halle, M. (1956). *Fundamentals of language*. The Hague: Mouton.

Jarvis, S. (2000). Methodological rigor in the study of transfer: Identifying L1 influence in the interlanguage lexicon. *Language Learning*, *50*, 245-309.

Johnson, C. E., & Lancaster, P. (1998). The development of more than one phonology: A case study of a Norwegian-English bilingual child. *International Journal of Bilingualism*, *2*, 265-300.

Johnson, J. S., & Newport, E. L. (1991). Critical period effects on universal properties of language: The status of subjacency in the acquisition of a second language. *Cognition*, *39*, 215-258.

Johnson, C. E., & Wilson. I. L. (2002). Phonetic evidence for early language differentiation: Research issues and some preliminary data. *International Journal of Bilingualism. 6 (3),* 271-289.

Jusczyk, P. W. (2000). *The discovery of spoken language* (2nd edition). Cambridge, MA: MIT Press.

Jusczyk, P. W., & Thompson, E. J. (1978) Perception of a phonetic contrast in multisyllabic utterances by two-month-old infants. *Perception and Psychophysics*, *23*, 105-109.

Kappa, I. (1998). The realisation of affricates in child language. In S. Lambropoulou (Ed.), *Proceedings of the 12th International Symposium on Theoretical and Applied Linguistics* (pp.322-330). University of Thessaloniki, Greece.

Kappa, I. (1999). Consonant harmony in phonological development. Presentation at *Generative Approaches in Language Acquisition*. University of Potsdam, Germany.

Kappa I. (2000). On the acquisition of fricatives in Modern Greek. In K. Nikolaidis & M. Mattheoudaki (Eds.), *Proceedings of 13th International Symposium on Theoretical and Applied Linguistics* (197-205). University of Thessaloniki, Greece.

Kappa, I. (2001). Alignment and consonant harmony: evidence from Greek. In A. H-J. Do, L. Domínguez, & A. Johansen (Eds.), *Proceedings of the 25th Boston University Conference on Language Development I* (pp. 401-412). Sommerville, MA.: Cascadilla Press.

Kappa I. (2002). A longitudinal study on phonological development of the early words. In: M. Makri-Tsilipakou (Ed.), *Selected Papers: 14th International Symposium on Theoretical and Applied Linguistics* (124-133). Thessaloniki, Greece.

Kappa, I. (2009). On the acquisition of liquids in Modern Greek: A developmental account. *Studies on the Greek Language, 29,* 478-485.

Kappa, I. (in press). *Phonological acquisition*. Athens: Beta Publications (in Greek).

Kehoe, M. (2001). Prosodic patterns in children's multisyllabic word productions. *Language, Speech and Hearing Services in Schools*, *32*, 284-294.

Kehoe, M., Lleó, C., Rakow, M. (2001). Voice onset time in bilingual German-Spanish children. Presentation at the 3rd *International Symposium on Bilingualism*. Bristol, UK.

Kehoe, M. (2011). Relationships between lexical and phonological development: A look at bilingual children - A commentary on Stoel-Gammon's 'Relationships between lexical and phonological development in young children', *Journal of Child Language*, *38*, 75-81.

Kenstowicz, M. (1994). *Phonology in generative grammar*. Cambridge, MA: Blackwell.

Kent, R. D. (1992). The biology of phonological development. In: C. A. Ferguson, L. Menn, & C. Stoel-Gammon (Eds.), *Phonological development: Models, research, implications* (pp. 65-90). Timonium, MD: York Press.

Kenyeres, A. (1938). Comment une petite Hongroise de sept ans apprend le Francais. *Archives de Psychology*, *26*, 321-366.

Keshavarz, M. H., & Ingram, D. (2002). The early phonological development of a Farsi-English bilingual child. *International Journal of Bilingualism*, *6 (3)*, 255-269.

Kim, K. H. S., Relkin, N. R., Lee, K. M., & Hirsch, J. (1997). Distinct cortical areas associated with native and second languages. *Nature*, *388*, 171-174.

King, C. (1967). Functional load and sound change. *Language*, *43*, 831-852.

Kiparsky, P. (1973). 'Elsewhere' in phonology. In P. Kiparsky & S. Anderson (Eds.), *A festschrift for Morris Halle* (pp. 93-106). New York: Halt, Rinehart, and Winston.

Kiparsky, P. (1994). Remarks on markdeness. Handout from the *Second Annual Trilateral Phonology Weekend (TREND 2)*. Stanford University, USA.

Kiparsky, P. & Menn, L. (1977). On the acquisition of phonology. In J. MacNamara (Ed.), *Language learning and thought* (pp. 47-78). New York: Academic Press.

Kirsner, K., Smith, M. C., Lockhart, R. L. S., King, M. L., & Jain, M. (1984). The bilingual lexicon: Language specific units in an integrated network. *Journal of Verbal Learning and Verbal Behavior*, *23*, 519-539.

Kisilevskya, B. S., Hainsa, S. M. J., Browna, C. A. Leec, C. T., Cowperthwaiteb, B., Stutzmana, S. S., Swansburga, M. L., Leec, K. Xied, X., Huangd, H., Yed, H.-H., Zhangd, K., Wang, Z. (2008). Fetal sensitivity to properties of maternal speech and language. *Infant Behavior & Development*, *32*, 59-71.

Klein, W. (1986). *Second language acquisition*. Cambridge: Cambridge University Press.

Kohnert, K. (2008). *Language disorders in bilingual children and adults*. San Diego: Plural.

Kollia, H. B. (1993). Segmental duration changes due to variations in stress, vowel, place of articulation, and voicing of stop consonants in Greek. *Journal of the Acoustical Society of America*, *93*, 2298-2298.

Krashen, S. D. (1973). Lateralization, language learning, and the critical period: Some new evidence. *Language Learning*, *23*, 63-74.

Krashen, S. D. (1982). Acounting for child-adult differences in second language rate and attainment. In S. D. Krashen, R. Scarcella & M. H. Long (Eds.), *Child-adult differences in second language acquisition* (pp. 202-226). Rowley, MA: Newbury House.

Krashen, S. D. (1985). *The input hypothesis: Issues and implications*. N. York: Longman.

Krashen, S. D. (1987). *Principles and practice in second language acquisition*. New York: Prentice Hall.

Krasinski, E. (1989). *Simultaneous acquisition and the bioprogram: A case study*. Unpublished doctoral dissertation, University of the West Indies, Jamaica.

Kroll, J. F., & Sunderman, G. (2003). Cognitive processes in second language learners and bilinguals: the development of lexical and conceptual representations. In C. Doughty & M. H. Long (Eds.), *The handbook of second language acquisition* (pp. 104-129). Cambridge, MA: Blackwell.

Kuhl, P. (1983). Perception of auditory equivalence classes for speech in early infancy. *Infant Behaviour and Development*, *6*, 263-285.

Kuhl, P. K. (2000). A new view of language acquisition. *Proceedings of the National Academy of Science*, *97*, 11850-11857.

Kuhl, P. K. (2010). The linguistic genius of babies. Online: htttp://www.ted.com/talk/ patriciakuhlthelinguisticgeniusofbabies.html.

Kuhl, P. K., Conboy, B. T., Coffey-Corina, S., Rivera-Caxiola, P., & Nelson. T. (2008). Phonetic learning as pathway to language: new data and native language magnet theory expanded. *Philosophical Transactions of the Royal Society Bulletin*, *363*, 979-1000.

Ladefoged, P. (1993). *A course in phonetics.* Fort Worth: Harcourt, Brace, Jovanovich.

Lado, R. (1957). *Linguistics across cultures: Applied linguistics for language teachers*. Ann Arbor, MI: University of Michigan Press:

Lai, C. S. L., Fisher, S. E., Hurst, J. A., Vargha-Khadem, F., & Monaco, A. P. (2001) A fork head domain gene is mutated in a severe speech and language disorder. *Nature*, *413*, 519-523.

Landauer, T. K., & Dumais, S. T. (1997). A solution to Plato's problem: The latent semantic analysis theory of the acquisition, induction and representation of knowledge. *Psychological Review*, *104*, 211-240.

Larsen-Freeman, D., & Long, M. H. (1991). *An introduction to second language acquisition research.* London: Longman.

Larsen-Freeman, D. (1997). Chaos/complexity science and second language acquisition. *Applied Linguistics*, *18*, 141-165.

Lenneberg, E. (1967). *Biological foundations of language*. New York: Wiley.

Leonard, L. B. (1985). Unusual and subtle phonological behavior in the speech of phonologically disordered children. *Journal of Speech and Hearing Disorders, 50,* 4-13.

Leonard, L. B., Newhoff, M., & Mesalam, L. (1980). Individual differences in early child phonology. *Applied Psycholinguistics*, *1*, 7-30.

Leonard, L. B., Schwartz, R. G., Folger, M. K., & Wilcox, M. J. (1978). Some aspects of child phonology in imitative and spontaneous speech. *Journal of Child Language*, *5 (3)*,

403-415.
Leonard, L. B., Schwartz, R. G., Morris, B., & Chapman, K. (1981). Factors influencing early lexical acquisition: Lexical orientation and phonological composition. *Child Development, 52*, 882-887.
Leopold, W. F. (1949). *Speech development of a bilingual child: A linguist's record.* Evanston, IL: Northwestern University Press.
Leopold, W. F. (1953/1954). Patterning in children's language learning. *Language Learning*, *5*, 1-14.
Levelt, C. C. (1994). *On the acquisition of place*. Doctoral dissertation 8, Holland Institute of Generative Linguistics (HIL), Leiden University. The Hague: Holland Academic Graphics.
Levelt, W. J. M. (1989). *Speaking: From intention to articulation.* Cambridge, MA: MIT Press.
Liberman, A. M., Copper, F. S., Shankweiler, D. P., & Studdert-Kennedy, M. G. (1967). Perception of the speech code. *Psychological Review*, *74*, 431-461.
Lightfoot, D. (1984). The relative richness of triggers and the bioprogram. *The Behavioral and Brain Sciences*, *7*, 2-18.
Linell, P. (1979). *Psychological reality in phonology*. Cambridge: Cambridge University Press.
Lisker, L., Abramson, A. S. (1964). A cross-linguistic study of voicing initial stops: Acoustical measurements. *Word*, *20*, 384-422.
Lleó, C. (1990). Homonymy and reduplication: On the extended availability of two strategies in phonological acquisition. *Journal of Child language*, *17*, 267-278.
Lleó, C., & Kehoe, M. (2002). On the interaction of phonological systems in child bilingual acquisition. *International Journal of Bilingualism*, *6*, 233-237.
Lleó, C., & Prinz, M. (1996). Consonant clusters in child phonology and the directionality of syllable structure assignment. *Journal of Child Language*, *23*, 31-56.
Lleó, C., & Prinz, M. (1997). Syllable structure parameters and the acquisition of affricates. In S. J. Hannas & M. Young-Scholten (Eds.), *Focus on phonological acquisition* (pp. 143-163). Amsterdam: John Benjamins.
Locke, J. L. (1960/2000). Essay concerning human understanding. In J. Gary, R. Stecker, & J. P. Wright (Eds.), *John Locke: An essay concerning human understanding in focus* (pp. 45-139). Routledge: Taylor & Francis.
Locke, J. L. (1983). *Phonological acquisition and change*. New York: Academic Press.
Locke, J. L. (1990). Structure and stimulation in the ontogeny of spoken language. *Developmental Psychobiology*, *23 (7)*, 621-643.
Lombardi, L. (1990). The nonlinear organization of the affricate. *Natural Language and Linguistic Theory*, *8*, 375-425.
Long, S. H., & Channell, R. W. (2001). Accuracy of four language analysis procedures performed automatically. *American Journal of Speech-Language Pathology*, *10*, 180-181.
Loraine, S. (2008). *Vocabulary development: Super duper handouts*, number 149. Greenville, SC: Super Duper Publications.
Louko, L. J., & Edwards, M. L. (2001). Issues in collecting and transcribing speech samples. *Topics in Language Disorders, 21,* 1-11.

Lowie, W (2010). Early L2 phonology: a dynamic approach. In M. Wrembel, M. Kul, & K. Dziubalska-Kołaczyk (Eds.), *Achievements and perspectives in the acquisition of second language speech: New Sounds 2010* (pp. 159-170). Frankfurt: Peter Lang.

Luce, P. A., & Pisoni, D. B. (1998). Recognizing spoken words: the neighborhood activation model. *Ear and Hearing, 19*, 1-36.

Lust, B. C., & Foley, C. (Eds.). (2004). *First language acquisition: The essential readings*. Oxford: Blackwell Publishers.

Kenyeres, E. (1926). *A gyermek elsö szavai es a szófajók föllépése*. Budapest: Kisdednevelés.

Macken, M. A. (1979). Developmental reorganization of phonology: A hierarchy of basic units of acquisition. *Lingua*, *49*, 11-49.

Macken, M. A. (1980a). Aspects of the acquisition of stop systems: A cross-linguistic perspective. In G. H. Yeni-Komshian, J. F. Kavanagh, & C. A. Ferguson (Eds.), *Child phonology 1: Production* (pp. 143-168). New York: Academic Press.

Macken, M. A. (1980b). The child's lexical representations: The 'puzzle-puddle-pickle' evidence. *Journal of Linguistics*, *16*, 1-17.

Macken, M. A. (1992). Where is phonology? In C. A. Ferguson, L. Menn, & C. Stoel-Gammon (Eds.), *Phonological development: Models, research, implications* (pp. 249-269). Timonium MD: York Press.

Macken, M. A. (1995). Phonological acquisition. In J. Goldsmith (Ed.), *A handbook of phonological theory* (pp. 671-696). Oxford: Blackwell.

Macken, M. A, & Barton, D. (1980). The acquisition of the voicing contrast in English: A study of voice onset time in word-initial stop consonants. *Journal of Child Language, 7,* 41-74.

Macken, M. A., & Ferguson, C. A. (1987). Phonological universals in language acquisition. In G. Ioup & S. H. Weinberger (Eds.), *Interlanguage phonology: The acquisition of second language sound system* (pp. 3-22). Cambridge, Mass.: Newbury House.

Macleod, A. A., Laukys, K., & Rvachew, S. (2011). The impact of bilingual language learning on whole-word complexity and segmental accuracy among children aged 18 and 36 months. *International Journal of Speech and Language Pathology*, *13*, 490-499.

Mackey, W. F. (1967). *Bilingualism as a world problem. Le bilingualisme: Phenomene mondial.* Montreal: Harvest House.

Macnamara, J., & Kushnir, S. (1971). Linguistic independence in bilinguals: The input switch. *Journal of Verbal Learning and Verbal Behavior*, *10*, 480-487.

MacWhinney, B. (1998). The CHILDES system. In: C. W. Ritchie & T.K. Bhatia (Eds.), *Handbook of child language acquisition* (pp. 457-494). Amsterdam: Elsevier Science and Technology Books.

MacWhinney, B. (2000). *The CHILDES project: Tools for analyzing talk*. Mahwah, NJ: Lawrence Erlbaum.

MacWhinney, B. (2001). Last words. In J. Cenoz & F. Genesee (Eds.), *Trends in bilingual acquisition* (pp. 273-288). Amsterdam: John Benjamins.

MacWhinney, B. (2004). A multiple process solution to the logical problem of acquisition. *Journal of Child Language*, *31*, 883-914.

MacWhinney, B., & Snow, K. (1985). The child language data exchange system. *Journal of Child Language*, *12*, 271-296.

Maddieson, I. (1984). *Patterns of sounds*. Cambridge: Cambridge University Press.

Magoula, E. (2000). *The acquisition of the phonological system in Modern Greek: The case of consonants*. Unpublished doctoral dissertation. University of Athens, Greece (in Greek).
Mairal, R., & Gil, J. (Eds.) (2006). *Linguistic universals*. Cambridge: Cambridge University Press.
Major, R. C. (1977). Phonological differentiation of a bilingual child. *Papers in Psycholinguistics and Sociolinguistics*. *Working Papers in Linguistics*, 22, 88-122.
Major, R. C. (2001). *Foreign accent: The ontogeny and phylogeny of second language phonology*. Hillsdale, NJ: Lawrence Erlbaum.
Major, R. C. (2008). Transfer in second language phonology. In J. G. H. Edwards & M. L. Zampini (Eds.), *Phonology and second language acquisition* (pp. 63-94). Philadelphia/Amsterdam: John Benjamins.
Malikouti, A. (1970). Transformational morphology of Modern Greek name. *Athens: Library of the Athenian Filoeducational Society*, *56*.
Malikouti-Drachman, A. (1984). Syllables in Modern Greek. In W. Dressler, W. U. Dressler, H. C. Luschützky, O. E. Pfeiffer, & J. R. Rennison (Eds.), *Phonologica* (pp. 181-186). Cambridge, UK: Cambridge University Press.
Malikouti-Drachman, A. (2001a). Syllabic constraints and dialectal variation. *Studies in Greek Linguistics*, *21,* 402-413.
Malikouti-Drachman, A. (2001b). Greek phonology: a contemporary perspective. *Journal of Greek Linguistics*, *2,* 187-243.
Malikouti-Drachman, A., & Drachman, G. (1976). The acquisition of stress in Modern Greek. In G. Drachman (Ed.), *Salzburger Beitrage zur Linguistik 2* (pp. 277-289). Tübingen: Gunter NarrVerlag.
Malikouti-Drachman, A., & Drachman, G. (1992). Greek clitics and lexical phonology. In W. U. Dressler, H. C. Luschützky, O. E. Pfeiffer, & J. R. Rennison (Eds.), *Phonologica 1988* (pp. 197-206). Cambridge: Cambridge University Press.
Mampe, B., Friederici, A. D., Christophe, A., & Wermke, K. (2009). Newborns' cry melody is shaped by their native language. *Current Biology*, *19 (23)*, 1994-1997.
Maneva, B., & Genesee, F. (2002). Bilingual babbling: evidence for language differentiation in dual language acquisition. In B. Skarabela, S. Fish, & A. Do (Eds.), *BUCLD 26: Proceedings of the 16th Annual Boston University Conference on Language Development* (Vol. 1, pp. 383–392), Somerville, MA: Cascadilla Press.
Marian, V., & Spivey, M. (2003). Competing activation in bilingual language processing: within- and between language competition. *Bilingualism: Language and Cognition*, *6 (2)*, 97-115.
Marcus, G. F. (1993). Negative evidence in language acquisition. *Cognition*, *46*, 53-85.
Markman, E. M., Wasow, J. L., & Hansen, M. B. (2003). Use of the mutual exclusivity assumption by young word learners. *Cognitive Psychology*, *47*, 241-275.
Marlett, S. A., & Stemberger, J. P. (1983). Empty consonants in Seri. *Linguistic Inquiry*, *14*, 617-639.
Marslen-Wilson W. (1993). *Lexical representation and process*. Cambridge, MA: MIT Press.
Masterson, J. J., & Oller, D. K. (1999). Use of technology in phonological assessment: Evaluation of early meaningful speech and prelinguistic vocalizations. *Seminars in Speech and Language*, *20 (2)*, 133-147.

Max Planck Institute (2012). *ELAN*. Online: www.lat-mpieu/tools/elan.
McCarthy, J., & Prince, A. (1994). The emergence of unmarked: Optimality in prosodic morphology. In M. Gonzalez (Ed.), *Proceedings of the North East Linguistic Society 24* (pp. 333-379). Amherst, MA: GLSA.
McCune, L., & Vihman, M. (2001). Early phonetic and lexical development. *Journal of Speech, Language, and Hearing Research*, *44*, 670-684.
McCurry, W. H., & Irwin, O. C. (1953) A study of word approximations in the spontaneous speech of infants. *Journal of Speech and Hearing Disorders, 18,* 133-139.
McLaughlin, B. (1978). *Second language acquisition in childhood.* Hillsdale, NJ: Lawrence Erlbaum.
McLaughlin, B. (1995). *Fostering second language development in young children: Principles and practices.* NCRCDSLL Educational Practice Reports. Online: http://escholarship.org/uc/item/23s607sr.
McLeod, S., & Bleile, K. (2003). Neurological and developmental foundations of speech acquisition. Invited seminar presentation at the *American Speech and Hearing Association Convention*, November 2003, Chicago, IL.
McLeod, S. (2007). *The international guide to speech acquisition*. Clifton Park, NY: Thomson Delmar Learning.
Meisel, J. M. (1989). Early differentiation of languages in bilingual children. In K. Hyltenstam & L. K. Obler (Eds.), *Bilingualism across the lifespan: Aspects of acquisition, maturity and loss* (pp. 13-40). Cambridge: Cambridge University Press.
Meisel, J. M. (2001). The simultaneous acquisition of two first languages: Early differentiation and subsequent development of grammars. In J. Cenoz & F. Genesee (Eds.), *Trends in bilingual* acquisition (pp. 11-42). Amsterdam: John Benjamins.
Meisel, J. M. (2004). The bilingual child. In T. Bhatia & W. R. Ritchie (Eds.), *The handbook of bilingualism* (pp. 91-113). Oxford: Blackwell.
Meisel. J. M. (2007). The weaker language in early child bilingualism: Acquiring a first language as a second language? *Applied Psycholinguistics*, *28*, 495-514.
Meisel, J. M. (2010). Age of onset in successive acquisition of bilingualism: Effects on grammatical development. In M. Kail & M. Hickman (Eds.), *Language acquisition across linguistic and cognitive systems* (pp. 225-247). Amsterdam: John Benjamins.
Meisel, J. M., Clahsen, H., Pienemann, M. (1981). *Studies in Second Language Acquisition*, *3 (2)*, 109-135.
Mellow, J. D., Reeder, K., & Forster, E. (1996). Using time-series research designs to investigate the effects of instruction on SLA. *Studies in Second Language Acquisition*, *18*¸ 325-350.
Meltzoff, A. N., & Moore, M. K. (1977). Imitation of facial and manual gestures by human neonates. *Science*, *198 (4312)*, 75-78.
Menn, L. (1971). Phonotactic rules in beginning speech. *Lingua*, *26*, 225-251.
Menn, L. (1976). *Pattern, control and contrast in beginning speech: A case study in the development of word form and word function*. Unpublished doctoral dissertation. University of Illinois at Urbana-Champaign, USA.
Menn, L. (1978). Phonological units in beginning speech. In A. Bell & J. B. Hooper (Eds.), *Syllables and segments* (pp. 157-172). Amsterdam: North Holland.
Menn, L. (1983). Developments of articulatory, phonetic and phonological capabilities. In B. Butterworth (Ed.), *Language production* (pp. 3-50). London: Academic Press.

Menn, L. & Matthei, E. (1992). The 'Two-Lexicon' account of child phonology looking ahead. In C. A. Ferguson, L. Menn, & C. Stoel-Gammon (Eds.), *Phonological development: Models, research, implications* (pp. 211-247). MD: York Press.

Mennen, I., & Okalidou, A. (2007). Acquisition of Greek phonology: An overview. In S. McLeod (Ed.), *The international guide to speech acquisition* (pp. 398-407). Clifton Park, NY: Thomson Delmar Learning.

