

Running Header: Continuity in Aspect

I'll Never Grow Up: Continuity in Aspect Representations

Laura Wagner
The Ohio State University

Address for Correspondence: Laura Wagner
Department of Psychology
1885 Neil Avenue
Ohio State University
Columbus, OH 43210

614-688-3260
wagner.602@osu.edu

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Abstract

Children's early production typically favors prototypical groupings of temporal-aspectual features; children prefer to say telic, perfective, past combinations (e.g. *broke*) and atelic, imperfective present combinations (e.g. *riding*). The current experiments examine the extent to which adults also favor these prototypical groups in a comprehension task (Experiment 1) and a sentence comparison task (Experiment 2). The results show that, like children, adults find prototypical combinations easier to understand, particularly in low-information contexts. Moreover, adults judge prototypical combinations as better sentences than non-prototypical sentences. The results are argued to support continuity in aspectual representations. The differences between children and adults is linked to the proposed origin of the prototypes themselves, namely, information processing demands.

I'll Never Grow Up: Continuity in Aspect Representations

Children's under-extensions have taken on a prominent role in current thinking about language acquisition. For example, Tomasello (2003) reviews data showing that children regularly produce only a sub-set of the structures allowed them by the adult grammar. He argues further that this systematic under-production reflects a fundamental difference between the child's grammar and the adult's, with the child's grammar being less abstract and less general. This paper examines a grammatical domain in which there is a well-documented under-extension in children's early production, namely, aspect. Two experiments will be reported that examine not only children's comprehension competence with an aspectual distinction, but also adults' understanding and preferences with different aspectual combinations. I will argue for continuity between children's and adults' representations in this domain, and suggest that the differences between the groups reflects quantitative differences in how they handle difficult cases, not qualitative differences in the grammatical tools they have to work with.

In children's early production of verbal morphology, there is a well-documented pattern of under-extension. Until some time around the age of 2;6, children acquiring a variety of languages produce telic verbs with past and/or perfective morphology and they produce atelic verbs¹ with present and/or imperfective morphology. That is, children often say things like *riding* (atelic & imperfective) and *broke* (telic & perfective) but very rarely say things like *rode* (atelic & perfective) or *breaking* (telic & imperfective). The basic pattern of temporal/aspectual grouping found in the first language acquisition production data is summarized in Table 1.

¹ The telic/atelic distinction does not, of course, rely just on the verb but on features of the entire predicate (e.g. *Tinkerbell ate* is atelic; *Tinkerbell ate a pizza* is telic). However, entire predicates are rarely available in early child speech, and thus the classifications are based on plausible interpretations of the verb in context.

<< INSERT TABLE 1 ABOUT HERE >>

Each row of the table shows an independent dimension of grammar. Lexical aspect (Aktionsarten) refers to inherent properties of a predicate. The primary semantic division is between telic and atelic predicates. Telic predicates specify the inherent end-point of an event, and include achievements and accomplishments; atelic predicates, by contrast can end at any arbitrary time, and include activities and states. As a result of this fundamental semantic difference, these predicates can be distinguished by a set of well-known linguistic tests (Dowty 1979, Vendler 1967). For example, an atelic predicate in imperfective aspect (1a) entails the truth of the same predicate with perfective aspect (1b), but this entailment does not hold for telic predicates (2a, 2b). The difference in completion entailments between (2a) and (2b) can be seen by adding the continuation in (3): this explicit denial of completion is fine after (2a) but seems a contradiction after (2b).

- (1) a) Nana was sleeping
b) Nana slept
- (2) a) The boys were building a house for Wendy
b) The boys built a house for Wendy
- (3) ... but they didn't finish it.

A secondary division within the Aktionsarten domain concerns the subjective duration of the event: durative predicates describe events which last for some time while punctual (or semelfactive) predicates describe those which subjectively take no time at all (cf. Smith 1991). The lack of subjective duration in punctuals can be seen by the fact that they sound awkward with adverbials that focus a sub-part of an event as in (4) (presumably because they have no sub-parts to speak of); and by the fact that they tend to create iterative interpretations with duration adverbials (5).

- (4) ?? Michael finished reaching the top
- (5) Michael snapped his fingers for an hour

Grammatical Aspect refers to the perfective/imperfective distinction. Perfective aspect signals that an event is closed, and if telic, completed (see (2b) above); Imperfective aspect indicates that an event is open and ongoing (cf. Comrie 1976). These intuitive notions have been formalized by Klein (1994) as differences in the inclusion relationship between the TT (Topic Time; similar to Reichenbach's R point) and T-Sit (Time of the Situation, or the lexically described event). Imperfective aspect signals that the TT is included within the T-Sit while perfective signals that the boundaries of the T-Sit are within the TT span. In English, the simple past marking contains perfective meaning and imperfectivity is conveyed through the progressive construction.

The final grammatical dimension, Tense, is a deictic function that relates the time of an event to a designated reference point, usually the time of utterance. In Klein's formulation, tense is defined by the ordering (and for the present tense, inclusion) relations between the TT and the UT (utterance time).

In principle, Aktionsart, Grammatical Aspect, and Tense are independent dimensions, and they freely and independently combine with each other². The practice in children's early production, however, is to combine the values for each dimension into sentences according to the groups outlined in the columns of Table 1. This grouping leads to a systematic under-extension, with children failing to utter legitimate cross-group options, such as telic-imperfective-present sentences (*Wendy is making a sandwich*) or atelic-perfective-past sentences (*Peter flew*).

The existence of these groups in first language acquisition production has been well documented for a variety of languages, including English (Bloom, Lifter & Hafitz 1980, Shirai & Andersen 1995), French (Bronckart & Sinclair 1973), Italian (Antinucci & Miller 1976), Polish

² There are some well-known exceptions – such as the fact that statives can't be in the progressive, which effectively rules out imperfective statives in a language like English which only has a progressive-imperfective form.

