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EARLY SENSITIVITY TO TELICITY: THE ROLE OF THE COUNT/MASS DISTINCTION IN EVENT INDIVIDUATION

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This paper presents evidence that English-speaking children are sensitive to telicity based on the count/mass distinction of the object noun in verb phrases such as *eat an apple* (telic) vs. *eat ice cream* (atelic). Previous work (Wagner and Carey 2003) has demonstrated that children use the presence/absence of the object in a verb phrase to recognize the end point of an event, though children continued to show a bias for a spatio-temporally defined individuation compared to adults. In the present experiment, telicity was specified by the count/mass distinction of the object noun. The results both replicated and extended the general findings of Wagner and Carey: children showed knowledge of telicity, but the spatio-temporal bias was still dominant in their event individuation. It is concluded that children's sensitivity to telicity stems from sources ranging from syntactic to semantic.

1. INTRODUCTION.

1. 1 TELICITY AND EARLY SENSITIVITY. A range of studies has shown that the aspectual property of telicity is crucial in child language. Aspect refers to the internal temporal properties of an event; telicity is a specific type of aspect that denotes an event's endpoint. A bounded event is telic, while an unbounded event without an obligatory endpoint is atelic. For example, *John swam across the river* is telic, as the event terminates when John reaches the other side of the river, while *John swam in the river* is atelic with no specified delimitation. It has been claimed that children initially develop past tense morphology with telic verbs, while they develop progressive morphology with atelic verbs (Antinucci and Miller 1976 with one English and seven Italian-speaking children, Bronckart and Sinclair 1973 with French-speaking children, Bloom et al. 1980 with English-speaking children, and Shirai and Andersen 1995 with three English-speaking infants showing sensitivity to telicity as young as 1;6 to 2;4 years).

Telicity has been suggested to correlate with the direct object noun (Levin and Rappaport 1995, Borer 2005, Folli and Harley 2006). This telicity/object correlation posits that predicates describe telic events when the object is present (e.g., *Mary ate the apple*) and atelic events when it is absent (e.g. *Mary ate* φ.). In Wagner and Carey 2003, children were instructed to watch a video clip of an event and to individuate it by answering the question 'how many times did X do Y?' Two conditions were tested: either telic (e.g., the direct object was present in the question) or atelic (e.g., the object was absent from the question).[2] The video clip showed a single event, *painting a flower*, with a temporal break in between. If children responded that the flower was painted *twice*, this would indicate that they used spatial/temporal criteria to define the activity, thereby regarding the action before the break and the one after it as two separate events. If they answered *once*, this would imply that they used a higher criteria, i.e., the event's endpoint, to define it, thereby regarding both actions as one whole event. In the object-present condition (1), children with a mean age of 3;6 years old answered *once*, indicating that they employed the higher criteria and considered the predicate a telic event. In the object-absent condition (2), however, these children responded *twice*, revealing that they considered the predicate atelic. These results show that children are able to use information from syntactic forms to determine whether a given event is telic.

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[1] I thank Dr. Kamil Deen for supporting me from the experimental design to the review of the article. My gratitude also goes to Dr. Amy Schafer for insightful advice on data analyses and the reviewing process. Any remaining errors are my own.

[2] Four types of syntactic devices that include this presence/absence of the direct object noun were used to specify the event goal in their experiment.

(1) 'How many times did she paint *a flower*?' *telic*

(2) 'How many times did she paint *φ*?' *atelic*

(3) 'How many times did she eat *an apple*?' *telic*

(4) 'How many times did she eat *ice cream*?' *atelic*

The present study investigates properties of the object noun in particular, focusing on the count noun vs. mass noun distinction as seen in (3) and (4). Here, the distinction encodes the boundedness of the entity. The object noun has been claimed to measure an event as the *incremental theme* (Dowty 1991, Krifka 1989, 1992, Ramchand 1997, and Tenny 1992, 1994): if the object noun refers to a bounded entity it makes the event telic, and if to an unbounded entity, atelic. The mass noun in (4) encodes no intrinsic boundary, making the event atelic, while the count noun in (3) delimits the entity, encoding a telic event. The question is whether children use this relationship between boundedness and telicity as it occurs with object nouns to help them interpret the temporal nature of events.

