

## Does Language Structure Affect Acquisition of Spatial Terms?

### Περίληψη

Η παρούσα εργασία εξετάζει τη σειρά κατάκτησης των σύνθετων τοπικών προθέσεων της ελληνικής, επιδιώκοντας ταυτόχρονα να ερευνηθεί πιθανές διαφορές στην κατάκτηση τοπικών εκφράσεων οι οποίες μοιάζουν μορφοσυντακτικά κατά ένα μέρος, αποδίδοντας όμως διαφορετικό νόημα, όπως οι σύνθετες προθέσεις *πάνω από* και *πάνω σε*. Το εμπειρικό κομμάτι της εργασίας βασίζεται σε τεστ επιλογής εικόνας, εξετάζοντας την κατανόηση των υπό μελέτη δομών. Τα ευρήματα δείχνουν ότι τα παιδιά σε γενικές γραμμές κατακτούν τις τοπικές προθέσεις βάσει της καθολικής σειράς με την οποία φαίνεται να εμφανίζονται αυτές οι έννοιες διαγλωσσικά, αλλά με σχετική καθυστέρηση σε δομές που επικλύπτονται μορφοσυντακτικά, όπως το *πάνω σε*, το οποίο και κατακτάται αργά. Καταλήγουμε στο ότι η μορφοσυντακτική δομή των τοπικών εκφράσεων μιας γλώσσας μπορεί να επηρεάσει την πορεία της κατάκτησής τους.

### 1. Introduction

This work investigates the developmental order of locative expressions manifested as complex Prepositions (henceforth, Ps) in Greek.<sup>1</sup> It is part of a larger project that studies the development of spatial Ps (locative and directional), both simple and complex. Building on previous linguistic studies on spatial development (Johnston & Slobin 1979; Choi & Bowerman 1991 a.o.), its aim is twofold: (a) to examine the order of development of locative prepositions in Greek, and (b) to investigate to what extent, if any, the linguistic means via which a language expresses spatial concepts affect the acquisition of the related terms. In doing so, it focuses on the development of the locative notions ‘on’ and ‘above’, for which Greek uses two-word expressions, *pano se* and *pano apo* respectively (Terzi & Tsakali 2009). Our approach intends to shed light on the role of the morphosyntactic structure of locative prepositions in the process of their acquisition and, consequently, in the overall development of spatial terms.

To anticipate some of our main conclusions, our findings show, on the one hand,

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<sup>1</sup> The term *simple*, *small* or *light* preposition is used interchangeably for prepositions that involve one lexical item, namely, *se* or *apo* here.

that the order of development of locative expressions, as reported in the literature (Johnston & Slobin 1979; Durkin 1981 a.o.), is indeed attested in Greek. On the other hand, although Greek, just as English, distinguishes between ‘on’ and ‘above’, ‘on’ is acquired relatively late according to the expected developmental pattern of spatial terms – although before ‘above’. We attribute the relatively late development of ‘on’ to its *morphological opacity*, namely, the fact that this P shares a heavy lexical semantic portion of its morphological make-up, i.e. *pano*, with a P, which is acquired later.

Before going into the details of our study, we offer background information on theoretical issues concerning locative prepositions (Section 2), and on the syntactic and developmental work on Greek locative prepositions in particular (Sections 3 & 4). The current study is presented in detail in Section 5, followed by the discussion (Section 6).

## 2. Theoretical issues on spatial prepositions

Locative Ps have preoccupied linguistic theory because of two reasons primarily: (a) the syntactic properties of the Ps themselves; (b) their link to cognition of space.

Regarding issue (a), one of the central questions is concerned with the syntactic nature of prepositions, namely, their functional vs. lexical dimension. A number of linguists consider locatives lexical elements (e.g. Svenonius 2010; den Dikken 2010), while others take them to be functional (e.g. Baker 2003; Botwinik-Rotem 2004). There are also accounts according to which locatives are in between, that is, *semi-lexical* (van Riemsdijk 1990 et seq.).