(Weist et al. 1984, Bronckart & Sinclair 1989), Mandarin (Li 1990), Japanese (Rispoli 1981, Shirai 1998), and Hebrew (Berman 1983). Children's early comprehension abilities appear to be somewhat more flexible, and children three years of age and slightly younger have been shown to be able to understand cross-group pairs, particularly telic-imperfective combinations (Weist 1991; Weist, Atanassova, Wysocka & Pawlak 1999; Weist Lyytinen, Wysocka & Atanassova 1997; Smith Naigles & Wagner 2002). However, other studies have found evidence for the continued influence of the groupings (though sometimes in a weakened form) even in children's comprehension of some languages (for English: Wagner 2002, Wagner 2001; for Mandarin: Li & Bowerman 1999; for Russian: Stoll 1998).

The most radical explanation of this phenomenon that has been suggested is essentially that children do not possess the distinct horizontal rows of Table 1: lexical aspect, grammatical aspect and tense are not separate and distinct categories but are combined in a more holistic and redundant fashion (cf. Bronckart & Sinclair 1973; Bloom, Lifter & Hafitz 1980). Less radical proposals have suggested that children have some, but not all of the horizontal rows (cf. Wagner 2002's suggestion that children do not make the tense-grammatical aspect distinction); or that the rows are importantly non-independent from each other (cf. Olsen & Weinberg 1999's proposal using the subset principle). Regardless, what all these proposals share is the fact that they posit – to a greater or lesser degree – that children have a grammar that is qualitatively different from that of adults.

The comprehension data noted above effectively undermines the most radical of these explanations: children can clearly understand more than they choose to say. However, accepting the comprehension data as a better window onto children's grammars only shifts the phenomenon from being a deficiency in children's language to being a paradox: why, if children's grammars demonstrably permit the entire range of forms in Table 1, do children generally refuse to spontaneously produce half of them? Moreover, the fact that many of the

comprehension experiments continue to see residual effects of the groupings suggests that there is a potency to the groupings that seems to be independent of the grammar itself.

One account of the aspectual groupings that has some traction on the paradox is the prototype account (Shirai & Andersen 1995, Li & Shirai 2000). This position argues that the groups reflect prototypical cases which serve as anchors for the temporal/aspectual categories. Children identify specific forms in their input and ascribe prototypical meaning to them. For example, children acquiring English identify the progressive *-ing* and assign a prototypical meaning to it such as “action in progress”. This prototypical meaning is not characterized at any one level of linguistic analysis but instead is best exemplified by a combination of features – in particular, by the features listed in Group 2. Cross-group combinations are those which conform less well to the prototype, and therefore are acquired later and generally dis-preferred. To the extent that the prototypes reflect the child’s understanding of the meaning of the progressive form, this account is a variant of the different-grammar views noted above: the meaning of the progressive is independent of the meaning of tense and lexical aspect; if children believe otherwise, then they are not using the adult grammar. However, one could understand the prototypes as reflecting not the structure of the linguistic categories themselves so much as cognitive constraints on the identification and use of those linguistic categories. Indeed, the information theoretic account proposed at the conclusion of this paper will take this line. On this cognitively-based interpretation, the prototypical groups constitute the ideal conditions for finding and using the independent levels of linguistic meaning. These cognitively-based prototypes are not, in and of themselves, products of the language acquisition process, and therefore one strong prediction made by this account is that these aspectual groupings should be found in other situations. And indeed, there is some evidence that they are.

For example, Andersen & Shirai (1996) considered adults engaged in L2 acquisition. They surveyed a variety of studies examining aspectual knowledge and usage in L2 learners and found evidence that in general, they produced more combinations that corresponded to the prototypical temporal/aspectual groupings and appeared to understand these combinations better as well. Similarly, Bickerton (1981) has found evidence for the prototypical groupings in pidgins and creole languages. Further evidence comes from Shirai & Andersen (1995). They analyzed the speech of 3 parents talking to children and found that the adult production also showed the prototypical groupings, although not as strongly as the children's speech did. It is unclear if this is a general phenomenon in adult speech (see Olsen, Weinberg, Lilly & Drury 1998 for evidence that it is not wholly general even in speech to children) but it is suggestive that under some circumstances, adults may talk – aspectually speaking – like children. A final piece of evidence comes from historical linguistics. In their examination of the historical evolution of tense, mood and aspect morphology, Bybee, Perkins & Pagliucca (1994) present strong evidence for the prototypical groupings, at least for tense and grammatical aspect: past and perfective markers are typically grammaticized out of the same sorts of linguistic elements (often completive and resultative markers), while imperfective and present tense markers are typically grammaticized out of a different set of linguistic elements (often progressives, or lexical items related to being or standing). Bybee et al. do find evidence for the existence of the dimensions of tense and grammatical aspect independent of the prototypical groupings (e.g., historically, the development of past perfective marking seems to depend on the prior existence of overt past imperfective marking), but the genetic lines, so to speak, operate over the prototypical groups.

One problem with these pieces of evidence is that they all implicate language acquisition in some way. L2 acquisition (whether in a classroom or a naturalistic language learning context) is clearly a case of language acquisition; adult speech showing the groupings

has been speech to children acquiring language; and historical change may critically depend on children's preferred analyses of language (Lightfoot 1988; but see also Bybee et al. 1994) The aim of the following experiments is to generate evidence about the strength of the temporal/aspectual groupings in adults in wholly non-acquisition settings: Experiment One is a simple comprehension study with children and adults; Experiment two is a sentence judgment task with adults only. The results from these studies will bolster the claim that the prototypical groupings persist into adulthood. The general discussion will consider the implications of this fact for our understanding of language acquisition and the grammar of tense and aspect more generally.