Merriam, S. (1998). *Qualitative research and case study applications in education.* San Francisco: Jossey-Bass.

Miles, M., Huberman, A. M. (1994). *Qualitative data analysis*. Thousand Oaks, CA: Sage.

Miller, J., & Chapman, R. (1983). *SALT: Systematic analysis of language transcripts, User's Manual*. Madison, WA: University of Wisconsin Press.

Mohanan, K. P. (1992). Emergence of complexity in phonological development. In C. A. Ferguson, L. Menn, & C. Stoel-Gammon (Eds.), *Phonological development: Models, research, implications* (pp. 635-662). MD: York Press.

Montrul, S. A. (2008). *Incomplete acquisition in bilingualism: Re-examining the age factor,* John Benjamins: Amsterdam/Philadelphia.

Montrul, S. A. (2009). Re-examining the fundamental difference hypothesis: What can early bilinguals tell us? *Studies in Second Language Acquisition 31 (2)*, 225-257.

Montrul, S. A. (2011). Interfaces and incomplete acquisition. *Lingua 212 (4)*, 591-604.

Moon, C., Cooper, R. P., & Fifer, W. P. (1993). Two-day-olds prefer their native language. *Infant Behavior and Development*, *16*, 495-500.

Morisette, M. L., & Gierut, J. A. (2001). Variables governing diffusion in phonological acquisition. In A. H.-J. Do, Dominguez, L., & Johansen, A. (Eds.), *Proceedings of the 25th Annual Boston University Conference on Language Development* (pp. 535-542). Somerville, MA: Cascadilla Press.

Morrisette, M. L., & Gierut, J. A. (2002). Effects of word frequency and neighborhood density on phonological treatment. *Journal of Speech, Language and Hearing Research*, *45*, 143-159.

Morse, P. A. (1972). The discrimination of speech and nonspeech stimuli in early infancy. *Journal of Experimental Child Psychology*, *13*, 477-492.

Morton, J. (1979). Facilitation in word recognition: experiments causing change in the logogen model. In P. A. Kohlers, M. E. Wrolstad & H. Borma (Eds.), *Processing of visible language* (pp. 259-268). New York: Plenum.

Moskowitz, A. I. (1971). *Acquisition of phonology*. Unpublished doctoral issertation, University of California, Berkeley, USA.

Moulton, W. (1962). Toward a classification of pronunciation errors. *Modern Language Journal*, *46*, 101-109.

Müller, N., & Hulk, A. (2001). Crosslinguistic influence in bilingual acquisition: Italian and French as recipient languages. *Bilingualism: Language and Cognition*, *4*, 1-21.

Murray W., & Corby, J. (1970). *Read with me,* Book 11. London: Ladybird Books.

Naeser, M. A. (1970). *The American child's acquisition of differential vowel duration*. Unpublished doctoral dissertation. University of Wisconsin, Madison, USA.

Nation, I. S. P. (2001). *Learning vocabulary in another language*. Cambridge: Cambridge University Press.

Natsopoulos, D. (1976). *Later linguistic development in Greek monoglot and bilingual children: Detection of ambiguity with verbs of reporting and planning*. Unpublished doctoral dissertation, University of Reading, UK.
Nemser, W. (1971). Approximate systems of foreign language learners. *International Review of Applied Linguistics, 9,* 115-124.
Nespor, M. (1999). *Phonology*. Athens: Patakis Publications (adapted in Greek by A. Ralli & M. Nespor).
Nespor, M., Peña, M., & Mehler, J. (2003). On the different roles of vowels and consonants in speech processing and language acquisition. *Lingue e Linguaggio, 2,* 203-229.
Newport, E. (1976). Motherese: The speech of mothers to young children. In N. Castelan, D. Pisoni, & G. Potts (Eds.), *Cognitive theory* (pp. 177-210). Hillsdale, NJ: Lawrence Erlbaum.
Newton, B. (1961). The rephonemicization of Modern Greek. *Lingua*, *10*, 275-284.
Newton, B. (1972). *The generative interpretation of dialect: A study of Modern Greek phonology*. Cambridge: Cambridge University Press.
Nice, M. (1915). The development of a child's vocabulary in relation to environment. *Pedagogical Seminary*, *17*, 565-573.
Nice, M. (1925). Length of sentence as a criterion of child progress in speech. *Journal of Educational Psychology*, *16*, 370-379.
Nicoladis, E., & Genesee, F. (1996). A longitudinal study of pragmatic differentiation in young bilingual children. *Language Learning, 46*, 439-464.
Norbert, F. (2011). Imbalances in bilingual development: A key to understanding the faculty of language. *Language Sciences*, *33*, 76-89.
Odlin, T. (2008). Cross-linguistic influence. In C. Doughty & M. H. Long (Eds.), *The handbook of second language acquisition* (pp. 436-486). Cambridge, MA: Blackwell.
Ohala, J. J. (1980). Moderator's summary of symposium on 'Phonetic universals in phonological systems and their explanation.' *Proceedings of the 9th International Congress of Phonetic Sciences* (Vol. 3, pp. 181-194). Copenhagen: Institute of Phonetics.
Ohala, J. J., & Ohala, M. (1993). The phonology of nasal phonology: Theorems and data. In M. K. Huffman & R. A. Krakow (Eds.), *Nasals, nasalization and the velum* (pp. 225-249). San Diego, CA: Academic Press.
Oksaar, E. (1983). Multilingualism and multiculturalism from the linguist's point of view. In T. Husén & S. Opper (Eds.), *Multicultural and multilingual education in immigrant countries* (pp. 17-36). Wenner Gren Symposium Series, Vol. 38, Oxford: Pergamon Press.
Oller, D. K. (1986). Metaphonology and infant vocalizations. In B. Lindblom (Ed.), *Precursors of early speech* (pp. 21-35). New York: Stockton Press.
Oller, D. K., Wieman, L., Doyle, W., & Ross, C. (1976). Infant babbling and speech. *Journal of Child Language*, *3*, 1-11.
Olmsted, D. (1971). *Out of the mouth of babes*. The Hague: Mouton.
Olswang, L. B., & Bain, B. A. (1985). Monitoring phoneme acquisition for making treatment withdrawal decisions. *Applied Psycholinguistics*, *6*, 17-37.
Ortega, L., & Iberri-Shea, G. (2005). Longitudinal research in second language acquisition: recent trends and future directions. *Annual Review of Applied Linguistics*, *25*, 26-45.
Padilla, A., & Lindholm, K. J. (1984). Hispanic behavioural science research: Recommendations for future research. *Hispanic Journal of Behavioural Sciences*, *6*, 13-32.

PAL (Panhellenic Association of Logopaedics) (1995). *Assessment of phonetic and phonological development*. Athens: PAL (in Greek).
Papadopoulou, K. (2000). *Phonological acquisition of Modern Greek*. Unpublished BSc Honours dissertation. University of Newcastle, UK.
Paradis, C. (2006). The unnatural /Cju/ (< foreign /Cy/) sequence in Russian loanwords: a problem for the perceptual view. *Lingua*, *116*, 976-995.
Paradis, J. (1996). Prosodic development and differentiation in bilingual first language acquisition. In A. Stringfellow, A. D. Cahana-Amitay, E. Hughes, & A. Zukowski (Eds.), *Proceedings of the 20th Annual Boston University Conference on Language Development* (pp. 528-539). Somerville, MA: Cascadilla Press.
Paradis, J. (2000). Beyond 'One system or two': Degrees of separation between languages of French-English bilingual children. In S. Döpke (Ed.), *Cross-linguistic structures in simultaneous bilingualism* (pp. 175-200). Amsterdam/Philadelphia: John Benjamins.
Paradis, J. (2001). Do bilingual two-year-olds have separate phonological systems? *International Journal of Bilingualism*, *5*, 19-38.
Paradis, J., Genesee, F., & Crago, M. (2011). *Dual language development and disorders*, Baltimore: Brookes.
Parker, M. D., & Brorson, K. (2005). A comparative study between mean length of utterance in morphemes (MLUm) and mean length of utterance in words (MLUw). *First Language*, *25*, 365-376.
Patowski, M. (1980). The sensitive period for the acquisition of syntax in a second language. *Language Learning*, *30*, 449-472.
Patterson, J. L. (2002). Relationships of expressive vocabulary to frequency of reading and television experience among bilingual toddlers. *Applied Psycholinguistics*, *23*, 493-508.
Patterson, J. L., & Pearson, B. Z. (2004). Bilingual lexical development: Influences, contexts, and processes. In B. A. Goldstein (Ed.), *Bilingual language development and disorders in Spanish-English speakers* (pp. 77-104). Baltimore, MD: Paul H. Brookes.
Patton, M. Q. (1990). *Qualitative evaluation methods*. Thousand Oaks, CA: Sage.
Pavlenko, A. (Ed.) (2008). *The bilingual mental lexicon: Interdisciplinary approaches*. Clevedon, England: Multilingual Matters.
Pearson, B., Fernandez, S., & Oller, D. K. (1993). Lexical development in bilingual infants and toddlers: comparison to monolingual norms. *Language Learning*, *43*, 93-120.
Penfield, W. & Roberts, L. (1959). *Speech and brain mechanisms*. Princeton: Princeton University Press.
Perani, D., Paulesu, E., Sebastian Galles, N., Dupoux, E., Dehaene, S., Betinardi, V., Cappa, S.F., Fazio, F., & Mehler, J. (1998). The bilingual brain: Proficiency and age of acquisition of the second language. *Brain*, *121*, 1841-1852.
Perani, D., Abutalebhi, J., Paulesu, E., Brambati, S., Scifo, P., Cappa, … & Dupoux, E. (2003). The role of age of acquisition and language usage in early high proficient bilinguals: A FMRI study during verbal fluency. *Human Brain Mapping*, *19*, 179-182.
Peters, S. (1972). The projection problem: How is grammar to be selected? In S. Peters (Ed.), *Goals of linguistic theory* (pp. 171-188). Englewood Cliffs, NJ: Prentice Hall.
Pettito, L. A., Berens, M. S., Kovelman, I., Dubins, M. H., Jasinska, K., & Salinsky, M. (2012). The 'Perceptual wedge hypothesis' as the basis for bilingual babies' phonetic processing advantage: New insights from FNIRS brain imaging. *Brain and Language, 121 (2)*, 130-143.

Piaget, J. (1955). *The language and thought of a child*. Translated by M. Gabain. Cleveland: Meridian Books.
Piaget, J. (1977). *The grasp of consciousness: Action and concept in the young child*. London: Routledge.
Piattelli-Palmarini M. (1980). Language and learning: The debate between Jean Piaget and Noam Chomsky. In B. C. Lust & C. Foley (Eds.), *First language acquisition: the essential readings* (pp. 64-98). Oxford: Blackwell Publishers.
Pienemann, M., & Keßler, J. (2007). Measuring bilingualism. In P. Auer & L. Wei (Eds.), *Handbook of multilingualism and multilingual communication* (pp. 247-267). The Hague: Mouton de Gruyter.
Pinker, S. (1994). *The language instinct*. New York: Murrow.
Piske, T., & Young-Scholten, M. (Eds.), (2009). *Input matters in SLA*. Clevedon: Multilingual Matters.
Place, S., & Hoff. E. (2011). Properties of dual language exposure that influence 2-year-olds' bilingual proficiency. *Child Development*, *82 (6)*, 1834-1849.
Polinsky, M., & Kagan, O. (2007). Heritage languages: in the 'wild' and in the classroom. *Language and Linguistics Compass, 1 (5)*, 368-395**.**
Poole, L (1934). Genetic development of articulation of consonant sounds in speech. *Elementary English Review*, *11*, 157-161.
Poplack, S. (1980). Sometimes I'll start a sentence in Spanish Y TERMINO EN ESPAÑOL: Towards a typology of code-switching. *Linguistics*, *18*, 581-618.
Poulisse, N., Bongaerts, T., & Kellerman, E. (1990). *The use of compensatory strategies by Dutch learners of English.* Dortdecht: Foris.
Powell, T. W. (2001). Phonetic transcription of disordered speech. *Topics in Language, 25*, *Disorders, 21,* 52-72.
Prather, E. M., Hedrick, D. L., & Kern, C. A. (1975). Articulation development in children aged two to four years. *Journal of Speech and Hearing Disorders, 40,* 179-191.
Preyer, W. (1882). *Die Seele des Kindes*. Leipzig: Grieben's.
Prigogine, I., & Stengers, I. (1984). *Order out of chaos*. New York: Fontana.
Prince, A., & Smolensky, P. (1993). *Optimality theory: Constraint interaction in generative grammar*. Unpublished master's dissertation. Rutgers University, NJ and University of Colorado at Boulder.
Prince, A., & Smolensky, P. (2004). *Optimality theory: Constraint interaction in generative grammar.* Oxford: Basil Blackwell.
Pye, C. (1986). One lexicon or two? An alternative interpretation of early bilingual speech. *Journal of Child Language*, *13*, 591-593.
Pye, C., Ingram, D., & List, H. (1987). A comparison of initial consonant acquisition in English and Quiche. In K. E. Nelson & A. van Kleeck (Eds.), *Children's language*. Hillsdale, N.J: Lawrence Erlbaum.
Quay, S. (1995). The bilingual lexicon: Implications for studies of language choice. *Journal of Child Language*, *22*, 369-387.
Ramscar M., & Gitcho, N. (2007), Developmental change and the nature of learning in childhood, *Trends in Cognitive Sciences*, *11 (7)*, 274-279.
Ramscar, M., & Yarlett, D. (2007). Linguistic self-correction in the absence of feedback: A new approach to the logical problem of language acquisition. *Cognitive Science*, *31*, 927-960.

Ratner, N. B., & Menn, L. (2000). In the beginning was the wug: forty years of language-elicitation studies. In L. Menn (Ed.), *Methods for studying language production*. Mahwah, NJ: Lawrence Erlbaum.
Reber, A. S. (1993). *Implicit learning and tacit knowledge: An essay on the cognitive unconscious*. New York: Oxford.
Reber, A. S., & Allen, R. (1978). Analogic and abstraction strategies in synthetic grammar learning: A functionalist interpretation. *Cognition*, *6*, 189-221.
Redlinger, W., & Park, T. (1980). Language mixing in young bilinguals. *Journal of Child Language*, *7*, 337-352.
Reiss, C. (2003). Deriving the feature-filling/feature-changing contrast: An application to Hungarian vowel harmony. *Linguistic Inquiry*, *34 (2)*, 199-224.
Revithiadou, A. & Tzakosta, M. (2004). Markedness hierarchies vs. positional faithfulness and the role of multiple grammars in the acquisition of Greek. In S. Baauw & J. van Kampen (Eds.), *Proceedings of Generative Approaches to Language Acquisition 2003* (Vol. 2, pp. 377-388), Utrecht University, The Netherlands.
Rice, K., & Avery, P. (1995). Variability in a deterministic model of language acquisition: A theory of segmental elaboration. In J. A. Archibald (Ed.), *Phonological acquisition and phonological theory* (pp. 23-42). Hillsdale, NJ: Lawrence Erlbaum.
Richardson, L. (2000). Writing: A method of enquiry. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of Qualitative Research* (pp. 516-529). Thousand Oaks, CA: Sage.
Richtsmeier, P. (2010). Child phoneme errors are not substitutions. *Toronto Working Papers in Linguistics*, *33*, 1-15.
Ritchie, W. R., & Bhatia, T. J. (Eds.) (1996). *Handbook of second language acquisition*. San Diego: Academic Press.
Ritchie, J., & Lewis, J. (Eds.) (2003). *Qualitative research practice: A guide for social science students and researchers.* Thousand Oaks, CA: Sage.
Roca, I., & Johnson, W. (1999). *A course in phonology*. Oxford: Blackwell Publishers.
Roeper, T. (1999). Universal bilingualism. *Bilingualism: Language and Cognition*, *2 (3)*, 169-186.
Roeper, T., & de Villiers, J. (1992). Ordered decisions in the acquisition of wh-questions. In J. Weissenborn, H. Goodluck, & T. Roeper (Eds.), *Theoretical issues in language acquisition: Continuity and change in development* (pp. 191-236). Hillsdale, NJ: Lawrence Erlbaum.
Ronjat, J. (1913). *Le développement du langage observé chez un enfant bilingue*. Paris: Champion.
Rosansky, E. J. (1976). Methods and morphemes in second language acquisition research. *Language Learning*, *26*, 409-425.
Rose, Y. (2000). *Headedness and prosodic licensing in the L1 acquisition of phonology*. Unpublished doctoral dissertation. McGill University, Montreal, Canada.
Rose, Y., MacWhinney, B., Byrne, R., Hedlund, G., Maddocks, K., O'Brien, P., & Wareham, T. (2005). Introducing phon: A software solution for the study of phonological acquisition. In D. Bamman, T. Magnitskaia, & C. Zaller (Eds.), *30th Annual Boston University Conference on Language Development* (pp. 489-500). Somerville, MA: Cascadilla Press.
Rutherford, & M. Sharwood Smith (Eds.), *Grammar and second language teaching: A book of readings* (pp. 19-30). Boston, Massachusetts: Heinle and Heinle Publishers.

Rytting, A. C. (2005). An iota of different attitudes to yod in lexical and social contexts. *Journal of Greek Linguistics*, *6*, 151-185.
Sagey, E. C. (1986). The representation of features and relations in non-linear phonology. Unpublished doctoral dissertation. Massachusetts Institute of Technology, USA.
Sagey, E. C. (1988). On the ill-formedness of crossing association lines. *Linguistic Inquiry*, *19*, 109-118.
Sampson, G. P., & Richards, J. C. (1973). Learner language systems. *Language Sciences*, *19*, 18-25.
Sander, E. (1972). When are speech sounds learned? *Journal of Speech and Hearing Research,* 37, 55-63.
Schlyter, S. (1993). The weaker language in bilingual Swedish-French children. In K. Hyltenstam & A. Viberg (Eds.), *Progression and regression in language*. Cambridge: Cambridge University Press.
Schmid, M. S., Verspoor, M., & MacWhinney, B. (2011). Coding and extracting. In M. Verspoor, K. de Bot, W. Lowie (Eds.), *A Dynamic approach to second language development* (pp. 39-54). Amsterdam/Philadelphia: John Benjamins.
Schmidt, R., & Frota, S. (1986). Developing basic conversational ability in a second language: A case study of an adult learner of Portuguese. In R. Day (Ed.), *Talking to learn: Conversation in second language acquisition* (pp. 237-326). Rowley, MA: Newbury House.
Schmitt, L. S., Howard, B. H., & Schmitt, J. F. (1983). Conversational speech sampling in the assessment of articulation proficiency. *Language, Speech, and Hearing Services in Schools, 14,* 210-214.
Schnitzer, M. L., & Krasinski, E. (1994). The development of segmental phonological production in a bilingual child. *Journal of Child Language*, *21*, 585-622**.**
Schnitzer, M. L., & Krasinski, E. (1996). The development of segmental phonological production in a bilingual child: A contrasting second case. *Journal of Child Language*, *23*, 547-571**.**
Schreuder, R., & Weltens, B. (Eds.) (1993). *The bilingual lexicon*. Amsterdam/Philadelphia: John Benjamins.
Schultze, F. (1880/1971). The speech of the child. In A. Bar-Adon & F. Leopold (Eds.), *Child language: A book of readings* (pp. 187-215). Englewood Cliffs, NJ: Prentice Hall.
Schumann, J. (1997). *The neurobiology of affect in language*. Malden, MA: Blackwell.
Schwartz, R., & Leonard, L. (1982). Do children pick and choose? An examination of lexical selection and avoidance in early acquisition. *Journal of Child Language*, *9*, 319-336.
Secord, W. A., & Donohue, J. S. (2004). *Clinical assessment of articulation and phonology: Supplemental examiner's manual*. Greenville, SC: Super Duper Publications.
Segalowitz, N. (2003). Automaticity and second languages. In C. Doughty & M. H. Long (Eds.), *The handbook of second language acquisition* (pp. 383-408). Cambridge, MA: Blackwell.
Selinker, L. (1969). Language transfer. *General Linguistics*, *9 (2)*, 67-92.
Selinker, L. (1972). Interlanguage**.** *International Review of Applied Linguistics*, *10*, 209-231.
Selinker, L., Swain, M., & Dumas, G. (1975) The interlanguage hypothesis extended to children. *Language Learning*, *25 (1)*, 139-152.

Selkirk, E. (1984). On the major class features and syllable theory. In M. Aronoff & R. T. Oehrle (Eds.), *Language sound structure: Studies in phonology presented to Morris Halle by his teacher and students* (pp. 107-136). Cambridge, MA: MIT press.

Setatos, M. (1974). *Phonology of Modern Greek*. Athens: Editions Papazisis (in Greek).

Shapira, R. (1978). The non-learning of English: Case study of an adult. In E. Hatch (Ed.), *Second language acquisition* (pp. 246-255). Rowley, MA: Newbury House.

Shinn, M. (1900). *The biography of a baby*. New York: Houghton Mifflin.

Shriberg, L. D., Austin, D., Lewis, B.A., McSweeny, J. L., & Wilson, D. L. (1997). The percentage of consonants correct (PCC) metric: Extensions and reliability data. *Journal of Speech, Language and Hearing Research, 40,* 708-722.

Silverman, D. (2000). *Doing qualitative research: A practical handbook.* Thousand Oaks, CA: Sage.

Singleton, D. (1987). *Mother and other tongue influence on learner French. Studies in Second Language Acquisition, 9,* 327-346.

Singleton, D. (1999). *Exploring the second language mental lexicon.* Cambridge: Cambridge University Press.

Skinner, B. F. (1938). *The behavior of organisms: An experimental analysis*. Cambridge, Massachusetts: B. F. Skinner Foundation.

Skinner, B. F. (1957). *Verbal behaviour*. Englewood Cliffs, NJ: Prentice Hall.

Slobin, D. I. (1973). Cognitive prerequisites for the development of grammar. In C. A. Ferguson & D. I. Slobin (Eds.), *Studies of Child Language Development* (pp. 175-202). New York: Holt, Rinehart & Winston.

Slobin, D. I. (Ed.) (1997). *The crosslinguistic study of language acquisition*. *Vol. 5: Expanding the contexts*. Hillsdale, NJ: Lawrence Erlbaum.

Sloetjes, H., & Wittenburh, P (2008). Annotation by category - ELAN and ISO DCR. In *Proceedings of the 6th International Conference on Language Resources and Evaluation* (*LREC 2008*).

Smit, A. B. (1993a). Phonologic error distributions in the Iowa-Nebraska articulation norms project: Consonant singletons. *Journal of Speech and Hearing Research, 36*, 533-547.

Smit, A. B. (1993b). Phonologic error distributions in the Iowa-Nebraska articulation norms project: Word initial consonant clusters. *Journal of Speech and Hearing Research, 36*, 931-947.

