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The acquisition of complex onsets and the role of input frequency in the Greek child speech

Master's thesis submitted by

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Abstract

The present thesis focused on the acquisition of the well-formed stop-liquid/nasal and fricative-liquid/nasal clusters in Standard Modern Greek. The data of this study are drawn from a longitudinal study of two typically developing Standard Modern Greek-acquiring children, SPI (age: 2;01,24 – 3;04,11) and DIM (age: 1;10,29 – 2;05, 15). The results indicate that, in the early intermediate phase, children's grammar does not allow complex onsets to emerge. Children apply several simplification strategies, i.e. reduction to the less sonorous or to the more sonorous (contiguity), coalescence, deletion of the entire cluster and epenthesis. The prevalent repair strategy is cluster reduction and children follow the sonority pattern. Also, in the data of the one child, coalescence may reflect a sub-stage in cluster acquisition, as instances of coalescence start fading away when faithfully produced target forms for each cluster type are realized. Hence, coalescence may serve as predictor for cluster acquisition. Also, regarding the process of deletion of the entire cluster and of contiguity, in the data of the one child, they have complementary distributions, namely contiguity is observed in labial-initial clusters while cluster deletions occur in dorsal- and coronal-initial clusters. Additionally, this study shows that stop-liquid and fricative-liquid clusters emerge in the medial intermediate phase. Faithfull productions of stop/fricative-nasal cluster were not observed in children's data. The results indicate that there is inter-child variation regarding the order of acquisition of clusters and the position in which clusters emerge first. Also, it seems that stress may not force the retention of the entire cluster. In addition, our study shows that the child's age cannot be considered as predictor for the phonological acquisition, i.e. a younger child may be more linguistically advanced than an older one. Also, this thesis provide evidence that the input frequency may not be considered as strong predictor for cluster acquisition.

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You gotta dream?
You gotta protect it. Peo-
ple can't do something themselves,
they wanna tell you you can't do it.
If you want something, go get it.
Period.
Steven Conrad

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Contents

1. Introduction

The phonological development is a puzzling phenomenon. In the earliest phases of phonological development, children's grammar does not allow complex onsets to emerge and, thus, only unmarked syllabic structures surface (e.g. Jakobson 1941/1968, Ingram 1989, Gnanadesikan 1995/2004, Smolensky 1996, Tesar & Smolensky 1998, Tzakosta 2005, Kappa 2002a, among others). Complex syllabic structures, such as consonant clusters, which are the focus of the present study, are excluded across the board in the earliest developmental phases. The avoidance of complex onsets is accomplished by using various cluster simplification strategies in the acquisitional process of consonant clusters. These simplification strategies[1] include cluster reduction (/C_1C_2V/ → [C_1V or C_2V]), vowel epenthesis (/C_1C_2V/ → [$C_1{}_VC_2V$]), coalescence (/C_1C_2V/ → [$C_{1,2}V$]) and deletion of the entire cluster (/C_1C_2V/ → [V])[2]. The application of these strategies results in realization of core syllables, namely universally unmarked syllables, i.e. CV (e.g. Drachman 1978, Prince & Smolensky, 1993, Kappa 2002a, 2004, 2009b among others). Put differently, in the early phases of acquisition, CV structures are mostly produced (e.g. Jakobson 1941/1968, Demuth & Fee 1995, Fikkert 1994, Rose 2000, Kappa 1999, 2002a, 2009b Tzakosta 2003 among others). Gradually, in the course of acquisition, consonant clusters start being produced faithfully (e.g Levelt, Schiller & Levelt 1999/2000, Levelt, van de Vijver 2004, Tzakosta & Kappa 2008, Kappa 2009a, b Kappa & Papoutsi 2019 among others). However, regressions to the previous developmental phase are observed in the child speech (e.g. Jakobson 1941/1968, Menn 1971, Macken & Ferguson 1983, Menn 1983, Bleile & Tomlin 1991, Tzakosta 2004, Kappa 2009b among others). In the final phase of acquisition, the output forms tend to be faithful to the input ones resulting in the two grammar systems, i.e., the adult one and the child one, finally being mapped (e.g. Jakobson 1941/1968, Tzakosta 2004).

The present study focuses on the acquisition of consonant clusters. Especially, we

[1] e.g Beers 1995, Berman 1977, Bernhardt and Stemberger 1998, Clausen & Fox Boyer 2017, Chin and Dinnsen 1992, Grunwell 1982, Ingram 1976, 1989, Lleó and Prinz 1996, Smit 1993, Fleischhacker 2000, Templin 1957, Smith 1973, Menn 1978, Gnanadesikan 1995/2004, Ohala 1996, 1999, Barlow 1997, Pater & Barlow 2003, Łukaszewicz 2007, van der Pas 2004, Freitas 2003, Bloch 2011, Ben David 2001, 2006, Lavie 1978, Jongstra 2003, Kappa 1999, 2002a, b, 2009a, b, 2019, Tzakosta 1999, 2003, Revithiadou & Tzakosta 2004a, b Sanoudaki 2007, 2010 Schaefer & Fox-Boyer 2017 among others.

[2] In the literature, it is reported that instances of deletions of the entire cluster are rare (Ingram 1976, Chin and Dinnsen 1992, Smit 1993, Freitas 2003).

focus on the acquisition of the well-formed consonant clusters, i.e. stop-liquid, fricative-liquid, stop-nasal and fricative-nasal clusters, which occur word-initially and word-medially in Standard Modern Greek. The data are drawn from a longitudinal study of two typically developing Standard Modern Greek-acquiring children, Spiros (henceforth SPI, age 2;01,24-3;04,11) and Dimitris (henceforth DIM, age 1;10,29-2;05,15).

Our longitudinal data show that consonant clusters are not allowed in children's grammar in the earliest phases of acquisition, (our results are consistent with those of other greek (e.g. Kappa 1999, 2002a, b 2004, Kappa 2009a, b, Tzakosta 2003, Tzakosta & Kappa 2008) and crosslinguistic studies (e.g. Smith 1973, Gnanadesikan 1995/2004, Barlow 1997, Fikkert 1994, Jongstra 2003, Freitas 2003 among others)). Before clusters become stable in Standard Modern Greek, children apply several simplification strategies. e.g. cluster reduction to the less sonorous, contiguity, coalescence, epenthesis and deletion of the entire cluster. Our data show that the prevalent simplification strategy is cluster reduction to the less sonorous and, therefore, children's productions mostly follow the sonority pattern. Also, the results indicate that different repair strategies may reflect different sub-stages in the course of acquisition. Specifically, coalescence may reflect a sub-stage in cluster acquisition. In the data of the one child, coalescence persists for a long period of time. However, instances of coalescence fade away when faithful forms for each cluster occur. Also, different strategies may have complementary distributions, i.e. in the data of the one child the process of deletion of the entire cluster is attested in [DORSAL Stop + Liquid], in [CORONAL Stop + Liquid] and in [DORSAL Fricative + Liquid] clusters while contiguity is observed in [LABIAL Stop + Liquid] clusters. Also, our data show that, in the course of development, branching onsets start being realized (our findings are consistent with those of other studies (e.g. Sanoudaki 2007, 2010, Kappa & Papoutsi 2019, 2019, Freitas 2003, Fikkert 1994, Fikkert & Freitas 2004, Levelt, Schiller & Levelt 1999/2000, Levelt, van de Vijver 2004 among others)). We suggest that the onset of the medial intermediate phase coincides with the emergence of branching onsets (we suggest that the early intermediate phase is characterized by the emergence of marked segments, i.e. fricative consonants, and of marked structures, such as the final coda position, and that the intermediate phase is characterized by more marked structures, such as complex onsets). SPI's data show that stop-liquid clusters emerge before fricative-liquid ones and DIM's data demonstrate that stop-liquid and fricative-liquid clusters emerge simultaneously. Thus, it seems that there is inter-child variation regarding cluster acquisition. Both DIM's and SPI's data lack faithfully produced stop-nasal and fricative-nasal clusters and, therefore, we suppose that these clusters emerge later in development. In addition, it seems that there is inter-child variation regarding the position in which clusters start being realized. Moreover, stress may not force the realization of the entire cluster. Children's data show that clusters start being produced both in stressed and in unstressed syllables. Also, despite the fact that faithful clusters productions are attested in the data of both children, we cannot suggest that they have been acquired. Also, our longitudinal data reveal that DIM, despite younger reaches the medial intermediate phase before SPI who is older. Therefore, we put forth the proposal that the child's age cannot be considered as strong predictor for the phonological acquisition. Put differently, younger children may be more linguistically advanced than older ones.

The longitudinal production data of this thesis are evaluated by means of the Three Scales Model (henceforth TMS) which was introduced by Tzakosta (2010, 2011, 2012, 2013a, b, 2016, 2019) and Tzakosta and Karra (2011). At the heart of the TMS lie three scales, namely the Manner of Articulation scale (MoA), the Place of Articulation scale (PoA) and the Voicing scale (V). These scales in combination with the Sonority Distance account for the acquisition of complex onsets and give new insights in the principles which govern the acquisition of clusters. A consonant cluster may be perfect, acceptable or non-acceptable (see Chapter 5). Children's data demonstrate that there is a preference for perfect and acceptable clusters to be realized. In the data of both children, the faithful cluster productions are perfect with respect to the manner scale. In addition, children's productions are perfect or acceptable with respect to the scale of place of articulation, i.e. cluster members mostly land on different positions on the scale or vacuously satisfy the place scale. Regarding the voicing scale, either perfect or acceptable clusters emerge.

Furthermore, the present thesis examines the role of input frequency of consonant clusters in the acquisition of stop-liquid/nasal and fricative-liquid/nasal clusters. Previous developmental studies in a variety of languages show that the input frequency plays an active role in language acquisition[3]. In this thesis, we examine if there is any

[3] e.g. Goad & Ingram 1987, Jusczyk et al., 1994 Ingram 1989, Zamuner 2003, Gerken & Zamuner 2007, Levelt et al. 1999/2000, Levelt & van de Weijer 2004, Stites et al., 2004, van de Weijer 2012, 2014, 2017, van de Weijer & Sloos 2013a, b, van de Weijer & Tzakosta 2017, Kappa 2009a, b among others.

correlation between the order of acquisition of clusters and the input frequency of clusters. In order to investigate this issue, we obtained two corpora, a corpus of Standard Modern Greek adult speech, available from http://speech.ilsp.gr/iplr and described by Protopapas et al. (2012) and a child-directed speech corpus which was collected for the purposes of this study. Quantitive evaluation of the data indicates that clusters are not acquired on the basis of ambient data. Hence, we suggest that input frequency may not be considered as strong predictor for cluster acquisition.

1.1. Objectives and outline of the thesis

This study provides both quantitative and qualitative analysis on the acquisition of stop-liquid/nasal and fricative-liquid/nasal clusters in Standard Modern Greek. The following issues and research questions are addressed:

1) The emergent developmental patterns found in our naturalistic longitudinal production data: What repair strategies are applied by children in their productions?

2) Sonority: What is the role of sonority in the reduction patterns? What is the role of sonority when complex onsets start to emerge?

3) The order of acquisition of clusters and the role of stress: Are clusters emerge word-initially or word-medially first? What is the role of stress in the order of cluster production/acquisition?

4) The role of input frequency on the emergence of complex onsets: Is there any correlation between the emergence of clusters and the input frequency?

This thesis is organized as follows: Chapter 2 discusses some preliminary theoretical principles and presents a short literature review on the phonological characteristics of Standard Modern Greek and on the acquisition of clusters in Standard Modern Greek. Furthermore, we present the results of cross-linguistic studies focusing on the acquisition of clusters in English, Polish, Hebrew, European Portuguese, Dutch as well as in Spanish. Chapter 3 covers the methodology. Chapter 4 presents and discusses the emergent developmental patterns commonly found in our acquisitional data and delves into the gradual development of word-initial and word-medial stop-liquid/nasal and fricative-liquid/nasal consonant clusters. Chapter 5 presents the theoretical framework which we adopt for the analysis of our longitudinal production data. Chapter 6 examines if there is any correlation between the input frequency and the acquisition of consonant clusters. In Chapter 7 the main points of the thesis are summarized.

2. Consonant clusters: Theory and data

Before proceeding our discussion on the acquisition of clusters in Standard Modern Greek, it is crucial to focus on some preliminary theoretical principles which govern the cluster formation.

Firstly, the syllable well-formedness is determined by the Sonority Sequence Generalization (Sievers 1881, Jespersen 1904, Steriade 1982, Selkirk 1984). The syllable nucleus, which is usually a vowel, constitutes the sonority peak of the syllable. As far as the consonantal segments are concerned, they are assigned either to onsets or to codas. The consonantal members of a tautosyllabic well-formed consonant cluster are organized as follows: The more sonorous a consonant is, the closer it is to the nucleus, and the less sonorous a consonant is, the further (away) it is from the nucleus. Put differently, as far as the onset clusters are concerned, the leftmost member of the cluster, i.e. the C_1, is less sonorous than the rightmost member of the cluster, i.e., the C_2, and, therefore, the sonority rises gradually from the leftmost member of the cluster towards the vowel. As far as the coda clusters are concerned, the leftmost member of the cluster is more sonorous than the rightmost one. According to the Universal Sonority Scale (e.g. Selkirk 1984), all segments, consonants and vowels, land on different positions on the scale. Segment positions are defined by their sonority values (1).

(1) Universal Sonority Scale (e.g. Selkirk 1984)

Stops > Fricatives > Nasals > Liquids > Glides > Vowels

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Less sonorous 1 2 3 4 5 6 more sonorous

Hence, a cluster is well-formed if its segments have different sonority values. Specifically, onset clusters are well-formed if the sonority value of the first member, i.e. of the leftmost consonant of the cluster, is lower than that of the second one, i.e. of the rightmost consonant of the cluster (2a-b). Moreover, coda clusters are well-formed if the sonority value of the consonant which is adjacent to the vowel nucleus, i.e. of the leftmost member of the cluster, is higher than the sonority value of the rightmost member of the cluster (2c).

Form	**Gloss**

2a.	[ˈpli.o]	ship
b.	[ɣra.ˈfi.o]	desk
c.	[golf]	golf

(Standard Modern Greek)

Malikouti-Drachman (1984) proposed a Standard Modern Greek-specific sonority scale in which voiceless stops and voiceless fricatives have the same sonority value and are less sonorous than voiced fricatives. Hence, [p, t, k/f, θ, x] and [v, ð, ɣ] land on different positions on the sonority scale, as can be seen in (3)[4]. Steriade (1982) argues that, a cluster is well-formed if between the two consonantal segments there is a minimal sonority distance. According to Malikouti-Drachman (1984), the minimal sonority distance for Standard Modern Greek is 4.

(3) Sonority Scale for Standard Modern Greek (Malikouti-Drachman 1984)

	[p, t, k/f, θ, x]	[v, ð, ɣ]	[s]	[z]	[m, n]	[l, r]	Vowels	
Less sonorous	1	2	3	4	5	6	7	More sonorous

Given the above, stop-liquid/nasal and fricative-liquid/nasal sequences form tautosyllabic consonantal sequences in Standard Modern Greek. Also, clusters, such as /ft/, constitute sonority plateau clusters and clusters, such as /st/, constitute antisonority clusters. All the above are exemplified in (4).

	Form	**Gloss**
4a.	[ˈpro.tos]	first
b.	[ˈkni.mi]	knee
c.	[ˈvri.si]	tap
d.	[ˈxno.ta]	breath
e.	[fte.ˈro]	feather
f.	[sta.ma.ˈto]	pause

(Standard Modern Greek)

A refined version of the sonority scale for Standard Modern Greek was proposed by

[4] According to Malikouti (1970), Malikouti-Drachman & Drachman (1992), Hamp (1961), Newton (1961, 1972), Pagoni (1993), Kappa (1995), Mikros (1997), Arvaniti (1999), /b, d, g/ are not phonemes, rather they are derived sounds. That is why /b, d, g/ are not represented on the Standard Modern Greek-specific sonority scale which is proposed by Malikouti-Drachman (1984). Nevertheless, Householder (1964), Koutsoudas (1962), Setatos (1974) and Viechnicki (1996) suggest that the voiced plosives are phonemes.

Kappa (1995:138). In her study, it is suggested that voiceless stops ([p, t, k]) are less sonorous than voiceless fricatives ([f, θ, x)] and, thus, they occupy different positions on the sonority scale. Also, voiceless fricatives are less sonorous than voiced fricatives ([v,ð,ɣ]). According to Kappa (1995), voiced stops, i.e. /b, d, g/, are derived sounds and, therefore, they are not represented on the scale (see footnote 3 for more references). The scale is presented below in (5).

(5) Sonority Scale for Standard Modern Greek (Kappa 1995:138)

	[p, t, k]	[f, θ, x]	[v, ð, ɣ]	[s]	[z]	[m, n]	[l, r]	Vowels	
Less sonorous	1	2	3	4	5	6	7	8	More sonorous

Thus, stop-liquid/nasal and fricative-liquid/nasal clusters are well-formed and clusters, such as /ft/ and /st/, are antisonority ones, as displayed in (6).

	Form	Gloss
6a.	[ˈpro.tos]	first
b.	[ˈkni.mi]	knee
c.	[ˈvri.si]	tap
d.	[ˈxno.ta]	breath
e.	[fte.ˈro]	feather
f.	[sta.ma.ˈto]	pause

(Standard Modern Greek)

Moreover, the syllabification is governed by the Maximal Onset Principle (Kahn 1976). Kahn suggests that, within the word, consonants are assigned to the onsets of the syllables as long as the phonotactic constraints of the language are not violated. Some representative examples are given in (7).

	Form	Gloss
7a.	[a.ˈfti]	ear
b.	[a.ˈplos]	simple

(Standard Modern Greek)

Nevertheless, syllabification is governed by language-specific conditions. Consonantal strength (Vennemann 1972a, b) may account for the syllabification within the word. For instance, within the word, a segment is assigned to the coda of the syllable if it is less strong than the onset segment of the next syllable (Drachman & Malikouti-Drachman 1997, Malikouti-Drachman 2001). The Universal Scale of Consonantal Strength defines the strength of each segment (Lass 1984) and is given in (8).

(8) Universal Scale of Consonantal Strength (Lass 1984)

Stops > Fricatives > Nasals > Liquids > Glides > Vowels

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Strong 1 2 3 4 5 6 Weak

Also, the Standard Modern Greek-specific Scale of Consonantal Scale which is proposed by Kappa (1995:138) is provided in (9).

(9) Scale of Consonantal Strength for Standard Modern Greek (Kappa 1995:138)

[p, t, k] [f, θ, x] [v, ð, ɣ] [s] [z] [m, n] [l, r] Vowels

---------●---------●----------●-------●-------●-------●--------●---------●---------------

Strong 1 2 3 4 5 6 7 8 Weak

A few representative examples are given in (10).

	Form	**Gloss**
10a.	[ˈtel.ma]	deadlock
b.	[ˈar.tos]	bread

(Standard Modern Greek)

To sum up, the formation of word-initial and -medial clusters is governed by phonological principles, such as the Sonority Sequence Generalization (Selkirk 1984), the Sonority Sequence Principle (Selkirk 1984) and the Minimal Sonority Distance (Steriade 1982). Also, Standard Modern Greek-specific sonority scales proposed by Malikouti-Drachman (1984) and Kappa (1995:138) shed more light on cluster formation. Within the word, language-specific conditions show that syllabification is a complex phenomenon due to the appearance of codas. However, the Maximal Onset Principle (Kahn 1976) and the theoretical proposal of Malikouti-Drachman (1984) shed light on the syllabification.

2.1. The consonant clusters in Standard Modern Greek

Standard Modern Greek is a language which shows preference for monopositional and open syllables (Kappa 1995, Tzakosta 2013c, and more references cited therein). Firstly, two- and three-member consonant clusters are attested word-initially in Standard Modern Greek. Two-member clusters are well-formed, if they satisfy the Sonority Sequence Generalization (Selkirk 1984), the Sonority Sequence Principle (Selkirk 1984) and the Minimal Sonority Distance (Steriade 1982), as can be seen in (11a). Also, two-member and three-member antisonority consonant clusters occur at the left edge of the word. The first member of an antisonority cluster, i.e. the leftmost consonant of the cluster, is more sonorous than the second one, i.e. the rightmost consonant of the cluster, and, thus, these clusters do not obey the Sonority Sequence Generalization (Selkirk 1984), the Sonority Sequence Principle (Selkirk 1984) and the Minimal Sonority Distance (Steriade 1982), which is 4 for Standard Modern Greek (Malikouti-Drachman 1984), as is indicated in (11b-c). In order for the antisonority consonant to be realized, it is analyzed as an adjunct attached to the syllabic node (Drachman 1989, Kappa 1995).

	Form	**Gloss**
11a.	[tri.pa]	gap
b.	[fte.ˈro]	feather
c.	[stra.ˈtos]	army

(Standard Modern Greek)

Secondly, as far as the word-medial sequences of two and three consonants are concerned, they are analyzed as clusters under certain circumstances. In particular, a two-member consonantal sequence forms a cluster if it obeys the Sonority Sequence Generalization (Selkirk 1984), the Sonority Sequence Principle (Selkirk 1984) and the Minimal Sonority Distance (Steriade 1982). Recall that the minimal sonority distance is 4 for Standard Modern Greek (Malikouti-Drachman 1984). Also, the Maximal Onset Principle (Kahn 1976) is satisfied. The above is indicated in (12a). In addition, two-member and three-member antisonority clusters which are permitted word-initially, are permitted word-medially, too (12b-c). Within the word, antisonority clusters do not obey the Sonority Sequence Generalization (Selkirk 1984), the Sonority Sequence Principle (Selkirk 1984) and the Minimal Sonority Distance (Steriade 1982). However, they satisfy the Maximal Onset Principle (Kahn 1976). In these cases, the antisonority consonant is analyzed as an adjunct attached to the syllabic node (Drachman 1989, Kappa 1995).

	Form	Gloss
12a.	[ka.ˈre.kla]	chair
b.	[o.ˈxto]	eight
c.	[ˈa.spros]	white

(Standard Modern Greek)

Also, homorganic clusters do not occur in Standard Modern Greek. To be more specific, two-member consonant clusters, such as *[pm], *[tl, tn] and *[sl, zl, sn, zn, zr], are not observed in Standard Modern Greek due to the Obligatory Contour Principle[5] (henceforth OCP).

All in all, in Standard Modern Greek, two-member and three-member clusters occur both at left edge of the word and within the word. However, phonological principles govern the cluster formation, i.e. the Sonority Sequence Generalization (Selkirk 1984) and the Sonority Sequence Principle (Selkirk 1984), and the Minimal Sonority Distance (Steriade 1982), determine the syllabification. Furthermore, the OCP applies in cluster phonotactics.

2.2. On the acquisition of clusters

Greek as well as crosslinguistic studies focused on the acquisition of clusters report that, in the initial phase of acquisition, children's grammar allows only unmarked syllabic structures to emerge (e.g. Jakobson 1941/1968, Gnanadesikan 1995/2004, Smolensky 199, Kappa 2002a, 2009a, b, Tzakosta 2003 among others). Therefore, branching onsets are not attested in the earliest acquisitional phases (e.g. Jakobson 1941/1968, Freitas 2003, Kappa 2002a, 2004, 2009a, b, Tzakosta 2003, 2006, 2007a, Sanoudaki 2007, 2010). The attested cluster simplification strategies[6] include cluster reduction (/C_1C_2V/ → [C_1V] or [C_2V]), vowel epenthesis (/C_1C_2V/ → [$C_{1V}C_2V$]),

[5] The OCP was first introduced by Goldsmith (1976). In his dissertation on the autosegmental phonology, it is argued that the adjacency of two identical tones is not permitted due to OCP effects. In segmental phonology, the OCP applies, too. Specifically, the adjacency of identical features is not allowed (Ito & Mester 1986, McCarthy 1986, Yip 1988).

[6] e.g Beers 1995, Berman 1977, Bernhardt and Stemberger 1998, Clausen & Fox Boyer 2017, Chin and Dinnsen 1992, Grunwell 1982, Ingram 1976, 1989, Lleó and Prinz 1996, Smit 1993, Fleischhacker 2000, Templin 1957, Smith 1973, Menn 1978, Mildner & Tomic 2010, , Gnanadesikan 1995/2004, Ohala 1996, 1999, Barlow 1997, Pater & Barlow 2003, Łukaszewicz 2007, van der Pas 2004, Freitas 2003, Bloch 2011, Ben David 2001, 2006, Lavie 1978, Jongstra 2003, Kappa 1999, 2002, 2003, 2004, 2009a, b, Kappa & Papoutsi 2019, Tzakosta 1999, 2003, 2005, 2006, 2007, 2009, 2016, Revithiadou & Tzakosta 2004a, b Sanoudaki 2007, 2010, Schaefer & Fox-Boyer 2017, Yavaş 2013, Yavaş & Core 2006, Yavaş & Marecka 2014, Yavas et al. 2018 among others. Also, in the literature, it is reported that instances of deletions of the entire cluster are rare (Ingram 1976, Chin and Dinnsen 1992, Smit 1993, Freitas 2003).

coalescence (/C_1C_2V/ → [$C_{1,2}V$]) and deletion of both cluster segments (/C_1C_2V/ → [V]). All the above will be presented in the following subsection s (2.2.1.-2.2.4).

2.2.1. Cluster reduction patterns

In this section, we are concentrating on the realization of the word-initial and word-medial input clusters and we delve into the reduction process (/C_1C_2V/ → [C_1V] or [C_2V]) which is reported in the greek and in the crosslinguistic literature (e.g. Smith 1973, Pater & Barlow 2003, Barlow 2003, Freitas 2003, Gnanadesikan 1995/2004, Kula & Tzaksota 2006, Mildner & Tomic, 2010, Łukaszewicz 2007, van der Pas 2004, Bloch 2011, Kappa 2002a, b 2009a, b, Tzakosta 2009, Sanoudaki 2010, Schaefer & Fox-Boyer 2017, Yavaş 2013, Yavaş & Core 2006, Yavaş & Marecka 2014, Yavas et al. 2018, Kappa & Papoutsi 2019 among others). The research question we must address is the following: When it comes to cluster reduction, a process which is very common in the acquisitional process, which segment is deleted and why? Several approaches have been proposed in order to explain how the acquisition of complex onsets proceeds.

The main bulk of the phonological acquisition literature suggests that children's grammar does not permit clusters in the initial phase of acquisition (e.g Jakobson 1941/1968, Barlow 2003, Kappa 2002a, b, 2004, Kappa 2009a, b, van de Weijer & Tzakosta 2017). The prevalent repair strategy in child speech is cluster reduction[7], whereby only one of the members of the adult cluster is realized (/C_1C_2V/ → [C_1V] or [C_2V]). In the literature, it is reported that the most commonly attested reduction pattern is the reduction to the less sonorous consonant of the cluster regardless of whether this consonant is the first or the second member of the cluster (e.g. Barlow and Gierut 1999; Gnanadesikan 1995/2004, Pater and Barlow 2002, Barlow 2003, for English, Rose 2000, for French, Fikkert 1994, for Dutch, Łukaszewicz 2007, for Polish, Kappa 2002, 2004, 2009a, b, Tzakosta 1999, for Greek among others). For example, in Greek,

[7] English: Templin (1957), Ferguson & Farwell (1975), Grunwell (1982), Locke (1983), Smith (1983), Ingram (1989), Chin and Dinnsen (1992), Smit (1993), Ohala (1996, 1999), Barlow (1997, 2001), Bernhardt & Stemberger (1998), Gnanadesikan, (1995, 1996, 2004), Gierut (1999), Pater & Barlow (2003). French: Rose (2000). Croatian: Mildner & Tomic (2010). German: Lleo & Prinz (1996), Grijzenhout & Joppen (1998, 2002). Greek: Kappa (1999, 2002a, b), Tzakosta (2007), Tzakosta & Revithiadou (2004a, b), Coutsougera (2007), Sanoudaki (2007), Coutsougera & Shelkovaya-Vasiliou (2008). Spanish: Lleo & Prinz (1996), Barlow (2003), Kehoe & Lleo (2003). Dutch: Fikkert (1994), Jongstra (2003), van der Pas (2004). Polish: Łukaszewicz (2000, 2007), Yavaş & Marecka (2014). European Portuguese: Freitas (1996, 2003)

Spanish, English and Polish (see examples in (13)), if the adult form contains a stop-sonorant cluster, the stop will be realized; if the target form contains a fricative-stop cluster, the stop will be realized. Put differently, children reduce to the less sonorous consonant following the sonority pattern. Therefore, sonority and unmarkedness drives the process of consonant cluster reduction. Hence, syllables with maximum rise in sonority from the onset of the syllable to the nucleus are produced (Clements 1988, 1990).

	Input form	Output form	Gloss	Child	Age
13a.	ˈkri.ma	ˈci.ma	pity	Sofia	2;02,28
b.	pro.ˈi	po.ˈi	morning	Sofia	2;03,25
c.	o.ˈbre.la	o.ˈbe.la	umbrella	Sofia	2;02,20
			(Standard Modern Greek, from Kappa 2002a:21-22)		
d.	ˈci.tri.no	ˈci.ti.no	yellow	M.	1;08,17
			(Standard Modern Greek, from Kappa 2009b:3)		
e.	plato	pato	plate	BL4	2;08
f.	tɾes	tes	three	BL4	2;08
g.	floɾ	fole	flower	BL4	2;08
h.	kumpleaɲos	kumpeaɲos	birthday	BL4	2;08
i.	liβro	libo	book	BL4	2;08
j.	neɣro	nego	black	BL4	2;08
			(Spanish, from Barlow 2003:186-194)		
k.		pliz	please	G.	2
l.		kin	clean	G.	2
m.		fɛn	friend	G.	2
n.		sip	slip	G.	2
o.		so	snow	G.	2
p.		sip	sleep	G.	2
q.		biw	spill	G.	2
r.		gɪn	skin	G.	2
s.		dɑ	star	G.	2
			(English, from Gnanadesikan 2004:77-78)		
t.	prɛzɛnt	pɛzɛnt	gift	Ola	4
u.	krula	kuja	king	Ola	4
v.	dla	da	for	Ola	4
			(Polish, from Łukaszewicz 2007:58)		

Nevertheless, it is not always the case that consonant clusters are reduced to the less sonorous segment, i.e. not all children follow the sonority pattern. In the literature, it is reported that sometimes the more sonorous consonantal segment of the adult cluster is preserved. Such instances are observed in European Portuguese (e.g. Freitas 2003) as well as in English (e.g. Smith 1973, Grunwell 1982, Gnanadesikan 1995/2004, Pater & Barlow 2003 among others) and in Hebrew (Bloch 2011:33). As can be seen in the data sets below (14), the reduction pattern which is attested in English, in European Portuguese and in Hebrew child language does not follow the sonority pattern, namely the more sonorous consonant, the sonorant, surfaces. We observe that this reduction pattern is attested not only in antisonority clusters (14a-d) but also in well-formed ones (14e-j) in word-initial and -medial stressed and unstressed syllables.

	Input form	**Output form**	**Gloss**	**Child**	**Age**
14a.		nek	snake	J.	1;11,22
b.		meʊ	smell	J.	2;04,28
c.		næ	snap	T.	1;01,04
d.		ni:z	sneeze	T.	1;10,05
			(English, from Pater & Barlow 2003:496)		
e.	bisiˈklɛtɐ	bsiˈletɐ	bicycle	Luis	2;02,27
f.	ˈfloriʃ	ˈloliʃ	flowers	Marta	1;07,17
			(European Portuguese, from Freitas 2003:35)		
g.	vʁu.’da	ʁu.’da	pink	RM.	2;04,05
h.	‘tʁaktor	‘ʁaktor	tracktor	RM.	2;06,12
i.	dli	li	bucket	RM.	2;06,12
j.	kmo	mo	like	RM.	2;10,03
			(Hebrew, from Bloch 2011:33)		

Another proposal regarding the reduction of consonant clusters was put forth by van der Pas (2004). Van der Pas proposed that contiguity may play a role in cluster simplification in Dutch[8] and that adjacency (contiguity) drives the reduction, i.e. it is preserved the consonant which is adjacent to the nucleus regardless of whether this segment is the least or the more sonorous one among the cluster members (15a-b). Furthermore, developmental data from children acquiring the Hebrew language provide further evidence for contiguity. According to Bloch (2011), children realize the more sonorous segment and contiguity may determine which member of the cluster will be produced. For example, input stop-fricative clusters are reduced to the fricative (15c-d). Accordingly, input fricative-nasal clusters are reduced to the nasal (15e-f). This production pattern was observed in Ben David's (2001) study, as well.

[8] In Smith (1973), it is reported that in stop-stop tautosyllabic consonantal sequences with the same manner of articulation, the segment which is adjacent to the syllabic nucleus is preserved regardless of place of articulation.

	Input form	Output form	Gloss	Child	Age
15a.	blad	lat	leaf		
b.	sla.pen	la.pe	sleep		
			(van der Pas 2004 as cited in Tzakosta 2009:365)		
c.	kviʄ	viʄ	road	RM	1;11,18
d.	kxi	xi	you take	SR	2;00,00
e.	ˈʃmone	ˈmone	eight	SR	1;06,20
f.	smiˈxa	miˈxa	blanket	RM	2;00,16
					(Hebrew, from Bloch 2011:45)

Also, longitudinal data drawn from Standard Modern Greek-acquiring children show that the consonant which is adjacent to the nucleus is preserved in the output form. According to Tzakosta (2009a), contiguity drives cluster reduction (16a-c). Nevertheless, a different analysis regarding the reduction to the more sonorous is proposed by Kappa (2002a). Kappa's longitudinal production data show that this reduction pattern is observed in prominent and non-prominent word positions. As it is demonstrated in the data set in (16d-f), reduction to the more sonorous segment occurs in word-initial and word-medial stressed and unstressed syllables. Kappa suggests that the OCP drives the reduction, i.e., this pattern is attested if the less sonorous segment of the target cluster contains the same specified feature of place of articulation with another consonant of the word[9]. For example, in (16d) the input cluster /vl/ is reduced to the more sonorous member of the cluster and, therefore, the sonorant /l/ is chosen rather than the fricative /v/. Both /p/ and /v/ are specified with the feature [LABIAL] in the mental lexicon. Therefore, /v/ is deleted and [l] is produced.

