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What Children Know When They Know About Viewpoint Aspect: Aspect and Theory of Mind

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There is a long history in psychology and linguistics of relating linguistic and cognitive development. In this paper, I will be considering the linguistic development of aspect and its relationship to cognitive development in the domain of theory of mind -- our ability to understand the desires, beliefs, and knowledge states of others. A tradition of linking language development to theory of mind ranges from Shatz et al.'s (1983) examination of children's early use of mental state verbs to more recent work by DeVilliers and Pyers (1996) looking at the relationship between children's competence with complementation structures and their performance on false belief tasks. In this paper, I argue for a link between a linguistic element -- viewpoint aspect -- and a theory of mind element -- intention. I report two experiments that examined normal children's comprehension of viewpoint aspect. The first experiment looked at their comprehension of the morpho-syntax of viewpoint aspect and the second looked at their comprehension of the concepts encoded by viewpoint aspect, as carried by open-class modifiers. I will argue that the tasks used in these experiments are structurally equivalent to a standard theory of mind task, the appearance-reality task. Finally, I will turn to a brief prospectus for studies currently being carried out in collaboration with Lila Gleitman and Kimberly Cassidy. Our studies are aimed at teasing apart the relative contributions of language and theory of mind in these tasks by looking at how special populations such as Specific Language Impaired children (and perhaps also autistic children) perform in them.

1. Aspect: Intention in Language

Aspect describes the temporal unfolding of events and covers two distinct (though related) phenomena. Situation aspect (following Smith 1991) is the term we will use for the relevant inherent properties of an event such as durativity and boundedness (telicity). The situation aspect of a predicate is determined by what the predicate means: "building a

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house" has a bounded and durative situation type because the action of house-building has a natural boundary (when the house is done) and house-building usually lasts in time. Viewpoint aspect (again following Smith 1991) is the term we will use for perspective information that is added onto a predicate. There are essentially only two perspectives that a speaker can take towards an event. She can view it from the outside, as a completed whole (the perfective viewpoint, conveyed by the simple past tense in English) or from the inside, as an ongoing concern (the imperfective viewpoint, conveyed by the progressive in English).

At this point you may wonder why this section labels aspect as an encoding of intention since intentions have not been brought up once in the definitions provided. However, intentions are presupposed in the calculation of aspect. Bounded predicates carry within them a goal: the natural boundary point. Knowing whether a predicate is bounded or not means knowing whether the action is an end in itself (as with "dancing") or whether there is a completion point being aimed for (as with "building a house")[1]. Moreover, viewpoint aspect requires calculating where a speaker is in relation to her goals. This can be seen most clearly in the so-called "imperfective paradox". Consider the sentences in (1) below and the continuation in (2).

(1a) Karl Wallenda were crossing the high-wire

(1b) Karl Wallenda crossed the high-wire

(2) ... but he fell off in the middle.

The predicate in (1) is bounded -- Karl Wallenda is intending to reach the other side of the high-wire. The only difference between the (a) and (b) sentences is that the (a) sentence is in the imperfective viewpoint and the (b) sentence is in the perfective viewpoint. But this difference translates into a difference in entailments: (1b) entails that Karl reached the other side and the continuation in (2) sounds contradictory but (1a) has no such entailment of completion and the continuation in (2) sounds quite natural. That is, the imperfective viewpoint permits the possibility that the goal has not yet been reached and thus allows for an intervention by another event (falling off, in this case). The perfective viewpoint indicates the goal has been fulfilled.

The speaker's choice of predicate (and thereby of situation aspect) and of viewpoint aspect commit her to a particular conceptualization of an event, including commitments about the agent's intentions. Imagine an event in which Mary is stacking up bricks. We might describe this event in the following ways:

(3) Mary was building a house

(4) Mary built a house

(5) Mary played with bricks

[1] Aspect isn't only about intentions: non-agentive actions (e.g., falling) are telic though their boundaries aren't part of any intentional process. Knowledge about physical and causal relationships contributes to aspectual knowledge just as intentions do.

