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Aspectuality and Scalar Structure

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1. Introduction

This paper focuses on the semantic and pragmatic properties of certain aspectual predicates (e.g. *start*) and degree modifiers (e.g. *half*). As is well-known, such terms typically give rise to SCALAR IMPLICATURES (SIs). For instance, an utterance such as (1a) or (2a) is often taken to carry the implicature in (1b) and (2b) respectively:

(1) a. John started eating his birthday cake.
b. John didn't finish eating his birthday cake.
(2) a. John ate half of his birthday cake.
b. John didn't eat all of his birthday cake.

Such aspectual verbs and degree modifiers can be treated as scalar expressions with lower-bounded ('at least') semantics (on scalar semantics, see Horn, 1972; Gazdar, 1979; Atlas and Levinson, 1981; Atlas, 1984; Grice, 1989; Levinson, 2000). In cases where this semantic content falls short of the informativeness and relevance expectations raised by the conversational exchange, the hearer is entitled to derive an upper-bounding implicature of the sort in (1b/2b). In other words, assuming that the speaker is trying to be co-operative and will say as much as she truthfully can that is relevant to the exchange, the fact that she chose a weaker term (e.g. *start*) from an informational scale <*finish*, *start*> gives the listener reason to think that she is not in a position to offer an informationally stronger statement (using *finish*) - presumably because such a statement is false.[1] In this sense, aspectual expressions resemble a variety

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1. There is disagreement in the literature about the precise mechanisms

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of scalar expressions, including quantifiers (<*all, some*>), connectives (<*and, or*>), cardinal numbers (<*...two, one*>), etc.

Recent experimental studies have suggested that preschool children are often insensitive to scalar implicatures in language comprehension tasks (Noveck, 2001; Chierchia, Crain, Guasti, Gualmini and Meroni, 2001; Gualmini, Crain, Meroni, Chierchia and Guasti, 2001; Musolino and Lidz, 2002; cf. Paris, 1973; Smith, 1980). In these studies, young language learners were shown to attend only to the semantic content of scalar expressions such as the quantifier *some* and the connective *or*; for instance, preschoolers would treat *some* as compatible with *all*, a fact which is consistent with the encoded content but not with the standard usage of the quantifier.

More recent results, however, raise the possibility that children's failures in previous studies might be due to experimental demands rather than a genuine inability to compute scalar pragmatics. Papafragou and Musolino (2003), using evidence from Modern Greek, showed that 5-year-olds had some success in computing non-completion SIs from aspectual terms such as 'start'[2] in cases where the experimental demands were clear and the information expectations salient. They also uncovered some intriguing asymmetries in children's success with scalar terms: Greek-speaking preschoolers were much more successful with the scalar pragmatics of numerals such as 'two' (*dio*) than with SIs derived from quantifiers such as 'some' (*meriki*) in otherwise identical experimental scenarios. The authors concluded that the nature of the scalar expression (e.g. whether the scale was discrete or continuous) crucially affected children's ability to compute the relevant SIs.

In this paper I present findings from a series of experimental studies conducted with native speakers of Modern Greek which probe further into the acquisition of non-completion SIs. The studies compared 5-year-olds' (and adults') comprehension of the SIs associated with two aspectual verbs, *arxizo* ('start') and *ksekino* ('begin'), and two degree modifiers, *miso* ('half') and *mexri ti mesi* ('halfway'). The aims of the experiments were two-fold: first, to identify the contexts in which children can draw non-completion inferences; second, to examine the properties of such SIs in child language, especially across semantically related expressions.

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which give rise to scalar implicatures. For discussion, see Carston (1998), Horn (1992), Sperber and Wilson (1995), Levinson (2000), Chierchia (2001).

2. Throughout this paper, I will use quotes (rather than italics) whenever an English form is used as a gloss of a Greek scalar term.

