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Acquiring sequential temporal connectives and adverbs in Modern Greek

Master thesis submitted by

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Abstract

The present study investigates the acquisition of sequential temporal connectives and adverbs in Modern Greek. Specifically, it concentrates on connectives 'prin' (before) and 'afu' (after) as well as adverbs 'prota' (first) and 'meta' (then). There is extensive literature on the acquisition of English equivalent temporal connectives but in Modern Greek studies are limited and incomplete. This study focuses exclusively on sequential temporal connectives and it is innovating that it aims to clarify whether there is correlation in the development of relevant temporal connectives and adverbs.

Research questions regard primary to the order of acquisition of connectives and adverbs as well as the age at which acquisition is completed. As mentioned before, another goal of the study is to reveal whether there is correlation in acquisition of connectives and adverbs that form semantic pairs: 'prin'- 'prota' and 'afu'- 'meta'. Moreover, a few questions about other factors that influence comprehension of sentences containing 'prin' and 'afu' are addressed. Previous studies observed that chronological sentences are easier in process than reverse and that children apply non linguistic strategies in order to cope with tasks when they lack linguistic knowledge. This study attempts to make clear whether these conclusions are verified for Modern Greek as well.

An experimental research (in the spirit of Blything 2016) was conducted so as to give specific answers in the questions addressed above. A total of 51 monolingual children between 3-6 years old participated in a picture selection task. Children were divided into 3 groups depending on their age (Group A (N=15): 3;0-4;0 years old, Group B (N=19): 4;0-5;0 years old, Group C (N=17): 5;0-6;0 years old). Participants were tested in sentences containing 'prin', 'afu', 'prota' and 'meta' in six different conditions. Children had to point to the correct picture based on the question that each time the experimenter asked. Performance in the task would reveal to what extent each age group comprehends temporal connectives and adverbs and how gradually children improve until they finally acquire them.

The present thesis negotiates the issue under investigation in three chapters. Chapter 1 refers to the theoretical background. Previous literature and other relevant aspects of the issue are extensively presented. Chapter 2 includes a detailed analysis of the study and the results that were extracted. The last chapter (Chapter 3) further discusses results and gives answers to initial research questions.

Theoretical background

1.1 Temporal cognition

Time is a fundamental human notion. Everything around us is temporally determined. Events happen in a specific time, they are characterized from their duration as well as their sequence with respect to another event. Although we constantly experience time, it still remains absolute abstract. Its basic concepts, present, past and future, are stimulated from events that occur in the here -and- now, occurred and will occur¹. Time is also expressed through language with words and grammatical constructions, such as temporal adverbs and connectives, aspect and tenses. An issue that arises is whether there is a correlation between the development of temporal cognition and more specifically temporal concepts with language acquisition².

1.1.1 Temporal concepts and language acquisition

According to Zhang and Hudson (2018a), development of temporal concepts is affected from both development of language and several cognitive processes (e.g. event representation and reasoning). At the same time, in order to process temporal language correctly, it is necessary to have acquired semantic knowledge of temporal words and to be able to map events in time. However, many studies have shown that there is a discrepancy between production and comprehension of temporal language. For example, children may produce temporal adverbs, but this does not mean that they fully conceive and comprehend the time notion that these adverbs represent.

¹ As McCormack (2015) notices, past and future events differ in that past events are unalterable while future ones can be altered.

² For a review of the issue, see: Zhang and Hudson (2018a).

Weist (1986,1989) - based on Reichenbach (1947) - proposed a theory about the connection between the development of temporal concepts and language³. He claimed that gradual development of temporal language corresponds to improvement in time perception. Weist distinguished three levels in time: Speech Time (ST), Event Time (ET) and Reference Time (RT). Speech Time refers to the time of utterance, Event Time to the time that an event happened and Reference Time does not necessarily coincide with them. This is obvious in a sentence with past perfect like 'I had read the book.' Children conceive ST at around 1;6 years old and they are capable of talking about the present. Two-year-old children start using tenses and this fact is considered to be an indication that they conceive ET as well. Perception of RT occurs around the age of three when -between others- temporal adverbs⁴ appear in children's speech. It must be mentioned though that development of RT occurs in two phases. Initially, during Restricted Reference Time (RT_r) children connect RT with ST or ET. Gradually, they use RT independently and as a result they pass to free Reference Time (RT_f) in which Weist posits usage of temporal propositions 'before' and 'after'.

Another issue that is connected with Weist's RT is temporal decentering as discussed specifically in McCormack & Hoerl (2008). Decentering is a basic tool that allows someone to 'travel' from present to another temporal point and context. This renders the perception of events from a different aspect possible. McCormack and Hoerl notice that Weist's RT_r is practically an early decentering. Children are capable of transferring themselves in another temporal level, for example past, but they cannot fully conceive what the exact relations between different levels are. Actual decentering corresponds to Weist's RT_f since children are able to perceive temporal relations and their connections independently of their own perspective.

Earlier, Harner (1980) determined children's temporal decentering as the perception of "past and future relations from a point of view other than their own." It is important to mention that Harner

³ For another proposal for the developmental path of temporal concepts and its impact in temporal language see: McCormack and Hoerl (2017). In short, they distinguish development of temporal concepts in 5 stages. Important improvement is noticed in the fourth stage when 4-5-year-old children start conceiving time in a linear and unified way. This is exactly the point in which they can comprehend adequately before-after relations. In the last stage, children up to five years old are able to perceive fully the notion of time.

⁴ Pawlak et al. (2006) discussed the emergence of temporal adverbs in English and Polish based on Weist's theoretical account.

attempted to connect comprehension of 'before-after' sentences with children's ability to decenter. She supported that understanding past and future is closely related to that of 'before' and 'after'. In order to construct a semantic chain between abstract time levels and temporal markers, she adopted the opinion (Leech 1970) that 'before' implicitly refers to a prior (past) notion while 'after' to a posterior (future) one.

Moreover, an important temporal concept is that of sequence. Time is considered to be linear and unified (McCormack and Hoerl 2017) and is determined to a large extent from 'before' and 'after' sequences. A research that focused on children's capability to sequence is that of Fivush and Mandler (1985). Their basic conclusion was that children improve their ability to sequence as they get older, especially at about 5-6 years old. They attribute children's difficulty in sequencing in that they cannot easily build a temporal representation of correct sequence. This is also the reason that justifies why children perform better in forward than backward sequence.

McCormack and Hanley (2011) also investigated sequencing ability and more specifically how this is related to temporal reasoning. Firstly, they clarified that the ability to represent a sequence differs from constructing one and be capable to locate and relocate events. For instance, Hoerl and McCormack (2011: cited in McCormack and Hanley 2011) concluded that children younger than 5 years old are able to represent temporal sequences but not reason about temporal order. Following the same line, it was supported that manipulating reverse sentences, that is, sentences in which events are not presented in the order of their occurrence, is difficult. It is necessary not only to represent events in a sequence but also to be able to re-place them in temporal order so as to match reality. McCormack and Hanley examined how children perceive and reason temporal order of past and future events as well as before and after sentences. They concluded that it was easier for children to reason about the past rather than future. In fact, it is interesting that there was a correlation between performance in future reasoning and reverse before and after sentences.

All cognitive issues that were addressed above and are related to language do not represent an exhaustive description of this theme. Many more could be referred and the present ones could be further analyzed. However, since the present study is not purely cognitive, there was a selection of

specific aspects that can be connected to before-after relations. The question of how these cognitive issues regard the research of the present study will be discussed later (chapter 3).

1.2 Temporal connectives

Temporal connectives place events in time with reference to each other. They fall within two categories: sequential and simultaneous (Fig.1.1). Sequential temporal connectives declare that one event succeeds another, that is, an event begins exactly when another one has just come to an end. On the other hand, simultaneous temporal connectives connect two events that actually occur in the same time. Their starting and ending point are unknown and the only thing that is pointed out is their simultaneous duration.

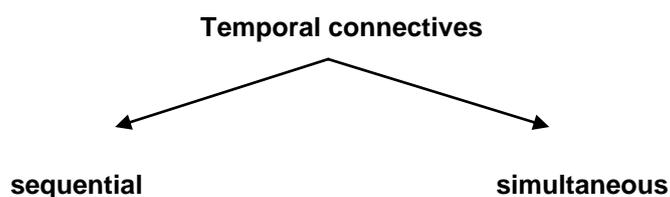


Figure 1.1

Previous literature (Diessel 2004: cited in De Ruiter et al. 2018) refers that production of temporal connectives occurs around 3 years old. However, their comprehension is more complex and it continues to develop far beyond this age, an issue that is going to be discussed in detail in a following section (section 1.3). As far as the order of acquisition of simultaneous and sequential temporal connectives is concerned, findings are contradicting. Some researches supported that simultaneous temporal connectives are earlier acquired (e.g Munro & Wales 1982) whereas other (e.g Ferreiro and Sinclair 1971) concluded that sequence is acquired before simultaneity.

1.2.1 Temporal connectives in Modern Greek

Temporal connectives in Modern Greek -as presented in Triantafilidis (1946) and Mackridge (2011)- are listed in the following figure (1.2). Mackridge (2011:421) notices that 'afu', 'otan' and 'molis' are the most frequently used in Modern Greek.

Temporal connectives in Modern Greek	
Sequential temporal connectives	Simultaneous temporal connectives
afu (after)	otan (when)
prin (before)	eno (whilst)
molis (as soon as)	kaθos (while)
mehri (until)	

Figure 1.2

Previous studies on the acquisition of Greek temporal connectives are not extensive. Natsopoulos and Abadzi (1986) as well as Papakonstantinou (2015) investigated simultaneous and sequential temporal connectives. Both researches concluded that sequence is acquired earlier than simultaneity in Modern Greek.

Greek sequential temporal connectives 'prin' and 'afu' need to be further analyzed since this is the subject of the present thesis. As it is shown below, 'afu' and 'prin' vary in language uses⁵.

afu	prin
temporal connective	preposition
causal connective	temporal connective
	adverb

⁵ As presented in Haralambakis (ed.) (2014).

Both are recognized as temporal connectives and this is exactly their common basis. Temporal connective 'prin' can also function as a preposition and adverb. Taking everything into consideration, it is clear that 'prin' can be used in the same way as its English equivalent 'before'. On the other hand, 'afu' functions exclusively as a connective, temporal or causal⁶. Its single identity as connective comes in contrast with the triple one of 'prin'. At the same time, 'afu' differs from 'after', which is simultaneously a potential preposition, adverb and temporal connective.

1.2.2 Temporal connectives and sentence structure

Temporal connectives always insert subordinate clauses which are connected necessarily with another clause, predominately a matrix one. The order in which a matrix and a temporal clause appear in an unique sentence determines its chronological or reverse order of event sequence with regard to the real sequence of events in time. Some examples could be really useful so as to understand exactly what happens.

(1) Diavase ena vivlio prin peksi ston kipo.

He read-PAST.3s a book-ACC.SING before he play-NON PAST in the garden.

'He read a book **before** he played in the garden'.

1

2

Chronological order

(2) Afu diavase ena vivlio epekse ston kipo.

After he read- PAST.3s a book-ACC.SING he play-PAST.3s in the garden.

'**After** he read a book, he played in the garden'.

⁶ Kalokerinos (2001) supported that 'afu' is not a causal connective and he connected its uses exclusively under its temporal perspective.

In sentences (1) and (2) events are presented in chronological order, that is, their order of reference corresponds to the order that events occurred in real world. In both sentences the first event in time is the reading of a book while the second one is playing in the garden. It is also important to underline that keeping chronological order prerequisites to place 'before' clauses in the second position of a sentence whereas 'after' clauses need to be posited initially.

(3) Prin peksi ston kipo diavase ena vivlio.

Before he play-NON PAST in the garden he read- PAST.3s a book-ACC.SING.

'**Before** he played in the garden he read a book'.

2

1

Reverse order

(4) Epekse ston kipo afu diavase ena vivlio.

He play-PAST.3s in the garden after he read- PAST.3s a book-ACC.SING.

'He played in the garden **after** he read a book'.

In sentences (3) and (4) events are reversed comparing with their actual order of occurrence. The only clue that indicates the real order of events is the temporal connective. As it is obvious, in reverse-ordered sentences 'before' clauses are posited first while 'after' clauses second. Table 1.1 below concentrates all possible combinations of the position⁷ that a temporal connective can have within sentence.

Connectives	before	after
Chronological order	2	1
Reverse order	1	2

Table 1.1 – Position of sequential temporal connectives depending on order of appearance of events

⁷ Number 1 indicates that temporal connective is posited sentence initially whereas number 2 that temporal connective is in the middle of a sentence.

1.3 Literature review

A number of studies have been conducted in order to examine the acquisition of temporal connectives and adverbs. Following main studies are presented focusing on their research questions and results. Section 1.3.1 concentrates on researches about temporal connectives whereas section 1.3.2 refers to literature on the acquisition of temporal adverbs.

1.3.1 Previous studies on the acquisition of temporal connectives

Clark (1971) is one of the earliest studies concerning the acquisition of 'before' and 'after'. It must be mentioned that her study is semantic-oriented; that is, Clark attempted to investigate the acquisition of word meaning through the research of the relevant temporal terms 'before' and 'after'.

She recognized 3 semantic features for each of the examined terms; +TIME (since 'before' and 'after' contain the notion of time) and -SIMULTANEOUS (both are sequential temporal connectives) are common semantic features for 'before' and 'after'. Their only difference is spotted in the feature PRIOR; 'Before' has the positive value (+PRIOR) and 'after' the negative one (-PRIOR). It was supported that 'before' precedes 'after' in acquisition because it has more positive values⁸; that is, Clark advocated that 'before' is easier and consequently earlier acquired. Clark did not take into account only semantic factors for the acquisition of 'before' and 'after'. She considered as a fact that the second position of a subordinate clause (that is, when a temporal connective is in the middle of a sentence) is easier to process⁹. According to her though, results revealed that the position of the clause (initial or in the middle of the sentence) had no impact on performance. It must have been a matter of the temporal connective ('before' or 'after') combined with the position of the subordinate clause.

⁸ Moreover, in the article a correlation is made between 'before' and 'after' and the spatial prepositions 'in front of' and 'behind' (Clark 1969). Based on this correlation, Clark characterizes 'before' as the positive term of the couple.

⁹ Based solely on this criterion, before-chronological and after-reverse sentences are supposed to be processed more easily.

She conducted an experiment¹⁰ that consisted of two parts¹¹: a production and an act-out comprehension task. The analysis of the results showed that age is connected to successful performance; older children made fewer errors than younger ones. It was also noticed that errors in the sentences containing 'before' were fewer than those containing 'after'¹². Based on that, Clark advocated that the semantic simplicity of 'before' is the reason of its earlier acquisition. As far as very young children are concerned, she supported that they probably used an order of mention strategy so as to interpret sentences containing 'before' and 'after'. Indeed, Clark noticed that when chronological order of events was preserved¹³, the order of mention strategy was applied¹⁴ by younger children.

Taking everything into account, Clark ended up supporting that the acquisition of the meaning of 'before' and 'after' passes through 3 different stages. In Stage A an order of mention strategy is broadly used, especially from younger groups. This occurs because children cannot understand either before or after. During the second stage (Stage B) 'before' seems to be acquired since it is treated correctly by children. At the same time the acquisition of 'after' is still incomplete. At Stage C the perception of the meaning of 'before' and 'after' is adultlike, that is, children comprehend both 'before' and 'after'. Based on these stages, Clark strongly supported that children acquire word meaning by learning gradually its semantic features¹⁵.

¹⁰ Forty kids participated in the study; their age ranged between 3;0-5;0.

¹¹ In the production task, children were expected to answer two when-questions using spontaneously 'before' and 'after'. The process was the following: the experimenter acted out two different actions with toys (e.g. The boy kicked the rock (Event 1), The boy patted the dog. (Event 2)) and then asked the participant: 'When did the boy kick the rock?', 'When did the boy pat the dog?'. The analysis of the production task results showed that there was a correlation between the production and comprehension performance for temporal connectives 'before' and 'after'. Moreover, comparison between 'when' and sequential connectives indicated according to Clark that simultaneity is acquired earlier than sequence.