These theoretical approaches have influenced language acquisition studies in their attempt to explain children’s difficulties with some prepositions as opposed to others. The guideline for predictions on the development of prepositions for Littlefield (2006), for instance, is the idea that acquisition proceeds from the most to the least lexical item, that is, from top to bottom of the underlined item in [1].<sup>2</sup>

[1]

- |    |  |                           |
|----|--|---------------------------|
| a. | Adverbs: <i>put <u>down</u> the cup</i>                        | [+ lexical, – functional] |
| b. | Particles: <i>he ate it <u>up</u></i>                          | [– lexical, –functional]  |
| c. | Semi-lexical prepositions: <i>run <u>to</u> the store</i>      | [+ lexical, + functional] |
| d. | Functional prepositions: <i>translation <u>of</u> the book</i> | [– lexical, + functional] |

Regarding issue (b), the cognitive revolution of the 60’s and the 70’s adopted the view that children’s first words label concepts that originate non-linguistically (Piaget & Inhelder 1956). Spatial terms seemed to offer a good amount of evidence to this effect, since children know a lot about space before they use language to represent this knowledge, words like *up*, *down* and *back* appear early and rapidly, and spatial

<sup>2</sup> Somehow similar conclusions, although from a different viewpoint, have been reached at by Leikin (1998) for Russian, where locative Ps, unlike in English or Greek, overlap with Case inflections.

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terms seem to follow the order in [2], which was first established by Piaget & Inhelder (1956) via non-linguistic tests.

- [2] Words of containment (*in*) > words of contiguity and support (*on*) and occlusion (*under*) > words for proximity (*next to, beside, between*) > words for projective relationships (*in front of, behind*).<sup>3</sup>

Subsequent theoretical work on the mapping of spatial concepts on linguistic encoding (Landau & Jackendoff 1993; Jackendoff 1996; Levinson 1996; 2003, a.o.) offered a number of possible approaches for developmental and psycholinguistic studies. However, acquisition research on the aforementioned order is rather limited, and the information comes from fractional examination of the spectrum in [2] (Conner & Chapman 1985; Durkin 1981; Johnston 1984; Cox & Isard 1990). A systematic and truly crosslinguistic research, testing production, is reported in Johnston & Slobin (1979), who conclude that the way a language expresses spatial terms, such as those in [2], may affect their order of acquisition – reporting nevertheless that this was not found to hold for the terms considered to be the earliest acquired, i.e., *in, on* and *under*. More recently, Bowerman & Choi (2001, 477) argue for *a more interactive view of how children's early word meanings arise*, by focusing precisely on spatial terms; for them, early semantic development involves the interaction of nonlinguistic conceptual development and the input of the particular language.

In line with the latest advances, we examine whether the linguistic means encoding spatial expressions indeed affect the acquisition of the corresponding terms and how. In doing so we look into: (a) the under-investigated issue of the order of acquisition of locative prepositions in Greek, and (b) the role of language specific properties, as contributing to this order. We focus primarily on the locative notions of 'on' and 'above', as the lexical component of these two-word expressions, i.e., *pano*, is common, thus, setting an ideal minimal pair for testing language specific properties. Given that in both expressions the first part is followed by either one of the two (allegedly) functional prepositions, *se* or *apo*, the pattern is crucially dissimilar to English, which uses radically different lexical items for the two notions. Building on this distinction, we will be able to shed light on whether the development of 'on' and 'above' differs cross-linguistically and why.<sup>4</sup>

### 3. The system of Greek spatial prepositions

The Greek spatial prepositional system encompasses simple prepositions, as well as complex. The main simple spatial prepositions are *se* 'on/in/to/at' and *apo* 'from'.

<sup>3</sup> We adopt the terminological description of the notions as discussed in Johnston & Slobin (1979). Johnston & Slobin make a further distinction for *back* and *front*, depending on the inherent properties of the ground argument of the P.

<sup>4</sup> Information on the acquisition of *above* is scarce, with Durkin (1981) reporting that English-speaking children fall behind even by school age. The other studies mentioned here do not discuss *above*, while they never fail to report the early acquisition of *on*.

Both of them can be combined with a nominal ground argument to express direction, either goal (*se*, cf. [3]), or source (*apo*, cf. [4]). *Se* is also employed to express location, as in [5], while both simple Ps convey several non-spatial meanings (see Terzi 2010).