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2. Experiment 1

2.1 Method

2.1.1 Participants

Participants in this study were a group of 40 Greek-speaking 5-year-olds between the ages of 4;10 and 5;11 (mean 5;6) and a group of 40 adult native speakers of Greek. Children participants were recruited from a daycare in Athens, Greece. The adult speakers were also recruited from the Athens area.

2.1.2 Materials and Procedure

Following Papafragou and Musolino (2003), the present study used a pragmatic judgment task in order to tap into children's comprehension of scalar inference. The main phase of the experiment was preceded by a training phase which aimed at making children familiar with the task of detecting pragmatic infelicity. Children were presented with a puppet, Minnie. They were told that Minnie would be shown some acted-out stories and then she would be asked what happened in the story. Children were told that Minnie sometimes says 'silly things' and that the child should help her 'say things better'. In one of the training scenes, Minnie was shown a spoon and asked what it was. She described the object as 'something we use for eating'. When asked whether Minnie answered well, children were expected to correct this truth-conditionally accurate but pragmatically infelicitous statement. Whenever they failed to do so, the experimenter finally corrected Minnie and offered a more appropriate description of the object ('Minnie didn't say that very well. This is a SPOON'). The training phase included two truth-conditionally correct but pragmatically inappropriate descriptions and two descriptions which were both correct and appropriate. This was to make sure that children didn't develop a bias for assuming that Minnie always said silly things.

In the main part of the experiment, children were shown a set of four test stories and four control stories. Each test story satisfied the truth conditions of an informationally stronger element within an aspectual/degree scale but was described by Minnie in terms of a weaker element from that scale. For instance, in one of the test stories, Daisy watched Mickey while he carefully colored a star. Daisy wanted to color another star for herself, even though Mickey doubted that she could do it. At the end of the story, Daisy managed to color the star. When asked how Daisy did, Minnie offered a statement such as the following (I use English translations of the Greek examples throughout):

(3) Daisy started painting the star.
(4) Daisy began painting the star.
(5) Daisy painted half the star.
(6) Daisy painted the star halfway.

After hearing Minnie's statement, children were asked whether Minnie had 'answered well'. In case they responded 'Yes', no further questions were asked. In case they responded 'No', children were asked whether we can 'say it better'. It was expected that, if children are pragmatically savvy, they should reject statements such as (3)-(6) as descriptions of the story and offer utterances such as (7)-(9) as improved ways of describing what happened:

(7) Daisy finished the star.
(8) Daisy painted all of the star.
(9) Daisy painted the star completely/to the end.

Children were randomly assigned to one of the four aspectual/degree expressions, 'start' (*arxizo)*, 'begin' (*ksekino)*, 'half' (*miso)* and 'halfway' (*mexri ti mesi)*. All test stories were identical across all conditions: for instance, children in all conditions saw the star-coloring scene as described above. What was different across conditions was the critical statements used to describe these stories. The purpose of this step was to ensure that, other things being equal, any differences among conditions should be attributable only to aspects of the semantics-pragmatics of individual scalar terms.

Control items (which were identical across conditions) also involved two characters engaged in some sort of contest. They were always correctly (and felicitously) described by Minnie and never involved the use of scalar terms. For instance, in one of the fillers a horse and a turtle entered a race and the horse finished first. Minnie described the scene with the sentence 'The horse beat the turtle'. It was expected that children should find no difficulty accepting all control statements as good answers. The test stories and the control stories were administered in a pseudo-random order. Within each condition, order of presentation was counterbalanced.

Adult participants were randomly assigned to one of the four conditions in a modified version of the same task. They were given a leaflet which contained in written form the instructions verbally given to the children. For the warm-ups, the control and critical trials, adults read a description of the stories which did not contain any scalar items and which did not specify the ending. For instance, for the star-coloring story, adults read the following description (translated from Greek):

(10) Daisy and Mickey are playing with markers. Mickey shows Daisy a star and how to color it. He tells her that one should not leave white spaces and makes it clear that he doesn't trust her to color a star on her own. Daisy thinks she can manage. She takes another star and a marker. The story ends as shown in picture [number of picture provided].