¹² In another study however, Barrie-Blackley (1973) concluded that 6-year-old children comprehended 'after' better than 'before'.

¹³ In another contemporary study, Hatch (1971) noticed that temporal order highly affected children's responses. Chronological order of events helped kindergarten and second-grade subjects to respond correctly. Furthermore, Hatch investigated sentence structures with 'and then' and 'but first'. Taking all tested sentence structures into account, she concluded in the following ranking from the most simple to the most complex structure: 1. 'and then', 2. Before-chronological sentences, 3. After-chronological sentences, 4. 'but first' (note: this sentence structure is reversed ordered), 5. After-reverse sentences, 6. Before-reverse sentences.

¹⁴ This practically means that children succeed in before-chronological and after-chronological sentences but made a lot of errors in before and after reverse sentences.

¹⁵ Carni & French (1984) put into doubt Clark's semantic theory. They supported that children's performance improved as they get older mostly because their cognitive ability develops. Children are capable to handle chronological and especially reverse sentences better since it becomes easier for them to build the mental

Amidon & Carey (1972) is another research¹⁶ that investigated temporal connectives 'before' and 'after'. Their point of view is totally different than Clark's (1971), since it is syntactic rather than semantic. They tried to explain children's difficulty in comprehending sentences based on a claim of Smith and McMahon (1970), who supported that processing in main clauses is simpler than in subordinate ones. It must be mentioned that the research was divided in two parts: a training trial¹⁷ and a posttest. Amidon & Carey tried to find out in this way whether training conditions would influence children's performance in the posttest session. Analyzing results, it was noticed that only feedback proved to be helpful since subjects that were in the feedback group had better performance than others. Furthermore, three types of errors were observed: reversals (in case that children performed both actions but in reverse order), omission of the subordinate or the main clause (this practically means that children performed only the action of the main sentence or the subordinate respectively). Researchers underlined that F and FE groups made foremost reversal errors. On the other hand, E and C₁ groups had a total of more subordinate clause omission errors than reversal. As far as C₂ is concerned, the comparison with C₁ group revealed that processing sentences with 'first' and 'last' is easier than those with temporal connectives. Amidon and Carey attributed this difference in the fact that first – last sentences are solely main, whereas other sentences contain a before or after subordinate clause. This is in accordance with Smith and McMahon's claim (1970) about the easier processing of main clauses. The researchers ended up supporting that comprehension of temporal sentences is affected by a strategy that children use, that is, not processing subordinate clauses¹⁸. However, performance can be improved if errors are pointed out (i.e. corrective feedback is given). Children seem to change their way of sentence processing and as a result sentences with 'before' and 'after' seem to be better comprehended.

representation of a sentence. Comprehension of 'before' and 'after' is not just a matter of their semantic features but predominately understanding of the context (sentence) within temporal connectives appear.

¹⁶ The experiment included an act-out task in which 50 children between 5;4 and 6;3 years old participated. The task was based on sentences that described one event with two different objects. (e.g. Put the ball in the box before you put the scissors in the box. The same sentence could be presented in another form: 'Put the ball in the box first. Put the scissors in the box last'.)

¹⁷ In the training trial, subjects were divided into 5 groups, each of which had a different experimental purpose. During examination, the first group (F group) was corrected in case of error. In the second one (E group) intonational emphasis was given on the temporal connective. There was also another one (FE group) that received correction and intonational emphasis. Moreover, two control groups (C₁ & C₂) were not instructed at all, that is, there was no stimulus of feedback or emphasis. The difference between them was that C₂'s examination contained sentences with the words 'first' and 'last'.

¹⁸ A similar conclusion is found in Amidon (1976).

Johnson (1975) reexamined¹⁹ the acquisition of temporal connectives 'before' and 'after' by including in her study the tasks used in Clark (1971) and Amidon-Carey (1972). As she pointed out, differences between the results of these previous researches were basically a matter of methodology. Analyzing the results, Johnson noticed that children succeeded much better in the comprehension rather than the command task. It is important to refer though, that the type of errors made in the tasks were different. In the comprehension task, reversal errors were very frequent whereas in the command task children made a lot of omissions errors, that is, they acted out only one of the two actions. As it is pointed out in the article, reversal errors truly showed that children do understand that they have to deal with two sequential events. The problem is that they cannot order them correctly because of their lack of knowledge of the semantic features of the connectives. On the other hand, omission errors cannot give this kind of information. She also noticed that children widely used the order of mention strategy. Johnson concluded that Clark's semantic theory and method were reliable to use. Basically, her research was more a comparison of the two previous studies and no new finding for the acquisition of temporal connectives under investigation was extracted.

French and Brown (1977) concentrated on whether logical sentences, that is, sentences which correspond with world knowledge, affect processing and performance. 'Before-after' logical sentences contain two events that are semantically connected and they usually happen in a fixed order. Logical sentences are contradicted with arbitrary ones in which events are irrelevant and are not logically connected. It is expected that logical sentences are easier in process because children conceive logical sequence of events no matter what the order of reference is but the same is not valid for arbitrary sentences²⁰. Forty children between 3;5-5;1 participated in an act-out task. The analysis of results indicated that performance was better in logical sentences and according to researchers this exactly shows that logical sequence leads children to success. Furthermore, it was noticed that there was no significant gap in comprehension of 'before' and 'after'. Both

¹⁹ Only 18 children, aged between 4-5 years old, participated. The small number of participants and the limit in age can be regarded as disadvantages. As in the previous experiments the method of the act-out task was used. There were two main parts: a comprehension task (as in Clark 1971) and a command task (based on Amidon-Carey 1972).

²⁰ For further reading on arbitrary and logical sequences see: Brown & Murphy (1975) and Brown and French (1976).

omission of subordinate clauses and reversal errors were committed with the latter ones being more frequent in arbitrary – reverse sentences and they were connected with order of mention strategy. In general, French and Brown supported that there might be three stages of comprehension. During the first, children performed equally low in all sentence types whereas in the second stage performance was superior in logical and not arbitrary sentences simply because logical semantic relations helped children. The final stage was characterized by good performance in both logical and arbitrary sentences and this fact reveals actual comprehension of temporal connectives.

Coker (1978) focused on whether ‘before’ and ‘after’ are used and comprehended initially as prepositions or as connectives²¹. Moreover, she tried to clarify whether children extensively apply strategies (order of mention and main-clause-first strategy²² (Bever 1970)) in order to cope with different tasks. Based on total results, Coker concluded that prepositional interpretation of ‘before’ and ‘after’ preceded in acquisition since performance was better in these tasks. In the subordinate clause task it was revealed that participants extensively applied main-clause-first and order of mention strategy²³ while even 6-year-old children faced difficulty in comprehending ‘before’ and ‘after’. Most importantly, Coker concluded that ‘before’ did not proceed ‘after’ in comprehension.

Feagans (1980) adopted a cognitive-philosophical point of view. She focused on three different temporal concepts, that is, order, duration and simultaneity and examined²⁴ them through their equivalent linguistic structures. Order was connected with ‘before’, ‘after’, ‘since’ and ‘until’, duration with ‘since’ and ‘until’ and simultaneity with the connective ‘while’. Based on a philosophical theory, the predicted order of acquisition was the following: order > duration > simultaneity. The researcher came up with some general conclusions that are in accordance with Clark’s findings. Chronological or reverse order of a sentence had an important impact on

²¹ The research included two prepositional and a single subordinate clause task in which 120 children (5;3-7;7 years old) participated. In the prepositional tasks subjects memorized a sequence of three pictures and then the experimenter asked a question containing ‘before’ and ‘after’ as prepositions. On the other hand, the subordinate clause task was an act-out one through which comprehension of temporal connectives ‘before’ and ‘after’ was examined.

²² The logic of this strategy is that children interpret a sentence as if the main clause always describes the first event in order.

²³ Coker supported that strategy use can interpret Clark’s (1971) substage of ‘after’ as meant ‘before’ and Amidon & Carey’s (1972) omission errors.

²⁴ A total of sixty 3-7-year-old children participated in the study in which the act-out task method was used.

performance²⁵. Another finding that put into doubt Clark's semantic theory is that sequential temporal connectives 'before' and 'after' seemed to be acquired earlier than simultaneous 'while'. What would be expected according to Clark's semantic theory is quite the opposite order of acquisition. Taking everything into consideration, Feagans concluded that the acquisition of temporal connectives could be better explained based on a cognitive rather a semantic account.

Richards and Hawpe (1981) investigated²⁶ three opposite pairs: before-after, first-last and ahead-behind²⁷. they based their research theoretically in that all these words have both a temporal and a spatial dimension²⁸. Researchers attempted to clarify whether spatial dimension²⁹ precedes in acquisition (as Clark (1973) supported) or order of acquisition depends on frequency of their everyday use³⁰. Richards and Hawpe pointed out that 'before' and 'after' are used presumably as temporal terms and spatially only as prepositions. The same is valid for the pair 'first-last' as their temporal usage predominates. Overall results revealed that children initially acquire temporal dimension of before-after whereas spatio-temporal and spatial follow. Performance in 'before' was higher and it was generally affected by sentence type (chronological or reverse) for both words³¹. Temporal sense of 'first-last' also preceded in acquisition. 'First' was comprehended earlier than 'last'. Richards and Hawpe underlined that this could be a result of strategy use: 4-year-old children tended to act first whatever they were instructed first without taking into account the word included in a sentence due to their inadequate semantic knowledge. Use of this strategy was limited as children got older. Generally, researchers advocated that the acquisition of temporal and spatial sense of a word is relevant to its predominant use in language.

²⁵ At the same time, putting the main clause in the beginning of a sentence did not facilitate children's performance.

²⁶ Research was divided into three act-out tasks, each of which tested a different dimension of words under investigation: temporal, spatial and spatial-temporal. In each task 40 children between 4-6 years old participated.

²⁷ Analytical reference will be made only for the first two pairs since these are relevant to the present study.

²⁸ Estaún (1992) investigated Spanish 'antes' (before) and 'después' (after). 'Antes' has exclusively a temporal meaning whereas 'después' has both a spatial and temporal interpretation. In an act-out task 21 children (5;4-6;3 years old) participated. Results indicated that performance in 'antes' was superior than 'después'. Moreover, errors were more frequent in reverse sentences.

²⁹ In her study of 'before' and 'after', Trosborg (1982) referred that the spatial dimension of time influences its perception.

³⁰ Practically it is supported that stimuli that children perceive from their environment largely determine precedence of temporal or spatial reading in acquisition.

³¹ It must be noted though that success in after-chronological sentences was better than before-reverse. Moreover, performance did not improve in case that matrix sentence was the first in order.

Goodz (1982) based her study³² in the idea³³ that performance in 'before-after' sentences is foremost determined by the use of two specific strategies: order of mention strategy and main-clause-first strategy (Bever 1970). The use of the latter strategy leads children to respond correctly in before-sentences but not in 'after' ones. On the other hand, appliance of order of mention strategy corresponds to correct answers in 'before'³⁴ and 'after'-chronological sentences. According to the researcher, results revealed that Group C performed better in before-sentences. At the same time, Group Q showed similar performance in 'before' and 'after'. Shortly, Goodz concluded that comprehension of 'before' and 'after' is a matter of complexity of their sentence context that allows or not successful application of strategies. She did not exclude semantics factors but she underlined that it is not easy to discriminate the limits between semantic knowledge and strategy use.

Evers-Vermeul & Sanders (2009) developed the Semantic Cumulative Complexity Theory through which they tried to predict the order of acquisition of connectives based on semantic features (cognitive primitives). Connectives are determined through these primitives which render acquisition of a connective easy or more complex. Evers-Vermeul & Sanders analyzed three specific categories of cognitive primitives: basic operation, polarity and temporality. Basic operation refers to the discrimination between additive and causal relations of connectives. Causal relations are marked since they presuppose an additive one. Polarity is connected with positive and negative relations. It is logically assumed that negative feature is more complex. The last cognitive primitive, temporality, determines whether or not a connective contains the sense of time, so there are temporal and non-temporal connectives. Connectives are positively marked or underspecified for each cognitive primitive. The more positive values a connective has, the more marked it is, thus it is more complex to be acquired. That means that the values of cognitive primitives of each

³² Goodz formed two task, an act-out and a production task. In the first task, only before-chronological and after-reverse sentences were included. In the production task, there were two stimulus sentences, a when-question and another one that included 'before' and 'after' (as temporal adverbs) without the presence of a matrix sentence. Goodz divided 24 children (3;4-4;2 years old) in two groups: Group C participated in the comprehension and Group Q in the production task.

³³ Goodz refers that Bever (1970) attributed differences in 'before-after' sentences in their cognitive complexity and not in semantic factors as Clark supported.

³⁴ In before-chronological sentences both strategies can be applied successfully whereas in after-reverse sentences none of them works correctly.

connective determine the order of their acquisition. Based on this theory, Evers-Vermeul & Sanders made all possible combinations of cognitive features and predicted the order of acquisition of connectives. Researchers analyzed spontaneous speech data of Dutch speaking children aged between 1;5-5;6. The only temporal connective which was examined is 'toen' (=when/then). It was pointed out that the adverbial use of 'toen' is earlier than its use as connective. In general, Semantic Cumulative Complexity Theory offers a theoretical context within which the acquisition of temporal connectives can be explained³⁵.

Pyykkönen & Järvikivi (2012) investigating Finnish tried to find out the reasons that children face difficulties in interpreting sentences³⁶ with temporal connectives 'before' and 'after'³⁷. The analysis of results showed that children performed better in sentences in which a subordinate clause preceded the main clause. Based on this, Pyykkönen & Järvikivi advocated that it is easier for children to process this kind of sentences for the following reason: the initial position of the connective allows children to start building instantly the mental representation of events no matter if the latter ones are presented in chronological or reverse order. They also supported that difficulty in comprehending sentences lies on the medial position of a connective in a sentence. This makes it really complex for children to rebuild their mental representation regarding the order of events described. Pyykkönen & Järvikivi also noticed that it is easier to process a sentence with reverse order and the temporal connective initially posited rather than a chronological sentence containing the temporal connective in a medial position. Chronological or reverse order is not the only factor that influences performance. That means that researchers basically give priority to the position of the temporal connective and not to the order of events presented. It was finally revealed that there was an interaction between the order of events and the position of the connective. Moreover, it was indicated that Finnish 'before' is acquired earlier than 'after', which is not acquired even at age 11.

³⁵ Based on this theory, Greek sequential connectives 'prin' and 'afu' are connected with the following primitives: 'prin': additive, positive and +temporal, 'afu': +causal, positive, +temporal. It is obvious that 'prin' has one determined value and 'afu' two. This fact renders 'afu' more difficult in acquisition.

³⁶ They also examined converb constructions but there will be no reference for this issue in the present review.

³⁷ In their study 132 children between 8-12 years old participated. They were asked to fill in 4 questionnaires containing 40 sentences and converb constructions. They had to decide which event occurred first by circling the correct verb from the choices given.

Blything (2016) conducted an extensive research on the acquisition of 'before' and 'after'³⁸. His theoretical approach is quasi semantic-cognitive. He pointed out that comprehension of a sentence containing sequential temporal connectives is not only a matter of having acquired the semantic features of the latter ones (as Clark 1971 supported). There are also other factors that influence children's comprehension. He took into consideration the 'memory capacity account' (Just & Carpenter, 1992) according to which the construction of the mental representation of a sentence depends on working memory. In case that a lot of information is concentrated in working memory, sentence processing can be quite difficult. As a result, there is high probability that the comprehension of the chronological sequence of events can be problematic.