1. 2 OBJECT AND EVENT INDIVIDUATIONS. We have noted that telicity encodes the boundary of an event, and that these boundaries are understood in this paper to be reflected in the count/mass status of nouns. A count noun supplies a boundary if it specifies a certain quantity for its referent (such as a/one or three). Mass nouns (such as water), as well as count nouns that indicate an unspecified plural number of referents (such as apples), supply the property of unboundedness. The parallelism between bounded events and objects has prompted researchers to compare the two (Jackendoff 1991). Interestingly, they are not parallel in terms of individuation.

Individuation refers to breaking down a stream into units. Researchers have suggested that spatio-temporal criteria, which rely on physical/ perceivable boundaries, are of primary importance in child language representation of the object domain (see also Spelke, Breinlinger, Macomber, and Jacobson 1992, Xu and Carey 1996). Shipley and Shepperson (1990) showed children three intact cars along with a car broken into two distinct pieces, and found that children counted each piece of the broken car as one unit equal in value to an intact car when asked to count how many cars there were. To individuate an entity called "a car," comprehenders must correctly decode linguistic information contained within this label that refers to a specific boundary. Children thus showed divergence from adults, who have access to the higher-level criteria (the basic label of *car*) and who would not count broken pieces as *cars*. In this way, language imposes the criteria for individuation, and children need to develop these criteria. Crucially, Shipley and Shepperson (*ibid*.) revealed that the *spatio-temporal criteria* persist as a powerful basis of object individuation into childhood; in their study, children as old as five years would count objects using these criteria.

Studies have shown that children individuate events based on spatio-temporal criteria, by pauses between motion and discontinuity in kinds of motion (Wynn 1996), or by repeating patterns of motion (Sharon and Wynn 1998, 2000). Accurate event individuation, however, often requires use of conceptual criteria of a higher level than just spatio-temporal; factors such as the intentions and goals of the actor must often be considered. These higher-level criteria are referred to as *goal-based* criteria. For example, the telic event *build a house* should be counted as a goal even if fits[3] of action were involved during the building. If the building process stops short of a completed house, it would not constitute an entire instance (Wagner and Carey 2003:166). There is some strong evidence that infants *represent* events in terms of goal states by the end of the first year (Gergely, Nadasdy, Csibra, and Bíró 1995, Csibra and Gergely 1996, Bíró, Gergely, Koós, and Csibra 1996, Csibra, Gergely, Brockbanck, Bíró, and Koós 1998, and Woodward 1998), indicating that "the goal was a natural break point in infants" (Wagner and Carey

[3] A *fit* refers to the internal discreteness of an event. For example, eat an apple is a culmination of a single event that can be accomplished in fits of activity such as multiple bites.

2003:166). However, little is known about whether children use a goal-based strategy when they *individuate* events.

Wagner and Carey (*ibid.*) tested event individuation with children, and the results revealed two important facts. First, children were sensitive to linguistic cues used when asked about events. Specifically, when questions about events included the object noun (Condition *i* in table 1), children more often counted the event as one culminating whole, while they counted more often individual fits of activity as separate events when the researchers' questions did not include the object noun (Condition *ii* in table 1). Secondly, children continued to show a bias toward spatio-temporal individuation. However, telicity can be determined by other factors and we cannot be certain whether children are only sensitive to telicity due to these particular syntactic sources.

TABLE 1. Example stimuli for testing event individuation in Wagner and Carey 2003

Condition	Video	Test Question	Possible Answers
i Presence of the object (Telic description)	- Boy blowing up a balloon with a pause between puffs of air	'How many times did the boy blow up the balloon?'	1 → telic events 2 → sub-actions
ii Absence of the object (Atelic description)		'How many times did the boy blow?'	2 → sub-actions

In the experiments conducted for the present study, we always included the direct object in the question; therefore, children interpreted telicity based on the boundary information of the stated entity. We tested two hypotheses: First, if telicity due to count/mass nouns has the same effects as telicity due to the presence/absence of the object noun, a child who is sensitive to telicity should count telic boundaries using goal-based criteria with count nouns (Condition *i* in table 2). On the contrary, a child who is not sensitive to these boundaries should use spatio-temporal criteria, meaning that s/he will count sub-actions with this telic description. Their behaviors are compared with an atelic condition (Condition *ii* in table 2), that has spatio-temporal breaks alone. Another possible outcome is that children could count a *single situation*; that is, they could count the sequence of events/actions as a single situation for some reason beyond the proposed criteria.