Experiment One: Sentence-to-Scene Matching

This study tests participants' ability to understand grammatical aspect (perfective and imperfective) across a lexical aspect distinction, namely, telicity. Participants are shown two versions of the same event – one ongoing and one terminated/completed. Based on the semantics of grammatical aspect, the ongoing version is a correct match for imperfective aspect while the terminated/completed version is a match for perfective aspect. Weist et al. (1999) used this 2-picture matching task and found that English acquiring children as young as 2;6 were able to correctly match a telic-imperfective sentence – that is, a non-prototypical combination³. However, using an act-out version of the task (in which the events were acted out and not displayed in pictures) Wagner (2002) found children unsuccessful with that non-prototypical combination until children were 5-years-old. One possibility for the discrepancy

³ Other researchers have used richer event representations using multiple pictures (Li & Bowerman 1998) and short videos (Smith et al. 2002, Stoll 1998 and even Weist et al. 1999). No doubt these richer representations are better in many ways, but that does not take away from the fact that children do succeed at this task with the simpler 2-picture version, and moreover, that the youngest children on record as having succeeded at this task (Weist et al. 1999's 2 year olds) did so with the simpler version.

between the results of Wagner and Weist et al. was that Weist's materials portrayed the agent of the event in both ongoing and completed versions, while in Wagner (2002), the events were shown without agents (the participants' task was to match the agent to her proper version). It may be, therefore, that non-prototypical combinations require richer sources of evidence; in particular, they may require specific information about how the agent interacts with the event.

This study extends the Weist et al. (1999) result in three ways. First, it uses both telic and atelic situations/sentences to allow for an evaluation of participants' abilities to understand both prototypical groupings as well as a larger range of non-prototypical combinations. Second, following the discrepancy with Wagner (2002), it uses two levels of informativeness with the telic situations: all events were displayed in pictures, but some telic pictures were parallel to Weist et al (1999) and displayed the agent, while others were parallel to Wagner (2002) and displayed only the relevant objects in the scene. Finally, in keeping with the overall goal of assessing continuity, adults were tested on all materials and their responses were compared to the children's data.

Methods

Participants

Two groups of participants were tested. The Child group consisted of 24 children, with a mean age of 4;0 (ranging from 3;3 to 5;5). Children were brought into a lab and were given token gifts for their participation. According to parental report, all participants had English as their primary (and in most cases, only) language. The Adult group consisted of 20 college-age students who received partial course credit for their participation. All adults reported being native speakers of English.

Stimuli

The stimuli consisted of pairs of pictures. The pictures were simple line and marker drawings, some in black and white, some in color (see Figure 1 for example stimuli). They were presented in a book so that the halves of the pair appeared on facing pages.

There were three types of test picture pairs. The **Atelic** pictures showed the agent engaged in the described action or finished with it. For example, in the scribble event, the engaged picture showed a boy facing a blackboard with some scribbling on it, chalk in hand. The finished picture showed the boy facing forward, standing in front of a chalkboard with scribbles on it. The **Telic-Object Only** pictures portrayed the result state of a complete and incomplete event, with no people present at all. For example, in the paint a flower event, the incomplete picture showed an easel with a half-painted flower and the complete picture showed an easel with a complete flower painted on it. The **Telic-Object and Agent** pictures portrayed both the result state of the event and an agent whose actions matched the result. For example, in the paint a flower event, the incomplete picture showed both an easel with a half-painted flower and a woman facing the easel, brush in hand. The complete picture showed both the easel with a complete flower and a woman facing forward sitting beside the easel.

There were four atelic events described with activity predicates: scribbling, driving, playing with blocks, and pulling a wagon. There were eight telic events described with accomplishment predicates: painting a flower, drawing a house, making a snowman, building a sandcastle, frosting a cake, filling up a glass with juice, filling in a puzzle, closing a window. The first four are all creation events while the last four are all change of state events.

The linguistic targets were in the past progressive (for the imperfective) and the simple past (for the perfective). Sample sentences are shown in Figure 1.

<< FIGURE 1 ABOUT HERE >>

Procedures

Participants were shown the picture books and taught the task using practice pictures. Attention was drawn to each picture in the pair; then both perfective and imperfective sentences were produced. To insure that participants had heard both sentences, they were asked to repeat them. Finally, participants were asked to choose a match for one of the sentences: “In one of these pictures, the woman painted a flower, and in the other picture, she was painting a flower. Can you say she PAINTED a flower? Can you say she WAS PAINTING a flower? For these pictures, I want you to show me where the woman PAINTED a flower.”

To insure reasonable counter-balancing of the order of the items, the target sentence for matching, and the side of the matching picture, four sets of stimuli were created. Each Child participant went through one complete set; each Adult participant went through two complete sets.

Scoring

Following the standard practices of previous research, the correct match for the imperfective sentence was the picture showing an incomplete/ongoing version of the event while the correct match for the perfective sentence was the completed version of the event⁴.

Results

⁴ The scoring scheme incorporates both semantic entailments and pragmatic implications. With telic predicates, perfective aspect does entail completion and has a clear match (the completed picture); imperfective aspect, however, has open entailments and can semantically be applied to either picture. The ongoing/incomplete picture is counted as correct by implication: since each sentence can only be matched to a single picture, the imperfective must be matched to the ongoing/incomplete picture. The pros and cons of adopting this system have been discussed in more detail in Wagner (2002). There is a similar difficulty with atelic predicates: because of their homogeneous nature, both perfective and imperfective sentences can semantically be matched to either picture. Again, the correct answers depend on understanding a pragmatic dimension of this task as well.

The mean proportion correct are shown in Figure 2. Each of the conditions was compared to chance (.5) to determine a basic criterion of success. Adults were significantly above chance for every condition: the weakest items for adults were the Atelic pictures with Perfective morphology ($M = .75$) but even here, adults were above chance by a 2-tailed t-test ($t(19) = 2.65, p < 0.016$). Children's performance was above chance (at the $p < .01$ level by t-test) for all but 2 conditions: they scored no better than chance with Atelic pictures paired with Perfective morphology ($M = .42$) and with Telic-Object only pictures paired with Imperfective morphology ($M = .40$) ($t(23) = 1.0$ and 1.2 , respectively; $p > .2$ for both).