Based on this theory, Blything supported that comprehension process can be affected by different factors. First of all, order of reference (chronological or reverse) is important: in a chronological ordered sentence, information is processed gradually and at the same time the mental representation of events is built. In contrast, in a reverse ordered sentence this is not possible. Mental representation can be correctly structured after reading is completed. That means that all information need to be kept in memory until then. Moreover, the connective itself is another factor that influences comprehension. Blything accepts Clark's semantic theory which proposed that 'after' is semantically more complex than 'before'. The semantic complexity of a connective gives extra burden to working memory. The position of a connective in a sentence also plays a role in comprehension. A connective appears in initial or medial position. The first is considered to be more marked because it is necessary to keep the semantic information of the connective in memory in order to make the connection between the clauses of a sentence. Last but not least, the presence of world knowledge in a sentence can influence processing as well. All these factors affect sentence processing as they create extra demands in working memory. It is logically assumed that children that have limited storing capacity cannot develop a precise representation during comprehension.

³⁸ It must be mentioned that the construction of the experiment of the present study was based in the spirit of Blything's first comprehension experiment.

	Reverse order	Later acquired connective ³⁹	Initial position	World knowledge ⁴⁰
Before-chronological (world knowledge present)				
After-chronological (world knowledge present)		√	√	
Before-reverse (world knowledge present)	√		√	
After-reverse (world knowledge present)	√	√		
Before-chronological (world knowledge absent)				√
After-chronological (world knowledge absent)		√	√	√
Before-reverse (world knowledge absent)	√		√	√
After-reverse (world knowledge absent)	√	√		√

Table 1.2 – Factors that influence processing of a sentence

The first column of table 1.2 concentrates all possible combinations of the order of appearance of events (chronological or reverse) and the connective included in a sentence. There is variety in difficulty of processing for each type of sentence because in each case the factors that affect comprehension are not the same. The more criteria a sentence satisfies, the more difficult it is. Following this line, before-chronological sentences are considered to be the easiest of all in processing. All the other sentence categories include two factors – if not world knowledge is taken into account- in different combinations. Blything did not clarify whether difficulty in processing depends only on the number of factors or their nature.

Blything conducted a research⁴¹ in order to find out in which age children comprehend sentences with ‘before’ and ‘after’. Moreover, he tried to clarify the reasons for which these sentences are difficult in processing even after children partially understand the meaning of connectives. In total 91 subjects between 3;0-7;0 years old were examined by using the forced choice touch-screen

³⁹ This specific factor is not in the same category with the others. Basically, it is connected with the order of acquisition of the connectives based on their semantic features. Blything is concerned about how the nature of a connective could interact with other factors.

⁴⁰ The analysis of results showed that this strategy did not affect children’s performance.

⁴¹ The research included two comprehension and two production experiments. In this review, there will be extensive reference only to the first comprehension experiment. The latter one also appears in Blything et al. (2015).

method. Children had to choose each time one out of a pair of pictures so as to answer the question of what happened first based on a sentence .

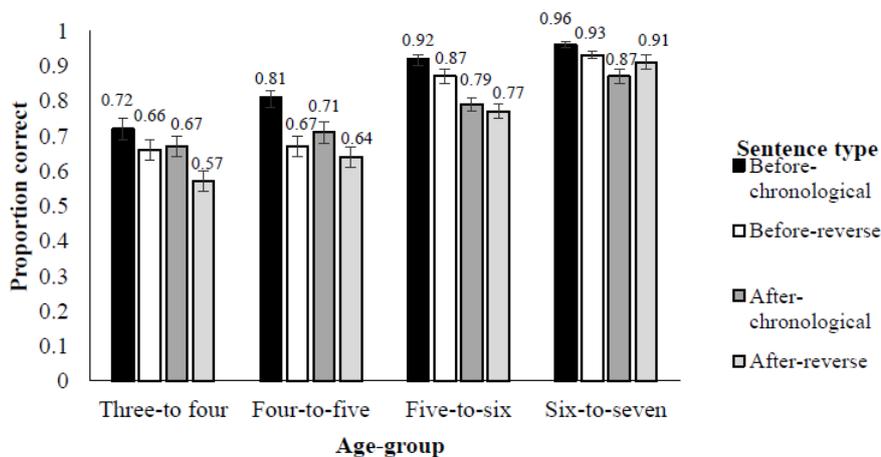


Figure 1.3 (adapted from Blything (2016):54)

Analyzing the results, Blything indicated some interesting points. First of all, there is a clear interaction between age, order and connective. This practically means that the combination of these factors –and not each one separately- plays a role in comprehension. Results also revealed that comprehension of ‘before’ precedes that of ‘after’. As far as older children are concerned, Blything underlines that the acquisition of temporal connectives is completed around the age of 7.

In the second comprehension experiment methodology was the same with the difference that children were asked to choose the picture that showed what happened last. Furthermore, response time was measured and it was revealed that participants responded more quickly in chronological sentences. In general, Blything noticed that children performed better in chronological sentences rather than on reverse. This was attributed to the fact that subjects needed more time to rebuild their mental representation in a reverse sentence.

In the production experiments 3-6-year-old children participated in a sentence repetition and an elicited production task. In the first task, children had difficulty in repeating reverse sentences and especially after-reverse ones. In the elicited production task participants watched two videos and then they had to described what happened using temporal connectives ‘before’ and ‘after’. Once again it was revealed that production of reverse ordered sentences –and more specifically after-reverse- is the most demanding for children.

1.3.1.1 Research on the acquisition of temporal connectives in Greek

Natsopoulos and Xeromeritou (1988) investigated Greek sequential temporal connectives⁴². They considered that there are three significant factors that influence comprehension: chronological and reverse order of sentences, precedence of matrix sentence, which is supposed to make comprehension easier, and order of mention strategy. Participants consisted of two different groups: typical developing children (3;6-4;9 years old) and Educable Mentally Retarded (EMR) children (7;9-13;6 years old). Two methods were used: an act-out and a picture task in which children had to put two pictures in the correct order. Results revealed that despite the fact that typical developing and EMR had the same mental ability, there was quite a difference in their performance. In general, for both groups 'before' was better comprehended and chronological sentences were processed more easily. Typical developing children applied an order of mention strategy, especially for after-chronological sentences. Researchers also underlined that before-chronological is the easiest sentence type whereas after-reverse the most difficult. At the same time after-chronological and before-reverse sentences were not treated differentially.

Papakonstantinou (2015) is a recent research regarding the acquisition of temporal connectives in Greek⁴³. She focused on temporal connectives *afu* (after/since), *eno* (whilst) and *kaθos* (while/since), which are considered to be ambiguous⁴⁴, as well as on the unambiguous *prin* (before) and *otan* (when). Her research consisted of two comprehension and two production experiments in which a total of 120 children between 5;2-11;9 years old participated.

Papakonstantinou adopted a theoretical approach (Tsimpli, Papadopoulou & Mylonaki 2010) according to which aspect plays a role in the way that an ambiguous connective is interpreted. Connectives have a semantic feature, called boundedness, which has a negative and a positive value and denotes initial and final endpoints. In case that the value of boundedness coincides with the one of aspect, then the temporal interpretation of a connective is allowed. Based on that, a

⁴² Sequential temporal connectives were also included in Natsopoulos and Abadzi (1986).

⁴³ In Papakonstantinou (2015) some others studies which investigate acquisition of (non)temporality in Greek from different perspectives are referred : Kantzou (2010), Stamouli (2012) and Mastropavlou et al. (2010) (for SLI).

⁴⁴ In general, a connective is characterized as ambiguous in case it has a double reading. Talking specifically for the mentioned Greek connectives, they have a temporal interpretation and a second one (premise/concessive).

connective that is positively determined combines with perfective aspect (+bounded, perfective aspect). This combination renders sequential temporal reading possible. At the same time, the negative value of boundedness is connected with imperfective aspect (-bounded, imperfective aspect) and allows simultaneous temporal reading. Thus, the theory⁴⁵ logically predicts that connectives under investigation have the following features: *afu* (after/since): +bounded, +perfective, *kaθos* (while/since): -bounded, -perfective, *eno* (whilst): -bounded, -perfective and *prin*⁴⁶ (before): +bounded.

In the first comprehension experiment Papakonstantinou tried to clarify whether 'prin' (before) and 'afu' (after) are acquired simultaneously or ambiguity affects acquisition. Moreover, another issue under investigation regarded the order of acquisition of sequence and simultaneity.

Group	Success (%) (prin)	Success (%) (afu)
5;6	78%	36%
7;6	82%	57%
9;6	88%	74%
11;6	93%	77%
Adults	100%	99%

Table 1.3 – Success in temporal connectives 'prin' and 'afu'

Total results (Table 1.3) revealed that 'prin' was comprehended prior to 'afu', which was still developing even after 11;6 years old. As far as simultaneous connectives are concerned, 'eno and 'kaθos' are fully developed around 9;6. Generally, this specific experiment showed that acquisition of simultaneity preceded sequence⁴⁷.

Another issue that Papakonstantinou discussed is whether the order of appearance of a matrix or adverbial clause in a sentence affects comprehension. This question was based in Diessel (2004), who supported that sentence processing is easier in case that matrix sentence proceeds. On the

⁴⁵ In general, the theory has some weak points and can be put into doubt, that's why I did not take it into consideration in my study.

⁴⁶ Since 'prin' is not ambiguous, boundedness does not affect its reading.

⁴⁷ Papakonstantinou pointed out that this might be a matter of methodology. Though, as a final remark of her study, she concluded that sequential connectives are acquired first (same finding in: Keller-Cohen (1981), Atanassova (2001), Winskel (2004) among others).

other hand, in adverbial- first sentences processing gets really difficult since information has to be kept in memory so as to be connected with the matrix afterwards⁴⁸. Based on Diessel's proposal, prin chronological and afu reverse sentences are considered to be easier in comprehension. Analyzing results Papakonstantinou reported that performance is indeed better in after-reverse sentences. As far as temporal connective 'prin' is concerned, there was no difference between adverbial and matrix-first sentences.

The second comprehension experiment, the truth-value judgment task, investigated how aspect affects the interpretation of ambiguous connectives. Results revealed that ambiguous temporal connectives are still being acquired at age 11;6. Temporal reading of 'afu' preceded those of 'eno' and 'kaθos'. This confirms the precedence of sequential over simultaneous connectives in acquisition. Moreover, the comparison between the temporal and the non-temporal reading showed that children performed better when the correct answer was connected with the temporal interpretation. Children even at the age of 11;6 seem to find it really difficult to understand afu, eno and kaθos. It must be mentioned that even between these connectives the development of premise interpretation precedes the concessive one.

The sentence completion and the short story retell task are the two production tasks of the research. The first task was conducted in order to reassure that children can produce aspectual forms. It was noticed that subjects produced more often the imperfective aspect. The second production task revealed that participants reproduce predominately sentences containing the temporal reading of an ambiguous connective. That practically means according to Papakonstantinou that temporality precedes non-temporality in acquisition.

⁴⁸ Basically, this theory is similar to what Blything (2016) remarks about the order of reference (chronological/reverse) and the position of a connective within a sentence. However, Papakonstantinou did not clearly take into account these factors in her research and moreover her data is quite limited in order to make safe conclusions about the issue.

1.3.1.2 Intermediate summary

Previous studies investigated the acquisition of temporal connectives under different points of view: semantic (e.g. Clark 1971), syntactic (Amidon-Carey 1972), cognitive (e.g. Carni & French 1984) or by combining different factors (e.g. Blything 2016). Common ground of most researches is that acquisition of 'before' precedes 'after' (for contrastive results see Barrie-Blackley 1973). Despite this fact, there is no consensus about the exact age of acquisition. Clark (1971) supported that children acquire both connectives around 5 years old, Blything (2016) at about 7 years old whereas Pyykkönen & Järvikivi (2012 for Finnish) and Papakonstantinou (2015 for Greek) concluded that 'after' is still not acquired at age 11;0. Moreover, it was generally accepted that chronological sentences are easier in processing than reverse. The combination of a connective and the order of a sentence can predict how easy or difficult processing is for each sentence type (Blything 2016). Another factor that was manipulated in many studies and is connected with sentence order is the position of a connective within a sentence. From one side it is supported that connectives in the middle position render sentence processing easier (Clark 1971, Diessel 2004 as cited in Papakonstantinou 2015). The opposite view states that connectives in initial position facilitate construction of the mental representation of a sentence (e.g. Pyykkönen & Järvikivi 2012). A number of studies have also noticed that lack of knowledge can lead children to use non linguistic strategies such as order of mention (e.g Johnson 1975) and main-clause-first strategy (Coker 1978). As soon as children get older and gradually acquire the meaning of connectives they stop applying strategies.

1.3.2 Previous studies on the acquisition of temporal adverbs

As mentioned in the previous section there were some researches that combined the investigation of temporal connectives with other temporal adverbs. Hatch (1971) investigated structures 'and then' and 'but first'. The first structure proved to be the easiest of all, even of chronological sentences containing temporal connectives. Children's performance indicated that 'but first' structures, which are reversed, were easier than reverse sentences but at the same time more difficult than chronological. Another study, that of Amidon & Carey (1972), examined 'first' and 'last'. They concluded that these types of sentences are more easily processed than 'before'-'after' sentences. Comparison between 'first' and 'last' in Richards & Hawpe (1981) revealed that 'first' is comprehended before 'last'. Taking everything into account, it can be supported that temporal adverbs 'first', 'then' and 'last' are in general easier and therefore earlier comprehended than connectives.

Within the category of temporal adverbs fell words like 'yesterday', 'tomorrow', 'now', 'today' and others. Seemingly acquisition of such words is not connected with that of temporal connectives 'before' and 'after'. However, a closer look in comprehension of 'yesterday' and 'tomorrow' would probably reveal some connections with sequential temporal connectives under an abstract cognitive perspective.

Earlier studies (e.g Harner 1975) concluded that children comprehend 'yesterday' better than 'tomorrow'. More recently, Zhang and Hudson (2018b) investigated temporal reasoning through temporal adverbs 'yesterday' and 'tomorrow'. In the experiment they examined 3-5-year-old children by showing them each time two pictures representing the same object in an initial and final state (e.g a present and an opened present). Test sentences included yesterday or tomorrow (e.g. I opened the present yesterday. / I'm gonna open the present tomorrow.) and participants had to point to the picture that showed the present state of the object based on the sentence. Researchers concluded that children conceive better the relation between past-present than future-present. However, it was indicated that 'yesterday' did not facilitate performance while tomorrow helped children make correct judgments. In a relevant experiment, tense and temporal adverbs in

test sentences were mismatched (e.g. I opened the present tomorrow. / I'm gonna open the present yesterday.). Subjects predominately chose the outcome picture based on temporal adverb 'yesterday' or past tense. In the same experiment, adults responded based solely on temporal adverbs.

It is also worth mentioning that Zhang and Hudson conducted an 'after and before' task. They underlined that yesterday equals to '1 day before' and tomorrow to '1 day after'. It was expected that performance in 'after' would be superior because children are supposed to perceive forward reasoning better than backward. Questions were constructed as following: 'What did the present look like before/after I opened it?'. The prediction was actually confirmed from results since performance was better for 'after'. However, it is important to take into consideration that researchers underlined that children had a general tendency to choose constantly the outcome picture and that might affected results.

1.3.2.1 Temporal connectives and adverbs in combination

It is attempting to try to make a connection between 'yesterday' - 'tomorrow' and 'before' – 'after'. Earlier studies, such as Clark (1971), and even more recent (e.g. De Ruiter et al. 2018) accept that 'before' contains a sense of priority whereas 'after' that of posteriority. This automatically connects these temporal connectives with temporal levels that have a relevant notion. 'Before' is therefore related to past and its equivalent temporal adverb 'yesterday' while 'after' relates to future and 'tomorrow'. Taking into account findings on acquisition of temporal adverbs, it can be supported that comprehension of adverbs reflects comprehension of connectives. This means that 'before' is expected to be earlier comprehended since 'yesterday' (Harner 1975) and past-present relations (Zhang and Hudson 2018b) are referred to be earlier comprehended and manipulated. On the other hand, 'after' is supposed to be more difficult in comprehension as 'tomorrow' and future-present relations. Certainly, these are just preliminary thoughts that need to be supported from research data. In the following chapter results are presented so it is possible to check whether this theoretical correlation is verified in Modern Greek.