	Input form	Output form	Gloss	Child	Age
16a.	ˈvle.pi	ˈle.pi	see 3.Sg.PR	Bebis	1;11,29
					(Tzakosta 2003:2)
b.	ˈvle.po	ˈle.po	see 1.Sg.PR	B.M	2;02,12
c.	ˈpa.vlos	ˈpa.lo	proper name	F.	2;02,03
					(Tzakosta 2009a:368)
d.	ˈpa.vlo	ˈpa.lo	proper name	Sofia	2;4,11/2;6
e.	ɣli.ˈko	li.ˈko	sweet	Sofia	2;6,7/2;9
f.	ˈɣli.ka	ˈɣli.ka	sweety	Sofia	2;09,15
					(Kappa 2002:31)

[9] As it will be shown in 4.5.1., our longitudinal data demonstrate that the preservation of the more sonorous consonant of the input cluster is not driven by the OCP.

OCP effects in child productions are also attested in later developmental studies (Kappa & Papoutsi 2019). Specifically, it is reported that, in the intermediate phase, despite the fact that children realize stop-liquid, stop-nasal, stop-s and fricative-stop clusters (17a-h), they do not produce branching onsets whose members contain the same feature of place of articulation (17i-l). Put differently, children's grammar avoids homorganic clusters. Hence, complex onsets are reduced to the less sonorous (17i-j) or the second member of the cluster is metathesized and is realized in the coda position of the preceding syllable (17k) or a change in the place of articulation of the first member of the cluster takes place (17l). This asymmetry is explained in OCP terms. The domain in which the OCP applies is the syllable of the complex onset and applies in word-initial and word-medial stressed and unstressed syllables. The data sets in (17) reflect the above pattern.

	Input form	**Output form**	**Gloss**	**Child**	**Age**
Faithful cluster productions					
17a.	ˈpra.si.ni	ˈpra.si.ni	yellow		2;06,21
b.	kri.ˈfto	kri.ˈfto	hide and seek		2;06,15
c.	ˈxno.ta	ˈxno.ta	breath		2;06,20
d.	θli.ˈme.ni	θli.ˈme.ni	sad		2;07,29
e.	ˈksi.pni.sa	ˈksi.pni.sa	wake up		2;06,16
f.	ˈpsi.ni	ˈpsi.ni	bake		2;06,18
g.	ˈspi.ti	ˈspi.ti	house		2;06,20
h.	ˈla.spi	ˈla.spi	mud		2;06,20
Reduction to the less sonorous					
i.	ja.ˈtros	ja.ˈtos	doctor		2;06,16
j.	tra.ˈvas	ta.ˈvas	pull		2;06,17
Metathesis of the more sonorous member of the cluster and its assignment to coda position					
k.	ˈpu.δra	ˈpur.δa	face-powder		2;07,29
Change in place of articulation of the first member of the cluster					
l.	θni.ˈtos	fni.ˈtos	mortal		2;06,22

(Kappa 2019:438-439)

According to Goad and Rose (2004), the notion of headedness must be taken into consideration, namely it is proposed that headedness governs the realization of clusters in child language. In the initial developmental phase, children follow the sonority pattern and they realize the head of a complex onset which is the less sonorous segment. For instance, if the target cluster is a stop-sonorant, the stop is prosodified and preserved (e.g. /tr/ → [t]), if the target cluster is a fricative-sonorant, the fricative is prosodified and retained (/sl/ → [s]) and if the target cluster is a fricative-stop, the stop is prosodified and preserved (/sp/ → [p]). At a later acquisitional phase, the child diverges from the sonority pattern. Specifically, at this phase the child has acquired, firstly, that the word-initial sC clusters are heterosyllabic and, secondly, that /s/ is in an appendix and, therefore, that /s/ in not the head of the onset. Thus, child has learned that the other member of the cluster is the head of the onset. For example, if the target onset is s-sonorant, the sonorant is the head and if the target onset is s-stop, the stop is the head of the onset.

To sum up, there are several cluster reduction patterns. In the phonological acquisitional literature on the acquisition of clusters, it is reported that clusters may be reduced to the less sonorous member of the cluster, i.e. the first member of the cluster is preserved (/C_1C_2V/ → [C_1]) or to the more sonorous member of the cluster, i.e. the second member of the cluster is retained in the output form (/C_1C_2V/ → [C_2]). Therefore, children reduce clusters following the sonority pattern or diverging from it. In the latter cases, contiguity drives the reduction. Also, greek studies show that the OCP effects are well-attested in cluster reductions and other cross-linguistic studies suggest that headedness governs the realization of clusters in the process of cluster acquisition.

2.2.2. Coalescence

Coalescence is another repair strategy which is attested in child data. Coalescence is attested when children retain the most unmarked features of the two segments in the onset and fusion them. Therefore, a /C_1C_2V/ form is produced as [$C_{1,2}$V]. For example, the input cluster */kl/* is realized as *[t]* (18).

	Input form	**Output form**
(18)	kl	t

The unmarked features of the input cluster /kl/ are retained in the output form. Children preserve the coronal place of articulation of /l/ and combine it with the stop manner of articulation and the voicing of /k/. Thus, the consonant which is produced is [t] (19).

(19)	**Segments**	**/k/**	**/l/**	**[t]**
	Place of articulation	Dorsal	CORONAL	CORONAL
	Manner of articulation	[-continuant]	[+lateral]	[-continuant]
	Voicing	[-voiced]	[+voiced]	[-voiced]

Hence, universally unmarked CV syllables are produced. Data examined in previous developmental studies demonstrate that coalescence applies in obstruent-sonorant clusters (Tzakosta 2009a) as well as in obstruent-obstruent ones (Tzakosta 2016, Kappa 2004). Furthermore, we observe that this simplification pattern is attested in prominent positions, i.e. in stressed and/or word-initial syllables and in non-prominent ones, i.e. unstressed and/or word-medial syllables, and results in unmarked CV syllables (Clements 1990). Also, we observe that it is not always the case that children retain only the unmarked features of the input cluster in the output form. For example, in (20f) Chr. preserves the fricative manner of articulation of /s/ and combines it with the coronal place of articulation of /s/ and the voicing of /k/ and /s/. All the above are exemplified in (20).

	Input form	**Output form**	**Gloss**	**Child**	**Age**
20a.	ˈkle.i	ˈte.i	cry 3.Sg.PR	B.M.	1;10,26
b.	kli.ˈði	ti.ˈði	key	I.	2;05,19
					(Tzakosta 2009a:369)
c.	ˈe.ksi	ˈe.ti	six	Chr.	1;18,10
d.	ma.ksi.ˈla.ri	ma.θi.ˈla.li	pillow	Chr.	1;18,10
					(Tzakosta 2016:8)
e.	sku.ˈfa.ci	te.ˈfa.ci	hat.DIM	B.M.	2;07
f.	sci.ˈla.ci	ti.ˈla.ci	dog.Dim	I.	2;04,03
					(Tzakosta 2009a:369)

In the Standard Modern Greek literature, coalescence is reported in Kappa (2004), too. In this study, Kappa focuses on obstruent-obstruent clusters and argues that in her data coalescence is observed in unstressed syllables in word-medial positions (21a-e), and that cluster reduction is observed in stressed syllables in word-initial positions (21f-h). To put it differently, Kappa suggests that the domain is crucial when it comes to cluster simplification. The above claims are exemplified below (21).

	Input form	**Output form**	**Gloss**	**Child**	**Age**
	Coalescence				
21a.	ˈe.ksi	ˈe.ti	six	Sofia	2;02.20
b.	ˈe.kso	ˈe.to	outside	Sofia	2;05,09/2;06
c.	ˈma.ska	ˈma.ta	mask	Sofia	2;02,20
d.	ˈa.ni.ksi	ˈa.ni.ti	spring	Sofia	3;01,10
e.	a.ˈni.ksi	ˈa.ni.ti	open2.Sg.PR	Sofia	3;05
	Cluster reduction				

f.	ˈksi.lo	ˈci.lo	wood	Sofia	2;02,20/2;05,09
g.	ˈska.la	ˈka.la	stairs	Sofia	2;05,09
h.	ˈspi.ti	ˈpi.ti	house	Sofia	2;02/2;09,13

(Kappa 2004:210)

Crosslinguistic studies show that coalescence is a crosslinguistic phenomenon (e.g. Gnanadesikan 2004, Bloch 2011 among others). Gnanadesikan (2004) report insances of labialising coalescence in English, (22a-d). Furthermore, data from Hebrew show that, when a cluster is coalesced, the manner of articulation of the first consonant and the place of articulation of the second consonant are retained, as can be seen in 22e-g (Bloch 2011).

	Input form	**Output form**	**Gloss**	**Child**	**Age**
22a.	$g_1r^w{}_2in$	$b_{1,2}in$	green	G.	2
b.	b_1l_2u	$b_{1,2}u$	blue	G.	2
c.		$f_{1,2}ok$	smoke	G.	2
d.		$f_{1,2}$ɔw	small	G.	2
			(English, from Gnanadesikan 2004:95-97)		
e.	d_1v_2oˈʁa	$p_{1,2}o$ˈʁa	bee	RM	2;00,09
f.	k_1l_2ips	$t_{1,2}its$	clip	RM	2;02,04
g.	k_1m_2o	$b_{1,2}o$	like	RM	2;05,29
			(Hebrew, from Bloch 2011:66)		

2.2.3. Epenthesis

Vowel epenthesis[10] is a marginal repair strategy in child speech and concerns the insertion of a vowel which breaks up a cluster, namely a C_1C_2V syllable is realized as C_1vC_2V. As far as the epenthetic vowel is concerned, it seems that it may vary across the languages as well as within the same language. For instance, the epenthetic vowel varies in Hebrew (Bloch 2011), as can be seen in (23a-c). However, this is not the case in European Portuguese, i.e. it is the [ɨ] (Freitas 2003), as displayed in (23d-g).

	Input form	**Output form**	**Gloss**	**Child**	**Age**
23a.	ktaˈna	ketaˈna	small	RM	2;00,16
b.	gdoˈlim	katoˈiim	big	RM	2;02,11

[10] According to Fleischhacker (2000), epenthesis concerns either the anaptyxis of a vowel to break up an obstruent-sonorant cluster or the prothesis of a vowel before a sibilant-stop cluster.

c.	zvuv	ʄəˈvau	fly	RM	1;10,28
				(Hebrew, from Bloch 2011:59-60)	
d.	ˈgrɐdɨ	kɨˈrɐdɨ	big	Luis	2;05,27
e.	ˈfraɫdɐ	fɨˈrawdɐ	diaper	Luis	2;06,26
f.	ˈkɔbrɐ	ˈkobɨrɐ	snake	Pedro	3;05,18
g.	ˈpɛdrɐ	ˈpɛdɨrɐ	rock	Luis	2;05,07
			(European Portuguese, from Freitas 2003:35)		

In the greek phonological acquisitional literature, it is reported that epenthesis is a marginal simplification process (Drachman 1978, Kappa 2002a). Regarding the epenthetic vowel, it varies in the Greek child speech. Kappa (2002a) suggests that the epenthetic vowel is not selected randomly, rather it is the /e/ (Kappa 1999, 2002a). The fact that the /e/ is the default epenthetic vowel in Standard Modern Greek is reported in Malikouti-Drachman & Drachman (1988). Nevertheless, in Tzakosta's (2009a:369) study, the epenthetic vowel is the /æ/. The relevant data are provided in (24).

	Input form	**Output form**	**Gloss**	**Child**	**Age**	
24a.	ˈblu.za	b**e**.ˈlu.la	blouse		2;05;09	
b.	ble	b**e**.ˈle	blue		2;02	
						(Kappa 2002a:24)
c.	ˈkri.o	k**æ**.ri.o	cold	B.M.	2;02,12	
d.	ˈtsi.xles	ti.ˈt**æ**.la	gum	I.	3;03,08	
e.	ble	b**æ**.ˈle	blue	I.	2;08,11	
						(Tzakosta 2009:369)

2.2.4. Deletion of the entire cluster

Moreover, in child language clusters are avoided by deletion of the entire cluster, as can be seen in data drawn from European Portuguese (Freitas 2003). In other words, in the child form both cluster members are deleted. In the data from European Portuguese-acquiring children, we observe that cluster deletions occur both in stressed and unstressed syllables in word-initial and -medial word positions. Furthermore, it seems that cluster deletions occur in obstruent-sonorant clusters. This repair strategy is presented below (25).

	Input form	**Output form**	**Gloss**	**Child**	**Age**
25a.	ˈbruʃɐ	ˈugɐ	witch	JoaoII	2;02,28
b.	ˈflor	ˈolɨ	flower	Ines	1;09,19
c.	bisiˈklɛtɐ	pisiˈɛtɐ	bicycle	Luis	1;11,20

d.	futugrɐˈfia	ftuɐˈfiɐ	picture	Raquel	2;10,08

(European Portuguese, from Freitas 2003:34)

Cluster deletions are not reported in the greek acquisitional literature. However, as it will be shown in Chapter 4.5.3., cluster deletions are attested in our longitudinal developmental data.

2.2.5. Positional faithfulness

Instances of positional faithfulnes[11] are reported in the Greek acquisitional literature (Revithiadou & Tzakosta 2004a, Tzakosta 2009). More specifically, greek longitudinal acquisitional data reveal that in the output form the leftmost consonant of the word-initial cluster is preserved regardless of the degree of markedness (26a-d). Also, we observe that the children retain the vowel of the stressed syllable (26a-d) and the word-final vowel (26a-d) in their outputs.

	Input form	**Output form**	**Gloss**	**Child**	**Age**
18a.	ˈvle.po	vle	see.1.Sg.PR	F.	2;05,09
b.	fri.ɣa.ˈnu.la	ˈfu.la	cracker.DIM	D.	2;03,07
c.	kra.ˈta.o	ˈka.o	keep.1.Sg.PR	F.	1;11,15
d.	ɣli.ˈko	ɣo	sweet	D.	2;01,09

(Revithiadou & Tzakosta 2004a:4-8)

2.3. Summary

Greek and crosslinguistic studies revealed that branching onsets are not allowed by children's grammar in the initial developmental phase. Therefore, various simplification strategies are attested in child speech, i.e. reduction to the less sonorous segment, contiguity, coalescence, epenthesis and deletion of the entire cluster, Also, there is evidence that positional faithfulness influences child productions. Among all the attested simplification strategies, cluster reduction is the prevalent repair strategy in child speech. Furthermore, OCP effects influence child productions. All the simplification strategies which are attested in children's data result in CV productions,

[11] Slobin (1973) argues that children pay attention to word edges. To put it differently, word edges are perceptually prominent. Therefore, strong positions (syllables in word edges, stressed syllables) tend to be faithfully realized. The perceptual prominence of left edge of the word is reported in Smith (2002 and more references therein), as well. Positional faithfulness was proposed by Beckman (1998). In her dissertation, it is suggested that contrasts are neutralized in non-prominent positions.

namely the universally unmarked syllable is produced.

3. Methodology

This chapter covers the methodology of this longitudinal developmental study. The subjects of the study and the research process will be presented in detail in the subsections 3.1 and 3.2.

3.1. Subjects

The production data are drawn from a longitudinal study of two typically developing Standard Modern Greek-acquiring children, Spiros (henceforth SPI) and Dimitris (henceforth DIM). Both of them were males born and raised in Rethymnon, Crete. The children went to kindergarten every day. SPI and DIM were exposed to Standard Modern Greek. Their parents were monolingual speakers of Standard Modern Greek and they did not speak the Cretan Greek dialect. Also, the teachers of the children were monolingual speakers of Standard Modern Greek. However, given that children were born and raised in the city of Rethymnon, in which Cretan Greek are used, we suppose that both children may be exposed to the idiosyncratic phonological characteristics of this dialect through their interaction with their grandparents and relatives who were speakers of the dialect. Nevertheless, children's speech does not reveal idiosyncratic phonological characteristics of Cretan Greek.

SPI started being recorded at the age of 2;01,24 and stopped being recorded at the age of 3;04,11, namely we interacted with him for 1 year 2 months and 18 days. The total number of recording sessions are 55 and the child was recording for 18 hours and 21 minutes (1,093 minutes). Furthermore, the total number of linguistic tokens which were elicited are 8,667. As far as DIM is concerned, he started being recorded at the age of 1;10,29 and stopped being recorded at the age of 2;05,15, namely we interacted with him for 6 months and 16 days. The total number of recording sessions are 19 and the child was recording for 7 hours and 18 minutes (431 minutes). In addition, the total number of linguistic tokens which were elicited are 3899. All the above are summarized in Table 1 right below.

Child	Spiros (SPI)	Dimitris (DIM)
Sex	Male	Male
Age in the First Recording Session	2;01.24	1;10,29
Age in the Last Recording Session	3;04,11	2;05,15

Duration of the recordings	1 year 2 months and 18 days	6 months and 16 days
Total recorded sessions	55	19
Totat recorded minutes	18 hours and 21 minutes	7 hours and 18 minutes
Tokens	8.667	3.899

Table 1

To sum up, the current study focuses on the acquisition of two monolingual Standard Modern Greek male children, SPI (2;01,24 – 3;04,11) and DIM (1;10,29 – 2;05,15) born and raised in the city of Rethymnon, Crete. 74 recording sessions took place and 25 hours and 40 minutes were recorded. Furthermore, 12.566 linguistic tokens were recorded.

3.2. Research process

Firstly, the parents of the children were aware of the research and the recording sessions. Before we started the interactions with their children, they were informed about the research purposes and the materials and methods which would be used. Also, by signing the relevant consent form they gave their consent for the participation of their children in this study. Finally, after the end of the recording sessions, we gave parents copies of all the .mp4 files in a usb stick, as it was asked at the beginning of the research.

The research process was held in the kindergarten in which each child was hosted and specifically in a quiet place that was offered to us for the research purposes. The research took place on a weekly basis and each session lasted from twenty (20) to forty (40) minutes. At the end of each recording session, the children were given a pack of stickers as a gift.

Also, we interacted with SPI twice a week until the age of 2;06,08 and, then, only once a week until the age of 3;04,11, when the recordings stopped. As far as DIM is concerned, we interacted with him once a week from the beginning of our recording sessions (age 1;10,29) until the end of our sessions (age 2;05,15). Also, it was not possible to interact with the children during the Christmas and the Easter break as well as when they were absent from kindergarten.

The data collection process was based on a picture naming task. These pictures were shown to the children by using an MLS tablet with an 8 inch LCD screen. Almost all the pictures were animated and depicted objects familiar to the children, for example, animals, clothes and everyday objects. The experimenter showed the child a picture and asked the child '*What is this*?'. Then the experimenter was expecting that the child would tell what it is depicted in the picture. Also, the experimenter asked additional questions for the picture, for instance '*What color is it?*', '*What is he or she wearing?*', '*What is this?*', '*How do we use this?*'. Furthermore, the experimenter proceeded to free interaction with each child and discussions on topics which were familiar to them. Also, animated books, fairytales, teddy bears and everyday objects were used. Moreover, there were instances in which children were interacting with other fellow-students. Therefore, the natural speech was recorded, too. Each recording session was recorded by using a professional recorder Marantz Professional PMD661MKII.

The data transcription process took place right after the recording session was finished. We used the Audacity software in order to hear the recordings and, then, we transcribed them in the IPA using the Doulos SIL font. The target forms were transcribed in the IPA, too. All the data were entered in an Excel database.

4. Data description

This chapter focuses on the acquisition of the well-formed stop-liquid, fricative-liquid, stop-nasal and fricative-nasal clusters by two typically developing Standard Modern Standard Modern Greek-acquiring children, Dimitris (henceforth DIM, age: 1;10,29 – 2;05,15) and Spiros (henceforth SPI, age: 2;01,24 – 3;04,11). Firstly, I focus on the reduction patterns attested in DIM's and SPI's speech, i.e. reduction to the less sonorous segment (C_1) (see subsections 4.1. – 4.4.) and reduction the more sonorous segment (C_2) (see subsection 4.5.1.) and, secondly, I explore the other repair strategies, namely, epenthesis (see subsection 4.5.2.), deletion of the entire cluster (see subsection 4.5.3.) and coalescence (see subsection 4.5.4.). Finally, the emergence of faithful target forms will be presented and discussed (see subsection 4.6.). Finally, in 4.7. some aspects regarding the children's development will be discussed.

4.1. Stop-liquid clusters: Reduction to the less sonorous consonant

In this subsection, I will focus on the reduction simplification strategy in stop-liquid clusters which occur in stressed and unstressed syllables in word-initial and word-medial positions. In Standard Modern Greek, a stop-liquid consonant cluster consists of a LABIAL, a CORONAL or a DORSAL stop consonant as the first member of the cluster (C_1) and a lateral or a rhotic as the second member of the cluster (C_2). A few representative examples from Standard Modern Greek are given in (19).

	Form	**Gloss**
19a.	pli.o	ship
b.	kri.o	cold
c.	fa.'gri	seabream
d.	te.'tra.ɣo.no	square
e.	'ðe.dro	tree

(Standard Modern Greek)

DIM's and SPI's data show that, in the early intermediate phase, their grammar does not allow complex onsets to emerge. Hence, clusters are reduced to singletons. The leftmost consonant of the well-formed stop-liquid cluster, i.e. the C_1, surfaces in children's productions. As can be seen in the data set below (20), the first member of the cluster, namely the voiceless or the voiced LABIAL, CORONAL or DORSAL plosive, is preserved and the second member of the cluster, namely the sonorant, is deleted in word-initial and -medial stressed and unstressed syllables.

	Input form	Output form	Gloss	Child	Age
20a.	ˈpra.si.no	ˈpa.ti.no	green	DIM	1;10,29
b.	ble	be	blue	DIM	1;10,29
c.	ˈkle.i	ˈce.i	cry 3PR Sg	DIM	1;11,28
d.	ˈtri.a	ˈti.a	three	DIM	1;11,28
e.	ˈðe.dro	ˈðe.do	tree	DIM	1;11,28
f.	o.ˈbre.la	ˈbe.la	umbrella	DIM	2;00,04
g.	a.e.ro.ˈpla.no	o.ˈpa.no	airplane	DIM	2;00,26
h.	ka.ˈre.kles	ka.ˈle.ceç	chairs	DIM	2;01,02
i.	bro.ˈsta	bo.ˈta	front	DIM	2;01,09
j.	ble	be	blue	SPI	2;02,04
k.	kre.ˈva.ti	ce.ˈka.ci	bed	SPI	2;02,04
l.	ka.ˈre.kla	ca.ˈce.ka	chair	SPI	2;02,04
m.	ˈpra.si.no	pa	green	SPI	2;02,07
n	kli.ˈði	ɟi	key	SPI	2;02,07
o.	bre.ˈlok	pe.ne.ˈno.nu	key chain	SPI	2;02,13
p.	ˈkri.o	ci	cold	DIM	2;02,23
q.	ˈplu.to	ˈpu.toç	proper name	DIM	2;03,06
r.	klo.ˈtsa.i	ko.ˈtsa.i	buck 3PR Sg	DIM	2;03,06
s.	pli.ˈdi.ri.o	bi.ˈdi.i.o	washing machine	SPI	2;03,08
t.	ˈðe.dro	ˈde.do	tree	SPI	2;03,08
u.	va.tra.ˈxa.ci	va.ta.ˈxa.tsi	frog DIM	DIM	2;03,13
v.	pli.ˈdi.ri.o	pi.ˈdi.o	washing machine	DIM	2;03,13
w.	kli.ˈði	ci.ˈci.ði	key	SPI	2;03,16
x.	pro.ˈxθes	po.ˈçes	the day before yesterday	DIM	2;04,10
y.	kra.ˈta.i	ka.ˈta.i	keep 3PR Sg	DIM	2;04,10
z.	ˈci.tri.no	ˈpi.ti.no	yellow	SPI	2;04,12
aa.	mi.ˈkro	mi.ˈko	little	DIM	2;04,18
bb.	ˈtre.no	ˈte.no	train	SPI	2;04,29
cc.	ˈkra.nos	ˈka.no	helmet	SPI	2;04,29
dd.	te.ˈtra.ɣo.no	te.ˈta	square	DIM	2;05,15
ee.	kro.ˈko.ði.los	koç	crocodile	DIM	2;05,15
ff.	ˈta.blet	ˈta.ble	tablet	DIM	2;05,15
gg.	ðen ‘kli.ni	e ˈci.ni	it doesn’t close	DIM	2;05,15
hh.	to.ko.ˈdrol	to.ko.ˈdes	remote control	SPI	2;07,16
ii.	ta ˈple.nu.me	po.ˈpe.no.ne	we wash them	SPI	2;08,08
jj.	tre.ˈna.ci	te.ˈna.ci	train DIM	SPI	2;08,08
kk.	pro.va.ˈta.ci	pa.ˈta.ci	sheep DIM	SPI	2;09,13
ll.	ti kra.ˈta.i	ti ka.ˈta.i	what is he keeping?	SPI	2;10,25
mm.	ðe.ka.ˈtri.a	ˈti.a	thirteen	SPI	2;10,25
nn.	ˈklo.un	koːn	clown	SPI	3;00,09
oo.	o ˈklo.un	o kon	clown	SPI	3;00,09
pp.	mi.ˈkro	ma.ˈko	tiny	SPI	3;02,09
qq.	kli.’ði	ci	key	SPI	3;03,28

The first member of the cluster, the stop, is less sonorous than the second member of the cluster, the sonorant, and, therefore, the child reduces the sonorant following the sonority pattern. The Standard Modern Greek-specific sonority scale which is proposed by Kappa (1995:138) in (5), repeated here as (21), accounts for this reduction pattern. Thus, SPI and DIM reduce both word-initial and word-medial clusters in a manner which produces a maximal rise in sonority.

(21) Sonority Scale for Standard Modern Greek (Kappa 1995:138)

[p, t, k] [f, θ, x] [v, ð, ɣ] [s] [z] [m, n] [l, r] Vowels

---------●----------●----------●-------●------●-------●---------●---------●----------

Less sonorous 1 2 3 4 5 6 7 8 More sonorous

Alternatively, it can be proposed that children retain the strongest consonant of the cluster, i.e. the stop (Drachman 1973, Kappa 1999, 2002), which is selected as the head of the syllable. The scale of consonantal strength which is proposed for Standard Modern Greek by Kappa (1995) is presented in (9) and is repeated in (22) and explains this reduction pattern. We suggest that these clusters are reduced to the stronger consonant due to children's preference for strong consonants to occupy the onset positions. Hence, consonants which are underspecified for manner of articulation occupy the word-initial and -medial onsets in early child productions.

(22) Scale of Consonantal Strength for Standard Modern Greek (Kappa 1995:138)

[p, t, k] [f, θ, x] [v, ð, ɣ] [s] [z] [m, n] [l, r] Vowels

---------●---------●----------●-------●-------●-------●--------●---------●---------------

Stronger 1 2 3 4 5 6 7 8 Weaker

Also, the data of both children may provide evidence that the simplification of word-initial clusters may be driven by positional faithfulness (Beckman 1997, Reviathiadou & Tzakosta 2004a, Tzakosta 2009a). The first member of the cluster is retained regardless of whether or not it is the most marked segment within the word. Data in (20n, kk, qq) are the 'clearest' examples of this pattern. For example, in (20n) the input form */kli.ˈði/* is realized as [*ɟi*]. The first member of the cluster which is a dorsal stop consonant is preserved despite the fact that it is the most marked consonant witin the word. Interestingly, SPI's data shows that this pattern persists for a long period of time as can be seen in (20qq).

Interestingly, children's productions show that, when a word-initial stop-liquid cluster whose the leftmost member is a voiced plosive is reduced, the less sonorous segment is retained, i.e. the C_1, and it is realized as [-voiced]. For example, the input complex onset /bl/ is realized as [p] by DIM (23a). Our data show that children's early productions often exhibit a pattern of 'devoicing', whereby voiced stops are realized as voiceless stops and, therefore, the unmarked consonant with respect to voicing occupies the onset position. This pattern demonstrates the children's preference for the syllabic onset to be occupied by a consonant of lower sonority or a stronger consonant. The relevant examples mainly with reduction in word-initial position are provided in (23).

	Input form	**Output form**	**Gloss**	**Child**	**Age**
23a.	ble	pe	blue	DIM	1;11,06
b.	ˈblu.za	ˈpu.ɟa	blouse	DIM	1;11,28
c.	ˈblu.za	ˈpu.ja	blouse	DIM	2;00,04
d.	ˈðe.dro	ˈve.to	tree	DIM	2;00,04
e.	ˈðe.dro	ˈðe.to	tree	DIM	2;02,23
f.	sta ˈðe.dra	ta ˈve.ta	tree	DIM	2;03,06
g.	ble	pe	blue	SPI	2;03,23
h.	ˈðe.dro	ˈðe.to	tree	SPI	2;07,16
i.	ˈblu.za	ˈpu.ja	blouse	SPI	3;01,02
j.	ˈblu.za	ˈpu.ja	blouse	SPI	3;01,26

This pattern indicates that the children's grammar favors optimal syllables, i.e. syllables with a maximum sonority rise from the onset to the syllabic nucleus. This production pattern cannot be explained in terms of consonantal strength in the sense of Lass (1984); Consonants of both pair of segments, i.e. [b, p] and [d, t] have the same landing point on the Scale of Consonantal Strength (Lass 1984), as they are all stops. The Scale of Consonantal Strength which is proposed by Lass (1984) is presented in (24).

(24) Scale of Consonantal Strength (Lass 1984)

Stops > Fricatives > Nasals > Liquids > Glides > Vowels

---------------●-----------●------------●----------●----------●---------●-----------

Stronger 1 2 3 4 5 6 Weaker

This production pattern may be an example of regression to the previous developmental phase, i.e. to the initial one, in which only unmarked structures surface. (e.g. Jakobson 1941/1968, Menn 1971, Macken & Ferguson 1983, Meen 1983, Bleile & Tomlin 1991, Tzakosta 2004, Kappa 2009b among others)[12] Also, this pattern may reflect distinct grammars which are available to children in the course of development. Hence, this pattern may be explained in terms of multiple parallel co-grammars (e.g. Tzakosta 2004, 2005, 2006, Revithiadou & Tzakosta 2004a, b, Tzakosta & Kappa 2008). This pattern is observed both in word-initial and word-medial positions. Specifically, word-initially this pattern is observed only in [Voiced LABIAL Stop + Lateral] clusters. Word-initial [Voiced CORONAL Stop + Liquid], [Voiced DORSAL Stop + Liquid] clusters are not attested in DIM's data. Also, SPI's data lack word-initial [Voiced CORONAL Stop + Liquid] consonant clusters. Word-medially, this pattern is attested only in [Voiced CORONAL Stop + Rhotic] clusters. This pattern is not a systematic pattern of production. Overall, this reduction pattern accounts for 15,9% of DIM's [Voiced Stop + Liquid] cluster productions, namely 10 out of 63 productions follow this simplification pattern. As far as SPI is concerned, this pattern account for 13,4% of his [Voiced Stop + Liquid] cluster productions, namely 27 out of 202 productions follow this pattern.

Another interesting speech pattern is attested in SPI's longitudinal data. Specifically, as can be seen in (25), the cluster /bl/ is reduced to singleton following the sonority pattern. In the output form, the onset of the syllable is not occupied by /b/, i.e. the leftmost consonant of the input cluster, rather, it is occupied by [v].

	Input form	**Output form**	**Gloss**	**Child**	**Age**
25a.	ble	ve	blue	SPI	2;05,03
b.	ˈblu.za	ˈvo.i.ða	blouse	SPI	2;06,08
c.	ˈblu.za	ˈvu.tsa	blouse	SPI	2;11,01

Both /b/ and [v] are voiced labials. [v] differs from /b/ with respect to the feature [continuant], i.e. [v] is [+continuant] and /b/ is [-continuant]. This production pattern, if explained in terms of consonantal strength, demonstrates that the onsets are occupied by fricatives rather than stops, i.e. by weaker rather than stronger consonants. As can be seen in the Scale of Consonantal Strength (24, Lass 1984), /b/ and [v] do not land on

[12] Given that both SPI and DIM started being recorded when they had already reached the intermediate phase, we do not have data from the previous phase of their acquisition.

the same position on this scale. Specifically, fricatives are weaker than stops, and, thus, [v] is weaker than /b/. Data in (25) shows that it is preferred a marked consonant with respect to manner of articulation ([+continuant]) to occupy the onset positions.

. These productions are infrequent in SPI's speech. We suppose that the above pattern reflects distinct grammars which are available to children in the course of development. Therefore, this speech pattern may be explained in terms of multiple parallel co-grammars (Tzakosta 2004a, b, 2005, 2006a, b, Revithiadou & Tzakosta 2004a, b, Tzakosta & Kappa 2008).

Also, DIM's and SPI's data may provide evidence regarding the status of the voiced plosives in Standard Modern Greek, i.e. [b, d, g]. Specifically, there are some instances in which the cluster is reduced to the leftmost member and the segment which surfaces is either prenasalized or nasal. As can be seen in (26a), the target stop-liquid cluster consists of the voiced plosive /b/ and the lateral /l/ and is reduced to the less sonorous segment, i.e. [b]. However, it is realized as a prenasalized voiced plosive despite the fact that in the input form there is not the feature [nasal]. In (26b) the cluster is reduced, too. The labial voiced plosive is absent from the output form and the labial nasal [m] is realized.