In order to see how the story ended, adults had to consult a photograph in the booklet which showed the outcome of the event (here, Daisy holding a completed star). Participants then read Minnie's statement and had to answer the same

questions as the children ('Did Minnie answer well? If not, can we say it better?') by filling in their answers in the space provided.

2.2 Results and Discussion

Beginning with test trials, it was found that adult subjects overwhelmingly rejected the puppet's statements in all four conditions (95% of the time for 'start', 97.5% of the time for 'begin', 95% of the time for 'half' and 100% of the time for 'halfway'). By contrast, 5-year-olds did not generally reject the puppet's statements in the critical trials (32% of rejections for 'start', 37% for 'begin' and 32% for 'halfway'), with the exception of 'half' (67% of the answers were rejections). Adults' corrections of Minnie's statement included a stronger, more informative term; of children's correct responses, 91% were accompanied by such (adult-like) justifications.

On the control items, adults gave correct answers 70% of the time for 'start', 82.5% of the time for 'begin', 97.5% of the time for 'half' and 87.5% of the time for 'halfway'. On the same items, children gave correct responses 97.5% of the time in the 'start' condition, 87.5% of the time in the 'begin' condition, 100% in the 'half' condition and 90% of the time in the 'halfway' condition.

These findings confirm and empirically extend previous experimental reports that scalar inferences are regularly computed, when appropriate, during adult language comprehension but do not surface consistently in language processing by young children (Noveck, 2001; Chierchia et al., 2001; Gualmini et al., 2001; Papafragou and Musolino, 2003; among others).[3] The most intriguing aspect of the present findings is the fact that, even though children generally have limited sensitivity to the pragmatics of scalar terms such as 'start' and 'halfway', they are very successful at deriving SIs from the scalar modifier 'half' (67% of correct responses). Given that the materials and stories used were identical for all scalar terms in this study, this difference introduces an unexpected asymmetry in the derivation of SIs. This is an interesting and unexpected outcome, and one I return to below.

A potential worry with the present experimental design is that the derivation of SIs is removed from the contexts in which it most naturally occurs during actual conversations. In order to pass this task, children need to perform a pragmatic judgment task by explicitly comparing a certain linguistic stimulus (Minnie's description) to other potential stimuli which could have been produced in the given context. This is very different from situations in which SIs are computed during naturalistic conversations. The question that arises now is whether children might be more successful with SIs overall if the methodological requirements of the task were different. This possibility was pursued in Experiment 2.

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3. Papafragou and Musolino (2003) report higher success rates with 'start' using the same method but with a slightly older population of 5-year-olds.

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3. Experiment 2

3.1 Method

3.1.1 Participants

Participants were a new group of 40 Greek-speaking preschoolers (age range: 5;1-6;3, mean age: 5;6). Children were recruited from the same Athens area as in Experiment 1.

3.1.2 Materials and Procedure

The experiment involved an act-out task in which a set of animals decided to build a school for young animals. Their model was a school for (human) children which was in the experimental scene. Each animal was assigned a certain task (e.g. build the building, bring in books, find a school sign, etc.) so as to contribute to that goal. If at the end of the game the animal performed the assigned task, children were instructed to give the animal a prize, if not, the animal should get nothing. For instance, the horse was asked to build the school. After going away for some time, the animal was brought back and was asked whether he built the school. The horse then replied with one of the following:

(11) I started building it.
(12) I began building it.
(13) I built half of it.
(14) I built it halfway.

After hearing the animal's response, children had to decide whether he should receive a prize or not and justify their response. It was hypothesized that, if children were able to compute SIs, they should refuse to award a prize to the horse; furthermore, their justifications should reflect their sensitivity to the presence of the implicature.

