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Aspectual influences on early tense comprehension*

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ABSTRACT

This study investigated the ASPECT FIRST HYPOTHESIS which claims that children initially use verbal morphology to mark aspect and not tense. Experiment 1 tested 46 two- and three-year-old children's comprehension of tense as it is marked in the auxiliary system using a sentence-to-scene matching task. Children were presented with multiple performances of the same event and asked where a character *is V'ing*, *was V'ing* and *is gonna V*. Results showed that even the two-year-old children could successfully understand tense in this experiment. Experiment 2 changed the information available in the scenes by varying whether or not the past-time event reached its completion point. Thirty-six two-, three- and four-year-old children participated. The results showed that the two-year-olds could only successfully understand past and present auxiliaries when past-time information in the scenes was co-extensive with completion information in the scenes. This result suggests that these children may be making a grammatical aspect (perfective/imperfective) judgment and not a tense (past/present) judgment, or at least, that grammatical aspect influences tense interpretation for these children.

INTRODUCTION

Our intuitive notion of what information temporal expressions should encode corresponds pretty well to what the linguistic category of tense actually does encode, namely, WHEN something happened. Locating an event in time is an important thing to do, and in fact, tense morphology is among

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the earliest morphology productively used by English speaking children (Brown, 1973, DeVilliers & DeVilliers, 1973). This intuitive notion, however, is incomplete with respect to temporal location. Events, which are the primary things we locate on the time-line, are not instantaneous elements but instead take up intervals of time. Temporal location, therefore, also requires knowing HOW in time an event happened – was it continuous through an interval? did it progress towards a completion point? did it reach its completion? This second kind of information is systematically encoded by languages through the category of ASPECT. Analyses of children's early usage of verbal morphology have suggested that children may initially use it to mark aspectual distinctions where the adult language often marks tense. The crux of this claim, which I shall call the Aspect First Hypothesis, is that the temporal information that talks about HOW an event uses a time interval is linguistically encoded prior to temporal information that is strictly about WHEN an event happens. The aim of the current study is to assess the Aspect First Hypothesis using comprehension experiments that look at children's comprehension of verbal morphology, focusing first on children's knowledge of the temporal ordering function of tense and then on their knowledge of the contrast between tense and aspect semantics.

The Aspect First Hypothesis

Any discussion of the aspectual meanings associated with verbal morphology must begin by defining two types of aspect: lexical aspect and grammatical aspect. The primary distinction within the linguistic category of LEXICAL ASPECT is between predicates describing bounded and non-bounded events (i.e. telic and atelic predicates, from the Greek word *telos* meaning 'end'). Lexical aspect is conveyed through the meaning of the verb (and predicate)[1] itself: predicates such as *break a toy* or *make a sandwich* specify the temporal end-point of the events they describe (when the toy is in pieces and the sandwich ready to eat) and are therefore TELIC; events such as riding and playing may last indefinitely and end at any arbitrary point in time, and the verbs describing these events (i.e. *riding* and *playing*) are therefore ATELIC.

GRAMMATICAL ASPECT, like lexical aspect, conveys information about an event's completeness, but it does so by taking a perspective on the event. The PERFECTIVE perspective (from the Latin word *perfectus*, meaning 'complete')

[1] Lexical aspect must be computed over an entire predicate, as the nature of the verb's object and the presence of certain prepositional phrases can dramatically affect aspectual interpretations. For example, *Mary ran around* is atelic while *Mary ran a mile/to the store* are both telic. In the child data under consideration, entire predicates are rarely present (many of the subjects studied were still in the one- and two-word stages), so I will be referring to aspectual classifications based on the verb alone. Such classifications are obviously incomplete; they therefore further motivate the need for controlled comprehension studies.

sees an event from the outside, as a completed whole, while the IMPERFECTIVE perspective sees an event from the inside and potentially incomplete. The imperfective aspect is marked via the progressive construction in English (simple tenses receive perfective interpretations by contrast, cf. Smith, 1991). Grammatical aspect is independent of lexical aspect: telic predicates may appear in either perfective or imperfective aspect (1) as can atelic predicates (2).

(1) The Wallendas crossed/were crossing the high-wire.
(2) The clown laughed/was laughing.

The primary source of evidence for the Aspect First Hypothesis comes from close inspection of the distribution of children's production of verbal morphology. Examinations of the utterances of children under the age of approximately 2;6 has found that past tense morphology (and in some languages, perfective morphology) is generally restricted to verbs describing naturally bounded events, while present tense morphology (and in some languages, imperfective morphology) is restricted to verbs describing events without any inherent end-point.

Thus, in children's early production data for English, we find children saying things like *broke* and *made* (telic and past) and things like *playing* and *riding* (atelic and imperfective) while forms which combine an atelic verb with past marking or a telic verb with imperfective marking (e.g. *breaking*, *played*) are extremely rare. This distribution of verbal morphology according to lexical aspectual type of the verb has been documented in a variety of languages, including English (Bloom, Lifter & Hafitz, 1980, Shirai & Anderson, 1995, Olsen & Weinberg, 1999), Italian (Antinucci & Miller, 1976), French (Bronckart & Sinclair 1973), Polish (Weist, Wysocka, Witkowska-Stadnik, Buczowska & Konieczna, 1984, Bloom & Harner, 1989), Turkish (Aksu-Koç, 1988), Japanese (Rispoli, 1981), German (Behrens, 1993), Portuguese (DeLemos, 1981), Mandarin (Li, 1990) and Hebrew (Berman, 1983).