	Input form	**Output form**	**Gloss**	**Child**	**Age**
26a.	ble	ᵐbe	blue	DIM	1;11,28
b.	ˈblu.za	ˈmu.ja	blouse	DIM	2;00,26
c.	ble	ᵐbe	blue	SPI	2;03,23
d.	ˈðe.dro	ˈne.ⁿdo	tree	SPI	2;04,09
e.	ble	me	blue	SPI	2;06,08

In the literature, there is an ongoing debate regarding the status of the voiced plosives in Standard Modern Greek. It is suggested that the voiced plosives in Standard Modern Greek consist of sequences of /Nasal + voiceless plosives/ and, therefore, they are derived sounds (cf. Malikouti-Drachman & Drachman 1992, Pagoni 1993, Kappa 1995, Arvaniti 1999, Tzakosta 2009b among others); On the contrary, Householder (1964), Koutsoudas (1962), Setatos (1974) and Viechnicki (1996) propose that the voiced plosives are phonemes[13]. Our longitudinal production data may provide evidence that the voiced plosives in Standard Modern Greek are derived sounds, i.e., sequences of /Nasal

[13] Supporting evidence that the voiced plosives /b, d, g/ are phonemes comes from Janse's (2009) study, in which it is referred that /b, d, g/ have phonemic status in Capadocian Greek, a dialect of Standard Modern Greek.

+ voiceless plosives/[14]. Also, this speech pattern may provide supporting evidence that the acquisition proceeds by means of multiple parallel co-grammars (Tzakosta 2004a, b, 2005, 2006a, b, Revithiadou & Tzakosta 2004a, b, Tzakosta & Kappa 2008).

Taking all the above into account, it is suggested that, in the early intermediate phase, the children's grammar does not allow complex onsets to emerge and clusters are reduced to singletons. Thus, the universally unmarked CV syllable is massively realized. Cluster reduction is the prevalent repair strategy applied by both DIM and SPI in stop-liquid clusters both word-initially and word-medially. More specifically, the children reduce clusters mostly to the less sonorous consonant, i.e. the C_1 is preserved in the child form, as can be seen in Table 2 below (for cases in which clusters are reduced to the more sonorous consonant see 4.5.1.).

	DIM							**SPI**						
CL T	**T**	**C_1**	**%**	**C_2**	**%**	**MS**	**%**	**T**	**C_1**	**%**	**C_2**	**%**	**MS**	**%**
/LAB S +L/														
/pl/	**23**	18	78,2%	1	4,3%	2	8,7%	**25**	16	64%	-	-	9	36%
/pr/	**32**	32	100%	-	-	-	-	**38**	32	84,2%	-	-	6	15,8%
/bl/	**24**	22	91,7%	2	8,3%	-	-	**157**	128	81,5%	6	3,8%	22	14%
/br/	**8**	8	100%	-	-	-	-	**2**	2	100%	-	-	-	-

[14] Further evidence regarding the status of the voiced plosives in Greek come from monopositional onsets, as displayed in (27). As DIM's and SPI's data demonstrate prenasalized consonants can occupy monopositional onsets both word-initially and word-medially. Surprisingly, as can be seen in (27c, d, k, m) prenasalized voiceless consonants are attested in the children's speech violating the NC constraint. However, given that we have only 4 tokens which violate the NC constraint, we cannot make any generalization regarding NC constraint violations. Also, since this issue if out of the scope of this study is left open for future research.

	Input form	**Output form**	**Gloss**	**Child**	**Age**
27a.	ˈba.les	ˈ^{m}ba.leç	balls	DIM	2;00,04
b.	me.ˈre.da	me.ˈle.^{n}da	merenda	DIM	2;01,09
c.	mi.xa.ˈni	mi.xa.ˈ^{n}ti	motor bike	DIM	2;01,16
d.	fe.ˈga.ri	ve.ˈ^{ŋ}ka.li	moon	DIM	2;01,16
e.	pa.de.ˈlo.ni	pa.^{n}de.ˈlo	pants	DIM	2;02,30
f.	o ba.ˈbas	o va.ˈ^{m}ba	dad	DIM	2;04,18
g.	ble	^{m}be	μπλε	SPI	2;05,23
h.	ba.ˈlo.ni	ˈ^{n}do.ni	balloon	SPI	2;06,06
i.	ˈme.ra	ˈ^{m}be.la	day	SPI	2;10,25
j.	fe.ga.ˈra.ci	pe.^{n}ga.ˈla.tsi	moon DIM	SPI	3;03,06
k.	ˈce.ik	ˈce.i^{ŋ}k	cake	SPI	3;03,14
l.	to ma.ksi.ˈla.ri	to.^{m}ba.ksi.ˈla.ri	the pillow	SPI	3;03,28
m.	ti ˈvri.ka	ti ˈvi.^{ŋ}ka	what did I find?	SPI	3;04,04

[DOR S + L]														
/kl/	**70**	69	98,6%	-	-	1	1,4%	**126**	92	73%	-	-	35	27,8%
/kr/	**72**	72	100%	-	-	-	-	**45**	34	75,5%	-	-	11	24,5%
/gl/	**-**	-	-	-	-	-	-	**-**	-	-	-	-	-	-
/gr/	**-**	-	-	-	-	-	-	**1**	-	-	-	-	1	100%
[COR S + L]														
/tr/	**141**	135	95,7%	-	-	6	4,3%	**250**	243	97,2%	-	-	6	2,4%
/dr/	**31**	31	100%	-	-	-	-	**42**	42	100%	-	-	-	-
Total	**401**	387	96,5%	3	0,7%	9	2,2%	**686**	589	85,9%	6	0,9%	89	13,2%

Table 2 [LABIAL Stop + Liquid], [DORSAL Stop + Liquid] and [CORONAL Stop + Liquid] in children's speech
CL T = Cluster Type, T = Tokens, C1 = C1 preservation, C2 = C2 preservation, MS = Marginal Strategies, % = Percentage

4.1.1. Interim Summary

All in all, in the early intermediate developmental phase, cluster reduction is the most preferred simplification repair strategy which applies in word-initial and -medial stressed and unstressed syllables with stop-liquid clusters. Therefore, cluster reduction is very common in all word positions and stress does not force the retention of the entire cluster. Stop-liquid clusters are mostly reduced to the less sonorous consonant, i.e. the C_1 is realized, as sonority influences DIM's and SPI's productions and low-sonority onsets are preferred (for example, the adult cluster /tr/ is realized as [t]). In other words, children reduce clusters in a manner which produces a maximal rise in sonority. Hence, the voiceless or the voiced plosive stop ([i.e. [p, t, k] and [b, d, g]) is retained when the cluster is reduced. Interestingly, not only the less sonorous consonant is retained but it is also sometimes realized as a consonant of lower sonority (for instance, the adult cluster /bl/ is realized as [p]). Hence, a stronger consonant occupies the onset of the syllable and maximum sonority slope is attained. Nevertheless, there are instances in which the leftmost member of the cluster, i.e. the stop, is realized as a fricative, i.e. a consonant which is marked for manner of articulation (for example, the adult cluster /bl/ is realized as [v]). This pattern results in realizations of weaker or more sonorous onsets. All the aforementioned, namely the attested intra-child and inter-child variation, may suggest, that in the course of development, children do not have only one grammar available. Rather, children may have distinct grammars available in development. Finally, data may indicate that the voiced plosives are derived sounds and not phonemes in Standard Modern Greek.

4.2. Fricative-liquid clusters: Reduction to the less sonorous consonant

This subsection is focused on the reduction patterns in fricative-liquid clusters which are attested in word-initial and -medial stressed and unstressed syllables. In Standard Modern Greek, a voiced or a voiceless LABIAL, CORONAL or DORSAL fricative consonant is followed by a lateral or a rhotic, i.e. the fricative is the C_1 and the liquid is the C_2. A few representative examples from Standard Modern Greek are given in (28).

	Form	Gloss
28a.	'fra.u.la	strawberry
b.	'xro.ma	color
c.	'vri.si	tap
d.	zo.ɣra.fi.'ci	drawing

(Standard Modern Greek)

Firstly, our acquisitional data show that DIM and SPI mostly reduce the fricative-liquid clusters to the less sonorous segment in word-initial and word-medial stressed and unstressed syllables, i.e. the C_1 is retained in the output form. The relevant data are provided in (29).

	Input form	Output form	Gloss	Child	Age
29a.	ˈxro.ma.ta	ˈxo.ma.ta	colors	DIM	1;10,29
b.	xri.ˈsu.la	çi.ˈsu.la	Proper name	DIM	1;11,28
c.	vi.ˈvli.a	ti.ˈvi.a	books	DIM	2;00,04
. d.	ˈvle.pi	ˈve.pi	βλέπει	DIM	2;01,09
e.	a.ˈxla.ði	a.ˈxa.si	pear	DIM	2;01,16
f.	xri.ˈstu.je.na	çi.ˈsti.nis	Christmas	SPI	2;02,07
g.	ˈxro.ma	ˈso.ma	color	SPI	2;02,07
h.	ˈvri.ce	ˈvi.ce	find 3PR Sg	DIM	2;02,23
i.	ˈɣlo.sa	ˈɣo.sa	tongue	DIM	2;02,30
j.	ˈfra.u.la	fa	strawberry	DIM	2;02,30
k.	pa.ˈdo.fles	ba.ˈdo.fe	slippers	DIM	2;03,06
l.	sta.ˈvros	ta.ˈvo	cross	DIM	2;03,06
m.	ˈðro.mo	ˈjo.mo	road ACC.	DIM	2;03,06
n.	ˈti.ɣris	ˈti.ɟiç	tiger	SPI	2;03,08
o.	ˈfru.ta	ˈfu.pa	fruits	SPI	2;04,29
p.	ˈvri.ka	ˈvi.ka	find 1PR Sg	SPI	2;05,03
q.	ˈma.vro	ˈma.vo	black	SPI	2;05,14
r.	ˈvle.pu.me	ˈve.po.me	see 1PR Pl	SPI	2;08,16
s.	ˈɣlo.sa	ˈjo.θa	tongue	SPI	2;08,16
t.	vi.ˈvli.o	ve.ˈvi.o	book	SPI	2;08,30
u.	vro.ˈmɲes	vo.ˈmɲes	dirtiness	SPI	2;10,10
v.	ˈɣra.fu.me	ˈja.fo.me	write 1PR Pl	SPI	2;10,10
w.	ço.ˈnan.θro.pos	so.ˈna.po.pos	snowman	SPI	3;01,19

x.	ti ˈxro.ma	ti ˈxo.ma	what color is it?	SPI	3;02,09
y.	ɣra.ˈfi.o	ɣa.ˈfi.o	desk	SPI	3;03,14
z.	je.ˈne.θli.a	je.ˈne.si.a	birthday	SPI	3;03,14
aa.	ston ˈðro.mo	to ˈðo.mo	on the road	SPI	3;03,14
bb.	ti ˈvri.ka	ti ˈvi.ka	What did I find?	SPI	3;04,04
cc.	ta xri.ˈstu.je.na	ta çi.ˈtu.je.na	Christmas	SPI	3;04,04

The first member of the cluster, the fricative, is less sonorous than the second member of the cluster, the sonorant, and, the children produces the fricative rather than the sonorant following the sonority pattern (21). Therefore, low-sonority onsets are produced.

Alternatively, the strongest consonant of the cluster, i.e. the fricative (Drachman 1973, Kappa 1999, Kappa 2002a) surfaces, which is selected as the head of the syllable. The head's complement is deleted in this developmental phase. The scale of consonantal strength which is proposed for Standard Modern Greek by Kappa (1995:138) (22) explains this simplification pattern. We suggest that fricative-liquid clusters are reduced to the stronger consonant due to the children's preference for strong consonants to occupy the onsets of the syllables in this phase.

Interestingly, instances in which the retained consonant, i.e. the fricative, is realized as stop are observed in our data (31a, b, c, d, e, f, h, j). For instance, as can be seen in (30a) and (30b), /x/ is realized as [k] and, therefore, a CV syllable, the head of which is a less sonorous consonant or a stronger one is realized. Alternatively, an unmarked consonant occurs in onset position. Also, there are some rare instances in which the produced consonant is faithful to the marked feature of manner of articulation, i.e. the [+continuant], but is not faithful to the marked feature of voicing, i.e. it is realized as [-voiced] (30g, i). In addition, it seems that this production pattern is mostly observed in stressed syllables in word-initial and word-medial positions. A few representative examples are provided in (30).

	Input form	**Output form**	**Gloss**	**Child**	**Age**
30a.	ˈxro.ma.ta	ˈko.ma.ta	colours	DIM	1;10,29
b.	ˈxro.ma	ˈko.ma	colour	DIM	2;01,09
c.	ˈti.ɣris	ˈti.ɟiç	tiger	SPI	2;03,08
d.	vi.ˈvli.o	bi.ˈpi.o	book	SPI	2;03,19
e.	vi.ˈvli.o	bi.ˈbi.o	book	SPI	2;03,16
f.	ˈvre.çi	ˈpe.si	rain 3PR Sg	DIM	2;04,10
g.	ˈvre.çi	ˈfe.çi	rain 3PR Sg	DIM	2;05,01

h.	ˈfra.u.la	ˈpa.u.ʎa	strawberry	SPI	2;06,06
i.	vi.ˈvli.o	i.ˈfi.o	book	SPI	2;10,25
j.	ˈvro.mi.ci	ˈbo.mi.ci	dirty	SPI	3;03,14

This pattern may be an example of regression to the previous phase, i.e. to the initial one, in which unmarked structures are produced. (e.g. Jakobson 1941/1968, Menn 1971, Macken & Ferguson 1983, Meen 1983, Bleile & Tomlin 1991, Tzakosta 2004, Kappa 2009b among others). Overall, this reduction pattern occurs in word-initial and word-medial fricative-liquid clusters and accounts for 6% of DIM's productions, namely 6 out of 97 productions follow this simplification pattern. As far as SPI is concerned, this pattern accounts for 13,7% of his fricative-liquid productions, namely 20 out of 146 productions follow this pattern.

Taking all the aforementioned into consideration, it is suggested that in the early intermediate developmental phase, DIM's and SPI's data show that fricative-liquid clusters are not produced faithfully and, thus, they are reduced to singletons. As Table 3 demonstrates, the first member of the cluster is realized, namely the obstruent is chosen instead of the sonorant in the most cases.

	DIM							SPI						
CL T	**T**	**C_1**	**%**	**C_2**	**%**	**MS**	**%**	**T**	**C_1**	**%**	**C_2**	**%**	**MS**	**%**
/Lab F +L/														
/fl/	**3**	3	100%	-	-	-	-	**-**	-	-	-	-	-	-
/fr/	**11**	10	90,1%	-	-	1	9,9%	**15**	8	53,3%	1	6,7%	6	40%
/vl/	**14**	13	92,8%	1	7,2%	-	-	**65**	59	90,8%	2	3,1%	4	6,1%
/vr/	**19**	19	100%	-	-	-	-	**21**	17	81%	1	4,8%	3	14,2%
[Dor F + L]														
/xl/	**4**	4	100%	-	-	-	-	**-**	-	-	-	-	-	-
/xr/	**16**	14	87,5%	-	-	2	12,5%	**15**	13	86,7%	-	-	2	13,3%
/ɣl/	**1**	1	100%	-	-	-	-	**7**	1	14%	2	29%	4	57%
/ɣr/	**14**	13	92,8%	-	-	1	7,2%	**15**	9	60%	5	33%	1	7%
[Cor F + L]														
/θl/	**-**	-	-	-	-	-	-	**1**	1	100%	-	-	-	-
/θr/	**2**	2	100%	-	-	-	-	**3**	3	100%	-	-	-	-
/ðr/	**13**	13	100%	-	-	-	-	**4**	4	100%	-	-	-	-
Total	**97**	91	94,8%	1	1%	4	4,2%	**146**	115	78,8%	11	7,5%	19	19,7%

Table 3 [Labial Fricative + Liquid], [Dorsal Fricative + Liquid] and [Coronal Fricative + Liquid] in children's speech
CL T = Cluster Type, T = Tokens, C1 = C1 preservation, C2 = C2 preservation, MS = Marginal Strategies, % = Percentage

Taking into account all the above, the fricative-liquid clusters are mostly reduced to the less sonorous consonant and, therefore, the fricative which is the head of the onset of the syllable is realized and the more sonorous segment which is the one adjacent to the nucleus is deleted. This pattern is attested both in stressed and unstressed syllables in all word positions. In addition, there are instances in which the preserved consonant is realized as stop, i.e. a less sonorous or a stronger consonant occupies the onset position. This pattern results in creating syllables with bigger sonority slope from the onset to the nucleus. Also, it can be proposed that these instances of inter- and intra-child variation may indicate that distinct grammars are available to children in the course of development.

4.3. Stop-nasal clusters

This subsection focuses on the stop-nasal clusters which are observed in the data of both children. Firstly, stop-nasal clusters consist of a voiceless LABIAL, DORSAL or CORONAL stop consonant as C_1 and a labial or coronal nasal consonant as C_2, as displayed in (31).

	Form	Gloss
31a.	'tmi.ma	part
b.	'kmi.mi	knee
c.	pno.'i	breath

(Standard Modern Greek)

Stop-nasal clusters are infrequent cluster forms in Standard Modern Greek. For the purposes of this study, we obtained a corpus of Standard Modern Greek adult speech, available from http://speech.ilsp.gr/iplr and described by Protopapas et al. (2012). This corpus consists of documents published in magazines, newspapers and parliament proceedings and provides both transcriptions and frequency information. In this corpus, for 1000 most frequent words in Standard Modern Greek only 1 contains a stop-nasal complex onset, as displayed in (32).

32	**Adult form**	**Gloss**	**Structure**
	'tmi.ma	part	CCV.CV

Therefore, given that stop-nasal forms are rarely attested in Standard Modern Greek, it is expected to be realized less frequently in child speech. This assumption is verified by our data, as can be seen in Table 4. For reasons of space limitations, only the attested stop-nasal cluster types are presented. Stop-nasal clusters are never attempted by DIM. In SPI's data only /pn/ is attested.

	DIM							SPI						
CL T	**T**	**C_1**	**%**	**C_2**	**%**	**MS**	**%**	**T**	**C_1**	**%**	**C_2**	**%**	**MS**	**%**
/Lab S + N/														
/pn/	-	-	-	-	-	-	-	14	12	85,7%	-	-	2	14,3%
Total	-	-	-	-	-	-	-	14	12	85,7%	-	-	2	14,3%

Table 4 [Labial Stop + Nasal] clusters in children's speech
CL T = Cluster Type, T = Tokens, C_1 = C_1 preservation, C_2 = C_2 preservation, MS = Marginal Strategies, % = Percentage

As can be seen in (33), the target cluster /pn/ is reduced to the less sonorous segment. Consequently, the stop /p/ is chosen instead of the more sonorous sonorant /n/.

	Input form	Output form	Gloss	Child	Age
33a.	ka.ˈpnos	pa.ˈpoç	smoke	SPI	2;09,19
b.	ka.ˈpnos	ka.ˈpo	smoke	SPI	3;01,02

Hence, SPI preserves the leftmost member of the cluster, i.e. the stop, following the sonority pattern. However, we cannot make any generalization regarding the dominant simplification pattern due to lack of more data.

4.4. Fricative-nasal clusters

This subsection focuses on the fricative-nasal clusters which are attested in DIM's and SPI's data. Firstly, a fricative-nasal cluster consists of a voiced or voiceless LABIAL, DORSAL or CORONAL fricative consonant as C_1 and a nasal consonant as C_2, as can be seen in (34).

	Form	Gloss
34a.	ksa.fni.'ka	suddenly
b.	'ɣno.mi	opinion

(Standard Modern Greek)

In Standard Modern Greek, fricative-nasal clusters are not frequently attested cluster forms. In the corpus of adult Standard Modern Greek (Protopapas et al. 2012), of the 1000 most frequent words in Standard Modern Greek, 23 contain a fricative-nasal complex onset, as displayed in (35).

	Adult form	Gloss	Structure
35a.	sti.'ɣmi	moment	CCV.CCV
b.	e.θni.'cis	national GEN	V.CCV.CVC
c.	'pra.ɣma.ta	things	CCV.CCV.CV
d.	pe.'xni.ði	toy	CV.CCV.CV
e.	ðra.'xmes	drachma	CCV.CCVC
f.	pa.'ra.ði.ɣma	example	CV.CV.CV.CCV
g.	ðra.'xmon	drachma GEN Pl	CCV.CCVC
h.	e.θni.'ci	national	V.CCV.CVC
i.	pra.ɣma.ti.'ko.tita	reality	CCV.CCV.CV.CV.CV.CV
j.	'pra.ɣma	thing	CCV.CCV
k.	'ði.xni	point 3PR Sg	CV.CCV
l.	ði.e.'θni	national	CV.V.CCV
m.	ði.e.'θnus	national	CV.V.CCVC
n.	'ɣno.mi	opinion	CCV.CV
o.	pro.'xθes	the day before yesterday	CCV.CCVC
p.	a.ri.'θmos	number	V.CV.CCVC
q.	a.ri.'θmo	mumber	V.CV.CCV
r.	'pra.ɣma.ti	indeed	CCV.CCV.CV
s.	pra.ɣma.ti.'ka	indeed	CCV.CCV.CV.CV
t.	'ði.xnun	point 3PR Pl	CV.CCVC
u.	'te.xnis	art GEN	CV.CCVC
v.	pe.'xni.ðja	toys	CV.CCV.CCV
w.	ði.e.'θnes	national	CV.V.CCVC

In the data of both children, fricative-nasal clusters are rarely attested, as Table 5 reveals. For reasons of space limitations, only the attested fricative-nasal cluster types are presented.

	DIM							**SPI**						
CL T	**T**	**C_1**	**%**	**C_2**	**%**	**MS**	**%**	**T**	**C_1**	**%**	**C_2**	**%**	**MS**	**%**
/Dor F +N/														
/xn/	2	-	-	2	100%	-	-	1	-	-	1	100%	-	-
Total	2	-	-	2	100%	-	-	1	-	-	1	100%	-	-

Table 5 [DORSAL Fricative + Nasal] clusters in children's speech
CL T = Cluster Type, T = Tokens, C_1 = C_1 preservation, C_2 = C_2 preservation, MS = Marginal Strategies, % = Percentage

A glance at the data reveals that both DIM's and SPI's productions do not follow the sonority pattern, i.e. the less sonorous segment of the cluster does not surface. Thus, reduction to the more sonorous consonant occurs and, therefore, the sonorant member of the cluster survives in the output form. Put differently, the consonant adjacent to the syllable nucleus, i.e. the C_2, is realized in the early intermediate acquisitional phase, as displayed in (36). This reduction pattern is known as contiguity. We assume that the sonorant is chosen instead of the obstruent due to the children's tendency to combine coronal consonants with front vowels (for further discussion, see subsections 4.5.1 and 5.6.1. (discussion on the data in (70))). Keep in mind that in (36c) the place harmony took place after cluster reduction.

	Input form	Output form	Gloss	Child	Age
36a.	pe.ˈxni.ðja	ne.ˈni.ja	toys	DIM	1;10,29
b.	pe.ˈxni.ðja	pe.ˈni.ja	toys	DIM	2;02,23
c.	pe.ˈxni.ðja	pe.ˈmi.za	toys	SPI	2;08,23

However, due to the fact that the available data with fricative-nasal clusters are limited, it is not possible to make any generalization as far as the prevalent reduction pattern of these clusters.

Interestingly, in SPI's data seems to be a conspiracy in the sense of Kisserberth (1970). As can be seen in (37), the input forms contain an obstruent-nasal cluster. Since, SPI's grammar does not allow clusters to emerge in the output forms, cluster reduction is applied, and thus, the target clusters are reduced to singletons.

	Input form	Output form	Gloss	Child	Age
37a.	pe.ˈxni.ðja	pe.ˈmi.za	toys	SPI	2;08,23
b.	ka.ˈpnos	pa.ˈpoç	smoke	SPI	2;09,19
c.	ka.ˈpnos	ka.ˈpo	smoke	SPI	3;01,02

In (37a) the rightmost member of the cluster surfaces while in (37b-c) the leftmost member of the cluster is realized. In (37a) there is an instance of place of articulation harmony. Harmony is regressive, namely the harmonized consonant precedes the triggering consonant. The targeted segment is coronal and the triggering segment is labial. The labial /p/ spreads its [LABIAL] feature to /n/ and thus, [m] is realized. It seems that there is a preference for labial segments to occupy onset positions when an obstruent-nasal cluster is reduced. If any of the consonants of the cluster is labial, then there is no need that another process take place. However, if neither of the cluster consonants is labial, then, in the presence of a labial consonant within the word, place harmony takes places resulting in the onset of the reduced cluster be occupied by a labial segment. Therefore, our data may provide evidence that we have here an example of a conspiracy (Kisseberth 1970) and of homogeneity of target and heterogeneity of process (McCarthy 2002). However, we cannot make any generalization due to lack of more data.

All in all, our data provide evidence that fricative-nasal clusters are reduced to the more sonorous segment. This reduction pattern may be forced by the children's tendency to combine coronal consonants with front vowels in the same syllable. Also, SPI's data may indicate that when the obstruent-nasal complex onsets are reduced, it is preferred that the monopositional onset be occupied by a labial consonant.

4.5. Marginal strategies in children's speech

As it was shown in 4.1 - 4.2, in the early intermediate developmental phase, DIM's and SPI's grammar does not allow branching onsets to emerge. The dominant simplification strategy is cluster reduction to the less sonorous segment ($C_1C_2V \rightarrow C_1V$). However, cluster reduction to the less sonorous segment of the adult cluster is not the only repair strategy which is observed in the data of both children. Put simply, DIM and SPI employ several strategies in cluster simplification[15], namely cluster reduction to the more sonorous consonant (contiguity, $C_1C_2V \rightarrow C_2V$, see subsection 4.5.1.), vowel epenthesis ($C_1C_2V \rightarrow C_1vC_2V$, see subsection 4.5.2.), deletion of the entire cluster ($C_1C_2V \rightarrow V$, see subsection 4.5.3.) and coalescence ($C_1C_2V \rightarrow C_{1,2}V$, see subsection 4.5.4.). Contiguity, vowel epenthesis, coalescence and deletion of the entire cluster are marginal simplification strategies in the data of both children. Regarding epenthesis, instances of epenthesis are rarely found in DIM's and in SPI's data. Interestingly, the process of contiguity and of deletion of the entire cluster have complementary distributions in DIM's data, as Table 7 displays. On the other hand, this complementary relationship is not observed in SPI's data, as Table 6 reveals. Specifically, in DIM's data contiguity is attested in LABIAL-initial clusters while deletion of the entire cluster is attested in DORSAL- and CORONAL-initial clusters (see subsection 4.5.3. for discussion). Also, DIM's and SPI's data indicate that coalescence is attested due to the children's preference for unmarked and underspecified segments for place and/or manner of articulation and/or for voicing to occur in prominent word positions. SPI's

[15] e.g Beers 1995, Berman 1977, Bernhardt and Stemberger 1998, Chin and Dinnsen 1992, Grunwell 1982, Ingram 1976, 1989, Lleó and Prinz 1996, Smit 1993, Fleischhacker 2000, Templin 1957, Smith 1973, Menn 1978, Gnanadesikan 1995/2004, Ohala 1996, 1999, Barlow 1997, Pater & Barlow 2003, Łukaszewicz 2007, van der Pas 2004, Freitas 2003, Bloch 2011, Ben David 2001, 2006, Lavie 1978, Jongstra 2003, Kappa 1999, 2002, 2003, 2009a, b, 2019, Tzakosta 1999, 2003, Revithiadou & Tzakosta 2004a, b Sanoudaki 2007, 2010 among others.

data demonstrate that coalescence is a repair strategy which is attested before the child start producing target clusters faithfully. Put simply, coalescence may reflect a sub-stage in SPI's cluster development (see subsection 4.5.4. for discussion). The Tables 6 and 7 provide information regarding the marginal simplification strategies attested in the data of both children.

	DIM								
CL T	**T**	**CON**	**%**	**EP**	**%**	**COAL**	**%**	**DE**	**%**
/Lab S +L/									
/pl/	**23**	1	4,3%	-	-	4	17%	-	-
/pr/	**32**	-	-	-	-	-	-	-	-
/bl/	**24**	2	8,3%	-	-	-	-	-	-
/br/	**8**	-	-	-	-	-	-	-	-
/Dor S +L/									
/kl/	**70**	-	-	-	-	-	-	1	
/kr/	**72**	-	-	-	-	-	-	-	-
/gr/	**1**	-	-	-	-	-	-	-	-
/gl/	**-**	-	-	-	-	-	-	-	-
/Cor S +L/									
/tr/	**141**	-	-	-	-	-	-	6	
/dr/	31	-	-	-	-	-	-	-	-
/Lab F +L/									
/fl/	**3**	-	-	-	-	-	-	-	-
/fr/	**11**	-	-	-	-	1	9%	-	-
/vl/	**14**	1	7,2%	-	-	-	-	-	-
/vr/	**19**	-	-	-	-	-	-	-	-
/Dor F +L/									
/xl/	**4**	-	-	-	-	-	-	-	-
/xr/	**16**	-	-	1	6,5%	-	-	1	6,5%
/ɣl/	**1**	-	-	-	-	-	-	-	-
/ɣr/	**14**	-	-	-	-	-	-	1	7,1%
/Cor FS +L/									
/θl/	**-**	-	-	-	-	-	-	-	-
/θr/	**2**	-	-	-	-	-	-	-	-
/ðr/	**13**	-	-	-	-	-	-	-	-
/Lab S +N/									
/pn/	**-**	-	-	-	-	-	-	-	-
/Dor F +N/									
/xn/	**2**	2	100%	-	-	-	-	-	-
Total	**501**	6	1,2%	1	0,2%	5	1%	9	1,8%

Table 6 Marginal repair strategies: Contiguity, epenthesis, coalescence and deletion of the entire cluster in DIM's speech
CL T = Cluster Type, T = Tokens, CON = Contiguity, EP = Epenthesis, COAL = Coalescence, DE = Deletion of the entire cluster, % = Percentage

	SPI

CL T	T	CON	%	EP	%	COAL	%	DE	%
/Lab S +L/									
/pl/	**25**	-	-	-	-	6	24%	3	12%
/pr/	**38**	-	-	-	-	6	15,8%	-	-
/bl/	**157**	6	3,8%	1	0,6%	22	14%	-	-
/br/	2	-	-	-	-	-	-	-	-
/Dor S +L/									
/kl/	**126**	-	-	-	-	11	8,7%	1	0,8%
/kr/	**45**	-	-	-	-	9	20%	1	2,2%
/gr/	**1**	-	-	-	-	1	100%	-	-
/gl/	**-**	-	-	-	-	-	-	-	-
/Cor S +L/									
/tr/	**255**	-	-	2	0,8%	-	-	4	2%
/dr/	42	-	-	-	-	-	-	-	-
/Lab F +L/									
/fl/	-	-	-	-	-	-	-	-	-
/fr/	**15**	1	6,7%	-	-	6	40%	-	-
/vl/	**65**	2	3,1%	-	-	9	13,8%	1	1,5%
/vr/	**21**	1	4,8%	-	-	3	14,28	-	-
/Dor F +L/									
/xl/	-	-	-	-	-	-	-	-	-
/xr/	**15**	-	-	-	-	2	13,3%	-	-
/ɣl/	**7**	2	29%	-	-	3	42,6%	1	14,3%
/ɣr/	**15**	5	33%	-	-	-	-	-	-
/Cor F +L/									
/θl/	**1**	-	-	-	-	-	-	-	-
/θr/	**3**	-	-	-	-	-	-	-	-
/ðr/	**4**	-	-	-	-	-	-	-	-
/Lab S +N/									
/pn/	**14**	-	-	-	-	2	14,3%	-	-
/Dor F +N/									
/xn/	**1**	1	100%	-	-	-	-	-	-
Total	**852**	18	2,1%	3	0,4%	80	9,4%	11	1,3%

Table 7 Marginal repair strategies: Contiguity, epenthesis, coalescence and deletion of the entire cluster in SPI's speech
CL T = Cluster Type, T = Tokens, CON = Contiguity, EP = Epenthesis, COAL = Coalescence, DE = Deletion of the entire cluster, % = Percentage

Finally, as can be seen in Tables 6 and 7, the prevalent simplification pattern in the data of both children is cluster reduction to the less sonorous, i.e. the C_1 is chosen rather the C_2. In DIM's speech, deletion of both cluster segments ($C_1C_2V \rightarrow V$) is the second most common simplification strategy and contiguity is the third most common one ($C_1C_2V \rightarrow C_2V$). Coalescence ($C_1C_2V \rightarrow C_{1,2}V$) is the fourth most common repair strategy and epenthesis ($C_1C_2V \rightarrow C_{1v}C_2V$) is the least common one. In SPI's data, coalescence is the second most common repair strategy and contiguity is the third most common one. Deletion of the two-member cluster is the fourth most common simplification strategy and epenthesis is the lest common one. The aforementioned are depicted in (38) and (39).