[3] Piga            s-to            grafio  
went-1S        se-the        office  
'I went to the office'

[4] Erxome        apo        to        grafio  
come-1S        apo        the        office  
'I come from the office'

[5]  
a. To            vivlio        ine        s-to        trapezi/sirtari.  
the            book        is        se-the     table/drawer  
'The book is on the table / in the drawer'  
b. Meno        s-tin        Aθina  
live-1S        se-the     Athens  
'I live in Athens'

While *se* and *apo* are one-word spatial prepositions, hence, simple, the majority of spatial Ps involve a complex structure. The complex prepositions in the acquisition study of Terzi & Tsakali (2009), for instance, are the ones in [6].

[6]  
a. ekso            \*se/apo        'outside of'  
kato            \*se/apo        'under'  
piso            \*se/apo        'behind'  
makria        \*se/apo        'far'  
b. konda        se/\*apo        'near'  
c. brosta        se/apo        'in front'  
      ðipla        se/apo        'beside'  
      anamesa    se/apo        'between'  
d. (e)pano     se/apo        'on/above'  
      mesa        se/apo        'inside/from inside'

The complex Ps in [6] are formed by an item expressing location, followed by one of the two small Ps, *se* or *apo*. In [6a]–[6b], the locative item can be followed by only one of the small prepositions. In [6c]–[6d], on the other hand, either small P can be employed. In [6d] however, there is a difference in meaning, corresponding to *on* and *above* in English for the first pair (cf. [7]). As for *brosta* in [6c], it is not entirely clear if and how its meaning differs depending on whether it is followed by *se* or *apo*, neither has there been research on the issue so far. This is why *brosta se* and *brosta apo* were taken to have the same interpretation in the above study, as well as in the current one.<sup>5</sup>

<sup>5</sup> A reviewer correctly notes that *ekso* and *kato* ([6a]) are also possible with *se*. This is probably true for all items in [6a], but the phrase introduced by *se* is then an adjunct (hence, not immediately relevant for the current study). This is why: (a) a comma is possible in *kato, sto patoma* 'down, on the floor',

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- [7] Pano *se/apo* to trapezi.  
 on *se/apo* the table  
 ‘On/above the table’

Theoretical work on Greek Ps has held that: (a) the first part of complex Ps, to which traditional grammars often refer as locative *adverbials* (Tzartzanos 1996 [1945]), are lexical elements (Terzi 2010) and (b) the second parts, i.e., the ‘small’ Ps *se* and *apo* are functional (Theophanopoulou-Kontou 2000; Terzi 2010). In a comparative study of Greek and Hebrew locative Ps, Botwninik-Rotem & Terzi (2008) claim that *se* and *apo* are responsible for checking the Case feature of the noun complements of the locative, known as their *ground arguments*; thus, they are indeed functional. Only *apo* seems to contribute semantic input in some environments, such as [7] (see Terzi 2010).

The lexical parts of Complex Ps can be followed by their noun complements without the mediation of a small P, as long as the complement is expressed as a clitic (with genitive Case):

- [8]  
 a. Brosta tu  
 in-front he-cl  
 ‘In front of him’  
 b. Pano tis  
 on she-cl  
 ‘On her’

Finally, the lexical parts of complex Ps can also appear without a complement, in a frame presumably responsible for their being considered as adverbs. Their meaning is similar, but not always identical to the meaning they have when in complex Ps (cf. [9a] vs. [9b]).

- [9]  
 a. O Petros stekotan brosta/piso  
 the Peter was-standing in-front/behind  
 ‘Peter was standing in front/behind.’  
 b. I Maria kaθete pano/kato – meni pano/kato  
 the Mary sits on/under – lives on/under  
 ‘Mary is sitting on/down – lives upstairs/downstairs’

While [8] comes as no surprise, since Greek clitics cannot be preceded by any preposition, probably due to the fact that they themselves are Case absorbers (Tsakali 2006), it is worth pointing out that [9] is possible with the interpretation that there is an implicit relevant point of reference, namely, *in front of/behind/on/down* in relation to something or somebody (see Terzi 2006, for syntactic evidence to this effect). Summarizing the discussion related to our experimental work, while we investigate the development of most complex locatives in [6], we focus on those in [7], in which a different meaning emerges depending on whether *se* or *apo* is employed.

but not in *\*kato, apo to trapezi* ‘under the table’ and (b) while *kato sto patoma* is grammatical, *\*kato sto trapezi* is not.