One very strong way to conceive of the Aspect First Hypothesis is that verbal morphology initially marks lexical aspect for these children (i.e. the *-ed* suffix means 'this is a telic predicate' and the *-ing* suffix means 'this is an atelic predicate'). This conception is in line with a localist view of language acquisition (e.g. Tomasello, 1992, Li & Bowerman, 1998) which holds that children's initial understanding of syntax and morphology operates on a verb by verb basis. The meaning of verbal morphemes are therefore expected to be highly particularized to the verbs they are attached to.

An alternative conception contends that children are using the verbal morphology to encode grammatical aspect. There are, in fact, many reasons to expect children to be confused about whether to map tense or grammatical aspect onto their verbal morphology. In the first place, sometimes

grammatical aspect is precisely what the morphology does encode, as with the English progressive *-ing* which marks imperfective grammatical aspect. Moreover, many languages conflate tense and grammatical aspect information into a single morpheme. For example, the simple past tense form in English conveys both past tense and perfective aspect, while the French imparfait conveys both past tense and imperfective aspect. Indeed, for some of the languages investigated for the Aspect First Hypothesis, (including English, French, Italian, Japanese, and Portuguese) it is impossible to say whether the right characterization of the morphology used in the distributional pattern is tense or grammatical aspect.[2] Similarly, Smith (1980) found that younger children tend to align present tense with imperfective marking even when the language does not require it. Thus, in the speech of children under three years old, past progressive forms (*was V'ing*) are quite rare, particularly in comparison to the speech of older children.[3] Lastly, some languages opt to grammaticize only one of tense and grammatical aspect (e.g. Mandarin marks only grammatical aspect and Modern Hebrew marks only tense), trusting in the dependency between the two categories (along with some pragmatic implications) to convey the remaining information. Thus, there is no *a priori* way for a child to know whether they should be focusing on tense or grammatical aspect.

Despite the fact that encoding grammatical aspect in the verbal morphology is often correct, the Aspect First Hypothesis makes the stronger claim that grammatical aspect is being marked at the expense of tense in the early stages. The argument in favour of this idea that children are initially ignoring tense information rests on the fact that the morphology is distributed according to lexical aspectual type of the verb. There are languages (e.g. Mandarin, cf. Smith, 1991, Li & Bowerman, 1998) which do restrict at least some perfective markers to telic predicates and some imperfective markers to atelic predicates. Olsen & Weinberg (1999) have argued, therefore, that children's optimal learning strategy (cf. the subset principle, Wexler & Manzini, 1987) is to begin by adopting the most restrictive rule (i.e. restrict grammatical aspect by lexical aspect type) and to break the rule (to allow grammatical aspect and lexical aspect to interact independently) only after finding positive evidence that this is allowed in their target language. In their

[2] In the one language studied in which it is in principle possible to determine which morphology is being used (i.e. Polish, which marks each category through distinct morphology), it turns out that children distribute BOTH grammatical aspect and tense morphology according to lexical aspect (past and perfective marking both align with telic verbs and present and imperfective marking both align with atelic verbs).

[3] It should be noted, however, that this is not the point Smith (1980) is trying to make. She believes that the presence of any past progressive forms in the younger children's data is important. Nevertheless, her reported data do show a strong effect of age such that the use of past progressive forms increases dramatically with age.

investigations of children's acquisition of aspect morphology in Mandarin, Li & Bowerman (1998), moreover, have shown that children are very sensitive to that language's restricted use of grammatical aspect; when the children do err, they are even more restrictive than adults are in the application of grammatical aspect morphology with respect to the lexical aspect of the predicate.

Nevertheless, in order for this learning story to make sense, it must be the case that children are oblivious to tense information when it is in fact present in the verbal morphology. There are, after all, no languages that restrict tense marking according to lexical aspectual class. The real force of the Aspect First Hypothesis, therefore, is its claim that tense information is NOT being coded by children's early verbal morphology.

Comprehension studies

The basis for the Aspect First Hypothesis comes from children's early production data. To truly determine what children are marking morphologically, however, we must turn to a more controlled source of information: comprehension studies. Previous investigations of children's comprehension of tense semantics have been conducted most thoroughly by Richard Weist and his colleagues (Weist, 1991, Weist, Lyytinen, Wysocka & Atanassova, 1997. Weist, Atanassova, Wysocka & Pawlak, 1999). Weist used a forced-choice comprehension task in which children chose which of two pictures was being described on the basis of the tense of the sentence used to describe it. For example, a child might have been shown a picture of a boy about to throw a snowball and a picture of someone getting hit by a snowball. The child's task was to match these two pictures to the following sentences: *The boy will throw the snowball* and *The boy threw the snowball*. Weist and colleagues found that children acquiring English performed better than chance on this task by the age of 2;6. His results appear to show that even children who are only slightly older than those showing the distributional phenomenon discussed above have nevertheless mastered the ordering function of tense. These results therefore argue against the Aspect First Hypothesis: if children understand the tense semantics associated with tense morphology, then they have clearly NOT mis-assigned aspectual information to that morphology.

One difficulty in evaluating Weist's results is that his tense comparisons always involved the future tense. That is, children were always being asked to choose based on either a future/present contrast or a future/past contrast. The future tense is, of course, more than just a temporal marker, as it has modal properties as well. The children in his task could be successful if they could make a realis/irrealis distinction (i.e. roughly, a non-future/future distinction), even if they did not understand the tense ordering relationship *per se*. Moreover, the tenses which participate in the distributional

phenomenon are the present and the past, but none of Weist's experiments directly contrasted these two. Thus, it remains an open question whether children use past and present morphology to mark past and present semantics, or to mark some aspectual distinction, such as perfective and imperfective meaning.