Smit, A. B., Hand, L., Freilinger, J. J., Bernthal, J. E., & Bird, A. (1990). The Iowa articulation norms project and its Nebraska replication. *Journal of Speech and Hearing Disorders*, *55*, 779-798.

Smith, B. L. (1979). A phonetic analysis of consonantal devoicing in children's speech. *Journal of Child Language*, *6*, 19-28.

Smith, J. (2002). *Phonological augmentation in prominent positions.* Unpublished doctoral dissertation. University of Massachusetts, Amherst, USA.

Smith, N. V. (1973). *The acquisition of phonology: A case study*. Cambridge Studies in Linguistics 25, Cambridge: Cambridge University Press.

Smith, N. V. (2010). *Acquiring phonology: A cross-generational case-study*. Cambridge: Cambridge University Press.

Smith, N. V., & Tsimpli, I. (1991). Linguistic modularity? A case study of a "*savant*" linguist. *Lingua*, *84*, 315-351.

Smolensky, P. (1996). *The initial state and "Richness of the base" in optimality theory*. Rutgers Optimality Archives, ROA # 154. Online: http://roa.rutgers.edu.

Snow, K. (1979). Conversations with children. In P. Fletcher & M. Garman (Eds.), *Language acquisition: Studies in first language development* (pp. 363-376). Cambridge: Cambridge University Press.

Snow, C. E., & Ferguson, C. A. (1977). *Talking to children: Language input and acquisition*. Cambridge: Cambridge University Press.

Sosa, A. V., & Bybee, J. (2008). A cognitive approach to clinical phonology. In M. Ball, M. Perkins, N. Muller, & S. Howard (Eds.), *The handbook of clinical linguistics* (pp. 480-490). Malden, MA: Blackwell Publishing.

Speake, J., Howard, S., & Vance, M. (2011). Intelligibility in children with persisting speech disorders: A case study. *Journal of Interactional Research in Communication Disorders*, *2*, 131-151.

Stampe, D. (1969). The acquisition of phonetic representation. In R. I. Binnick (Ed.), *Papers from the 5th Regional Meeting of the Chicago Linguistic Society* (pp. 433-444). Chicago: Chicago Linguistic Society.

Stampe, D. (1979). *A dissertation on natural phonology*. New York: Garland.

Stampe, D. (2004). The acquisition of phonetic representation. In B. C. Lust & C. Foley (Eds.), *First language acquisition: The essential readings* (pp. 307-314). Oxford: Blackwell Publishers.

Stark, R. E. (1980). Stages of speech development in the first year of life. In G. Yeni-Komshian, J. F. Kavanagh, & C. A. Ferguson (Eds.), *Child phonology I: Production* (pp. 73-92). New York: Academic Press.

Stemberger, J. P. (1983). *Speech errors and theoretical phonology: A review*. Bloomington, IN: Indiana University Linguistics Club.

Stemberger, J. P. (1989). Speech errors in early child language production. *Journal of Memory and Language*, *28*, 164-188.

Stemberger. J. P. (1991). Radical underspecification in language production. *Phonology*, *8*, 73-112.

Stemberger, J. P. (1992a). A connectionist view of child phonology: Phonological processing without phonological processes. In C. A. Ferguson, L. Menn, & C. Stoel-Gammon (Eds.), *Phonological development: Models, research, implications* (pp. 165-189). MD: York Press.

Stemberger, J. P. (1992b). A performance constraint on compensatory lengthening in child phonology. *Language and Speech*, *35*, 207-218.

Stemberger, J. P. (1996). The scope of the theory: Where does beyond lie? In L. McNair, K. Singer, L. M. Dobrin, & M. M. Aucoin (Eds.), *Papers from the parasession on theory and data in linguistics, CLS 23* (pp. 139-164). Chicago: Chicago Linguistic Society.

Stemberger, J. P. (2012). Review of Neil Smith '*Acquiring phonology: a cross-generational case-study*'. *Journal of Linguistics*, *48 (1)*, 243-248.

Stemberger, J. P, Bernhardt, B. H., & Johnson, C. E. (1999). U-shaped learning in phonological development. Presentation at the *6th International Child Language Congress*. Online: http://roa.rutgers.edu/files/471-1101/471-1101-stemberger-0-0.pdf.

Stemberger, J. P., & Stoel-Gammon, C. (1991). The underspecification of coronals: Evidence from language acquisition and performance errors. In C. Paradis & J. F. Prunet (Eds.), *The special status of coronals* (pp. 181-199). San Diego: Academic Press.

Stemberger, J. P., & Treiman, R. (1986). The internal structure of word initial consonant clusters. *Journal of Memory and Language*, *25*, 163-180.
Stephany, U. (1997). The acquisition of Greek. In D. I. Slobin (Ed.), *The crosslinguistic study of language acquisition,* Vol. 4. (pp. 183-333). London: Lawrence Erlbaum.
Steriade, D. (1995). Underspecification and markedness. In J. A. Goldsmith (Ed.), *The handbook of phonological theory* (pp. 114-174). Oxford: Blackwell Publishers.
Stern, C., & Stern, W. (1907). *Die Kindersprache*. Leipzig: Barth.
Stern, W., & Barwell, A. (1924). *Psychology of early childhood: Up to the sixth year of age*. New York, NY: Henry Holt & Co.
Stoel-Gammon, C. (1985). Phonetic inventories, 15-24 months: A longitudinal study. *Journal of Speech and Hearing Research*, *28*, 505-512.
Stoel-Gammon, C. (1998a). The role of babbling and phonology in early linguistic development. In A. M. Wetherby, S. F. Warren, & J. Reichle (Eds.), *Communication and language intervention series: Transitions in prelinguistic communication* (Vol. 7, pp. 87-110). Baltimore: Paul H. Brookes.
Stoel-Gammon, C. (1998b). Sounds and words in early language acquisition: The relationship between lexical and phonological development. In R. P. D. Paul (Ed.), *Exploring the speech language connection* (Vol. 8, pp. 25–52). Baltimore, MD: Paul H. Brookes.
Stoel-Gammon, C. (2011). Relationships between lexical and phonological development in young children. *Journal of Child Language*, *38*, 1-34.
Stoel-Gammon, C., & Cooper, J. A. (1984). Patterns of early lexical and phonological development. *Journal of Child Language*, *11*, 247-272.
Stoel-Gammon, C., & Dunn, C. (1985). *Normal and disordered phonology in children*. Baltimore, MD: University Park Press.
Stoel-Gammon, C., & Stemberger, J. P. (1994). "Consonant harmony and phonological underspecification in child speech". In M. Yavaş (Ed.), *First and Second Language Phonology* (pp. 63-80). San Diego: Singular Publishing Group.
Stoel-Gammon, C., & Williams, A. L. (2012). Early phonological development: creating an assessment test. Presentation at the *14th Meeting of the International Clinical Phonetics and Linguistics Association*, June 2012, Cork, Ireland.
Storkel, H. L. (2002). Restructuring of similarity neighborhoods in the developing mental lexicon. *Journal of Child Language*, *29*, 251-274.
Storkel, H. L., & Morrisette, M. L. (2002). The lexicon and phonology: Interactions in language acquisition. *Language, Speech and Hearing Service in Schools*, *4*, 24-37.
Swain, M. (1972). *Bilingualism as a first language*. Unpublished doctoral dissertation, University of California, Irvine, USA.
Swain, M., & Wesche, M. (1975). Linguistic interaction: Case study of a bilingual child. *Language Sciences*, *37*, 17–22.
Szreder, M. (2011). The acquisition of consonant clusters in Polish. *York Papers in Linguistics, 2 (11)*, 88-102.
Szuman, S. (1955). Rozwój tresci slownika u dziece. *Studia Pedagogicane*, *2*.
Tabain, M. (1998). Non-sibilant fricatives in English: Spectral information above 10 kHz. *Phonetica*, 55, 107–130.
Tabors, P. O. (2008). *One child, two languages: A guide for early childhood educators of children learning English as a second language.* Baltimore: Paul H. Brookes.

Tarone, E. (1979). Interlanguage as chameleon. *Language Learning*, *29*, 181–191.
Tarone, E. (1990). On variation in interlanguage: A response to Gregg. *Applied Linguistics 11 (1)*, 392-400.
Templin, M. (1947). Spontaneous versus imitated verbalization in testing articulation in preschool children. *Journal of Speech, Hearing and Disorders*, *12*, 293-300.
Templin, M. (1957). *Certain language skills in children: Their development and inter-relationships*. Institute of Child Welfare Monograph 26. Minneapolis: The University of Minnesota Press.
Tesar, B., & Smolensky, P. (1998). Learnability in optimality theory. *Linguistic Inquiry*, *29*, 229-268.
Thelen, E. (1989). Self-organization in developmental processes: Can systems approach work? In M. R. Gunnar & E. Thelen (Eds.), *Systems and development*. The Minnesota symposia on Child Psychology: *Systems & Development 22* (pp. 77-117). Hillsdale, NJ: Lawrence Erlbaum.
Thiery, C. (1978). True bilingualism and second language learning. In D. Gerver & H. Sinaiko (Eds.), *Language, interpretation and communication* (pp. 145-153). New York: Press.
Thomadaki, E. & Magoula, E. (1998). The acquisition of palatal [ʎ] and [ɲ] in Modern Greek. *Studies in Greek Linguistics*, *18*, 211-221.
Tomasello, M. (2000). First steps toward a usage-based theory of language acquisition. *Cognitive Linguistics*, *11*, 61-82.
Tomasello, M., & Slobin, D. I. (Eds.), (2005). *Beyond nature-nurture: Essays in honor of Elizabeth Bates.* Mahwah, NJ: Lawrence Erlbaum.
Towell, R. & Hawkins, R. (1994). *Approaches to second language acquisition*. Clevedon: Multilingual Matters.
Trevarthen, C., & Aiken, K. J. (2001). Infant intersubjectivity: Research, theory, and clinical applications. *Journal of Child Psychology and Psychiatry*, *42*, 3-48.
Trubetzkoy, N. S. (1939/1958). *Fundamentals of phonology*. Travaux du Cercle Linguistique.
Tse, S. M., & Ingram. D. (1987). The influence of dialectal variation on phonological acquisition: A case study on the acquisition of Cantonese. *Journal of Child Language*, *14*, 281-294.
Tsiartsioni, E. (2010). An acoustic analysis of L2 English speech rhythm produced by Greek children and adolescents. In M. Wrembel, M. Kul, & K. Dziubalska-Kołaczyk (Eds.), *Achievements and perspectives in the acquisition of second language speech: New Sounds 2010* (pp. 261-274). Frankfurt: Peter Lang.
Tsimpli, I. (2007). First language attrition from a minimalist perspective: Interface vulnerability and processing effects. In B. Köpke, M. Schmid, M. Keijzer, & S. Dostert (Eds.), *Language attrition: Theoretical perspectives* (pp.83-98). Amsterdam: John Benjamins.
Tucker, G. R. (1998). A global perspective on multilingualism and multilingual education. In J. Cenoz & F. Genesee (Eds.), *Beyond bilingualism: Multilingualism and multilingual education* (pp. 3-15). Clevedon, England: Multilingual Matters.
Tzakosta, M. (2001a). The acquisition of manner features in Modern Greek. In C. Fery, A. Dubach Green, & R. van de Vijver (Eds), *Linguistics in Potsdam 12. Proceedings of HILP5* (pp. 178-193). Potsdam: University of Potsdam.

Tzakosta, M. (2001b). The realization of consonant clusters in child speech. *Studies in Greek Linguistics*, *21*, 736-746.
Tzakosta, M. (2004). *Multiple parallel grammars in the acquisition of stress in Greek L1*. Doctoral dissertation. ULCL/ Leiden University. LOT Dissertation Series 93.
Tzakosta, M. (2007). Genetic and environmental effects in L1 phonological acquisition: The case of consonant harmony in Greek child speech. *Journal of Greek Linguistics*, *8*, 5-30.
Tzakosta, M., Levelt, C. C., & van de Weijer, J. (2005). Developmental paths in phonological acquisition. *Leiden Papers in Linguistics*, *2 (1)*, 13-38.
Tzakosta, M., & Vis, J. (2009). Phonological representation of consonant sequences: The case of affricates vs. true clusters. *Proceedings of the 8th International Conference of Greek Linguistics* (pp. 558-573). University of Ioannina, Greece.
Unsworth, S., Argyri, F., Cornips, L., Hulk, A., Sorace, A., & Tsimpli, I. (2011). On the role of age of onset and input in early child bilingualism in Dutch and Greek. *Selected Proceedings of GALANA4 2010* (pp. 249-265). Online: www.lingref.com/cpp/galana/4/.
Valdés, G. (2001). Heritage language students: profiles and possibilities. In J. K. Peyton, D. A. Ranard, & S. McGinnis (Eds.), *Heritage languages in America: Preserving a national resource* (pp. 37-80). McHenry, IL: The Center for Applied Linguistics and Delta Systems.
van Alphen, P. M., & Smits, R. (2004). Acoustical and perceptual analysis of the voicing distinction in Dutch initial plosives: The role of prevoicing. *Journal of Phonetics*, *32(4)*, 455-491.
van der Hulst, H. (2000). Modularity and modality in phonology. In N. Burton-Roberts, P. Carr, & G. Docherty (Eds.), *Phonological knowledge: Its nature and status* (pp. 207-244). Oxford: Oxford University Press.
van der Hulst, H. (2009). Two phonologies. In J. Grijzenhout & B. Kabak (Eds.), *Phonological domains: Universals and deviations.* Interface Explorations 16 (pp. 315-344). Mouton de Gruyter: Berlin/New York.
van Dijk, M., Verspoor, M., & Lowie, W. (2011). Variability and DST. In M. Verspoor, K. de Bot & W. Lowie (Eds.), *A dynamic approach to second language development* (pp. 39-54). Amsterdam/Philadelphia: John Benjamins.
van Geert, P. (1994). *Dynamic systems of development: Change between complexity and chaos.* New York: Harvester Wheatsheaf.
van Lier, L. (2005). Case study. In E. Hinkel (Ed.), *Handbook of research in second language teaching and learning* (pp. 195-208). Mahwah, NJ: Lawrence Erlbaum.
Velleman, S. L. (1995). Metathesis highlights feature-by-position constraints. In B. Bernhardt, J. Gilbert, & D. Ingram (Eds.), *Proceedings of the UBC International Conference on Phonological Acquisition.* Somerville, MA: Cascadilla Press.
Velleman, S. L., & Vihman, M. M. (2006). Phonological development in infancy and early childhood: Implications for theories of language learning. In M. C. Pennington (Ed.), *Phonology in context* (pp. 25-50). Luton: Macmillan.
Velten, H. (1943). The growth of phonemic and lexical patterns in infant language. *Language*, *19*, 281-292.
Verhulst, P. (1838). Notice sur la loi que la population poursuit dans son accroissement. *Correspondance Mathématique et Physique*, *10*, 113–121.
Verspoor, M., de Bot, K., & Lowie, W. (Eds.) (2011). *A dynamic approach to second language development*. Amsterdam/Philadelphia: John Benjamins.

Verspoor, M., Lowie, W., van Geert, P., van Dijk, M., & Schmid, M. S. (2011). In M. Verspoor, K. de Bot, & W. Lowie (Eds.), *A dynamic approach to second language development* (pp. 138-199). Amsterdam/Philadelphia: John Benjamins.

Viechnicki, P. (1996). The problem of voiced stops in Modern Greek: A non-linear approach. *Studies in Greek Linguistics*, *16*, 59-70.

Vihman, M. M. (1978). Consonant harmony: Its scope and function in child language. In J. H. Greenberg (Ed.), *Universals of human language* (pp. 281-334). Stanford: Stanford University Press.

Vihman, M. M. (1985). Language differentiation by the bilingual infant. *Journal of Child Language*, *12*, 297-324.

Vihman, M. M. (1992). Early syllables and the construction of phonology. In C. A. Ferguson, L. Menn, & C. Stoel-Gammon (Eds.), *Phonological development: Models, research, implications* (pp. 393-422). Timonium MD: York Press.

Vihman, M. M. (1993). The construction of a phonological system. In B. de Boysson Bardies, S. de Schonen, P. Jusczyk, P. MacNeilage, & J. Morton (Eds.), *Developmental neurocognition: Speech and face processing in the first year of life* (pp. 96-112). Dordrecht: Kluwer Academic.

Vihman, M. M. (1996). *Phonological development: The origins of language in the child.* Cambridge. MA: Blackwell Publishing.

Vihman, M. M. (2002). Getting started without a system: From phonetics to phonology in bilingual development. *International Journal of Bilingualism*, *6*, 239-254.

Vihman, M. M., & Croft, W. (2007). Phonological development: Toward a 'radical' templatic phonology. *Linguistics*, *45*, 683-725.

Vihman, M. M., De Paolis, R. A., & Keren-Portnoy, T. (2008). Babbling and words: A dynamic systems perspective on phonological development (pp. 163-182). In E. Bavin (Ed.), *The Cambridge handbook of child language*. Cambridge: Cambridge University Press.

Vihman, M. M., Ferguson, C. A., & Elbert, M. (1986). Phonological development from babbling to speech: Common tendencies and individual differences. *Applied Psycholinguistics*, *7*, 3-40.

Vihman, M. M., & Keren-Portnoy, M. (2011). The role of production practice in lexical and phonological development - A commentary on Stoel-Gammon's 'Relationships between lexical and phonological development in young children. *Journal of Child Language*, *38*, 41-45.

Vihman, M. M, Macken, M. A., Miller, R., Simmons, H., & Miller, J. (1985). From babbling to speech: A reassessment of the continuity issue. *Language, 61*, 397-445.

Vihman, M. M., & Velleman, S. L. (2000). The constraction of a first phonology. *Phonetica*, *57*, 255-256.

Vihman, M. M., Velleman, S. L., & McCune, L. (1994). How abstract is child phonology? Towards an integration of linguistic and psychological approaches. In M. Yavaş (Ed.), *First and second language phonology* (pp. 9-44). San Diego: Singular Publishing Group.

Vogel, I. (1975). One system or two: An analysis of a two-year-old Romanian-English bilingual's phonology. *Papers and Reports on Child Language Development*, *9*, 43-62.

Volterra, V., & Taeschner, T. (1978). The acquisition and development of language by bilingual children. *Journal of Child Language*, *5*, 311-326.

von Raffler-Engel, W. (1965). Del bilinguismo infantile. *Archivio Glottologico Italiano*, *50*, 175-180.

Vygotsky, L. S. (1987). Mind in society: the development of higher psychological processes. In R. W. Rieber (Ed.), *The collected works of L. S. Vygotsky*, *Vol. 4*: Kluwer Academic/Plenum Publishers.

Watson, I. (1991). Phonological processing in two languages. In E. Bialystok (Ed.), *Language processing in bilingual children* (pp. 25-48.). Cambridge: Cambridge University Press.

Waterson, N. (1971). Child phonology: A prosodic view. *Journal of Linguistics, 7,* 179–211.

Wei, L. (Ed.) (2000). *The bilingualism reader*. Routledge: Taylor & Francis.

Wei, L. (Ed.) (2007). *The bilingualism reader* (2nd edition). Routledge: London & New York.

Wei, L. (2010). BAMFLA: Issues, methods and directions. *International Journal of Bilingualism*, *14 (1)*, 3-9.

Weinberger, S. H. (2012). The speech accent archive: How to build an L2 phonology corpus. Presentation at the *Second Language Research Forum (SLRF): Building bridges between disciplines*, October 2012, Carnegie Mellon University, USA.

Weinberger, S. H. (2013). *Speech accent archive*. George Mason University. Online: http://accent.gmu.edu.

Weinberger, S. H., & Kunath, S. A. (2011). A computational model for accent identification. In M. Wrembel, M. Kul, & K. Dziubalska-Kołaczyk (Eds.), *Achievements and perspectives in the acquisition of second language speech: New Sounds 2010* (pp. 287-296). Frankfurt: Peter Lang.

Weinert, S. (2009). Implicit and explicit modes of learning: Similarities and differences from a developmental perspective. *Linguistics*, *47 (2)*, 241–271.

Weinreich, U. (1953). *Languages in contact: Findings and problems*. The Hague: Mouton.

Weinreich, U. (1966). *Explorations in semantic theory*. The Hague: Mouton.

Weissenborn, J., Goodluck, H., & Roeper, T. (1992). Old and new problems in the study of language acquisition. In J. Weissenborn, H. Goodluck & T. Roeper (Eds.), *Theoretical issues in language acquisition: Continuity and change in development* (pp. 1-23). Hillsdale, NJ: Lawrence Erlbaum.

Wellman, B. L., Case, I. M. Mengert, I. G., Bradbury, D. E. (1931). Speech sounds of young children. *University of Iowa Studies in Child Welfare, 2 (5).*

Werker, J. F., Hall, D. G., & Fais, L. (2004). Reconstruing U-shaped functions. *Journal of Cognition and Development*. *5 (1)*, 147-151.

Werker, J. F., & Byers-Heinlein, K. (2008). Bilingualism in infancy: First steps in perception and comprehension. *Trends in Cognitive Science, 12*, 144-151.

Werker, J. F., Byers-Heinlein K., & Fennell, C. T. (2009). Bilingual beginnings to learning words. *Philosophical Transactions of the Royal Society of London B*, *364*, 3649-3663.

Wernicke, C. (1874). *Die Aphasische Symptomenkomplex*. Breslau: Cohn & Weigart.

Wester, F., Gilbers, D., & Lowie, W. (2007). Substitution of dental fricatives in English by Dutch L2 speakers. *Language Sciences*, *29*, 477-491.

Wexler, K. & Culicover, P. (1980). *Formal principles of language acquisition*. Cambridge, MA: MIT Press.

White, L. (1989). *Universal grammar and second language acquisition*. Amsterdam/ Philadelphia: John Benjamins.

Wilson, C. (2006). Learning phonology with substantive bias: An experimental and computational study of velar palatalization. *Cognitive Science*, *30 (5)*, 945-982.

Winitz, H. (1984). Native language and foreign language acquisition. *Annals of the New York Academy of Sciences*, *379*, 9-22.

Wode, H. (1980). Phonology in L2 acquisition. In S. Felix (Ed.), *Second language development: trends and issues* (pp. 123-136). Tübingen: Gunter Narr.

Wode, H. (1994). Nature, nurture, and age in second language acquisition: The case of speech perception. *Studies in Second Language Acquisition*, *16*, 325-345.

Wong Fillmore, L. (1979). Individual differences in second language acquisition. In C. J. Fillmore, D. Kempler, & W. S. Y. Wang (Eds.), *Individual differences in language ability and language behavior* (pp. 203-228). NewYork: Academic Press.

Wong, W.W.-Y., & Stokes, SF. (2001). Cantonese consonantal development: A non-linear account. *Journal of Child Language*, *28 (1)*, 191-212.

Yavaş, M. (1994). *First and second language phonology*. San Diego: Singular.