The present study

An experimental study (in the spirit of Blything 2016) was conducted in order to investigate the comprehension of Greek sequential temporal connectives ‘prin’ (before) and ‘afu’ (after). At the same time, the comprehension of temporal adverbs ‘prota’ (first) and ‘meta’ (then) was examined so as to find out whether there is a correlation between comprehension of these adverbs and their equivalent connectives. Section 2.1 concentrates on the main research questions of the study as well as the predictions for each of them. Section 2.2 describes the experimental methodology and the constructions that were examined. In section 2.3 the results that were extracted from the research are presented.

2.1 Research questions

The present study focuses on the acquisition of specific Greek temporal connectives and adverbs. The main aim of the research is certainly to map the developmental path that comprehension of temporal connectives and adverbs follows. Performance of all groups can show us exactly what are the phases that children pass through until they achieve satisfactory comprehension. It is important to mention though that investigation could give answers to parallel research questions as well. A number of other factors, except from temporal connectives and adverbs, were manipulated. Following, basic research questions are addressed and a hypothesis for each of them is made.

Our central research question regards to the order of acquisition of Greek temporal connectives ‘prin’ (before) and ‘afu’ (after). Previous literature (e.g. Clark 1971 among others for English and Papakonstantinou 2015 for Greek) stands for earlier comprehension of before. This is exactly what is expected to occur in this experiment as well. I hypothesize that ‘prin’ is earlier comprehended

and consequently acquired than 'afu'. Certainly, the same question can be addressed for temporal adverbs 'prota' (first) and 'meta' (then). It must be noted that 'prota' is semantically connected with 'prin' and 'meta' with 'afu' since they denote similar notion of time. Following the hypothesis for temporal connectives it is expected that comprehension of 'prota' precedes that of 'meta'. Furthermore, another question arises that unifies both temporal connectives and adverbs under investigation: Is there a correlation between the development of equivalent temporal connectives and adverbs? What is basically assumed is that development of these two pairs is parallel. High or low performance in adverbs corresponds to equal success in comprehension of connectives. It is hypothesized that there is such a connection in the acquisition of temporal connectives and adverbs.

There are also other research questions that can be addressed which do not refer exclusively to connectives and adverbs but are related to other factors that could influence children's comprehension and performance in general. Such a question is about the effect that chronological or reverse order of events can have in processing during comprehension. Previous studies (e.g. Kavanaugh 1979, Blything 2016) noticed that chronological sentences are easier in process since they correspond to the actual order of events. On the other hand, reverse sentences are more demanding because they do not correspond to the appropriate mental representation of events and they require revising. For this study, it is assumed that there is no difference. Performance in chronological sentences is expected to be superior than in reverse.

Another issue that must be addressed is whether children apply any linguistic strategy while trying to cope with a sentence containing temporal connectives. It has been observed (Clark 1971) that children may use order of mention strategy to interpret a sentence in case they lack semantic knowledge of a temporal connective. There are also other strategies (e.g. matrix-clause-first strategy) but the one that can be applied in a picture selection task such as the present is what I call 'picture sequencing strategy'. Children need to select each time one out of two pictures. Pairs of pictures were counterbalanced so that half of them were presented in the order that corresponded to the order of reference in the sentence while the remaining did not. Children were asked to answer 'What happened first?' by showing the correct picture based upon the sentence

they heard before. Use of picture sequencing strategy would lead children to choose predominately the first picture in order without taking into account what each sentence referred to.

2.2 Methodology

The method used in the comprehension experiment was the picture selection task. Each time two pictures were presented to the child. These pictures⁴⁹ represented the same cartoon character doing a different action. Cartoon images were presented in a booklet⁵⁰ and were counterbalanced. Pictures appeared either according to the order of reference of actions in the sentence or in the reverse one. That practically means that in half sentences picture A was the correct answer and picture B in the others. This sequence was a way to reveal whether picture ordering affects children's performance.

2.2.1 Sentence structure

In the experiment six different conditions were examined. Four sentences⁵¹ were constructed for each condition so that makes a total of 24 sentences (6 conditions x 4 sentences). Moreover, the training trial included four sentences, one for each condition 1-4 (4 conditions x 1 sentence). That means that there were in total 28 stimulus sentences. It must be noted that in the examination all sentences were presented in random order. Following, the characteristics of each sentence type are described.

Sentence construction was based on six different conditions. Specifically, Condition 1-4 differentiate on the temporal connective and its position in the sentence. The first two conditions regard temporal connective 'prin'. Condition 1 represents chronological order and Condition 2

⁴⁹ I do not own any intellectual rights of pictures. Pictures were used exclusively for experimental purpose since children are familiar with these cartoon characters. The research was conducted in the absence of any financial relationships that could be construed as a potential conflict of interest.

⁵⁰ Direction of pictures was vertical and not horizontal from left to right.

⁵¹ There were four stable action verbs that were included in adverbial-clauses: /*điavazo*/ (read), /*zoğrafizo*/ (paint), /*pezo*/ (play) and /*troo*/ (eat).

reverse order of events. As far as Condition 3 and 4 are concerned, they included temporal connective ‘afu’ and they represented its chronological and reverse order respectively.

Condition	Structure
Condition 1	[CP.....,PRIN-CP]
Condition 2	[PRIN-CP,.....CP]
Condition 3	[AFU-CP,.....CP]
Condition 4	[CP.....,AFU-CP]

Table 2.1 – Structure of condition 1-4

Sentences of conditions 5 and 6 did not contain temporal connectives but instead temporal adverbs ‘prota’ and ‘meta’. These conditions were included in the experiment in order to examine whether there is parallel in acquisition of temporal connectives under investigation and their equivalent temporal adverbs. Sentences in both conditions consisted of two smaller main ones in chronological order and their structure differentiate in the adverb included and as a result its position within the sentence.

Condition 5: SUBJECT+VERB and THEN +VERB+COMPLEMENT/ADJUSTMENT

(1) O Giannis epekse kai meta efage ena milo.

John-NOM.SING play-PAST.3s and then eat-PAST.3s an apple-ACC.SING.

‘John played and **then** ate an apple’.

Condition 6: SUBJECT+FIRST+VERB and VERB+COMPLEMENT/ADJUSTMENT

(2) I Maria prota epekse kai ðiavase ena vivlio.

Mary-NOM.SING. first play-PAST.3s and read-PRESENT.3s a book-ACC.SING

‘ Mary **first** played and read a book’.

As it is obvious from the examples above, sentences in condition 5 include ‘meta’ and those in condition 6 ‘protá’. It is important to note that stimulus sentences in Condition 6 are more complex in interpretation. Reading a sentence such as (2) above would lead in two possible interpretations. It could be simply assumed that Mary first played and then read a book. However, it is possible to suppose that playing and reading are two sequential actions that occurred one after the other but within the same time limits. Whatever happened next is unknown. Children might not think in this way and be confused but all possibilities but be taken into consideration. Moreover, it must be underlined that questions were different for Condition 5 and 6. In Condition 5 the experimenter asked⁵²: “Which picture does show what John did first?” and in Condition 6 “Which picture does show what Mary did then?” In this way, it was possible to examine comprehension of each temporal adverb separately by including the other one in the stimulus sentence.

⁵² It is important to make clear that only the question in Condition 6 referred to what happened last. For Condition 1-5 the question was about what happened first.

Condition	Sentence type	Example
Condition 1	Before-chronological	I Maria horepse prin peksi. Mary-NOM.SING. dance-PAST.3s before play-NON PAST.3s 'Mary danced before she played'.
Condition 2	Before-reverse	Prin peksi, I Maria horepse. Before play-NON PAST.3s Mary-NOM.SING. dance-PAST.3s 'Before she played, Mary danced'.
Condition 3	After-chronological	Afu horepse, I Maria epekse. After dance-PAST.3s. Mary-NOM.SING. play-PAST.3s After she danced, Mary played.
Condition 4	After-reverse	I Maria epekse afu horepse. Mary-NOM.SING. play-PAST.3s after dance-PAST.3s Mary played after she danced.
Condition 5	Main clause and THEN + main clause	I Maria horepse kai meta epekse Mary-NOM.SING. dance-PAST.3s and then play-PAST.3s Mary danced and then played.
Condition 6	Subject + FIRST+verb and main clause	I Maria prota horepse kai epekse. Mary-NOM.SING. first dance-PAST.3s and play-PAST.3s Mary first danced and played.

Table 2.2 – Summary of conditions

2.2.2. Procedure

Examination began with sentences of conditions 5 and 6. Following, training trial intervened before condition 1-4 sentences were presented. Furthermore, 12 fillers were included in the test, each of which appeared after two sentences. The main procedure was as following: firstly, the experimenter introduced the cartoon character by asking: "Do you know who this is?". The participant was expected to answer by saying the name of the character. In case that the child was not familiar with the cartoon character or did not remember his name, the experimenter informed the child about it⁵³. After that, the experimenter oriented the child's attention to each of the two pictures separately. Participant was asked about what the cartoon seemed to be doing in each picture. At the same time, the experimenter also asked the child about himself/herself. For instance, the experimenter could ask the participant if he/she likes painting or what he/she loves to paint in case that a picture showed a cartoon painting. The target of these adding questions was to make children feel more comfortable and interested in the experimental examination. Moreover, subjects had the opportunity to have a small interval during testing. Following, the experimenter said to the child: 'Now, I am going to tell you a sentence. Listen carefully, because then I am going to ask you something and you need to show me the correct picture'. The experimenter read a sentence and then asked the child 'Which picture does show what SUBJECT⁵⁴ did first?' The child would answer correctly if he/she pointed to the picture that corresponded to the first action. The experimenter was noticing each participant's answers on an answer sheet⁵⁵. She was rewording the child each time with a sticker no matter if the latter one gave the correct answer or not⁵⁶. The examination lasted about 20-30 minutes depending on the age and concentration of the subject.

⁵³ For example, frequently children did not know Snoopy, the cartoon dog. If that was the case, the experimenter told the name of the character to the child: "This is Snoopy." Sometimes it was difficult for children to pronounce or remember the cartoon's name. In order to make the process easier, the experimenter added: "This is a little dog."

⁵⁴ Each time subject position was filled from each character's name.

⁵⁵ In Appendix A there is a sample of the answer sheet with all test sentences and pictures as they appeared in the actual exam.

⁵⁶ Only during training trial the experimenter corrected the child's answers.

2.2.3 Participants

In the study 51 children⁵⁷ (26 girls and 25 boys), aged between 3;0-6;0 years old participated in the study. They were all acquiring Modern Greek as a first language and they were recruited from two private kindergartens in Iraklion, Crete. Consent forms were given and children were examined only if their parents agreed. Subjects were classified in three groups in accordance with their age (Group A: 3;0-4;0 (N=15), Mean age: 3;4, Group B: 4;0-5;0 (N=19), Mean age: 4;5, Group C: 5;0-6;0 (N=17), Mean age: 5;6). Moreover, the control group consisted of 20 adults who were tested on exactly the same material as children.

2.3 The results

In this section the results⁵⁸ of the experimental study are presented. The analysis of results gives information about the development of temporal connectives 'prin' and 'afu' and temporal adverbs 'prota' and 'meta' that could give answers to the research questions of this study. In section 2.3.1 total results are presented so as to create an overall picture of the acquisition of temporal connectives and adverbs under investigation. Following, in section 2.3.2 results for each connective are presented separately so as to understand clearer the transition from one developmental phase to the other. Section 2.3.4 analyzes results for temporal adverbs and section 2.3.5 discusses correlations between conditions.

Results were also analyzed statistically so as to extract more precise conclusions about the acquisition of both temporal connectives and adverbs. In total, three statistical methods were used and each of them served for a different reason. A dependent variable of cumulative success was set for each condition while independent variable was age. Firstly, a Kruskal-Wallis H test (one-

⁵⁷ Nine more children participated but they were excluded from results either because they did not complete the task or because they were unwilling to take part in the task.

⁵⁸ In Appendix B there is a list with individual and adults' results as well as analytical results for each sentence. Some notes about Appendix B: pink and blue color in individual results denote whether the participant was a girl or a boy. S₁, S₂ symbolizes sentence 1, sentence 2 e.t.c. while Q.N.=Question Number (as each sentence appears in the answer sheet (Appendix A)). A and B denotes picture A and picture B. Number 1 and 0 symbolize correct and wrong answer respectively. For example, A=1 means that picture A was the correct answer whereas B=0 means that picture B was the wrong answer.

way ANOVA on ranks) was performed in order to check whether age significantly affected success rate in each condition. Afterwards, a Friedman test was run. Friedman test is a non parametric alternative to repeated measures ANOVA. It was applied so as to clarify whether each condition had impact on success independently of age. Finally, the non parametric measure of rank correlation ‘Spearman Rank’ was applied because it was necessary to reveal whether there is a correlation in success between conditions. Only statistically significant results are referred in the following presentation in combination with tables containing descriptive results.

2.3.1 Total results

Table 2.3 summarizes overall results for the three groups in all conditions. In general, this table shows approximately the development of temporal connectives and adverbs under investigation and at the same time allows comparisons between groups. Still, a closer look at the results is necessary so as to extract more specific conclusions.

Group	Condition 1	Condition 2	Condition 3	Condition 4	Condition 5	Condition 6
Group A (N=15) (Mean age:3;4)	48%	72%	50%	47%	55%	55%
Group B (N=19) (Mean age:4;5)	59%	72%	66%	65%	62%	68%
Group C (N=17) (Mean age:5;6)	86%	88%	75%	55%	80%	66%
Adults	99%	99%	99%	93%	99%	100%

Table 2.3 – Total results

A Kruskal-Wallis H test was performed in order to check whether age significantly affected success rate in each condition. Significance was set at $p=0.05$. In case the effect of age was significant, pair wise comparisons were performed between the three age groups. Statistical analysis revealed

that there was an age effect. The effect of age was statistically significant for Condition 1 (Ustat=14.786, p=0.001), Condition 2 (Ustat=5,835, p=0.05), Condition 3 (Ustat=7,581, p=0.023) and Condition 5 (Ustat=9,099, p=0.011). On the other hand, there was no age effect for Condition 4 (Ustat= 3,398, p=0.183) and Condition 6 (Ustat=4,857, p=0.088). Moreover, Friedman test indicated that in general there was significance in performance in different conditions (p=0.001). Analysis for each group separately revealed that there were diversities. Although there were significant differences between conditions in Group A (p=0.021), there were no significant pair wise comparisons. For Group B no significance was spotted (p=0.06). On the other hand, there were significant differences of success rate between different conditions in Group C (p=0.001). Following, results are presented and further analyzed for each connective and temporal adverb separately.

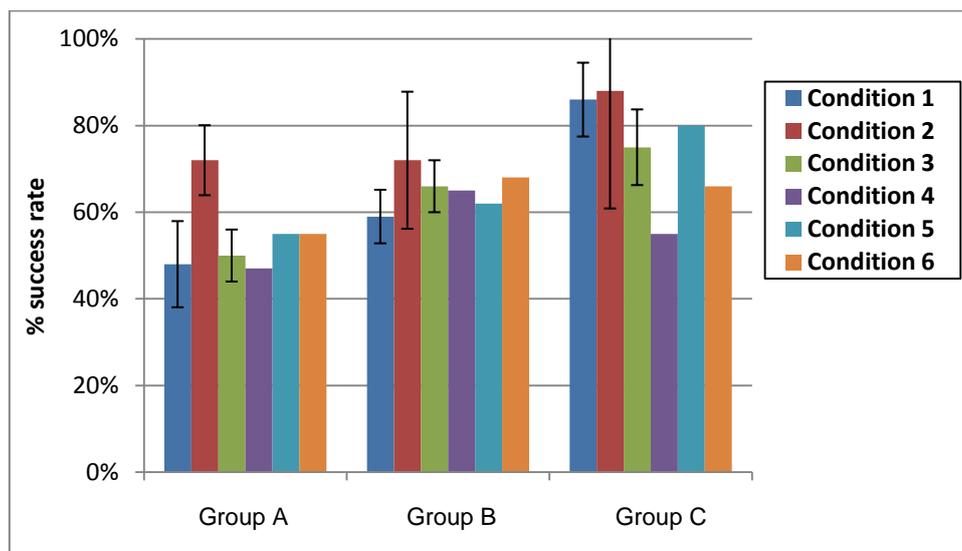


Figure 2.1-Total success. Bars denote standard deviation.