TABLE 2. Example of the present experiment's design

Condition	Video	Test Question	Possible Answers
i Count noun (Telic description)	- Girl eating 3 apples - Each apple eaten in 2 bites	'How many times does/did she eat an apple?'	3 → telic events 6 → sub-actions 1 → single situation
ii Mass noun (Atelic description)	- Boy eating ice cream - Ice cream eaten in 5 bites	'How many times does/did he eat ice cream?'	5 → sub-actions 1 → single situation

2. EXPERIMENT

2. 1 METHOD

2. 1. 1 SUBJECTS. Sixteen children with a mean age of 4;6 (range: 3;8 to 5;5) at the University of Hawai'i at Mānoa's Children's Center and fifteen undergraduate and graduate students at the University of Hawai'i at Mānoa as adult control participants were tested for compensation of small gifts. Their first language was English.

2. 1. 2 STIMULUS SENTENCES. Six pairs of sentences were created, resulting in twelve experimental items. Six verbs were used, once each with both a count noun and a mass noun (see the Appendix for the full sentence lists). Nouns were preceded by the indefinite article *an*/*a* for the count noun condition and were used in bare form in the mass noun condition.

All count noun materials were designed to allow both spatio-temporal and goal-based individuation. All mass noun materials consisted of temporally discrete process actions. Counting sub-actions indicates that subjects are making use of spatio-temporal criteria, counting telic events shows use of goal-based

criteria that allow access to an event boundary, and counting a single situation indicates reliance on a factor beyond these criteria.

2. 1. 3 STIMULI. Animated movies were created by importing pictures of event scenes hand-drawn by the experimenter into Microsoft Paint and then collecting them into Windows Movie Maker to produce movie clips. Each clip was made of a sequence of one-second-long scenes, totaling no longer than 32 seconds. No audio track was included. A gender-neutral character was shown engaging in the described actions and the use of *she/he* in the target question sentences was balanced. No fillers or comprehension questions were included.

2. 1. 4 PROCEDURE. A counting task from Wagner and Carey 2003 was employed. Experiment sessions were individually completed, one child at a time. Each child sat together with the experimenter, who presented a set of twelve animations on a 15.4 inch screen computer. Before and after each movie, children were asked questions orally in the form, "*How many times does/did s/he...*?", with a change of tense from present before a movie to past after a movie. The question was also visually presented in words on the screen before and after each animation. This was done to maintain consistency within the stimuli used across age groups. The children responded by answering aloud to the post-animation question, and their responses were hand recorded. They were free to count along with the animations, and the timing of their responses relative to the animation was used to resolve any ambiguities in their answers. The twelve animations were presented in either of two fixed pseudo-randomized lists. Subjects were free to ask to see the video more than once, and if a child was inattentive during the movie, the experimenter replayed it. The experiment session took approximately thirty minutes for each child.

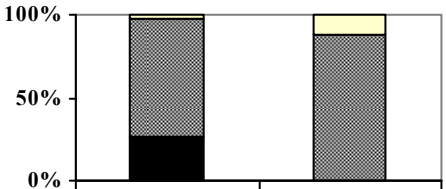
An adult control group was tested using similar procedures, except they did not receive a verbal presentation of the test questions. Adults answered by filling in a questionnaire. The twelve items were presented in one fixed pseudo-randomized order by placing the stimuli on a website.

2. 2 CODING. The responses were coded into three categories: sub-actions, telic events, and single situations. Seven percent of the adults' responses to count noun stimuli were removed from the analysis, as they proved difficult to classify into any of the three categories. For example, some participants counted two or four telic events when there were actually three. All the children's responses, by contrast, fit clearly into one of the categories. Some children counted each slide in an animation rather than the sub-actions (e.g., two strokes that expressed one sub-action of drawing some rain), but these responses were coded as counting sub-actions as long as their intention to do so was clear.

2. 3 RESULTS. Figures 1 and 2 below present the categorical responses across each noun type by children (figure 1) and adults (figure 2). With count nouns, children counted sub-actions 71% of the time, indicating a clear bias toward spatio-temporal criteria in counting. This contrasts with the adults, who counted sub-actions only 1% of the time. A significant number of child responses (27%) did, however, involve the goal-based criteria.