Yavaş, M. (1995). Phonological selectivity in the first fifty words of a bilingual child. *Language and Speech*, *38 (2)*, 189-202.

Yavaş, M. (2011). *Applied English phonology* (2^{nd} edition). Malden, MA: Wiley-Blackwell.

Yin, R. (2003). *Applications of case study research*. Thousand Oaks, CA: Sage.

Yip, V., & Matthews, S. (2007). *The bilingual child: Early development and language contact*. Cambridge: Cambridge University Press.

Young-Scholten, M. (2001). Second language acquisition and the critical period hypothesis: D. Birdsong [book review]. *Studies in Second Language Acquisition*, *23 (3)*, 434-435.

Young-Scholten, M. (2009). Introduction. In T. Piske & M. Young-Scholten (Eds.), *Input matters in SLA* (pp. 1-14). Clevedon, England: Multilingual Matters.

Zentella, A. C. (1999). *Growing up bilingual.* Malden, MA: Blackwell Publishers.

APPENDIX

APPENDIX A

DATABASE LOG

age	*situation*	*media file*	*durn*	*U E*	*U G*	*tks E*	*tks G*	*TUR E*	*TUR G*	*TTR E*	*TTR G*
2;07.01	at home, playing - Chania	WS 310009	0:01:33	3	9	4	35	1.33	3.89	0.75	0.63
2;07.05	at home, chatting, looking at a book	WS 310010	0:07:06	12	33	19	127	1.58	3.85	0.90	0.55
	singing	WS 310027	0:00:21	4	3	9	4	2.25	1.33	0.89	1.00
	chatting	WS 310029	0:00:40	4	3	10	12	2.50	4.00	0.60	0.83
2;07.06	ibid	WS 310011	0:02:22	6	9	12	33	2.00	3.67	0.67	0.76
	at home	WS 310013	0:00:14	1	2	2	6	2.00	3.00	0.50	0.83
	ibid	WS 310030	0:05:36	21	30	34	121	1.62	4.03	0.62	0.58
	ibid	WS 310031	0:15:01	68	58	114	184	1.68	3.17	0.55	0.60
	ibid	WS 310032	0:03:56	13	22	23	49	1.77	2.23	0.52	0.80
	ibid	WS 310034	0:01:26	6	5	15	22	2.50	4.40	0.80	0.64
2;07.09	singing	WS 310036	0:00:29	1	2	6	9	6.00	4.50	1.00	0.56
	chatting	WS 310037	0:00:22	1	1	1	2	1.00	2.00	1.00	1.00
	ibid	WS 310039	0:00:35	1	4	1	19	1.00	4.75	1.00	0.84
2;07.10	ibid	WS 310035	0:12:46	35	62	60	293	1.71	4.73	0.43	0.48
	ibid	WS 310038	0:10:21	49	44	117	185	2.39	4.20	0.34	0.49
	ibid	WS 310040	0:09:45	51	45	84	165	1.65	3.67	0.56	0.55
2;07.11	at home, playing	WS 310009	0:01:33	2	10	3	34	1.50	3.40	1.00	0.65
	out walking the dog	WS 310041	0:03:56	34	16	59	40	1.74	2.50	0.58	0.65
2;07.12	at home	WS 310043	0:04:38	7	10	12	40	1.71	4.00	0.92	0.73
2;07.13	at home	no audio	0:00:00	5	0	14	0	2.80	n/a	0.86	n/a
2;07.15	ibid	WS 310017	0:01:26	6	5	18	19	3.00	3.80	0.72	0.53
2;07.16	singing	WS 310021	0:02:04	3	18	5	49	1.67	2.72	0.60	0.71
	ibid	WS 310023	0:01:36	0	9	0	40	n/a	4.44	n/a	0.68
	ibid	WS 310025	0:04:28	6	5	7	6	1.17	1.20	0.43	0.83
	ibid	WS 310026	0:00:30	4	1	10	1	2.50	1.00	0.60	1.00
2;07.18	Easter, at home - **Athens**	WS 310047	0:22:34	92	67	175	236	1.90	3.52	0.37	0.48
2;07.19	ibid	WS 310044	0:04:29	29	34	47	146	1.62	4.29	0.62	0.53
2;07.20	ibid	no audio	0:00:00	12	1	31	1	2.58	1.00	0.81	1.00
2;07.22	ibid	no audio	0:00:00	3	1	6	1	2.00	1.00	0.83	1.00
2;07.23	ibid	WS 310048	0:14:14	76	38	140	164	1.84	4.32	0.41	0.47

age	*situation*	*media file*	*durn*	*U E*	*U G*	*tks E*	*tks G*	*TUR E*	*TUR G*	*TTR E*	*TTR G*
	at home - **Chania**	WS 310049	0:03:08	18	7	44	19	2.44	2.71	0.39	0.90
	ibid	WS 310050	0:00:39	5	5	5	15	1.00	3.00	0.80	0.73
	oudoors	WS 310051	0:04:26	2	1	5	2	2.50	2.00	0.60	1.00
2;07.25	out walking	no audio	0:00:00	3	0	8	0	2.67	n/a	1.00	n/a
	ibid	WS 310052	0:01:20	8	4	22	17	2.75	4.25	0.78	0.71
	ibid	WS 310053	0:00:16	1	0	10	0	10.0	n/a	1.00	n/a
2;07.26	at home chatting	WS 310055	0:09:35	52	32	127	125	2.44	3.91	0.48	0.54
2;07.27	ibid	WS 310054	0:18:43	73	52	169	201	2.32	3.87	0.42	0.52
	ibid	WS 310056	0:10:35	54	33	126	96	2.33	2.91	0.39	0.67
2;07.28	ibid	no audio	0:00:00	11	5	28	11	2.55	2.20	0.82	0.82
2;07.29	ibid	no audio	0:00:00	3	2	7	2	2.33	1.00	1.00	1.00
2;7 T		**41 files**	**3:02:43**	**785**	**688**	**1589**	**2531**	**2.02**	**3.68**	**0.69**	**0.72**
2;08.02	ibid	no audio	0:00:00	17	16	50	56	2.94	3.50	0.84	0.77
2;08.05	ibid	WS 310057	0:07:09	30	14	72	50	2.40	3.57	0.53	0.82
2;08.06	ibid	WS 310058	0:03:37	35	18	103	60	2.94	3.33	0.65	0.67
	ibid	WS 310059	0:05:45	40	17	83	56	2.08	3.29	0.59	0.64
2;08.07	ibid	WS 310060	0:01:57	24	10	80	45	3.33	4.50	0.67	0.61
2;08.07-2;08.14	ibid	no audio	0:00:00	81	11	284	23	3.51	2.09	0.46	0.83
2;08.11	ibid	WS 310061	0:01:05	3	4	5	5	1.67	1.25	0.80	1.00
2;08.15	ibid	WS 310062	0:01:15	2	7	2	25	1.00	3.57	1.00	0.72
	ibid	WS 310063	0:00:31	1	3	1	9	1.00	3.00	1.00	0.33
	ibid	WS 310064	0:04:27	11	22	34	90	3.09	4.09	0.47	0.49
	ibid	WS 310065	0:02:00	8	9	23	41	2.88	4.56	0.39	0.66
2;08.15-2;08.17		no audio	0:00:00	31	1	127	2	4.10	2.00	0.49	1.00
2;08.16	ibid	WS 310066	0:02:29	2	12	5	53	2.50	4.42	1.00	0.59
	ibid	WS 310067	0:00:48	0	4	0	15	n/a	3.75	n/a	0.93
2;08.17	ibid	WS 310068	0:02:58	7	16	15	80	2.14	5.00	0.67	0.59
	at home free play	WS 310069	0:16:14	68	84	128	353	1.88	4.20	0.42	0.43
2;08.18	at home with dad	WS 310070	0:05:16	0	31	0	141	n/a	4.55	n/a	0.48
	at home	WS 310071	0:08:41	18	57	35	222	1.94	3.89	0.51	0.42
	ibid	no audio	0:00:00	37	0	195	0	5.27	n/a	0.42	n/a
2;08.19	ibid	no audio	0:00:00	19	11	76	44	4.00	4.00	0.61	0.86
2;08.20	ibid	no audio	0:00:00	39	28	175	124	4.49	4.43	0.49	0.71
2;08.21	ibid	no audio	0:00:00	9	0	30	0	3.33	n/a	0.83	n/a
2;08.23	ibid	WS 310073	0:02:35	25	10	85	43	3.40	4.30	0.61	0.70

age	*situation*	*media file*	*durn*	*U E*	*U G*	*tks E*	*tks G*	*TUR E*	*TUR G*	*TTR E*	*TTR G*
	ibid	WS 310074	0:08:28	38	43	134	182	3.53	4.23	0.46	0.44
2;08.25	ibid	no audio	0:00:00	15	13	54	66	3.60	5.08	0.69	0.65
2;08.27	at home playing- at free play	WS 310075	0:13:11	41	57	145	321	3.54	5.63	0.50	0.36
	at free play	WS 310076	0:09:36	21	69	94	353	4.48	5.12	0.63	0.39
2;08.28	ibid	WS 310077	0:43:21	8	8	33	40	4.13	5.00	0.67	0.70
2;08.29	ibid	WS 310078	1:10:16	33	65	100	311	3.03	4.78	0.48	0.43
2;08.30	at home chatting	WS 310079	0:09:50	26	29	69	108	2.65	3.72	0.52	0.64
	ibid	WS 310080	0:00:50	3	1	5	1	1.67	1.00	1.00	1.00
	ibid	WS 310081	0:21:07	60	34	191	176	3.18	5.18	0.38	0.51
2;08.31	ibid	WS 310082	0:04:45	12	13	22	44	1.83	3.38	0.82	0.64
	ibid	WS 310083	0:09:18	7	29	17	98	2.43	3.38	0.53	0.59
2;8 T		**34 files**	**4:17:29**	**771**	**746**	**2472**	**3237**	**3.21**	**4.34**	**0.63**	**0.64**
2;09.01	at home, snacking, reading books	WS 310085	1:07:28	222	160	604	590	2.72	3.69	0.24	0.42
2;09.02	at home chatting	WS 310087	0:00:58	0	8	0	9	n/a	1.13	n/a	0.56
	ibid	WS 310088	0:14:32	12	17	34	71	2.83	4.18	0.65	0.59
2;09.03	ibid	no audio	0:00:00	47	21	187	72	3.98	3.43	0.56	0.72
	ibid	WS 310089	0:00:19	1	0	3	0	3.00	n/a	1.00	n/a
	ibid	WS 310090	0:15:08	83	35	147	116	1.77	3.31	0.45	0.53
	ibid	WS 310091	0:07:06	26	25	67	116	2.58	4.64	0.36	0.53
	in the car	WS 310092	0:00:45	5	0	21	0	4.20	n/a	0.43	n/a
	ibid	WS 310093	0:11:46	83	6	152	17	1.83	2.83	0.57	0.94
2;09.04	ibid	no audio	0:00:00	33	45	140	295	4.24	6.56	0.53	0.60
2;09.05	at free play	WS 310100	0:36:24	57	100	150	429	2.63	4.29	0.38	0.42
	ibid and chatting with mum	WS 310101	0:18:27	33	50	101	194	3.06	3.88	0.41	0.59
2;09.07	ibid	WS 310102	0:28:42	48	28	191	107	3.98	3.82	0.45	0.65
2;09.08	at home chatting	WS 310103	0:03:14	2	6	6	30	3.00	5.00	1.00	0.80
2;09.09	ibid	no audio	0:00:00	0	10	0	84	n/a	8.40	n/a	0.80
	playing with granny	WS 310104	0:18:09	4	99	9	314	2.25	3.17	1.00	0.43
2;09.10	playing, toilet training	WS 310105	0:29:54	145	35	358	105	2.47	3.00	0.33	0.60
2;09.11	reading books, lunch, playing with granny	WS 310106	0:47:03	86	116	230	393	2.67	3.39	0.37	0.41
2;09.12	at home, toilet training	WS 310107	0:40:54	58	143	136	409	2.34	2.86	0.40	0.39

age	situation	media file	durn	U E	U G	tks E	tks G	TUR E	TUR G	TTR E	TTR G
2;09.14	playing with granny	WS 310108	0:00:59	0	6	0	19	n/a	3.17	n/a	0.74
	ibid	WS 310109	0:10:49	5	60	6	221	1.20	3.68	0.67	0.50
2;09.15	ibid	WS 310111	0:20:41	18	71	76	214	4.22	3.01	0.61	0.44
2;09.16	at home playing	WS 310112	0:31:24	93	86	250	252	2.69	2.93	0.36	0.45
2;09.17	at home on the way out	WS 310113	0:07:46	41	9	166	36	4.05	4.00	0.39	0.72
	in the car picking her up from daycare	WS 310114	0:55:07	210	69	683	289	3.25	4.19	0.23	0.47
2;09.18	at home free play	WS 310115	0:05:26	9	14	33	50	3.67	3.57	0.61	0.67
	in the car back from the beach	WS 310117	0:13:38	35	23	130	91	3.71	3.96	0.37	0.50
2;09.19	at home free play	WS 310118	0:29:50	155	28	450	118	2.90	4.21	0.33	0.58
	at home	WS 310120	0:00:43	1	3	2	11	2.00	3.67	1.00	0.82
	ibid	WS 310121	0:17:10	22	86	59	334	2.68	3.88	0.66	0.34
2;09.20	at home	WS 310122	0:51:53	149	93	501	386	3.36	4.15	0.33	0.46
2;09.22	ibid	WS 310124	0:36:07	145	102	437	402	3.01	3.94	0.28	0.42
2;09.23	ibid	WS 310125	1:00:16	172	130	493	538	2.87	4.14	0.27	0.35
2;09.24	ibid	WS 310126	0:43:14	55	110	207	503	3.76	4.57	0.32	0.36
	at home free play	WS 310127	0:13:26	24	46	88	256	3.67	5.57	0.49	0.48
2;09.26	ibid	WS 310128	0:31:32	107	99	264	464	2.47	4.69	0.34	0.33
	at home chatting	WS 310129	0:17:02	90	48	210	183	2.33	3.81	0.48	0.49
	at home	WS 310130	0:05:35	28	15	96	62	3.43	4.13	0.44	0.65
2;09.27	at home free play	WS 310132	0:09:29	17	10	56	45	3.29	4.50	0.75	0.62
2;09.28	travelling	WS 310133	0:02:58	29	5	77	21	2.66	4.20	0.60	0.67
2;09.29	at home - **Athens**	WS 310134	0:01:53	6	4	13	23	2.17	5.75	0.83	0.48
	in flight	WS 310135	0:34:23	75	156	232	795	3.09	5.10	0.38	0.33
2;09.30	at home - **Chania**	WS 310136	0:52:01	226	106	523	330	2.31	3.11	0.28	0.38
2;9 T		**43 files**	**14:54:11**	**2657**	**2283**	**7588**	**8994**	**2.86**	**3.94**	**0.50**	**0.54**
2;10.01	at home, free play, in the car, at the park	WS 310137	0:47:06	158	66	421	301	2.66	4.56	0.33	0.46
	in the car returning	WS 310138	0:00:22	2	0	8	0	4.00	n/a	0.50	n/a
2;10.02	at home chatting and free play	WS 310140	0:20:52	81	29	161	110	1.99	3.79	0.37	0.60
	at home playing	WS 310141	0:14:58	58	56	174	227	3.00	4.05	0.31	0.40

age	situation	media file	durn	U E	U G	tks E	tks G	TUR E	TUR G	TTR E	TTR G
2;10.03	at home, playing and reading a book	WS 310142	0:48:04	179	90	462	434	2.58	4.82	0.29	0.42
	at home playing	WS 310143	0:11:39	10	45	22	213	2.20	4.73	0.46	0.42
2;10.04	ibid	WS 310144	0:06:27	58	16	228	81	3.93	5.06	0.50	0.64
	ibid	WS 310145	0:15:58	75	27	164	109	2.19	4.04	0.41	0.56
	ibid	WS 310146	0:02:07	18	0	26	0	1.44	n/a	0.35	n/a
2;10.05	ibid	no audio	0:00:00	16	0	71	0	4.44	n/a	0.70	n/a
2;10.06	ibid	WS 310147	0:32:59	139	35	413	129	2.97	3.69	0.25	0.50
2;10.07	ibid	WS 310148	0:04:42	40	5	64	7	1.60	1.40	0.64	0.43
	ibid and free play	WS 310149	0:20:39	63	56	211	255	3.35	4.55	0.36	0.41
	at home playing and reading a book	WS 310150	0:17:44	33	73	92	323	2.79	4.42	0.63	0.45
2;10.08	ibid and preaparing a snack	WS 310151	0:27:34	46	59	166	243	3.61	4.12	0.36	0.47
2;10.09	at home playing	WS 310152	0:54:01	220	101	604	323	2.75	3.20	0.29	0.47
2;10.10	at home free play	WS 310153	0:05:45	5	10	17	39	3.40	3.90	0.88	0.87
	ibid and reading a book	WS 310154	0:42:20	178	45	649	220	3.65	4.89	0.24	0.45
2;10.12	at home chatting in bed	WS 310155	0:04:05	28	3	73	7	2.61	2.33	0.55	0.86
	ibid	WS 310156	0:17:19	103	17	387	60	3.76	3.53	0.26	0.57
2;10.13	chores at the porch, free play	WS 310157	0:31:21	155	31	628	118	4.05	3.81	0.26	0.62
2;10.14	at home with dad	WS 310159	0:08:34	10	16	41	93	4.10	5.81	0.63	0.44
	ibid	WS 310160	0:17:44	16	95	59	432	3.69	4.55	0.51	0.34
	ibid	WS 310161	0:02:39	6	10	29	33	4.83	3.30	0.52	0.58
2;10.15	at home and free play	WS 310163	0:43:33	13	80	31	347	2.38	4.34	0.45	0.39
2;10.16	at home chatting	WS 310164	0:16:13	9	19	30	77	3.33	4.05	0.73	0.35
	at home and free play	WS 310165	0:22:13	32	37	126	139	3.94	3.76	0.44	0.59
	ibid	WS 310166	0:10:06	18	21	73	86	4.06	4.10	0.37	0.62
2;10.17	ibid	no audio	0:00:00	5	0	29	0	5.80	n/a	0.82	n/a
2;10.18	at home playing	WS 310167	0:22:33	152	12	582	46	3.83	3.83	0.30	0.78
	ibid	WS 310168	0:08:00	10	19	40	76	4.00	4.00	0.50	0.62
	at home playing, colouring, reading books	WS 310169	0:33:49	158	39	521	142	3.30	3.64	0.27	0.53

age	***situation***	***media file***	***durn***	***U E***	***U G***	***tks E***	***tks G***	***TUR E***	***TUR G***	***TTR E***	***TTR G***
2;10.20	at home playing	WS 310170	0:24:41	83	9	287	30	3.46	3.33	0.37	0.87
	at home and free play	WS 310171	0:15:49	57	16	189	71	3.32	4.44	0.40	0.62
2;10.22	at home playing	WS 310172	0:24:14	17	82	77	466	4.53	5.68	0.52	0.41
2;10.23	at home and free play	WS 310173	0:20:26	13	63	58	285	4.46	4.52	0.60	0.48
	at home chatting	WS 310174	0:20:29	15	54	70	310	4.67	5.74	0.44	0.44
	at home playing	WS 310175	0:07:39	61	10	297	39	4.87	3.90	0.43	0.82
2;10.25	at home free play	WS 310176	0:10:52	57	19	278	110	4.88	5.79	0.41	0.54
	ibid	WS 310177	0:12:18	29	29	146	162	5.03	5.59	0.37	0.41
	ibid playing with dad	WS 310178	0:12:17	12	33	79	134	6.58	4.06	0.57	0.49
2;10.27	at home free play	WS 310179	0:03:15	0	2	0	12	n/a	6.00	n/a	0.75
2;10.28	ibid	WS 310181	0:03:39	0	12	0	66	n/a	5.50	n/a	0.59
	at home solving a puzzle and free play	WS 310182	0:24:43	92	15	337	74	3.66	4.93	0.31	0.57
	at home playing	WS 310183	0:04:47	5	9	18	49	3.60	5.44	0.78	0.69
	ibid	WS 310184	0:08:21	27	14	90	64	3.33	4.57	0.43	0.64
2;10.29	ibid	WS 310185	0:42:23	72	41	269	177	3.74	4.32	0.30	0.49
	ibid	WS 310186	0:06:44	57	0	239	0	4.19	n/a	0.34	n/a
2;10.30	at home	no audio	0:00:00	9	0	43	0	4.78	n/a	0.77	n/a
2;10 T		**49 files**	**14:14:03**	**2700**	**1520**	**9079**	**6719**	**3.36**	**4.42**	**0.46**	**0.55**
2;11.01	at home playing, making a tent	WS 310188	0:13:27	28	31	178	157	6.36	5.06	0.31	0.49
	at home playing and free play	WS 310189	0:21:50	34	18	174	89	5.12	4.94	0.37	0.44
2;11.02	at home playing, puzzles	WS 310190	0:09:28	33	2	142	8	4.30	4.00	0.32	0.75
	ibid	WS 310191	0:05:07	42	9	200	58	4.76	6.44	0.43	0.60
	solilloquy	WS 310192	0:06:37	19	26	81	191	4.26	7.35	0.34	0.46
2;11.04	in bed	WS 310193	0:06:13	18	5	64	26	3.56	5.20	0.56	0.64
2;11.05	at home, summer vacation - **Athens**	WS 310194	0:02:33	15	2	37	5	2.47	2.50	0.78	1.00
	at home	WS 310196	0:01:15	5	0	19	0	3.80	n/a	0.79	n/a
2;11.06	ibid	WS 310197	0:09:40	17	15	78	72	4.59	4.80	0.49	0.50
	bath time and getting dressed	WS 310198	0:16:13	43	15	157	70	3.65	4.67	0.31	0.53
	bedtime	WS 310199	0:02:42	7	2	24	2	3.43	1.00	0.83	0.50

