The Development of Temporality in Greek Child Language: Acting-Out the Interaction between Connectives and Cognitive Complexity

Abstract

The study investigates the acquisition of temporality as expressed by the Greek connectives: eno, kathos ‘while’ and afu ‘after’, which are ambiguously (non)temporal, and the unambiguous prin ‘before’. An act-out task based on Winskel’s (2004) model was designed for the elicitation of comprehension data. Four age groups were tested (6, 8, 10, 12 years), comprising 30 children each and a control group of adults. There were four sub-tasks of increasing cognitive complexity (measured by number of actions, participants and events). Three sentences were combined with each connective in every sub-task. Afu and prin, though, were involved twice in two sub-tasks in order to examine the effect of ordering between the adverbial and the matrix clause. The results show that simultaneity is acquired around age 10, while sequentiality around age 12. Moreover, anteriority (expressed with afu) poses more problems than posteriority (expressed by prin). Differences between the present results and those of previous studies may be due to methodological (Faegans 1980) or crosslinguistic differences in the choice of connectives (cf. Winskel 2004).

Introduction

The present study examines the acquisition of connectives since connectives are representative markers of the syntax–discourse interface and, hence, through studying them we can observe the development of both grammar and cognition. The acquisition of the connectives presupposes knowledge of (a) the semantics of the connective and, in particular, knowledge of the semantics of temporality; (b) the syntax of subordination so that the adverbial clause be temporally anchored to the matrix clause; and (c) at the discourse level, pragmatic-processing abilities for the appropriate integration of the matrix and the adverbial clause events.

The focus of the present study is to examine four Greek temporal connectives; eno and kathos ‘while’ [1], which express simultaneity, and afu ‘after’ [2], which expresses anteriority; these three connectives can also have a non-temporal reading. We also study the unambiguous temporal prin ‘before’ [3], which expresses posteriority with respect to the matrix clause.

1 Ambiguous connectives are also common to other languages; for instance, English while can be both temporal and adversative.
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[1] kaθos/eno etrexε iδε ton filo tu

‘While/Since he was running he saw his friend’

[2] afu δipsase, ipje ena bukali nero

‘After /Since he got thirsty, he drank a bottle of water’

[3] prin bi stin taxi, xtenise ta malia tu

‘Before entering the class, he combed his hair’

It has been proposed (Tsimpli, Papadopoulou & Mylonaki 2010) that the ambiguity of afu, eno, kaθos and the final (non)temporal interpretation they get is imposed by the [+/- boundedness] feature of the connective and the dependency formed with verbal Aspect. In particular, the boundedness feature of the connective imposes restrictions on the selectional properties of its predicate; connectives like afu, which is specified as [+ bounded], require a perfective verb form in order to allow a temporal interpretation, while eno and kathos, which are [– bounded], select imperfective aspect. Not all connectives are specified in the lexicon for [boundedness] however; for connectives which are not marked for this feature, like the Greek connective prin, aspectual choices do not constrain interpretation (Τσοπανάκης 1994).

Developmental studies for English (Bloom et al. 1979) and for Greek (Κατή & Κάντου 2004), report that temporal connectives are acquired before non-temporal ones. Other studies which focus on the acquisition of temporality, report that connectives and clauses which express sequence are acquired earlier than those which express simultaneity; however there are conflicting results (cf. Faegans 1980; Keller-Cohen 1981; Winskel 2004). These differences can be attributed to the methodology used for data elicitation (Winskel 2004). Stevenson & Pollitt (1987) observed that there is better performance in cognitively less complex structures and tasks. Winskel’s (2004) results suggest that the effect of cognitive complexity in linguistic performance is language-specific.

The present study aims at investigating whether the Greek connectives which express sequentiality are acquired earlier than those which encode simultaneity, whether anteriority is acquired later than posteriority and whether cognitive complexity affects linguistic performance. We further examine the ordering factor, taking into account processing constraints (Hawkins 1990) and the Iconicity Principle (Haiman 1983). Processing accounts support that the adverbial clause should follow the matrix to minimize processing cost. Starting with the adverbial clause is more costly to process, as the processor has to retain all the information of the adverbial clause until the matrix is there in order to temporally anchor it to the matrix clause. On the other hand, the Iconicity Principle requires that the clause structure should reflect the event structure.