2.3.2 Results per connective

In this section results are discussed for each connective that was included in this study, that is 'prin' (before) and 'afu' (after). It is reminded that 'prin' is connected with Condition 1 and 2 as these represent prin-chronological and prin-reverse sentences respectively. As far as temporal connective 'afu' is concerned, it corresponds to Condition 3 and 4. Performance in each condition and total success in condition 1-2 and condition 3-4 reveals comprehension of 'prin' and 'afu'.

Group	Condition 1	Condition 2
Group A (N=15) (Mean age:3;4)	48%	72%
Group B (N=19) (Mean age:4;5)	59%	72%
Group C (N=17) (Mean age:5;6)	86%	88%
Adults	99%	99%

Table 2.4 – Comprehension of 'prin'

Performance in Condition 1 and Condition 2 reflects comprehension of temporal connective 'prin'. It is obvious that success in prin- reverse sentences is higher for all groups. This is unexpected because chronological sentences are supposed to be easier in process than reverse. Specifically, for Group A there seems to be a big difference between Condition 1 and 2. However, statistical analysis revealed that the apparent difference is not significant. Group B performed better in prin-chronological sentences than Group A but success in prin-reverse sentences is better. It must be noted once again though that Group B did not show significance in performance for any condition. As for Group C, success in Condition 1 and Condition 2 is basically the same. This is also confirmed from the fact that there was no significant difference between these two conditions ($p=1.000$). Comparisons between groups revealed that there were significant differences for both 'prin' chronological and reverse sentences. Starting with Condition 1, there was significance in performance between groups ($U_{stat}=14,786$, $p=0.001$). There was difference for Group A and C

and Group B and C (Group A<Group B<Group C). Practically that means that as children get older, their comprehension of prin-chronological sentences improves. As far as Condition 2 is concerned, significance was obtained for Group A and Group C (Ustat=5,835, p=0.05). In general, comparison between Condition 1 and 2 (independently of age) did not reveal any significance (p=0.708). Consequently, children treat temporal connective ‘prin’ in a similar way no matter the context in which it appears.

Group	Condition 3	Condition 4
Group A (N=15) (Mean age:3;4)	50%	47%
Group B (N=19) (Mean age:4;5)	66%	65%
Group C (N=17) (Mean age:5;6)	75%	55%
Adults	99%	93%

Table 2.5 – Comprehension of ‘afu’

Table 2.5 represents performance in comprehension of temporal connective ‘afu’. It is observed that success in Condition 3, that is in ‘afu’-chronological sentences, is superior for all groups comparing to ‘afu’-reverse sentences (Condition 4). Group A performed almost the same for both sentence types and there was no significant difference. The second group’s success rate did not differ and this was also confirmed from the statistical analysis as well. Although, there was a 20% difference in Condition 3 and 4 for older children (Group C), it was not significant (p=0.130). So far, no significant difference was found in the pair wise comparisons between ‘afu’-chronological and reverse sentences for either group. However, as mentioned earlier, the effect of age was statistically significant for Condition 3 (Ustat=7.581, p = 0.023) with Group C having significantly higher success rate compared to Group A. Apparently comprehension of ‘afu’ improves as children get older. On the other hand, it is reminded that no significance was revealed for Condition 4

(Ustat=3,398, $p=0.183$). Furthermore, comparison of 'afu'-chronological and 'afu'-reverse sentences did not reveal significant difference in performance ($p=0.315$).

2.3.3 Intermediate summary

In this part, main points of the previous section (2.3.2) in which results for temporal connectives 'prin' and 'afu' were discussed, are summarized. Starting with 'prin', it was initially observed that performance in 'prin'-reverse (Condition 2) was better than in 'prin'-chronological sentences (Condition 1). Statistical analysis however indicated that there was no significant difference between these two conditions. Taking into consideration each condition separately, it must be underlined that children were continuously improving their comprehension in 'prin'-chronological sentences. Significant difference in performance of Group A and C as well as Group B and C shows that children process 'prin'-chronological sentences more successfully as they get older. For Condition 2, it was noticed that improvement is spotted especially between Group A and C. That means that within 2-3 years children comprehend 'prin'-reverse sentences much better.

Some basic observations must be also pointed out for temporal connective 'afu'. Firstly, it is important to mention that comparison of success in 'afu'-chronological (Condition 3) and afu-reverse sentences (Condition 4) did not reveal any significant difference. The same is valid for each group separately as well. Another interesting fact is that there was significant difference in afu-chronological sentences between Group A and C. This practically means that younger children initially lack comprehension of 'afu' but they manage to improve within a few years. However, there was no equivalent observation for 'afu'-reverse sentences. There was no significant difference among groups for Condition 4.

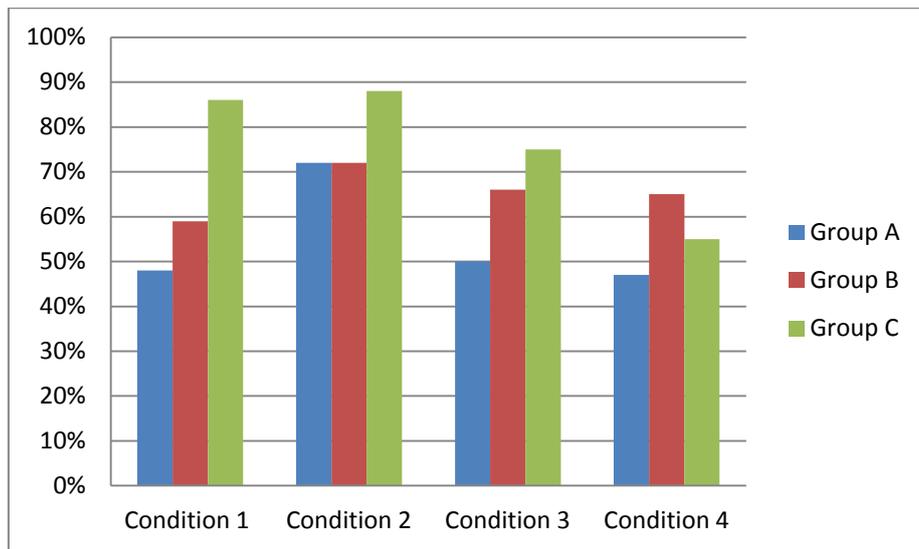


Figure 2.2 – Performance in Condition 1-4

2.3.4 Results for temporal adverbs

In this section results for temporal adverbs ‘prota’ and ‘meta’ are presented. Condition 5 examined comprehension of ‘prota’ while containing in the stimulus sentence temporal adverb ‘meta’ and Condition 6 examined ‘meta’ but included ‘prota’ in stimulus sentences.

Group	Condition 5	Condition 6
Group A (N=15) (Mean age:3;4)	55%	55%
Group B (N=19) (Mean age:4;5)	62%	68%
Group C (N=17) (Mean age:5;6)	80%	66%
Adults	99%	100%

Table 2.6 – Comprehension of ‘prota’ and ‘meta’

Condition 5 and Condition 6 reflect comprehension of two different temporal adverbs, ‘prota’ and ‘meta’ respectively. In table 2.6 it is obvious that Group A’s performance reached the same

success rate for both conditions and consequently there is no statistical difference. Group B performed almost in the same level for 'prota' and 'meta' and once again significance was not observed. Older children seemed to comprehend better temporal adverb 'prota' than 'meta' but still difference between percentages is not significant. Moreover, it must be underlined that age effect was statistically significant for Condition 5 (Ustat=9.099, $p = 0.011$) as Group C had significantly higher success rate compared to Group A. This shows that children gradually comprehend 'prota' much better. On the other hand, no significance was revealed for Condition 6.

2.3.5 Correlations

The Spearman's Rank was applied in order to find out whether there are correlations between conditions. In general, correlations would reveal whether there is interaction between the development of two conditions. For instance, improvement in one condition could be related to equivalent improvement in a second one. In the following table (table 2.7) results of the correlation analysis are presented.

Condition	Condition 1	Condition 2	Condition 3	Condition 4	Condition 5	Condition 6
Condition 1						
Condition 2	√					
Condition 3	√	√				
Condition 4						
Condition 5	√	√	√			
Condition 6						

Table 2.7 – Correlation of conditions

Table 2.7 contains correlations that occurred between conditions for all age groups⁵⁹. It is observed that there is a significant correlation between Condition 1 and Condition 2 ($p=0,00^{**}$)⁶⁰. Both

⁵⁹ Analysis of each group separately indicated the following: for Group A no correlation occurred. For Group B correlation occurred between: Condition 3 and Condition 1, Condition 5 and Condition 2,3 and 4. For Group C there was only one correlation between Condition 5 and Condition 3.

⁶⁰ Two stars (**) next to numbers denote that correlation is significant at the 0.01 level. One star (*) denotes that correlation is significant at the 0.05 level.

conditions are connected with temporal connective 'prin' and they differ only in order, chronological or reverse. It can be assumed that this correlation exists exactly because of their common base, that is temporal connective. As comprehension of 'prin' improves, it is logical to affect both conditions. Moreover, correlation is spotted between Condition 3 and Condition 1 ($p=0,00^{**}$). These two conditions contain different temporal connectives, 'afu' and 'prin' respectively, but they do have a common feature, that is chronological order. Perhaps this correlation is a matter of their mutual order. At the same time correlation between Condition 3 and Condition 2 ($p=0.03^*$) cannot be easily interpreted. They differ in order and temporal connective included. The only thing in common is that temporal connective is placed in initial position in both cases. Correlations are also observed between temporal adverb 'prota' (Condition 5) and temporal connectives. There is a correlation among Condition 5, Condition 1 and Condition 2 ($p=0,00^{**}$ in both pairs). This is expected since temporal adverb 'prota' corresponds to temporal connective 'prin'. Logically development of both follows a parallel path and that's why this correlation occurred. Furthermore, Condition 5 correlates with Condition 3 ($p=0,00^{**}$). These two conditions are connected from the fact that stimulus sentences in Condition 5 included temporal adverb 'meta'. The latter one is semantically connected with temporal connective 'afu'. The correlation of Condition 5 and Condition 3 could be justified in that way. It is necessary to mention that no correlation was found for Condition 4⁶¹ and Condition 6.

All in all, results depicted the development of both temporal connectives and adverbs under investigation. Statistical analysis and correlations gave extra information about which findings are more significant and how they interact to each other. However, in this chapter there was just a preliminary presentation of results. Further discussion and analysis as well as comparison with previous studies follow in the next chapter.

⁶¹ It was mentioned earlier that a correlation occurred between Condition 5 and Condition 4 for Group B but there will be no reference to it because it was not found in total correlations as well.

Discussion

In this chapter the results of the study are reconsidered and further discussed with reference to the research questions. The main purpose of this chapter is to interpret results so as to reach final conclusions about the acquisition of sequential temporal connectives and adverbs in Modern Greek. Comparison and combination of different findings of the study as well as contrast with previous researches can be proved to be useful in order to reach the main goal of this chapter. Section 3.1 regards comprehension of temporal connectives 'prin' and 'afu' and section 3.2 comprehension of temporal adverbs. Moreover, section 3.3 discusses the issue of strategy use whereas section 3.4 attempts to connect results within a cognitive perspective. Finally, section 3.5 summarizes conclusions.

3.1 Comprehension of temporal connectives

In the previous chapter it was observed that performance in prin-reverse sentences (Condition 2) was superior than prin-chronological sentences (Condition 1) but they did not differ significantly. That means that comprehension of temporal connective 'prin' was not affected from the context in which it appears, that is, in chronological or reversed ordered sentences. Still, it is important to clarify why performance was better in reverse sentences. It is generally admitted that chronological sentences and especially before-chronological are the easiest in processing (e.g Blything 2016) because they represent the exact order of event sequence. Moreover, in before-chronological sentences temporal connective is placed in the middle⁶² and this does not add extra burden in working memory (Blything 2016). However, results of the present study are not in accordance with this pattern. On the other hand, results confirmed Pyykkönen & Järvikivi (2012) who supported that

⁶² Clark (1971) also supported that this position renders a sentence easier.

sentences in which a temporal connective is placed initially are more easily processed. In this way, children build their mental representation of event sequence instantly without the need to revise it in case that temporal connectives are in the middle of a sentence. Furthermore, Papakonstantinou (2015) observed the same pattern for Greek as the present study. Chronological or reverse order of sentence did not play a role in performance of temporal connective 'prin'.

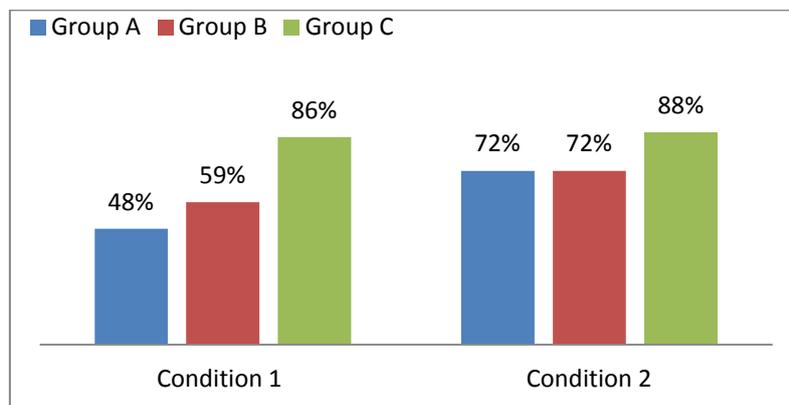


Figure 3.1 – Acquisition of temporal connective 'prin'

It is important to mention though that there were significant differences in performance between groups within the same condition. Statistical analysis revealed that Group A and Group B performed significantly lower than Group C in Condition 1. That means that 3-5-year-old children develop comprehension of temporal connective 'prin' and they manage to have almost acquired it until age six. The same is valid for Condition 2. Comparison between younger participants (Group A) and older ones (Group C) revealed that within a few years children improved processing of reverse sentences.

Another issue that regards comprehension of 'prin' is the correlation of Condition 1 and 2. This exactly indicates that improvement in comprehension of 'prin' consequently leads to improvement in performance of both chronological and reverse sentences. This fact can be interpreted as following: as children get older they comprehend better 'prin' since they gradually acquire its semantic features (as Clark 1971 supported). In this way, chronological and reverse order start not to influence children's performance because they comprehend 'prin' and they can build a mental representation based solely on its semantic information.

Taking everything into consideration, several conclusions can be extracted for the comprehension of 'prin'. Younger children (Group A & B) lack knowledge of temporal connective 'prin' and this is more obvious in prin-chronological sentences. It is assumed that it is easier for 3-5-year-old participants to process prin-reverse sentences because they are able to construct correctly their mental representation of event order regardless of their limited knowledge of 'prin'. However, children are constantly improving and at around the age of 6 they have mastered 'prin' since they treat both chronological and reverse sentences equally well. Consequently, acquisition of temporal 'prin' is completed at about 6 years old.