(38) The frequency of simplification strategies in DIM's data

CR less sonorous   CL del   Cont   Coal   Ep

----------------●--------------------●-----------------●------------------●----------------●-------

More frequent strategy   Less frequent strategy

CR less sonorous: Cluster reduction to the less sonorous consonant, CL del: Deletion of the entire cluster, Cont: Contiguity, Coal: Coalescence, Ep: Epenthesis

(39) The frequency of simplification strategies in SPI's data

CR less sonorous   Coal   Cont   CL del   Ep

----------------●--------------------●-----------------●------------------●----------------●-------

More frequent strategy   Less frequent strategy

CR less sonorous: Cluster reduction to the less sonorous consonant, CL del: Deletion of the entire cluster, Cont: Contiguity, Coal: Coalescence, Ep: Epenthesis

It is interesting that in the data of both children cluster reduction to the less sonorous is the prevalent simplification pattern and that epenthesis is the least common pattern. Also, in the data of both children contiguity is the third most frequent repair strategy. Additionally, it is interesting that the process of deletion of the entire cluster is the second most common strategy in DIM's data while this process is the fourth most common in SPI's ones and that coalescence is the second most commonly attested simplification strategy in SPI's data while this strategy is the fourth most one in DIM's ones. Therefore, it seems that there is inter-child variation regarding the frequency of simplification strategies which children apply in the process of cluster acquisition.

4.5.1. Contiguity

In DIM's and SPI's production data, there are some instances in which, when a consonant cluster is reduced, the more sonorous consonant which is adjacent to the nucleus surfaces in the output form. This strategy is known as contiguity (van der Pas 2004). In the data of both children, it is evident that contiguity is attested in stop-liquid, fricative-liquid and in fricative-nasal consonant clusters which are contained in stressed and unstressed word-initial and word-medial syllables.

Firstly, DIM's data show that [LABIAL Stop + Liquid], [LABIAL Fricative + Liquid] and [DORSAL Fricative + Nasal] clusters are reduced to the more sonorous segment. Interestingly, in the child's data contiguity is observed only in word-initial and word-medial stressed syllables. In SPI's data, this simplification pattern is observed in [LABIAL Stop + Liquid], [LABIAL Fricative + Liquid], [DORSAL Fricative + Liquid] and in [DORSAL Fricative + Nasal] complex onsets which are contained in word-initial and -medial stressed and unstressed syllables. The relevant data are presented in (40).

	Input form	**Output form**	**Gloss**	**Child**	**Age**
40a.	vi.ˈvli.o	le.ˈli.o	book	DIM	1;11,06
b.	a.e.ro.ˈpla.no	to.ˈla.no	airplane	DIM	1;11,06
c.	ˈblu.za	ˈlu.sa	blouse	SPI	2;03,19
d.	ˈblu.za	ˈʎu.ta	blouse	SPI	2;05,06
e.	ble	le	blue	DIM	2;05,01
f.	ble	le	blue	DIM	2;05,08
g.	ble	le	blue	SPI	2;04,09
h.	so.ko.ˈfre.ta	ko.ko.ˈle.ta	wafer	SPI	2;04,06
i.	vi.ˈvli.o	e.ˈli.o	book	SPI	2;10,03
j.	vi.vli.o.ˈθi.ci	ˈvi.li.o	bookcase	SPI	2;02,07
k.	ˈvri.si	ˈli.si	tap	SPI	2;04,26
l.	ˈti.ɣris	ˈti.lis	tiger	SPI	2;09,06
m.	ɣli.ˈko	li.ˈko	sweet	SPI	2;05,06
n.	pe.ˈxni.ðja	pe.ˈmi.za	toys	SPI	2;08,23
o.	pe.ˈxni.ðja	pe.ˈni.ja	toys	DIM	2;02,23
p.	zo.ˈɣra.fi.se	ɣo.ˈla.fi.θe	draw 3PR Sg	SPI	3;02,09
q.	zo.ɣra.ˈfi.sa.ne	xo.ra.ˈfi.sa.ne	draw 1PR Pl	SPI	3;02,09

Contiguity pattern presented above diverges from that presented in Kappa (2002a), Kappa & Papoutsi (2019) and in Tzakosta (2009). Recall that, in their studies, the OCP influences child productions, namely reduction to the more sonorous segment of the adult cluster is observed if the less sonorous consonant of the target cluster contains the same specified feature of place of articulation with another consonant of the word. In our data, it seems that there is a preference for the [+anterior] member of the cluster[16], i.e. the coronal sonorant, to occupy the onset of the syllable. Specifically, in (40a) the first member of the cluster, i.e. the voiced fricative /v/, is deleted and the one retained, namely the lateral /l/ which contains the coronal feature of articulation, triggers regressive consonant harmony so that the consonants of the word have the same place of articulation. Also, in (40b-d) the cluster is reduced to the more sonorous consonant and, therefore, the preserved consonant has the same place of articulation with the other consonants of the word, i.e. the coronal place of articulation. Interestingly, all the consonants of the words in (40a-g, i, k-l) are coronals and by default [+anterior]. We assume that SPI's and DIM's grammars require that the consonants of the word agree in [anterior] feature. Further evidence for the fact that the front segments force contiguity comes from the interaction between the front vowels of the word and the coronal [+anterior] consonant of the cluster, i.e. the sonorant. To be more specific, (40a, e-o) may provide evidence that in the presence of a front vowel in the same syllable with the cluster, for example /e/ or /i/, the [+anterior] coronal lateral consonant is preserved. Additionally, (40p-q) may provide further evidence for the fact that there is an interaction between the consonantal and the vocalic segments of the word. Specifically, in (40p-q) the coronal sonorant member of the cluster is chosen rather the obstruent due to the presence of a front vowel in the next syllable of the word. Hence, we assume that the front segments of the word force the retention of the more sonorous consonant of the cluster. Put differently, we suggest that front vowels tend to co-occur with coronal consonants. Also, we assume that this pattern may reflect distinct grammars which are available to children in the course of development. Hence, this pattern may be explained in terms of multiple parallel co-grammars (Tzakosta 2004a, b, 2005, 2006a, b, Revithiadou & Tzakosta 2004a, b, Tzakosta & Kappa 2008). Overall, contiguity accounts for 1,2% of DIM's data, namely 6 out of 501 productions exhibit this pattern and for 2,1% of SPI'Ss data, namely 18 out of 852 productions display this pattern.

4.5.2 Epenthesis

[16] The coronals [t, d, θ, ð, s, z, n, l, r, t^s, d^z] are specified as [+anterior]. /l/ is specified as [+lateral]. The labials [p, b, m] are specified as [LABIALS] and are underspecified as [anterior]. The distinctive feature [+/- anterior] does not distinct labial sound and is not contrastive for these phonemes in Standard Modern Greek (Kappa 2002a).

Epenthesis is the least common repair strategy attested in the data of both children, namely it only accounts for 0,2% of DIM's data, namely 1 out of 501 productions are instances of epenthesis and accounts for 0,4% of SPI's data, namely 3 out of 852 productions exhibit this simplification pattern. The only epenthetic instance in DIM's data is attested in a [voiceless DORSAL Fricative + Rhotic] cluster, namely /xr/, which is contained in a word-initial stressed syllable (41a). As far as the epenthetic instances found in SPI's data (41b-d), two of them are attested in [voiceless CORONAL Stop + Rhotic] clusters, namely /tr/, and one of them is attested in a [Voiced LABIAL Stop + Lateral] cluster, namely /bl/. All the epenthetic instances are observed in word-initial complex onsets which are contained in stressed syllables. Regarding the epenthetic vowel, it seems that it varies. However, it is not selected randomly, namely it is either the vowel of the stressed syllable of the word (41a-c) or a vowel which agrees in [-back] feature with the vowel of the stressed syllable (41d). The relevant data are provided in (41).

	Input form	**Output form**	**Gloss**	**Child**	**Age**
41a.	‘xro.ma.ta	xo.’lo.ma.ta	colours	DIM	2;02,06
b.	ˈtri.a	ti.ˈri	three	SPI	2;08,30
c.	ˈtri.a	ˈti.ri	three	SPI	3;03,21
d.	ble	bi.ˈle	blue	SPI	2;10,10

The epenthetic patterns presented above diverge from those presented in Kappa's (2002) study. In her study, epenthesis was attested only in word-initial stressed syllables which contained a stop-liquid cluster and the epenthetic vowel was the /e/, the vowel which, according to Malikouti-Drachman & Drachman (1992), is the default epenthetic vowel in Standard Modern Greek. Also, our data are not in congruence with Tzakosta's (2009) ones, in which the epenthetic vowel is the /æ/, a vowel that is absent from the segmental inventory of Standard Modern Greek.

4.5.3 Deletion of the entire cluster

The process of deletion of the entire cluster are observed in the longitudinal data of both children. DIM's data show that this pattern is observed in [DORSAL Stop + Liquid], [CORONAL Stop + Liquid] and in [DORSAL Fricative + Liquid] consonant clusters which are contained in word-initial and word-medial stressed and unstressed syllables (42).

	Input form	Output form	Gloss	Child	Age
42a.	tra.ˈpe.zi	a.ˈpe.ji	table	DIM	1;10,29
b.	tra.ˈpe.zi	a.ˈpe.ji	table	DIM	1;11,06
c.	tra.ˈpe.zi	a.ˈpe.ji	table	DIM	1;11,06
d.	tra.ˈpe.zi	a.ˈpe.zi	table	DIM	2;01,02
e.	tra.ˈpe.zi	o.ˈpe.si	table	DIM	2;01,09
f.	tra.ˈpe.zja	a.ˈpe.ca	tables	DIM	2;02,06
g.	zo.ɣra.ˈfi.zi	ɣo.a.ˈfi.zi	paint 3 PR.Sg	DIM	2;03,13
h.	ˈxro.ma	ˈo.ma	colour	DIM	2;04,18
i.	kli.ˈðja	i.ˈja	keys	DIM	2;05,08

Interestingly, in DIM's speech the following complementary distributions is observed. Specifically, deletion of the entire cluster is attested in [DORSAL Stop + Liquid], in [CORONAL Stop + Liquid] and in [DORSAL Fricative + Liquid] clusters while contiguity occurs only in [LABIAL Stop + Liquid] clusters, as DIM's data in (40), rewritten here as (42a-d), show. Therefore, in the marginal repair strategies, DORSAL- and CORONAL-initial clusters are prone to deletion and LABIAL-initial clusters are prone to reduction to the more sonorous segment.

	Input form	Output form	Gloss	Child	Age
42a.	a.e.ro.'pla.no	to.'la.no	airplane	DIM	1;11,06
b.	vi.'vli.o	le.'li.o	book	DIM	1;11,06
c.	ble	le	blue	DIM	2;05,01
d.	ble	le	blue	DIM	2;05,08

SPI's longitudinal data demonstrate that the process of deletion of the entire cluster is attested in [LABIAL Stop + Liquid], [DORSAL Stop + Liquid], [CORONAL Stop + Liquid], [LABIAL Fricative + Liquid] and in [DORSAL Fricative + Liquid] clusters which are contained in stressed and unstressed syllables in word-initial and word-medial positions. The relevant data are provided in (43).

	Input form	Output form	Gloss	Child	Age
43a.	kre.ˈva.ti	e.ˈja.ti	bed	SPI	2;02,13
b.	ɣli.ˈko	o.ˈko	sweet	SPI	2;03,19
c.	vi.ˈvli.o	ˈði.i.o	book	SPI	2;05,06
d.	tra.ˈkter	a.ˈtet (m)	tractor	SPI	2;06,15
e.	pli.ˈdi.ri.o	e.ˈdi.li.o	washing machine	SPI	2;08,23
f.	kli.ˈðja	i.ˈja	keys	SPI	2;09,13
g.	pli.ˈdi.ri.o	i.ˈbi.li.o	washing machine	SPI	2;09,19

h.	tre.ˈna.ci	e.ˈla.ci	train	SPI	2;10,03
i.	pli.ˈdi.ri.o	i.ˈⁿdi.li.o	washing machine	SPI	2;11,01
j.	tra.ˈpe.zi	o.ˈpe.ni	table	SPI	3;00,09

As can be seen in (43) above, SPI shows a tendency to delete the entire cluster in word-initial unstressed syllables. To be more specific, 9 out of 10 SPI's linguistic tokens presented above show that cluster deletions are more common for word-initial clusters.

Also, this strategy is observed mostly in unstressed syllables at the left edge of the word, position which is perceptually prominent. Despite the positional prominence (Smith 2002) and despite the fact that children pay attention to word edges and tend to retain the information they carry (Slobin 1973), here DIM and SPI do not do so. Also, the fact that this simplification pattern is attested mostly in unstressed syllables may indicate that stress may forces the preservation of both cluster members or of at least the head of the cluster (44).

	Input form	Output form	Gloss	Child	Age
44a.	ble	be	blue	DIM	1;10,29
b.	ˈpra.si.no	ˈpa.ti.no	green	DIM	1;10,29
c.	ble	ble	blue	DIM	2;00,26
d.	ˈkri.o	ci	cold	DIM	2;02,23
e.	ˈfra.u.la	fa	strawberry	DIM	2;02,30
f.	ˈplu.to	ˈpu.toç	proper name	DIM	2;03,06
g.	ˈkra.nos	ˈka.no	helmet	SPI	2;04,29
h.	ˈkle.i	kle	cry 3PR Sg	SPI	2;08,08
i.	ˈvle.pu.me	ˈve.po.me	see 1PR Pl	SPI	2;08,16
j.	ˈklo.un	koːn	clown	SPI	3;00,09

To sum up, this repair strategy is infrequent in DIM's and in SPI's speech. This strategy accounts for 1,8% (9 out of 501 tokens) and 1,3% (11 out of 852 tokens) of children's data, respectively. In the literature, it is reported that the process of deletion of the entire cluster is a marginal repair mechanism, too (Ingram 1976, Chin and Dinnsen 1992, Smit 1993, Freitas 2003).

4.5.4. Coalescence

Coalescence is another simplification strategy which is attested in the data of both childre. Children retain the unmarked features of the two clustered segments and fusion them. For instance, the input form /*ka.ˈpnos/* is realized as *ˈ[ko.ˈto]* by SPI (45).

	Input form	Output form	Gloss	Child	Age
45	ka.ˈpnos	ko.ˈto	smoke	SPI	3;00,09

The unmarked features of the input cluster /pn/ are retained in the output form. SPI preserves the (unmarked) CORONAL place of articulation of the sonorant /n/ and combines it with the unmarked feature [-cont] (manner of articulation) and the unmarked feature [-voiced] of the LABIAL stop /p/. Therefore, the segment which is produced is [t] (46).

46	**Segments**	**/p/**	**/n/**	**[t]**
	Place of articulation	[LABIAL]	[CORONAL]	[CORONAL]
	Manner of articulation	[-continuant]	[+nasal]	[-continuant]
	Laryngeal feature (Voicing)	[-voiced]	[+voiced]	[-voiced]

Alternatively, an analysis within the theoretical framework of Radical Undespecification (Kiparsky 1982, Archangeli 1984, 1985, 1988, Pulleyblank 1986, 1988) explains the instances of coalescence found in our data. Within the framework of Radical Underspecification, only the marked feature values of segments are specified in the mental lexicon (Kiparsky 1982, Archangeli 1984, 1985, 1988, Pulleyblank 1986, 1988). Also, bear in mind that the coronal node is unmarked and underspecified (Avery & Rice 1989). For instance, /t/ is underspecified for place and for manner of articulation and for voicing, /p/ is specified as [LABIAL] and underspecified for manner of articulation and for voicing. /ɣ/ is specified as [DORSAL], [+continuant] and [+voiced]. /l/ is specified as [+lateral] and underspecified for place and for voicing[17] and /n/ is specified for manner of articulation [+nasal] and underspecified for place and for voicing. A representative example of segment specifications is given in (47).

47	**Segments**	**/t/**	**/p/**	**/ɣ/**	**/l/**	**/n/**
	Place of articulation	[ ]	[LABIAL]	[DORSAL]	[ ]	[ ]
	Manner of articulation	[ ]	[ ]	[+continuant]	[+lateral]	[+nasal]
	Laryngeal feature (Voicing)	[ ]	[ ]	[+voiced]	[ ]	[ ]

Therefore, as displayed in (45), the child coalesces the clustered consonants /pn/, and realizes a single unmarked consonant [t], which contains the unmarked values for

[17] /l, r, n, m/ as sonorants are by default [+voiced]. It is not necessary to be specified as [+voiced] in the lexicon.

place ([CORONAL]), manner of articulation ([-cont]) and for voicing ([-voice]) of the adult cluster /pn/ (48). Hence, a C_1C_2V syllabic shape is realized as $C_{1,2}V$.

48	**Segments**	**/p/**	**/n/**		**[t]**
	Place of articulation	[LABIAL]	[ ]	→	[CORONAL]
	Manner of articulation	[ ]	[+nasal]	→	[-continuant]
	Laryngeal feature (Voicing)	[ ]	[ ]	→	[-voice]

In DIM's longitudinal data, coalescence is attested in clusters which are constituted by the voiceless LABIAL stop /p/ and the lateral /l/ contained in stressed word-medial syllables. In his data, coalescence accounts for 0,8%% of his data, as 4 out of 501 productions exhibit this pattern. In SPI's data, coalescence is attested in (un)stressed LABIAL- and DORSAL-initial clusters. Overall, this pattern accounts for 9,4% of SPI's data, as 80 out of 852 productions concern this marginal repair strategy. The relevant data from both children are presented below (49).

	Input form	**Output form**	**Gloss**	**Child**	**Age**
49a.	a.e.ro.ˈpla.no	e.ˈta.no	airplane	DIM	1;11,28
b.	a.e.ro.ˈpla.no	e.ˈta.no	airplane	DIM	1;11,28
c.	a.e.ro.ˈpla.no	ˈta.no	airplane	DIM	1;11,28
d.	a.e.ro.ˈpla.no	ˈta.no	airplane	DIM	2;00,04
e.	kli.ˈði	ti.ˈi	key	SPI	2;04,06
f.	a.e.ro.ˈpla.no	ˈta.no	airplane	SPI	2;05,03
g.	ˈci.klos	ˈtsi.tos	circle	SPI	2;07,16
h.	mi.ˈkra	mi.ˈta	small	SPI	2;08,30
i.	ˈple.ni	ˈte.ni	wash 3PR Sg	SPI	2;09,06
j.	ˈkli.ni	ˈti.ni	close 3PR Sg	SPI	2;09,19
k.	ˈpra.si.no	ˈta.si.no	green	SPI	2;10,03
l.	ka.ˈpnos	ko.ˈto	smoke	SPI	3;00,09
m.	ksi.ˈpna.me	ci.ˈta.me	wake up 1PR Pl	SPI	3;04,11

Interestingly, despite the fact that the coalesced output segment tends to be unmarked, SPI's data show that it is not always the case that only unmarked segments surface in the output form, variable outputs with a marked feature, i.e. [+voiced] consonants, are also realized, as the data in (50b, e-g) reveal. Also, some further observation can be made if we focus on the data below.

	Input form	**Output form**	**Gloss**	**Child**	**Age**
50a.	ˈma.vro	ˈta.no	black	SPI	2;02,07

b.	ˈblu.za	ˈdu.za	blouse	SPI	2;04,12
c.	ˈfru.to	ˈtu.to	fruit	SPI	2;04,12
d.	ˈvri.si	ˈti.si	tap	SPI	2;04,26
e.	ble	de	blue	SPI	2;05,16
f.	vi.ˈvli.o	ⁿdi.o	book	SPI	2;06,15
g.	ˈɣri.ɣo.ra	ˈdi.ɣo.la	quickly	SPI	2;08,08

For instance, the adult form /ˈble/ is produced as /de/ by SPI (50e). The child coalesces the input stop-liquid cluster /bl/ and produces a single voiced CORONAL segment [d]. As can be seen in (51), [d] is underspecified for place and for manner of articulation and is specified as [+voiced]. SPI retains the unmarked place of articulation of the sonorant /l/ (CORONAL), the unmarked manner of articulation [-continuant] of /b/ and the marked [+voice] feature of /b/. We suppose that SPI's grammar prefers strong or low sonority consonants to occupy the onsets which are in prominent positions of the word, i.e. in stressed syllables or in the word-initial position[18].

51	**Segments**	**/b/**	**/l/**	**[d]**
	Place of articulation	[LABIAL]	[ ]	[ ]
	Manner of articulation	[ ]	[+lateral]	[ ]
	Laryngeal feature (Voicing)	[+voiced]	[ ]	[+voiced]

All in all, SPI shows preference for the onsets be occupied by a low- sonority or a strong consonant, as it was demonstrated in (49e-m) and in (50). Specifically, SPI shows a strong preference for the coalesced output consonants in word-initial and -medial onsets be a plosive, i.e. underspecified for manner of articulation. Interestingly, SPI's data demonstrate that the coalesced output consonant in the onsets should agree in their voicing status with the consonant which occupies the following or the preceding onset, namely if the following or the preceding onset is occupied by a [-voiced] consonant, then the coalesced output in the onset is [-voiced] (for instance, the input form /ˈvri.si/ is realized as [ˈti.si] by SPI (50d)). Accordingly, if the consonant in the following or the preceding onset is [+voiced], then the coalesced output in the onset is [+voiced] (for example, the input form /ˈblu.za/ is realized as [ˈdu.za] by SPI (50b)). The only apparent exception is the following: If the following or the preceding consonant in the onset is [+nasal], then the coalesced output segment which occupies the onset may be [-voiced] (for example, the input form /ˈple.ni/ is realized as [ˈte.ni] by SPI (49i)). Recall that

[18] Smith (2002) argues that prominent syllables are those which are stressed and in word-initial position.

nasals are sonorants. Sonorants are by default [voiced]. In the mental lexicon, nasals are not specified as [+voiced], rather, they are underspecified for voicing. Therefore, we suggest that both onset consonants are underspecified for voicing underlyingly and, therefore, the fact that in the output form a [-voiced] coalesced output consonant which occupies the onset position follows or precedes a [+voiced] onset which is occupied by a nasal consonant is due to the redundancy rules which assign the specification of [+voiced] to the nasal during the derivation. Given all the above, SPI's coalesced output consonants in the onsets are the following (52):

52	**Segments**	/t/	/d/
	Place of articulation	[ ]	[ ]
	Manner of articulation	[ ]	[ ]
	Laryngeal feature (Voicing)	[ ]	[+voiced]

Furthermore, we suppose that coalescence in SPI's data may reflect a different sub-stage in cluster development. Put simply, the child exhibits coalescence for a long period of time. However, instances of coalescence fade away when faithful forms for each cluster occur. The instances of coalescence may provide evidence that SPI is aware of the root node under which is organized every segment of the cluster given the fact that the coalesced output segment combines features of the two nodes. The fact that clusters are not produced is due to the child's grammar which does not allow branching onsets. Later in development, clusters start being realized. Instances of coalescence stop occurring due to the fact that SPI's grammar start allowing complex onset. Therefore, as a result, coalescence fades away immediately after faithful forms start being produced. Hence, coalescence may serve as predictor for cluster acquisition, namely SPI's data may indicate that coalescence precedes the stage in which faithful cluster forms occur, as can be seen if we focus on the rightmost column in (53). (see subsection 4.6. for detailed discussion on faithful forms).

	Input form	**Output form**	**Gloss**	**Child**	**Age**
/bl/ in word-initial position					
53a.	ble	de	blue	SPI	2;05,16
b.	ˈblu.za	ˈdu.za	blouse	SPI	2;04,12
c.	to.ˈble	to.^{n}de	blue	SPI	2;07,16
d.	ble	ble	blue	SPI	2;08,08
e.	ble	ble	blue	SPI	2;09,06
f.	ble	ble	blue	SPI	3;03,14

/bl/ in word-medial position					
g.	ˈta.blet	ˈpa.tet	tablet	SPI	2;08,23
h.	ta ˈta.blet	ta ˈta.blet	tablet	SPI	3;04,11
/pr/ in word-initial position					
i.	ˈpra.si.no	ˈta.si.no	green	SPI	2;10,10
j.	ˈpra.si.no	ˈpla.si.no	green	SPI	2;10,25
k.	ˈpra.si.no	ˈpla.si.no	green	SPI	3;02,09
/kl/ in word-medial position					
l.	ka.ˈre.kla	ka.ˈle.ta	chair	SPI	2;06,22
m.	ka.ˈre.kla	ka.ˈlot	chair	SPI	3;01,02
n..	ka.ˈre.kla	ka.ˈle.kla	chair	SPI	3;01,19
o.	ka.ˈre.kles	ka.ˈle.kles	chair	SPI	3;02,29
/kr/ in word-medial position					
p..	mi.ˈkro	mi.ˈto	small	SPI	2;09,06
q.	mi.ˈkru.li.ka	mi.ˈtu.li.ka	small DIM	SPI	3;01,02
r.	mi.ˈkri	mi.ˈkri	small	SPI	3;02,09
s.	mi.ˈkres	mi.ˈkleθ	small	SPI	3;03,06
/pl/ in word-medial position					
t.	a.e.ro.ˈpla.no	ˈta.no	airplane	SPI	2;05,03
u.	a.e.ro.ˈpla.no	a.e.ˈpʎa.no	airplane	SPI	2;08,08
v.	a.e.ro.ˈpla.no	a.lo.ˈpla.no	airplane	SPI	2;09,19
/vr/ in word-initial position					
w.	ˈvri.si	ˈti.si	tap	SPI	2;04,26
x.	ˈvri.ka	ˈvli.ka	find 1PR Sg	SPI	3;04,11
/vr/ in word-medial position					
y.	ˈma.vro	ˈta.no	black	SPI	2;02,07
z.	ˈma.vro	ˈma.vro	black	SPI	3;02,29
aa..	ˈma.vri	ˈma.vli	black	SPI	3;03,14
/vl/ in word-medial position					
bb.	vi.ˈvli.o	de.ˈzi.o	book	SPI	2;08,30
cc.	vi.ˈvli.o	me.ˈvli.o	book	SPI	2;09,06
/fr/ in word-initial position					
dd.	ˈfru.to	ˈtu.to	fruit	SPI	2;04,12
ee.	ˈfru.to	ˈtu.to	fruit	SPI	2;06,15
ff.	ˈfra.u.les	ˈfla.u.e	strawberry	SPI	3;03,06
gg.	ˈfra.u.les	ˈfla.u.es	strawberry	SPI	3;03,21

4.6. Faithfull productions

During the medial intermediate developmental phase faithful forms start being produced. Therefore, complex syllabic structures, for example C_1C_2V and C_1C_2VC forms, are realized. SPI's data demonstrate that the emergence of stop-liquid clusters precedes the emergence of fricative-liquid clusters. Also, the emergence of stop-liquid clusters in word-initial and word-medial stressed syllables precedes the emergence of the same clusters in word-initial and word-medial unstressed syllables. Fricative-liquid clusters emerge simultaneously in word-initial and -medial stressed and unstressed syllables. Moreover, in SPI's data were not found faithfully produced stop-nasal and fricative- nasal clusters. We suppose that these cluster types emerge later in development. All this information is summarized in (54) below.

(54) Order of emergence[19] of stop-liquid and fricative-liquid clusters in SPI's data

Clusters	stop-liquid clusters	>	fricative-liquid clusters

-----------------●-------------------------------------●-----------------------

earlier later

Stress	**stop-liquid clusters**	**fricative-liquid clusters**
	stressed syllables > unstressed syllables	stressed syllables, unstressed syllables
	----------●--------------------●-------------	---------------------●------------------------------
	earlier later	earlier later

Also, SPI's longitudinal production data reveal that, regarding the emergence of stop-liquid clusters, the emergence of LABIAL-initial clusters precedes the emergence of DORSAL- and CORONAL-initial clusters. Additionally, the emergence of DORSAL-initial clusters precedes the emergence of CORONAL-initial clusters (55).

(55) Order of emergence of stop-liquid clusters in SPI's data

LABIAL-initial clusters DORSAL-initial clusters CORONAL-initial clusters

-------------●-------------------------------●---------------------------------●--------------

earlier later

Moreover, as far as the fricative-liquid clusters are concerned, the emergence of LABIAL- initial clusters precedes the emergence of DORSAL- and CORONAL-initial clusters. Furthermore, the emergence of CORONAL-initial clusters precedes the emergence of DORSAL-initial clusters (56).

[19] I use the term 'emergence' rather than 'acquisition' due to the fact that our data show that SPI has not accomplished the acquisition of clusters, as it will be shown later in this chapter.

(56) Order of emergence of fricative-liquid clusters in SPI's data

LABIAL-initial clusters	CORONAL-initial clusters	DORSAL-initial clusters

-------------●--------------------------●-------------------------------●---------------------

earlier later

A few representative examples are given in (57).

	Input form	Output form	Gloss	Child	Age
Stop-liquid clusters					
57a.	ˈkle.i	kle	cry 3PR Sg	SPI	2;08,08
b.	ble	ble	blue	SPI	2;08,08
c.	a.e.ro.ˈpla.no	a.e.ˈpʎa.no	airplane	SPI	2;08,08
d.	ˈpra.si.no	ˈpla.si.no	green	SPI	2;10,25
e.	ka.ˈre.kla	ka.ˈle.kla	chair	SPI	3;01,19
f.	ˈpli.nu.me	ˈpli.nu.me	wash 1PR Pl	SPI	3;02,02
g.	mi.ˈkri	mi.ˈkri	small	SPI	3;02,09
h.	gri	gli	grey	SPI	3;03,21
i.	ˈtri.a	ˈtli.a	three	SPI	3;03,21
j.	ta ˈta.blet	ta ˈta.blet	tablet	SPI	3;04,11
Fricative-liquid clusters					
k.	vi.ˈvli.o	me.ˈvli.o	book	SPI	2;09,06
l.	ˈma.vro	ˈma.vro	black	SPI	3;02,29
m.	ˈfra.u.les	ˈfla.u.e	strawberries	SPI	3;03,06
n.	je.ˈne.θli.a	ne.ˈne.θli.a	birthday	SPI	3;03,06
o.	i ˈfra.u.la	to ˈfla.o	strawberry	SPI	3;03,14
p.	ˈti.ɣris	ˈti.ɣris	tiger	SPI	3;03,21
q.	ˈvri.ka	ˈvli.ka	find 1PR Sg	SPI	3;04,11

All above information is summarized in Tables 8 and 9.

	SPI			
Cluster Type	**Cluster**	**Tokens**	**Faithful productions**	**Percentage**
[LABIAL Stop + Liquid]	/pl/	36	10	27,8%
	/pr/	58	20	34,5%
	/bl/	252	95	37,7%
	/br/	2	-	0%
[DORSAL Stop + Liquid]	/kl/	146	24	16,4%
	/kr/	51	6	11,8%
	/gr/	2	1	50%
	/gl/	-	-	-
[CORONAL Stop + Liquid]	/tr/	268	19	7,1%

	/dr/	42	-	0%
Total		857	175	20,2%

Table 8

	SPI			
Cluster Type	**Cluster**	**Tokens**	**Faithful productions**	**Percentage**
[LABIAL Stop + Liquid]	/fl/	23	8	34,8%
	/fr/	-	-	0%
	/vl/	68	3	4,4%
	/vr/	27	6	22,2%
[DORSAL Stop + Liquid]	/xl/	-	-	0%
	/xr/	15	-	0%
	/ɣl/	7	-	0%
	/ɣr/	17	2	11,8*
[CORONAL Stop + Liquid]	/θl/	2	1	50%
	/θr/	3	-	0%
	/ðr/	4	-	0%
Total		166	20	12%

Table 9

A glance at the Tables 8-9 reveals that faithful productions of stop-liquid clusters are more frequently attested (20,2%) than of fricative-liquid clusters (12%). Firstly, LABIAL stop-initial clusters are more frequently faithfully produced than DORSAL stop- or CORONAL stop-initial consonant cluster. Among all the cluster types /bl/ is faithfully realized more frequently (37,7%). On the other hand, /br/ (0%) and /dr/ (0%) have the lowest percentage of faithful productions among all the well-formed stop-liquid clusters. As far as the fricative-initial clusters are concerned, /fl/ is the most frequently faithfully produced cluster among the fricative-initial clusters (34,8%). /vr/ is the second more frequently faithfully realized cluster among the fricative-initial clusters (22,2%). DORSAL fricative- and CORONAL fricative-initial cluster have the lowest percentage of faithful productions with only exception the cluster /θl/ (50%). However, we cannot suggest that /θl/ is nearly to be acquired due to the lack of more data. Put differently, no generalization can be made regarding the acquisition of /θl/. Despite the fact that faithful clusters productions are attested in SPI's speech, we cannot suggest that the child has fully acquired the well-formed consonant clusters. According to Kappa (2009), partial acquisition has been accomplished if the child realizes faithfully the structure under investigation 50-75 out of 100 times, that is 50-75%. Also, she suggests that full acquisition has been accomplished when the average of faithfully productions is above 75%. Taking into account the percentage of faithful productions of the stop-liquid and fricative-liquid clusters, we suggest that SPI has not even partially acquired these clusters.

DIM's data show that both stop-liquid and fricative-liquid clusters start to emerge simultaneously in word-initial stressed syllables. This observation may agree with Slobin's (1973) observation that children tend to pay attention to the word edges, and, therefore, they retain the information they carry. Later in development, both stop-liquid and fricative-liquid clusters are attested in medial unstressed syllables. In DIM's data, there were not attested faithfully produced stop-liquid and fricative-liquid clusters in word-initial unstressed syllables. Also, faithfully realized stop-liquid and fricative-liquid target clusters in word-medial stressed syllables were not observed, too. In addition, faithfully produced stop-nasal and fricative-nasal clusters were not attested in DIM's production data. All this information is summarized below in (58).

(58) Order of emergence[20] of stop-liquid and fricative-liquid clusters in DIM's data

Clusters stop-liquid clusters, fricative-liquid clusters

----------------------------------●--

earlier later

Position stop/fricative-liquid clusters,

Str #CCV(C) > (unstressed #CCV(C))

----------●--------------------●-------------

earlier later

stop/fricative-liquid clusters

Unstr Med CCV(C) > (Str Med CCV(C))

-----------●----------------------●---------------

earlier later

Furthermore, DIM's longitudinal production data reveal that, regarding the emergence of stop-liquid clusters, the emergence of LABIAL-initial clusters precedes the emergence of DORSAL-initial clusters. Regarding the emergence of CORONAL-initial clusters, DIM's data lack faithfully produced CORONAL-initial clusters. Therefore, we suppose that they emerge later in development (59).