age	situation	media file	durn	U E	U G	tks E	tks G	TUR E	TUR G	TTR E	TTR G
2;11.07	in the car, at the shops	WS 310200	0:04:05	27	15	118	61	4.37	4.07	0.63	0.79
2;11.08	out in the stores	WS 310202	0:01:24	3	4	6	17	2.00	4.25	1.00	0.82
	in the car	WS 310203	0:30:25	130	55	417	201	3.21	3.65	0.30	0.53
2;11.09	at home	WS 310204	0:00:13	1	0	7	0	7.00	n/a	1.00	n/a
	in the car	WS 310205	0:02:12	5	5	23	15	4.60	3.00	0.65	0.93
	in the stores	WS 310206	0:00:24	2	0	5	0	2.50	n/a	0.80	n/a
	at home	WS 310208	0:31:21	104	52	376	258	3.62	4.96	0.30	0.43
	at home, bedtime, reading a book	WS 310209	0:06:41	32	2	56	3	1.75	1.50	0.80	1.00
2;11.10	at home	WS 310210	0:09:48	30	13	93	46	3.10	3.54	0.55	0.78
2;11.11	ibid	WS 310212	0:01:22	6	0	20	0	3.33	n/a	0.80	n/a
	at home bedtime	WS 310213	0:22:32	93	4	423	23	4.55	5.75	0.31	0.74
2;11.12	at home playing	WS 310215	0:45:51	151	39	526	172	3.48	4.41	0.34	0.51
	at home	WS 310216	0:13:33	36	30	201	206	5.58	6.87	0.33	0.41
2;11.13	ibid	no audio	0:00:00	6	5	21	24	3.50	4.80	0.81	0.88
2;11.15	ibid	no audio	0:00:00	7	1	41	5	5.86	5.00	0.66	1.00
2;11.18	at home - **Agia Anna**	WS 310219	0:16:05	70	28	242	152	3.46	5.43	0.39	0.54
2;11.19	at the beach	WS 310220	0:21:22	81	38	258	200	3.19	5.26	0.39	0.43
	at home	WS 310221	0:05:42	21	8	85	24	4.05	3.00	0.47	0.67
2;11.20	at the beach	WS 310222	0:18:20	48	16	204	112	4.25	7.00	0.33	0.51
2;11.24	at home	WS 310223	0:04:53	20	7	44	25	2.20	3.57	0.75	0.80
	ibid	WS 310224	0:19:18	50	55	162	244	3.24	4.44	0.41	0.36
2;11.25	ibid	WS 310228	0:14:10	7	26	17	111	2.43	4.27	0.71	0.53
	ibid	WS 310229	0:35:09	96	75	374	336	3.90	4.48	0.31	0.43
2;11.26	at the beach	WS 310230	0:23:57	83	31	332	140	4.00	4.52	0.28	0.60
2;11.27	at home	WS 310231	0:01:15	1	5	1	14	1.00	2.80	1.00	0.86
	ibid	WS 310232	0:00:20	0	3	0	12	n/a	4.00	n/a	0.67
	ibid	WS 310233	0:14:04	43	33	163	162	3.79	4.91	0.42	0.54
	ibid	WS 310234	0:23:08	48	59	148	257	3.08	4.36	0.47	0.47
2;11.28	ibid	no audio	0:00:00	2	0	17	0	8.50	n/a	0.71	n/a
2;11.29	ibid	WS 310237	0:00:57	0	7	0	38	n/a	5.43	n/a	0.45
	ibid	WS 310240	0:02:40	11	3	45	14	4.09	4.67	0.53	0.86
2;11.30	ibid	WS 310241	0:00:38	0	7	0	31	n/a	4.43	n/a	0.61
	ibid	WS 310242	0:36:55	91	108	290	557	3.19	5.16	0.37	0.35

age	***situation***	***media file***	***durn***	***U E***	***U G***	***tks E***	***tks G***	***TUR E***	***TUR G***	***TTR E***	***TTR G***
2;11 T		**44 files**	**8:23:49**	**1566**	**859**	**5869**	**4138**	**3.75**	**4.82**	**0.55**	**0.63**
3;00.01	at home, her birthday	WS 310243	0:01:13	0	2	0	6	n/a	3.00	n/a	1.00
	ibid at home	WS 310244	0:19:32	5	80	8	316	1.60	3.95	0.75	0.39
	ibid	WS 310245	0:03:12	16	5	36	21	2.25	4.20	0.78	0.81
3;00.03	at home	WS 310247	0:05:54	19	21	72	98	3.79	4.67	0.50	0.51
	ibid	WS 310248	0:02:48	3	5	6	17	2.00	3.40	0.83	0.94
3;00.04	ibid	WS 310250	0:00:43	0	4	0	26	n/a	6.50	n/a	0.69
	ibid	WS 310251	0:00:25	0	2	0	6	n/a	3.00	n/a	0.83
	ibid	WS 310252	0:10:27	31	29	94	203	3.03	7.00	0.39	0.43
	ibid	WS 310253	0:32:57	26	84	83	409	3.19	4.87	0.48	0.40
	ibid	WS 310254	0:09:21	47	15	188	76	4.00	5.07	0.31	0.53
3;00.14	**mother back** from Portugal at home - **Athens**	WS 310256	0:06:47	7	26	22	116	3.14	4.46	0.50	0.49
	ibid	WS 310257	0:19:51	11	33	39	168	3.55	5.09	0.62	0.48
3;00.15	at home	WS 310258	0:07:12	16	32	35	221	2.19	6.91	0.71	0.44
	ibid	WS 310259	0:14:28	38	59	117	424	3.08	7.19	0.44	0.39
3;00.16	back home - **Chania**	WS 310261	0:09:38	5	22	33	142	6.60	6.45	0.79	0.50
3;00.17	ibid	WS 310262	0:03:33	10	5	32	23	3.20	4.60	0.59	0.74
	at the grocery store	WS 310263	0:56:01	139	158	430	831	3.09	5.26	0.34	0.30
	at home	WS 310264	0:10:40	29	39	82	209	2.83	5.36	0.48	0.38
	at home playing	WS 310265	0:29:11	103	105	265	509	2.57	4.85	0.42	0.36
	out in the street	WS 310266	0:02:00	9	8	48	50	5.33	6.25	0.56	0.56
3;00.18	at home	WS 310267	1:04:01	218	182	629	928	2.89	5.10	0.31	0.33
3;00.20	in the car	WS 310268	0:00:22	23	0	112	0	4.87	n/a	0.65	n/a
	at home, bedtime	WS 310269	0:04:42	22	6	77	21	3.50	3.50	0.66	0.86
3;00.21	walking the dog	WS 310271	0:11:27	108	34	476	252	4.41	7.41	0.39	0.34
3;00.22	at home	WS 310272	0:25:53	153	61	494	230	3.23	3.77	0.33	0.57
3;00.23	ibid	WS 310273	0:07:38	39	25	114	147	2.92	5.88	0.40	0.52
	ibid	WS 310274	0:11:17	52	45	171	269	3.29	5.98	0.43	0.42
	in the car	WS 310275	0:01:55	12	8	51	43	4.25	5.38	0.66	0.58
	at home, bedtime	WS 310276	0:03:58	16	1	40	1	2.50	1.00	0.58	1.00
3;00.24	at home and free play	WS 310277	0:10:39	37	35	97	218	2.62	6.23	0.57	0.46

age	situation	media file	durn	U E	U G	tks E	tks G	TUR E	TUR G	TTR E	TTR G
	at home	WS 310278	0:24:20	127	82	484	538	3.81	6.56	0.34	0.37
	at home	WS 310279	0:04:51	18	9	73	43	4.06	4.78	0.47	0.70
3;00.25	bedtime, reading a story	WS 310280	0:01:05	8	4	20	30	2.50	7.50	0.79	0.70
	bedtime	WS 310281	0:11:30	63	16	227	61	3.60	3.81	0.41	0.75
3;00.26	in the car	WS 310282	0:04:03	32	5	108	19	3.38	3.80	0.60	0.90
	at home, coloring	WS 310283	0:11:56	49	36	196	212	4.00	5.89	0.44	0.46
	out in the street	WS 310284	0:00:15	3	0	14	0	4.67	n/a	1.00	n/a
	at home	WS 310285	0:00:05	1	0	3	0	3.00	n/a	1.00	n/a
	in the car	WS 310286	0:00:51	16	0	50	0	3.13	n/a	0.76	n/a
	bedtime, reading a story	WS 310287	0:00:11	3	0	19	0	6.33	n/a	0.68	n/a
	at home, chores and playing	WS 310288	0:20:26	83	51	321	294	3.87	5.76	0.35	0.46
3;00:28	at home	no audio	0:00:00	6	0	26	0	4.33	n/a	0.80	n/a
3;00.29	ibid	no audio	0:00:00	1	0	4	0	4.00	n/a	1.00	n/a
3;00.30	in the car and out	WS 310290	0:45:57	215	112	895	604	4.16	5.39	0.25	0.38
	taking a walk, at home bathtime	WS 310291	0:12:55	74	28	256	165	3.46	5.89	0.40	0.47
	bathtime contd., coloring, reading a book bedtime	WS 310292	0:25:58	105	80	374	520	3.56	6.50	0.28	0.34
3 T		**46 files**	**9:12:08**	**1998**	**1554**	**6921**	**8466**	**3.46**	**5.45**	**0.56**	**0.56**
3;01.02	in the car, picking her up from day care	WS 310293	0:38:23	182	71	650	368	3.57	5.18	0.29	0.45
	at home	WS 310294	0:08:24	16	33	59	158	3.69	4.79	0.53	0.55
	at home playing	WS 310295	0:03:15	14	6	59	40	4.21	6.67	0.51	0.83
3;01.02	ibid	WS 310297	0:18:35	82	45	325	285	3.96	6.33	0.40	0.50
	out walking	WS 310298	0:00:53	5	1	25	3	5.00	3.00	0.60	1.00
	at home, bathtime	WS 310299	0:04:40	26	7	117	31	4.50	4.43	0.45	0.71
	at home	WS 310300	0:17:51	72	18	252	93	3.50	5.17	0.37	0.58
3;01.03	in the morning, off to daycare	WS 310301	0:09:29	24	13	76	57	3.17	4.38	0.57	0.67
3;01.05	in the car, back from daycare, at home, at the grocery store	WS 310302	0:28:07	109	60	351	386	3.22	6.43	0.36	0.35

age	situation	media file	durn	U E	U G	tks E	tks G	TUR E	TUR G	TTR E	TTR G
	at home playing	WS 310303	0:44:10	192	78	741	402	3.86	5.15	0.27	0.45
	ibid	WS 310304	0:01:21	5	3	19	9	3.80	3.00	0.74	1.00
3;01.06	ibid	WS 310305	0:41:53	151	62	551	317	3.65	5.11	0.32	0.48
3;01.07	ibid	WS 310306	0:25:37	103	58	398	259	3.86	4.47	0.36	0.57
3;01.09	ibid	WS 310307	0:06:13	39	10	177	57	4.54	5.70	0.48	0.68
	walking in the park, at the grocery store, back home	WS 310308	0:13:08	61	26	223	186	3.66	7.15	0.39	0.55
	at home bedtime	WS 310309	0:15:50	60	38	183	197	3.05	5.18	0.43	0.44
3;01.10	in the car	WS 310310	0:03:21	12	11	50	43	4.17	3.91	0.60	0.67
	ibid	WS 310311	0:02:12	11	9	36	36	3.27	4.00	0.81	0.69
	at home	WS 310312	0:02:46	11	4	49	8	4.45	2.00	0.63	1.00
	ibid	WS 310313	0:11:03	40	22	200	125	5.00	5.68	0.40	0.64
3;01.12	ibid, making lunch, daddy joins	WS 310314	1:24:40	138	135	487	624	3.53	4.62	0.36	0.35
3;01.13	at home	WS 310316	0:01:47	7	8	9	19	1.29	2.38	0.78	0.90
	ibid	WS 310317	0:16:39	65	35	277	209	4.26	5.97	0.37	0.52
	at the park	WS 310319	0:02:53	14	6	45	33	3.21	5.50	0.60	0.76
3;01.14	at home	WS 310320	0:06:57	26	14	60	54	2.31	3.86	0.52	0.70
	walking the dog and back home	WS 310321	0:36:43	146	89	506	519	3.47	5.83	0.31	0.45
	at home	WS 310322	0:08:35	29	4	98	18	3.38	4.50	0.52	0.72
3;01.15	in the car, picking her up from day care, at home, at the park	WS 310323	0:44:16	178	107	612	582	3.44	5.44	0.29	0.38
3;01.18	at home	WS 310324	0:04:37	22	14	60	62	2.73	4.43	0.63	0.73
	ibid	WS 310325	0:39:03	152	59	493	268	3.24	4.54	0.35	0.51
3;01.19	ibid	WS 310326	0:08:30	36	18	109	110	3.03	6.11	0.59	0.65
	walking the dog	WS 310327	0:03:27	17	10	63	51	3.71	5.10	0.68	0.57
3;01.21	at home	WS 310330	0:33:58	197	32	738	107	3.75	3.34	0.28	0.65
	ibid	WS 310331	0:19:49	99	11	380	58	3.84	5.27	0.37	0.66
3;01.22	ibid	WS 310332	0:10:04	61	10	327	70	5.36	7.00	0.35	0.77
	ibid	WS 310333	0:09:41	57	22	256	126	4.49	5.73	0.31	0.48
3;01.25	ibid	WS 310334	0:10:23	48	20	240	90	5.00	4.50	0.36	0.59

age	situation	media file	durn	U E	U G	tks E	tks G	TUR E	TUR G	TTR E	TTR G
	ibid	WS 310335	0:12:01	18	17	89	105	4.94	6.18	0.56	0.55
3:01.26	walking the dog and in the car	WS 310336	0:10:34	40	32	145	185	3.63	5.78	0.50	0.52
3;01.28	at home	WS 310339	0:29:57	84	72	320	451	3.81	6.26	0.38	0.48
	out walking	WS 310340	0:14:12	62	18	295	125	4.76	6.94	0.32	0.59
3;01.29	at home	WS 310341	0:33:45	142	45	497	182	3.50	4.04	0.25	0.60
3;01.30	bedtime	WS 310342	0:29:33	141	19	434	59	3.08	3.11	0.37	0.75
	at home	WS 310344	0:03:43	14	5	36	21	2.57	4.20	0.64	0.86
3;1 T		**44 files**	**12:52:58**	**3008**	**1377**	**11117**	**7188**	**3.70**	**5.22**	**0.46**	**0.63**
3;02.01	ibid	WS 310346	0:03:18	7	2	28	10	4.00	5.00	0.89	1.00
	ibid	WS 310347	0:32:13	61	49	241	268	3.95	5.47	0.34	0.46
3;02.03	ibid	WS 310354	0:26:03	85	47	374	275	4.40	5.85	0.30	0.47
	ibid, playing	WS 310355	0:29:07	116	72	441	381	3.80	5.29	0.32	0.43
	ibid bedtime	WS 310356	0:18:09	68	30	246	178	3.62	5.93	0.41	0.55
	at the airport	WS 310358	0:18:43	43	22	266	12	6.19	0.55	0.44	0.59
3;02.11	at home	WS 310367	0:24:30	96	53	387	300	4.03	5.66	0.33	0.47
	ibid	WS 310369	0:41:03	200	85	743	393	3.72	4.62	0.27	0.44
3;02.13	ibid	WS 310374	0:38:24	201	48	904	247	4.50	5.15	0.16	0.39
3;02.15	ibid	WS 310375	0:04:03	14	7	50	35	3.57	5.00	0.56	0.74
3;02.16	out walking	WS 310379	0:17:08	94	30	509	179	5.41	5.97	0.24	0.56
3;02.17	at home playing	WS 310380	0:18:46	114	26	645	143	5.66	5.50	0.25	0.60
3;02.18	at home	WS 310386	0:10:24	50	19	227	116	4.54	6.11	0.34	0.50
3;02.22	at home playing	WS 310401	0:47:55	174	107	788	728	4.53	6.80	0.26	0.39
3;02.29	ibid	WS 310415	0:45:06	215	76	1147	502	5.33	6.61	0.19	0.39
3;02.30	ibid	WS 310416	0:42:16	133	102	639	494	4.80	4.84	0.22	0.41
3;2 T		**16 files**	**6:57:08**	**1671**	**775**	**7635**	**4261**	**4.57**	**5.50**	**0.34**	**0.52**
3;03.01	ibid	WS 310422	1:10:31	263	176	1231	990	4.68	5.63	0.19	0.34
3;03.04	ibid	WS 310429	0:19:04	76	46	383	329	5.04	7.15	0.30	0.45
3;03.09	ibid	WS 310437	0:44:43	199	71	827	387	4.16	5.45	0.28	0.48
3;03.11	at home and free play	WS 310441	0:08:25	15	18	73	126	4.87	7.00	0.63	0.56
	in the car	WS 310442	0:14:38	29	66	134	387	4.62	5.86	0.48	0.39
3;03.12	at home	WS 310446	0:03:33	10	4	42	20	4.20	5.00	0.67	0.85
	walking outdoors	WS 310447	0:02:35	16	2	90	7	5.63	3.50	0.40	0.86
	at home	WS 310448	0:10:29	49	16	211	59	4.31	3.69	0.43	0.61

age	situation	media file	durn	U E	U G	tks E	tks G	TUR E	TUR G	TTR E	TTR G
3;03.13	at home	WS 310452	0:06:53	14	15	72	80	5.14	5.33	0.56	0.63
	outdoors walking	WS 310453	0:07:29	41	17	144	69	3.51	4.06	0.48	0.75
	at home	WS 310454	0:03:58	11	28	41	107	3.73	3.82	0.49	0.63
3;03.15	ibid	WS 310457	0:51:38	159	141	643	1070	4.04	7.59	0.27	0.30
3;03.16	ibid	WS 310458	0:02:00	9	7	30	21	3.33	3.00	0.66	0.71
3;03.18	ibid playing	WS 310461	0:17:43	87	45	455	246	5.23	5.47	0.31	0.54
3;03.19	in the car	WS 310463	0:00:42	5	0	22	0	4.40	n/a	0.68	n/a
	outdoors	WS 310464	0:01:33	17	1	46	2	2.71	2.00	0.65	1.00
3;03.21	at home playing	WS 310466	0:22:22	114	45	465	173	4.08	3.84	0.29	0.53
3;03.22	ibid	WS 310468	0:16:46	64	58	275	420	4.30	7.24	0.41	0.42
3;03.24	ibid	WS 310473	0:06:14	12	17	78	178	6.50	10.47	0.40	0.48
	ibid	WS 310475	0:04:28	17	15	94	143	5.53	9.53	0.50	0.43
3;03.25	Christmas day, bedtime reading	WS 310477	0:19:35	100	28	293	91	2.93	3.25	0.43	0.77
3;03.26	in the car	WS 310481	0:11:46	71	18	213	64	3.00	3.56	0.44	0.73
3;03.28	at home	WS 310484	0:24:17	80	35	362	198	4.53	5.66	0.31	0.46
3;03.30	ibid	WS 310490	0:37:35	176	56	761	299	4.32	5.34	0.24	0.50
3;3 T		**24 files**	**6:48:57**	**1634**	**925**	**6985**	**5466**	**4.27**	**5.91**	**0.44**	**0.58**
3;04.02	ibid	WS 310493	0:22:24	89	43	420	304	4.72	7.07	0.32	0.41
3;04.03	at home and free play	WS 310494	0:37:24	166	81	871	506	5.25	6.25	0.25	0.36
3;04.04	at home	WS 310498	0:30:00	166	44	895	198	5.39	4.50	0.23	0.55
3;04.05	ibid	WS 310500	0:22:59	113	35	538	179	4.76	5.11	0.29	0.53
3;04.12	ibid	WS 310512a	0:49:44	164	153	680	1011	4.15	6.61	0.30	0.34
	ibid	WS 310512b	0:36:12	132	74	659	557	4.99	7.53	0.25	0.38
3;04.13	in the car	WS 310513	0:43:42	115	82	495	423	4.30	5.16	0.33	0.46
	at home playing	WS 310514	0:04:18	29	4	79	15	2.72	3.75	0.63	0.93
3;04.14	ibid	WS 310518	1:10:04	316	74	1430	371	4.53	5.01	0.22	0.48
	ibid	WS 310520	0:11:19	45	25	250	115	5.56	4.60	0.43	0.63
3;04.15	ibid	WS 310521	0:07:14	33	11	138	81	4.18	7.36	0.50	0.58
3;04.16	in the car	WS 310523	0:03:44	28	5	117	27	4.18	5.40	0.54	0.78
3:04.18	at home playing	WS 310524	0:03:15	19	5	92	22	4.84	4.40	0.54	0.64
3;04.20	ibid	WS 310527	0:05:40	29	5	131	29	4.52	5.80	0.43	0.59
	ibid	WS 310528	0:23:00	122	56	517	390	4.24	6.96	0.29	0.44

age	situation	media file	durn	U E	U G	tks E	tks G	TUR E	TUR G	TTR E	TTR G
3;04.28	outdoors, at the store, at home solving a puzzle, bedtime	WS 310539	0:23:09	113	46	489	256	4.33	5.57	0.30	0.56
3;04.29	outdoors and home	WS 310541	0:34:28	214	30	1106	172	5.17	5.73	0.25	0.58
3;04.31	bedtime reading	WS 310548	0:06:05	43	9	116	34	2.70	3.78	0.63	0.71
3;4 T		**18 files**	**7:14:41**	**1936**	**782**	**9023**	**4690**	**4.66**	**6.00**	**0.37**	**0.55**
3;05.02	at home colouring	WS 310553	0:08:42	36	22	147	144	4.08	6.55	0.52	0.59
	bedtime	WS 310555	0:02:44	14	7	71	31	5.07	4.43	0.65	0.81
3;05.03	at home playing	WS 310558	0:41:18	144	48	825	264	5.73	5.50	0.25	0.49
	at home bedtime	WS 310560	0:09:54	45	4	173	20	3.84	5.00	0.54	0.80
3;05.06	at home	WS 310566	0:02:03	16	3	51	11	3.19	3.67	0.77	0.91
	ibid	WS 310567	0:02:10	13	5	73	24	5.62	4.80	0.55	0.79
	ibid, playing blocks, hide and seek	WS 310568	0:07:01	45	4	219	12	4.87	3.00	0.40	0.92
	at home	WS 310570	0:20:09	91	22	388	171	4.26	7.77	0.31	0.63
3;05.09	ibid and free play	WS 310574	0:01:38	1	0	2	0	2.00	n/a	1.00	n/a
	at home	WS 310575	0:09:25	33	26	132	162	4.00	6.23	0.55	0.61
3;05.10	ibid	WS 310578	0:23:18	102	34	451	270	4.42	7.94	0.31	0.47
3;05.13	in the car	WS 310590	0:01:10	3	3	30	12	10.0	4.00	0.73	0.92
	at home	WS 310591	0:00:14	3	1	16	5	5.33	5.00	0.94	1.00
	ibid	WS 310592	0:02:42	9	2	12	2	1.33	1.00	0.42	0.50
	at home	WS 310593	0:22:31	105	34	449	176	4.28	5.18	0.35	0.54
3;05.14	ibid	WS 310595	0:09:28	52	6	172	18	3.31	3.00	0.50	1.00
3;05.15	ibid	WS 310597	0:21:09	99	32	387	189	3.91	5.91	0.40	0.61
3;05.19	at home and bath time	WS 310607	0:29:15	130	57	603	382	4.64	6.70	0.30	0.46
3;05.20	at home, reading a book	WS 310616	0:47:07	191	22	756	124	3.96	5.64	0.29	0.65
3;05.21	at home	WS 310618	0:33:57	164	72	748	410	4.56	5.69	0.30	0.47
	ibid	WS 310619	0:03:44	19	2	71	11	3.74	5.50	0.65	0.91
	ibid playing	WS 310620	0:16:02	82	25	456	111	5.56	4.44	0.27	0.66
3;05.24	ibid	WS 310624	0:11:51	54	17	353	108	6.54	6.35	0.38	0.59
	at home	WS 310625	0:12:06	52	9	363	42	6.98	4.67	0.34	0.76
3;05.27	ibid	WS 310627	0:03:20	12	2	40	10	3.33	5.00	0.85	0.80
	ibid	WS 310631	0:03:02	14	7	65	19	4.64	2.71	0.46	0.84