This task offers a fairly straightforward means of evaluating children's pragmatic sophistication by making a certain behavior (here, the refusal to give a reward) contingent on the spontaneous computation of an implicature. The experimental scenarios resemble naturalistic communicative circumstances in which implicatures are actually computed. Notice that the indirect responses of the animals, and hence the presence of an SI, in (11)-(14) have a natural motivation: animals which were unable or unwilling to complete their task chose to report their partial progress (and only imply that the task was not completed) in the hope of getting at least some reward. For these reasons, the present method is an improvement on pragmatic judgment tasks previously used as a means of assessing early implicature calculation.

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Children also received a number of control trials (which were identical across conditions and did not involve scalar expressions). In control items, the animal characters always performed the action they had been assigned. Control items ensured that children could give positive (alongside negative) responses when asked whether an animal should be rewarded. Children were randomly assigned to one of four conditions, which corresponded to the four scalar expressions used. Ten children participated in each condition. In each condition, subjects received four critical trials and four test trials administered in a pseudo-random order. Within each condition, order of presentation was counterbalanced among subjects.

3.2 Results and Discussion

The overall result from the test trials is that children were now more likely to show evidence for SI-computation. 5-year-olds correctly refused to give a prize in the critical trials 50% of the time for 'start', 47.5% of the time for 'begin' and

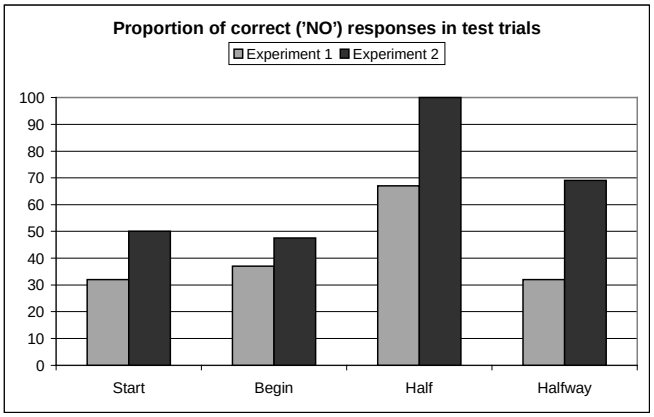

Figure 1: Children's correct responses on critical trials in Exp. 1 & 2.

69% of the time for 'halfway', while in the case of 'half' they reached ceiling performance (100% of the answers were rejections). Furthermore, justifications for their refusal always correctly made reference to a stronger scalar term (e.g. 'The horse didn't FINISH the school'). On the control items, children always gave correct answers in all conditions. Figure 1 presents a comparison of results from Experiments 1 and 2.

Once again, children were much more successful in computing the SIs triggered by 'half' rather than the closely semantically related 'halfway', even in contexts which were otherwise exactly identical. However, one might reasonably argue that children at this age do not yet fully know their semantics. If this is the case, children's failures with 'halfway' (but also with 'start' and 'begin') may be

attributed to lack of relevant semantic knowledge rather than inability to compute scalar pragmatics. At this stage some evidence is needed that Greek-speaking preschoolers have acquired the truth-conditional semantics of degree and aspectual terms. A control task was designed which sought to separate the semantics from the pragmatics of scalar terms.

4. A Control Task

4.1 Method

4.1.1 Participants

Participants in this control task were a new group of 40 Greek-speaking children between the ages of 4;4 and 5;11 (mean age 5;6). They were recruited from the same Athens daycare as the children in the main studies.

4.1.2 Materials and Procedure

Children were told that they would witness a drawing competition. Four animals, a lion, a bear, a giraffe and a horse, were given a sheet of paper and a pencil each and got ready to draw. Before the drawing started, children were informed of the terms of the competition, which were phrased in terms of one of the following statements:

(15) Whoever starts drawing a star gets a prize.
(16) Whoever begins drawing a star gets a prize.
(17) Whoever draws half a star gets a prize.
(18) Whoever draws a star halfway gets a prize.