2 Afu can get [– perfective] to express the habitual, while kathos [+ perfective] can be interpreted as ‘as soon as’ and thus express temporality with semelfactives (pidho ‘jump’, xtipo ‘hit’) and achievement (anaynorizo ‘recognize’) verbs (Tsimpli, Papadopoulou & Mylonaki 2010, 661).
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Method

An act-out task based on the model of Winskel (2004) was designed for the elicitation of comprehension data. 120 typically-developing L1 monolingual Greek children divided in four age groups were tested (6, 8, 10, 12 years) as well as a control group of 15 adults. The participants’ task was to act-out the test sentences read by the experimenter with the use of animal toys. The four connectives were involved in their temporal interpretation.

We tested the connectives in conditions of (a) increased cognitive complexity; and (b) ordering of the adverbial with respect to the matrix clause, i.e., matrix1-adv2 vs. adv1-matrix2. To investigate cognitive complexity we manipulated the complexity of the task; namely, there were two levels of task complexity. In the first sub-task both the participant and the experimenter acted-out the events described in the test sentences, while in the other three sub-tasks only the participant performed the events. Regarding sentence structure complexity, this was measured in subtasks b, c and d and there was an increased complexity in the number of agents and actions the participant had to act-out.

Each connective was involved in three sentences in each subtask. All sentences were declarative, consisting of a matrix and an adverbial clause. In order to test the extra condition of ordering we used the test sentences which involved the connectives expressing sequence (afu and prin) twice in subtasks b, c and d; once in the order ‘matrix1-adv2’ and a second time in the order ‘adv1-matrix2’, with the aim to observe any ordering preferences of the children.

Predictions

Based on results from previous studies we expect better performance in sentences expressing sequence than simultaneity. Differences between connectives which express same relations (afu vs. prin, kathos vs. eno) are expected due to different lexical properties of the connectives. In particular, the connective afu which is ambiguous between a temporal and a non-temporal interpretation is expected to pose more problems than the unambiguous prin. Clause structures which reflect the event structure will probably achieve better scores (afu + matrix BUT matrix + prin). Finally, less cognitive complexity is expected to be related to better performance, i.e., subtask a will possibly have an advantage over subtasks b, c and d.

Results

The overall performance of the participants shows significant developmental changes (Graph 1). But still 11:6 year olds have not reached adult performance ($\chi^2 = 57.493$, df=1, p = .000)
Graph 1: Target vs. non-target performance across subtasks and connectives

The trend described above is not the result of one or some of the subtasks but it is observed within all subtasks (Graph 2) and for all age groups.

Graph 2: Target performance in each subtask

Results per connective across subtasks reveal that *afu* in the condition where the clause structure reflects the event structure (Graph 3) generates more target than non-target scores in all child groups, while in the reverse ordering condition (Graph 4) the youngest groups perform at chance. Developmentally, in both ordering conditions target scores increase by age (except between 9–11), but still the oldest chil-
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dren have not reached adult-like performance \( (afu: \chi^2 = 45.5, df = 1, p = .000; afu R: \chi^2 = 12.7, df = 1, p = .000) \).

**Graph 3:** \( afu \) – target vs. non-target scores

**Graph 4:** \( afu R \) – target vs. non-target scores

Prin seems to be easier than \( afu \), since all child groups give significantly more target than non-target scores in both ordering conditions (Graphs 5, 6). But at the age of 11;6 years, children have not yet reached the adult performance \( (prin \ \chi^2 = 12.5, df = 1, p = .000; prin R \ \chi^2 = 3.9, df = 1, p = .000) \).
The connectives which encode simultaneity seem to be easier than those which express sequence. Adult-like performance is achieved at 9;6 years both for *kaθos* ($\chi^2 = 36.6$, df = 1, p = .000; Graph 7) and *eno* ($\chi^2 = 39.7$, df = 1, p = .000; Graph 8).
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Graph 7: kathos – target vs. non-target scores

Graph 8: eno – target vs. non-target scores

The comparison between connectives that express sequence reveal better performance for prin when compared to afu, even in the oldest group examined, for both the ordering conditions in which the clause structure reflects the event structure ($\chi^2 = 37.215, df = 1, p = .000$; Graph 9), and the condition in which the clause structure is the reverse of the event structure ($\chi^2 = 4.286, df = 1, p = .038$; Graph 10).
Graph 9: afu vs. prin – ordering which respects ‘iconicity requirement’

Graph 10: afu vs. prin – reverse ordering condition

Simultaneity is expressed similarly for *eno* and *kathos* resulting in non-significant differences between the two connectives. Ordering does not seem to affect performance of *prin* while for *afu*, surprisingly, there was higher accuracy when the clause structure did not reflect the event structure, and the matrix preceded the adverbial respecting the processing principle of economy even at 11;6 ($\chi^2 = 12.005$, df = 1, $p = .001$; Graph 11).
Next we report results regarding cognitive complexity. ANOVAs conducted revealed a significant interaction between cognitive complexity and performance ($F=3.331$, $p=.001$). Subtask $d$, was significantly more difficult up to 7;6 than tasks $b$ ($t=3.903$, $p=.001$) and $c$ ($t=2.333$, $p=.027$). Note that subtask $d$ involved two agents and two events, while subtasks $b$ and $c$ one agent in two actions and two agents in one action, respectively. This effect was found only for the ‘simultaneous’ connectives (Graph 12).