The current studies were designed to find out what impact aspectual information might have, if any, on tense interpretation. Following Weist's lead, the experiments test for children's knowledge of the adult state, namely, that tense morphology, as carried by the auxiliary *be* (*is* vs. *was*), codes tense information. Experiment 1 provides a more rigorous test of tense knowledge than those previously used. By contrasting past, present and future information in the same scene, it insures that children's success cannot rest solely on the ability to make a realis/irrealis contrast but must also include an ability to differentiate past from present. Experiment 2 focuses on the role that grammatical aspect may be playing in tense interpretation. It tests whether children can understand tense independently of grammatical aspect; in particular, it asks if children can comprehend the past tense equally when it is applied to events that are completed and to events that are incomplete.

EXPERIMENT 1

This experiment tested children's comprehension of the past, present and future tenses as they are marked in the auxiliary system (*was/is* for the past and present; *gonna* for the future). Subjects watched a toy kitty walk down a road performing an event three times in three separate locations, corresponding to the past, the present, and the future, and were asked to match a sentence in one of the three tenses to the correct performance. As in the experiments conducted by Weist and colleagues, all the past and present test sentences here used the progressive form (be + V-*ing*). The reason for this was to insure that the only linguistic manipulation concerned tense (carried by the auxiliary in the progressive construction); a present progressive contrasted with a simple past form would confound tense and grammatical aspect information, and continue to leave open the question of whether children were truly using tense information in the task.

This task improves upon the one previously used by Weist and colleagues in several ways. First, it tests all three tenses (past, present, and future) in the same experiment. Success on this task, therefore, cannot be driven solely by an ability to make a realis/irrealis distinction, as such a distinction will not distinguish properly between the past and present tenses. Second, it tests children on both telic and atelic events. The purpose of including this variety of events (aside from wanting to show the generality of children's tense interpretation) was to provide an opportunity to find evidence favouring the localist hypothesis that children may be using their verbal morphology to

mark the telic/atelic distinction of lexical aspect. Recall that the *-ing* suffix is initially restricted to atelic predicates, and that all of the past and present sentences in this experiment are in the progressive form (be + V-*ing*). If indeed the *-ing* suffix is lexically restricted, we may see an overall advantage for the atelic predicates, as they would be used in a grammatical sentence while the telic predicates (also used in the progressive form) may not be in a grammatical sentence for the youngest age group. Third, it presents the subjects with actual, acted-out events instead of static pictures representing the events. The depictions, therefore, are much closer to the way children actually experience events in time. Last, the experiment also has a conceptual control condition in which the subjects are asked to perform the experimental task with the aid of extra adverbial cues. These adverbial cues conveyed the same information as the auxiliaries, but in a more salient linguistic form that the children were expected to find easier to understand. The purpose of this control is to provide the children with a sure opportunity to succeed, and thereby check the validity of the task in general.

Subjects

Subjects were drawn from Philadelphia area daycare centres. Two groups of children were tested: a two-year-old group (N = 25, mean age = 2;9, range = 1;11 to 3;2) and a three-year-old group (N = 21, mean age = 3;10, range = 3;3 to 4;6). All subjects were required to pass a pre-test in which they demonstrated knowledge of how a road works (by driving a car down a sample road) and a willingness to point. An additional 12 subjects were tested but not counted in the analysis because they either failed to pass the pre-test or failed to complete at least half of the trials.

Stimuli and procedures

Children were presented with an illustration of a road drawn on a piece of paper and were introduced to a toy kitty who liked to do things on the road. The kitty performed the same test event three times along the road, at the beginning, middle and end of the road. As the kitty went down the road from event to event, it left a trail of inky footsteps (thanks to a rubber stamp attached to its bottom) which allowed the child to trace the path of the kitty, and provided a constant cue to the temporal ordering of the events. Before a trial began, appropriate toys were placed at each location on the road; as the drawing and hopping events used no particular toys, each location was pre-marked with an 'X'. While the kitty was in the midst of performing the test event for the second time, the child was asked about the event in either the past, present, or future tense. The test query was in one of the following forms: *Show me where the kitty was V'ing* (past), *Show me where the kitty is V'ing* (present), or *Show me where the kitty is gonna V* (future). During the control trials, these queries were augmented with appropriate adverbials,

such as *right now* (present), *before/already* (past) and *in a second/next* (future). The experiment had a total of 12 distinct conditions: 3 tenses (past, present, future) applied to 2 lexical aspect types (telic, atelic), and 2 linguistic versions (with and without adverbial cues). Subjects received one trial for each condition, administered over two six-trial blocks. The full set of events and queries used in the experiment can be found in Table 1.