Both the sentences in (3) and (5) could be true of that event, since stacking up bricks is both a reasonable way to play with them and a reasonable step of house-building. The difference between (3) and (5) depends on Mary's intentions: if stacking them is an end in itself then (5) is an adequate description but if she intends to get a house out of the process, then (3) is the right description. Notice that in either case, (4) is an incorrect description. Sentence (4) is in the perfective and that viewpoint indicates that any goal mentioned has been realized. Since Mary has no house, she has not done (4). In this way, we can see that aspect is in fact a subtle encoding of intentions.

We turn now to a set of experiments looking at young children's comprehension of lexical and viewpoint aspect. We will return to aspect's encoding of intentions and its relationship to theory of mind after we have come to some tentative conclusions about children's linguistic abilities with aspect.

2. Testing Children's Comprehension of Aspect

Examinations of young children's (approximately age 2;6 and younger) production data show an interesting distribution in the viewpoint aspect morphology. The imperfective viewpoint marker (the progressive -ing in English) appears almost exclusively on atelic verbs while the perfective viewpoint marker (past tense -ed in English) appears on telic verbs. Thus, children produce forms like "riding" and "dancing" (atelic + imperfective) and "made" and "found" (telic + perfective) but not "rode" or "danced" (atelic + perfective) nor "making" or "finding" (telic + imperfective). This distribution of viewpoint morphology (or a similar one involving tense morphology) according to situation type has been found in English (Bloom, Lifter and Hafitz 1980), French (Bronckart and Sinclair 1973), Italian (Antinucci and Miller 1976), Polish (Bloom and Harner 1989), and other languages as well (cf. Cziko 1989 for a review).

But what does this distribution mean? One interpretation of this phenomenon is that children are in fact using viewpoint aspect morphology as a marker of situation aspect: for these children, perfective morphology marks telicity and imperfective morphology in fact marks atelicity. This interpretation fits in well with a cognitive development story (cf. especially Bronckart and Sinclair 1973, Antinucci and Miller 1976) in which children pass through developmental stages: children initially use viewpoint aspect to mark telicity because they are in a stage where they can understand inherent event properties but have not yet cognitively mastered abilities such as perspective taking. However, there is reason to be skeptical of this interpretation. Viewpoint aspect is largely under speaker control. Since none of the forms that the children are saying are in themselves unadult-like (there is nothing wrong, or even unusual about forms like "riding" and "broke"), the distribution may simply reflect a rather biased set of choices on the part of the child. Moreover, Shirai and Anderson (1995) have argued that there is a similar distribution of forms in parental input, so perhaps the child's bias is well founded.

These experiments examine children's comprehension of viewpoint and situation aspect and asks if children show the same biases in understanding that they do in

production. Their aim was to see if children could distinguish viewpoint aspect from situation aspect. Both experiments make use of essentially the same task (described in section 2.1); they differ with respect to the kinds of cues used to convey the viewpoint aspect information: experiment 1 requires children to understand viewpoint aspect as it is conveyed through the morpho-syntax of English but experiment 2 only requires them to be able to map viewpoint aspect concepts onto open-class words.

2.1 The Imperfective Paradox Task

In order to disentangle knowledge of viewpoint aspect from knowledge of situation aspect we took advantage of the well known interactions between imperfective viewpoint and telic predicates: the imperfective paradox discussed above (cf., among others, Dowty 1979, Smith 1991). The experimental task was a sentence-to-scene matching task. The subject was presented with two versions of a telic event, one completed and one incomplete. Two characters (stuffed animals) then each provided a sentence and both characters had to be matched to the correct event version based on what was said. For example, in one condition, the child would be presented with a toy school-house and two toy cars -- one located about a foot from the school and the other abutting the school-house. The telic predicate in this case would be *roll the car to school.* One character would say the imperfective version of the sentence: "I was rolling my car to school" and the other character would say the perfective version: "I rolled my car to school". The perfective sentence must be matched with the complete version of the event (the car at school) but, given the imperfective paradox, the imperfective sentence may felicitously be matched with the incomplete event. Thus, the only way to satisfy the task demands that each character has his own event (or car, in this case) was to match the imperfective sentence to the incomplete event and the perfective sentence to the complete event. On all trials, the child had to match both sentences (i.e., place each character in turn by his car) though the order of the matching (perfective or imperfective) was counterbalanced and only the first match was counted as the response. Four telic events were used in these experiments: *drawing a circle, filling in a puzzle, emptying out a cup, and rolling a car to school.*