<<FIGURE 2 ABOUT HERE>>

An ANOVA was performed on percentage correct, with Morphology (imperfective vs. perfective) and Picture (telic-object only, telic-object and agent, and atelic) as within subjects factors and Age as a between-subjects factor (children vs. adults). Results showed main effects for age (adults were better overall than children $F(1,42) = 40.7, p < 0.001$), and picture (Atelic pictures were worse overall $F(1, 41) = 10.4, p < 0.001$); significant interactions were found between picture and age ($F(1,41) = 3.3, p < .05$), picture and morphology ($F(1, 42) = 18.5, p < 0.001$), as well as a 3-way interaction ($F(1, 41) = 4.0, p < .03$).

Critical support for the prototype grouping was found in the interaction between Picture type and Morphology. As can be seen in Figure 2 (and as confirmed by paired t-tests), participants were equally good with perfective and imperfective morphology with the most informative pictures (Telic - Object and Agent) (for children: $t(23) = 1, p > .3$; for adults: $t(19) = 1.7, p > .1$). However, for the Telic - Object Only pictures, there was an advantage for perfective morphology (for children: $t(23) = 4.3, p < .001$; for adults: $t(19) = 2.9, p < .01$) while for the Atelic pictures, there was an advantage for imperfective morphology (for children: $t(23) = 2.9, p < .008$; for adults: $t(19) = 2.3, p < .04$). It is important to note that both children and adults showed this same pattern, although the children showed it more extremely.

In addition, there were no effects of particular items, nor was there any effect between creation and change of state telic predicates. The source of the 3-way interaction is linked to the main effect of picture, and reflects slightly different sources of difficulty across the ages. Children found both Telic - Object only and Atelic pictures to be harder than the Telic Object and Agent pictures; the interaction between morphology and picture just noted is a reasonably complete account of the children's data. For adults, the Atelic pictures caused (relatively speaking) particular difficulties relative to both kinds of Telic pictures.

Discussion

These results confirm that children can comprehend at least one non-prototypical grouping, namely an imperfective & telic combination. However, children's knowledge is dependent on their receiving highly informative situations: when the agent of the event is present in the scene (parallel to Weist et al. 1999), children succeed; when the agent is absent (parallel to Wagner 2002) children fail. It is unclear at this point whether children's failure with perfective & atelic items reflects the fact that the situations were insufficiently informative, or if the atelic situations are intrinsically less informative. Alternatively, it may be that the greater need to consider pragmatic factors with the atelic items made them more difficult (see footnote 4).

These results also provide strong support for continuity in aspectual representations. Adults were highly successful on this task (scoring well above chance on every combination and informative condition). Nevertheless, within the ceiling levels of their success, adults showed an interaction exactly comparable to that of children: adult performance dipped in just those cases where children's performance fell to chance. The similarity in the patterns of child and adult responses suggests that the difference between the groups is one of degree, not kind.

Both groups agree about what the difficult cases are, but only the adults were able to compensate for these difficulties and perform successfully.

Experiment 2: Adult Judgments

Experiment One showed that adults agree with children that non-prototypical combinations are (comparatively) harder to understand. This experiment pushes adults further to see if they will show sensitivity to the prototypical groups in a completely different domain. Unlike all previous investigations of aspect, this experiment requires participants neither to freely generate items nor to make any explicit assessment of meaning. Participants are not asked at any level to compare these sentences to situations in the world, but simply to consider them as sentences of their language. Participants are presented with two sentences, both of them grammatically correct, acceptable sentences of English. The sentences vary only in how well they correspond to the prototypical groups. The participant's task is to choose which sentence is the better one. For example, in one trial, participants were asked to choose between *The teacher carried the box* and *The child was tapping the table*; in another trial, between *The man has built a house* and *The woman is winning the race*.

If adults are influenced by the prototypical groups in this task, then it can be used as a means to determine whether some dimensions of the groups are more central in defining the prototypical groupings than others. For example, it may be that what centrally unites the groups is a generalized notion of (potential) completion which links the lexical aspect dimension of telicity and grammatical aspect. Comrie (1976) has suggested that telicity and perfectivity express the same information in the lexical and grammatical domains respectively: telic predicates are those which have the potential to complete and perfective aspect signals actual completion; atelic predicates and imperfective aspect mark the opposite. Another potential core for the groups might be created out of grammatical aspect and tense. In many

languages, these two dimensions of meaning are conflated into unified forms (cf. English simple past which conflates past and perfective and French imparfait which conflates past and imperfective). Indeed some languages even opt to mark only one of these two, relying on adverbial expressions and pragmatic implications to signal the missing meanings (e.g. Mandarin marks only grammatical aspect and Modern Hebrew marks only tense). Alternatively, the groups may in fact be more canonical prototypes, with all the dimensions importantly contributing. If this is the case, then adults may be generally sensitive only to how many dimensions come from the same group.

Methods

Participants

Twelve undergraduate adults participated. They received course participation credit for their time.

Stimuli

The stimuli consisted of 16 sentences. Four base sentences were constructed by combining the two lexical aspect values of durativity and telicity (see Table 2). All the sentences were transitive to avoid any possible confound of transitivity with lexical aspect. Each of these base sentences appeared in four forms corresponding to all the combinations of tense and grammatical aspect. One base set is shown in Table 3 in the full four forms.

<< TABLES 2 AND 3 ABOUT HERE >>

Procedure

Participants were seated in front of a computer. Via written instructions on the screen, they were told “You will see two sentences presented to you. Your task is to indicate which

sentence you think is better. This may strike you as a funny question – you may believe that both sentences are perfectly OK. If you are unsure which sentence is better, just go with your gut instinct. In some cases, the differences between the two sentences will be very small, so please read the sentences carefully.” Participants were also informed to press the “T” key if they chose the top sentence as better and the “B” key if they chose the bottom sentence as better.

Following the instructions, participants were presented with every possible pairing of the 16 sentences for a total of 120 judgments. The two sentences appeared in 24 pt. font and were easily readable by the participants. To encourage participants to read both sentences before making their choice, the top sentence was presented alone for 500 ms, and 500 ms after both sentences were present on screen a row of three pink asterisks was flashed in the middle of the screen. Participants were unable to choose either sentence until after the asterisks had flashed (participants were also informed of this on the instructions screen). Both sentences remained on the screen until participants made a choice. Sentences were presented with Psyscope; presentation order was randomly generated by the program. Participants were given two breaks during the study. The task took approximately 20 minutes to complete.