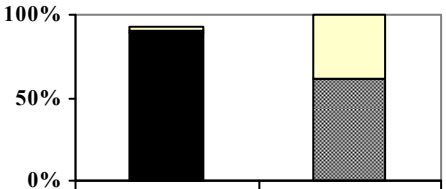
With mass nouns, a strong majority of children (88%) and adults (62%) counted sub-actions (i.e., used spatio-temporal criteria): this is parallel to Wagner and Carey's finding that, "when given an atelic description, both [children and adults] relied on spatio-temporal criteria." In addition, the current study's results indicate that some adults and children saw events as a single situation but more often with adults than with children.

FIGURE 1. Responses by children (N=16)



	Count	Mass
Single sit.	2%	13%
Sub-action	71%	88%
Telic	27%	0%

FIGURE 2. Responses by adults (N=15)



	Count	Mass
Single sit.	3%	38%
Sub-action	1%	62%
Telic	89%	0%

Note. Both figures show mean use of individuation criteria over the total responses for each condition.

A 2 (telicity: count vs. mass noun) X 2 (age: children vs. adult) ANOVA, with the telicity variable as a within-subject factor and the age variable as a between-subject factor for subject analyses, and with both variables as within-item factors for item analyses, was applied to each of the three categorical responses, and confirmed the above impressions. This led to three pairs of ANOVAs by subject and by item. The dependent measure was the number of a given categorical response over the total responses on a given condition. For example, a proportion of the subject analyses reflects how many items out of the six within either the count or mass noun condition a participant responded to in a given category; likewise, a proportion in the item analyses represents how many participants out of sixteen children or fifteen adults answered for a given item by a given category. Table 3 summarizes mean percentage scores with the standard deviations from the twelve groups used for these ANOVA analyses.

The results of the two-way ANOVA analyses revealed that noun type was significant in both telic and sub-action responses: count nouns elicited significantly more counting of telic events than mass nouns regardless of participant age [F_1 (1,29) = 141.03, p <.001), F_2 (1,5) = 975.14, p <.001]. In contrast, participants counted sub-actions when mass nouns were used in the question stimulus more often than they did when count nouns were used [F_1 (1,29) = 124.31, p <.001, F_2 (1,5) = 36.62, p =.002]. Participants also regarded events as single situations more often when mass nouns were used than when count nouns were [F_1 (1,29) = 20.67, p <.001), F_2 (1,5) =12.88, p =.016]. The overall results indicate that the count/ mass distinction played a role in determining how participants conceived of events and how they decided which particular individuation criteria to use.

The differences observed between children and adults replicated those found by Wagner and Carey (*ibid.*). Age was a significant factor in all the categorical responses, demonstrating that adults counted more telic events [F_1 (1,29) = 40.05, p <.001, F_2 (1,5) = 40.09, p =.001] and more single situations than children [F_1 (1,29) = 12.505, p=.001), F_2 (1,5) = 4.07 p =.100], while children counted more sub-actions than adult speakers across noun types [F_1 (1,29) =41.35, p <.001), F_2 (1,5) =42.57, p =.001]. These results suggest that children see more physical/spatial boundaries than telic/goal boundaries, indicating that they favor more spatio-temporal than goal-based criteria for individuation of events. By contrast, the adults sharply reflected telicity in their individuation when given count nouns.

The interaction effect was significant in counting of sub-actions [F_1 (1,29) = 40.59, p <.001), F_2 (1,5) = 10.65, p =.022], in counting of telic events [F_1 (1,29) = 40.05, p<.001), F_2 (1,5) = 40.09, p =.001], and in counting of single situations by participants but not in items [F_1 (1,29) = 5.93, p = .021, F_2 (1,5) = 3.08, p =.140], indicating that the effect of noun type was greater in the adult group than in the children group. Overall, adults showed more sensitivity to the noun type than children.