The animals took turns in drawing but each one produced something different. The lion drew a star; the bear drew a circle; the giraffe drew half a star; and the horse drew nothing. Children, after being briefly reminded what the condition for winning a prize was, had to determine for each animal whether it should get a prize or not.

Notice that the aspectual/degree expressions in (15)-(18) appear in environments where scalar implicatures are canceled (cf. Chierchia, 2001): intuition confirms that all of the utterances in (15)-(18) allow for a prize to be awarded not only to contest participants who draw part of/half of a star but also to those who complete a star. In this situation, that is, the semantic content of the scalar expressions places a minimal requirement on the contestants (drawing part/half of a star) and is compatible with actions which go beyond that (completion of the star). The prediction then is that, if children know the semantics of degree/aspectual expressions, even if they are not sensitive to their pragmatic (SI-triggering) properties, they should award a prize to both the animal which produced half of the star (i.e. the giraffe) and to the animal which drew the whole star (i.e. the lion). Crucially, this task from the beginning leaves open the possibility that the drawing competition will have more than one winner. First,

many prizes (coins) were available in the scene and were ready to be distributed, if needed. Second, the formulation of the statements in (15)-(18) ('Whoever...') specifically allows for multiple winners.

There were four groups in the task, depending on the kind of scalar expression used ('start', 'begin', 'half', 'halfway'). Children were randomly assigned to one of these groups so that there were ten children per group.

4.2 Results and Discussion

Overall, 85% of the children gave errorless responses, i.e. (a) they awarded a prize to both the animal which drew a star and to the animal which drew half of the star, and (b) they didn't give a prize to anyone else. Errorless performance was observed on 90% of the responses in the *ksekino* ('begin') group, 80% of the responses in the *arxizo* ('start') group, 90% of the responses for the *mexri ti mesi* ('halfway') group and 80% of the responses in the *miso* ('half') group.

Results from the control task suggest that children around the age of five can assign the correct truth-conditional content to both aspectual verbs such as 'start' and 'begin' and to degree modifiers such as 'half' and 'halfway'. Specifically, children can give a lower-bounded interpretation of these terms in environments in which the upper-bounding (scalar) implicatures typically associated with these expressions are canceled.

The findings from the control task enable us to reject lack of semantic knowledge of aspectual/degree expressions as a possible explanation of children's pragmatic failures with such expressions in the first experiment. Specifically, insensitivity to the scalar pragmatics of 'start'/'begin' cannot be attributed to poor grasp of the truth-conditional content of aspectual verbs. More importantly, perhaps, the fact that children are better at detecting the scalar inferences generated by 'half' than the SIs triggered by 'halfway' is probably not due to lack of knowledge of the semantics of the adverbial. I return to the issue of why children might generally fail with the SIs of degree/aspectual expressions but succeed with the scalar inferences of 'half' in the discussion below.

5. General Discussion

The experimental results reported here confirm and empirically extend previous experimental reports that scalar inferences are regularly computed, when appropriate, during adult language comprehension but are not consistently derived by otherwise linguistically savvy young children. Specifically, it was found that, even though 5-year-olds show some evidence of knowing the semantics of aspectual verbs such as 'start' and degree modifiers such as 'half', their ability to draw scalar inferences from these terms is fragile. Children's success with SIs generated from the use of aspectual/degree terms depends on the type of aspectual/degree expression: 'half' is a much better trigger of such inferences than, for instance, inchoative verbs. Children's performance also crucially differs depending on the type of test used to measure pragmatic

sophistication: as Experiment 2 showed, a more naturalistic dialogue-like setting leads to greater success than a pragmatic judgment task.

These results raise a number of methodological and theoretical issues in the area of semantic-pragmatic development. On the methodological side, the present studies illustrate how specific task demands may mask children's early pragmatic abilities (a point also emphasized by Papafragou and Musolino, 2003). One positive contribution of this work is to offer a naturalistic alternative to pragmatic judgment tasks which seems a fairer way to evaluate preschoolers' sensitivity to implicature (cf. Experiment 2). This method has recently been extended to test 5-year-olds' sensitivity to SIs in contexts which include context-dependent, or even purely ad hoc 'scales' (A: 'Did you read the book? - B: 'I read chapter 1.' -> B didn't read the whole book). It turns out that children of this age have no problem with these very idiosyncratic non-completion inferences (Papafragou and Tantalou, 2002).