age	*situation*	*media file*	*durn*	*U E*	*U G*	*tks E*	*tks G*	*TUR E*	*TUR G*	*TTR E*	*TTR G*
3;5 T		**26 files**	**5:46:00**	**1529**	**466**	**7053**	**2728**	**4.61**	**5.85**	**0.50**	**0.71**
3;06.03	at home, beginning to write, out walking, back home	WS 310662	0:18:26	101	27	427	165	4.23	6.11	0.35	0.61
3;06.04	at home	WS 310664	0:03:33	8	7	23	50	2.88	7.14	0.78	0.74
	ibid	WS 310665	0:02:39	15	0	57	0	3.80	n/a	0.70	n/a
3;06.05	ibid	WS 310668	0:16:37	56	26	253	142	4.52	5.46	0.43	0.61
	ibid	WS 310669	0:01:09	6	2	18	20	3.00	10.0	0.89	0.85
3;06.06	outdoors	WS 310670	0:04:26	15	3	66	10	4.40	3.33	0.65	1.00
	in the car, back home	WS 310671	0:06:07	23	14	127	68	5.52	4.86	0.51	0.66
	at home solving a puzzle	WS 310672	0:26:04	85	42	397	266	4.67	6.33	0.36	0.44
	at home	WS 310673	0:01:52	14	0	47	0	3.36	n/a	0.70	n/a
3;06.07	ibid	WS 310674	0:01:56	14	2	57	10	4.07	5.00	0.68	1.00
	ibid	WS 310675	0:01:04	9	1	28	4	3.11	4.00	0.71	1.00
	at the park	WS 310676	0:03:42	26	1	150	3	5.77	3.00	0.55	1.00
	at home	WS 310677	0:03:04	13	3	50	14	3.85	4.67	0.72	0.86
3;06.08	bedtime	WS 310678	0:04:40	20	9	84	43	4.20	4.78	0.49	0.72
3;06.09	bedtime	WS 310679	0:14:32	70	21	283	103	4.04	4.90	0.48	0.57
	bedtime contd	WS 310680	0:07:34	42	3	163	9	3.88	3.00	0.53	1.00
3;06.11	at home	WS 310683	0:04:19	19	4	58	15	3.05	3.75	0.73	0.73
	ibid playing	WS 310684	0:14:21	59	26	199	90	3.37	3.46	0.48	0.49
3;06.12	at home, breakfast time	WS 310685	0:13:02	42	19	168	91	4.00	4.79	0.58	0.60
	at home, snack time, reading a book	WS 310688	0:11:16	42	15	192	78	4.57	5.20	0.45	0.72
3;06.13	at home, doing chores, in bed	WS 310689	0:20:00	104	12	378	50	3.63	4.17	0.35	0.76
3;06.15	at home	WS 310700	0:10:48	30	12	104	71	3.47	5.92	0.59	0.69
3;06.18	ibid, reading a book	WS 310705	0:24:14	142	9	383	39	2.70	4.33	0.45	0.85
3;06.19	outdoors, back home, browsing an album	WS 310712	0:34:08	185	39	689	193	3.72	4.95	0.29	0.56
	dinner and bedtime	WS 310714	0:21:16	118	17	517	82	4.38	4.82	0.32	0.62
3;06.21	at home playing	WS 310716	0:18:01	91	28	358	149	3.93	5.32	0.39	0.51
3;06.25	at home	WS 310725	0:24:06	22	69	122	500	5.55	7.25	0.53	0.44

age	situation	media file	durn	U E	U G	tks E	tks G	TUR E	TUR G	TTR E	TTR G
3;06.26	ibid	WS 310735	0:35:06	191	34	1128	220	5.91	6.47	0.25	0.64
3;06.28	in the car	WS 310739	0:03:56	11	19	33	67	3.00	3.53	0.58	0.60
	at home	WS 310741	0:07:19	38	9	191	42	5.03	4.67	0.44	0.64
	ibid	WS 310744	0:09:13	43	3	238	11	5.53	3.67	0.48	1.00
3;06.30	ibid	WS 310748	0:15:49	84	16	413	110	4.92	6.88	0.33	0.55
3;06.31	ibid resting	WS 310752	0:57:47	304	57	1507	347	4.96	6.09	0.20	0.47
3;6 T		**33 files**	**7:22:06**	**2042**	**549**	**8908**	**3062**	**4.36**	**5.58**	**0.51**	**0.71**
3;07.02	at home, Good Friday	WS 310755	0:06:58	30	1	118	9	3.93	9.00	0.57	0.78
	at home	WS 310756	0:06:28	20	9	98	59	4.90	6.56	0.54	0.64
	ibid	WS 310757	0:31:20	174	10	1024	70	5.89	7.00	0.18	0.54
3;07.03	ibid	WS 310759	0:06:14	20	7	69	53	3.45	7.57	0.64	0.83
	ibid	WS 310760	0:02:04	10	6	50	68	5.00	11.3	0.76	0.63
3;07.06	ibid	WS 310761	0:21:21	85	47	350	291	4.12	6.19	0.38	0.52
	ibid	WS 310762	0:02:46	15	4	55	10	3.67	2.50	0.56	1.00
3;07.07	at home - **Athens**	WS 310764	0:09:47	41	11	166	58	4.05	5.27	0.35	0.67
	ibid	WS 310765	0:00:25	3	0	17	0	5.67	n/a	0.82	n/a
3;07.10	ibid	WS 310775	0:01:18	10	6	33	26	3.30	4.33	0.76	0.65
3;07.12	at home - **Chania**	WS 310777	0:32:02	173	31	765	166	4.42	5.35	0.27	0.57
	ibid, solving puzzles	WS 310779	0:21:53	112	11	583	54	5.21	4.91	0.27	0.80
3;07.13	ibid	WS 310782	0:01:46	8	1	49	4	6.13	4.00	0.63	0.50
	ibid, breakfast time	WS 310783	0:40:15	193	29	729	171	3.78	5.90	0.28	0.59
3;07.16	ibid	WS 310796	0:02:49	15	2	62	15	4.13	7.50	0.63	0.87
3;07.19	ibid	WS 310807	0:44:34	103	107	406	783	3.94	7.32	0.34	0.37
	ibid	WS 310810	0:06:45	35	6	234	26	6.69	4.33	0.38	0.85
	ibid	WS 310811	0:28:44	88	39	371	212	4.22	5.44	0.33	0.63
3;07.21	ibid	WS 310817	0:26:09	73	40	352	252	4.82	6.30	0.39	0.54
3;07.22	at the park, back home	WS 310820	0:32:21	149	28	719	200	4.83	7.14	0.26	0.54
3;07.24	at home	WS 310827	0:11:58	53	5	245	14	4.62	2.80	0.42	0.71
3;07.27	in the car, back home	WS 310838	0:33:07	142	19	710	98	5.00	5.16	0.30	0.64
3;07.28	at home	WS 310842	0:54:06	196	108	1131	617	5.77	5.71	0.26	0.41
3;7 T		**23 files**	**7:05:10**	**1748**	**527**	**8336**	**3256**	**4.77**	**6.18**	**0.45**	**0.65**
3;08.04	mother back from Poznan	WS 310853	0:45:51	219	22	1343	124	6.13	5.64	0.19	0.65

age	situation	media file	durn	U E	U G	tks E	tks G	TUR E	TUR G	TTR E	TTR G
3;08.05	at home playing and reading	WS 310855	1:01:41	311	46	1861	222	5.98	4.83	0.18	0.54
3;08.06	ibid	WS 310858	0:26:05	64	44	346	211	5.41	4.80	0.38	0.58
3;08.07	ibid	WS 310861	0:31:19	159	27	724	134	4.55	4.96	0.27	0.63
3;08.09	ibid	WS 310866	0:10:06	45	22	305	120	6.78	5.45	0.37	0.59
3;08.10	outdoors walking	WS 310872	0:27:22	97	30	532	162	5.48	5.40	0.26	0.59
3;08.12	at home	WS 310878	0:06:13	32	5	161	14	5.03	2.80	0.46	0.79
3;08.15	ibid, playing	WS 310888	0:53:13	276	18	1525	71	5.53	3.94	0.22	0.80
3;08.17	at home	WS 310893	0:42:43	231	33	1203	135	5.21	4.09	0.25	0.70
3;08.19	ibid	WS 310904	0:26:33	113	15	685	94	6.06	6.27	0.31	0.61
3;08.22	ibid	WS 310917	0:33:41	125	55	850	330	6.80	6.00	0.31	0.49
3;08.23	at home playing	WS 310928	0:33:29	172	3	1025	6	5.96	2.00	0.22	1.00
3;08.29	at home	WS 310951	0:32:42	162	21	1077	86	6.65	4.10	0.26	0.74
	at the park	WS 310961	0:02:23	21	1	103	1	4.90	1.00	0.58	1.00
3;8 T		**14 files**	**7:13:21**	**2027**	**342**	**11740**	**1710**	**5.79**	**5.00**	**0.30**	**0.69**
3;09.03	at home	WS 310971	0:21:21	134	2	1094	4	8.16	2.00	0.23	1.00
3;09.04	walking outdoors, back inside, bath & bed time	WS 310973	0:17:28	105	8	662	50	6.30	6.25	0.33	0.80
3;09.06	at home crafting	WS 310978	0:59:09	304	73	1504	436	4.95	5.97	0.25	0.44
	at home, solving a puzzle	WS 310979	0:15:43	78	3	368	15	4.72	5.00	0.36	0.40
3;09.08	at home reading a book	WS 310983	0:52:38	285	24	1382	124	4.85	5.17	0.29	0.61
3;09.09	at home	WS 310988	0:10:53	48	5	230	22	4.79	4.40	0.55	0.86
3;09.10	ibid	WS 310992	0:22:08	98	21	417	119	4.26	5.67	0.42	0.71
	ibid	WS 310998	0:09:53	52	3	350	12	6.73	4.00	0.39	1.00
3;09.14	ibid	WS 311001	0:42:09	226	35	1268	209	5.61	5.97	0.22	0.56
3;09.17	at the beach	WS 311007	0:00:16	1	0	9	0	9.00	n/a	1.00	n/a
	at home	WS 311009	0:36:17	182	5	903	24	4.96	4.80	0.31	0.83
3;09.20	ibid	WS 311019	0:39:20	208	23	1498	110	7.20	4.78	0.23	0.68
3;09.21	ibid	WS 311024	0:24:06	97	44	465	157	4.79	3.57	0.40	0.58
3;09.27	on vacation in public places - **Rhodes**	WS 311039	0:33:37	149	14	926	57	6.21	4.07	0.30	0.75
3;09.28	various activities	WS 311043	0:15:29	65	11	374	77	5.75	7.00	0.39	0.62

age	situation	media file	durn	U E	U G	tks E	tks G	TUR E	TUR G	TTR E	TTR G
3;09.29	ibid	WS 311046	0:07:00	26	2	202	16	7.77	8.00	0.42	0.81
	ibid	WS 311051	0:14:26	90	7	527	33	5.86	4.71	0.38	0.88
	ibid	WS 311052	0:05:41	25	0	134	0	5.36	n/a	0.60	n/a
3;9 T		**18 files**	**7:07:34**	**2173**	**280**	**12313**	**1465**	**5.67**	**5.23**	**0.39**	**0.72**
3;10.02	back home - Chania	WS 311062	0:27:34	127	24	662	122	5.21	5.08	0.33	0.66
3;10.04	at home	WS 311066	0:15:31	75	1	465	2	6.20	2.00	0.40	1.00
3;10.05	ibid	WS 311070	0:46:00	253	6	1319	30	5.21	5.00	0.26	0.80
3;10.07	ibid	WS 311076	0:15:18	69	10	471	59	6.83	5.90	0.35	0.63
	ibid	WS 311078	0:16:18	93	1	503	4	5.41	4.00	0.38	1.00
	at home solving a puzle	WS 311079	0:12:35	65	0	367	0	5.65	n/a	0.40	n/a
3;10.11	in the car	WS 311092	0:30:17	84	33	468	182	5.57	5.52	0.41	0.63
3;10.12	at home	WS 311096	0:37:15	157	27	960	113	6.11	4.19	0.32	0.66
3;10.14	ibid	WS 311102	0:08:22	27	14	155	50	5.74	3.57	0.53	0.65
3;10.15	ibid	WS 311105	0:08:40	32	1	201	3	6.28	3.00	0.50	1.00
	ibid	WS 311108	0:32:16	118	27	492	144	4.17	5.33	0.36	0.54
3;10.16	ibid	WS 311110	0:07:20	38	2	199	9	5.24	4.50	0.50	0.89
3;10.17	ibid	WS 311111	0:15:11	57	9	242	39	4.25	4.33	0.45	0.87
	outdoors walking	WS 311113	0:14:10	82	3	423	11	5.16	3.67	0.39	0.91
3;10.18	at home	WS 311114	0:03:33	22	1	125	8	5.68	8.00	0.60	0.88
3;10.20	at home solving a puzzle	WS 311117	0:06:04	37	0	207	0	5.59	n/a	0.52	n/a
3;10.22	at home	WS 311126	0:15:23	87	7	388	34	4.46	4.86	0.40	0.71
3;10.25	ibid	WS 311135	0:15:04	79	5	471	25	5.96	5.00	0.36	0.52
3;10.27	ibid	WS 311144	0:44:22	272	8	1864	22	6.85	2.75	0.22	0.91
3;10.30	ibid	WS 311150	0:21:28	47	48	307	261	6.53	5.44	0.39	0.55
3;10 T		**20 files**	**6:32:41**	**1821**	**227**	**10289**	**1118**	**5.65**	**4.93**	**0.40**	**0.77**
3;11.01	ibid	WS 311157	0:23:01	137	0	965	0	7.04	n/a	0.24	n/a
	ibid	WS 311159	0:11:58	56	9	411	60	7.34	6.67	0.44	0.87
3;11.03	ibid	WS 311161	0:08:21	54	1	366	10	6.78	10.0	0.41	1.00
3;11.04	ibid	WS 311164	0:15:50	33	0	180	0	5.45	n/a	0.61	n/a
3;11.05	ibid	WS 311167	0:19:35	83	0	609	0	7.34	n/a	0.32	n/a
	ibid	WS 311169	0:08:41	27	0	131	0	4.85	n/a	0.65	n/a
3;11.08	at home playing	WS 311175	0:56:24	245	5	1917	22	7.82	4.40	0.20	1.00

age	situation	media file	durn	U E	U G	tks E	tks G	TUR E	TUR G	TTR E	TTR G
3;11.13	at home	WS 311191	0:12:09	57	0	314	0	5.51	n/a	0.48	n/a
	ibid	WS 311192	0:17:02	74	0	542	0	7.32	n/a	0.33	n/a
3;11.14	ibid	WS 311198	0:22:15	105	4	610	54	5.81	13.5 0	0.35	0.69
3;11.17	ibid	WS 311199	0:15:51	76	3	434	7	5.71	2.33	0.38	1.00
3;11.20	at home bedtime	WS 311205	0:19:00	82	1	417	2	5.09	2.00	0.38	1.00
3;11.21	at the stores - **Athens**	WS 311206	0:27:40	30	0	196	0	6.53	n/a	0.48	n/a
	in the park	WS 311208	0:16:20	74	4	457	35	6.18	8.75	0.35	0.66
3;11.25	at home	WS 311222	0:29:43	154	3	1116	11	7.25	3.67	0.25	1.00
3;11.27	ibid	WS 311224	0:35:11	123	7	757	43	6.15	6.14	0.31	0.77
	ibid	WS 311225	0:36:43	154	3	1128	16	7.32	5.33	0.23	0.94
	ibid	WS 311230	0:11:39	54	0	402	0	7.44	n/a	0.38	n/a
3;11 T		**18 files**	**6:27:23**	**1618**	**40**	**10952**	**260**	**6.77**	**6.50**	**0.38**	**0.89**
2;7-4;0	**1 utterance every 10.7 seconds**	**511 files**	**135:32:22**	**31684**	**13940**	**137869**	**69289**	**4.35**	**4.97**	**0.47**	**0.65**
	89.3 utterances per file										

NB. **durn:** duration, **U E:** utterances in English, **U G:** utterances in Greek, **tks E:** word tokens in English, **tks G:** word tokens in Greek, **TUR:** word tokens/utterance, **TTR:** word types/ word tokens

APPENDIX B
THE CHILD'S TARGETED WORDS IN GREEK AT 2;7

Word Types	*Adult Production*	*Gloss/Gram*
αγελάδα	aʝe'laða	cow (N)
αγκαλιά	aga'ʎa	cuddle (N)
αγκαλίτσα	aga'liʦa	cuddle (N dim)
άδειο	'aðʝo	empty (ADJ S ntr)
ακόμα	a'koma	still/yet (ADV)
ακουμπάμε	aku'bame	touch (V 1 Pl)
αλήθεια	a'liθça	truth (N)
άλλη	'ali	other (ADJ S fm)
άλλο	'alo	other (ADJ S ntr)
άλλος	'alos	other (ADJ S ms)
αλογάκι	alo'ɣaci	horsey (N dim)
Άλπεις	'alpis	Alps (nm)
άμα	'ama	if (PREP)
αν	an	if (CONJ)
Αναργύρου	anaɾ'ʝiɾu	(nm)
ανέβω	a'nevo	go up (V 1 S)
άνοιξε	'anikse	open (V 3 S past)
ανοίξει	a'niksi	open (V 3 S fut)
ανοίξεις	a'niksis	open (V 2 S fut)
ανοίξω	a'nikso	open (V 1 S fut)
αντίο	a'dio	adieu (excl)
από	a'po	from (PREP)
αρκουδάκι	aɾku'ðaci	teddy (N dim)
αρχή	aɾ'çi	beginning (N)
άσε	'ase	let (V S imp)
άσπρη	'aspɾi	white (ADJ S fm)
άσπρο	'aspɾo	white (ADJ S ntr)
άστη	'asti	let her (V+PRON S imp) 1
άστηνε	'astine	let her (V+PRON S imp) 2
άστο	'asto	let it (V+PRON S imp)
αυγό	a'vɣo	egg (N)
αύριο	'avɾio	tomorrow (ADV)
αυτά	a'fta	these (PRON)
αυτή	a'fti	she/her (PRON)
αυτί	a'fti	ear (N)
αυτό	a'fto	this (PRON)
αυτοκίνητο	afto'cinito	car (N)
αυτός	a'ftos	he (PRON)

Word Types	***Adult Production***	***Gloss/Gram***
αφήνει	a'fini	allow/let (V 3 S)
αφήνεις	a'finis	allow (V 2 S)
αφήσει	a'fisi	let (V 3 S past)
αφήσεις	a'fisis	let (V 2 S past)
βάζανε	'vazane	put (V 3 Pl past)
βάλει	'vali	put/wear (V 3 S)
βάλεις	'valis	put/wear (V 2 S)
βάλω	'valo	put/wear (V 1 S)
βγάλεις	'vɣalis	take off (V 2 S)
βγάλω	'vɣalo	take off (V 1 S)
βγει	'vʝi	exit (V 3 S)
βγεις	'vʝis	exit (V 2 S)
Βενιζέλο	veni'zelo	(nm)
βιβλίο	vi'vlio	book (N)
βλέπω	'vlepo	see (V 1 S)
βόλτα	'volta	walk (N)
βουνά	vu'na	mountains (N)
βρεις	'vris	find (V 2 S)
βρήκες	'vrices	find (V 2 S past)
βρούμε	'vɾume	find (V 1 Pl)
γάλα	'ɣala	milk (N)
γατούλα	ɣa'tula	cat (N dim)
γαύγισε	'ɣavʝise	bark (V 3 S past)
γειά	ʝa	hi (excl)
γέρος	'ʝeɾos	old man (N)
γη	ʝi	earth (N)
γιαγιά	ʝa'ʝa	granny (N)
γιατί	ʝa'ti	because/why (PRCL)
γιατρό	ʝa'tɾo	doctor (N)
γίνουμε	'ʝinume	become (V 1 Pl)
Γιώργος	'ʝoɾɣos	George (nm)
γλύψει	'ɣlipsi	lick (V 3 S)
γράμματα	'ɣɾamata	letters (N)
γραφείο	ɣɾa'fio	office (N)
γράψω	'ɣɾapso	write (V 1 S)
γυρίσω	ʝi'ɾiso	return (V 1 S)
γύρω	'ʝiɾo	around (ADV)
γω	ɣo	I (PRON abr)
δαχτυλίδι	ðaxti'liði	ring (N)
δε	ðe	don't (PRCL abr)

Word Types	Adult Production	Gloss/Gram
δείξω	'ðikso	show (V 1 S)
δεν	ðen	don't (PRCL)
Δημήτρης	ði'mitɾis	Dimitris (nm)
διαβάσεις	ðʝa'vasis	read (V 2 S)
διαβάσουμε	ðʝa'vasume	read (V 1 Pl)
διαβάσω	ðʝa'vaso	read (V 1 S)
διάλεξα	'ðʝaleksa	choose (V 1 S past)
δικά	ði'ka	mine (PRON Pl)
δική	ði'ci	mine (PRON S fm)
δικό	ði'ko	mine (PRON S ntr)
δίνω	'ðino	give (V 1 S)
δουλειά	ðu'ʎa	job (N)
δυνατά	ðina'ta	loud (ADV)
δύο	'ðio	two (num)
δω	ðo	here (ADV abr)
δώσε	'ðose	give (V 2 S imp)
δώσει	'ðosi	give (V 3 S)
δώσεις	'ðosis	give (V 2 S)
δώσω	'ðoso	give (V 1 S)
έβαλα	'evala	put (V 1 S past)
έβαλες	'evales	put (V 2 S past)
έβγαλα	'evɣala	took off (V 1 S)
έγλειψα	'eɣlipsa	lick (V 1 S past)
έγλειψε	'eɣlipse	lick (V 3 S past)
εγώ	e'ɣo	I (PRON)
εδώ	e'ðo	here (ADV)
έδωσε	'eðose	gave (V 3 S)
είμαι	'ime	am (V 1 S)
είμαστε	'imaste	are (V 1 Pl)
είναι	'ine	is (V 3 S)
είπα	'ipa	say (V 1 S past)
είπε	'ipe	say (V 3 S past)
είσαι	'ise	be (V 2 S)
έκανα	'ekana	do (V 1 S past)
έκανες	'ekanes	do (V 2 S past)
εκεί	e'ci	there (ADV)
εκκλησία	ekli'sia	church (N)
έκλεισα	'eklisa	close (V 1 S past)
έκλεισε	'eklise	close (V 1 S past)
έλα	'ela	come (V 2 S imp)