Scoring

Every time a sentence was chosen, it received 1 point. The mean number of points a sentence received across all participants was taken and used to create an overall score for each of the sentences. The scores could range, therefore, from 0 (a sentence that was never chosen as better, regardless of what it was in competition with) to 15 (a sentence was chosen as better against every other sentence in the set).

Results

The scoring method used creates a ranking of all the test sentences for each participant, with higher scores indicating a sentence is more preferred. Accordingly, the data were treated as ordinal and non-parametric tests were conducted. A non-parametric Friedman ANOVA was conducted on the scores of the full set of 16 sentences to determine if there were overall differences among the sentences. This analysis was highly significant: $\chi^2_{(15)} = 79.65, p < 0.0001$. As predicted by the prototype account, the highest scoring sentence was in fact a prototypical one: “telic & punctual & perfective & past”, *The woman won the race* (mean score = 11.75). The complementary prototype sentence was the fourth highest scoring sentence: “atelic & durative & imperfective & present”, *The teacher is carrying the box* (mean score = 9.5). The lowest scoring sentence was very non-prototypical, drawing equally from both temporal/aspectual groups: “atelic & punctual & perfective & present”, *The child has tapped the table* (mean score = 2.75). Indeed, all of the four lowest scoring sentences contained two values from each temporal/aspectual group. The full set of sentences, organized by rank, is in Appendix A.

The first analysis concerned the semantically related dimensions of lexical aspect telicity and grammatical aspect (that is, the two dimensions that contribute potential completion information). A Wilcoxon matched-pairs signed-ranks test showed that sentences which drew telicity and grammatical aspect values from the same group scored higher than those which did not (i.e. “telic & perfective” and “atelic & imperfective” scored higher than “telic & imperfective” and “atelic & perfective”): $Z = 3.06, p < 0.002$; 12/12 subjects showed this pattern. A second analysis found similar support for the dimensions of grammatical aspect and tense. Sentences which drew grammatical aspect and tense values from the same group scored higher than those which did not (i.e. “past & perfective” and “present & imperfective” scored higher than “past & imperfective” and “present & perfective”): $Z = 2.55, p < 0.01$; 11/12 subjects showed this pattern. The values of the scores for these groupings are shown in Table 4.

To directly test the idea that all four factors contribute to the groups, the test sentences were re-coded for the number of values they contained that were drawn from the same temporal/aspectual group. The two most prototypical sentences (discussed above) drew all four of their values from the same group; an additional eight sentences drew three of their values from the same group; and five sentences split their values equally between the groups. A non-parametric Friedman ANOVA conducted over the scores of items sharing two, three, and four values from the same temporal/aspectual group was significant: $X^2_{(2)} = 22.17$, $p < 0.0001$. Wilcoxon matched-pairs signed-ranks tests were used to compare the items. These tests showed that sentences sharing three values from the same group received higher scores than those sharing only two ($Z = 2.9$, $p < 0.004$; 11/12 subjects showed pattern) and those sentences sharing four values received higher ranks than those sharing only three ($Z = 3.1$, $p < 0.002$; 12/12 subjects showed pattern). The values of the scores for the three categories is shown in Table 5⁵.

<<TABLES 4 AND 5 ABOUT HERE>>

Discussion

These results show that the temporal/aspectual groupings have force outside of a semantic interpretation task, and furthermore, that all the dimensions of the groups (lexical

⁵ One potential concern arose from exit interviews with the participants. A few participants apparently allowed an odd sort of prescriptive judgment to interfere with their comparisons. They had mistakenly analyzed the present progressive constructions as passives and reported that they knew passive sentences were “bad”. Other participants reported finding the present perfect construction unnatural and unlike anything they would say. This claim is not unreasonable given the relative infrequency of the construction, and the fact that it may be genuinely infelicitous with an unbounded predicate (cf. Comrie 1976). Clearly these participants are linguistically unsophisticated, but it is nevertheless possible that present tense interpretations are more difficult without any contextual support, and this could have affected participants’ comparison judgments. To insure that the effects found are not being driven solely by a dis-preference for certain present tense sentences, the previous analyses were re-performed using just test items in the past tense. This restricted analysis produced very similar results to the complete analysis and did not change any significant findings.

aspect telicity, lexical aspect durativity, grammatical aspect, and tense) contribute to the coherence of the prototypical groups.

General Discussion

Children acquiring their first language tend to produce only a sub-set of the temporal-aspectual combinations available to them. Two experiments were conducted here to determine if adults – in contexts wholly divorced from the language acquisition setting – would also show an influence of the prototypical temporal-aspectual groupings that are most commonly used by children. The results were clear: Even though adults are capable of the full range of forms, they are slightly better at comprehending prototypical combinations (Experiment 1) and further, judge sentences which conform to the prototypes as better than sentences which draw features equally from both groups (Experiment 2).

The implications of these adult data for the first language acquisition literature are partly theoretical and partly methodological. Theoretically, they suggest a continuity between the grammatical representations of adults and children in this domain. The difference between adults and children is not one of qualitative kind (i.e., adults know something different than children) but simply of quantitative degree (i.e., adults are better than children at using their knowledge). Adults and children agree on what the hard cases are (the cross-group combinations), but they do not deal with these hard cases equally well: adults can compensate (they are only marginally worse at comprehending non-prototypical forms) while children fall apart. Moreover, the fact that children (and adults) are better at comprehending non-prototypical cases when the situation provides more information (i.e., the Telic pictures showing agent and object information) strongly suggests that their difficulties lie in integrating their grammar with the world and not in the grammatical representation itself. That said, the fact that adults judge non-prototypical combinations as less good than their prototypical

counter-parts suggests that the processing considerations that make these sentences hard are persistent, and continue to play a role in how even adults access their grammar⁶.