TABLE 1. *Stimuli used for Experiment 1 : events and queries in present, past and future forms*

Events	Test queries 'Show me where the kitty …'	Control queries 'Show me where the kitty …'
TELIC		
Kitty fills in a puzzle by inserting pieces into appropriate slots	is filling in a puzzle was filling in a puzzle is gonna fill in a puzzle	is filling in a puzzle right now was filling in a puzzle before/already is gonna fill in a puzzle in a second/next
Kitty empties blocks out of a cup	is emptying out a cup was emptying out a cup is gonna empty out a cup	is emptying out a cup right now was emptying out a cup before/already is gonna empty out a cup in a second/next
Kitty draws a face at pre-marked locations	is drawing a face was drawing a face is gonna draw a face	is drawing a face right now was drawing a face before/already is gonna draw a face in a second/next
ATELIC		
Kitty plays with a different toy animal in each location	is playing with a friend was playing with a friend is gonna play with a friend	is playing with a friend right now was playing with a friend before/already is gonna play with a friend in a second/next
Kitty hops around at pre-marked locations, leaving several inky footprints	is hopping around was hopping around is gonna hop around	is hopping around right now was hopping around before/already is gonna hop around in a second/next
Kitty rests on a toy chair, couch and rug	is resting was resting is gonna rest	is resting right now was resting before/already is gonna rest in a second/next

The timing of the test query (always given during the midst of the second event version) is crucial because it permits a logical connection between the tense values and the locations on the road. The past tense corresponds to the location where the kitty first performed the event, the present tense corresponds to the location with the ongoing action, and the future tense corresponds to the location on the road the kitty has not yet gotten to. Given the pragmatics of this task and the timing of the query, there is therefore one right location to choose for each of the tenses. However, in principle, the second (ongoing) location is a potential correct answer for all three queries. As the query is always offered after the second version has already begun, the second event can be referred to with the past tense (particularly as the past query is in the progressive aspect which does not entail the completion of the event). Moreover, as the query is also offered before the second version has

TABLE 2. *Mean proportion correct, Experiment 1*

	With adverbial cues			Verbal morphology only		
	Past	Present	Future	Past	Present	Future
Two-year-olds	0·62***	0·59***	0·63***	0·48*	0·57**	0·43 n.s.
Three-year-olds	0·82***	0·95***	0·76***	0·71***	0·88***	0·53*

*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$ compared to chance = 0·33.

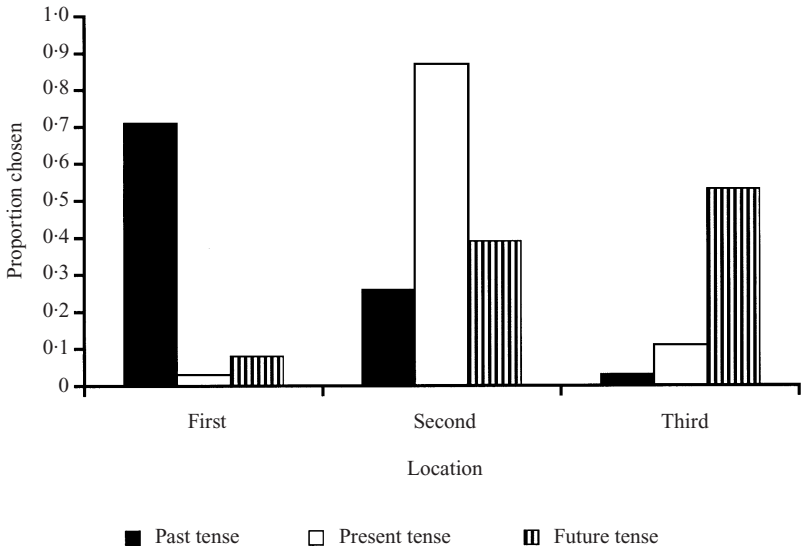

Fig. 1. Experiment 1. Proportion of times a location was chosen for each query type. Three-year-olds, test sentences.

completed/ended, and the event will continue for at least a few seconds into the future, the second event can also be referred to with the future tense as well. Despite these potential semantic pitfalls, the child's response was scored as correct only if she chose the first location for the past tense query, the second location for the present tense query, and the remaining location for the future tense query.

Results

Table 2 shows the mean proportion correct for the queries in each of the three tenses (past, present and future) for the test sentences and the control sentences containing adverbials. Subjects could respond in one of three ways, so chance performance was set at 0·33. A mixed design ANOVA over the test sentences (the between-subjects factor was age group; tense and lexical

aspect were within-subjects factors) found main effects for age group (the three-year-olds did better than the two-year-olds, $F(1, 36) = 10{\cdot}72, p < 0{\cdot}01$) and tense ($F(2, 35) = 5{\cdot}78, p < 0{\cdot}01$). There was no main effect for lexical aspect type, and there were no significant interactions.

Further analysis of the main effect of tense showed that it was driven by the fact that children's performance given present tense queries was significantly better than given future tense queries ($t(44) = 2{\cdot}0, p < 0{\cdot}05$). However, the data in this form does not take into consideration probable differences in base-line rates for choosing different locations. The second location (the correct answer for the present tense query) is more salient than the other two locations (it is where the kitty is located at the time of the queries) and, as we have seen, there are also semantic reasons to expect children to choose the second location. These extra factors may artificially inflate our perception of children's knowledge of the present tense at the expense of other tenses. To adjust for potential differences in each location's base-line rate, we must examine how often each location was chosen given each tense type. This information is graphed for the three-year old group (test sentences only) in Figure 1, and for the two-year old group in Figures 2 (control adverbial sentences) and 3 (test sentences).