2.2 Experiment 1: Comprehension of the Morpho-Syntax of Viewpoint Aspect

This experiment tested children's abilities to distinguish viewpoint aspect from situation aspect. Two groups of children were tested. Twenty-nine children were tested from area Philadelphia daycares. The younger group (N = 11, mean age = 2;6) was of an age comparable to the children who showed the distributional phenomenon in their production. The older group (N = 11, mean age = 3;7) was older than most of the children who showed the production phenomenon. The task used was the imperfective paradox task, just as it is described in section 3. Not all children were able to engage all four events but every child whose data is counted here did complete at least two, counterbalanced trials (the data from seven children had to be discarded for failure to meet this condition).

The results of this experiment showed a strong age difference. The older children had a mean percent correct of 0.80 which was significantly better than chance ($t=3.96$, $p<.003$). The younger children, on the other hand, had a mean percent correct of 0.59, which was not statistically different from chance ($t=0.8$, ns). We also checked to see if the children performed differently on the perfective as compared to the imperfective sentences. All the sentences have a telic situation type, and in the production data, telic verbs appear (almost) always with perfective marking. Thus, it may be that the younger children's chance score is the result of perfect performance on the perfective sentences and very poor performance on the imperfective sentences. This however, was not the case. The mean percent correct (for the younger children) of the perfective sentences was 0.59 and the mean correct for the imperfective sentences was also 0.59. The difference between these two means is not significantly different. Comparing the older and younger groups to each other, despite the fact that the older group is above chance and the younger group is not, the difference between the two groups does not quite reach statistical significance ($t=1.56$, $p < .10$).

To summarize, experiment one showed that relatively older children have an adequate command of the difference between viewpoint and situation aspect, as demonstrated through their success in the imperfective paradox task, but relatively younger children do not. However, younger children do not apparently show the same bias in their comprehension of viewpoint aspect that they do in their production of it: they did not perform any better on the sentences similar to what they produce (telic + perfective) than on the sentences they do not produce (telic + imperfective).
What is the source of the younger children's difficulty? On the cognitive development story, their difficulty arises from the conceptual difficulty of viewpoint aspect. But there is another alternative. These children may understand the concepts of underlying viewpoint aspect but not yet know how their target language encodes them morpho-syntactically. Experiment two takes up the question of whether the problem is basically conceptual or has to do with a linguistic mapping problem.

2.3 Experiment 2: Comprehension of Viewpoint Aspect Concepts

The aim of this experiment was to see if younger children could understand the concepts that underlie viewpoint aspect. To get at children's conceptual knowledge, as distinct from their knowledge of morphological encoding, we used open-class items which meant approximately what viewpoint aspect morphology means. Open-class items differ from closed-class items in a variety of ways (cf. Gleitman and Wanner 1980, for some discussion); most notable for the current purposes, the two appear to be learned differently. It is not impossible that a child might know how to express a concept through the open-class domain before she has mastered the closed-class representation. A complete semantics of viewpoint aspect was beyond the scope of this study, so we used open-class items that corresponded to the semantic contribution of viewpoint aspect in the imperfective paradox. Thus, the imperfective viewpoint was cued by open-class items such as "in the middle of" and "part of the way" while the perfective viewpoint was cued by closed-class items such as "all done" and "finished". These items identify the basic entailment relations necessary to solve the imperfective paradox task.

Since the older children had succeeded in experiment one (at what was presumably a harder task), only younger children were tested in this experiment. Fifteen subjects were tested from Philadelphia area daycares; four were removed for failure to meet the counterbalancing criteria discussed in section 4. The mean age of the remaining subjects was 2;7 (N=11). The task used in this experiment differed slightly from the previous experiment. The stimuli and procedure of the task were the same, but now, the sentences all contained open-class cues. Thus the imperfective version of *roll the car to school* was now: "I was in the middle of rolling my car to school" and the perfective version was: "I'm all done rolling my car to school."