**Graph 12: Structural complexity effects**

The comparison between subtasks $a$ and $b$ revealed further task effects (Graph 13). Subtask $a$ where both the child and the experimenter acted-out one event, was sig-
nificantly worse than subtask \( b \), where only the child acted-out two events, in all child groups except 9;6. Even the adult group exhibited significantly different performance in the two tasks \( (\chi^2 = 9.231, df = 1, p = .002) \), which leads to the assumption that other than language factors affected performance.

![Graph 13: Task type effects](image)

**Graph 13: Task type effects**

Winskel (2004) reports differences between tasks only for one of the three languages she investigated; task effects were attributed to the different types of verbs used in the different subtasks, namely accomplishment verbs in subtask \( a \) and action verbs in the other tasks. But it seems more probable that task demands for coordination of actions between the experimenter and the participant – as is the case with subtask \( a \) – as well as inhibition effects may be responsible for task effects and divergent results observed in different studies.

**Conclusion**

The results of this study indicate that temporal connectives are acquired around 9;6 years (80% >), but are not adult-like even at the age of 11;6 years. **Simultaneity** is adult-like before **Sequence** around 9;6, while **Sequence** seems to be fully developed after 11;6. Results of other studies, though, report the opposite. In Feagans (1980) and Keller-Cohen (1981) the ‘sequential’ connectives are acquired earlier than the ‘simultaneous’ ones. Methodology and choice of the connectives under investigation may explain the differences in the results between different studies (cf. Winskel 2004). It is also possible that frequency is a factor too: sequentiality can be expressed with simple coordination (**and, and then**), which is considerably more frequently attested in adult and child language.

Among the connectives which express sequence, **afu** ‘after’ is more problematic than **prin** ‘before’. This is possibly due to the fact that **afu** and **prin** do not have the
same lexical properties. *Afu* is cognitively more demanding since, apart from expressing temporal sequence, it also has a premise, i.e., a non-temporal reading while *prin* only encodes temporality. The ambiguity of *afu* reduces the prototypicality of the temporal meaning and could thus delay acquisition in the case of *afu*. Also, *prin* restricts the selection of the verb form it introduces to the ‘dependent’ one, i.e., the non-past, perfective form, while *afu* introduces an independent, finite form. Studies on English connectives report that *before* is acquired earlier than *after* (Clark 1971; cf. Clancy, Jakobsen & Silva 1976 for Italian and English) but other studies report no significant differences between the two connectives (Amidon & Carey 1972). In Winskel (2004), performance of *before* and *after* is affected both by task and language investigated.

Regarding ordering, our results do not support the Iconicity requirement. Performance of *prin* is unaffected by ordering, while for *afu* the preferred order is the reverse, i.e., the one which does not reflect the events in the order they occurred. This might mean that processing considerations are more crucial for comprehension, since for *afu* the reverse order is matrix1-adv2.

Complexity of sentence structure significantly affects performance in younger ages. This is evident only in the connectives which express simultaneity; we assume that the cognitive load of clauses introduced by connectives which express simultaneous actions is heavier than the ones which express sequence; the increase of complexity in these structures with the addition of extra actors and events which have to be acted-out simultaneously may lead to poorer performance in the younger groups of children.

Task type also seems to affect performance. But, the results of the present study do not support the prediction that less demanding tasks will give higher performance; at least in the sense of Winskel (2004), who considers subtask *a* less complex than the rest of the subtasks, since subtask *a* requires from the children the act-out of a single event, while the others demand the act-out of two events. Nevertheless, counting the number of the required act-outs is not the only way to measure task complexity. Task complexity is also related to the degree to which the participants of the task have to interact with the experimenter. In particular, in subtask *a* the children have to coordinate their actions with those of the experimenter; this renders the subtask more demanding, since it is required from the participants to have their inhibition control developed in order to coordinate their actions properly with the ones of the experimenter. These methodological considerations may explain divergent results among different studies.

Overall, the acquisition of temporality appears to be a ‘late’ acquisition compared to morphosyntactic aspects of language including the marking of tense and aspect on the verb form. This possible stems from the interaction between cognitive and linguistic prerequisites for the representation of temporality.
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