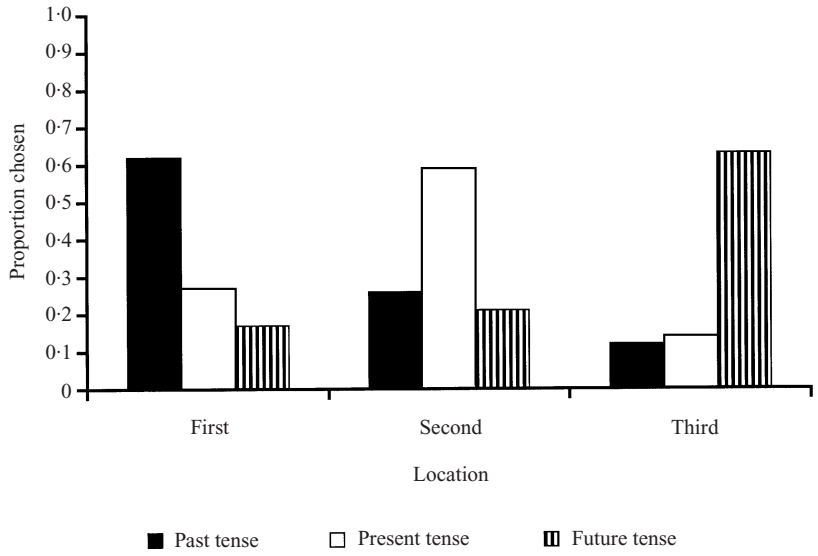

Fig. 2. Experiment 1. Proportion of times a location was chosen for each query type. Two-year-olds, adverbial control sentences.

Figures 1 and 2, showing the three-year-old data for the test sentences and the two-year-old data for the control sentences, demonstrate a clear pattern

of knowledge. All three tenses are differentiated: the first location, at the road's beginning, is chosen most often given a past tense query, the second location was chosen most often given a present tense query and the third location was chosen most often given a future tense query. The peaks in the graphs are striking and they correspond to the right answers. We can verify this interpretation statistically by computing a pair of difference scores for each location which compare how often the location was chosen given the matching test query compared to the other two queries. Failure to find a significant difference score would indicate that the tense of the query had no effect on location choice. For the three-year-olds' performance with the test sentences (their performance with the adverbial controls is even better), the difference scores confirm that the first location is indeed chosen significantly more often given a past tense query than a present tense query (t (20) = 8·5, $p < 0{\cdot}0001$) or a future tense query (t (20) = 7·0, $p < 0{\cdot}0001$); the second location is chosen significantly more often given a present tense query than a past tense query (t (20) = 5·9, $p < 0{\cdot}0001$) or a future tense query (t (20) = 6·4, $p < 0{\cdot}0001$); and the third location is chosen significantly more often given a future tense query than a past tense query (t (20) = 6·5, $p < 0{\cdot}0001$) or a present tense query (t (20) = 5·9, $p < 0{\cdot}0001$). To correct for a possible type I error due to the application of several t-tests on the same data, the conservative Bonferroni correction was computed on the significance values; these results were all significant at a Bonferroni p-value of 0·01.

Similarly, an analysis of these difference scores for the two-year-olds' control data also reveals that the first location is chosen marginally more often given a past tense query than a present tense query (t (24) = 2·8, $p < 0{\cdot}02$, Bonferroni $p < 0{\cdot}12$) and significantly more than a future tense query (t (24) = 3·5, $p < 0{\cdot}002$, Bonferroni $p < 0{\cdot}05$); the second location is chosen marginally more often given a present tense query than a past tense query (t (24) = 2·3, $p < 0{\cdot}03$, Bonferroni $p < 0{\cdot}18$) and significantly more than a future tense query (t (24) = 3·8, $p < 0{\cdot}001$, Bonferroni $p < 0{\cdot}05$); and the third location is chosen significantly more often given a future tense query than a past tense query (t (24) = 5·22, $p < 0{\cdot}0001$ Bonferroni $p < 0{\cdot}01$) or a present tense query (t (24) = 5·17, $p < 0{\cdot}0001$, Bonferroni $p < 0{\cdot}01$).

As can be seen in Figure 3, a less clear-cut picture emerges for the two-year-olds with the test sentences, but it is one which nevertheless suggests that these children do understand tense. The results with the third location shows the familiar pattern of knowledge: this location was chosen significantly more often given a future tense query than a past tense query (t (23) = 3·8, $p < 0{\cdot}001$, Bonferroni $p < 0{\cdot}01$) or a present tense query (t (24) = 5·2, $p < 0{\cdot}0001$, Bonferroni $p < 0{\cdot}01$). The second location was chosen marginally more given a present tense than a past tense query (t (24) = 2·46, $p < 0{\cdot}02$, Bonferroni $p < 0{\cdot}12$) but not significantly more often with the present tense than with the future tense (t (24) = 1·6, n.s.). This

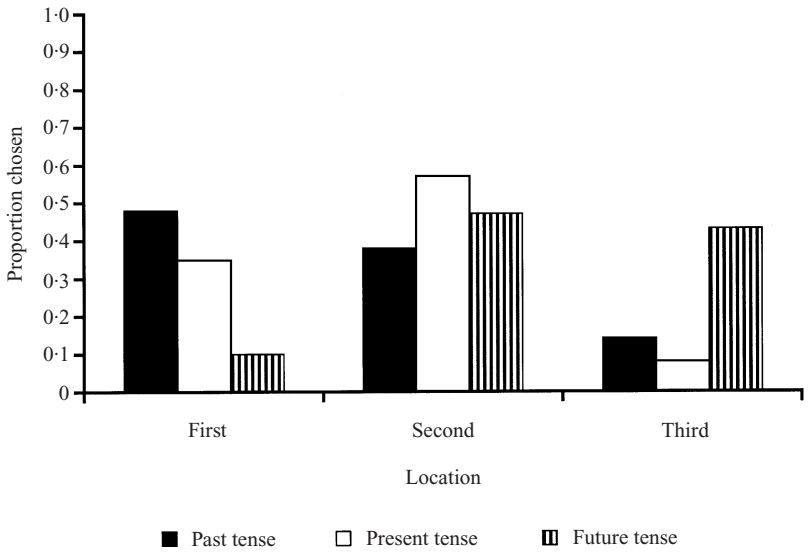

Fig. 3. Experiment 1. Proportion of times a location was chosen for each query type. Two-year-olds, test sentences.