Methodologically, these data suggest that children's under-extensions do not provide a good source of evidence for their having a different grammar. There are many reasons that a child might choose not to say something⁷ – in the case of aspect, those reasons appear to remain relevant even for adults. The fact that extra-linguistic factors have more extreme effects on young children than adults is an interesting and important fact, but it is not an argument against continuity. It is still possible, of course, that the causes of the children's errors and the patterns found with adults are wholly different, and that continuity is just an illusion. If so, however, data beyond children's under-extension with temporal-aspectual forms would be needed to establish it.

Beyond the realm of language acquisition, moreover, these data are consonant with the idea that there are prototypical combinations which are better – intuitively better, and based on empirical data, better understood, more easily produced, judged as better, and learned more easily. But what exactly are these prototypes? What exactly does it mean to say that a past-perfective-telic sentence is more prototypical than a past-imperfective-telic one?

Li and Shirai (2000) essentially adopt a frequency based definition: the prototypical groups are the ones most frequently present. They propose a connectionist network which learns the prototypical groups as a function of the frequency of the tense-aspect combinations in its inputs. Previous accounts in this line (cf. Shirai & Andersen 1995) had suggested that the organizing force for the prototypes was the morphology itself (the *-ing* and the *-ed*) but the

⁶ Contrarily, one might argue that these data provide evidence that adults don't have the traditionally defined adult grammar, but instead have their temporal-aspectual categories organized in a prototypical fashion. Such a position is at odds with a large body of semantic results that depend on the independence and separability of tense, grammatical aspect and lexical aspect.

⁷ See also Fisher (2002) for similar arguments pertaining to children's under-extensions in the domain of argument structure.

2000 model is quite general. As input, the network takes a phonological form and a semantic representation. Both the form and the meaning include lexical and grammatical information⁸, but the two kinds of information are not specially distinguished in any way. The grammatical forms emerge in the model by virtue of their frequency and regularity. Similarly, the semantic space becomes organized as a function of frequently and regularly co-occurring semantic elements. Telic predicates occur more frequently with perfective and past semantics which creates a highly active, connected space in the network for that combination of features. They argue that children's extreme reliance on prototypical groupings can be modeled in their network; it is the natural output of the network given a limited amount of slightly skewed input. The results from the adults in the experiments reported here would also reflect adults' easier access to higher frequency items.

The semantic space of Li & Shirai's model, like the input it receives, does not distinguish between lexical and grammatical information. Indeed, lexical aspect categories emerge within the model partly as a function of their systematic co-occurrence with their prototypically associated grammatical morphology. There are instead, only clusters of features. Telic, perfective and past items create a strongly active cluster as do atelic, imperfective and present items; cross-group pairings also appear in the model, but they do so in less active, more disparately connected associations. Because their model effectively creates a single cluster for each prototype, Li & Shirai suggest that this unified semantics may reflect an actual early state of the grammar. As noted in the introduction, such a claim puts this position in the camp claiming that there is a radically different grammar for the child relative to the adult. It has the virtue, however, of providing an account of how children would

⁸ This is a slightly generous interpretation of their semantic representations. Li & Shirai (2000) actually use lexical co-occurrence patterns as semantic representations; grammatical information is incorporated to the extent that, for example, *is making* and *made* have slightly different co-occurrence patterns. As Li & Shirai themselves note, however, one could certainly use other semantics as input, including notions like currently ongoing or completely finished.

become adults: they don't change qualitatively (as the experimental data provided here shows, adults continue to show effects of the prototypes) but only quantitatively (the non-prototypical combinations compete more effectively for activation within the network).

As a frequency based account, however, Li & Shirai's model leaves open an explanatory question: Why are the prototypical groups more frequent? The model does not require the input to have the extreme frequency distribution that the output has, but it must be at least slightly skewed in that direction. In other words, the prototypical groups are transmitted precisely because they have existed in the past. What is needed in addition is an account of why people want to talk about the prototypical cases more than the non-prototypical cases. Li & Shirai (see also Andersen & Shirai 1994) point to what must be the right answer: the semantic features that organize temporal/aspectual space are not distributed randomly in our conceptualization of the world. What these prototypes offer us is actually a window on how we process time and event information and translate it into linguistic form.

Indeed, it is possible to account for the temporal-aspectual prototypes in purely information theoretic terms: the most frequent and prototypical combinations are the ones that make it easiest to compute the temporal-aspectual information. For example, in order to determine if perfective aspect is warranted, it is necessary to determine if the event in question has terminated. Telic predicates, by virtue of specifying a designated end-point, make it comparatively easy to identify the termination point of the event, and thereby warrant perfective aspect. By contrast, attempting to take an imperfective perspective on a telic event immediately mires one in the traditional problems of the imperfective paradox – for example, if I've only built a tenth of a house, is it even fair to use the predicate *build a house* to describe what I'm doing? To the extent that the predicate does apply, it requires making a claim about my intentional state and probable future actions. That is, the amount of information and reasoning needed to assess an imperfective-telic combination as true (or even felicitous) is

much greater than what is required for a perfective-telic combination. The link between perfective aspect and past tense may be even stronger. To determine whether an event's termination point has been reached, one must be able to identify the point in time when the termination happened and be certain that it did not continue at the next point in time. This judgment can easily be made for times that are in the past, but it is virtually impossible to make for the present time: who can say what will happen in the next moment in the future?⁹ On this story, the prototypical combinations are those for which the semantic components aid in their mutual interpretation; they are simply easier to compute than the non-prototypical combinations.

Support for this information processing view comes from the results of Experiment 1. Both children and adults found imperfective aspect more difficult to comprehend with Telic predicates relative to Atelic ones, but only when the Telic predicates were being matched to the comparatively low-information set of pictures. It is not the non-prototypical linguistic combination which causes trouble per se; it is trying to evaluate this combination with restricted information that seems to be particularly difficult. Non-prototypical cases are those which require additional or very specific pieces of information to evaluate; they are therefore more likely to be influenced by specific informational conditions¹⁰.