(59) Order of emergence of stop-liquid clusters in DIM's data

[20] I use the term 'emergence' rather than 'acquisition' due to the fact that our data show that DIM has not accomplished the acquisition of clusters, as it will be shown later in this chapter.

LABIAL-initial clusters DORSAL-initial clusters (CORONAL-initial clusters)

-------------●--------------------------●------------------------------●----------------------

earlier later

Moreover, as far as the fricative-liquid clusters are concerned, the emergence of DORSAL- initial clusters precedes the emergence of CORONAL-initial clusters. As far as the LABIAL-initial clusters are concerned, DIM's data lack faithfully produced LABIAL-initial clusters. Hence, we assume that they emerge later in development. This information is presented below in (60).

(60) Order of emergence of fricative-liquid clusters in DIM's data

DORSAL-initial clusters CORONAL-initial clusters (LABIAL-initial clusters)

---------------●----------------------------●-------------------------------●-------------------

earlier later

A few examples are provided in (61).

	Input form	Output form	Gloss	Child	Age
Stop-liquid clusters					
61a.	ble	ble	blue	DIM	2;00,26
b.	ˈplu.to	ˈplu.tos	proper name	DIM	2;03,06
c.	ˈple.ni	ˈple.ni	wash 3PR. Sg.	DIM	2;03,06
d.	ˈblu.za	ˈblu.za	blouse	DIM	2;03,06
e.	ble	bles	blue	DIM	2;04,10
f.	ˈkle.i	ˈkle.i	cry 3PR Sg	DIM	2;05,01
g.	to ˈta.blet	to ˈta.ble	the tablet	DIM	2;05,01
h.	ble	blel	blue	DIM	2;05,08
i.	ble	ble	blue	DIM	2;05,15
j.	to ˈta.blet	to ˈta.ble	the tablet	DIM	2;05,15
k.	ˈci.klos	ˈci.kluç	circles	DIM	2;05,15
Fricative-liquid clusters					
l.	ˈxro.ma.ta	ˈxlo.ma.ta	colours	DIM	2;02,06
m.	ˈxro.ma.ta	ˈxlo.ma.to	colours	DIM	2;02,23
n.	je.ˈne.θli.a	e.ˈne.θli.a	birthday	DIM	2;04,18

All this information is summarized in Tables 10 and 11.

	DIM			
Cluster Type	**Cluster**	**Tokens**	**Faithful productions**	**Percentage**
[LABIAL Stop + Liquid]	/pl/	25	2	8%
	/pr/	32	0	0%
	/bl/	52	28 (22 [bl] and 6 substitutions by [pl]	53,8%
	/br/	5	0	0%
[DORSAL Stop + Liquid]	/kl/	70	2	2,9%
	/kr/	72	0	0%
[CORONAL Stop + Liquid]	/tr/	141	0	0%
	/dr/	28	0	0
Total		425	32	7,5%

Table 10

	DIM			
Cluster Type	**Cluster**	**Tokens**	**Faithful productions**	**Percentage**
[LABIAL Fricative + Liquid]	/fl/	3	0	0%
	/fr/	11	0	0%
	/vl/	14	0	0%
	/vr/	13	0	0%
[DORSAL Fricative + Liquid]	/xl/	4	0	0%
	/xr/	18	2 (2 out of 2 substitutions by [xl])	11,1%
	/ɣl/	1	0	0%
	/ɣr/	14	0	0%
[CORONAL Fricative + Liquid]	/θl/	1	1	100%
	/θr/	2	0	0%
	/ðr/	14	0	0%
Total		95	3	3,2%

Table 11

Tables 10-11 reveals that faithful productions of stop-liquid clusters are more frequently attested (7,5%) than of fricative-liquid clusters (3,2%). LABIAL stop-initial clusters are more frequently faithfully produced than DORSAL stop-initial consonant cluster. Among all the cluster types /bl/ is faithfully realized more frequently (53,8%). On the other hand, /pr/, /br/, /kr/, /tr/ and /dr/ were never faithfully produced (0%). As far as the fricative-initial clusters are concerned, only 3 instances of faithful productions are attested in DIM's data. In DIM's data, there two instances of faithful productions of /xr/ and one of /θl/. Interestingly, 1 out of 1 tokens of /θl/ are faithfully realized (100%). Nevertheless, we cannot suggest that /θl/ has been acquired due to the lack of more data. Put differently, no generalization can be made regarding the acquisition of /θl/. Despite the fact that faithful clusters productions are attested in DIM's speech, we cannot suggest that the child has acquired the stop-liquid and fricative-liquid consonant clusters. According to Kappa (2009), partial acquisition has been accomplished if the child realizes faithfully the structure under investigation 50-75 out of 100 times, that is 50-75%. Also, she suggests that full acquisition has been accomplished when the average of faithfully productions is above 75%. Given the percentage of faithful productions of the stop-liquid and fricative-liquid clusters we suggest that DIM has not even partially acquired these clusters.

All in all, SPI's data show that stop-liquid clusters emerge before fricative-liquid clusters. Also, the emergence of stop-liquid clusters in word-initial and word-medial stressed syllables precedes the emergence of the same clusters in word-initial and word-medial unstressed syllables. Fricative-liquid clusters emerge simultaneously in word-initial and -medial stressed and unstressed syllables. Additionally, SPI's longitudinal data reveal that the emergence of LABIAL stop-initial clusters precedes the emergence of DORSAL stop- and CORONAL stop-initial clusters. Additionally, dorsal stop-initial clusters emerge before coronal-initial clusters. Moreover, the development of LABIAL fricative-initial clusters precedes the development of DORSAL fricative- and coronal fricative-initial clusters. Furthermore, the emergence of CORONAL fricative-initial clusters precedes the emergence of dorsal fricative-initial clusters. DIM's data demonstrate that stop-liquid and fricative-liquid clusters start to emerge simultaneously in word-initial stressed syllables. In the course of development, both stop-liquid and fricative-liquid clusters start to emerge in medial unstressed syllables. DIM's longitudinal data reveal that, regarding the emergence of stop-liquid clusters, the emergence of labial-initial clusters precedes the emergence of dorsal-initial clusters. DIM's data lack faithfully produced coronal-initial clusters and we suppose that they emerge later in development. Moreover, as far as the fricative-liquid clusters are concerned, the emergence of DORSAL- initial clusters precedes the emergence of CORONAL-initial clusters. DIM's data lack faithfully produced -LABIAL initial clusters and, thus, we assume that they emerge later in development. Finally, both DIM's and SPI's data lack faithfully produced stop-nasal and fricative-nasal consonant clusters.

4.6.1. Discussion on the faithful cluster realizations

Firstly, DIM's and SPI's data demonstrate that the stop-liquid and fricative-liquid clusters whose their rightmost member is the rhotic /r/ are not faithfully realized with respect to the their sonorant member. Put simply, the rhotic /r/ is substituted by the lateral /l/, as can be seen in (62). It is interesting that both DIM and SPI realize the lateral /l/ instead of the rhotic /r/. Furthermore, this pattern persists even during SPI's final recording sessions.

	Input form	**Output form**	**Gloss**	**Child**	**Age**
62a.	ˈxro.ma.ta	ˈxlo.ma.ta	colors	DIM	2;02,06
b.	ˈxro.ma.ta	ˈxlo.ma.to	colors	DIM	2;02,23
c.	ˈpra.si.no	ˈpla.si.no	green	SPI	2;10,25
d.	mi.ˈkri	mi.ˈkri	small	SPI	3;02,09
e.	ˈfra.u.les	ˈfla.u.e	strawberries	SPI	3;03,06
f.	mi.ˈkru.ʎa	mi.ˈklu.ja	small DIM	SPI	3;03,06
g.	ˈfra.u.les	ˈfla.u.les	strawberries	SPI	3;03,14
h.	mi.ˈkres	mi.ˈkle	small	SPI	3;03,14
i.	ˈma.vri	ˈma.vli	black	SPI	3;03,14
j.	gri	gli	grey	SPI	3;03,21
k.	ˈtri.a	ˈtli.a	three	SPI	3;03,21
l.	ˈfra.u.les	ˈfla.u.es	strawberries	SPI	3;03,21
m.	zo.ɣra.ˈfi.zu.me	o.ɣla.ˈfi.ðu.me	paint 1PR Pl	SPI	3;03,21
n.	ˈfra.u.la	ˈfla.u.wa	strawberry	SPI	3;03,28
o.	ˈtri.a	ˈtli.a	three	SPI	3;04,04
p.	ce ˈfra.u.la	ce ˈfla.u.a	strawberry	SPI	3;04,11
q.	ˈvri.ka	ˈvli.ka	find 1PR Sg	SPI	3;04,11
r.	tin ˈtro.me	ti ˈtlo.me	eat 1PR Pl	SPI	3;04,11

According to Walsh Dickey (1997), as cited in Kappa (2009:479) *LIQUID constitutes a class, that is organized under the SV-node and LIQUID dominates LATERAL (default) and VOCALIC (r-sounds, the marked ones)*. In DIM's grammar, it seems that there is not contrast between the LATERAL and the VOCALIC and that is why the lateral [l], i.e. the default, is realized not only in complex onsets but also in monopositional (singleton) onsets (63a, c) and in word-medial codas (63b)[21].

	Input form	**Output form**	**Gloss**	**Child**	**Age**
63a.	fe.ga.ˈra.ci	fe.ka.ˈla.tsi	moon DIM	DIM	2;02,06
b.	ma.ˈçer.ja	a.ˈsel.ja	knives	DIM	2;05,01
c.	pa.ˈra.θi.ro	pa.ˈla.si.o	window	SPI	2;08,08

[21] SPI does not produce word-medial codas.

In addition, SPI's and DIM's longitudinal production data show that the emergence of word-initial and word-medial complex onsets does not precede the emergence of branching rhymes in word-medial position. Therefore, our observations differ from the observation which were made by Kappa (2009), as can be seen in (64). In her study, the emergence of word-initial and word-medial branching onsets precedes the emergence of branching rhymes word-medially, as displayed in (64).

	Input form	Output form	Gloss	Child	Age
64a.	mi.'kra	mi.'kra	little	M.	1;09
b.	'kle.i	'kle.i	cry	B.	1;10
c.	'val.to	'val.to	put it	M.	1;11,07
d.	'kar.ta	'kal.ta	card	B.	2;09,05

Kappa (2009:500)

As can be seen in (65), the emergence of the word-initial and -medial consonant clusters follows the emergence of the medial-codas in the data of both children. Nevertheless, we can not claim that children have acquired the word-medial codas. Neither medial codas nor word-initial and -medial clusters have been acquired by children (also, clusters are attested more frequently in the data of both children). Additionally, the following observation can be made: In (65), it seems that both children produce a coda in word-medial position regardless of whether or not the input form contains a coda. In the data of both children, the liquid consonant, which is in a word-medial monopositional onset in the input form, is metathesized to be produced as coda despite the fact that there is not a coda position in the input form (65a-b, n-s). Also, it seems that codas start being produced under the condition that the following onset segment is coronal, namely both coda and onset segments agree in the coronal feature (65a-c and 65m-s, the only exception are 65d-e). This observation is more apparent in (65o), in which the input form /ðel.ˈfi.ni/ is produced as /ðe.ˈfil.ni/. /l/, which occupies the coda position of the word-initial syllable, is metathesized and is produced as coda in the second syllable of the word due to the fact that the next onset of the word, i.e. the third one, is occupied by a coronal consonant. However, we cannot make any generalization due to lack of more data. Also, as this issue is out for the scope of the present thesis, it is left for future research.

	Input form	Output form	Gloss	Child	Age
Word-medial codas					
65a.	a.fto.ˈko.li.ta	a.ˈkol.tsi.ta	stickers	DIM	2;00,04
b.	e.ˈle.fa.das	el.ˈðef	elephant	DIM	2;01,16
c.	ˈtur.ta	ˈtur.ta	cake	DIM	2;03,06
d.	i ɣor.ˈɣo.na	i ɣor.ˈɣo.la	mermaid	DIM	2;03,06
e.	ma.ˈçer.ja	a.ˈsel.ja	knives	DIM	2;05,01
Consonant clusters					
f.	ble	ble	blue	DIM	2;00,26
g.	ˈxro.ma.ta	ˈxlo.ma.ta	colours	DIM	2;02,06
h.	ˈxro.ma.ta	ˈxlo.ma.to	colours	DIM	2;02,23
i.	ˈplu.to	ˈplu.tos	proper name	DIM	2;03,06
j.	ˈple.ni	ˈple.ni	wash 3PR. Sg.	DIM	2;03,06
k.	ˈblu.za	ˈblu.za	blouse	DIM	2;03,06
l.	ble	bles	blue	DIM	2;04,10
Word-medial codas					
m.	ˈtur.ta	ˈtur.ta	cake	SPI	2;05,06
n.	ɣu.ru.ˈna.ci	ɣu.ul.ˈna.ti	pig DIM	SPI	2;06,15
o.	ðel.ˈfi.ni	ðe.ˈfil.ni	dolphin	SPI	2;10,10
p.	a.fto.ˈko.li.ta	ˈko.il.ta	stickers	SPI	2;10,25
q.	a.fto.ˈko.li.to	ko.ˈko.il.to	sticker	SPI	2;10,25
r.	çe.ˈlo.na	se.ˈðol.na	turtle	SPI	3;01,02
s.	ro.ˈlo.i	lol.ˈðo.i	watch	SPI	3;01,19
Consonant clusters					
t.	ˈkle.i	kle	cry 3PR Sg	SPI	2;08,08
u.	ble	ble	blue	SPI	2;08,08
v.	a.e.ro.ˈpla.no	a.e.ˈpʎa.no	airplane	SPI	2;08,08
w.	vi.ˈvli.o	me.ˈvli.o	book	SPI	2;09,06
x.	ˈpra.si.no	ˈpla.si.no	green	SPI	2;10,25
y.	ˈtri.a	ˈtli.a	three	SPI	3;03,21
z.	ˈtre.no	ˈtre.no	three	SPI	3;04,04

Only 5 out of 155 productions are faithful to the word-medial coda position in DIM's speech. Recall that faithful cluster productions are attested more frequently (7,5 % for stop-liquid clusters and 3,2% for fricative-liquid clusters.). As far as SPI is concerned, 7 out of 182 are instances of word-medial coda productions while 175 out of 857 (20,2%) and 20 out of 166 (12%) productions are faithful to stop-liquid and fricative-liquid clusters.

SPI's longitudinal data demonstrate that /l/ substitutes /r/ for long period during acquisition. Additionally, these two segments co-occur, as displayed in (66). These instances of variation may provide supportive evidence regarding the fact that distinct grammars are available to children during the acquisition. Hence, this pattern may be explained in terms of multiple parallel co-grammars (Tzakosta 2004a, b, 2005, 2006a, b, Revithiadou & Tzakosta 2004a, b, Tzakosta & Kappa 2008).

	Input form	**Output form**	**Gloss**	**Child**	**Age**
66a.	to ˈpra.si.no	to pra	green	SPI	3;02,02
b.	mi.ˈkri	mi.ˈkri	small	SPI	3;02,09
c.	mi.ˈkres	mi.ˈkleθ	small	SPI	3;03,06
d.	ˈpra.si.no	ˈpla.si.no	green	SPI	3;02,09
e.	ˈpra.si.no	ˈpra.si.no	green	SPI	3;03,14
f.	zo.ɣra.ˈfi.zu.me	o.ɣla.ˈfi.ðu.me	paint 1PR Sg	SPI	3;03,21
g.	ˈti.ɣris	ˈti.ɣris	tiger	SPI	3;03,21
h.	ˈtre.no	ˈtle.no	train	SPI	3;04,04
i.	to ˈtro.me	to ˈtro.me	eat 1PR Sg	SPI	3;04,11
j.	ce ˈpra.si.no	ce ˈpla.si.no	green	SPI	3;04,11
k.	ce ˈpra.si.no	ce ˈpra.si.no	green	SPI	3;04,11

Also, data show that the sonority influences children production when it comes to cluster realizations. In DIM's and in SPI's data, there are some instances in which the voiced plosive /b/ is realized as [p], namely it is realized as unmarked with respect to voicing. Such productions are attested only in labial stop-initial clusters which are contained in word-initial stressed syllables, as displayed in (67). This pattern accounts for 21% of DIM's faithful productions, as 6 out of 26 /bl/ targets exhibit this pattern and for 7% of SPI's faithful production, as 7 out of 95 /bl/ target clusters display this production pattern.

	Target word	**Child's output**	**Gloss**	**Child**	**Age**
67a.	ble	ple	blue	DIM	2;01,02
b.	ble	ples	blue	DIM	2;02,30
c.	ble	ple	blue	DIM	2;05,08
d.	ble	ple	blue	DIM	2;05,15
e.	ble	ple	blue	SPI	2;09,19
f.	ˈblu.za	ˈpru.ja	blouse	SPI	2;11,29
g.	ble	ple	blue	SPI	3;03,28
h.	ble	ple	blue	SPI	3;03,14

Interestingly, SPI's data show that the LABIAL-initial cluster /bl/ is sometimes realized as /vl/, as can be seen in (68). This pattern results in a more sonorous or a weaker consonant to be selected as the head of the complex onset of the initial syllable of the word. In terms of a radical underspecification account (Kiparsky 1982, Archangeli 1984, 1985, 1988, Pulleyblank 1986, 1988), the leftmost member of the cluster, i.e. /b/ which is specified for place of articulation ([LABIAL]) and for voicing ([+voiced]) and is underspecified for manner of articulation ([-continuant]) is realized as [v] which is specified for place ([LABIAL] and for manner of articulation ([+continuant]) and for voicing ([+voiced]). These instances of substitutions, despite rare, provide evidence that distinct grammars are available to children in the acquisitional process (Tzakosta 2004a, b, 2005, 2006a, b, Revithiadou & Tzakosta 2004a, b, Tzakosta & Kappa 2008).

	Target word	**Child's output**	**Gloss**	**Child**	**Age**
68a.	ble	vle	blue	SPI	2;08,23
b.	to ble	to vle	blue	SPI	2;08,23
c.	ble	vle	blue	SPI	3;01,02

Also, there are instances of variation in our data, i.e. variable forms are attested in children productions. For example, a single input form may have variable output forms (69). These instances of variation may provide further evidence regarding the fact that distinct grammars are available to children in development. Thus, variable forms may be explained in terms of multiple parallel co-grammars (Tzakosta 2004a, b, 2005, 2006a, b, Revithiadou & Tzakosta 2004a, b, Tzakosta & Kappa 2008).

	Target word	**Child's output**	**Gloss**	**Child**	**Age**
69a.	ble	ble	blue	SPI	2;08,08
b.	ble	vle	blue	SPI	2;08,23
c.	to ble	to vle	blue	SPI	2;08,23
d.	ble	ple	blue	SPI	2;09,19
e.	ˈblu.za	ˈpru.ja	blouse	SPI	2;11,29
f.	ble	vle	blue	SPI	3;01,02

Also, children's data show that the vowel of the syllable which contains a complex onset may force the retention of the entire cluster, namely the rightmost member of the cluster being CORONAL [+anterior] start being realized as part of the complex onset if the syllabic nucleus is occupied by a front vowel. As displayed in (70), if the vowel of the syllable is front, the CORONAL [+anterior] sonorant consonant is realized as the second member of the cluster. Consequently, if the vowel of the syllable is not front, the rightmost member of the cluster is deleted. Hence, it seems that there is an interaction between the vowels and the consonants of the complex onset of the syllable. Thus, we suggest that the vowel of the syllable may influences the realization of the head's complement.

	Target word	Child's output	Gloss	Child	Age
70a.	ble	ble	blue	SPI	2;08,08
b.	ˈkle.i	kle	cry 3PR Sg	SPI	2;08,08
c.	ble	ble	blue	SPI	3;00,09
d.	ˈklo.un	ko:n	clown	SPI	3;00,09
e.	ˈble	ˈble	blue	SPI	3;01,19
f.	mi.ˈkro	ma.ˈko	small	SPI	3;02,09
g.	mi.ˈkri	mi.ˈkri	smal	SPI	3;02,09
h.	ble	ble	blue	SPI	3;03,14
i.	ˈtri.a	ˈtli.a	three	SPI	3;03,21
j.	ˈtro.o	ˈto.o	eat 1PR Sg	SPI	3;03,21
k.	θa to ˈkli.so	ta to ˈkli.so	close 1PR Sg	SPI	3;03,21
l.	ˈtre.no	ˈtle.no	train	SPI	3;03,28
m.	ta ˈtro.me	ta ˈto.me	eat 1PR Pl	SPI	3;03,28

Gradually, this pattern fades away as language acquisition proceeds, as can be seen in (71). We assume that the child, as the acquisition proceeds, gains enough positive evidence that the [+anterior] coronal rightmost member of the cluster can be part of the complex onset regardless of whether the vowel of the syllable is front or not.

	Target word	Child's output	Gloss	Child	Age
71a.	ˈblu.za	ˈblu.zda	blouse	SPI	3;03,21
b.	ˈkra.nos	ˈkla.nos	helmet	SPI	3;04,04

In the intermediate phase, faithful outputs may co-occur with outputs which are not produced faithfully. In the course of development, regressions to previous developmental phases occur (e.g. Jakobson 1968, Tzakosta 2004 among others). Hence, not faithful outputs, which are observed in previous phases, are attested in the intermediate phase, too. Simplified outputs may co-occur with faithful ones. Children may reduce cluster to the less sonorous, namely the C_1 survives, or to the more sonorous member of the cluster, namely the C_2 surfaces. Also, they may apply coalescence[22], epenthesis or deletion of the entire cluster. These instances of regressions may provide evidence regarding the fact that distinct grammars are available to children during the acquisition. Thus, regressions may be explained in terms of multiple parallel co-grammars (Tzakosta 2004a, b, 2005, 2006a, b, Revithiadou & Tzakosta 2004a, b, Tzakosta & Kappa 2008). All the above are exemplified in (72).

	Input form	**Output form**	**Gloss**	**Child**	**Age**
72a.	pli.ˈdi.ri.o	pi.ˈdi.o	washing machine	DIM	2;04,18
b.	ˈblu.za	ˈbu.ja	blouse	DIM	2;04,18
c.	kli.ˈði	ci.ˈzi	key	DIM	2;05,15
d.	ble	be	blue	SPI	2;08,08
e.	kli.ˈðja	i.ˈja	keys	SPI	2;09,13
f.	ˈkli.ni	ˈti.ni	close 3PR Sg	SPI	2;09,19
g.	vi.ˈvli.o	e.ˈli.o	book	SPI	2;10,03
h.	ble	be	blue	SPI	2;10,10
i.	ˈblu.za	ˈpu.ja	blouse	SPI	3;01,02
j.	ˈtri.a	ˈti.ri	three	SPI	3;03,21
k.	ˈtre.no	ˈte.no	train	SPI	3;03,28
l.	ˈpra.si.na	ˈpla.si.na	green	SPI	3;03,28
m.	ˈpra.ɣma.ta	ˈpa.ma.ta	things	SPI	3;03,28
n.	ˈpro.tos	ˈpo.to	first	SPI	3;04,11

Given all the above, DIM's data show that clusters start being faithfully realized in the medial intermediate phase. Specifically, both stop-liquid and fricative-liquid clusters start being produced faithfully first in stressed syllables in the word-initial position, which is psycholinguistically a prominent position (Smith 2002). Stress and word position may play an active role when it comes to cluster production at this part of the intermediate developmental phase, as clusters which are contained in initial stressed syllables are the first to be produced. In the course of development, stop-liquid and fricative-liquid clusters gradually emerge word-medially, too. Both cluster types start being faithfully realized in medial word positions simultaneously. As DIM's data suggest stress play no role in cluster retention in the middle of the word. Furthermore, as it is indicated by the child's data, the sonority influences cluster productions. That is why voiced plosives are realized as voiceless in the intermediate phase. This pattern

[22] As it was shown in subsection 4.5.4. coalescence gradually fades away when the first faithful forms of each cluster type are realized.

results in bigger sonority distance between the members of the consonant cluster and, thus, the sonority slope is bigger, too.

4.7. Discussion on children's development

DIM started being recorded at the age of 1;10,29 and stopped being recorded at the age of 2;05,15. His longitudinal production data provide evidence that, when the recordings started, the child's development had already reached the intermediate acquisitional phase, as marked structures, for instance, word-final codas and fricative consonants, were attested in his speech. Specifically, taking into account his phonological patterns, we suggest that DIM was in the early intermediate phase of his development when we started the recording sessions.

As far as SPI is concerned, he started being recorded at the age of 2;01,24 and stopped being recorded at the age of 3;04,11. A glance at his data reveals that he was in a transitional phase between two major phases, i.e. the initial developmental phase and the intermediate one, since the phonological characteristics of the first phase were attested in his speech patterns and the emergence of marked structures had just started to emerge, for example, fricative consonants.

In the phonological acquisition literature, it is reported that the intermediate developmental phase starts either at the age of 18 months (Ingram 1989) or at around 24 months (Macken 1992) and that it is characterized by the emergence of marked structures, namely the emergence of fricatives, affricates, word-final and -medial codas and of marked syllabic structures, such as V, VC, CCV, CVC, CCVC, CCCVC (e.g. Jakobson 19411/968, Ingram 1989, Macken 1992, Fikkert 1994, Levelt et al. 1999/2000 Kappa, 1999, 2002a, b, 2004, Kappa 2009a, b, Kappa and Papoutsi 2019, Tzakosta 2003, Tzakosta & Kappa 2008, Papoutsakis 2018 among others).

The phonological characteristics of the intermediate phase which are attested in DIM's and SPI's longitudinal spontaneous production data are the following; first, voiceless and voiced fricatives are attested in children's data, as displayed in (73). (For clarification reasons only, we present the data from each child separately, i.e. DIM's data follow SPI's data. Also, children's data are presented chronologically.)

	Input form	**Output form**	**Gloss**	**Child**	**Age**
73a.	ˈxro.ma.ta	ˈxo.ma.ta	colors	DIM	1;10,29
b.	mo.ˈli.vi	ˈmi.vi	pencil	DIM	1;10,29

c.	er.ɣa.ˈsi.a	ɣa.ˈçi.a	homework	DIM	1;10,29
d.	ka.ˈfe	ka.ˈfe	coffee	DIM	1;11,06
e.	ˈðe.dro	ˈðe.do	tree	DIM	1;11,28
f.	pa.ˈra.θi.ro	pa.ˈla.θi.lo	window	DIM	2;01,09
g.	ci.ˈri.as	ˈci.as	madam's	SPI	2;02,11
h.	ˈli.ɣo	ˈji.ɣo	little	SPI	2;02,13
i.	ˈe.çi	ˈe.çi	have 3PR Sg	SPI	2;03,04
j.	roz	los	pink	SPI	2;03,16
k.	ˈɣo.ma	ˈxa.ma	rubber	SPI	2;03,19
l.	ti.ˈle.fo.no	ˈfe.to.no	telephone	SPI	2;03,23
m.	lu.ˈlu.ði	ˈlu.ði	flower	SPI	2;03,30
n.	ˈbri.za	ˈmi.za	plug	SPI	2;04,06

In addition, DIM produces mono-, di- and tri-, tetra- and pentasyllabic words faithfully. SPI produces mono-, di- and tri- and tetrasyllabic words faithfully. In SPI's data, faithfully realized pentasyllabic words are not attested. Also, there are instances in which both children truncate their target forms. The relevant data are given in (74).

	Input form	Output form	Gloss	Child	Age
74a.	ne	ne	yes	DIM	1;10,29
b.	ba.ˈbas	ba	dad	DIM	1;10,29
c.	a.ˈfto	a.ˈto	this	DIM	1;10,29
d.	ka.ˈpe.lo	pa.ˈpe.lo	hat	DIM	1;10,29
e.	pa.ra.ˈmi.θi	ˈni.çi	fairytale	DIM	1;10,29
f.	por.to.ka.ˈli	e.ka.ˈli	oragne	DIM	1;10,29
g.	pu.ˈka.mi.so	a.ˈka.nu.ço	shirt	DIM	2;00,04
h.	o.ˈbre.la	ˈbe.la	umbrella	DIM	2;00,04
i.	pa.pa.ˈɣa.la.ci	pa.pa.ˈɣo.la.ci	parrot DIM	DIM	2;00,04
j.	ne	ne	yes	SPI	2;01,24
k.	ˈkse.ro	ˈce.o	know 1PR Sg	SPI	2;01,24
l.	ˈka.ˈre.kla	ka.ˈje	chair	SPI	2;01,24
m.	por.to.ka.ˈli	ka.ˈli	orange	SPI	2;01,24
n.	a.ˈfto	ko	this	SPI	2;02,07
o.	ˈpra.si.no	pa	green	SPI	2;02,07
p.	a.fto.ˈci.ni.to	ci	car	SPI	2;02,11
q.	ti.ˈle.fo.no	ˈe.to.no	telephone	SPI	2;03,16
r.	vi.ˈvli.o	bi.ˈbi.o	book	SPI	2;03,19
s.	ma.ka.ˈro.ni	ka.ka.ˈlo.ni	spaghetti	SPI	2;03,30
t.	a.e.ro.ˈpla.no	ˈta.no	airplane	SPI	2;05,03
u.	a.e.ro.ˈpla.no	a.e.ˈpʎa.no	airplane	SPI	2;08,08

Interestingly, despite the fact that SPI was in the early intermediate phase, his data exhibit some reduplication instances. On the other hand, DIM, despite younger, does not exhibit reduplication instances in his speech. As can be seen in SPI's forms in (75), reduplication applies on di-, tri- and tetrasyllabic adult forms. What is copied may vary. Specifically, our data demonstrate that the stressed (75a-c, f) or an unstressed syllable of the word (75d-e) may be copied. In the Greek literature, it is suggested that the reduplication process forces the preservation of the prosodic/syllabic structure of the target forms (Christofidou & Kappa 1998) and that involves the copy of an entire syllable or foot[23] (Tzakosta 2007b). Tzakosta's (2007b) suggestion seems to explain our data. In the literature, reduplication instances are well-attested in the child speech (e.g. Schwartz et a. 1980, Fee & Ingram 1982, Lleo 1990, Berg 1992, Vihman 1996, Muller 1997, Christofidou & Kappa 1998, Klampfer 2001, Inkelas & Zoll 2004, Dressler et al. 2005, Kappa 2009b, Johnson & Reimers 2010 among others) and it is reported that reduplication is a universal phenomenon in child speech and, thus, reduplication instances can be found in all child languages regardless of whether or not this repetitive process is present in the children's target language (Johnson & Reimers 2010).

	Input form	**Output form**	**Gloss**	**Child**	**Age**
75a.	ba.ˈlo.ni	lo.ˈlo.ni	ballon	SPI	2;02,04
b.	o.ˈbre.la	be.ˈbe.ʎa	umbrella	SPI	2;02,13
c.	kli.ˈði	ci.ˈci.ði	hey	SPI	2;03,16
d.	ku.ne.ˈla.ci	te.te.ˈʎa.li	rabbit DIM	SPI	2;03,19
e.	sci.ˈla.ci	ci.ci.ˈla.ci	dog DIM	SPI	2;04,06
f.	pa.ˈta.tes	pa.pa.ˈpa.tes	potatoes	SPI	2;04,09

Furthermore, codas start to emerge in word-final positions. CVC syllabic shapes start being realized but, at first, only word-finally (76a, c, h, j, k). The coda segment is a fricative consonant, it signals the onset of the morphological development and functions as a morphological marker since it carries information about the gender, the case and the person (Kappa 2002a, 2009b). Regarding the word-medial codas, they are absent from children's productions (76b,) untill the age of 2;03,06 for DIM (76d) and the age of 2;05,06 for SPI (76i-j. l). Specifically, only 5 out of 155 productions are faithful to the word-medial coda position in DIM's speech. As far as SPI is concerned, 7 out of 182 are instances of word-medial coda productions. Despite the fact that SPI is older

[23] According to Tzakosta (2007b), reduplication involves the copy of the entire syllable or foot and consonant harmony involves segmental or featural copy.

than DIM, he does not produce word-medial codas systematically. Rather, his productions lack branching rhymes in the word medial position.

	Input form	Output form	Gloss	Child	Age
76a.	ba.ˈbas	ba.ˈbaç	dad	DIM	1;10,29
b.	er.ɣa.ˈsi.a	va.ˈçi.a	homework	DIM	1;10,29
c.	a.ˈftes	a.ˈtes	these	DIM	2;01,09
d.	ˈtur.ta	ˈtur.ta	cake	DIM	2;03,06
e.	i ɣor.ˈɣo.na	i ɣor.ˈɣo.la	mermaid	DIM	2;03,06
f.	ma.ˈçer.ja	a.ˈsel.ja	knives	DIM	2;05,01
g.	ma.ˈçer.ja	a.ˈsel.ja	knives	DIM	2;05,01
h.	i.ˈko.nes	ˈko.neç	εικόνες	SPI	2;02,04
i.	ˈkal.tsa	ˈtsa.tsa	sock	SPI	2;03,08
j.	ka.ˈfes	ka.ˈses	coffee	SPI	2;03,23
k.	i.ˈko.nes	ˈko.neç	pictures	SPI	2;03,23
l.	ˈtur.ta	ˈtu.ta	cake	SPI	2;04,06
m.	ˈtur.ta	ˈtur.ta	cake	SPI	2;05,06

Moreover, in parallel with the CV syllables, V, VC, CVC, CCV, CCVC syllabic shapes start to emerge, as it is shown in (77).