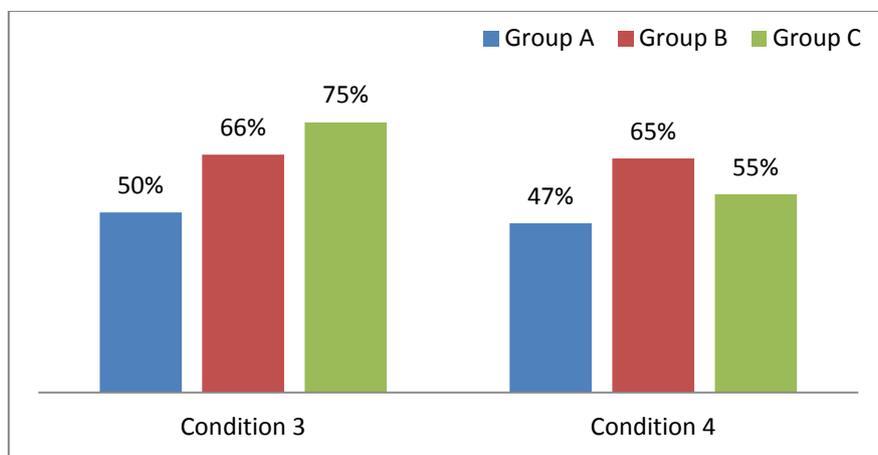


Figure 3.2 – Acquisition of temporal connective 'afu'

In general, temporal connective 'afu' indicated a different pattern of development comparing with 'prin'. Performance in afu-chronological sentences (Condition 3) was superior than afu-reverse sentences (Condition 4) for all groups. However, significance was not spotted in the comparison between them for neither age group. Pair wise comparisons in Condition 3 revealed that there was significant difference in performance of Group A and C. Younger children performed around chance whereas Group C succeeded in responding much higher correctly. It is for sure a fact that indicates that participants have improved. As they get older, children comprehend 'afu' better because they acquire its semantic features (see Clark 1971) and that's how improvement in chronological sentences occurs. However, comprehension of 'afu' is still incomplete even at the age of 6 because there was no significance in Condition 4 between groups. In case that Group C

had adequate awareness of 'afu', chronological and reverse 'afu' sentences should have been processed more successfully. This is not valid for the present study. Results indicated that children did improve in comprehension of 'afu' until 6 years old but still comprehension is incomplete. This can be justified from the fact that children's success rate was better in afu-chronological sentences since this sentence structure facilitates building of the mental representation of event order. Afu-chronological sentences follow the actual order of event sequence and moreover temporal connective is placed sentence initially⁶³. Even though children have inadequate knowledge of 'afu', sentence structure helps them in processing. On the other hand, afu-reverse sentences are really difficult in processing as order forces children to reconsider their mental representation while at the same time connective is in the middle of a sentence. This fact combined with insufficient comprehension of 'afu' is the reason for poor performance in Condition 4. To sum up, results revealed that even 6-year-old children have not fully acquired temporal connective 'afu'. This is in accordance with Papakonstantinou (2015) who also observed late acquisition of 'afu', even after the age of 11;6.

The analysis of results indicated that there is a discrepancy in acquisition of 'prin' and 'afu' at the age of 6. It is sure that within years both temporal connectives develop but not to the same extent. Correlations could advocate for this. They prove that there is interaction between conditions so that development of one influences that of others. In the previous chapter (Section 2.3.5) it was referred that there were correlations between Condition 3 and Condition 1 and 2. To start with, Condition 1 and Condition 3 regard different connectives, 'prin' and 'afu' respectively. That means that their correlation is not a matter of parallel development of the same connective. What Condition 3 and 1 have in common is that they represent chronological sentences. Presumably their correlation indicates that there is parallel improvement in processing of chronological sentences. However, it must be noted that in chronological 'afu' and 'prin' sentences connective is placed in a different position (Condition 3=sentence initially, Condition 1=sentence medially). This fact raises some questions about which state is more complex since there are different perspectives on the issue. Clark (1971), Diessel (2004 as cited in Papakonstantinou 2015) and

⁶³ As mentioned before, this is considered to be the ideal position for a temporal connective according to Pyykkönen & Järvikivi (2012).

Blything (2016) generally support that a connective in the middle of a sentence renders processing easier. On the other hand, Pyykkönen & Järvikivi (2012) advocated that processing is facilitated in case that temporal connective is posited sentence initially. This issue can be further addressed in the discussion of the correlation between Condition 3 and 2. In both conditions temporal connectives are placed sentence initially but they represent chronological and reverse sentences respectively. It is possible to assume a common interpretation for both correlations (Condition 3 – Condition 1, Condition 3 – Condition 2). These correlations indicate that there is parallel cognitive development of specific capabilities. Children improve their performance in chronological sentences (Condition 3-1) and at the same time they improve processing of temporal connectives in initial position (Condition 3 and 2). This equilibrates the difference of the position of a connective in 'afu' and 'prin' chronological sentences and as a result the latter ones are treated equally. What remains unequal is the nature of temporal connective included and that's what determines the difference in performance of 'prin' and 'afu' chronological sentences.

To summarize main points for both temporal connectives, it is supported that acquisition of 'prin' is completed around 6 years old but acquisition of 'afu' is not. Manipulating both chronological and reverse 'prin' sentences is mastered in that age but children still face problems in comprehension of afu-reverse sentences and to a smaller extent in afu-chronological. This fact indicates that acquisition of 'afu' is still in process even beyond the age of 6. Our results are not in accordance with Clark (1971) who concluded that acquisition of both connectives is accomplished at about 5 years old. Furthermore, our findings differ from studies which ended up supporting that there is no specific order of acquisition of sequential temporal connectives (e.g. French and Brown 1977, Coker 1978).

3.1.1 Comparison with previous studies

It is really important to make a comparison⁶⁴ of present results with that of Blything (2016) for English connectives and Papakonstantinou (2015) for Greek. Blything (2016) was the prototype for the experimental research of the present thesis so it would be useful to compare results from different languages that occurred from the use of the same methodology. Moreover, results of the experimental study in Papakonstantinou (2015) give further information for the acquisition of Greek temporal connectives and a measure to evaluate results of the present study. Generally, both Blything (2016) and the present study coincide in that English 'before' and its Greek equivalent 'prin' are acquired earlier than 'after' and 'afu'. Blything posits complete acquisition of both connectives around 7 years old. Since the present study examined children until 6 years old it can be determined that 'prin' has been acquired until then but acquisition of 'afu' cannot be certain. Looking results in more detail –and especially results of 5-6-year-old children, which are representative- it is indicated that poor performance is spotted only in 'after' (afu) reverse sentences. In English, performance in these type of sentences seems to be much better (77%) than Greek 'afu' (55%). A question that arises regards this difference and where it would be attributed. It could be assumed that Greek temporal connective 'afu' is more complex than English 'after'. As it has been already mentioned, 'afu' has a dual interpretation as connective: a clausal and a temporal one. In contrast, 'after' has a triple language use: as a preposition, adverb and temporal connective. Perhaps Greek 'afu' is more difficult to be acquired due to its ambiguous interpretation as a connective. English 'after' has three possible language uses but still it might be easier to acquire a term which has three distinct uses rather than 'afu' which falls within one category –that of connective- with ambiguous interpretations. Certainly these are just preliminary thoughts and further investigation on the issue is necessary. Moreover, in case that the present study had a group of 7-year-old children conclusions would be much more clear for Greek.

⁶⁴ It is reminded that relevant results of each study were presented in Chapter 1 (Figure 1.3 for Blything and table 1.3 for Papakonstantinou).

Comparison between the present study and Papakonstantinou (2015) is limited since only the first group (with mean age 5;6) corresponds to Group C. Papakonstantinou presented results for 'prin' and 'afu' as a total and does not separate between chronological and reverse sentences. Even in this way, comparison is possible if we take into account the average of Condition 1 and 2 (87%) and Condition 3 and 4 (65%) of the present study. Comprehension of temporal connective 'prin' seems to be better in the present study rather in Papakonstantinou (78%). Basically Group C performed almost the same with the group of 7;6 years old (82%). As far as temporal connective 'afu' is concerned, there is a big gap in performance. Group C's success rate was about 65% whereas in Papakonstantinou children of the same age gathered 39%. Group C's performance was similar to children with mean age 7;6 (64%). Certainly different methodology can affect performance but still difference is big enough. All these reveal that children have problematic perception of 'afu'. In total, our results indicate that children acquire 'prin' earlier in comparison with Papakonstantinou (2015) whereas comprehension of 'afu' cannot be accurately predicted. It is for sure that acquisition of 'afu' has not been completed until 6 years old but it might also be earlier than the age of 11;6 that Papakonstantinou concluded that it still develops.

3.2 Comprehension of temporal adverbs

In this section, results and statistical analysis for temporal adverbs 'prota' (Condition 5) and 'meta' (Condition 6) are further analyzed and interpreted. It is important to clarify when exactly children seem to have acquired these temporal adverbs. Moreover, it is even more crucial to find out whether there is a correlation between development of comprehension of temporal connectives 'prin' and 'afu' and their equivalent adverbs 'prota' and 'meta'.

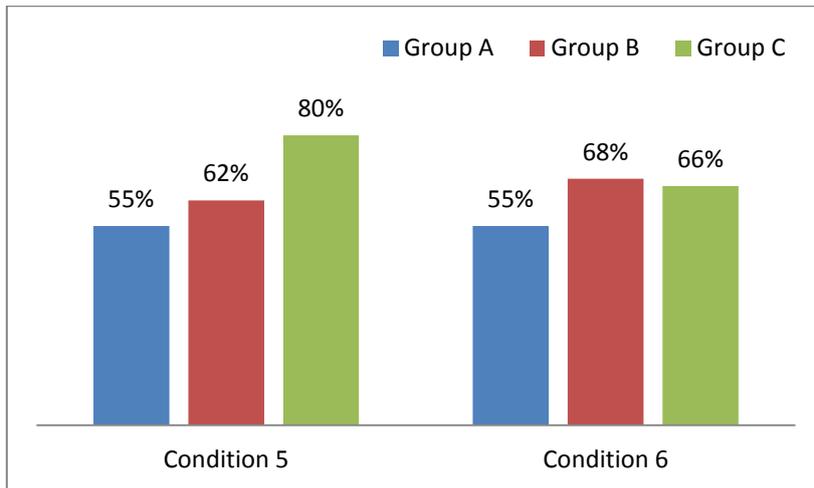


Figure 3.3 – Comprehension of temporal adverbs

Younger children (Group A and B) performed almost the same in both conditions and this was also confirmed from statistical analysis. It is worth mentioning that 5-6-year-old participants performed well enough in Condition 5. There was significant improvement in comprehension of ‘prota’ from age 3-4 until 6. This practically means that older children comprehend temporal adverb ‘prota’ adequately. At the same time, they performed poorly in Condition 6 but there was no significant difference in their performance in these two conditions. It is obvious that Group C has not developed comprehension of temporal adverb ‘meta’ enough. A more precise picture about the acquisition of temporal adverbs can be formed if we take into account correlations between conditions.

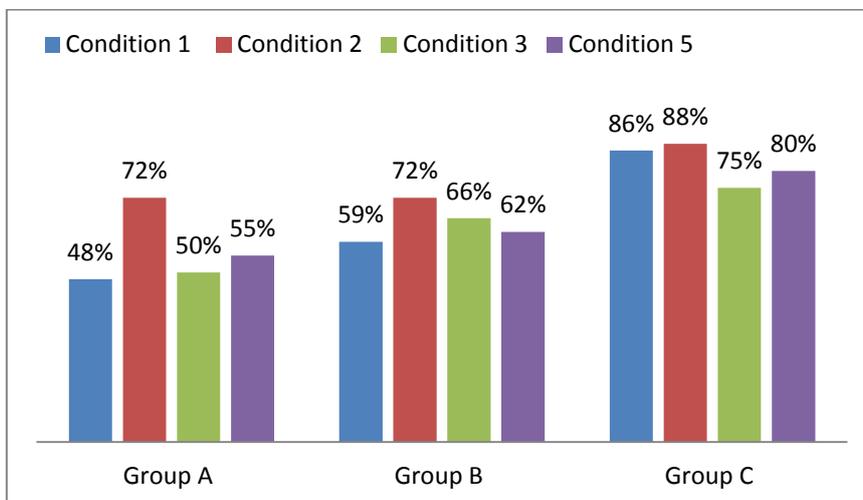


Figure 3.4 – Correlations between temporal adverb ‘prota’ and other conditions

Statistical analysis revealed that there is a correlation among Condition 5, Condition 1 and 2 (temporal connective 'prin') and Condition 3 (afu-chronological sentences). Firstly, it must be mentioned that initial research hypothesis supposed that there would be a correlation between temporal connective 'prota' and temporal connective 'prin'. This is actually what results indicated. Correlation between Condition 5 and Condition 1-2 reveals that development of 'prota' and 'prin' is parallel. Improvement in 'prota' reflects comprehension of 'prin'. It is obvious that older children perform really good for both 'prin' and 'prota'. Since we considered that children have acquired 'prin' at around 6 years old, the same can be concluded for 'prota'. It is proposed that comprehension of 'prota' is almost or totally completed at age 6.

Interpreting correlation of Condition 5 and 3 is more complex. Condition 3 regards to afu-chronological sentences and Condition 5 represents comprehension of 'prota'. It is reminded though that stimulus sentence in Condition 5 includes temporal adverb 'meta'. Temporal connective 'afu' and adverb 'meta' are semantically connected. We would assume that correlation is generated because of this connection. Perhaps improvement in perception of 'afu' leads to improvement in 'meta'. However, this would logically create a correlation between Condition 3 and Condition 6, which examines comprehension of 'meta'. Such a correlation though was not revealed. There must be another reason that generates correlation between Condition 5 and 3. Condition 3 represents chronological order, that is, linear order of events. Conditions 5 as well as Condition 6 always present events in linear order. Presumably, correlation between Condition 5 and 3 corresponds to improvement in perception of linearity of time. This fact in combination with that Condition 5 examines 'prota' facilitates processing in comparison with Condition 6.

Taking everything into consideration, results indicated that temporal adverb 'prota' follows a parallel developmental path as temporal connective 'prin' and is acquired until 6 years old. On the other hand, comprehension of 'meta' is still limited around the same age. No significant improvement occurred between groups and there was no correlation for Condition 6 with any condition. As a result, comprehension of 'meta' seems to develop even after 6 years old. Consequently, comprehension of relational terms 'afu' and 'meta' is incomplete until this age. Further investigation is needed in order to determine the exact age of acquisition.

3.3 Strategy use

One of the research questions are regarded with the use of strategies from children in order to cope with the task. Previous studies pointed out that subjects –especially younger ones- use strategies because they lack linguistic knowledge (Clark 1971). As they get older, children improve their linguistic and cognitive skills and use of strategies is eliminated. The most common strategy is that of order of mention and several researchers (e.g Clark 1971, Johnson 1975, Richards and Hawpe 1981) refer that children apply it. Other strategies, like main-clause-first strategy (Coker 1978, Goodz 1982), are not referred extensively in literature. It has been proposed for the present study that children could use picture sequencing strategy. According to the logic of the latter one, children are expected to be biased from the order of appearance of pictures in the booklet. That practically means that each time children were asked ‘What happened first?’ they would point to the first picture. When the question referred to ‘What happened then?’ they would point to the second picture in order. In both cases participants would not take into account stimulus sentences at all. In the present study no strategy use was observed. Children did not apply order of mention strategy and this can be justified from the fact that performance in ‘prin’ - reverse sentences was superior than in prin-chronological. If children had used this specific strategy, the reverse pattern should have occurred. For the same reason, it is supported that matrix-clause-first strategy was not applied either. In contrast with Goodz (1982), the present study did not confirm that both strategies can be applied in before-chronological sentences and result in good performance.