A related explanation has been articulated by Bohnemeyer & Swift (2004). They note that telic predicates only achieve their full "event realization" in perfective aspect. That is, the

⁹ Indeed, the combination of present and perfective (in English, the present perfect) typically targets the result state that follows an event (see Comrie 1976 among others). Since telic predicates are much more likely to lead to specific results than atelic predicates, they tend to be more felicitous in that construction.

¹⁰ Further support is found in recent work of Johnson & Morris (submitted). They asked 3-year-old children to imitate telic and atelic predicates in the past tense. Children were better with the former, prototypical items than the latter, non-prototypical ones. Moreover, there was an interaction with phonological complexity: Children were much better at imitating the non-prototypical (atelic & past) items when the past marker required an easy consonant cluster (e.g. /Id/ in "Sue peeled the stickers") than when it required a difficult cluster (e.g. /ft_d/ in "Sue lifted light packages"). This data suggests that phonology may also contribute to informational complexity.

meaning of a telic predicate such as *Nana made a sandwich* critically includes the end-point of the event (the completed sandwich). Thus, the full realization of such a predicate must include that end-point. Perfective aspect includes the temporal ending of an event (Bohnenmeyer & Swift adopt the formalism of Klein 1994 outlined previously) and therefore it allows for the full event realization of the telic predicate. Atelic predicates, specifying no inherent end-point, can be fully realized under either perfective or imperfective aspect. They argue that there is a natural preference for full event realization and, on Gricean grounds, argue further that this preference leads to a natural linkage between telic predicates and perfective aspect, and between atelic predicates and imperfective aspect. These links they call default aspect. In other words, the prototypical groupings are defaults, and allow for maximal instances of full event realization. If we assume that fully realized event are easier to identify and compute, then Bohnemeyer & Swift's view is essentially the same as the information-theoretic view proposed here.

Bohnenmeyer and Swift, moreover, adduce intriguing linguistic data in support of this view. They argue that in languages which do not have overt marking for perfective and imperfective aspect (e.g. German), predicates will typically be interpreted according to their default aspect. In such languages, the default aspect is a pragmatic implicature: often present, but cancelable under the right circumstances. More strongly, they note that there are languages that codify these pragmatic implicatures into the grammar itself. For example, in Inuktitut, verbs may be unmarked (or 0-marked) for grammatical aspect. In such cases, telic predicates are interpreted as perfective and atelic predicates as imperfective, in concert with the default or prototype. Unlike the German case, Inuktitut does have morphological markers for imperfective and perfective, but these are used to signal divergence from the default. That is, telic predicates get overtly marked for imperfective while atelic predicates get overtly marked for perfective. Thus, in these languages, it is the non-prototypical cases which receive

overt marking. Predicates are assumed to have their default (or prototypical) aspectual interpretation unless that assumption is explicitly contravened with an overt marker.

The idea that the default interpretations would be unmarked is unproblematic from a linguistic point of view, but it is unclear how a connectionist net would be able to handle it. In effect, the most frequent separable phonological forms will end up linking to the less frequent semantic combinations, and the absence of specific marking will be associated with two distinct meanings – imperfectivity with atelic predicates and perfectivity with telic predicates. To the extent that a connectionist model depends on frequency of form information to drive the emergent organization, a language like Inuktitut will be quite difficult to account for.

Alternatively, an information-processing view can capture the Inuktitut facts quite easily: the easier it is to compute a piece of information, the less evidence we need for it, including overt marking. In the end, the bedrock of semantic understanding lies not in specific forms, but in the relationship between language and our conceptualization of the world. Frequency information can act as a proxy for highly connected pieces of information, and Gricean maxims can stand in for inferential processes. But ultimately, in trying to understand how children acquire a semantic system and how adults use such a system, we must understand how the system itself is organized and how its pieces correspond to the world we want to describe and understand.

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Figure 1

Example Picture Pairs and Target Sentences for Experiment One

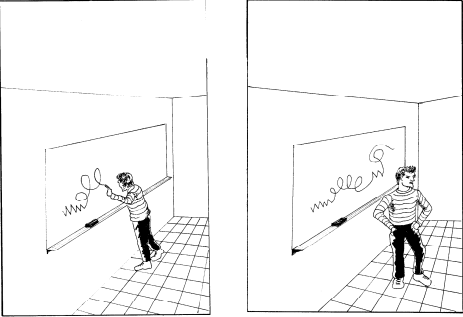
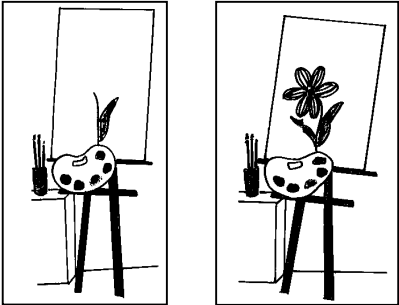

		Imperfective Sentence (matches Left picture)	Perfective Sentence (matches Right picture)
Atelic		The boy was scribbling.	The boy scribbled
Telic – Object Only		Somebody was painting a flower.	Somebody painted a flower.
Telic – Object and Agent		The woman was painting a flower.	The woman painted a flower.

Figure 2

Children and adult performance on Experiment 1. All adult scores are significantly above chance ($p < .02$ level). Children's scores are all above chance ($p < .02$) with the exception of Imperfective + Telic-Object Only and Perfective + Atelic, both of which are at chance. Both children and adults show a significant advantage for the Perfective over the Imperfective given Telic – Object Only pictures, and for the Imperfective over the Perfective given the Atelic pictures.