	Input form	Output form	Gloss	Child	Age
77a.	a.ma.ˈli.as	a.ma.ˈli.as	proper name	DIM	1;11,06
b.	ˈi.ʎos	ˈi.joç	sun	DIM	1;10,29
c.	tsu.ˈgra.na	tu.ˈgla.na	rake	DIM	2;04,03
d.	ble	bles	blue	DIM	2;04,10
e.	ˈa.lo	ˈa.lo	other	SPI	2;02,04
f.	ci.ˈri.as	ˈci.as	madam’s	SPI	2;02,11
g.	i.ˈko.nes	ˈko.neç	pictures	SPI	2;03,23
h.	ble	ble	blue	SPI	2;08,08
i.	a.ˈftos	a.ˈptos	he	SPI	3;00,09

As it was aforementioned, consonant clusters are expected to emerge during the intermediate phase of acquisition (e.g Jakobson 1941/1968, Kappa 2002a, b 2009a, b 2019, Tzakosta & Kappa 2008 among others). DIM’s and SPI’s production patterns confirm this claim. Despite the fact that, in the early intermediate phase, clusters are not allowed in their grammar both word-initially and word-medially, in the medial intermediate phase they start gradually being produced faithfully (78).

	Input form	Output form	Gloss	Child	Age

78a.	ble	ble	blue	DIM	2;00,26
b.	ˈplu.to	ˈplu.tos	proper name	DIM	2;03,06
c.	ˈblu.za	ˈblu.za	blouse	DIM	2;03,06
d.	to ˈta.blet	to ˈta.ble	tablet	DIM	2;05,15
e.	a.e.ro.ˈpla.no	a.e.ˈpʎa.no	airplane	SPI	2;08,08
f.	ble	ble	blue	SPI	2;08,23
g.	a.e.ro.ˈpla.no	a.lo.ˈpla.no	airplane	SPI	2;09,19
h.	ka.ˈre.kla	ka.ˈle.kla	chair	SPI	3;01,19

However, regressions to previous developmental phases still occur and, thus, various repair strategies apply, i.e. reduction to the less sonorous or to the more sonorous segment of the cluster, coalescence, epenthesis and deletion of the entire cluster, as displayed in (79).

	Input form	**Output form**	**Gloss**	**Child**	**Age**
79a.	ble	be	blue	DIM	1;10,29
b.	a.e.ro.ˈpla.no	e.ˈta.no	airplane	DIM	1;11,28
c.	ble	be	blue	SPI	2;02,04
d.	tra.ˈpe.zja	a.ˈpe.ca	tables	DIM	2;02,06
e.	‘xro.ma.ta	xo.ˈlo.ma.ta	colours	DIM	2;02,06
f.	ka.ˈre.kla	ce.ˈle.ta	chair	SPI	2;03,04
g.	ɣli.ˈko	o.ˈko	sweet	SPI	2;03,19
h.	ble	le	blue	SPI	2;04,09
i.	ble	le	blue	DIM	2;05,08
j.	ble	bi.ˈle	blue	SPI	2;10,10

Given all the aforementioned, children’s longitudinal spontaneous production data show that when the recordings started, they had already reached the intermediate developmental phase, as marked syllabic structures, namely V, VC, CVC, CCV and CCVC, polysyllabic words and marked segments, for example fricative consonants, were attested in their production patterns.

We suppose that the children’s development reaches the medial intermediate phase when complex onsets start to emerge. Therefore, we propose that DIM reaches the medial intermediate phase at the age of 2;03 and SPI at the age of 2;08. Put simply, we propose that the onset of the medial intermediate phase coincides with the emergence of branching onsets. i.e. when children start combining two consonantal segments within the onset. If we compare the age in which the medial intermediate phase starts for each child, it is evident that SPI reaches this phase relatively late in development and that DIM appears to be more linguistically advanced compared to SPI. DIM reaches the medial intermediate phase 5 months before SPI.

Nevertheless, SPI, when reaches the medial intermediate phase, starts realizing branching onsets more frequently than DIM. Recall that, as it was aforementioned in subsection 4.6, SPI produces faithfully stop-liquid and fricative-liquid clusters more frequently than DIM. Specifically, 175 out of 857 (20,2%) and 20 out 166 (12%) productions of stop-liquid and fricative-liquid clusters, respectively, are faithful to the input forms in SPI's data. Regarding DIM's data, 32 out of 425 (7,5%) and 3 out 95 (3,2%) productions of stop-liquid and fricative-liquid clusters, respectively, are faithful to the adult clusters.

Despite the fact that faithful clusters productions are attested in both SPI's and DIM's speech, we cannot claim that the children have acquired the stop-liquid and fricative-liquid consonant clusters. According to Kappa (2009b), a child has partially acquired a structure, if he produced this structure faithfully 50-75 out of 100 times, namely 50-75%. Also, she suggests that full acquisition has been accomplished when the average of faithfully productions is above 75%. Given the percentage of faithful productions of the stop-liquid and fricative-liquid clusters which are attested in the data of both children, we suggest that neither SPI nor DIM have even partially acquired these clusters.

Therefore, we suggest that the child's age cannot be considered as strong predictor for phonological acquisition. In other words, younger children may be more linguistically advanced than older children. In addition, younger children may reach the intermediate phase before older children. We propose that the developmental phases cannot be defined strictly chronologically. DIM and SPI are such representative examples confirming this claim.

4.8. Summary

This chapter focused on the acquisition of the well-formed stop-liquid and fricative-liquid, stop-nasal and fricative-nasal consonant clusters by DIM, the youngest child at the time when the recording sessions started (1;10), and SPI, the older child at the time when the recording sessions started (2;1). DIM's and SPI's developmental data show that, in the early intermediate phase, consonant clusters undergo several simplification strategies, i.e. reduction to the less sonorous segment (e.g. /bl/ → [b]) or to the more sonorous segment (e.g. /bl/ → [l]), epenthesis (e.g. /bl/ → [bel]), coalescence [e.g. /pl/

→ [t]) and deletion of the entire cluster (e.g. /bl/ → ∅) , due to the fact that complex onsets are not allowed by their grammar. Both children's data show that cluster reduction is the prevalent simplification strategy in stop-liquid/nasal and fricative-liquid/nasal clusters. SPI and DIM reduce the fricative-nasal to the more sonorous consonant and SPI reduces the stop-nasal to the more sonorous[24]. Stop-liquid and fricative-liquid clusters are mostly reduced to the less sonorous consonant by both children. We propose that they show strong preference for the onsets be occupied by the less sonorous segment among the cluster members. This simplification pattern may be driver from children's preference for 'optimal' syllables, namely syllables which display maximum rise in sonority from the onset to the nucleus. Alternatively, we can propose that stronger consonants are preferred over weaker ones in onset positions. Also, in the data of both children are found instances in which a marked consonant (for example the voiced /b/ and /v/) is realized as unmarked with respect to voicing (for example [p] and [f]) or to manner of articulation (for example [b]). Also, the aforementioned simplification patterns may suggest that children prefer mostly underspecified segments for manner of articulation or for voicing to occupy onset positions. Supportive evidence regarding this preference come from the instances of coalescence which are attested in DIM's and SPI's longitudinal spontaneous production data. Children's data demonstrate that coalescence may serve as strategy by which unmarked segments occur. Also, in SPI's data it seems that coalescence may reflect a sub-stage in cluster development, as instances of coalescence start fading away when faithful forms for each cluster type occur. Also, as far as the process of deletion of the entire cluster and of contiguity are concerned, in DIM's data, they have complementary distributions, i.e. contiguity is attested in labial-initial clusters while cluster deletions occur in dorsal- and coronal-initial clusters. In SPI's data, there is no evidence regarding a complementary relationship of the aforementioned processes. Regarding epenthesis, instances of epenthesis are rarely found both in DIM's and in SPI's data.

In the medial intermediate phase, complex onsets start being produced. SPI's data show that stop-liquid clusters emerge before fricative-liquid clusters. Also, the emergence of stop-liquid clusters in word-initial and word-medial stressed syllables precedes the emergence of the same clusters in word-initial and word-medial unstressed syllables. Fricative-liquid clusters emerge simultaneously in word-initial and -medial

[24] Recall that in DIM's data were not attested stop-nasal clusters as target forms.

stressed and unstressed syllables. DIM's data demonstrate that stop-liquid and fricative-liquid clusters start to emerge simultaneously in word-initial stressed syllables. In the course of development, both stop-liquid and fricative-liquid clusters start to emerge in medial unstressed syllables. Both DIM's and SPI's data lack faithfully produced stop-nasal and fricative-nasal clusters. Despite the fact that faithful clusters productions are attested in both SPI's and DIM's speech, we cannot propose that the children have acquired the stop-liquid and fricative-liquid clusters. Also, children's data reveal that DIM, despite younger reaches the medial intermediate phase before SPI who is older. We assume that the onset of the medial intermediate phase coincides with the emergence of branching onsets. Therefore, we suggest that the child's age cannot be considered as predictor for the phonological acquisition. In other words, younger children may be more linguistically advanced than older children.

5. Data analysis

This chapter presents the analysis of the faithfully realized clusters by DIM and SPI in light of the Three Scales Model (henceforth TSM, Tzakosta 2010, 2011, 2012, 2013a, b, 2016, 2019 and Tzakosta and Karra 2011). Firstly, in section 5.1, the theoretical model of the TSM is presented. Secondly, section 5.2 presents the analysis of DIM's faithfully produced clusters and, thirdly, section 5.3 presents the analysis of SPI's faithfully realized target clusters. Finally, in section 5.4 the main points of the data analysis are summarized.

5.1. Evaluation of cluster formation

The possible consonant combinations in a cluster are restricted by the sonority profile of the consonants. In other words, not all consonantal combinations form tautosyllabic consonant clusters. Cluster well-formedness is determined by the Sonority Scale (Selkirk 1984) (henceforth SS) and Sonority distance (SD) which is language-specific (Steriade 1982). Given that the SS is satisfied in a rightward manner, a cluster is well-formed if the first member of the cluster is less sonorous than the second one. For instance, stop-liquid, stop-nasal, fricative-liquid and stop-nasal clusters are well-formed due to the fact that the C_1 is less sonorous than the C_2. Also, as it was aforementioned above, the SD between the cluster members determines the degree of well-formedness of the cluster. By way of illustration, the following example is given; Both stop-nasal and stop-liquid clusters are well-formed. However, stop-liquid clusters are better-formed compared to stop-nasal ones due to the fact that the distance between stops and liquids is bigger, i.e. it is 4, compared to stops and nasals, i.e. it is 3. The universal SS is provided in (1) and is repeated here as (80).

(80) Univesal Sonority Scale (e.g. Selkirk 1984)

Stops > Fricatives > Nasals > Liquids > Glides > Vowels

--------------●-----------●------------●----------●----------●----------●-----------

Less sonorous 1 2 3 4 5 6 more sonorous

In the literature, language specific sonority scales have been proposed (e.g. Steriade 1982, Malikouti-Drachman, Kappa 1995:138 among others). Specifically, Malikouti-Drachman (1984) and Kappa (1995:138) have proposed sonority scales specific for

Standard Modern Greek. These scales are provided in (X) and (X) and are repeated below as (81) and (82).

(81) Sonority Scale for Standard Modern Greek (Malikouti-Drachman 1984)

	[p,t,k/f,θ,x]	[v,ð,ɣ]	[s]	[z]	[m,n]	[l,r]	Vowels
Less sonorous	1	2	3	4	5	6	more sonorous

(82) Sonority Scale for Standard Modern Greek (Kappa 1995:138)

	[p, t, k]	[f, θ, x]	[v, ð, ɣ]	[s]	[z]	[m, n]	[l, r]	Vowels
Less sonorous	1	2	3	4	5	6	7	8 More sonorous

As can be seen, in above scales segments are grouped with respect to manner of articulation and voicing. Thus, they are not grouped with respect to place of articulation. For example, in the sonority scales proposed by Malikouti-Drachman (1984) and Kappa (1995:138), both /pl/ and /kl/ are well-formed to the same degree regardless of the fact that the C_1 of /pl/ is labial and the C_1 of /kl/ is dorsal.

The distributions of clusters allowed within languages may be explained through a pair of Margin Hierarchies. Baertsch (2002) introduces the Split Margin Hierarchy. Her theoretical proposal splits the Margin Hierarchy proposed by Prince & Smolensky (1993). According to Baertsch (2002:58) *'The second segment of a complex onset is subordinate to the first and it is the relationship between the sonority levels of the two segments that largely determines whether that second segment can join with the first as a complex onset.'*

(83) Onset Structure (Baertsch 2002:58)

Onset

↓ ↘

M_1 M_2

The first member of the complex onset is the M_1 and the second member of the complex onset is the M_2. Therefore, the Syllable Position Prominence scale is the following:

$M_1 > M_2$

According to Baertsch (2002:58), '*aligning the $M_1 > M_2$ Syllable Position Prominence scale with Segmental Sonority Prominence generates the two Margin hierarchies'*. These two Margin Hierarchies are given in (84).

(84) M_1 and M_2 hierarchies (Bartsch 2002: 59)

M_1 Hierarchy: $*M_{1/a} >> *M_{1/i} >> *M_{1/r} >> *M_{1/l} >> *M_{1/n} >> *M_{1/t}$

M_2 Hierarchy: $*M_{2/t} >> *M_{2/n} >> *M_{2/l} >> *M_{2/r} >> *M_{2/i} >> *M_{2/a}$

The M_1 hierarchy is similar to Prince & Smolensky's (1993) Margin Hierarchy. The M_2 hierarchy drives the analysis of complex onsets. Finally, cluster acceptability is determined by the sonority distance between the two consonantal segments and the acceptability of these two consonants in each position. Local constraint conjunction plays a key role in determining if a complex onset is acceptable or not.

In the following subsection we suggest that cluster well-formedness is evaluated taking into account the distinct role of manner and place of articulation and of voicing (Tzakosta 2010, 2011, 2012, 2013a, b 2016, 2019, Tzakosta and Karra 2011).

5.2. Three Scales Model

A theoretical model which can be used in order to evaluate the formation of consonant clusters is the Three Scales Model (TSM) which was initially introduced by Tzakosta (2010, 2011, 2012, 2013a, b 2019) and Tzakosta and Karra (2011) in order to account for the clusters which are attested in dialects of Standard Modern Greek. Later studies show that the TSM can account for the acquisitional data adequately, too (Tzakosta 2016). At the core of the TSM lie three scales, namely the Manner of Articulation scale (MoA) (85), the Place of Articulation scale (PoA) (86) and the Voicing scale (V) (87).

(85) The Manner of Articulation scale (Tzakosta 2010:216)

S	F/Sib	Affr	N	L	G	V
●	●	●	●	●	●	●
1	2	3	4	5	6	7

(86) The Place of Articulation scale (Tzakosta 2010:216)

	Dorsals	Labials	Coronals	
-------------●	-------------------------●	-------------------------●	-----------------------	
	1	2	3	

(87) Voicing scale (Tzakosta 2010:219)

	[-voiced]	[+voiced]	
---------------------●	---●	-------------------	
	1	2	

The above scales are satisfied in a rightward manner. All the consonant clusters satisfy or violate the aforementioned scales to a certain degree. The degree of satisfaction of each scale is measured taking into account the distance (D) among the members of the consonant cluster on the scale. Therefore, using the TSM it is possible to assess the tautosyllabic consonantal sequences and to capture the subtle cluster differentiations. Furthermore, based on the degree of satisfaction or violation of the scales of MoA, PoA and V, clusters fall into three distinct categories. To be more specific, clusters are either perfect either acceptable or non-acceptable. However, another issue must be taken into consideration. Specifically, not all perfect clusters are perfect to the same extent. Accordingly, not all acceptable clusters are acceptable to the same degree. Put differently, cluster perfection and acceptability are gradient due to distance. The following examples will shed light in the above claims (88).

	Form	**Gloss**
Perfect clusters		
88a.	ˈpro.tos	first
b.	ˈvri.si	tap
Acceptable clusters		
c.	fθi.ˈnos	cheap
d.	fti.ˈnos	cheap

In (88a-b), both /pr/ and /vr/ are perfect clusters, as they satisfy all three scales, i.e. the MoA scale, the PoA scale and the V scale. However, on the manner level, /pr/ is better than /vr/ due to the fact that the D between /p/ and /r/ is 4, while it is 3 between /v/ and /r/. Accordingly, in (88c-d) /fθ/ and /ft/ are both acceptable clusters. /fθ/ is better than

/ft/ because the former satisfies vacuously the MoA scale and the latter violates it. Also, /fθ/ satisfies minimally the place scale, i.e. the D is 1, and /ft/ satisfies the same scale vacuously, i.e. the D is 0. In addition, both clusters satisfy vacuously the V scale. Therefore, a perfect cluster satisfies at least minimally all three scales. An acceptable cluster needs to satisfy the MoA or the PoA scale at least vacuously and violate the other and at the same time satisfy at least vacuously the V scale. Furthermore, a cluster is acceptable if it satisfies vacuously all three scales. Moreover, an acceptable consonant cluster may violate both the MoA and the PoA scale and at least vacuously satisfiy the V scale. As far as the non-acceptable clusters are concerned, such a cluster violates all three scales or satisfies the MoA and the PoA scale but violates the V scale. The above claims suggest that among the three scales, the role of the V scale is crucial. In other words, the violation of the V scale results in non-acceptable clusters. Tables (12), (13) and (14) presents the gradience in cluster formation with respect to manner and place of articulation and to voicing.

Table 12 Gradience in cluster formation (MoA)

TYPES	PERFECT	ACCEPTABLE	NON-ACCEPTABLE
Stop + Liquid	✓		
Fricative + Liquid	✓		
Stop + Stop		✓	
Fricative + Fricative		✓	
Stop + Fricative	✓		
Fricative + Stop			✓
Stop + Affricate	✓		
Affricate + Stop			✓
Fricative + Affricate	✓		
Affricate + Fricative			✓

Table 13Gradience in cluster formation (PoA)

TYPES	PERFECT	ACCEPTABLE	NON-ACCEPTABLE
Labial + Labial		✓	
Labial + Coronal	✓		
Labial + Velar			✓
Coronal + Coronal		✓	
Coronal + Labial			✓
Coronal + Velar			✓
Velar + Velar		✓	
Velar + Coronal	✓		
Velar + Labial	✓		

Table 14 Gradience in cluster formation (Voicing)

TYPES	PERFECT	ACCEPTABLE	NON-ACCEPTABLE
[+voiced] + [+voiced]		✓	
[+voiced] + [-voiced]			✓
[-voiced] + [+voiced]	✓		
[-voiced] + [-voiced]		✓	

To sum up, the TSM evaluates the cluster formation using three distinct scales, i.e. the MoA scale, the PoA scale and the V scale. A cluster may be perfect, acceptable or non-acceptable. A perfect cluster satisfies all three scales at least minimally, an acceptable cluster satisfies at least vacuously all three scales and a non-acceptable cluster either violates all three scales or satisfies the MoA and/or PoA scale at least vacuously and violates the V scale. Last but not least, cluster perfection and acceptability are gradient due to distance.

5.2.1. DIM's and SPI's analysis of faithful produced clusters

In DIM's and SPI's speech, the well-formed stop-liquid and fricative-liquid clusters emerge in the medial intermediate phase, as it was aforementioned in chapter 4. In children's data, there are no faithful productions of stop-nasal and fricative-nasal clusters[25]. In children's data, perfect and acceptable clusters are attested in their speech, as displayed in Table (15) below.

Table 15 Clusters attested in DIM's and SPI's data

Clusters	Perfect	Acceptable	Non-Acceptable	Child
/pl/	✓			DIM and SPI
/pr/	✓			SPI
/bl/		✓		DIM and SPI
/kl/	✓			DIM and SPI
/kr/	✓			SPI
/gr/		✓		DIM and SPI
/tr/		✓		SPI
/fl/	✓			SPI

[25] Specifically, in DIM's data there are no stop -nasal clusters as target forms. As far as the fricative-nasal clusters are concerned, only 2 fricative-nasal clusters as target forms are attested. However, the child applied the simplification strategy of cluster reduction. In SPI's data is attested fourteen tokens of stop-nasal clusters as target forms and one token of fricative-nasal clusters as target forms. SPI applies reduction to the more sonorous segment, and, thus the sonorant member of the cluster is chosen rather than the obstruent.

/vl/		✓		SPI
/vr/		✓		SPI
/xr/	✓			DIM
/ɣr/		✓		SPI
/θl/		✓		DIM and SPI

As it was shown in Table (15) above, the faithfully produced clusters are either perfect or acceptable, as they satisfy all three scales at least vacuously, i.e. the MoA scale, the PoA scale and the V scale, presented in (85-87) and repeated below as (89-91).

(89) The Manner of Articulation scale (Tzakosta 2010:216)

S F/Sib Affr N L G V

----------●-----------●-------------●---------●--------●--------●----------●---------

1 2 3 4 5 6 7

(90) The Place of Articulation scale (Tzakosta 2010:216)

Dorsals Labials Coronals

------------●-------------------------●-------------------------●-----------------------

1 2 3

(91) Voicing scale (Tzakosta 2010:219)

[-voiced] [+voiced]

---------------------●---●------------------

1 2

The TSM evaluates clusters and captures their differentiations. The categorization of clusters as perfect, acceptable or non-acceptable is determined by the degree of satisfaction or violation of the MoA scale, the PoA scale and the V scale. Both stop-liquid and fricative-liquid clusters which are attested in the children's data are perfect on the manner scale (e.g. /pl and /θl/). The distance among the members of a stop-liquid cluster is 4 while it is 3 among the members of a fricative-liquid one. Thus, the former types constitute better-formed clusters compared to the latter ones since cluster perfection is gradient due to distance. Additionally, both stop-liquid and fricative-liquid clusters form either perfect or acceptable clusters since they satisfy at least vacuously the PoA scale. [DORSAL-CORONAL] (e.g. /ɣr/) and [LABIAL-CORONAL] (e.g. /bl/) sequences form perfect clusters since the distance is 2 and 1, respectively. A coronal-coronal sequence (e.g. /tr/) forms an acceptable cluster as it satisfies vacuously the PoA scale. Last but not least, both stop-liquid and fricative-liquid clusters satisfy minimally or vacuously the V scale. A [-voiced] + [+voiced] sequence (e.g. /pl/) forms a perfect cluster with distance 1 and a [+voiced] + [+voiced] (e.g. /gr/) sequence forms an acceptable cluster with distance 0. Table (16) below summarizes the subtle differentiations among the attested consonant clusters in DIM's and SPI's data and, also, incorporates the clusters' category.

Table 16 Distance between the cluster members and their category

Clusters	**MoA**	**PoA**	**V**		**Child**
/pl/	4	1	1	Perfect	DIM and SPI
/pr/	4	1	1	Perfect	SPI
/bl/	4	1	0	Acceptable	DIM and SPI
/kl/	4	2	1	Perfect	DIM and SPI
/kr/	4	2	1	Perfect	SPI
/gr/	4	2	0	Acceptable	DIM and SPI
/tr/	4	0	1	Acceptable	SPI
/fl/	3	1	1	Perfect	SPI
/vl/	3	1	0	Acceptable	SPI
/vr/	3	1	0	Acceptable	SPI
/xr/	3	2	1	Perfect	DIM
/ɣr/	3	2	0	Acceptable	SPI
/θl/	3	0	1	Acceptable	DIM and SPI

As Table 16 shows, both DIM and SPI produce both perfect and acceptable clusters. With respect to the MoA scale, all the produced clusters by the children are perfect. /pl/, /pr/, /bl/, /kl/, /kr/, /gr/ and /tr/ are better-formed clusters compared to /fl/, /vl/, /vr/, /xr/, /ɣr/ and /θl/ due to the fact that the distance between the members of the former clusters is 4, while it is 3 for the latter ones. Accordingly, with respect to the PoA scale both perfect and acceptable clusters are attested. Specifically, /kl/, /kr/, /gr/, /ɣr/ and /xr/ are better-formed clusters than /pl/, /pr/, /bl/, /fl/, /vr/, /vl/, /tr/ and /θl/. The distance among the members of /kl/, /kr/, /gr/, /ɣr/ and /xr/ is 2 while it is 1 among the members of /pl/, /pr/, /bl/, /fl/, /vr/ and /vl/ and 0 among the members of /tr/ and /θl/. Recall that the maximal possible distance for perfect clusters is 2 and the minimal is 1 on the place scale. If the distance is 0, then the cluster is acceptable. Last but not least, with respect to the V scale, /pl/, /pr/, /kl/, /kr/, /tr/, /fl/, /xr/ and /θl/ are all better-formed clusters than /bl/, /vl/, /vr/, /ɣr/ and /gr/. /pl/, /pr/, /kl/, /kr/, /tr/, /fl/, /xr/ and /θl/ satisfy the V scale, i.e. the distance is 1, and form a perfect cluster. /bl/, /vl/, /vr/, /ɣr/ and /gr/ form acceptable clusters due to the fact that the distance among their members is 0.

DIM's and SPI's data show that, at the manner level, all the cluster types which are attested in the children's speech are perfect. The distance between stops and liquids is 4 and it is 3 between fricatives and liquids. Since cluster perfection is gradient due to distance, stop-liquid sequences are better-formed than fricative-liquid ones. Furthermore, we assume that stop-liquid clusters emerge more frequently than fricative-liquid ones. The children's data confirm this assumption. Specifically, in DIM's data, 33 out of 419 (7,9%) stop-liquid output forms are faithful to the input forms while 3 out of 92 fricative-liquid output forms (3,3%) are faithful to the input clusters. As far as SPI is concerned, in his data, 175 out of 857 (20,4%) stop-liquid output forms are faithful to the input forms while 20 out of 166 (12%) fricative-liquid output forms are faithful to the input clusters. Faithful productions of stop-nasal and fricative-nasal clusters were not attested in DIM's and SPI's data. Recall that the distance between fricatives and nasals is 2, and, therefore, these clusters are worse-formed compared to stop-liquid and fricative-liquid ones and it is expected to emerge later in development. All the aforementioned, are depicted in Tables 17 through 20.

Table 17DIM's and SPI's faithful productions of stop-liquid clusters

	DIM			SPI		
CL T	**T**	**Faithful productions**	**Percentage**	**T**	**Faithful productions**	**Percentage**
stop-liquid						
/pl/	25	2	10,5%	36	10	27,8%
/pr/	32	0	0%	58	20	34,5%
/bl/	52	28 (22 [bl] and 6 substitutions by [pl]	53% (21% substitutions by [pl]	252	95	37,7%
/br/	8	0	0%	2	-	0%
/kl/	70	2	2,9%	146	24	16,4%
/kr/	72	0	0%	51	6	11,8%
/gr/	1	1	100%	2	1	50%

/tr/	131	0	0%	268	19	7,1%
/dr/	28	0	0%	42	-	0%
Total	**419**	**33**	**7,9%**	857	175	20,4%

Table 18 DIM's and SPI's Faithful productions of fricative-liquid clusters

	DIM			**SPI**		
CL T	**T**	**Faithful productions**	**Percentage**	**T**	**Faithful productions**	**Percentage**
fricative-liquid						
/fl/	3	0	0%	23	8	34,8%
/fr/	11	0	0%	-	-	0%
/vl/	14	0	0%	68	3	4,4%
/vr/	13	0	0%	27	6	22,2%
/xl/	4	0	0%	-	-	0%
/xr/	18	2 (2 out of 2 substitutions by [xl])	11,1%	15	-	0%
/ɣl/	1	0	0%	7	-	0%
/ɣr/	14	0	0%	17	2	11,8*
/θl/	1	1	100%	2	1	50%
/θr/	2	0	0%	3	-	0%
/ðr/	13	0	0%	4	-	0%
Total		92	3	166	20	12%

Table 19 Faithful productions of stop-nasal clusters

	DIM			**SPI**		
CL T	**T**	**Faithful productions**	**Percentage**	**T**	**Faithful productions**	**Percentage**
stop-nasal						
/pn/	-	-	-	14	0	0%
Total	-	-	-	14	0	0%

Table 20 Faithful productions of fricative-nasal clusters

	DIM			**SPI**		
CL T	**T**	**Faithful productions**	**Percentage**	**T**	**Faithful productions**	**Percentage**
fricative-nasal						
/xn/	2	0	0%	1	0	0%
Total	2	0	0%	1	0	0%

A glance at the data reveals that the PoA scale needs to be satisfied at least vacuously.

It is interesting that 3 out of 6 cluster types attested in Dimitris' data, i.e. /kl/, /xr/ and /gr/ are [VELAR + CORONAL] sequences and that 2 out of 6 cluster types, i.e. /pl/ and /bl/, are [LABIAL + CORONAL] sequences. Also, in SPI's data, 4 out of 12 cluster types attested in his speech, i.e. /kl/, /kr/, /gr/ and /ɣr/, are [VELAR + CORONAL] sequences and 6 out of 12 cluster types attested in his data, i.e. /pl/, /pr/, /bl/, /fl/, /vl/ and /vr/ are [LABIAL + CORONAL] sequences. Both [VELAR + CORONAL] and [LABIAL + CORONAL] sequences form perfect clusters with respect to the place scale. Nevertheless, given that cluster perfection is gradient due to distance, the former clusters are better-formed than the latter ones since the distance is 2 among the members of the former and it is 1 among the members of the latter. In DIM's data, only one cluster type, namely /θl/, and, in SPI's data, only two cluster types, namely /θl/ and /tr/, are [CORONAL + CORONAL] sequences. The aforementioned consonantal sequences form acceptable clusters since the distance among their members on the place scale is 0. Consequently, given that cluster perfection and cluster acceptability is gradient due to distance, [VELAR + CORONAL] clusters are better than [LABIAL + CORONAL] and [CORONAL + CORONAL]. Consequently, [LABIAL + CORONAL] are better-formed than [CORONAL + CORONAL] clusters. Hence, at the place level, perfect as well as acceptable clusters emerge in the children's data.

[CORONAL + CORONAL] clusters are little preferred by the children, as only two cluster types, i.e. /tr/ and /θl/, are faithfully realized by them. Recall that DIM produces /θl/ and SPI produces both /θl/ and /tr/. Firstly, since their members have the same landing point on the PoA scale, /θl/ and /tr/ constitute acceptable clusters. I suppose that, in the medial intermediate phase, the children's grammar requires that the PoA scale be satisfied with the maximal or the minimal possible distance, i.e. 2 or 1. Therefore, [VELAR + CORONAL] clusters and [LABIAL + CORONAL] ones are mostly preferred. However, The TSM may only partially explains the lack of preference for [CORONAL + CORONAL] clusters. The fact that these clusters are mostly absent from DIM's and SPI's grammar may be due to OCP effects, i.e. the adjacency of identical features is not permitted (Goldsmith 1976, Ito & Mester 1986, McCarthy 1986, Yip 1988). As has been shown in previous developmental studies (Kappa 2002a, Kappa & Papoutsi 2019, Tzakosta 2009a), OCP effects are well-attested in the Greek child speech. Overall, in DIM's data, 1 out of 183 (0,54%) output forms are faithful to the input ones. Also, in SPI's data 20 out of 319 (6,7%) output forms are faithful to the input ones. All the above can be seen in Table (21).

Table 21 [Coronal + Coronal] sequences in DIM's and SPI's speech

	DIM			SPI		
CL T	**T**	**Faithful productions**	**Percentage**	**T**	**Faithful productions**	**Percentage**
[CORONAL + CORONAL]						
/tr/	131	0	0%	268	19	7,1%
/dr/	28	0	0%	42	-	0%
/θl/	1	1	100%	2	1	40%
/θr/	2	0	0%	3	0	0%
/ðr/	13	0	0%	4	0	0%
Total	**183**	**1**	**0,54%**	**319**	**20**	**6,7**

Additionally, despite the fact that more [VELAR + CORONAL] cluster types, category which, at the place level, forms perfect clusters with the maximal possible distance among the cluster members (2), are attested in DIM's production data, only 5 out of 179 output forms (2,8%) are faithful to the input ones. Also, as far as SPI is concerned, 33 out of 238 (13,7%) output forms are faithful to the input ones. Table (22) demonstrates the above.

Table 22 [VELAR + CORONAL] sequences in DIM's and SPI's speech

	DIM			SPI		
CL T	**T**	**Faithful productions**	**Percentage**	**T**	**Faithful productions**	**Percentage**
[VELAR + CORONAL]						
/kl/	70	2	2,9%	146	24	16,4%
/kr/	72	0	0%	51	6	11,8%
/gl/	-	-	-	-	-	-
/gr/	1	1	100%	2	1	50%
/xl/	4	0	0%	-	-	0%
/xr/	18	2 (2 out of 2 substitutions by [xl])	11,1%	15	-	0%
/ɣl/	1	0	0%	7	-	0%
/ɣr/	14	0	0%	17	2	11,8%
Total	**5**	**179**	**2,8%**	**238**	**33**	**13,7%**

Also, data show that [LABIAL + CORONAL] clusters are mostly successfully targeted by DIM and SPI. The members of the [LABIAL + CORONAL] clusters do not land on the same position on the scale, i.e. the distance is 1. It is interesting that 30 out of 158 forms (19%) are realized faithfully by DIM. Also, 142 out of 466 (30,5%) forms are faithfully produced by SPI. The above are depicted in Table (23).