#### 4. Previous research on the acquisition of Greek spatial Ps

Previous work on acquisition of prepositions in Greek was primarily concerned with the following issues:

- (a) whether there is a difference in age of acquisition between the first (i.e., lexical) and the second part (i.e., functional) of complex Ps.
- (b) whether there is a difference in age of acquisition between small Ps when they are part of complex prepositions, i.e., as functional, and when used alone to convey location, i.e., as semi-lexical.

##### 4.1 Alexaki, Kambanaros & Terzi (2009)

The Alexaki, Kambanaros & Terzi (2009) study employed both structured experiments (69 children, age 2 to 6, divided in eight age groups), and data analysis of spontaneous speech. The first task was a comprehension task targeting the lexical parts of complex Ps ([10a]) via picture verification, while the second investigated comprehension of the complex preposition structures ([10b]). The third experimental task investigated production of complex Ps.

[10]

- a. I        Maria        meni        kato  
       the        Mary        lives        under  
       'Mary lives downstairs'
- b. O        Kostas        ine        kato        apo        to        trapezi  
       the        Costas        is        under        apo        the        table  
       'Costas is under the table'

The spontaneous speech data came from the CHILDES database (Stephany Corpus, Janna: ages 1;11, 2;5, 2;9), and from a longitudinal study of the spontaneous speech of 3 children age 2;2 to 3;5, from an *Archimedes-I* project. According to the results (reported in Alexaki, Kambanaros & Terzi 2009) children's production of small Ps explodes at age 3, but only after age 3;6 the use of *se* and *apo* as parts of complex Ps is attained at a percentage higher than 90%.

The study focused on whether there is a difference in the acquisition of locative expressions depending on whether they appear as complex prepositions or as adverbials. The spontaneous speech indicated that children start using *se* and *apo* alone as locatives, earlier than the age of 3, as one would indeed expect if they are semi-lexical. The first small P they produce in this frame seems to be *apo*. Moreover, only after the age of 3 do they use the lexical part of complex Ps productively; prior to that stage a small percentage of complex Ps is substituted for adverbials, and only 21% of their elicited sentences contained a complex P.

The experimental work of Alexaki, Kambanaros & Terzi (2009) has been of great importance and gave rise to a number of questions for further research, including the motivation for the current study. However, it is impossible to conclude from it at what age children have full mastery even of the prepositions they start using ear-

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ly on. Thus, although a 3-year-old child uses spontaneously a good number of prepositions, this does not necessarily imply that mastering of the whole meaning and relations expressed by them is in place. The current study shows that this is a longer process than it may seem.

4.2 Terzi & Tsakali (2009): Acquisition of ‘on’ vs ‘above’ in Greek

Based on the data corpus of the previous study, and, in particular, on its three older age groups, Terzi & Tsakali (2009) focused on discrepancies in the comprehension and production of ‘on’ vs ‘above’. As depicted in Table 1, children performed better on production than on comprehension of these two Ps, and better on ‘above’ rather than on ‘on’. Therefore, the following questions were raised: (a) why is comprehension on these two locatives worse than production? (b) why is it that the preposition ‘above’ is comprehended (acquired?) before ‘on’?

	Age group 1 (5;7–5;11, n=9)	Age group 2 (5;0, 5;06, n=9)	Age group 3 (4;7–4;11, n=9)
Comprehension			
	above (for on) 5	above (for on) 4	above (for on) 4
	o	o	on (for above) 2
Production			
	o	o	above (for on) o
	o	o	on (for above) 1

Table 1: Children’s errors on ‘above’ and ‘on’ (from Terzi & Tsakali 2009)

Terzi & Tsakali suggest that the problems children have with understanding ‘on’ in Greek most likely follows from not understanding/knowing the properties of the small Ps *se* and *apo*. They also suggest that children’s impeccable production of *pano se* ‘on’ does not reflect that they know the meaning of this complex preposition. Instead, what they do when they produce *pano se* is to use *se* as a Case marker for the ground argument of the preposition.