Word Types	*Adult Production*	*Gloss/Gram*
ελίτσες	e'litses	olives (N dim)
εμείς	e'mis	we (PRON)
εμένα	e'mena	me (PRON)
ένα	'ena	one (num)
έξω	'ekso	outside (ADV)
έπαιξες	'epekses	play (V 2 S past)
έπεσαν	'epesan	fall (V 3 Pl past)
έπεσε	'epese	fall (V 3 S past)
έρχεται	'erçete	come (V 3 S)
έρχομαι	'eɾxoμe	come (V 1 S)
εσένα	e'sena	you (PRON acc)
εσύ	e'si	you (PRON nom)
έτρεξα	'etɾeksa	run (V 1 S past)
έτρωγα	'etɾoɣa	eat (V 1 S past)
έτσι	'etsi	so (ADV)
ευχαριστώ	efxari'sto	thank (V 1 S)
έφαγα	'efaɣa	eat (V 1 S past)
εφτά	e'fta	seven (num)
έχασε	'exase	lose (V 3 S past)
έχει	'eçi	have (V 3 S)
έχεις	'eçis	have (V 2 S)
έχω	'exo	have (V 1 S)
ζαμπόν	za'bon	ham (N)
ζούσε	'zuse	live (V 3 S past)
ζώα	'zoa	animals (N)
ζωγραφήσεις	zoɣɾa'fisis	color (V 2 S)
ζωγραφήσουμε	zoɣɾa'fisume	color (V 1 Pl)
Ζωή	zo'i	(nm)
ήθελες	'iθeles	want (V 2 S past)
ήμουνα	'imuna	be (V 1 S past)
ήρθε	'iɾθe	come (V 3 S past)
ήρθες	'iɾθes	come (V 2 S past)
ήτανε	'itane	be (V 3 S past)
θα	θa	will (PRCL)
θάλασσα	'θalasa	sea (N)
θεία	'θia	aunt (N)
θέλει	'θeli	want (V 3 S)
θέλεις	'θelis	want (V 2 S)
θέλω	'θelo	want (V 1 S)
θεού	θe'u	god (N gen)

Word Types	Adult Production	Gloss/Gram
θές	θes	want (V 2 S abr)
θυμάσαι	θi'mase	remember (V 2 S)
Θωμαίς	θoma'is	(nm)
κάθησε	'kaθise	sit (V 3 S past)
καθήσει	ka'θisi	sit (V 3 S)
κάθομαι	'kaθome	sit (V 1 S)
κάθονται	'kaθode	sit (V 3 Pl)
και	ce	and (CONJ)
καιρό	ce'ɾo	time (N)
κακός	ka'kos	bad (ADJ S ms)
καλά	ka'la	well (ADV)
καλή	ka'li	good (ADJ S fm)
καλημέρα	kali'meɾa	good morning (excl)
καναπέ	kana'pe	sofa (N)
κάνε	'kane	do (V S imp)
κάνει	'kani	do (V 3 S)
κάνεις	'kanis	do (V 2 S)
κάνουμε	'kanume	do (V 1 Pl)
κάνω	'kano	do (V 1 S)
κάπου	'kapu	somewhere (ADV)
καράβι	ka'ɾavi	boat (N)
καρέκλα	ka'ɾekla	chair (N)
καρότσι	ka'ɾoʦi	stroller (N)
καταλαβαίνει	katala'veni	understand (V 3 S)
κατάφερα	ka'tafeɾa	succeed (V 1 S past)
κατεβάσεις	kate'vasis	lower (V 3 S)
κατσαρόλα	kaʦa'ɾola	pot (N)
κάτσε	'kaʦe	sit (V S imp)
κάτσεις	'kaʦis	sit (I 2 S)
κατσίκες	ka'ʦices	goats (N)
κάτσω	'kaʦo	sit (I 1 S)
κάτω	'kato	down/under (ADV)
κει	ci	there (ADV abr)
κ'εμένα	ce'mena	me too (CONJ+ADV)
κεφάλα	ce'fala	head (N)
κεφαλάκι	cefa'laci	head (N dim)
κι'άλλη	'cali	more (ADV S fm)
κι'αυτά	ca'fta	these too (CONJ+PRON)
κι'ο	co	he too (CONJ+ART)
κιόλας	'colas	already (ADV)

Word Types	***Adult Production***	***Gloss/Gram***
κίτρινα	'citrina	yellow (ADJ Pl ntr)
κίτρινη	'citrini	yellow (ADJ S fm)
κίτρινο	'citrino	yellow (ADJ S ntr)
κλείσε	'klise	close (V 2 S imp)
κλείσετε	'klisete	close (V 2 Pl)
κλείσω	'kliso	close (V 1 S)
κοιμάται	ci'mate	sleep (V 3 S)
κοιμηθεί	cimi'θi	sleep (V 3 S fut)
κοιμηθούμε	cimi'θume	sleep (V 1 Pl fut)
κοιμηθώ	cimi'θo	sleep (V 1 S fut)
κοίτα	'cita	look (V S imp)
κόκκινα	'kocina	red (ADJ Pl ntr)
κολλήσουμε	ko'lisume	stick (V 1 Pl)
κοντά	ko'da	close to (ADV)
κοριτσάκι	kori'ʦaci	girl (N dim)
κουβέρτα	ku'verta	blanket (N)
κουζίνα	ku'zina	kitchen (N)
κούκλα	'kukla	doll (N)
κουκλίτσα	ku'kliʦa	dollie (N dim)
κούκλες	'kukles	dolls (N)
κουνάς	ku'nas	swing (V 2 S)
κούνιες	'kuɲes	swings (N)
κουράζομαι	ku'razome	be tired (V 1 S)
κουτάκι	ku'taci	box (N dim)
κουτάλι	ku'tali	spoon (N)
κουτί	ku'ti	box (N)
κράτα	'krata	hold (V S imp)
κρατάς	kra'tas	hold (V 2 S)
κρατάω	kra'tao	hold (V 1 S)
κρέας	'kreas	meat (N)
κρεβάτι	kre'vati	bed (N)
κρεμούλα	kre'mula	cream (N dim)
κρυμμένος	kri'menos	hidden (PRTL S ms)
κρύφτηκε	'kriftice	hidden (V 3 S)
κρυφτούμε	kri'ftume	hide (V 1 PL)
κρύψω	'kripso	hide (V 1 S)
κρυώνω	kri'ono	be cold (V 1 S)
κύκλο	'ciklo	circle (N)
κυρία	ci'ria	lady (N)
λαμπάδα	la'baða	candle (N)

Word Types	***Adult Production***	***Gloss/Gram***
λαμπρό	la'bɾo	bright (ADJ S ntr)
λέγανε	'leɣane	say (V 3 Pl past)
λέει	'lei	say (V 3 S)
λένε	'lene	say (V 3 Pl)
λες	les	say (V 2 S)
λέω	leo	say (V 1 S)
λιγάκι	li'ɣaci	some (ADV)
λίγη	'liʝi	some (ADV S fm)
λίγο	'liɣo	some (ADV S ntr)
λιοντάρι	ʎo'daɾi	lion (N)
λουλουδάκια	lulu'ðaca	flowers (N dim)
λουράκι	lu'ɾaci	leash (N)
λύκο	'liko	wolf (N acc)
λύκος	'likos	wolf (N nom)
μαγειρεύω	maʝi'ɾevo	cook (V 1 S)
μαγκώσει	ma'gosi	jam (V 3 S)
μαγκώσω	ma'goso	jam (V 1 S)
μαζί	ma'zi	together (ADV)
μαθαίνω	ma'θeno	learn (V 1 S)
μακαρόνια	maka'ɾoɲa	spaghetti (N)
μακριά	makɾi'a	far (ADV)
μαλλιά	ma'ʎa	hair (N)
μάλωσε	'malose	fought (V 3 S)
μαλώσεις	ma'losis	fight (V 2 S)
μαμά	ma'ma	mammy (N)
Μανώλη	ma'noli	(nm acc)
Μανώλης	ma'nolis	(nm nom)
μαργαρίτα	maɾɣa'ɾita	daisy (N)
Μαρία	ma'ɾia	(nm)
μαρμελάδα	maɾme'laða	jam (N)
μας	mas	us (PRON acc)
μάτι	'mati	eye (N)
μάτια	'matça	eyes (N)
μαύρο	'mavɾo	black (ADJ S ntr)
μαύρος	'mavɾos	black (ADJ S ms)
μ'αυτό	ma'fto	with this (PREP+PRON el)
μ'αφήνει	ma'fini	lets me (V+PRON 3 S)
με	me	with (PREP)
μεγάλες	me'ɣales	big (ADJ Pl fem)
μεγάλη	me'ɣali	big (ADJ S fm)

Word Types	***Adult Production***	***Gloss/Gram***
μεγάλο	me'ɣalo	big (ADJ S ntr)
μεγάλωσα	me'ɣalosa	grow up (V 1 S past)
μεγάλωσε	me'ɣalose	grow up (V 3 S past)
μεγαλώσεις	meɣa'losis	grow up (V 2 S)
μεγαλώσω	meɣa'loso	grow up (V 1 S)
μείνε	'mine	stay (V S imp)
μείνεις	'minis	stay (V 2 S)
μείνουμε	'minume	stay (V 1 Pl)
μέλι	'meli	honey (N)
μένα	'mena	me (PRON acc abr)
μέρα	'meɾa	day (N)
μέσα	'mesa	inside (ADV)
μέση	'mesi	middle (N)
μετά	me'ta	later (ADV)
μη	mi	don't (PRCL)
μια	mɲa	one (num S fem) 1
μία	'mia	one (num S fem) 2
μικρή	mi'kɾi	small (ADJ S fm)
μικρό	mi'kɾo	small (ADV S ntr)
μίλα	'mila	talk (V S imp)
μίλησα	'milisa	talk (V 1 S past)
μίλησε	'milise	talk (V 3 S past)
μιλήσεις	mi'lisis	talk (V 2 S)
μιλήσουμε	mi'lisume	talk (V 1 Pl)
μιλήσω	mi'liso	talk (V 1 S)
μόνη	'moni	alone (ADJ S fm)
μόνο	'mono	only (ADV)
μου	mu	me (PRN gen)
μουσούδα	mu'suða	muzzle (N)
μπάλα	'bala	ball (N)
μπαλόνι	ba'loni	balloon (N)
μπαμπά	ba'ba	daddy (N acc)
μπαμπάς	ba'bas	daddy (N nom)
μπάνιο	'baɲo	bath (N)
μπει	bi	enter (V 3 S)
μπιστόλα	bi'stola	gun (N)
μπλούζα	'bluza	blouse (N)
μπογιά	bo'ʝa	paint (V)
μπορεί	bo'ɾi	can (V 3 S)
μπορείς	boɾis	can (V 2 S)

Word Types	Adult Production	Gloss/Gram
μπορούμε	bo'ɾume	can (V 1 Pl)
μπορώ	bo'ɾo	can (V 1 S)
μπροστά	bɾo'sta	in front (ADV)
μπω	bo	enter (V 1 S)
μωβ	mov	purple (N)
μωρά	mo'ɾa	babies (N)
μωρό	mo'ɾo	baby (N)
να	na	to (CONJ)
ναι	ne:	yes (ADV)
Νάσια	'nasça	(nm)
νάτα	'nata	there they are (PRCL Pl ntr)
νάτη	'nati	there she is 1 (PRCL S fm) 1
νάτην	'natin	there she is 2 (PRCL S fm) 2
νάτηνε	'natine	there she is 3 (PRCL S fm) 3
νάτος	'natos	there he is (PRCL S ms)
Ναταλία	nata'lia	(nm)
νεράκι	ne'ɾaci	water (N dim)
νερό	ne'ɾo	water (N)
Νικόλας	ni'kolas	(nm)
νομίζω	no'mizo	think (V 1 S)
νούμερα	'numeɾa	numbers (V)
ξάπλω	'ksaplo	lie down (V S imp abr)
ξάπλωσε	'ksaplose	lie down (V S imp)
ξέρεις	'kseɾis	know (V 2 S)
ξέρω	'kseɾo	know (V 1 S)
ξέχασα	'ksexasa	forget (V 1 S past)
ξέχασες	'ksexases	forget (V 2 S past)
οδηγάω	oði'ɣao	drive (V 1 S)
όλες	'oles	all (ADJ Pl fm)
όλο	'olo	whole (ADJ S ntr)
όλοι	'oli	everybody (PRON Pl ms)
όμως	'omos	though (CONJ)
όπως	'opos	as (ADV)
όρεξη	'oɾeksi	appetite (N)
όρθια	'oɾθia	standing (ADJ S fm)
όταν	'otan	when (CONJ)
ουρά	u'ɾa	tail (N)
ουρανό	uɾa'no	sky (N)
όχι	oçi	no (ADV)
οχτώ	o'xto	eight (num)

Word Types	*Adult Production*	*Gloss/Gram*
πάει	'pai	to go (I 3 S)
παίζαμε	'pezame	play (V 1 Pl past)
παίζει	'pezi	play (V 3 S)
παίξει	'peksi	play (V 3 S fut)
παίξουμε	'peksume	play (V 1 Pl fut)
πάλι	'pali	again (ADV)
πάμε	'pame	go (V 1 PL)
πάντα	'pada	always (ADV)
πάνω	'pano	on (ADV)
παπάκι	pa'paci	duckling (N dim)
Πάπη	'papi	(nm acc)
Πάπης	'papis	(nm nom)
παπούτσια	pa'putsça	shoes (N)
παππού	pa'pu	grandpa (N)
παρακαλώ	paɾaka'lo	please (exp)
παραμυθάκι	paɾami'θaci	fairytale (N)
παραπάνω	paɾa'pano	further up (ADV)
πάρε	'paɾe	take (V S imp)
πάρει	'paɾi	take (V 3 S)
πάρεις	'paɾis	take (V 2 S)
πάρουμε	'paɾume	take (V 1 Pl)
πάρτα	'paɾta	take them (V+PRON S imp)
πάρτηνε	'paɾtine	take her (V+PRON S imp)
πάρτο	'paɾto	take it (V+PRON S imp)
πάρω	'paɾo	take (V 1 S)
πάς	pas	go (V 2 S abr)
παστίτσιο	pa'stitsço	type of dish (N)
πάτα	'pata	step (V S imp)
πατήσεις	pa'tisis	step (V 2 S)
πάω	'pao	go (V 1 S)
πειράζει	pi'ɾazi	matters (V 3 S)
πεις	pis	say (V 2 S)
πέντε	'pede	five (num)
περάσει	pe'ɾasi	heal (V 3 S)
περιμένεις	peɾi'menis	wait (V 2 S)
περιμένουμε	peɾi'menume	waiting (V 1 Pl)
περπατώ	peɾpa'to	walk (V 1 S)
πεταλούδα	peta'luða	butterfly (N)
πέταξε	'petakse	throw (V S imp)
πετάξω	pe'takso	fly/throw (V 1 S)

Word Types	*Adult Production*	*Gloss/Gram*
πεταχτεί	peta'xti	spring up (V 1 S)
Πέτρο	'petɾo	(nm acc)
πήγα	'piɣa	go (V 1 S past)
πηγαίνω	pi'ʝeno	go (V 1 S)
πήγαμε	piɣame	go (V 1 Pl past)
πήγες	'piʝes	go (V 2 S past)
πιάσω	'pçaso	catch (V 1 S)
πιάτο	'pçato	plate (N)
πιείς	pçis	drink (V 2 S)
πιο	pço	more (ADV S ntr)
πιούμε	'pçume	drink (V 1 PL)
πίσω	'piso	behind (ADV)
πιώ	pço	drink (V 1 S)
ποδαράκια	poða'ɾaca	feet (N dim)
ποδήλατο	po'ðilato	bike (N)
πόδια	'poðʝa	feet (N)
ποιό	pço	which (PRON S ntr inter)
πολλά	po'la	many (ADV)
πόνεσα	'ponesa	hurt myself (V 1 S past)
ποπός	po'pos	butt (N)
πόρτα	'poɾta	door (N)
πορτοκαλί	poɾto'kali	orange (N)
που	pu	that (PRON)
πού	pu	where (ADV)
πούμε	'pume	say (V 1 Pl)
πράγματα	'pɾaɣmata	things (N)
πράσινο	'pɾasino	green (N)
πρέπει	'pɾepi	must (V)
προκομμένη	pɾoko'meni	hard working (PRTL S fm)
προκομμένος	pɾoko'menos	hard working (PRTL S ms)
πρώτα	'pɾota	first (ADV)
πώς	pos	how (ADV)
θα'ρθεί	θaɾ'θi	come (V 3 S fut el)
θα'ρθώ	θaɾ'θo	come (V 1 S fut el)
ρυζάκι	ɾi'zaci	rice (N dim)
ρωτάς	ɾo'tas	ask (V 2 S)
ρωτήσουμε	ɾo'tisume	ask (V 1 Pl)
σαλάτα	sa'lata	salad (N)
σαπούνι	sa'puni	soap (N)
σας	sas	you (PRON Pl acc)

Word Types	***Adult Production***	***Gloss/Gram***
σε	se	you (PRON S acc) 1
σελίδα	se'liða	page (N)
σένα	'sena	you (PRON S acc) 2
σηκωθείς	siko'θis	get up (V 2 S)
σηκώσεις	si'kosis	lift (V 2 S)
σήμερα	'simeɾa	today (ADV)
σκαμνί	skam'ni	stool (N)
σκεπάσω	sce'paso	cover (V 1 S)
σοκολάτα	soko'lata	chocolate (N)
σου	su	you (PRON S gen)
Σοφία	so'fia	(nm)
σπιτάκι	spi'taci	house (N dim)
σπίτι	'spiti	house (N)
σπρώξεις	'spɾoksis	push (V 2 S)
Σπυριδούλα	spiɾi'ðula	(nm)
στα	sta	to the (PREP+ART Pl ntr)
στ'αγγλικά	stagli'ka	in English (PREP+ART+N Pl el)
στη	sti	to the (PREP+ART S fem) 1
στην	stin	to the (PREP+ART S fem) 2
στις	stis	to the (PREP+ART Pl fem)
στο	sto	to the (PREP+ART S ntr)
στόμα	'stoma	mouth (N)
συ	si	you (PRON S abr)
σχολείο	sxo'lio	school (N) 1
σχολιό	sxo'ʎo	school (N) 2
τα	ta	the (ART Pl ntr)
ταίσεις	ta'isis	feed (V 2 S)
τελείωσα	te'liosa	finish (V 1 S past)
τελείωσε	te'liose	finish (V 3 S past)
τελειώσω	te'ʎoso	finish (V 1 S)
τέσσερα	'teseɾa	four (num)
τη	ti	the (ART S fm acc) 1
τηλέφωνο	ti'lefono	telephone (N)
την	tin	the (ART S fm acc) 2
της	tis	her , the (ART S fm gen)
τί	ti	what (PRON inter)
τίποτα	'tipota	nothing (PRON)
τις	tis	the (ART Pl fm)
το	to	the (ART S ntr)
τον	ton	the (ART S ms)

Word Types	***Adult Production***	***Gloss/Gram***
τόσο	'toso	so much (ART S ntr)
του	tu	the (ART S ntr gen)
τουβλάκια	tu'vlaca	bricks (N dim)
τραβήξω	tɾa'vikso	pull (V 1 S)
τραπέζι	tɾa'pezi	table (N)
τρένο	'tɾeno	train (N)
τρία	'tɾia	three (num)
τρώμε	'tɾome	eat (V 1 Pl)
τρώνε	'tɾone	eat (V 3 Pl)
τρως	tɾos	eat (V 2 S)
τσάι	ʦai	tea (N)
τσάντα	'ʦada	bag (N)
τσου	ʦu	(onm)
τσουρέκι	ʦu'ɾeci	sweet bread (N)
τώρα	toɾa	now (ADV)
φάγαμε	'faɣame	eat (V 1 Pl past)
φαγητό	faʝi'to	food (N)
φάει	fai	eat (V 3 S)
φακές	fa'ces	lentils (N)
φάμε	'fame	eat (V 1 Pl)
φάνε	'fane	eat (V 3 Pl)
Φασουλής	fasu'lis	jack-in-the-box (nm)
φάω	fao	eat (V 1 S)
φεγγαράκι	fega'ɾaci	moon (N dim)
φέγγε	'feɟe	shine (V S imp)
φέρω	'feɾo	bring (V 1 S)
φίλη	'fili	friend (N fm)
φοβάται	fo'vate	to be scared (V 3 S)
φορά	fo'ɾa	(e.g. each) time (N)
φτάσεις	'ftasis	reach (V 2 S)
φτάσω	'ftaso	reach (V 1 S)
φτιάξε	'ftçakse	make (V S imp)
φύγει	'fiʝi	go (V 3 S)
φύγεις	'fiʝis	go (V 2 S)
φύγω	'fiɣo	leave (V 1 S)
φυλάξω	fi'lakso	keep (V 1 S)
Φωκίωνα	fo'ciona	(nm)
φωνάζουμε	fo'nazume	yell (V 1 Pl)
φωνάζω	fo'nazo	yell (V 1 S)
χαιδέψεις	xai'ðepsis	pet (V 2 S)

Word Types	***Adult Production***	***Gloss/Gram***
χαιδέψουμε	xai'ðepsume	pet (V 1 Pl fut)
χαιδέψω	xai'ðepso	pet (V 1 S fut)
Χάιντι	'xaidi	(nm)
χαλάει	xa'lai	break (V 3 S)
χάλασε	'xalase	break (V 3 S past)
χαρούμενη	xa'ɾumeni	glad (ADJ S fm)
χαρτάκια	xaɾ'taca	papers (N dim)
χειμώνας	çi'monas	winter (N)
χεράκι	çe'ɾaci	hand (N dim)
χέρι	'çeɾi	hand (N)
χέρια	'çeɾja	hands (N)
χορέψουμε	xo'ɾepsume	dance (V 1 Pl fut)
χρώμα	'xɾoma	color (N)
χτενίσω	xte'niso	comb (V 1 S)
χτύπησα	'xtipisa	hurt myself (V 1 S past)
χωρέσω	xo'ɾeso	fit (V 1 S)
χώρο	'xoɾo	room, space (N acc)
ψηλά	psi'la	high (ADV)
ψηλή	psi'li	tall (ADJ S fm)
ψιθυρίζω	psiθi'ɾizo	whisper (V 1 S)
ψωμάκι	pso'maci	bread (N dim)
ωραία	o'ɾea	nice (ADJ Pl ntr)