Table 23 [LABIAL + CORONAL] sequences in DIM's and SPI's speech

	DIM			SPI		
CL T	**T**	**Faithful productions**	**Percentage**	**T**	**Faithful productions**	**Percentage**
[LABIAL + CORONAL]						
/pl/	25	2	10,5%	36	10	27,8%
/pr/	32	0	0%	58	20	34,5%
/bl/	52	28 (22 [bl] and 6 substitutions by [pl]	53% (21% substitutions by [pl]	252	95	37,7%
/br/	8	0	0%	2	-	0%
/fl/	3	0	0%	23	8	34,8%
/fr/	11	0	0%	-	-	0%
/vl/	14	0	0%	68	3	4,4%
/vr/	13	0	0%	27	6	22,2%
Total	**158**	**30**	**19%**	466	142	30,5%

The satisfaction of the Voicing scale is crucial in both DIM's and SPI's speech. Specifically, DIM clusters are mostly constituted by a [-voiced] segment as the leftmost member of the cluster and a [+voiced] segment as the rightmost one. Interestingly, 4 out of 6 faithfully produced clusters, i.e. /pl/, /kl/, /xr/ and /θl/ are sequences of a [-voiced] consonant followed by a [+voiced]. SPI shows the same tendency. Specifically, 7 out of 12 clusters types in SPI's speech, i.e. /pl/, /pr/, /kl/, kr/, /tr/, /fl/ and /θl/ are [-voiced + +voiced] sequences. However, in DIM's data, despite the fact that 4 out of 6 cluster types attested in his data are sequences of a [-voiced] followed by a [+voiced] consonant, only 13 out of 377 output forms are faithful to the input ones (3,4%). In SPI's data 88 out of 602 output forms are faithful to the input ones (14,6%). The aforementioned are illustrated in Table (24).

Table 24 [-voiced] + [+voiced] sequences in DIM's and SPI's speech

	DIM	SPI

CL T	T	Faithful productions	Percent-age	T	Faithful produc-tions	Percentage
[-voiced + +voiced]						
/pl/	25	2	8%	36	10	27,8%
/bl/ substi-tuted by [pl]		6				
/pr/	32	0	0%	58	20	34,5%
/kl/	70	2	2,85%	146	24	
/kr/	72	0	0%	51	6	
/tr/	141	0	0%	268	19	7,1%
/fl/	3	0	0%	23	8	34,8%
/fr/	11	0	0%	-	-	0%
/xl/	4	0	0%	-	-	0%
/xr/	18	2 (2 out of 2 substitutions by [xl])	11,1%	15	-	0%
/θl/	1	1	100%	2	1	50%
/θr/	2	0	0%	3	-	0%
Total	**377**	**13**	**3,4%**	**602**	**88**	**14,6%**

As far as the [+voiced] + [+voiced] sequences are concerned, only 2 out of 6 faithfully produced clusters consist of a [+voiced] consonant followed by a [+voiced] in DIM's data. However, as Table (25) demonstrates, 23 out of 129 output forms are realized faithfully to the input ones (17,8%). Interestingly, a glance at the Table 25 shows that 22 out of 52 /bl/ clusters are realized faithfully (53%). In SPI's speech, 5 out of 12 cluster types are [+voiced + +voiced] sequences. Specifically, 12 out 421 forms are produced faithfully. All the above are demonstrated in Table (25).

Table 25 [+voiced + +voiced] sequences in DIM's and SPI's speech

	DIM			**SPI**		
CL T	**T**	**Faithful productions**	**Percentage**	**T**	**Faithful produc-tions**	**Percentage**
[+voiced + +voiced]						
/bl/	52	28 (22 [bl] and 6 substi-tutions by [pl]	53% (21% substitutions by [pl]	252	95	37,7%
/br/	8	0	0%	2	-	0%
/gr/	1	1	100%	2	1	50%

/dr/	28	0	0%	42	-	0%
/vl/	14	0	0%	68	3	4,4%
/vr/	13	0	0%	27	6	22,2%
/ɣl/	1	0	0%	7	-	0%
/ɣr/	14	0	0%	17	2	11,8%
/ðr/	13	0	0%	4	-	0%
Total	**129**	**23**	**17,8%**	**421**	**12**	**2,8%**

Also, some interesting observation can be made if we look at DIM's and SPI's data. It is interesting that there are some instances in which /bl/ is realized as [pl]. Recall that /bl/ constitutes an acceptable cluster and /pl/ constitutes a perfect one. Specifically, /bl/ is an acceptable cluster due to the fact that it satisfies both the MoA and the PoA scale but satisfies vacuously the V scale, i.e. the distance is 0. /pl/ constitutes a perfect cluster, as all three scales, i.e. the MoA scale, the PoA scale and the V scale, are satisfied. This pattern may provide evidence that the maximal satisfaction of the Voicing scale is crucial in DIM's and SPI's earliest CCV(C) forms and that [-voiced] + [+voiced] sequences are more natural and unmarked in their speech. By way of illustration, the data in (67) are repeated here as (92).

	Target word	**Child's output**	**Gloss**	**Child**	**Age**
92a.	ble	ple	blue	DIM	2;01,02
b.	ble	ples	blue	DIM	2;02,30
c.	ble	ple	blue	DIM	2;05,08
d.	ble	ple	blue	DIM	2;05,15
e.	ble	ple	blue	SPI	2;09,19
f.	ˈblu.za	ˈpru.ja	blouse	SPI	2;11,29
g.	ble	ple	blue	SPI	3;03,28

In addition, in SPI's data there are instances in which the first member of the cluster /bl/, i.e. /b/, is realized as [v]. Both /b/ and [v] are voiced LABIALS. They differ with respect to the manner of articulation, namely /b/ is stop and [v] is fricative. Despite the fact that both /bl/ and [vl] are acceptable clusters since they satisfy the MoA and the PoA scale and satisfy the V scale vacuously, [vl] is worse-formed compared to /bl/. The distance between the members of [vl] is 3 while it is 4 between the members of [bl] on the manner scale. The data in (68) repeated here as (93) illustrate this pattern.

	Target word	**Child's output**	**Gloss**	**Child**	**Age**

93a.	ble	vle	blue	SPI	2;08,23
b.	to ble	to vle	blue	SPI	2;08,23
c.	ble	vle	blue	SPI	3;01,02

Given all the above, the children's data demonstrate that perfect and acceptable clusters are produced. There is not a single instance of a non-acceptable cluster production in DIM's and SPI's data. Specifically, stop-liquid and fricative-liquid clusters are the ones which are produced. Stop-nasal and fricative-nasal clusters were not attested in the children's data. We suppose that the latter cluster types emerge later in development. Also, DIM's and SPI's data show that the manner scale is the one which is always satisfied given that distance between stops and liquids is 4 while it is 3 between fricatives and liquids. Therefore, with respect to the MoA scale, perfect clusters emerge. Furthermore, children's productions show that LABIAL-CORONAL and VELAR-CORONAL sequences are mostly preferred. CORONAL-CORONAL clusters are not produced frequently. Thus, with respect to the PoA scale, both perfect and acceptable clusters emerge. Moreover, both DIM and SPI mostly produce [-voiced + +voiced] clusters. Therefore, there is a tendency for perfect clusters to emerge with respect to the voicing scale. All the aforementioned are summarized in the Table (16), repeated here as (26).

Table 26 DIM's and SPI's clusters and subtle differentiations among them

Clusters	MoA	PoA	V	Category	Child
/pl/	4	1	1	Perfect	DIM and SPI
/pr/	4	1	1	Perfect	SPI
/bl/	4	1	0	Acceptable	DIM and SPI
/kl/	4	2	1	Perfect	DIM and SPI
/kr/	4	2	1	Perfect	SPI
/gr/	4	2	0	Acceptable	DIM and SPI
/tr/	4	0	1	Acceptable	SPI
/fl/	3	1	1	Perfect	SPI
/vl/	3	1	0	Acceptable	SPI
/vr/	3	1	0	Acceptable	SPI
/xr/	3	2	1	Perfect	DIM
/ɣr/	3	2	0	Acceptable	SPI
/θl/	3	0	1	Acceptable	DIM and SPI

5.3. Summary

This chapter dealt with the issue of faithful cluster productions by DIM and SPI within the theoretical model of Three Scales Model. The TSM evaluates the cluster formation using three distinct scales, namely the manner of articulation scale, the place of articulation scale and the voicing scale. A consonant cluster may be perfect, acceptable or non-acceptable. A perfect cluster satisfies all three scales at least minimally, an acceptable cluster satisfies at least vacuously all three scales and a non-acceptable cluster either violates all three scales or satisfies the MoA and/or PoA scale at least vacuously and violates the V scale. Also, cluster perfection and acceptability are gradient due to distance. The children's data demonstrate that stop-liquid and fricative-liquid clusters are the cluster types which are preferred the most by DIM and SPI. On the contrary, faithful productions of stop-nasal and fricative-nasal clusters were not attested in the children's data. Children's data show that there is a preference for perfect and acceptable clusters to be realized. Also, there is a tendency that the cluster members display the biggest possible distance between them on the manner of articulation scale. Additionally, data show that the maximal satisfaction of the V scale drives DIM's and SPI's realizations since [-voiced, + voiced] cluster types mostly emerge. Also, the minimal or maximal satisfaction of the PoA scale is crucial as well, since the members of the attested clusters in the children's data mostly do not land on the same position on the place scale.

6. The impact of input frequency in acquisition

This chapter investigates the impact of the input frequency in the acquisition of the well-formed clusters, i.e. stop-liquid, fricative-liquid, stop-nasal and fricative-nasal clusters in Standard Modern Greek. Previous acquisitional studies showed that the frequency plays a significant role in language acquisition (Goad & Ingram 1987, Jusczyk et al., 1994, Ingram 1989, Zamuner 2003, Gerken & Zamuner 2007, Levelt et al. 1999/2000, Levelt & van de Weijer 2004, Stites et al., 2004, van de Weijer 2012, 2014, 2017, van de Weijer & Sloos 2013a, b, van de Weijer & Tzakosta 2017, Kappa 2009a,b, Tzakosta & Kappa 2008). Tzakosta & Kappa (2008) based on longitudinal production data of Standard Modern Greek-acquiring children suggest that in the initial developmental phase CV, V, VC, CVC, CCV syllabic shapes are produced before CCCV, CCVC and CCCVC ones and that in the intermediate acquisitional phase, all syllabic forms may emerge in parallel. However, as they stress, input frequency may play a role in the acquisitional order of syllabic structures. Also, Levelt et al. (1999/2000) based on acquisitional data of Dutch-acquiring children suggest that frequency may serve as predictor for cluster acquisition. Specifically, their study showed that children acquired CV, CVC, V and VC syllabic structures in this order, and that one group of children acquired the coda clusters before the onset clusters (CVCC,VCC > CCV→CCVC > CCV, CCVC→CVCC, VCC) while another group of children acquired the onset clusters before the coda clusters (CCV, CCVC > CVCC, VCC > CVCC, VCC > CCV, CCVC). According to Levelt & van de Vijver (2004:216) ‘*If the child has a choice between various paths, the path of the noticeably most frequent syllable type is chosen. If there is no noticeable difference between the frequencies of syllable types that correspond to different possible paths, variation is expected and attested*.’

6.1. The frequency of consonant clusters in Standard Modern Greek

In this subsection, we investigate if there is any correlation between the frequency of clusters in Standard Modern Greek and the acquisition of them.

We obtained a corpus of Standard Modern Greek adult speech which is available from http://speech.ilsp.gr/iplr and described by Protopapas et al. (2012). This corpus consists of documents published in magazines, newspapers and parliament proceedings and provides both transcriptions and frequency information. For the purposes of this study, we extracted the 1000 most frequent words and we present the 100 most frequent ones below (94).

(94) [ce] ‘and’	[tu] ‘of’	[to] ‘the’	[na] ‘to’
[tis] ‘of’	[i] ‘the’	[tin] ‘the’	[pu] ‘that’
[o] ‘the’	[me] ‘with’	[a.ˈpo] ˈfromˈ	[ton] ‘ofˈ
[ta] ‘the’	[ˈi.ne] ‘be’	[i] ‘the’	[θa] ‘will’
[sto] ‘to’	[ðen] ‘not’	[se] ‘to’	[ton] ‘theˈ
[stin] ‘to’	[ti] ‘the’	[ˈo.ti] ‘that’	[tus] ‘the’
[tis] ‘the’	[sti] ‘to’	[a.ˈla] ‘but’	[‘e.çi] ‘have.SG.3’
[ˈe.na] ‘a’	[stis] ‘to’	[sta] ‘to’	[ˈi.tan] ‘be.SG.3.Past’
[a.ˈfto] ‘that’	[mas] ‘ours’	[ston] ‘to’	[an] ‘if’
[ˈo.pos] ‘as’	[ˈo.mos] ˈbut’	[os] ‘as’	[ka.ˈta] ‘against’
[a.ˈfti] ‘she’	[ci] ‘and’	[‘i.çe] ‘have.SG.3.Past	[ˈði.o] ‘two’
[ˈe.xun] ‘have.SG.3.Present	[ˈpre.pi] ‘must’	[mu] ‘mine’	[e.ˈno] ‘during’
[ˈo.tan] ‘when’	[me.ˈta] ‘after’	[ˈo.pça] ‘whoever’	[bo.ˈri] ‘can.SG.3.Present
[ˈmo.no] ‘only	[po.ˈli] ‘a lot’	[pros] ‘to’	[stus] ‘to’
[ˈme.sa] ‘in’	[ja.ˈti] ‘why’	[xθes] ‘yesterday’	[ˈo.çi] ‘no’
[ˈka.θe] ‘every’	[ti] ‘what’	[ˈxro.ɲa] ‘years’	[a.ˈko.mi] ‘yet’
[pos] ‘how’	[ˈe.tsi] ‘so’	[ˈsi.me.ra] ‘today’	[a.ˈfta] ‘these’
[ˈi.pe] ‘say.SG.3.Past’	[ˈo.la] ‘all’	[xo.ˈris] ‘without’	[ˈto.ra] ‘now’
[ˈme.xri] ‘until’	[i.ˈpar.çi] ‘exist’	[ˈθe.ma] ‘issue’	[ˈo.pu] ‘where’
[me.ta.ˈksi] ‘between’	[ci.ˈver.ni.si] ‘government’	[ˈe.nas] ‘a’	[ˈmi.a] ‘a’
[po.li.ti.ˈci] ‘politics’	[ka.ˈθos] ‘while’	[prin] ‘before’	[ˈo.pço] ‘whatever’
[ˈu.te] ‘neither’	[ˈsim.fo.na] ‘according to’	[ˈi.xan] ‘have.PL.3.Past	[ˈo.so] ‘as…as’
[a.ˈfu] ‘since’	[ˈθe.siˈ] ‘position’	[ˈto.te] ‘then’	[e.ˈpi.sis] ‘also’
[a.ˈftes] ‘these’	[ˈpro.ti] ‘first’	[‘ji.ni] ‘become.SG.3.Present’	[ˈto.so] ‘so’
[sas] ‘you’	[ˈka.ni] ‘do.SG.3.Present’	[ði.la.ˈði] ‘that is’	[e.ˈnos] ‘a’

Firstly, in (94) it is evident that, the most frequent words are characterized from simple structural content. To put it differently, these words tend to be the shortest and the least marked. As words gradually get less frequent, they tend to consist of more syllables and the featural content of their segments tends to get more marked. As far as the consonant clusters are concerned, they are attested both word-initially and word-medially. As can be seen above, the well-formed clusters, i.e. stop-liquid, fricative-liquid, stop-nasal and fricative-nasal clusters, are rare among the 100 most frequent words. On the contrary, anti-sonority clusters, such as /st/, are more common in the 100 most frequent words.

Most frequent words	Words with clusters	Percentage
100	21	21%
200	47	24%
300	93	31%
400	128	32%
500	177	35%
600	214	36%
700	257	37%
800	309	39%
900	348	39%
1000	395	40%

Table 27: The relation between word frequency and consonant clusters in Standard Modern Greek

As can be seen in Table 27, the number of words with word-initial and word-medial clusters is considerable. Also, the percentage of words with clusters goes up in a gradual manner as the words get less frequent. For instance, for the 100 most frequent words, 21% contain a cluster and for 1000 most frequent words, 40% contain a cluster. However, an issue arises. This issue is associated with the exact number and the exact percentage of words which contain word-initial and -medial clusters. In order to shed light on this issue we proceeded as follows: We reexamined the 1000 most frequent words and then we classified them into two groups; The first group consists of the words which contain word-initial clusters and the second one is composed of the words which contain word-medial clusters. By way of illustration, Table 28 and 29 are presented and discussed right below:

Most frequent words	Words with word-initial clusters	Percentage
100	13	13%
200	28	14%
300	43	14%
400	52	13%
500	64	13%
600	76	12%
700	90	13%
800	109	14%
900	123	14%
1000	137	14%

Table 28*: The relation between word frequency and word-initial consonant clusters in Standard Modern Greek*

Most frequent words	Words with word-medial clusters	Percentage
100	8	8%

200	19	10%
300	50	17%
400	76	19%
500	113	23%
600	138	28%
700	167	24%
800	200	25%
900	225	25%
1000	258	26%

Table 29*: The relation between word frequency and word-medial consonant clusters in Standard Modern Greek*

Tables 28 and 29 above, show that the classification of the words into two groups depending on whether they contain word-initial or word-medial clusters was crucial. Firstly, we arrive at the general observation that as the words get less frequent, the percentage of words which contain a cluster increase gradually. Also, the comparison of these two tables shows that the frequency of word-initial clusters and the frequency of word-medial clusters differs. In particular, the frequency of word-medial clusters is higher than the rate of word-initial ones. More specifically, for the 100 most frequent words, 13 contain a word-initial cluster and for the 1000 most frequent words, 137 contain a word-initial cluster. Also, for the 1000 most frequent words, 8 contain a word-medial cluster and for the 1000 most frequent words, 258 contain a word-medial cluster. Therefore, the words which contain a cluster in the middle of the word are much more than the ones which contain a cluster at the initial word position.

However, another issue arises again and deserves further investigation. Recall that the corpus we just examined consists of documents published in magazines, newspapers and parliament proceedings. Put differently, this corpus contains documents written in formal speech. We assume that it does not demonstrate the frequency of word-initial and -medial clusters accurately and adequately. Therefore, for the purposes of this study a corpus that consists of child-directed speech is deemed to be of great importance for the following reason: Children are not exposed to formal speech during the process of language acquisition, rather they are mostly exposed to informal speech. As a consequence, a child-directed speech corpus is expected to show the frequency of word-initial and -medial clusters in Standard Modern Greek accurately. Hence, any correlation between the acquisition of clusters and their frequency is expected to be captured more accurately.

6.2. The child-directed speech corpus and the frequency of clusters

Taking all the above into account, we proceeded to collect a child-directed speech corpus (henceforth CDS). This corpus consists of data of two preschool teachers who work in a kindergarten in Rethymno, Crete. The research was held on a weekly basis and each session lasted from twenty-five to forty minutes. A Marantz Professional PMD661MKII recorder was used in order to collect the data. The data collection process was based on the free interaction between the teachers and the children. Every recording was transcribed in the International Phonetic Alphabet.

CDS data were analyzed and the frequency information was obtained. The 1000 most frequent words were extracted. These words were classified into 10 groups. Each group contains 100 words. Then, the percentage of words which contain a cluster was calculated for each group. By way of illustration, the 100 most frequent words are given in (95). In addition, three Tables are provided below. In particular, Table (30) shows the relation between the word frequency and the presence of clusters in the CDS corpus in general, Table (31) and (32) illustrate the relation between the word frequency and the presence of word-initial and word-medial clusters in the CDS corpus, respectively.

(95) [na] ‘to’	[to] ‘the’	[ce] ‘and’	[ˈe.la] ‘come’
[ˈbra.vo] ‘well done’	[mu] ‘mine’	[ðen] ‘not’	[θa] ‘will’
[o] ‘the’	[ta] ‘the’	[ˈto.ra]‘now’	[su] ‘yours’
[pe.ˈðja] ‘children’	[mas] ‘ours’	[tin] ‘the’	[ˈi.ne] ‘be.SG.3.Present’
[i] ‘the’	[ja.ˈti] ‘why’	[ˈe.na] ‘a’	[pu] ‘that’
[stin] ‘to’	[ti] ‘what’	[tu] ‘tu’	[sto] ‘to’
[o.ˈre.a] ‘nice’	[po.ˈli] ‘a lot’	[ja] ‘for’	[e.ˈðo] ‘here’
[ˈli.ɣo] ‘a little’	[ˈsta.vro] ‘proper name’	[ton] ‘the’	[vre] ‘hey'
[ne] ‘yes’	[pços] ‘who’	[min] ‘do not’	[θes] ‘want.SG.3.Present
[se] ‘to’	[a.ˈfto] ‘this’	[ne.ˈfe.li] ‘proper name’	[sas] ‘yours’
[fas] ‘to eat’	[ˈte.li.a] ‘great’	[ma.ri.ˈle.na] ‘proper name’	[ma.ˈnu.so] ‘proper name’
[me] ‘with’	[ˈpi.je.ne] ‘go’	[e.ˈsi] ‘you’	[tra.ˈpe.zi] ‘table’
[ˈtro.i] ‘eat.SG.3.Present’	[li.ˈpon] ‘so’	[e.çi] ‘have.SG.3.Present’	[tis] ‘of’
[ˈca.lo] ‘more’	[e.ˈɣo] ‘I’	[xri.ˈsi] ‘proper name’	[ˈpre.pi] must
[me.ˈɣa.li] big	[a.ˈɣa.pi] love	[ˈjor.ɣo] ‘proper name’	[pe.ˈða.ca] children
[ni.ˈko.la] proper name	[ˈθe.lis] want.SG.2.Present	[ja.ˈur.ti] yogurt	[e.ˈda.ksi] okay

[ˈo.lo] all	[ˈka.tse] sit.SG.2.Present	[le.ˈpto] minute	[ˈa.de] hurry up
[ko.ˈsti] prope name	[ne.ˈro] water	[a.ˈko.ma] still	[ci.ˈri.a] miss
[ˈka.to] down	[ˈka.ni] do.SG.2.Present	[ˈfa.me] eat.PL.1.Present	[ˈo.tan] when
[ˈda.ksi] okay	[ˈfa.i] eat.SG.2.Present	[ˈo.çi] no	[fa.ji.ˈto] food
[me.ˈta] after	[ma.ˈnu.sos] proper name	[ˈa.lo] other	[ˈka.nis] do.SG.2.Present
[te.ˈʎo.ni] finish.SG.1.Present	[ˈspi.ro] proper name	[i.o.ˈa.na] proper name	[me.ˈɣa.lo] big
[po] say.SG.2.Present	[ˈfa.i] food	[tros] eat.SG.2.Present	[psi.ˈla] high
[ˈpa.ra] too	[si] you	[oˈri.ste] here you are	[pas] go.SG.2.Present
[ˈe.ka.nes] do.SG.2.Past	[ˈmo.no] only	[e.ˈci] there	[ra.fa.ˈe.la] proper name

Most frequent words	**Words with clusters**	**Percentage**
100	20	20%
200	45	23%
300	75	25%
400	102	26%
500	135	27%
600	179	30%
700	218	31%
800	248	31%
900	290	32%
1000	329	33%

Table *4: The relation between word frequency and clusters in the CDS corpus*

First of all, it is essential that we remark a few things. The 100 most frequent words in the CDS corpus are characterized by simple structural composition and, at the same time, they tend to be short. However, as the words get less frequent, it is obvious that, on the one hand, the featural composition of word segments tend to get more marked and, on the other, the words tend to become polysyllabic.

As far as the words which contain word-initial and -medial clusters are concerned, they are plenty. In particular, for the 100 most frequent words, 20% contain a word-initial or a word-medial cluster, and for the 1000 most frequent words, 33% contain a cluster. Hence, as the words get less frequent, the percentage of words which contain a cluster goes up in a gradual manner. This percentage increase is considered significant. However, we must take into consideration that Table 30 shows the presence of consonant clusters in the CDS corpus in general, that is, the presence of both word-initial and word-medial clusters. So, now, we must turn to Tables 31 and 32, as these tables illustrate the presence of word-initial and word-medial clusters in the CDS corpus, respectively.

Most frequent words	Words with word-initial clusters	Percentage
100	13	13%
200	28	14%
300	37	12%
400	47	12%
500	66	13%
600	82	14%
700	100	14%
800	121	15%
900	141	16%
1000	161	16%

Table 31*: The relation between word frequency and word-initial clusters in the CDS corpus*

Most frequent words	Words with word-medial clusters	Percentage
100	7	7%
200	17	9%
300	38	13%
400	55	14%
500	69	14%
600	97	16%
700	118	17%
800	127	16%
900	149	17%
1000	168	17%

Table 32*: The relation between word frequency and word-medial clusters in the CDS corpus*

The close observation of Tables 31 and 32 shows that there is not a significant difference between the frequency of word-initial clusters and the frequency of word-medial ones in the 1000 most frequent words. Put differently, the percentage of all ten groups of the two tables does not differ significantly. Specifically, as Table 31 and 32 show, word-initial and word-medial clusters are attested with about the same frequency in the most frequent words of the CDS corpus.

Regarding the two corpora, it seems that they exhibit several interesting similarities. In particular, in both corpora, the 100 most frequent words are structurally unmarked and comprise of few syllables. However, the same does not hold as the words get less frequent and, thus, their structural complexity and the featural composition of their segments become more marked and the number of their syllables goes up. Also, despite the fact that the number of words which contain a cluster increases gradually, the percentage increase among the 10 groups and, more crucially, between the first and the tenth, is not considered significant.

Consequently, these two corpora are deemed to be comparable. The only minor difference between them is captured with respect to the percentage of words which contain a cluster. To be more specific, in Protopapas et al.'s corpus the percentage of the words which contain a word-initial and a word-medial consonant cluster is slightly higher than the percentage of the words which contain a word-initial and a word-medial cluster in the CDS corpus. However, we assume that this kind of differences are expected due to the fact that different corpora contain different words which may differ in their structural composition. Therefore, despite those minor differences, we cannot suggest that any of the corpora examined is more reliable than the other.

We suppose that both corpora can be used for the same research purposes and that, as far as the acquisition of clusters in the course of development is concerned, the same predictions can be made. More specifically, providing that both corpora differ minimally with respect to the percentage of the words which contain a word-initial and a word-medial cluster, the following suggestion regarding the cluster acquisition can be made: The frequency of clusters in the ambient data may not be considered as strong predictor for cluster acquisition. Put differently, given that the frequency of word-initial and word-medial clusters is about the same, we cannot suggest that, for example, clusters emerge and are acquired first either word-initially or word-medially in Standard Modern Greek.

The above suggestion is verified by SPI's and DIM's acquisitional data. Specifically, as it was aforementioned in Chapter 4, in the medial intermediate phase, i.e. in the phase in which complex onsets start being produced, SPI start realizing word-initial and word-medial clusters simultaneously. On the other hand, in the same acquisitional phase, DIM's word-initial faithful cluster productions precede the word-medial faithful cluster productions. Some representative data from each child are presented below (95-96). Specifically, SPI's data are provided in (95) and DIM's data are given in (96).

	Input form	**Output form**	**Gloss**	**Child**	**Age**
95a.	ˈkle.i	kle	cry 3PR Sg	SPI	2;08,08
b.	ble	ble	blue	SPI	2;08,08
c.	a.e.ro.ˈpla.no	a.e.ˈpʎa.no	airplane	SPI	2;08,08
d.	vi.ˈvli.o	me.ˈvli.o	book	SPI	2;09,06
e.	ˈpra.si.no	ˈpla.si.no	green	SPI	2;10,25
f.	gri	gli	grey	SPI	3;03,21

g.	ˈtri.a	ˈtli.a	three	SPI	3;03,21
h.	ta ˈta.blet	ta ˈta.blet	tablet	SPI	3;04,11

	Input form	**Output form**	**Gloss**	**Child**	**Age**
[Stop + Liquid] clusters					
96a.	ble	ble	blue	DIM	2;00,26
b.	ˈxro.ma.ta	ˈxlo.ma.ta	colours	DIM	2;02,06
c.	ˈxro.ma.ta	ˈxlo.ma.to	colours	DIM	2;02,23
d.	ˈplu.to	ˈplu.tos	proper name	DIM	2;03,06
e.	ble	bles	blue	DIM	2;04,10
f.	je.ˈne.θli.a	e.ˈne.θli.a	birthday	DIM	2;04,18
g.	ˈkle.i	ˈkle.i	cry 3PR Sg	DIM	2;05,01
h.	to ˈta.blet	to ˈta.ble	the tablet	DIM	2;05,01
i.	ble	ble	blue	DIM	2;05,15
j.	to ˈta.blet	to ˈta.ble	the tablet	DIM	2;05,15
k.	ˈci.klos	ˈci.kluç	circles	DIM	2;05,15

Therefore, our data demonstrate that there is variation regarding the word position in which clusters emerge and are acquired first. Hence, this variation may be due to phonological principles and individual variations which are present during the acquisitional process and not driven by frequency.

6.3. The frequency of the well-formed clusters in Protopapas et al.'s corpus and in the CDS corpus and the acquisition of clusters

This subsection focuses on the frequency of the well-formed clusters which are attested in Protopapas et al.'s corpus and in the CDS corpus. Firstly, in the 1000 most frequent words in Protopapas et al.'s corpus, all four categories of the well-formed consonant clusters, i.e. stop-liquid, fricative-liquid, stop-nasal and fricative-nasal cluster types, are attested. Regarding the 1000 most frequent words in the CDS corpus, the attested consonant cluster categories which are attested are stop-liquid, fricative-liquid and fricative-nasal cluster types. Therefore, the CDS corpus lacks stop-nasal clusters among the 1000 most frequent words.

The close observation of the two corpora reveals that the stop-liquid clusters are the most common clusters among the other cluster categories. Also, in both corpora the second most common cluster category is the category of fricative-liquid clusters and the third most common is the category of fricative-nasal clusters. The stop-nasal clusters comprise the least common category in Protopapas et al.'s corpus since only one token which contains a stop-nasal cluster is attested. In the1000 most frequent words of the CDS corpus there were not found words which contain stop-nasal clusters.

The comparison of the two corpora shows that Protopapas et al.'s corpus contains more well-formed clusters than the CDS corpus in the 1000 most frequent words. Put differently, stop-liquid, fricative-nasal, stop-nasal and the fricative-nasal clusters are more in Protopapas et al.'s corpus than in the CDS corpus. Specifically, in the 1000 most common words, the former corpus contains 95 stop-liquid clusters, 57 fricative-liquid clusters, 1 stop-nasal cluster and 25 fricative-nasal clusters. On the other hand, in the 1000 most common words, the CDS corpus contains 78 stop-liquid clusters, 37 fricative-liquid clusters, 0 stop-nasal clusters and 9 fricative-nasal clusters.

Regarding the stop-liquid clusters in Protopapas et al.'s corpus, /pr/ is the most common cluster type among the other types, as it is attested in 52 tokes in the 1000 most frequent words. /pl/, /kr/ and /tr/ are attested with the same frequency (/pl/ in 10 tokens, /kr/ in 12 tokens and /tr/ in 15 tokens). Also, /br/, /kl/, /tl/ and /dr/ are attested with the same frequency, too, i.e. /br/ is found in 1 token, /kl/ in 3 tokens, /tl/ and /dr/ in 1 token. Regarding the CDS corpus, the most frequent stop-liquid cluster type is /tr/, since it is attested in 19 tokens. As far as the other stop-liquid cluster types are concerned, /pr/, /kl/, /kr/ are attested with the same frequency. To be more specific, /pr/ is attested in 14 tokens, /kl/ in 10 and /kr/ in 12/. The other cluster types, i.e. /pl/, /dr/, /bl/, /br/ and /gr/ are the least frequent cluster types in the 1000 most common words in the CDS corpus. Also, in the 1000 most common words, Protopapas et al.'s corpus lacks /bl/, /gl/, /gr/ clusters while the CDS corpus lacks /gl/ and /tl/.

As it was aforementioned, fricative-liquid clusters are the second most frequent cluster category among the others. In the 1000 most common words in Protopapas et al.'s corpus, /vr/, /ɣl/, /ɣr/ and /ðr/ are attested with the same frequency, that is /vr/ is attested in 10 tokens, /xr/ in 11 tokens, /ɣr/ in 8 tokens and /ðr/ in 12 tokens. /fr/, /vl/, /ɣl/, /θl/ and /θr/ are the least commonly found cluster types in this corpus. /fl/ and /xl/ clusters were not attested in the 1000 most frequent words in this corpus.

As far as the fricative-nasal clusters are concerned, in the 1000 most frequent words in Protopapas et al.'s corpus, all the attested cluster types are observed with the same frequency, that is /vm/ and /vn/ are attested in 1 token each, /xm/ is attested in 2 tokens, /ɣm/, /ɣn/ and /θm/ are attested 3 times each, /xn/ is attested in 5 tokens and /θn/ is observed in 7 tokens. In the 1000 most frequent words in the CDS corpus, /vm/ and /ɣm/ are attested in 1 token each, /xn/ in 5 tokens and /ɣn/ in 2 tokens. /vn/, /xm/, /θn/ and /θm/ cluster types were not attested in 1000 most frequent words in the CDS corpus.

All the above are summarized in Tables 33-36.