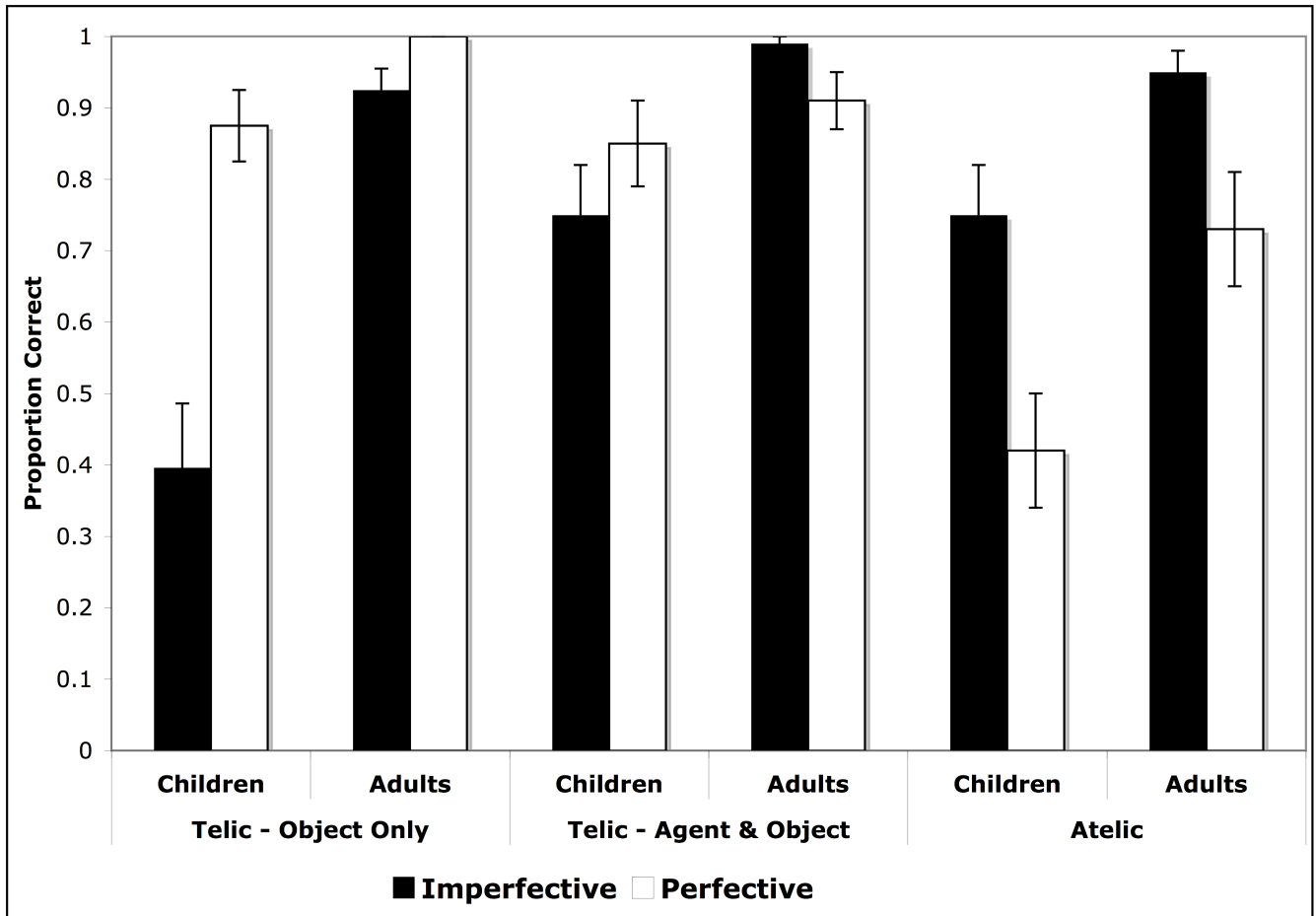


Table 1

Prototypical Temporal/ Aspectual Groupings

	Group 1	Group 2
Lexical Aspect	Telic (punctual)	Atelic (durative)
Grammatical Aspect	Perfective	Imperfective
Tense	Past	Present

Table 2

Base sentences used in Experiment 2

Telic	Durative (Accomplishment)	The man BUILD a house.
	Punctual (Achievement)	The woman WIN the race.
Atelic	Durative (Activity)	The teacher CARRY the box.
	Punctual (Semelfactive)	The child TAP the table.

Table 3

A full set of forms for one base in Experiment 2

Past	Imperfective	The woman was winning the race.
	Perfective	The woman won the race.
Present	Imperfective	The woman is winning the race.
	Perfective	The woman has won the race.

Table 4

Experiment 2: Mean scores (std dev) for sentences drawing values from the same or different groups

	Same Group	Different Groups
Telicity and Grammatical Aspect	8.6 (0.71)	6.4 (0.71)
Tense and Grammatical Aspect	9.23 (1.54)	5.77 (1.54)

Table 5

Experiment 2: Mean score (std dev) for sentences sharing 2, 3, and 4 values from the same temporal/aspectual group.

	Mean Score (std dev)
2 values shared	6.61 (0.7)
3 values shared	7.73 (0.3)
4 values shared	10.63 (1.28)

Appendix A:

Complete list of sentences used in Experiment 2, organized by features. They are arranged in order of their average ranking.

Mean Rank	Sentence	Telicity	Durativity	Grammatical Aspect	Tense
11.90	The woman won the race	Telic	punctual	Perf	Past
10.80	The man built a house	Telic	durative	Perf	Past
9.90	The woman is winning the race	Telic	punctual	Imperf	Present
9.50	The teacher is carrying the box	Atelic	durative	Imperf	Present
9.40	The man is building a house	Telic	durative	Imperf	Present
8.80	The woman has won the race	Telic	punctual	Perf	Present
8.50	The child is tapping the table	Atelic	punctual	Imperf	Present
8.10	The child tapped the table	Atelic	punctual	Perf	Past
7.70	The teacher was carrying the box	Atelic	durative	Imperf	Past
7.50	The teacher carried the box	Atelic	durative	Perf	Past
6.60	The man has built a house	Telic	durative	Perf	Present
5.80	The woman was winning the race	Telic	punctual	Imperf	Past
5.20	The child was tapping the table	Atelic	punctual	Imperf	Past
4.70	The man was building a house	Telic	durative	Imperf	Past
3.10	The teacher has carried the box	Atelic	durative	Perf	Present
2.50	The child has tapped the table	Atelic	punctual	Perf	Present