It must be noted though that there were some subjects that handle the task in a specific way based on pictures. To begin with, only one child from Group A chose picture A constantly. One more from the same group predominately pointed to picture A and chose picture B four times in total. Moreover, the reverse pattern was observed. Two participants chose mostly picture B and had only 2 or 3 A choices. In Group B, four out of five children pointed to the first picture in all conditions except Condition 6 in which they preferred picture B. The one remaining child randomly chose only once picture B. Among older children (Group C) there was only one case in which choosing of picture A predominated whereas picture B was chosen three times. Furthermore, it was interesting that some children that did not respond following a specific pattern in other conditions chose only

picture A in Condition 5 and picture B in Condition 6. Each time they were asked 'What happened first?' (Condition 5) they chose the first picture while when the experimenter asked 'What happened then?' they preferred the second picture. This behavior is an indication of picture sequencing strategy but it was quite limited. Only a single participant from Group A and two more from Group C acted in this way. Moreover, other children merely applied the pattern above. They did not always choose picture A in Condition 5 but they pointed to picture B in Condition 6. In this category, three participants from Group A and two from Group C are included.

All in all, no consistent pattern was observed that would reveal that there was use of picture sequencing or any other strategy among subjects. Performance in 'prin' sentences advocates that participants did not respond based on strategies. Children's influence from picture order was limited and as a result a general conclusion cannot be extracted.

3.4 Towards a cognitive explanation

In the first chapter (section 1.1.1) a number of cognitive concepts were discussed: decentering, sequencing of events and temporal reasoning. All these concepts are explicitly or implicitly connected with comprehension of before and after sentences (prin and afu in Greek). It is necessary for children to manipulate these concepts adequately in order to process successfully not only before-after sentences but generally temporal clauses.

To begin with, children have to decenter. They practically need to disconnect themselves from the present and transfer to the past, in the undetermined time that events in sentences occurred. Secondly, each time the experimenter utters a sentence, children need to use the sequencing mechanism. This is necessary so as to construct the mental representation of the order of events. Within a sentence, temporal connective is the clue that can guide them so as to build the correct sequence of events. However, there is also possibility that children understand the meaning of a temporal connective but they have not completely developed the sequencing mechanism. In case that children have developed sufficiently the latter concept, one more is necessary so as to respond correctly to the question of what happened first, that is, temporal reasoning. Subjects

might be able to locate events in the correct order but this is not enough. It is important to perceive that this specific sequence of events explains exactly why an event occurred first, this is practically temporal reasoning. Taken all together, these cognitive concepts are necessary for manipulating correctly sentences with temporal connectives.

Another indication of the importance of these cognitive concepts can be extracted from research data. Different theoretical cognitive accounts (Weist 1986/1989, McCormack and Hoerl 2017) supported that children's temporal system improves significantly at around the age of 5. This is exactly the time point in which participants in the present study started performing really good in sentences containing temporal connectives and especially 'prin'.

The discrepancy in comprehension of 'before' and 'after' sentences can also be discussed on a cognitive basis. As mentioned in chapter 2, 'before' is connected with priority and past while 'after' with posteriority and future. Several studies (e.g Harner 1975) have shown that children comprehend 'yesterday' better than 'tomorrow'. Connection of these temporal adverbs with 'before' and 'after' respectively indicates the same pattern. In this study comprehension of 'prin' is earlier than 'afu'. Generally, it could be assumed that what basically children comprehend each time tenses, temporal connectives and adverbs are investigated is not just linguistic structures. Presumably, it is the notion of priority or posteriority.

The way that cognitive concepts affect comprehension and acquisition of language is a really interesting issue. Specifically, limits between cognitive concepts and language in the acquisition of temporal connectives are still unknown. The present study is neither adequate or appropriate to give answers. It is extremely important to investigate the issue more closely on a cognitive basis so as to uncover the borders between cognition and language.

3.5 Conclusions

The present study investigated Greek sequential temporal connectives 'prin' and 'afu' as well as temporal adverbs 'prota' and 'meta'. Several interesting findings were revealed which enrich literature about the acquisition of Modern Greek. Following, main conclusions are summarized with reference to research questions and hypotheses.

The primary consideration of this study was to determine in which age children acquire temporal connectives 'prin' and 'afu'. Previous studies mostly for English concluded that 'before' is acquired earlier than 'after'. Based on that, a similar finding was expected for Greek as well. Results indicated that children have already acquired 'prin' until 6 years old but not 'afu'. The latter one seems to develop even beyond this age and it is necessary to conduct further research in order to determine in which age acquisition is completed.

Moreover, another goal of the study was to clarify which of the two temporal adverbs is acquired first. Semantic connection between 'prin' - 'prota' and 'afu' - 'meta' was the stimulus to hypothesize that 'prota' precedes 'meta'. The order of acquisition of temporal connectives indeed reflects that of temporal adverbs. 'Prota', as 'prin', is acquired until 6 years old whereas 'meta' has not developed completely yet. So far, it is obvious that corresponding temporal connectives and adverbs follow a similar developmental path. This issue is connected with another research question, that of correlation between development of sequential temporal connectives and adverbs.

Statistical analysis indicated that there was correlation between 'prin' and 'prota'. This practically means that improvement in comprehension of one of the relational words is related to better performance in the other. However, correlation did not occur for 'afu' and 'meta'. This was unexpected since both 'afu' and 'meta' are not fully developed until the age of 6.

Another factor that was manipulated in the study was chronological and reverse order of events in sentences. Previous literature refers that chronological sentences are easier in process. However, this was not confirmed from results. Performance in prin-reverse sentences was better than chronological. On the other hand, 'afu' chronological sentences were easier processed. Taking everything into consideration, it can be assumed that performance in chronological and reverse

sentences is not just a matter of order but it is basically the interaction of order and the connective included in a sentence (Clark 1971, Blything 2016). Sentences with 'prin' are better comprehended because of its earlier acquisition. On the other hand, 'afu' reverse sentences are the most difficult. Not only they are reversed but they also include 'afu', which develops more slowly than 'prin'.

The last research question that was addressed was whether children apply strategies in order to respond. Detailed observation of results revealed that there was no use of any strategy. This is not in accordance with many previous researches that supported that children apply extensively non linguistic strategies especially when they are younger (Clark 1971 among others).

All in all, conclusions of the present study contribute to research in language acquisition and most specifically in acquisition of sequential temporal connectives and adverbs in Modern Greek. Results confirmed some findings of previous literature and others not. However, it still remains unsure when exactly 'afu' and 'meta' are fully acquired and it is necessary to clarify this so as to have an overall picture about the comprehension of Greek sequential temporal connectives and adverbs. The present study motivates further research on the issue.

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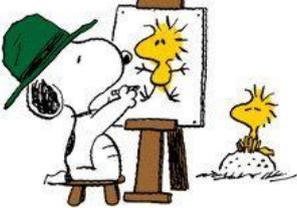
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Appendix A

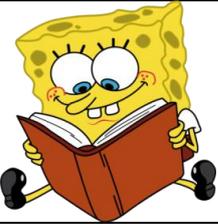
Material

**Test sentences &
pictures**

Question number	Sentence	Pictures (in order of appearance)	
1	Ο Winnie χόρεψε και μετά έφαγε μέλι. 'Winnie danced and then ate honey.'		
2	Ο Snoopy πρώτα έτρεξε και έφαγε παγωτό. 'Snoopy first ran and ate ice-cream.'		
Filler 1			
3	Η Minnie πήγε για κολύμπι και μετά έπαιξε με το σκοινάκι. 'Minnie swam and then played with the rope.'		
4	Ο Winnie πρώτα έπαιξε μουσική και διάβασε ένα βιβλίο. 'Winnie first played music and read a book.'		
Filler 2			
5	Ο Mickey μαγειρέψε και μετά διάβασε. 'Mickey cooked and then read.'		
6	Ο Mickey πρώτα χόρεψε με τη Minnie και ζωγράφισε. 'Mickey first danced with Minnie and painted.'		
Filler 3			

7	<p>Ο Snoopy μάζεψε λουλούδια και μετά ζωγράφισε. ‘Snoopy picked up flowers and then painted’</p>		
8	<p>Η Minnie πρώτα μαγείρεψε και έπαιξε μπάλα. ‘Minnie first cooked and played with a ball.’</p>		
Filler 4			
9 Training trial	<p>Αφού ζωγράφισε, ο Winnie μαγείρεψε. ‘After he painted, Winnie cooked.’</p>		
10 Training trial	<p>Πριν διαβάσει το βιβλίο, η Στρουμφίτα έκοψε ένα λουλούδι. ‘Before she read a book, Smurfette cut a flower.’</p>		
11 Training trial	<p>Η Minnie μάζεψε λουλούδια, αφού έπαιξε μπάλα. ‘Minnie picked up flowers after she played with the ball.’</p>		
12 Training trial	<p>Το στρουμφάκι τραγούδησε, πριν φάει παγωτό. ‘The Smurf sang before he ate ice-cream.’</p>		
Filler 5	INTERMEDIATE FILLER		

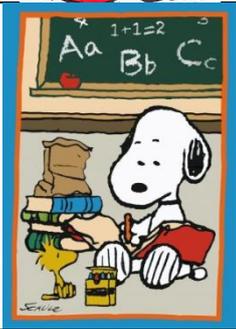
13	<p>Η Minnie έκανε κούνια, πριν διαβάσει το παραμύθι. 'Minnie swung before she read a fairytale.'</p>		
14	<p>Αφού ζωγράφισε, η Minnie χόρεψε. 'After she painted, Minnie danced.'</p>		
Filler 6			
15	<p>Πριν παίξει μπάλα, ο Snoopy έκανε ποδήλατο. 'Before he played with the ball, Snoopy rode a bike.'</p>		
16	<p>Ο Winnie πήγε για κολύμπι, αφού έφαγε μέλι. 'Winnie swam after he ate honey.'</p>		
Filler 7			
17	<p>Ο Snoopy χόρεψε, πριν ζωγραφίσει. 'Snoopy danced before he painted.'</p>		
18	<p>Πριν διαβάσει, ο Mickey έκανε ποδήλατο. 'Before he read Mickey rode a bike.'</p>		
Filler 8			
19	<p>Ο Winnie πότισε τα λουλούδια, αφού ζωγράφισε. 'Winnie watered the flowers after he painted.'</p>		

20	Αφού έφαγε πίτσα, το στρουμφάκι μάζεψε λουλούδια. 'After he ate pizza, the Smurf picked up flowers.'		
Filler 9			
21	Ο Mickey έτρεξε, πριν φάει το γλυκό. 'Mickey ran before he ate the candy.'		
22	Ο Snoopy πήγε για κολύμπι, αφού διάβασε το βιβλίο. 'Snoopy swam after he read the book.'		
Filler 10			
23	Πριν φάει, ο Μπομπ ο Σφουγγαράκης είδε τηλεόραση. 'Before he ate, SpongeBob watched TV.'		
24	Αφού έπαιξε μπάλα, το στρουμφάκι έφτιαξε μια τούρτα. 'After he played with the ball, the Smurf made a cake.'		
Filler 11			
25	Πριν ζωγραφίσει, ο Mickey πότισε τα λουλούδια. 'Before he painted, Mickey watered the flowers.'		
26	Αφού διάβασε ένα βιβλίο, ο Μπομπ ο Σφουγγαράκης τραγούδησε. 'After he read a book, SpongeBob sang.'		
Filler 12			

27	Ο Snoopy μαγείρεψε, αφού έπαιξε μπάλα. 'Snoopy cooked after he played with the ball.'	 A black and white cartoon illustration of Snoopy wearing a chef's hat and apron, standing at a table with a frying pan and a bowl, appearing to be cooking.	 A black and white cartoon illustration of Snoopy wearing a green headband and a jersey with the number 1, sitting on the floor and playing with an orange basketball.
28	Ο Mickey άκουσε μουσική, πριν παίξει μπάλα. 'Mickey listened to music before he played with the ball.'	 A colorful cartoon illustration of Mickey Mouse in his classic red shorts with white polka dots and yellow shoes, holding a soccer ball.	 A colorful cartoon illustration of Mickey Mouse in his classic outfit, dancing and listening to music from a blue boombox. Musical notes are floating around him.

Fillers

Filler	Picture	Question
Filler 1		<p>Τι κάνει ο Snoopy με τους φίλους του;</p> <p>'What is Snoopy doing with his friends?'</p>
Filler 2		<p>Τι κρατάει ο Winnie;</p> <p>'What is Winnie holding?'</p>
Filler 3		<p>Πού είναι ο Mickey με τους φίλους του;</p> <p>'Where is Mickey with his friends?'</p>
Filler 4		<p>Τι τρώει η Minnie και η Daisy;</p> <p>'What are Minnie and Daisy eating?'</p>
Filler 5 (INTERMEDIATE FILLER)		<p>Τι κάνει ο Mickey και οι φίλοι του;</p> <p>'What are Mickey and his friends doing?'</p>
Filler 6		<p>Τι έφτιαξε η Minnie;</p> <p>'What did Minnie make?'</p>
Filler 7		<p>Τι κάνει ο Winnie και οι φίλοι του;</p> <p>'What are Winnie and his friends doing?'</p>

<p>Filler 8</p>		<p>Ξέρεις πώς λένε το σκυλάκι; 'Do you know what the little dog's name is?'</p>
<p>Filler 9</p>		<p>Ποιος είναι αυτός; 'Who is this?'</p>
<p>Filler 10</p>		<p>Τι χρώμα είναι ο Snoopy; 'What color is Snoopy?'</p>
<p>Filler 11</p>		<p>Τι κρατάει το στρουμφάκι; 'What is the little Smurf holding?'</p>
<p>Filler 12</p>		<p>Τι κάνει ο Μπομπ ο Σφουγγαράκης; 'What is SpongeBob doing?'</p>

Appendix B

Individual results

**Correct answers per
sentence**

Adults' results

INDIVIDUAL RESULTS

Participant	Condition 1				Condition 2				Condition 3			
	S1 (Q.N.13)	S2 (Q.N.17)	S3 (Q.N.21)	S4 (Q.N.28)	S1 (Q.N.15)	S2 (Q.N.18)	S3 (Q.N.23)	S4 (Q.N.25)	S1 (Q.N.14)	S2 (Q.N.20)	S3 (Q.N.24)	S4 (Q.N.26)
Child 1 (3;4)	A=0	B=0	B=0	B=1	A=0	B=1	A=1	A=1	A=1	A=1	A=0	A=0
Child 2 (3;5)	A=0	B=0	A=1	A=0	B=1	A=0	A=1	A=1	A=1	A=1	A=0	B=1
Child 3 (3;6)	A=0	B=0	B=0	A=0	B=1	B=1	B=0	A=1	B=0	B=0	B=1	B=1
Child 4 (3;6)	B=1	B=0	B=0	B=1	B=1	B=1	A=1	B=0	B=0	B=0	B=1	B=1
Child 5 (3;6)	B=1	B=0	B=0	A=0	B=1	B=1	B=0	A=1	B=0	B=0	B=1	B=1
Child 6 (3;9)	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	A=0	B=1
Child 7 (3;10)	A=0	A=1	A=1	A=0	A=0	A=0	B=0	A=1	A=1	A=1	A=0	A=0
Child 8 (3;10)	B=1	B=0	B=0	A=0	B=1	B=1	A=1	A=1	B=0	B=0	B=1	B=1
Child 9 (3;10)	A=0	A=1	A=1	A=0	A=0	A=0	A=1	A=1	A=1	A=1	A=0	A=0
Child 10 (3;10)	B=1	B=0	A=1	B=1	B=1	B=1	B=0	A=1	B=0	B=0	B=1	A=0
Child 11 (3;11)	A=0	A=1	A=1	B=1	A=0	A=0	A=1	B=0	B=0	A=1	B=1	A=0
Child 12 (3;11)	B=1	A=1	A=1	A=0	B=1	A=0	A=1	A=1	A=1	A=1	A=0	A=0
Child 13 (3;11)	B=1	B=0	B=0	B=1	B=1	B=1	B=0	B=0	B=0	B=0	A=0	A=0
Child 14 (4;0)	B=1	B=0	B=0	A=0	B=1	B=1	A=1	A=1	A=1	A=1	B=1	A=0
Child 15 (4;0)	B=1	A=1	A=1	A=0	B=1	B=1	A=1	A=1	A=1	A=1	A=0	A=0
Child 16 (4;2)	A=0	B=0	B=0	A=0	A=0	B=1	B=0	B=0	A=1	A=1	A=0	A=0
Child 17 (4;2)	B=1	A=1	A=1	B=1	B=1	B=1	A=1	B=0	A=1	A=1	B=1	B=1
Child 18 (4;2)	A=0	A=1	A=1	A=0	A=0	A=0	A=1	A=1	A=1	A=1	A=0	A=0
Child 19 (4;2)	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Child 20 (4;3)	B=1	A=1	B=0	B=1	B=1	B=1	A=1	A=1	A=1	B=0	A=0	B=1
Child 21 (4;3)	A=0	B=0	A=1	A=0	A=0	A=0	A=1	A=1	A=1	A=1	A=0	A=0
Child 22 (4;3)	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Child 23 (4;4)	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	B=0	B=0	B=1	B=1
Child 24 (4;5)	B=1	A=1	A=1	A=0	A=0	B=1	A=1	B=0	A=1	A=1	B=1	B=1
Child 25 (4;5)	B=1	A=1	A=1	A=0	B=1	B=1	A=1	B=0	B=0	A=1	B=1	B=1