The explanation was consistent with the comprehension results, since children interpret ‘on’ as ‘above’, rather than ‘above’ as ‘on’ and lead the authors to consider ‘above’ to be mastered earlier than ‘on’ in Greek. Consequently, two possibilities were examined:

(a) The uniform order of (non-linguistically determined) acquisition of spatial expressions, with ‘on’ acquired before ‘above’ across languages, is not right.

(b) The view according to which ‘on’ is acquired before ‘above’ across languages is essentially right, but the order of acquisition is affected by the particular means languages utilize for expressing spatial terms.

The latter option was adopted because in Greek, the element (*e*)*pano* expresses vertical orientation, not distinguishing contiguity from the ground argument. The latter information is contributed by *apo*, which, as a (semi)lexical element, is mas-

tered before *se*. As a result, *pano + apo* = ‘above’ is mastered before *pano + se* = ‘on’.

The present study owes theoretical and experimental motivation to the above one, despite the fact that, as we will report, the order of mastery of ‘on’ and ‘above’ was not replicated in the same direction. We should add here though that, despite the higher number of errors that Terzi & Tsakali (2009) found on ‘on’ vs ‘above’, their body of data was extremely small (only 9 subjects were tested in each age group, on one item each). This was an additional reason why we decided to take up the current study.

## 5. The current study

As already mentioned, the present study investigates the developmental order of a number of prepositions, with particular focus on the differences between the locatives ‘on’ and ‘above’. The ultimate goal of the study is to test the order of acquisition in both Greek and English and detect cross-linguistic similarities and differences. In what follows we present the experimental methods used for data collection, and the results obtained so far on the comprehension of Greek complex locatives.<sup>6</sup>

### 5.1 Participants and methodology

Our sample consists of five age groups of Greek-speaking monolingual children, with 20 children in each group eventually. The division of age groups and the sample we have analyzed so far is as follows:

Age groups	Age	N
1	4;0 – 4;5	11
2	4;6 – 4;11	15
3	5;0 – 5;5	15
4	5;6 – 5;11	15
5	6;0 – 6;5	12

*Table 2: Age groups*

The comprehension task is a picture selection task. Participants were presented with 3 pictures per sentence, and had to choose the one corresponding to the sentence they heard. Sentences were recorded by two female native Greek speakers. Each target item appeared in 6 sentences (conditions). Sentences were pseudo-randomized and pictures within each condition were pseudo-randomized as well. The material was also administered to a control group of 13 adults with various educational backgrounds.

In order to be able to compare the results to other languages and to atypical

<sup>6</sup> We investigate both comprehension and production, but have not analyzed production results yet. Our study of English Ps is currently underway with the same experimental material as in Greek.



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populations, the testing was preceded by checking non-verbal and verbal skills of the participating children. Thus, we run the following baseline tasks: Raven's coloured progressive matrices (Raven 1998) > 80, DVIQ morphosyntax task (Stavrakaki & Tsimpli 2000), and Expressive Vocabulary Task (Vogindroukas, Protopapas & Siderides 2009).

The prepositions tested were used in predicative position, namely, as in [11]. A sample of a three picture set appears in Figure 1.

- [11]
- a. To kaðro ine pano ston kanape  
'The picture is on the sofa'
  - b. To kaðro ine pano apo ton kanape  
'The picture is above the sofa'

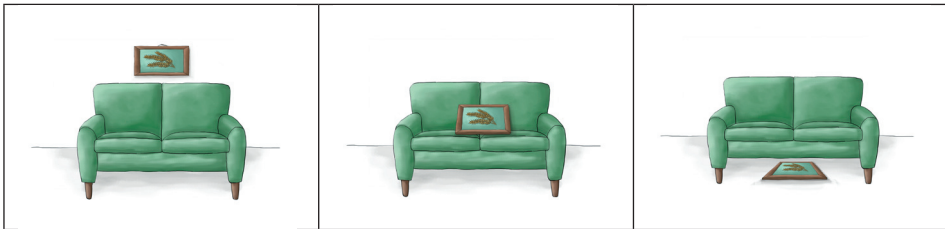


Figure 1: Example pictures

The full set of the complex prepositions tested appears in Figure 2.