Children's performance on the task given open-class cues was better than it had been in experiment one, without such cues. The mean percent correct on the revised task was 0.70 which is significantly better than chance ($t = 2.42$, $p < .03$). There was no significant difference between performance on imperfective items and perfective items ($t = 0.31$, ns). Thus the results from this experiment showed that these subjects were capable of both the mechanics and concepts involved in this task, at least when they were given open-class cues to help them. There were unexpected, but strong differences of performance depending on the particular event being tested: *roll the car to school* had mean score of 0.9, *fill in a puzzle* had a score of 0.75, *empty a cup* had a score of 0.62, and for *draw a circle* it dropped to 0.36. The implications of these item differences will not be discussed furthe
r in this paper.

2.4 Discussion of Experimental Results

Taken together, the results from these two experiments show that we can separate young children's ability to use viewpoint aspect morphology from their ability to understand the viewpoint aspect concepts more generally. Although young children (mean age 2;6) were unable to succeed at the imperfective paradox task given only closed-class morphological cues to work with (experiment one), comparable children (mean age 2;7) could succeed given open-class cues as an aid (experiment two). Somewhat older children (mean age 3;7) could succeed at the task using only closed-class cues (experiment one).

How can we use these results to bear on the phenomenon that in their production, young children's distribution of viewpoint aspect morphology is consistent with them using it to mark telicity. The results from experiment two argue strongly that if in fact these children are using viewpoint aspect to mark telicity, it is not because the concepts of viewpoint aspect are beyond their grasp -- they understand notions of completion and lack of completion quite well when those are presented through open-class words. Moreover, even where the children did not succeed at the task, they did not demonstrate the same bias in comprehension that they did in production (experiment one). That is, although the production data shows children restricting perfective marking to telic verbs, in this study, children did not succeed at a higher rate on this combination as compared to telic verbs with imperfective marking. It appears, therefore, that even young children understand the basic semantics of viewpoint aspect, but more work must be done to

establish the nature of their difficulty mapping the semantics to the morpho-syntax of their target language.

3. Relating Aspect to Theory of Mind

Theory of mind refers to our abilities to represent and understand the contents of our own minds and the minds of others. There are obviously many components to a theory of mind; we must understand about intentions, desires, beliefs, opacity of beliefs, how beliefs lead to actions, etc. Intention is usually considered one of the lower level pieces of theory of mind (Baron-Cohen 1995), partially because non-human primates seem capable of some understanding of intentions and partially because other components of theory of mind make reference to intentions (e.g., tasks assessing false belief usually rely on the fact that people intend to look where they believe something is).

As discussed in section 1, aspect is a linguistic marker of intention and the fact that children as young as 2;6 have some success with aspect suggests that they have command of the concept of intention. There is, moreover, a wealth of experimental data that supports children's very early comprehension of intention (e.g. Baldwin 1991 showed children able to use eye gaze as a cue to their mother's intentions in a naming task; cf Baron-Cohen 1995 for a review of evidence from a variety of sources). To this extent at least, therefore, we can say that aspect is an encoding of our theory of mind.

If we consider the task used in the experiments reported above, moreover, we can see another link to theory of mind. Consider what the imperfective paradox task is asking of the child: given two instances of an event, one which manifests the intention of the target predicate and the other of which does not, can the child distinguish between them based on linguistic cues. The perfective sentence can be matched in a "what you see is what you get" manner: the completion point, or the goal of the intention, is fully portrayed by the event. To match the imperfective sentence, however, the child needs to look past appearances and match this sentence to the event which does not fully portray the goal but instead portrays something like the intention to complete the event. This task is therefore parallel in structure to the appearance-reality task commonly used in the theory of mind literature. In that task (cf Flavell 1986, Gopnik and Astington 1988), a child is shown, for example, a sponge that looks like a rock. The child's task is to distinguish appearance from reality and answer questions such as: what does it look like? and what is it really? The appearance question (what does it look like) can be answered in a "what you see is what you get" manner since what you see is all the information called for. To answer the reality question (what is it really), however, the child must consider information beyond what she sees and use some additional representation of the object.