Child 26 (4;6)	B=1	B=0	A=1	A=0	B=1	B=1	A=1	A=1	B=0	A=1	A=0	A=0
Child 27 (4;6)	A=0	A=1	A=1	A=0	A=0	A=0	A=1	A=1	A=1	A=1	A=0	A=0
Child 28 (4;7)	A=0	A=1	B=0	A=0	B=1	B=1	A=1	B=0	A=1	B=0	A=0	B=1
Child 29 (4;8)	A=0	A=1	A=1	A=0	A=0	A=0	A=1	A=1	A=1	A=1	A=0	A=0
Child 30 (4;9)	A=0	A=1	A=1	A=0	A=0	A=0	A=1	A=1	A=1	A=1	A=0	A=0
Child 31 (4;9)	A=0	B=0	B=0	A=0	B=1	B=1	A=1	A=1	A=1	A=1	A=0	B=1
Child 32 (4;9)	B=1	A=1	A=1	A=0	B=1	A=0	B=0	A=1	A=1	A=1	B=1	B=1
Child 33 (4;9)	B=1	A=1	B=0	B=1	A=0	B=1	A=1	A=1	A=1	A=1	A=0	A=0
Child 34 (4;10)	B=1	B=0	B=0	B=1	B=1	B=1	A=1	A=1	A=1	A=1	A=0	B=1
Child 35 (5;1)	B=1	A=1	A=1	B=1	B=1	B=1	A=1	B=0	A=1	A=1	B=1	A=0
Child 36 (5;2)	B=1	A=1	A=1	A=0	B=1	A=0	A=1	A=1	A=1	A=1	A=0	A=0
Child 37(5;2)	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Child 38 (5;3)	A=0	B=0	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Child 39 (5;3)	B=1	A=1	B=0	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Child 40 (5;5)	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	A=0	B=1
Child 41 (5;5)	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Child 42 (5;6)	A=0	B=0	A=1	B=1	B=1	A=0	B=0	B=0	B=0	A=1	A=0	B=1
Child 43 (5;7)	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	B=0	A=1	B=1	A=0
Child 44 (5;9)	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Child 45 (5;9)	B=1	A=1	A=1	A=0	A=0	B=1	A=1	A=1	A=1	B=0	B=1	A=0
Child 46 (5;10)	B=1	B=0	A=1	B=1	B=1	B=1	B=0	A=1	B=0	A=1	B=1	B=1
Child 47 (5;11)	B=1	A=1	A=1	A=0	B=1	B=1	A=1	A=1	B=0	B=0	B=1	A=0
Child 48 (6;0)	B=1	A=1	A=1	B=1	B=1	B=1	B=0	A=1	A=1	A=1	B=1	B=1
Child 49 (6;1)	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	A=0	A=0
Child 50 (6;2)	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	A=0	B=1
Child 51 (6;3)	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1

Participant	Condition 4				Condition 5				Condition 6			
	S1 (Q.N.16)	S2 (Q.N.19)	S3 (Q.N.22)	S4 (Q.N.27)	S1 (Q.N.1)	S2 (Q.N.3)	S3 (Q.N.5)	S4 (Q.N.7)	S1 (Q.N.2)	S2 (Q.N.4)	S3 (Q.N.6)	S4 (Q.N.8)
Child 1 (3;4)	B=0	A=1	B=1	A=0	B=0	B=1	A=1	A=0	B=1	B=0	B=1	B=0
Child 2 (3;5)	B=0	A=1	A=0	A=0	B=0	B=1	A=1	A=0	A=0	A=1	A=0	B=0
Child 3 (3;6)	B=0	B=0	B=1	B=1	B=0	A=0	A=1	B=1	B=1	B=0	B=1	B=0
Child 4 (3;6)	B=0	B=0	B=1	B=1	B=0	B=1	B=0	A=0	B=1	B=0	B=1	B=0
Child 5 (3;6)	A=1	B=0	B=1	A=0	A=1	A=0	A=1	A=0	B=1	B=0	B=1	B=0
Child 6 (3;9)	B=0	B=0	A=0	A=0	A=1	B=1	B=0	B=1	B=1	A=1	B=1	B=0
Child 7 (3;10)	A=1	A=1	A=0	B=1	A=1	A=0	A=1	A=0	A=0	A=1	B=1	B=0
Child 8 (3;10)	B=0	B=0	B=1	B=1	A=1	A=0	B=0	B=1	B=1	B=0	B=1	A=1
Child 9 (3;10)	A=1	A=1	A=0	A=0	A=1	A=0	A=1	A=0	A=0	A=1	A=0	A=1
Child 10 (3;10)	B=0	A=1	B=1	A=0	A=1	B=1	B=0	B=1	B=1	A=1	A=0	B=0
Child 11 (3;11)	B=0	B=0	A=0	A=0	A=1	B=1	A=1	A=0	B=1	A=1	B=1	A=1
Child 12 (3;11)	B=0	A=1	A=0	A=0	A=1	A=0	A=1	A=0	B=1	B=0	B=1	B=0
Child 13 (3;11)	A=1	B=0	B=1	B=1	B=0	B=1	B=0	B=1	B=1	B=0	B=1	B=0
Child 14 (4;0)	A=1	A=1	B=1	B=1	A=1	B=1	B=0	B=1	B=1	B=0	B=1	B=0
Child 15 (4;0)	A=1	A=1	A=0	A=0	A=1	B=1	B=0	A=0	A=0	A=1	B=1	B=0
Child 16 (4;2)	A=1	A=1	B=1	B=1	A=1	A=0	A=1	A=0	A=0	A=1	A=0	A=1
Child 17 (4;2)	A=1	A=1	B=1	B=1	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Child 18 (4;2)	A=1	A=1	A=0	A=0	A=1	A=0	A=1	A=0	B=1	A=1	B=1	B=0
Child 19 (4;2)	A=1	A=1	B=1	A=0	A=1	A=0	A=1	A=0	B=1	A=1	A=0	A=1
Child 20 (4;3)	A=1	B=0	B=1	B=1	A=1	B=1	A=1	B=1	A=0	B=0	B=1	A=1
Child 21 (4;3)	A=1	A=1	A=0	A=0	A=1	A=0	A=1	A=0	A=0	A=1	A=0	A=1
Child 22 (4;3)	A=1	A=1	A=0	B=1	A=1	A=0	A=1	B=1	A=0	A=1	B=1	A=1
Child 23 (4;4)	A=1	B=0	B=1	B=1	B=0	B=1	A=1	A=0	B=1	A=1	B=1	A=1
Child 24 (4;5)	B=0	B=0	A=0	B=1	A=1	A=0	A=1	A=0	A=0	A=1	A=0	A=1
Child 25 (4;5)	A=1	B=0	B=1	A=0	B=0	B=1	A=1	A=0	B=1	B=0	A=0	A=1

Child 26 (4;6)	A=1	B=0	A=0	B=1	A=1	A=0	A=1	A=0	B=1	B=0	B=1	B=0
Child 27 (4;6)	A=1	A=1	A=0	A=0	A=1	A=0	A=1	A=0	B=1	B=0	B=1	B=0
Child 28 (4;7)	A=1	A=1	B=1	B=1	A=1	B=1	A=1	A=0	B=1	A=1	B=1	A=1
Child 29 (4;8)	A=1	A=1	A=0	A=0	A=1	A=0	A=1	A=0	B=1	A=1	B=1	A=1
Child 30 (4;9)	A=1	A=1	A=0	A=0	B=0	A=0	A=1	A=0	B=1	B=0	B=1	B=0
Child 31 (4;9)	A=1	A=1	B=1	B=1	B=0	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Child 32 (4;9)	A=1	B=0	A=0	A=0	A=1	A=0	A=1	A=0	B=1	A=1	B=1	B=0
Child 33 (4;9)	B=0	A=1	B=1	A=0	A=1	B=1	A=1	A=0	B=1	B=0	A=0	A=1
Child 34 (4;10)	B=0	A=1	B=1	B=1	A=1	B=1	A=1	B=1	A=0	A=1	B=1	B=0
Child 35 (5;1)	B=0	A=1	A=0	A=0	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Child 36 (5;2)	A=1	A=1	B=1	A=0	A=1	A=0	A=1	A=0	A=0	A=1	A=0	A=1
Child 37(5;2)	A=1	A=1	B=1	A=0	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Child 38 (5;3)	A=1	B=0	A=0	A=0	A=1	B=1	A=1	B=1	B=1	B=0	B=1	A=1
Child 39 (5;3)	A=1	B=0	B=1	B=1	A=1	B=1	A=1	B=1	A=0	B=0	B=1	A=1
Child 40 (5;5)	A=1	A=1	A=0	A=0	A=1	B=1	A=1	B=1	B=1	B=0	B=1	A=1
Child 41 (5;5)	B=0	B=0	A=0	A=0	A=1	A=0	A=1	A=0	B=1	B=0	B=1	B=0
Child 42 (5;6)	A=1	A=1	A=0	B=1	A=1	A=0	B=0	B=1	B=1	A=1	B=1	A=1
Child 43 (5;7)	A=1	B=0	A=0	B=1	A=1	A=0	A=1	A=0	B=1	B=0	B=1	A=1
Child 44 (5;9)	A=1	A=1	B=1	B=1	A=1	B=1	A=1	B=1	A=0	A=1	B=1	A=1
Child 45 (5;9)	A=1	B=0	A=0	A=0	A=1	B=1	B=0	B=1	B=1	B=0	B=1	B=0
Child 46 (5;10)	A=1	A=1	B=1	B=1	A=1	B=1	A=1	B=1	B=1	B=0	B=1	B=0
Child 47 (5;11)	B=0	A=1	A=0	B=1	A=1	A=0	A=1	A=0	B=1	B=0	B=1	B=0
Child 48 (6;0)	B=0	A=1	A=0	B=1	A=1	B=1	A=1	B=1	B=1	B=0	B=1	A=1
Child 49 (6;1)	A=1	B=0	A=0	B=1	A=1	B=1	A=1	A=0	B=1	A=1	A=0	B=0
Child 50 (6;2)	B=0	B=0	B=1	A=0	A=1	B=1	A=1	B=1	B=1	B=0	A=0	B=0
Child 51 (6;3)	A=1	B=0	B=1	B=1	A=1	A=0	A=1	A=0	B=1	B=0	B=1	A=1

Group	Condition 1				Condition 2			
	S1 (Q.N.13)	S2 (Q.N.17)	S3 (Q.N.21)	S4 (Q.N.28)	S1 (Q.N.15)	S2 (Q.N.18)	S3 (Q.N.23)	S4 (Q.N.25)
Group A (N=15) (Mean age: 3;4)	9	6	8	6	11	10	10	12
Group B (N=19) (Mean age: 4;5)	11	14	13	7	11	13	17	14
Group C (N=17) (Mean age: 5;6)	15	14	16	14	16	15	14	15

Group	Condition 3				Condition 4			
	S1 (Q.N.14)	S2 (Q.N.20)	S3 (Q.N.24)	S4 (Q.N.26)	S1 (Q.N.16)	S2 (Q.N.19)	S3 (Q.N.22)	S4 (Q.N.27)
Group A (N=15) (Mean age: 3;4)	8	9	7	6	6	8	8	6
Group B (N=19) (Mean age: 4;5)	16	16	7	11	16	13	10	10
Group C (N=17) (Mean age: 5;6)	13	15	12	11	12	9	7	9

Group	Condition 5				Condition 6			
	S1 (Q.N.1)	S2 (Q.N.3)	S3 (Q.N.5)	S4 (Q.N.7)	S1 (Q.N.2)	S2 (Q.N.4)	S3 (Q.N.6)	S4 (Q.N.8)
Group A (N=15) (Mean age: 3;4)	10	9	8	6	11	7	12	3
Group B (N=19) (Mean age: 4;5)	15	8	19	5	13	13	13	13
Group C (N=17) (Mean age: 5;6)	17	11	15	11	14	6	14	11

Correct answers per sentence

Adults

Participant	Condition 1				Condition 2				Condition 3			
	S1 (Q.N.13)	S2 (Q.N.17)	S3 (Q.N.21)	S4 (Q.N.28)	S1 (Q.N.15)	S2 (Q.N.18)	S3 (Q.N.23)	S4 (Q.N.25)	S1 (Q.N.14)	S2 (Q.N.20)	S3 (Q.N.24)	S4 (Q.N.26)
Participant 1	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Participant 2	B=1	B=0	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	A=0	B=1
Participant 3	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Participant 4	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Participant 5	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Participant 6	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Participant 7	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Participant 8	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Participant 9	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Participant 10	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Participant 11	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Participant 12	B=1	A=1	A=1	B=1	B=1	A=0	A=1	A=1	A=1	A=1	B=1	B=1
Participant 13	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Participant 14	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Participant 15	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Participant 16	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Participant 17	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Participant 18	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Participant 19	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1
Participant 20	B=1	A=1	A=1	B=1	B=1	B=1	A=1	A=1	A=1	A=1	B=1	B=1

Participant	Condition 4				Condition 5				Condition 6			
	S1 (Q.N.16)	S2 (Q.N.19)	S3 (Q.N.22)	S4 (Q.N.27)	S1 (Q.N.1)	S2 (Q.N.3)	S3 (Q.N.5)	S4 (Q.N.7)	S1 (Q.N.2)	S2 (Q.N.4)	S3 (Q.N.6)	S4 (Q.N.8)
Participant 1	A=1	A=1	B=1	B=1	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Participant 2	A=1	A=1	B=1	B=1	A=1	A=0	A=1	B=1	B=1	A=1	B=1	A=1
Participant 3	A=1	A=1	B=1	B=1	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Participant 4	B=0	B=0	B=1	B=1	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Participant 5	A=1	A=1	B=1	B=1	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Participant 6	A=1	A=1	B=1	B=1	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Participant 7	A=1	A=1	B=1	B=1	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Participant 8	A=1	B=0	B=1	B=1	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Participant 9	A=1	A=1	B=1	A=0	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Participant 10	A=1	A=1	B=1	B=1	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Participant 11	A=1	A=1	B=1	B=1	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Participant 12	B=0	B=0	B=1	B=1	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Participant 13	A=1	A=1	B=1	B=1	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Participant 14	A=1	A=1	B=1	B=1	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Participant 15	A=1	A=1	B=1	B=1	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Participant 16	A=1	A=1	B=1	B=1	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Participant 17	A=1	A=1	B=1	B=1	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Participant 18	A=1	A=1	B=1	B=1	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Participant 19	A=1	A=1	B=1	B=1	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1
Participant 20	A=1	A=1	B=1	B=1	A=1	B=1	A=1	B=1	B=1	A=1	B=1	A=1