More interestingly, perhaps, the present research shows that different, though semantically closely related, aspectual terms behave differently in terms of their semantic-pragmatic profile - the asymmetry of 'half' being the most intriguing example. Several reasons may be responsible for the special status of 'half' in our studies. First, unlike inchoative verbs ('start'/'begin'), 'half' is discrete, i.e. it denotes a precise boundary.[4] Furthermore, this boundary is cognitively salient, as shown by studies of proportional reasoning (Spinillo and Bryant, 1990). As a result, the evaluation of statements with 'half' may be easy for our young participants. By contrast, verbs of initiation are notoriously context-dependent and vague. Consider when it might be felicitous to say that the simple process of baking a cake has begun: when the recipe book is consulted? when all the ingredients are on the counter? when the packet of sugar has been torn open? when mixing has begun? The relative indeterminacy in the applicability of inchoative predicates may be responsible for the fact that children are more liberal than adults in mapping these predicates to circumstances in the world.

Some support for the role of discreteness comes from findings reported in Papafragou and Musolino (2003). According to these findings, 5-year-olds were more likely to reject an underinformative statement containing a cardinal such as *two* than a quantifier such as *some*, other things being equal. For instance, in a scenario where a group of three horses had jumped over a fence, children were more likely to reject the statement *Two of the horses jumped over the fence* than the sentence *Some of the horses jumped over the fence.* The number/quantifier asymmetry is explained by treating numbers as discrete and quantifiers such as *some* as vague.[5]

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4. Of course, this precise denotation can be (and frequently is) loosened in approximative uses. I can say *Half of the students in my class are women*, even if my class has 21 members.

5. The developmental data offer an additional piece of evidence for adopting an 'exact' semantics for numbers and the modifier 'half' (for independent

The vagueness/discreteness dichotomy may account for the difference between 'half' and inchoative verbs but cannot explain the asymmetry between 'half' and the other degree modifier in our study, 'halfway'. One possible reason for why 'half' and 'halfway' differ is frequency: 'half' is vastly more frequent than 'halfway' (for some English data, see Francis and Kučera, 1982). Furthermore, while 'half' modifies the direct object of the verb, 'halfway' modifies a measure provided by the direct object (cf. Tenny, 1994: 19) - a fact which may make it more costly for young learners.

I conclude by briefly considering the implications of these findings for properties of early conversational implicature. Conversational implicatures are assumed to be removable in context, hence CANCELABLE (cf. *I ate some of the cake - in fact, all of it*); they are also believed to survive across synonymous expressions which belong to the same grammatical class, hence to be NON-DETACHABLE (compare *I tried/attempted to kill my wife*). The present research has shown that both properties hold of conversational inferences in children's language processing. First, as our control test demonstrated, children treated 'half' and 'halfway' as being compatible with 'all' and 'completely' respectively in implicature-canceling environments. This offers evidence that children can contextually suspend a conversational inference which they can otherwise compute (cf. Experiment 2). Secondly, children were shown to treat 'start' and 'begin' equally with respect to their SI-generating potential, hence to observe non-detachability.[6] It follows that, even though the computation of conversational inference is still fragile in 5-year-old children, some fundamental properties of implicatures are the same for both adult and child comprehenders.

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arguments for cardinals see Carston, 1990; Horn, 1992; Koenig, 1993). For discussion, see Papafragou, 2002; in prep.

6. Things are less clear with respect to 'half' and 'halfway': even though no strict synonymy applies (and hence technically the non-detachability requirement may be relaxed), one could still expect the two terms to behave similarly.

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