Children are not generally able to pass the appearance-reality task until around the age of 4;0. Given the parallelism between the appearance-reality task and the imperfective paradox task used in the experiments reported here, it is somewhat surprising that children as young as 2;6 could solve the imperfective paradox task. There are of course several differences between the tasks -- for example, the appearance-reality task requires the child to conceive of something as two things at once while the

imperfective paradox task requires the child to compute a projected future completion -- and these differences may account for the ease with which children solve the aspect task relative to the appearance-reality task. But the similarity of the tasks combined with the difference in performance has led us to consider the question of the relationship between language competence and theory of mind competence. Does theory of mind competence necessarily follow linguistic competence in a domain? To what extent can a child use linguistic markers of theory of mind concepts without having a complete command of those concepts?

4. Teasing Apart the Problem: A Prospectus for Working With Special Populations

In this final section, I am going to outline an approach to answering these sorts of questions using special populations of children: those with Specific Language Impairment (SLI) and those with autism. This work is being done in collaboration with Lila Gleitman (of the University of Pennsylvania) and Kimberly Cassidy (of Bryn Mawr College). We have only just begun this project[2] so I will not present results but will simply lay out the logic of the approach.

What we are interested in is the relationship between language development and development of theory of mind. What we have in the SLI and autistic populations is an effective double-disassociation of these abilities. SLI is a disorder that selectively affects a person's ability to use grammatical components of language; SLI patients are most notable for their failure to use (or at best, unreliable use) of closed-class elements such as plural, person, tense and aspect markers (Leonard, 1995). This language deficiency is combined with apparently normal performance on non-linguistic cognitive tasks. By contrast, autism is a disorder that (among other things) disrupts the theory of mind (Leslie, 1992; Baron-Cohen, 1995). Autistic children are late in passing false-belief tasks and some low-functioning autistic patients never pass them. However, autistic children apparently have no difficulties with the formal aspects of language (although their communicative capacities are sometimes diminished). Painting the two disorders as starkly as possible, SLI children have a linguistic but not theory of mind deficit while autistic children have a theory of mind but not linguistic deficit . This pattern of capabilities and lack thereof is shown in table 1.

	Theory of Mind	Language
Normals	+	+
SLI	+	--
Autistic	--	+

table 1

We have devised a set of tasks which vary in the amounts of linguistic and theory of mind competence necessary t o pass them. For example, the imperfective paradox

[2] Currently, we have access to normal and SLI populations. Working with autistic children will come further in the future.

aspect task used in experiment one requires, along the theory of mind dimension, a knowledge of intentions, and along the linguistic dimension, a knowledge of the semantics of the closed-class elements *-ing* and *-ed*. We can make this task easier from a linguistic perspective as we did in experiment two -- by using open-class cues to encode the relevant semantic information. We can make the task easier from a theory of mind perspective by using non-agentive events. Intentions are linked to agents, but if the event is a physical action such as falling or breaking, then boundedness is maintained but the intentional element is lost. Similar manipulations can be created for other examples as well (DeVillers and Pyers (1996) comparison of sentence complementation competence and success on false belief tasks in normal children is one case we are hoping to extend).

If the picture in table 1 is correct, then we expect SLI children to pattern with normal children along the theory of mind dimension and autistic children to pattern with normals along the linguistic dimension. That is, SLI children will show a difference in performance depending on the difficulty of the linguistic nature of the task (open vs. closed cues) regardless of the difficulty of the theory of mind dimension (agentive vs. non-agentive events); Autistic children will show the opposite pattern, behaving consistently across the linguistic conditions but showing performance differences depending on the theory of mind condition. However, if language development is one of the determinants of theory of mind development, then we expect both SLI and autistic children to behave substantially the same, both equally different from the normal children. In this way, the special populations can tease apart for us the relative contributions of language and theory of mind in these tasks.

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