result appears to stem largely from the fact that these children apply the future tense roughly equally to the second and third locations; this response pattern is technically incorrect in this experiment, but plausible from a semantic-pragmatic perspective. Lastly, the first location was chosen significantly more given the past tense than the future tense (t (24) = 4·11, $p < 0{\cdot}001$, Bonferroni $p < 0{\cdot}05$) though not quite significantly more than the present tense (t (23) = 1·84, $p < 0{\cdot}08$, Bonferroni $p < 0{\cdot}48$).

One reviewer suggested that there might be differences within the two-year-old group, which spans a relatively broad age range. Inspection of the data revealed the not surprising fact that the youngest children in this group did worse overall than the oldest children in the group. However, even the youngest half of the two-year-old group showed trends in the right direction for each tense and location.

Finally, we consider children's performance in the adverbial control condition. A mixed design ANOVA parallel to the one performed on the test sentences was performed on the control data. The results showed a main effect for age (F (1, 35) = 17·01, $p < 0{\cdot}001$) but no significant effects for tense or lexical aspect, and no significant interaction effects. Although the three-year-olds did significantly better than the two-year-olds across the board, all children were performing well above chance for all tenses and all lexical aspect types in the control condition.

Discussion

On the whole, the children were successful in this experiment. Despite some differences in the base-rates for the different response locations, the analysis showed that the children had at least a statistical preference to match each tense to its designated correct location. Children in both age groups differentiated all three tenses in the adverbial control condition. With the test sentences, the three-year-olds strongly differentiated all three tenses; the two-year-olds succeeded here as well, though somewhat more marginally. The lack of effect found for lexical aspect type suggests that the local properties of the verb's meaning are not a central factor in understanding tense in the auxiliary system. Moreover, children's success did not rely on making a realis/irrealis distinction. Although the children did quite well with the future tense (the irrealis case), they also differentiated between the present and past tenses (both realis cases) almost equally as well.

In short, this experiment confirms Weist's previous finding that children understand tense markings in the auxiliary system as conveying tense. It therefore casts doubt on the Aspect First Hypothesis to the extent it shows that children understand tense in an adult-like fashion, at least in these experimental conditions.

EXPERIMENT 2

There was one major confound in Experiment 1: the events presented confounded pieces of information that cut across different linguistic categories. All the events at the past-time (first) location reached their conclusion (non-bounded events stopped; bounded events completed); all the events at the present-time (second) location were incomplete and ongoing at the time of the query. We assume that children were understanding the linguistic category of tense because we assume that the relevant information in the scenes was the temporal sequencing information. However, given the confound between temporal sequencing and completion information in the events themselves, it is equally possible that the children were interpreting the test queries as coding a grammatical aspect difference and basing their choices on the completion difference in the first and second locations and not the difference in temporal order. Experiment 2 attempts to remedy this confound. In this experiment, the perfect correlation between temporal ordering information and completion information is broken in order to see whether children are truly coding tense and not grammatical aspect through the auxiliary system.

The Aspect First Hypothesis claims that tense morphology is being used to code grammatical aspect and predicts, therefore, that children will succeed

at differentiating the past and present tense only when the past-time event is completed (i.e. perfective aspect can describe it) and the present-time event is incomplete (i.e. imperfective aspect can describe it); that is, only when the past/present distinction is co-extensive with the perfective/imperfective distinction. When the completion information in the scenes is held constant (e.g. if an incomplete past event is contrasted with an incomplete present event), the child must use temporal order information to discriminate between the two events. If the child is considering only completion information (needed for grammatical aspect) and not temporal order information (needed for tense), she will have no basis for making a choice between the two events. Thus, under the Aspect First Hypothesis, the child's performance in such a condition will suffer across the board.

This prediction can be contrasted with what we would expect given a true adult competence with the morphology tested. One potential criticism of Experiment 1 is that all the past tense queries contained imperfective grammatical aspect (they were in the past progressive form), despite the fact that all the past events they described were complete. Although it is possible to use an imperfective form to describe a completed action, one could argue that to do so violates the Gricean maxim of informativeness (Grice, 1968). If the speaker knows an event has finished, she should use the perfective form (which entails completion) to describe it, instead of the imperfective form (which leaves the completion of the event up for grabs). From this perspective, we predict exactly the opposite of the Aspect First Hypothesis: children's performance should improve when the past-time event is incomplete, as this is just the situation when the test query (in the past progressive) is most felicitously used.

In Experiment 2, temporal order and completion information are dissociated: on half the trials, the past-time event was complete (as in the previous experiment), but on the other half, the past-time event was incomplete. All the events used in this experiment were bounded and described by telic predicates, allowing for the strongest possible contrast between finished and ongoing event versions. Once again, all the test queries are in the progressive to insure that the actual linguistic coding of grammatical aspect is held constant across the tenses. This experiment used essentially the same procedures as the previous experiment, except that it focused exclusively on the past/present contrast (the future does not obviously interact with completion information) and omitted the control condition using adverbials.