	Protopapas et al. (2012)		CDS corpus	
CL T	Tokens	%	Tokens	%
/Lab S +L/				
/pl/	**10**	1%	**8**	0,8%
/pr/	**52**	5,2%	**14**	1,4%
/bl/	**-**	-	**2**	0,2%
/br/	**1**	0,1%	**3**	0,3%
[Dor S + L]				
/kl/	**3**	0,3%	**10**	1%
/kr/	**12**	1,2%	**12**	1,2%
/gl/	**-**	-	**-**	-
/gr/	**-**	-	**4**	0,4%
[Cor S + L]				
/tr/	**15**	1,5%	**19**	1,9%
/tl/	**1**	0,1%	**-**	-
/dr/	**1**	0,1%	**6**	0,6%
Total	**95**	9,5%	**78**	7,8%

Table 33 Stop-liquid clusters

	Protopapas et al. (2012)		CDS corpus	
CL T	Tokens	%	Tokens	%
/Lab F +L/				
/fl/	**-**	**-**	**-**	**-**
/fr/	**1**	0,1%	**1**	0,1%
/vl/	**6**	0,6%	**7**	0,7%
/vr/	**10**	1%	**12**	1,2%
[Dor F + L]				
/xl/	**-**	**-**	**-**	**-**
/xr/	**11**	1,1%	**5**	0,5%
/ɣl/	**1**	0,1%	**2**	0,2%
/ɣr/	**8**	0,8%	**4**	0,4%
[Cor F + L]				
/θl/	**2**	0,2%	**1**	0,1%
/θr/	**6**	0,6%	**-**	**-**
/ðr/	**12**	1,2%	**3**	0,3%
Total	**57**	5,7%	**37**	3,7%

Table 34 Fricative-liquid clusters

	Protopapas et al. (2012)		CDS corpus	
CL T	Tokens	%	Tokens	%
[Cor S + N]				
/tm/	**1**	0,1%	**-**	**-**
Total	**1**	0,1%	**-**	**-**

Table 35 Stop-nasal clusters

	Protopapas et al. (2012)		CDS corpus	
CL T	Tokens	%	Tokens	%
/Lab F +N/				
/vm/	**1**	0,1%	**1**	0,1%

/vn/	**1**	0,1%	**-**	-
[Dor F + N]				
/xm/	**2**	0,2%	**-**	-
/xn/	**5**	0,5%	**5**	0,5%
/ɣm/	**3**	0,3%	**1**	0,1%
/ɣn/	**3**	0,3%	**2**	0,2%
[Cor F + N]				
/θn/	**7**	0,7%	**-**	-
/θm/	**3**	0,3%	**-**	-
Total	**25**	2,5%	**9**	0,9%

Table 36 Fricative-nasal clusters

We suggest that neither of the four cluster categories, i.e. stop-liquid, fricative-liquid, stop-nasal and fricative-nasal cluster types, are frequently attested in the 1000 most frequent words neither in Protopapas et al.'s corpus nor in the CDS corpus. For the 1000 most frequent words in Protopapas et al.'s corpus, 9,5% contain a stop-liquid cluster, 5,7% a fricative-liquid cluster, 2,5% a fricative-nasal cluster and 0,1% a stop-nasal cluster. Also, for the 1000 most frequent words in the CDS corpus 7,8% words contain a stop-liquid cluster, 3,7% words contain a fricative-liquid cluster and 0,9% words contain a fricative-nasal cluster. Stop-nasal clusters were not attested in the 1000 most frequent words in the CDS corpus.

Taking all the above into consideration, we suggest that there is not a single well-formed cluster type which is attested with high frequency either in Protopapas et al.'s corpus or in the CDS corpus. In the 1000 most frequent words in Protopapas et al.'s corpus, the most frequent cluster is /pr/ (5,2%). Surprisingly, all the other cluster types attested in this corpus are below 1,5%. On the other hand, in the 1000 most frequent words in the CDS corpus, the most frequent attested cluster is /tr/ (1,9%). All the other clusters are below 1,4%.

The above observations show that the Standard Modern Greek-acquiring children are not frequently exposed to well-formed clusters during the acquisitional process. However, the frequency of the different cluster categories, i.e. stop-liquid, fricative-liquid, stop-nasal and fricative-nasal, in Standard Modern Greek may predict the acquisitional order of each cluster category by children. Recall that stop-liquid clusters is the most frequent cluster type category in the 1000 most frequent words in both Protopapas et al.'s corpus and CDS corpus. Also, recall that fricative-liquid is the second most common cluster type category while the third most common is the fricative-nasal one in the 1000 most frequent words in both corpora. Moreover, recall that stop-nasal clusters are the least frequent attested clusters in Protopapas et al.'s corpus while the CDS corpus lacks stop-nasal clusters in the 1000 most frequent words.

As far as the acquisitional order of these cluster type categories, firstly, recall that neither SPI nor DIM have fully acquired any cluster type which falls in any of the under-investigation cluster categories. Nevertheless, both children have started producing some well-formed clusters. Therefore, we may predict the acquisitional order of the cluster categories based on the faithful cluster productions which are attested in the data of both children. Recall that stop-liquid clusters were the first to be produced by both SPI and DIM. SPI's data show that stop-liquid clusters emerge before fricative-liquid clusters and DIM's data demonstrate that stop-liquid and fricative-liquid clusters start to emerge simultaneously. In addition, recall that neither in SPI's nor in DIM's data were attested stop-nasal and fricative-nasal clusters. Some representative examples from SPI are given in (97) and from DIM are provided in (98).

	Input form	**Output form**	**Gloss**	**Child**	**Age**
97a.	ˈkle.i	kle	cry 3PR Sg	SPI	2;08,08
b.	a.e.ro.ˈpla.no	a.e.ˈpʎa.no	airplane	SPI	2;08,08
c.	pe.ˈxni.ðja	pe.ˈmi.za	toys	SPI	2;08,23
d.	vi.ˈvli.o	me.ˈvli.o	book	SPI	2;09,06
e.	ka.ˈpnos	pa.ˈpoç	smoke	SPI	2;09,19
f.	ka.ˈpnos	ka.ˈpo	smoke	SPI	3;01,02
g.	ˈma.vro	ˈma.vro	black	SPI	3;02,29
h.	ˈfra.u.les	ˈfla.u.e	strawberries	SPI	3;03,06
i.	je.ˈne.θli.a	ne.ˈne.θli.a	birthday	SPI	3;03,06
j.	i ˈfra.u.la	to ˈfla.o	strawberry	SPI	3;03,14
k.	ˈtri.a	ˈtli.a	three	SPI	3;03,21
l.	ta ˈta.blet	ta ˈta.blet	tablet	SPI	3;04,11

	Input form	**Output form**	**Gloss**	**Child**	**Age**
98a.	pe.ˈxni.ðja	ne.ˈni.ja	toys	DIM	1;10,29
b.	ble	ble	blue	DIM	2;00,26
c.	ˈxro.ma.ta	ˈxlo.ma.ta	colours	DIM	2;02,06
d.	ˈxro.ma.ta	ˈxlo.ma.to	colours	DIM	2;02,23
e.	pe.ˈxni.ðja	pe.ˈni.ja	toys	DIM	2;02,23
f.	ˈplu.to	ˈplu.tos	proper name	DIM	2;03,06
g.	ble	bles	blue	DIM	2;04,10
h.	je.ˈne.θli.a	e.ˈne.θli.a	birthday	DIM	2;04,18
i.	ˈkle.i	ˈkle.i	cry 3PR Sg	DIM	2;05,01
j.	to ˈta.blet	to ˈta.ble	the tablet	DIM	2;05,01
k.	ble	ble	blue	DIM	2;05,15
l.	to ˈta.blet	to ˈta.ble	the tablet	DIM	2;05,15
m.	ˈci.klos	ˈci.kluç	circles	DIM	2;05,15

Therefore, we suggest that the acquisitional order of the different cluster categories may only partially be explained in terms of input frequency. To be more specific, we assume that stop-liquid clusters may emerge first in SPI's and DIM's grammars due to input frequency. Also, input frequency may determine the emergence of fricative-liquid clusters in both SPI's and DIM's grammars. Finally, input frequency may drive the emergence of stop-nasal and fricative-nasal clusters. In other words, the reason why there were not observed faithful stop-nasal and fricative-nasal cluster productions neither in SPI's nor in DIM's data may be due to the low frequency in Standard Modern Greek (recall that there were not found words which contain stop-nasal clusters in the 1000 most frequent words in the CDS corpus while in Protopapas et al.'s corpus it was found only one stop-nasal cluster and that in the 1000 most frequent words in Protopapas et al.'s corpus there was attested 25 fricative-nasal clusters and in the CDS corpus only 9).

Furthermore, we must turn to another interesting issue. The frequency of the different cluster types in Protopapas et al.'s corpus and in the CDS corpus may not predict the acquisitional order of clusters. For instance, cluster types which were found in the aforementioned corpora may not be faithfully produced by neither by SPI nor by DIM. For example, despite the fact that /pr/ is the most frequent cluster type in Protopapas et al.'s corpus and one of the most frequent in the CDS corpus, in DIM's data there were not attested faithful productions of /pr/. On the other hand, SPI produces /pr/ systematically, i.e. for 58 productions of /pr/, 34,5% were faithful to the input cluster.

Also, both DIM's and SPI's productions demonstrate that clusters which are not frequently attested in the corpora may emerge first. For example, both children produce /bl/ systematically, i.e. of the 52 productions of /bl/ by DIM 28 were faithful to the input cluster (=53%) and of the 252 productions of /bl/ by SPI 95 were faithful to the adult cluster (37,7%), despite the fact that this cluster type is not frequently attested in neither of the corpora we obtained. Recall that /bl/ is not attested among the 1000 most frequent words in Protopapas et al.'s (2012) corpus and is attested only twice in the 1000 most frequent words in the CDS corpus. Also, children faithfully produce clusters which were not found neither in Protopapas et al.'s corpus nor in the CDS corpus. For instance, in these corpora, /fl/ is not attested in the 1000 most frequent words. However, SPI produces /fl/. Specifically, of the 23 productions of /fl/ by SPI 8 were faithful to the adult cluster (=34,8%). The faithfully produced clusters by SPI and DIM are summarized in Table 37, a simplified version of Table 15 which was presented in Chapter 4.

	Children	
Clusters	**SPI**	**DIM**
/pl/	✓	✓
/pr/	✓	
/bl/	✓	✓
/kl/	✓	✓
/kr/	✓	
/gr/	✓	✓
/tr/	✓	
/fl/	✓	
/vl/	✓	
/vr/	✓	
/xr/		✓
/ɣr/	✓	
/θl/	✓	✓

Table 37 The attested clusters in SPI's and DIM's data

Given all the above, we suggest that the input frequency may not be a strong predictor of language acquisition. To put it in other words, the input frequency may partially only explain the acquisitional order of clusters. The Input frequency may partially drive the order of acquisition of the different cluster categories. Firstly, recall that in the 1000 most frequent words in both corpora stop-liquid clusters were the most frequent ones. Also, fricative-liquid were most frequent than fricative-nasal clusters. Additionally, stop-nasal clusters were the least frequent cluster category in Protopapas et al.'s corpus while the CDS corpus lacks stop-nasal clusters. Secondly, recall that stop-liquid clusters were the first cluster category which is observed in SPI's and DIM's data. However, in DIM's grammar stop-liquid clusters emerge simultaneously with fricative-liquid ones while in SPI's grammar the emergence of stop-liquids precedes the emergence of fricative-liquid clusters. As it was aforementioned above, faithful productions of stop-nasal and fricative-nasal clusters were not observed in SPI's and DIM's data. Children's data may lack faithful productions of stop-nasal and fricative-nasal clusters due to input frequency effects.

6.4. Summary

This section examined the impact of the input frequency in the acquisition of the well-formed clusters, i.e. stop-liquid, fricative-liquid, stop-nasal and fricative-nasal clusters. Firstly, in both corpora which we examined, i.e. Protopapas et al.'s corpus and the CDS corpus, stop-liquid, fricative-liquid, stop-nasal and fricative-nasal clusters were found. Interestingly, in the 1000 most common words in both corpora, stop-liquid clusters appear to be the most common cluster category. Also, in both corpora, fricative-liquid clusters comprised the second most common cluster category while fricative-nasal clusters constituted the third most common cluster category. Stop-nasal clusters constitute the least common cluster category in Protopapas et al.'s corpus while the CDS corpus lacks stop-nasal clusters. Both corpora show that word-initial and word-medial clusters are attested with about the same frequency. Therefore, we cannot suggest that, for example, initial clusters emerge before medial ones. Our acquisitional data show that there is not a strict order regarding the word position in which clusters emerge first. SPI' data demonstrate that word-initial and -medial clusters emerge simultaneously while DIM's data show that word-initial clusters emerge before word-medial ones. Surprisingly, these two corpora do not differ significantly regarding the frequency of the different cluster categories and the frequency of the different cluster types. Based on the frequency of the cluster categories we assume that stop-liquid and fricative-liquid cluster emerge first and stop-nasal and fricative-nasal cluster emerge later in development. SPI and DIM showed that this is the case, as stop-liquid clusters emerge slightly before fricative-liquid clusters in SPI's grammar and stop-liquid and fricative-liquid clusters emerge simultaneously in DIM's grammar. Additionally, stop-nasal and fricative-nasal faithfully produced clusters by SPI and DIM were not attested. Also, this section provided evidence that the first faithful cluster productions may occur regardless of whether these clusters are frequently attested in the ambient language or not. For instance, both SPI and DIM produce /bl/ systematically despite the fact that this cluster is infrequent in both corpora. Hence, we suggest that frequency may not be considered as strong predictor for language acquisition and cluster acquisition. Therefore, several factors such as phonological principles, individual variation as well as frequency may impact on the acquisitional process of clusters.

7. Conclusions

This thesis focused on the acquisition of the well-formed stop-liquid/nasal and fricative-liquid/nasal consonant clusters in Standard Modern Greek by two typically developing Standard Modern Greek-acquiring children, SPI (age: 2;01,24 – 3;04,11) and DIM (age: 1;10,29 – 2;05, 15). The major findings presented in this thesis are the following:

a) In the early intermediate phase, the prevalent simplification strategy is cluster reduction. Children reduce stop-liquid/nasal and fricative-liquid clusters to the less sonorous segment, i.e. children follow the sonority pattern. Fricative-nasal clusters are reduced to the more sonorous. However, due to the fact that the available data with fricative-nasal clusters are few, we cannot make any generalization regarding the reduction pattern of these clusters.

b) Coalescence may reflect a sub-stage in cluster acquisition. In SPI's data, coalescence persists for a long period of time. However, instances of coalescence start fading away when faithfully produced target forms for each cluster type are realized.

c) Regarding the process of deletion of the entire cluster and contiguity, in DIM's data they have complementary distributions, namely contiguity is observed in labial-initial clusters while cluster deletions occur in dorsal- and coronal-initial clusters.

d) There is inter-child variation regarding the cluster categories (e.g. stop-liquid and fricative-liquid clusters) which emerge first. Also, there is inter-child variation regarding the word-position in which clusters are produced first.

e) Stress may not play an active role in cluster retention. There is not a clear tendency for clusters to start being realized in stressed syllables first.

f) Younger children may be more linguistically advanced than older ones. The child's age should not be considered as strong predictor for the cluster acquisition.

g) Children's faithful cluster productions can be accounted for within the theoretical framework of the Three Scales Model. Children produce both perfect and acceptable clusters. Non-acceptable cluster forms were not attested in the data of children. Children's faithful clusters realizations are perfect with respect to the manner scale. Clusters are either perfect or acceptable with respect to place scale and to voicing scale.

h) Input frequency may not be considered as strong predictor for cluster acquisition. For instance, both corpora show that word-initial and word-medial clusters are attested with about the same frequency. Thus, we cannot propose that, for example, we expect word-initial clusters to emerge before -medial clusters. Our data demonstrate that there is not a strict order regarding the word position in which clusters emerge first, but the order is subject to inter-child variation. Also, the corpora do not differ significantly regarding the frequency of the different cluster categories and the frequency of the different cluster types. Based on the frequency of the cluster categories, we assume that stop-liquid and fricative-liquid cluster emerge first and stop-nasal and fricative-nasal cluster emerge later in development. SPI and DIM showed that this is the case. Last but not least, this thesis provides evidence that the early faithful cluster productions may occur regardless of whether these clusters are frequently attested in the ambient language or not. For instance, both SPI and DIM produce /bl/ systematically despite the fact that this cluster is infrequent in both corpora which we examined.

Περίληψη στα Ελληνικά (Summary in Standard Modern Greek)

Η παρούσα διπλωματική εργασία εστιάζει το ενδιαφέρον της στην κατάκτηση των καλοσχηματισμένων συμφωνικών συμπλεγμάτων στην Κοινή Νέα Ελληνική, δηλαδή των συμφωνικών συμπλεγμάτων που σχηματίζονται από τις ακολουθίες [κλειστό + υγρό], [τριβόμενο + υγρό], [κλειστό + έρρινο] και [τριβόμενο + έρρινο]. Η εργασία αυτή στηρίζεται σε αναπτυξιακά δεδομένα του παιδικού λόγου της Κοινής Νέας Ελληνικής. Συγκεκριμένα, τα δεδομένα προέρχονται από δύο παιδιά που κατακτούν την Κοινή Νέα Ελληνική ως πρώτη γλώσσα (Γ1), τον Σπύρο (στο εξής ΣΠΥ) και τον Δημήτρη (στο εξής ΔΗΜ). Ο ΣΠΥ ξεκίνησε να ηχογραφείται στην ηλικία των 2;01,25 και σταμάτησε στην ηλικία των 3;04,11 και ο ΔΗΜ ξεκίνησε να ηχογραφείται στην ηλικία των 1;10,29 και σταμάτησε στην ηλικία των 2;05,15.

Τα δεδομένα μας δείχνουν ότι, κατά την κατάκτηση, οι σύνθετες εμβάσεις απλοποιούνται με τη χρήση ποικίλων στρατηγικών απλοποίησης, δηλαδή της απαλοιφής του περισσότερο ηχητικού μέλους του συμπλέγματος ($/\Sigma_1\Sigma_2\Phi/ \rightarrow [\Sigma_1\Phi]$), της απαλοιφής του λιγότερου ηχητικού μέλους του συμπλέγματος ($/\Sigma_1\Sigma_2\Phi/ \rightarrow [\Sigma_2\Phi]$), της επένθεσης ($/\Sigma_1\Sigma_2\Phi/ \rightarrow [\Sigma_{1\varphi}\Sigma_2\Phi]$), της απαλοιφής και των δύο μελών του συμπλέγματος ($/\Sigma_1\Sigma_2\Phi/ \rightarrow [\emptyset\Phi]$) και της συγχώνευσης ($/\Sigma_1\Sigma_2\Phi/ \rightarrow [\Sigma_{1,2}\Phi]$). Τα δεδομένα μας δείχνουν ότι η πιο συχνή στρατηγική και για τα δύο παιδιά είναι η απαλοιφή του περισσότερου ηχητικού μέλους του συμπλέγματος. Για τον ΣΠΥ, η δεύτερη πιο συχνή στρατηγική είναι αυτή της συγχώνευσης, η τρίτης η αποβολή του λιγότερο ηχητικού μέλους της σύνθετης έμβασης, η τέταρτη η αποβολή ολόκληρου του συμπλέγματος και η πέμπτη η επένθεση. Αναφορικά με τον ΔΗΜ, η δεύτερη συχνότερη στρατηγική είναι η αποβολή και των δύο μελών του συμπλέγματος, η τρίτη η αποβολή του λιγότερο ηχητικού μέλους του συμπλέγματος, η τέταρτη η συγχώνευση και η πέμπτη η επένθεση. Τα δεδομένα του ΔΗΜ δείχνουν ότι η διαδικασία της απαλοιφής και των δύο μελών του συμπλέγματος και της απαλοιφής του λιγότερο ηχητικού μέλους του συμπλέγματος έχουν συμπληρωματική κατανομή, δηλαδή η πρώτη εμφανίζεται στα συμπλέγματα που το πρώτο μέλος είναι ΡΑΧΙΑΙΟ ή ΚΟΡΩΝΙΔΙΚΟ ενώ η δεύτερη εμφανίζεται στα συμπλέγματα που το πρώτο μέλος τους είναι ΧΕΙΛΙΚΟ. Τα δεδομένα του ΣΠΥ δείχνουν πως η διαδικασία της συγχώνευσης λειτουργεί σαν ένα υπο-στάδιο κατά την ανάπτυξη των συμπλεγμάτων, δηλαδή η συγχώνευση σταματά να εντοπίζεται στα δεδομένα του παιδιού, όταν η ξεκινούν να πραγματώνονται πιστοί τύποι ως προς

τα συμπλέγματα. Τέλος, η επένθεση είναι η λιγότερο συχνή στρατηγική και στα δύο παιδιά.

Αναφορικά με τις πιστές πραγματώσεις των υπό-διερεύνηση καλοσχηματισμένων συμφωνικών συμπλεγμάτων, τα δεδομένα μας δείχνουν πως δεν υπάρχει μία διαγλωσσικά αυστηρή σειρά κατά την οποία τα καλοσχηματισμένα συμφωνικά συμπλέγματα κατακτώνται. Συγκεκριμένα, κατά το ενδιάμεσο τμήμα της ενδιάμεσης αναπτυξιακής φάσης, τα δεδομένα του ΣΠΥ δείχνουν πως τα συμπλέγματα που σχηματίζονται από τις ακολουθίες [κλειστό + υγρό] αναδύονται πριν από τα συμπλέγματα που σχηματίζονται από τις ακολουθίες [τριβόμενο + υγρό]. Ακόμη, η ανάδυση των συμπλεγμάτων από [κλειστό + υγρό] σε τονισμένες συλλαβές στην αρχή ή ενδιάμεσα στη λέξη προηγείται της ανάδυσης των ίδιων συμπλεγμάτων σε άτονες συλλαβές στην αρχή ή ενδιάμεσα στη λέξη. Τα συμπλέγματα από [τριβόμενο + υγρό] εμφανίζονται ταυτόχρονα σε τονισμένες και άτονες συλλαβές στην αρχή και στο μέσο της λέξης. Τα δεδομένα του ΔΗΜ δείχνουν ότι οι ακολουθίες από [κλειστό + υγρό] και [τριβόμενο + υγρό] αναδύονται ταυτόχρονα σε τονισμένες συλλαβές στην αρχή της λέξης. Σταδιακά, αυτές οι ακολουθίες εμφανίζονται και σε άτονες συλλαβές ενδιάμεσα στην λέξη. Είναι ενδιαφέρον ότι σε κανένα από τα δύο παιδιά δεν εντοπίστηκαν πιστές πραγματώσεις από συμπλέγματα που αποτελούνται από [κλειστό + έρρινο] και [τριβόμενο + έρρινο]. Είναι ενδιαφέρον ότι στα δεδομένα μας εντοπίζεται διαγλωσσική ποικιλία ως προς την σειρά εμφάνισης των συμπλεγμάτων κατά την ανάπτυξή τους. Ακόμη, φαίνεται πως ο τονισμός δεν επιδρά στην κατάκτηση των συμφωνικών συμπλεγμάτων, δηλαδή οι εισαγόμενοι τύποι στους οποίους η τονισμένη συλλαβή περιέχει μία σύνθετη έμβαση δεν πραγματώνονται πιστά ως προς την τελευταία στον εξαγόμενο τύπο. Είναι σημαντικό να τονιστεί ότι, παρά το γεγονός ότι παρατηρούνται πιστές πραγματώσεις συμπλεγμάτων και από τα δύο παιδιά, ούτε ο ΣΠΥ ούτε ο ΔΗΜ έχει κατακτήσει τα συμπλέγματα. Ακόμη, τα αναπτυξιακά μας δεδομένα δείχνουν πως ο ΔΗΜ, αν και είναι μικρότερος ηλικιακά, εισέρχεται στο ενδιάμεσο τμήμα της ενδιάμεσης αναπτυξιακής φάσης νωρίτερα από τον ΣΠΥ, ο οποίος ηλικιακά είναι μεγαλύτερος. Ας ανακαλέσουμε εδώ ότι για την παρούσα εργασία θεωρούμε πως το αρχικό τμήμα της ενδιάμεσης αναπτυξιακής φάσης είναι αυτό κατά το οποίο οι πρώτες μαρκαρισμένες δομές αναδύονται, για παράδειγμα τα τριβόμενα σύμφωνα και οι έξοδοι στο τέλος της λέξης, και ότι το ενδιάμεσο τμήμα της ενδιάμεσης αναπτυξιακής φάσης ξεκινά με την πιστή πραγμάτωση των πρώτων συμφωνικών συμπλεγμάτων από τα παιδιά. Συνεπώς, προτείνουμε πως η ηλικία του παιδιού δεν μπορεί να θεωρηθεί ως αυστηρός δείκτης πρόβλεψης για την φωνολογική κατάκτηση και την κατάκτηση των συμπλεγμάτων. Με άλλα λόγια, παιδιά μικρότερα ηλικιακά μπορεί να είναι περισσότερο προχωρημένα γλωσσικά από τα μεγαλύτερα ηλικιακά παιδιά.

Οι πιστές πραγματώσεις των συμφωνικών των παιδιών αξιολογήθηκαν βάσει του Μοντέλου των Τριών Κλιμάκων. Το θεωρητικό αυτό μοντέλο αξιολογεί τον σχηματισμό των συμπλεγμάτων βάσει τριών κλιμάκων, δηλαδή των κλιμάκων του Τρόπου Άρθρωσης, του Τόπου Άρθρωσης και της Ηχηρότητας και τα κατατάσσει σε τρεις κατηγόριες, δηλαδή σε τέλεια, αποδεκτά και μη αποδεκτά. Τα τέλεια συμπλέγματα είναι όσα ικανοποιούν έστω ελάχιστα όλες τις κλίμακες, δηλαδή η απόσταση του ενός μέλους του συμπλέγματος από το άλλο πάνω στην κάθε κλίμακα είναι τουλάχιστον 1. Τα αποδεκτά συμπλέγματα είναι όσα α) ικανοποιούν κενώς την κάθε κλίμακα, δηλαδή η απόσταση των μελών του συμπλέγματος πάνω στην κάθε κλίμακα είναι 0, β) όσα παραβιάζουν μία από τις δύο ή και τις δύο κλίμακες του Τρόπου Άρθρωσης και του Τόπου Άρθρωσης αλλά ικανοποιούν έστω κενώς την κλίμακα της Ηχηρότητας., γ) όσα ικανοποιούν έστω ελάχιστα την κλίμακα του Τρόπου Άρθωσης ή του Τόπου Άρθρωσης και παραβιάζουν την άλλη και, παράλληλα, έστω κενώς ικανοποιούν την κλίμακα της Ηχηρότητας, δ) όσα ικανοποιούν έστω ελάχιστα την κλίμακα του Τόπου Άρθωσης ή του Τόπου Άρθρωσης και κενώς ικανοποιούν την άλλη και παράλληλα έστω κενώς ικανοποιούν την κλίμακα της Ηχηρότητας. Τα μη αποδεκτά συμφωνικά συμπλέγματα είναι όσα παραβιάζουν και τις τρεις κλίμακες ή μία από τις κλίμακες του Τρόπου Άρθρωσης και του Τόπου Άρθρωσης και παράλληλα παραβιάζουν την Κλίμακα της Ηχηρότητας ή όσα συμπλέγματα που, αν και ικανοποιούν τις κλίμακες του Τρόπου και του Τόπου Άρθρωσης, παραβιάζουν την κλίμακα της Ηχηρότητας. Ακόμη, η τελειότητα και η αποδεκτότητα του συμπλέγματος υπόκειται σε διαβάθμιση λόγω της απόστασης των μελών του συμπλέγματος. Σε αυτό το σημείο ας ανακαλέσουμε ότι και οι πιστές πραγματώσεις του ΔΗΜ και του ΣΠΥ αποτελούνται από [κλειστό/τριβόμενο + υγρό] ενώ πιστές πραγματώσεις από [κλειστό/τριβόμενο + έρρινο] δεν εντοπίζονται. Συνεπώς, τέλεια και αποδεκτά συμπλέγματα παράγονται από τα παιδιά. Η κλίμακα του Τρόπου Άρθρωσης ικανοποιείται πάντα μιας και η απόσταση των δύο μελών του συμπλέγματος είναι πάντοτε 3 ή 4. Η κλίμακα του Τόπου άρθρωσης ικανοποιείται στις περισσότερες περιπτώσεις τουλάχιστον στον ελάχιστο βαθμό, δηλαδή η απόσταση των μελών του συμπλέγματος είναι τουλάχιστον 1. Συμπλέγματα των οποίων και τα δύο μέλη είναι κορωνιδικά και, επομένως, ικανοποιούν κενώς την κλίμακα του Τόπου Άρθρωσης δεν εμφανίζονται ιδιαίτερα συχνά στα δεδομένα των παιδιών. Ακόμη, τα αναπτυξιακά μας δεδομένα δείχνουν πως υπάρχει η τάση να ικανοποιείται με τον μεγαλύτερο δυνατό βαθμό η κλίμακα της Ηχηρότητας, δηλαδή η απόσταση να είναι ίση με 1. Η ένδειξη αυτή πιστοποιείται και από δεδομένα κατά τα οποία το πρώτο μέλος του συμπλέγματος το οποίο είναι [+ηχηρό] παράγεται ως [-ηχηρό], δηλαδή ως αμαρκάριστο ως προς την ηχηρότητα (για παράδειγμα, το σύμπλεγμα /bl/ παράγεται ως [pl] σε κάποιες περιπτώσεις.

Επιπλέον, η παρούσα διπλωματική εργασία διερεύνησε την επίδραση της συχνότητας εμφάνισης των καλοσχηματισμένων συμφωνικών συμπλεγμάτων στην κατάκτησή τους. Διερευνήθηκαν δύο σώματα δεδομένων: Το πρώτο αποτελούνταν κείμενα που ήταν δημοσιευμένα σε εφημερίδες, περιοδικά και πρακτικά της Βουλής και το δεύτερο αποτελούνταν από τον φυσικό αυθόρμητο λόγο δασκάλων που απευθύνονταν σε παιδιά παιδικού σταθμού κατά τη διάρκεια του μαθήματος τους. Και στα δύο σώματα δεδομένων εντοπίζονται τα συμφωνικά συμπλέγματα [κλειστό + υγρό/έρρινο] και [τριβόμενο + υγρό/έρρινο]. Κατά σειρά συχνότητας τα [κλειστό + υγρό] ήταν συχνότερα από τα [τριβόμενο + υγρό] ενώ τα [κλειστό + υγρό] ήταν τα τρίτα κατά σειρά συχνότητας και στα δύο σώματα δεδομένων. Τα συμπλέγματα που σχηματίζονται από τις ακολουθίες [τριβόμενο + έρρινο] ήταν τα λιγότερο συχνά στο πρώτο σώμα δεδομένων ενώ τέτοια συμπλέγματα δεν βρέθηκαν καθόλου στο δεύτερο σώμα. Και τα δύο σώματα δεδομένων δείχνουν ότι τα συμπλέγματα στην αρχή της λέξης και τα συμπλέγματα ενδιάμεσα στη λέξη εμφανίζονται με περίπου την ίδια συχνότητα και, συνεπώς, δεν μπορούμε να προτείνουμε ότι, για παράδειγμα, τα πρώτα αναδύονται ή κατακτώνται πριν από τα δεύτερα. Πράγματι, τα αναπτυξιακά μας δεδομένα δείχνουν πως μία τέτοια αυστηρή σειρά δεν υπάρχει και ότι η ανάδυση των διαφορετικών κατηγοριών συμπλεγμάτων υπόκειται σε διαγλωσσική ποικιλία. Ας ανακαλέσουμε ότι ο ΣΠΥ παράγει ταυτόχρονα συμπλέγματα στην αρχή και ενδιάμεσα στην λέξη ενώ ο ΔΗΜ παράγει πρώτα συμπλέγματα στην αρχή της λέξης και έπειτα στο μέσο της. Τα δύο σώματα δεδομένων που εξετάσαμε δείχνουν ότι δεν διαφέρουν σημαντικά ως προς την συχνότητα των διαφορετικών κατηγοριών συμπλεγμάτων (για παράδειγμα, η συχνότητα των συμπλεγμάτων από [κλειστό + υγρό] δεν διαφέρει σημαντικά στα δύο σώματα) και των διαφορετικών τύπων συμπλεγμάτων. Βασιζόμενοι στην συχνότητα των διαφορετικών κατηγοριών συμπλεγμάτων, υποθέτουμε πως τα συμπλέγματα από [κλειστό + υγρό] και [τριβόμενο + έρρινο] αναδύονται πριν από τα συμπλέγματα από [κλειστό + έρρινο] και [τριβόμενο + έρρινο]. Πράγματι, τα δεδομένα και του ΣΠΥ και του ΔΗΜ επιβεβαιώνουν αυτήν την υπόθεση μιας και πιστές πραγματώσεις των συμπλεγμάτων από [κλειστό + υγρό] και [τριβόμενο + έρρινο] παρατηρούνται στον λόγο των παιδιών ενώ πιστές πραγματώσεις από [κλειστό + έρρινο] και [τριβόμενο + έρρινο] δεν παρατηρούνται. Είναι ενδιαφέρον ότι τα δεδομένα μας παρέχουν ενδείξεις ότι οι πρώτες πιστές πραγματώσεις συμπλεγμάτων από τα παιδιά εντοπίζονται ανεξάρτητα από το εάν αυτά τα συμπλέγματα παρατηρούνται με μεγάλη συχνότητα στο γλωσσικό περιβάλλον της γλώσσα-στόχου, εν προκειμένω της Κοινής Νέας Ελληνικής. Για παράδειγμα, και ο ΣΠΥ και ο ΔΗΜ παράγουν συστηματικά το σύμπλεγμα /bl/ το οποίο δεν είναι συχνό σε κάποιο από τα δύο σώματα που εξετάσαμε. Επομένως, προτείνουμε πως η συχνότητα εμφάνισης των συμπλεγμάτων στην γλώσσα-στόχο δεν μπορεί να νοηθεί ως αυστηρός δείκτης πρόβλεψης για την πρόβλεψη της κατάκτησης των συμπλεγμάτων. Συνεπώς, ποικίλοι παράγοντες, όπως οι φωνολογικές αρχές, τα διαφορετικά αναπτυξιακά μονοπάτια που κάθε παιδί έχει διαθέσιμα καθώς και η συχνότητα εμφάνισης των δομών επιδρούν στην διαδικασία της κατάκτησης των συμπλεγμάτων.

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