### 5.2 Results

Figure 2 below depicts the percentage of comprehension errors for each preposition. The bars that correspond to each P are in the order we see them on the top of the Figure. The 2nd age group contains bars with errors for all Ps. When there are fewer than six bars for some age group, it is because there are no errors on that particular P. At first glance, the order of prepositional development in Greek seems to obey the crosslinguistic order in [2], according to which 'in' and 'under' are the first prepositions to be acquired. We see in Figure 2 that there are hardly any errors on *mesa se* 'in' and *kato apo* 'under' (the last two of the six bars respectively). Projective prepositions 'in front' and 'behind' follow.<sup>7</sup> Given that we did not test proximity preposition (i.e., 'next to'), which are acquired between the previous two types, we expected 'in front' to be acquired after 'in', 'under', and 'on'. While this was true for 'in' and 'under', it was not so for 'on'.

<sup>7</sup> Performance on 'in front' is lower than expected probably because of one picture. However, errors on 'on' are higher compared to 'in front' even after having this picture excluded (see last paragraph of this section).

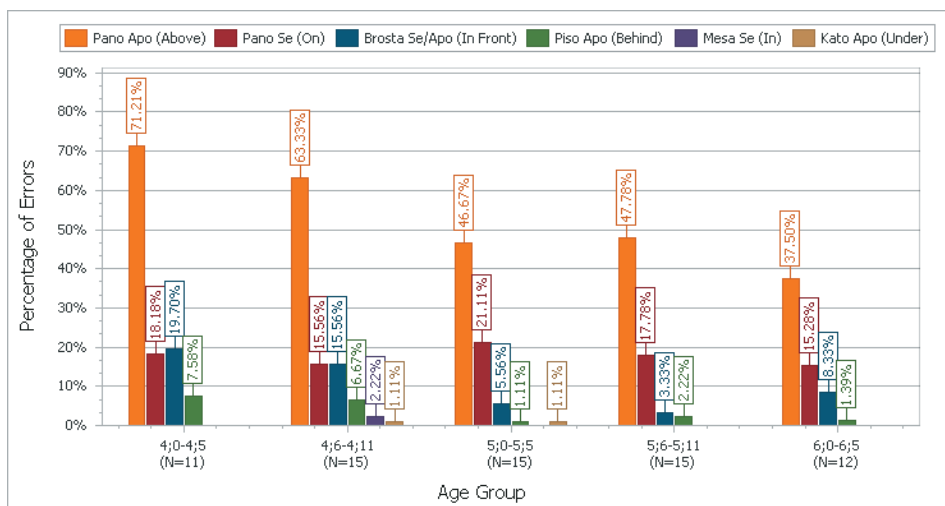


Figure 2: Overall results of Comprehension Task on Greek Prepositions

Strikingly enough, ‘on’ is not comprehended as early as expected, as errors on it (second bar from left above) exceed by far the errors on ‘in’ and ‘under’. ‘Above’ errors are in the first bar from left and we see clearly that ‘on’ is comprehended better/earlier than ‘above’, contrary to the findings of Terzi & Tsakali (2009). The difference in the development of these two Ps appears in Figure 3 below. Statistical analysis shows that this difference is significant for all age groups. Difference is also significant for all age groups together, while the adult control group had ceiling performance on ‘on’ and ‘above’ (as well as on all other Ps).