APPENDIX C
THE CHILD'S TARGETED /θ/ WORDS IN GREEK FROM 2;7 TO 3;11

Word Types	*Adult Production*	*Gloss/Gram*
αγκαθάκια	aga'θaca	thorns (N dim)
αγκίθες	a'ɟiθes	thorns (N)
Αθήνα	a'θina	Athens (nm)
Αθήνας	a'θinas	Athens (nm gen)
αισθάνομαι	e'sθanome	feel (V 1 S)
αλήθεια	a'liθça	truth (N)
αληθινά	aliθi'na	trully (ADV)
αληθινό	aliθi'no	true (ADJ S ntr)
αληθινός	aliθi'nos	true (ADJ S ms)
ανθίσαν	'anθisan	bloom (V 3 Pl past)
ανθρωπάκι	anθɾo'paci	human (N dim)
άνθρωποι	'anθɾopi	humans (N)
άνθρωπος	'anθɾopos	human (N)
ανθρώπους	a'nθɾopus	humans (N acc)
αντίθετα	a'diθeta	opposites (ADJ 3 Pl ntr)
αποκοιμηθούμε	apocimi'θume	fall asleep (V 1 Pl)
αποκοιμηθώ	apocimi'θo	fall asleep (V 1 S)
βαθιά	va'θça	deep (ADV)
βιβλιοθήκη	vivlio'θici	bookcase (N)
βοηθάς	voi'θas	help (V 2 S)
βοηθάω	voi'θao	help (V 1 S)
βοήθεια	vo'iθia	help (N)
βοήθησε	vo'iθise	help (V 2 S imp)
βοήθησες	vo'iθises	help (V 2 S past)
βοηθήσει	voi'θisi	help (V 3 S)
βοηθήσεις	voi'θisis	help (V 2 S)
βοηθήσετε	voi'θisete	help (V 2 Pl)
βρεθεί	vɾe'θi	be found (V 3 S)
γενέθλια	ʝe'neθlia	birthday (N)
γεννηθεί	ʝeni'θi	be born (V 3 S)
δεθήκαμε	ðe'θikame	be tied (V 1 Pl past)
δώθε	'ðoθe	this way (ADV)
ελευθερία	elefθe'ɾia	freedom (N)
έμαθα	'emaθa	learn (V 1 S past)
έμαθε	'emaθe	learn (V 3 S past)
έπαθε	'epaθe	suffer (V 3 S past)
επίθετο	e'piθeto	last name (N)

Word Types	*Adult Production*	*Gloss/Gram*
έρθει	'eɾθi	come (V 3 S)
έρθεις	'eɾθis	come (V 2 S)
έρθω	'eɾθo	come (V 1 S)
ζεσταθεί	zesta'θi	warm up (V 3 S)
ζεστάθηκα	ze'staθika	warm up (V 1 S past)
ζεστάθηκε	ze'staθice	warm up (V 3 S past)
ήθελα	'iθela	want (V 1 S past)
ήθελες	'iθeles	want (V 2 S past)
ηθοποιοί	iθopi'i	actors (N)
ήρθαμε	'iɾθame	come (V 1 Pl past)
ήρθανε	'iɾθane	come (V 3 Pl past)
ήρθατε	'iɾθate	come (V 2 Pl past)
ήρθε	'iɾθe	come (V 3 S past)
ήρθες	'iɾθes	come (V 2 S past)
θα	θa	will (PRCL)
θ'αλλάξω	θa'lakso	change (V 1 S fut el)
θάλασσα	'θalasa	sea (N)
θάλασσας	'θalasas	sea (N gen)
Θανάση	θa'nasi	(nm)
θά'μαστε	'θamaste	be (V 1 PL fut el)
θ'ανάψεις	θa'napsis	turn on (V 2 S fut el)
θ'ανέβει	θa'nevi	go up (V 3 S fut el)
θ'ανοίξει	θa'niksi	open (V 3 S fut el)
θα'ρθεί	'θaɾθi	come (V 3 S fut el)
θα'ρθείς	'θaɾθis	come (V 2 S fut el)
θα'ρθείτε	θa'ɾθite	come (V 2 Pl fut el)
θάρθετε	'θaɾθete	come (V 2 Pl fut el)
θα'ρθούμε	θaɾ'θume	come (V 1 Pl fut el)
θα'ρθούνε	θaɾ'θune	come (V 3 Pl fut el)
θα'ρθω	θa'ɾθo	come (V 1 S fut el)
θα'ρχεσαι	'θaɾçese	come (V 2 S fut el)
θα'ρχεται	'θaɾçete	come (V 3 S fut el)
θά'σαι	'θase	be (V 2 S fut el)
θα'χεις	'θaçis	have (V 2 S fut el)
θα'χω	'θaxo	have (V 1 S fut el)
θάψουμε	'θapsume	bury (V 1 Pl)
θέατρο	'θeatɾo	theater (N)
θεία	'θia	aunt (N)
θέλει	'θeli	wants (V 3 S)

Word Types	***Adult Production***	***Gloss/Gram***
θέλεις	'θelis	want (V 2 S)
θέλετε	'θelete	want (V 3 Pl)
θέλουμε	'θelume	want (V 1 Pl)
θέλουν	'θelun	want (V 3 Pl)
θέλουνε	'θelune	want (V 3 Pl)
θέλω	'θelo	want (V 1 S)
θεός	θe'os	god (N)
θεού	θe'u	god (N gen)
θερμόμετρο	θeɾ'mometro	thermometer (N)
θέση	'θesi	seat (N)
θές	θes	want (V 2 S abr)
θήκη	'θici	case (N)
θόρυβο	'θorivo	noise (N acc)
θόρυβος	'θorivos	noise (N nom)
θυμάμαι	θi'mame	remember (V 1 S)
θυμάσαι	θi'mase	remember (V 2 S)
θυμηθείτε	θimi'θite	remember (V 2 Pl fut)
θυμήθηκα	θi'miθika	remember (V 1 S past)
θυμήσεις	θi'misis	remember (V 2 S)
θυμόμαστε	θi'momaste	remember (V 1 Pl)
θυμωμένος	θimo'menos	angry (ADJ S ms)
Θωμαίς	θoma'is	(nm)
καλαθάκια	kala'θaca	baskets (N dim)
καλαθάς	kala'θas	basket-maker (N)
καλάθι	ka'laθi	basket (N)
καθαρές	kaθa'ɾes	clean (ADJ Pl fm)
καθαρή	kaθa'ɾi	clean (ADJ S fm)
καθαρίζεις	kaθa'ɾizis	clean (V 2 S)
καθαρίζουμε	kaθa'ɾizume	clean (V 1 Pl)
καθάρισα	ka'θaɾisa	clean (V 1 S past)
καθαρίσεις	kaθa'ɾisis	clean (V 2 S fut)
καθαρίσουμε	kaθa'ɾisume	clean (V 1 Pl)
καθαρίσω	kaθa'ɾiso	clean (V 1 S)
καθαρό	kaθa'ɾo	clean (ADJ S ntr)
καθαρός	kaθa'ɾos	clean (ADJ S ms)
κάθε	'kaθe	every (PRON)
καθένας	ka'θenas	everyone (PRON)
κάθεσαι	'kaθese	sit (V 2 S)
κάθεται	'kaθete	sit (V 3 S)

Word Types	*Adult Production*	*Gloss/Gram*
κάθησε	'kaθise	sit (V S imp)
καθήσει	ka'θisi	sit (V 3 S)
καθήσουμε	ka'θisume	sit (V 1 Pl)
καθήστε	ka'θiste	sit (V 2 Pl imp)
καθήσω	ka'θiso	sit (V 1 S)
κάθισμα	'kaθizma	seat (N)
κάθομαι	'kaθome	sit (V 1 Pl)
καθόμουνα	ka'θomuna	sit (V 1 S past)
κάθονται	'kaθode	sit (V 3 Pl)
καθρεφτάκι	kaθɾe'ftaci	mirror (N dim)
καθρέφτης	ka'θɾeftis	mirror (N)
κι'αληθινά	caliθi'na	trully (ADV el)
κιθάρα	ci'θaɾa	guitar (N)
κοιμηθεί	cimi'θi	sleep (V 3 S fut)
κοιμηθείς	cimi'θis	sleep (V 2 S fut)
κοιμηθείτε	cimi'θite	sleep (V 2 Pl)
κοιμήθηκα	ci'miθika	sleep (V 1 S past)
κοιμηθήκαμε	cimi'θikame	sleep (V 1 Pl past)
κοιμήθηκαν	ci'miθikan	sleep (V 3 Pl past)
κοιμήθηκε	ci'miθice	sleep (V 3 S past)
κοιμήθηκες	ci'miθices	sleep (V 2 S past)
κοιμηθούμε	cimi'θume	sleep (V 1 Pl fut)
κοιμηθούνε	cimi'θune	sleep (V 3 Pl fut)
κοιμηθώ	cimi'θo	sleep (V 1 S fut)
κουκλοθέατρο	kuklo'θeatɾo	puppet-show (N)
κουνηθείς	kuni'θis	move (V 2 S fut)
λαβύρινθος	la'viɾinθos	maze (N)
λάθος	'laθos	mistake (N)
λερωθείς	le'ɾoθis	get dirty (V 2 S)
λερωθούνε	leɾo'θune	get dirty (V 3 PL)
μαθαίνω	ma'θeno	learn (V 1 S)
μάθει	'maθi	learn (V 3 S)
μάθεις	maθis	learn (V 2 S)
μάθημα	'maθima	lesson (N)
μαθητές	maθi'tes	students (N)
μάθουμε	'maθume	learn (V 1 Pl)
μάθουνε	'maθune	learn (V 3 Pl)
μάθω	'maθo	learn (V 1 S)
Μαράθι	ma'ɾaθi	(nm)

Word Types	***Adult Production***	***Gloss/Gram***
μεθαύριο	me'θavɾio	day after tomorrow (ADV)
μπουμπουλήθρες	bubu'liθɾes	bubbles (N)
νά΄ρθει	'naɾθi	to come (V 3 S el)
να΄ρθείς	'naɾθis	to come (V 2 S el)
νά'ρθω	'naɾθo	to come (V 1 S el)
ντυθεί	di'θi	dress itself (V 3 S fut)
ντυθώ	di'θo	dress myself (V 1 S fut)
ξανακοιμηθείτε	ksanacimi'θite	go back to sleep (V 2 Pl)
ξανάρθω	ksanaɾ'θo	come again (V 1 S)
όρθια	'orθia	standing (ADJ S Fm)
πάθεις	'paθis	suffer (V 2 S)
παράθυρα	pa'ɾaθiɾa	windows (N)
παράθυρο	pa'ɾaθiɾo	window (N)
παρακολουθείς	paɾakolu'θis	watch (V 2 S)
παραμυθάκι	paɾami'θaci	fairytale (N dim)
παραμύθι	paɾa'miθi	fairytale (N)
παραμύθια	paɾa'miθça	fairytales (N)
πεθαμένη	peθa'meni	dead (PRTL fm)
πέθανε	'peθane	die (V 3 S past)
πεθάνεις	pe'θanis	die (V 2 S)
πλυθείς	pli'θis	wash (V 2 S)
πουθενά	puθe'na	nowhere (ADV)
προσπάθησε	pɾo'spaθise	try (V 2 S imp)
προσπαθήσω	pɾospa'θiso	try (V 1 S)
ρυθμό	ɾiθ'mo	rhythm (N acc)
σηκωθεί	siko'θi	stand (V 3 S fut)
σηκωθείς	siko'θis	stand (V 2 S fut)
σηκώθηκα	si'koθika	stood (V 1 S past)
σηκώθηκες	si'koθikes	stand (V 2 S past)
σηκωθώ	siko'θo	stand (V 1 S fut)
σκοτωθώ	skoto'θo	kill myself (V 1 S fut)
σταθεί	sta'θi	stand (V 3 S fut)
στ'αληθινά	staliθi'na	trully (ADV el)
συναντηθούμε	sinadi'θume	meet (V 1 Pl)
σωθήκαμε	siko'θikame	stand (V 1 Pl past)
τσακωθούμε	ʦako'θume	quarrel (V 1 Pl fut)
τσουλήθρα	ʦu'liθɾa	slide (N)
Φιλοθέη	filo'θei	(nm)
φοβηθείς	fovi'θis	be scared (V 2 S fut)
φοβήθηκα	fo'viθika	be scared (V 1 S past)

Word Types	*Adult Production*	*Gloss/Gram*
χάθηκα	'xaθika	be lost (V 1 S past)
χυθεί	çi'θi	be spilled (V 3 S fut)
χύθηκε	çiθice	be spilled (V 3 S past)
ψηθούνε	psi'θune	be baked (V 3 Pl)
ψιθυρίζω	psiθi'ɾizo	whisper (V 1 S)
ψιθύρησε	psi'θiɾise	whisper (V 3 S past)

APPENDIX D

THE CHILD'S TARGETED [ç] WORDS IN GREEK FROM 2;7 TO 3;11

Word Types	***Adult Production***	***Gloss/Gram***
αλήθεια	a'liθça	truth (N)
ανοιξιάτικα	aniks'çatika	spring (ADJ Pl ntr)
αρχή	aɾ'çi	beginning (N)
άρχισε	'aɾçise	start (V 3 S past)
αρχίσει	aɾ'çisi	start (V 3 S fut)
αρχίσεις	aɾ'çisis	start (V 2 S fut)
αρχίσετε	aɾ'çisete	start (V 2 Pl fut)
αρχίσουμε	aɾ'çisume	start (V 1 Pl fut)
αυτιά	a'ftça	ears (N)
βαθιά	va'θça	deep (ADV)
βατράχι	va'tɾaçi	frog (N)
βουτιά	vut'ça	dive (N)
βουτιές	vut'çes	dives (N)
βραχεί	vɾa'çi	get wet (V 3 S fut)
βράχηκες	'vɾaçices	get wet (V 2 S past)
βραχιόλι	vɾa'çoli	bracelet (N)
βραχιολάκι	vɾaço'laci	bracelet (N dim)
βρέχει	'vɾeçi	rain (V 3 S)
βρέχεται	'vɾeçete	get wet (V 3 S)
βροχή	vɾo'çi	rain (N)
έβρεχε	'evɾeçe	rain (V 3 S past)
είχε	'içe	have (V 3 S past)
είχες	'içes	have (V 2 S past)
έπιασα	'epçasa	catch (V 1 S past)
έπιασε	'epçase	catch (V 3 S past)
έπιασες	'epçases	catch (V 2 S past)
έρχεσαι	'eɾçese	come (V 2 S)
έρχεστε	'eɾçeste	come (V 2 Pl)
έρχεται	'eɾçete	come (V 3 S)
ευτυχισμένη	eftiçi'zmeni	happy (ADJ)
έφτιαξα	'eftçaksa	make (V 1 S past)
έφτιαξε	'eftçakse	make (V 3 S past)
έφτιαξες	'eftçakses	make (V 2 S past)
έχει	'eçi	have (V 3 S)
έχεις	'eçis	have (V 2 S)
έχετε	eçete	have (V 2 Pl)

Word Types	***Adult Production***	***Gloss/Gram***
έχυσα	eçisa	spill (V 1 S past)
ζητιάνος	zit'çanos	beggar (N)
ζωγραφιά	zoɣɾaf'ça	painting (N)
ήπια	'ipça	drink (V 1 S past)
ήπιες	'ipçes	drink (V 2 S past)
ήσυχη	'isiçi	quiet (ADJ fm)
ησυχία	isi'çia	quiet (N)
θά'ρχεται	'θaɾçete	come (V 3 S fut el)
θά'χεις	'θaçis	have (V 2 S fut el)
ίσια	'isça	straight (ADV)
καί'ρχεται	'ceɾçete	come (V 3 S el)
κάποια	'kapçia	someone (PRON S fm)
κάποιες	'kapçies	some (PRON Pl fm)
κάποιο	'kapço	some (PRON S ntr)
κάποιον	'kapçon	someone (PRON S ms acc)
κάποιος	'kapços	someone (PRON S ms nom)
κάποιου	'kapçu	someone (PRON S ms gen)
κατάπια	ka'tapça	swallow (V 1 S past)
κορίτσια	ko'riʦça	girls (N)
κοχύλι	ko'çili	shell (N)
μάτια	'matça	eyes (N)
μαχαιράκι	maçe'ɾaci	knife (N dim)
μαχαίρι	ma'çeɾi	knife (N)
μαχαίρια	ma'çeɾja	knives (N)
μονοπάτια	mono'patça	paths (N)
Νάσια	'nasça	(nm)
νά'χει	'naçi	have (I 3 S el)
νύχι	'niçi	nail (N)
νύχια	'niça	nails (N)
όποιο	'opço	whichever (PRON S ntr)
όποιοι	'opçi	whoever (PRON Pl ms)
όποιον	'opçon	whoever (PRON S ms acc)
όποιος	'opços	whoever (PRON S ms nom)
όχι	'oçi	no (inj)
πάπια	'papça	duck (N)
πάπιες	'papçes	ducks (N)
παπούτσια	pa'puʦça	shoes (N)
παραμύθια	paɾa'miθça	fairytales (N)

Word Types	*Adult Production*	*Gloss/Gram*
παστίτσιο	pa'stitsço	type of dish (N)
πιάνει	'pçani	catch (V 3 S)
πιάνεις	'pçanis	catch (V 2 S)
πιάνετε	'pçanete	catch (V 2 Pl)
πιάνουμε	'pçanume	catch (V 1 Pl)
πιάνω	'pçano	catch (V 1 S)
πιάσαμε	'pçasame	catch (V 1 Pl past)
πιάσε	'pçase	catch (V 2 S imp)
πιάσει	'pçasi	catch (V 3 S fut)
πιάσεις	'pçasis	catch (V 2 S fut)
πιάσου	'pçasu	catch (V 2 S imp)
πιάσουμε	'pçasume	catch (V 1 Pl imp)
πιάστηνε	'pçastine	catch her (V+PRON S imp el)
πιάστο	'pçasto	catch it (V+PRON S imp el)
πιάσω	'pçaso	catch (V 1 S fut)
πιάτα	'pçata	dishes (N)
πιατάκι	pça'taci	dish (N dim)
πιάτο	'pçato	dish (N)
πιεί	pçi	drink (V 3 S)
πιείτε	'pçite	drink (V 2 Pl imp)
πιεις	pçis	drink (V 2 S)
πιες	pçes	drink (V 2 S imp)
πιούμε	'pçume	drink (V 1 Pl)
πιώ	pço	drink (V 1 S)
πλατιά	plat'ça	wide (ADJ S fm)
ποια	pça	who (PRON S fm inter)
ποιανού	pça'nu	whose (PRON S ms inter gen)
ποιο	pço	who (PRON S ntr inter)
ποιον	pçon	who (PRON S ms inter acc)
ποιος	pços	who (PRON S ms inter nom)
πρόσεχε	'pɾoseçe	watch out (V 2 S imp)
πρόσεχες	'pɾoseçes	watch out (V 2 S past)
προσέχει	pɾo'seçi	watch out (V 3 S)
προσέχεις	pɾo'seçis	watch out (V 2 S)
σ’έπιασα	'sepçasa	catch you (V+PRON 1 S past el)
σκαλοπάτια	skalo'patça	steps (N)
σπίτια	'spitça	houses (N)
στ'αλήθεια	sta'liθça	trully (ADV)

Word Types	*Adult Production*	*Gloss/Gram*
συνέχεια	si'neçia	continuation (N)
συνεχίσεις	sine'çisis	continue (V 2 S fut)
συννεφιά	sinef'ça	downcast (N)
σχεδιάσω	sçeði'aso	sketch (V 1 S fut)
σχέδιο	'sçeðio	sketch (N)
τ’αυτιά	ta'ftça	the ears (ART+N el)
τέτοια	'tetça	such (PRON S fm)
τέτοιες	'tetçes	such (PRON PL fm)
τέτοιο	'tetço	such (PRON S ntr)
τέτοιοι	'tetçi	such (PRON Pl ms)
τό’πια	'topça	drink it (V+PRON 1 S past el)
τό’φτιαξα	'toftçaksa	fix it (V+PRON 1 S past el)
τρέχε	'tɾeçe	run (V 2 S imp)
τρέχει	'tɾeçi	run (V 3 S)
τρέχεις	'tɾeçis	run (V 2 S)
τρίχες	'tɾiçes	hair (N)
τυχερή	tiçe'ɾi	lucky (ADJ)
τύχη	'tiçi	luck (N)
φτιάξαμε	'ftçaksame	make (V 1 PL past)
φτιάξε	'ftçakse	make (V 1 S imp)
φτιάξεις	'ftçaksis	make (V 2 S fut)
φτιάξουμε	'ftçaksume	make (V 1 Pl fut)
φτιάξω	'ftçakso	make (V 1 S fut)
φτιάχνει	'ftçaxno	make (V 1 S)
φτιάχνεις	'ftçaxnis	make (V 2 S)
φτιάχνουμε	'ftçaxnume	make (V 1 Pl)
φτιάχνω	'ftçaxno	make (V 1 S)
φωτιά	fot'ça	fire (N)
χαιρετάει	çeɾe'tai	greet (V 3 S)
χαιρόμαστε	çeɾo'maste	rejoice (V 1 Pl)
χαρτιά	xaɾt'ça	papers (N)
χειμώνας	çi'monas	winter (N)
χειμώνιασε	çi'moɲase	winter is here (V)
χειμωνιάτικα	çimo'ɲatika	winter (ADJ Pl ntr)
χελιδόνι	çeli'ðoni	martin (N)
χεράκι	çe'ɾaci	hand (N dim)
χεράκια	çe'ɾaca	hands (N dim)
χέρι	'çeɾi	hand (N)

Word Types	***Adult Production***	***Gloss/Gram***
χέρια	'çeɾʝa	hands (N)
χειμώνα	çi'mona	winter (N acc)
χερούλι	çe'ɾuli	handle (N)
χερούλια	çe'ɾuʎa	handles (N)
Χιονάτη	ço'nati	Snow White (nm)
χιόνι	'çoni	snow (N)
χιόνια	'çona	snow (N Pl)
χυθεί	çi'θi	be spilled (V 3 S)
χύθηκαν	çiθikan	be spilled (V 3 Pl past)
χύθηκε	'çiθice	be spilled (V 3 S past)
χυμό	çi'mo	juice (N acc)
χυμός	çi'mos	juice (N nom)
χύσεις	'çisis	spill (V 2 S fut)
ψευτιές	pse'ftçes	lies (N)

APPENDIX E

KEY TO GRAMMAR ACRONYMS

1:	first person
2:	second person
3:	third person
abr:	abbreviation
acc:	accusative
ADJ:	adjective
ADV:	adverb
ART:	article
CONJ:	conjunction
dim:	diminutive
el:	ellipsis
excl:	exclamation
exp:	expression
fm:	feminine
fut:	future tense
gen:	genitive
imp:	imperative
inj:	interjection
inter:	interogative
ms:	masculine
N:	noun
nm:	proper name
nom:	nominative
ntr:	neutral
num:	numeral
onm:	onomatopeia
PART:	participle
past:	past tense
Pl:	plural
PRCL:	particle
PREP:	preposition
PRON:	pronoun
PRTL:	past participle
S:	singular
V:	Verb