Subjects

Subjects were drawn from a University of Massachusetts affiliated daycare or were recruited to come to an in-house testing site. Three groups of children were run: a two-year-old group (N = 16, mean age = 2;6, range = 2;2–2;11),

TABLE 3. *Stimuli used for Experiment 2. Events in complete and incomplete versions, and queries in present and past forms*

Events		Test queries
COMPLETE	INCOMPLETE	'Show me where the kitty…'
Kitty fills in a puzzle by inserting pieces into appropriate slots	Kitty only fills in half the pieces	is filling in a puzzle was filling in a puzzle
Kitty empties blocks out of a cup	Kitty leaves two blocks left in the cup	is emptying out a cup was emptying out a cup
Kitty draws a face at pre-marked locations	Kitty draws only a circle with one eye	is drawing a face was drawing a face
Kitty takes a coat off of toy Sesame Street characters	Kitty only takes one arm out of the coat	is taking off a coat was taking off a coat
Kitty covers up toy Sesame Street characters with small towels	Kitty only covers half the toy	is covering up a friend was covering up a friend
Kitty takes apart all the legos in a lego tower	Kitty takes off only two pieces from a lego tower	is tearing down a tower was tearing down a tower
Kitty zips up a small bag containing cotton-balls or q-tips	Kitty only zips the bag halfway	is closing up a bag was closing up a bag
Kitty puts together several curtain rings to make a bracelet	Kitty leaves the bracelet unfinished so it cannot be worn	is putting together a bracelet was putting together a bracelet

a three-year-old group (N = 12, mean age = 3;6, range = 3;2–3;10) and a four-year-old group (N = 8, mean age = 4;10, range = 4;6–5;2). All subjects were required to pass a pre-test in which they demonstrated familiarity with the directionality of the road and a willingness to point. There were six subjects replaced in the analysis for failure to pass the pre-test or to complete at least half of the trials.

Stimuli and procedures

Children were presented with a road drawn on a piece of paper on which a toy kitty walked down the road (leaving a trail of inky footsteps), performing events as required. Since this experiment only investigated past and present tense, only two locations were used and the kitty only demonstrated the event twice. In half the trials (i.e. half of the trials in which the query was in the past tense and half of the trials in which the query was in the present tense) the kitty failed to complete the event in the first location; in the remaining

trials, the kitty completed the event in the first location. When the kitty was at the second location and in the midst of performing the event for the second and final time, the child was asked about the event in either the past or present tense. All test queries were in the progressive form with the tense contrast being carried by the auxiliary: *Where is/was the kitty V'ing?* The full set of events and queries used is shown in Table 3. This experiment has a total of four distinct conditions created by contrasting two tenses for the query (past or present) and two states of the past-time event (completed or incomplete). Subjects received two trials of each condition for a total of eight trials.

Results

The mean percentage correct for each age group for each query type (past tense, present tense) and each past-time state condition (past-time complete, past-time incomplete) is shown in Table 4.

TABLE 4. *Mean proportion correct, Experiment 2*

	Past tense		Present tense	
	Past-time event incomplete	Past-time event complete	Past-time event incomplete	Past-time event complete
Two-year-olds	0·28†	0·38 n.s.	0·81**	0·88**
Three-year-olds	0·5 n.s.	0·44 n.s.	0·69 n.s.	0·88**
Four-year-olds	0·88*	0·94**	1·0**	1·0**

*, $p < 0{\cdot}01$; **, $p < 0{\cdot}001$ compared to chance = 0·5.
†, $p < 0{\cdot}01$, significantly below chance.

These raw scores seem to suggest that there is a clear advantage for present tense queries but it is difficult to interpret these data without taking into consideration possible base-rate effects. Recall that the correct response for the present tense queries (as well as the incorrect response for the past tense query) is to point to the location where the kitty is actually located. Assuming that the presence of the kitty is more salient than its absence (an assumption that seems warranted) we might expect that the subjects, particularly the younger ones, will be naturally biased to point to the kitty. Such a bias would artificially boost the percentage correct for present tense queries (following the salience bias leads to the right answer) and lower the percentage correct for past tense queries (following the salience bias leads to the wrong answer).

To correct for this possible bias for choosing the present-time location, a difference score was calculated for each child for each past-time state condition (past-time complete and incomplete). The difference score equalled

the percent of times the child chose the present-time location in response to a present tense query minus the percent of times the child chose the present-time location in response to a past time query. In effect what is being measured is the child's ability to differentiate between the two tenses: a child who always chose the present-time location would receive a difference score of 0, indicating that the tense of the query made no difference to her choices at all; a child who performed perfectly would receive a difference score of +1, indicating that the tense of the query determined her choices completely.[4] As can be seen in Table 5, the difference scores are all significantly

TABLE 5. *Mean Difference Scores, Experiment 2*

	Past-time event	
	Incomplete	Complete
Two-year-olds	0·09	0·27*
Three-year-olds	0·32*	0·36**
Four-year-olds	0·86**	0·94**

*, $p < 0{\cdot}05$; **, $p < 0{\cdot}01$ compared to chance = 0.

better than chance performance of 0 except for the youngest group when the past-time event was incomplete.