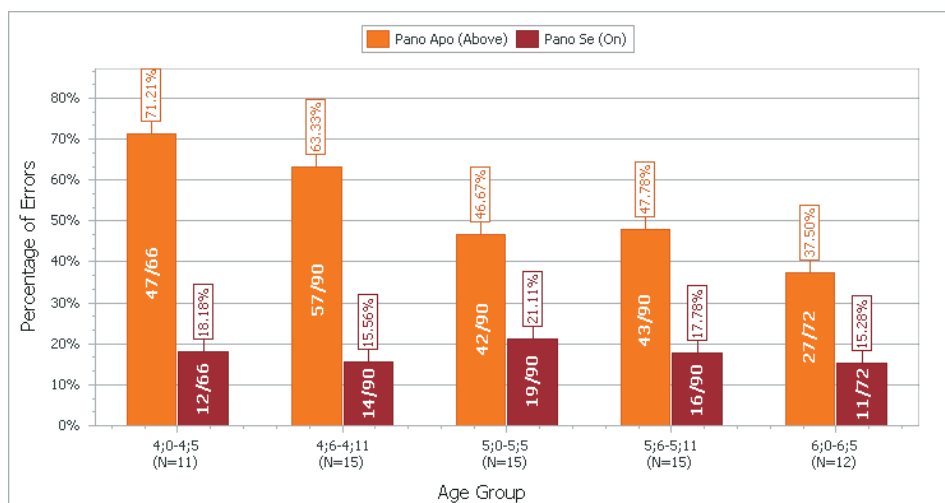


Figure 3: Zooming on ‘on’ and ‘above’

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The raw numbers of errors for each P, for all groups together, have as follows: 'Above': 216/408, 'on': 72/408, 'in front' (including challenging picture, see n. 8): 41/408, 'in front' (excluding challenging picture): 20/408, 'behind' errors: 15/408, 'in': 2/408, 'under': 3/408. The main result that calls for an explanation, and perhaps further research, is the much later mastery of 'on' as compared to 'in' and 'under', a striking and unexpected finding for the order in [2].

### 6. Discussion

The order of development of locative Ps that have been found to hold for other languages is attested as a whole in Greek with the single exception of 'on', which follows the acquisition of 'in' and 'under'. Hardly are there any errors with containment and occlusion ('in' and 'under'), while projective terms such as 'in front' and 'behind' follow in order of acquisition. Moreover, 'on' precedes the comprehension of 'above' (cf. Johnston & Slobin 1979; Gentner & Bowerman 2009; contra Terzi & Tsakali 2009), as is expected. We believe that this particular finding of the Terzi & Tsakali (2009) study was not right, because of their very small sample.

However, 'on' does not follow the expected developmental pattern, in the sense that it is acquired more or less at the same time as the last Ps in order of acquisition, falling by far behind 'in' and 'under'. We consider this to follow from the morphological opacity generated by its similarity to 'above', a P that is acquired later. In the spirit of Johnston & Slobin (1979), we consider the morphological opacity as one of the linguistic factors responsible for delaying the development of 'on' in Greek. While Johnston & Slobin (1979) refer to linguistic factors such as the position of Ps in a language (adpositions vs. prepositions), the lexical diversity, the semantic opacity, the morphological complexity and the homonymity, we believe that morphological opacity, created by the sharing of the heavily semantic part of *pano* in both *pano se* 'on' and *pano apo* 'above' in Greek, does not facilitate the full mastery of these prepositions. If this line of thought is on the right track, the reported comprehension results constitute clear evidence that language specific morphological make-up *does* affect order of acquisition. Error analysis corroborates this line, since in all but two errors (70/72), children interpreted 'on' as 'above' (and in all but one errors on 'above' (215/216), they interpreted it as 'on').<sup>8</sup>

There is a great deal of remaining issues that have to be addressed: when is acquisition of these two Ps completed in Greek? How do other languages, which distinguish 'on' and 'above', but use distinct lexical items for each, behave? English is such a language. How early (or late) acquisition of these two Ps is completed in the

<sup>8</sup> A reviewer raised the interesting question whether the delay in the acquisition of *pano se* is (also) due to the fact that the same concept is expressed by the small P *se* in Greek, which, moreover, has a number of other meanings (cf. [5]). Fortunately, our research has also investigated the comprehension and production of *se* with the interpretation of 'on' (and 'in'). As soon as these data are analyzed, we believe we will have a solid answer to give.

two languages? According to our predictions, acquisition of ‘on’ in English should be attained earlier than in Greek, but this can be confirmed only once we have results from the English study we are currently running.

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