A mixed design ANOVA was run with age as the between-subjects factor and past-time state (past-time complete or incomplete) as the within-subjects factor; the difference scores were the dependent measure. The analysis found a main effect for age ($F(2, 32) = 17{\cdot}86$, $p < 0{\cdot}001$). There was no main effect for status of the past-time event ($F(2, 32) = 2{\cdot}36$, $p < 0{\cdot}14$) and no significant interaction effect ($F(2, 32) = 0{\cdot}29$, $p > 0{\cdot}7$). Further analyses of the age effect using 2-tailed *t*-tests showed that the four-year-old group performed significantly better than the three-year-olds both when the past-time event was complete ($t(18) = 2{\cdot}24$, $p < 0{\cdot}05$) and when it was incomplete ($t(18) = 2{\cdot}3$, $p < 0{\cdot}05$). The three-year-old group performed marginally better than the two-year-old group both when the past-time event was complete (complete ($t(26) = 2{\cdot}01$, $p < 0{\cdot}06$) and when it was incomplete ($t(26) = 1{\cdot}8$, $p < 0{\cdot}07$).

Discussion

The results from this experiment argue that aspectual information plays a strong role in children's early interpretation of tense morphology, as

[4] One child's data (from the three-year-old group) was eliminated from further analysis because the child had negative difference scores for both informational conditions, indicating that the child reliably chose the past-time location for the present tense queries and the present-time location for the past tense queries.

predicted by the Aspect First Hypothesis. The three- and four-year-olds were able to differentiate the past and present tenses when the past-time event was both complete and incomplete. The two-year-olds, however, successfully distinguished between the past and present tense queries only when temporal ordering information was completely co-extensive with completion information. When the completion cue was removed (i.e. when the events at both the present-time and past-time locations were incomplete) the two-year-olds were at sea; not only did their performance on the past tense queries go down, but so did their performance on the present tense queries. This result stood out significantly despite the high, base-line differences between the past-time and present-time locations. It therefore appears that for the two-year-olds, the meaning difference between *is* and *was* is linked to completion information; that is, they appear to use the auxiliaries to mark grammatical aspect.

Some caution is required with this interpretation, however. There was no interaction effect found between the state of the past-time event (complete or incomplete) and age: all the children did at least somewhat worse when the past-time event was incomplete. This result is all the more striking as the sentences were always in the progressive form which is an explicit marker of the imperfective.

GENERAL DISCUSSION

The two experiments presented here were designed to investigate the central claim of the Aspect First Hypothesis: that children's early use of verbal morphology codes aspect and not tense. Experiment 1 cast doubt on the Aspect First Hypothesis by showing that children as young as 2;9 could understand the past, present and future tenses in an adult-like way. That experiment, however, did not control for the kind of information from the world (temporal order vs. relative completion) the children might be using to make their judgments. Experiment 2 did control for the information provided by the events themselves and found that the two-year-olds failed to differentiate past and present tenses when the temporal ordering cues were not co-extensive with the completion cues. That is, when the past time event was incomplete, the two-year-olds did not appear to understand the meaning of the tensed auxiliaries.

These results, therefore, provide limited support for the Aspect First Hypothesis. From Experiment 2, it appears that the two-year-olds are using completion information and not temporal ordering information; this suggests in turn that these children are making a grammatical aspect and not a tense distinction. However, the results from Experiment 1 are too strong to allow for a complete endorsement of the hypothesis. Recall that children's success there was equivalent with telic and atelic predicates. If completion were a

necessary cue for children's success with the past tense, we would expect much weaker performance with the atelic predicates, as the events they describe have relatively weak completion cues (the events described by atelic predicates don't complete, they just end).

The results from Experiment 1 may point away from the claim that children are actually marking grammatical aspect at the expense of tense, but the results from Experiment 2 argue that tense interpretation is subject to a strong influence of a grammatical aspect nature. There are two different ways we can think about this influence. First, children might be over-zealously conflating tense and grammatical aspect into the same morphemes. The results of Experiment 2 can be accounted for if the children mistakenly believed that every past marker (including auxiliary *was*) is also a perfective marker and every present marker is also an imperfective marker. Since many languages (including English) do conflate tense and grammatical aspect in certain forms, and since there is a great deal of cross-linguistic variation in this matter, it would be unsurprising if children showed some early errors in the precise mapping of these categories into morphology.

A second possibility is that children find temporal ordering information easier to understand when it is reinforced by completion information. The cognitive load involved in keeping track of the sequence of events may be lightened when other cues are present which generally correlate with different times. These experiments deliberately contained no causal cues (e.g. tripping precedes falling both temporally and causally) in the hopes of forcing children to rely exclusively on temporal sequencing knowledge. Completion cues, however, may have served a similar function to causal information, by providing an extra hint about which event was likely to be in the past time and which in the present time. Thus, the two-year-old children in Experiment 2 may have known quite well that, for example, *was V'ing* marked past tense, but found it difficult to calculate past-time without the completion cue.

What these explanations have in common is their reliance on natural classes, either at a linguistic or cognitive level. Perfective grammatical aspect and past tense are naturally conflated linguistic categories, as are imperfective aspect and present tense; similarly, completion and past time are naturally reinforcing cognitive categories as are incompletion and present time. This idea of natural classes is very similar to the notion of prototype discussed by Shirai & Anderson, 1995 (Anderson & Shirai, 1996). Shirai & Anderson extend these classes to include lexical aspect, so that telicity classes with perfectivity and pastness, while atelicity classes with imperfectivity and presentness. By including the lexical aspect dimension in their prototype, they account for the distributional phenomenon discussed previously, in which young children initially restrict their past (or perfective) markers to telic verbs and their present (or imperfective) markers to atelic verbs. These

experiments did not directly test these possible explanations and so cannot choose among them. The current results are consistent with the idea that tense interpretations can be influenced by aspect in some fashion; however, they also provide a strong indication that even at two years old, tense has some importance independent of aspect.

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