TABLE 3. Mean ratios for the twelve groups

	Single sit.		Telic events		Sub-actions	
	mean	SD	mean	SD	mean	SD
Count						
child	.02	(.057)	.27	(.316)	.71	(.319)
		(.032)		(.110)		(.094)
adult	.03	(.129)	.89	(.215)	.01	(.043)
		(.037)		(.144)		(.027)
Mass						
child	.13	(.224)	.00	(.000)	.88	(.224)
		(.105)		(.000)		(.105)
adult	.38	(.222)	.00	(.000)	.62	(.222)
		(.294)		(.000)		(.294)

Note. Values in parentheses indicate standard deviations (upper value for subject analyses, lower for item analyses)

Three further analyses (i.e., *t*-tests) were conducted to examine (A) whether children counted sub-actions differently when presented with count nouns as opposed to with mass nouns (paired *t*), (B) whether there were any significant differences in children's vs. adults' counting of sub-actions for mass nouns (subject analysis: unpaired *t*, item analysis: paired *t*), and (C) whether children and adults differed in their counting of events as single situations when presented with mass nouns (subject analysis: unpaired *t*, item analysis: paired *t*). Comparison A revealed that children counted sub-actions more when using mass nouns than count nouns [$t_1(15) = 2.13$, $p<.001$, $t_2(5) = 2.57$, $p=.048$]. On the other hand, Comparisons B and C were significant by participants [B: $t_1(29) = 2.05$, $p=.004$; C: $t_1(29) = 2.05$, $p=.0038$], but not items [B: $t_2(5) = 2.57$, $p=.115$; C $t_2(5) = 2.57$, $p=.115$]. Hence the results indicate that children were indeed sensitive to the count/mass distinction enough to react to the telic boundary with count nouns, and mass nouns elicited mixed results but showed some tendency for children to count more sub-actions than adults.

3. DISCUSSION. From the data, it is clear that the presence/absence of the object noun in verb phrases is not the only linguistic cue that children are sensitive to when deciding whether to interpret a given event as telic. The present study tested early knowledge of events centering on mass/count nouns for the interpretation of telicity, and the results implied that children are sensitive to the object/telicity correlation (Borer 2005, Levin and Rappaport-Hovav 1995, etc.) to the type of referent of the direct object.

Using noun type as a factor in deciding telicity, our results indeed replicated Wagner and Carey's two important findings: children showed some ability to individuate events in an adult-like fashion when the events owed their telicity to the count/mass distinction of the object noun (t-test A), but they nevertheless still preferred to individuate events on a spatio-temporal basis more often than adults (ANOVA on sub-actions). This was shown in the present experiment when children counted more sub-actions with mass nouns than with count nouns, but still counted more sub-actions across all conditions than the adult speakers did.

One important finding that did not appear in Wagner and Carey was that some participants tended to count events as a single situation rather than as sub-actions or telic events. This individuation strategy may have been induced by researchers' use of past tense morphology, which has the effect of assigning an end-point, as "the perfective aspect[4] conveys an outside-the-event perspective, and permits one to view the event as a complete whole" (Madden and Zwaan 2003:663). This result may also be due to idiosyncratic properties of individual items; both children and adults counted single situations with certain items (e.g., *knit wool, eat ice cream, fold paper*) but not with others (e.g., *draw rain, make café au lait*). Still, crucially, consistent with the tendency that children preferred to count spatio-temporally defined events rather than goal-based events, they were less likely to count a complete whole than adults. This finding

4 Madden and Zwaan use perfective aspect to refer to simple past tense (not perfective tense).

may suggest that grammatical aspect, i.e., simple past tense, could have an equally powerful influence on individuation with lexically-defined aspect such as the count/mass distinction.

One may question whether children considered *object individuation* at all when they individuated events with the present stimuli, thinking that telicity in this study was determined by the boundedness of the object entity, which might let event individuation resort to object individuation. Particularly, the resulting state in this study was explicitly presented in the form of creation or consumption. For instance, children might count *a scarf* (which is the result of a part-by-part creation process) or *a disappeared apple* (which is the result of a part-by-part consumption process) instead of events. If this were the case, children might have counted the parts of the object instead of the whole, using the spatio-temporal criteria, considering that even 5 year-olds continue to prefer spatio-temporal criteria for object individuation (see Shipley and Shepperson 1990, as well as the results from object individuation in Wagner and Carey 2003). The present results indicate, however, that children do attempt to use conceptually-higher criteria, as indicated by their use of the telic boundary with count nouns. I would like to conclude, therefore, that the present result indicates that children appear to employ criteria for event individuation rather than simply allowing object individuation, with which they would have used spatio-temporal criteria that would preclude the use of telicity. This result also indicates that children are able to incorporate the boundedness information of the object noun in recognizing telicity, despite the fact that children have difficulty performing object individuation itself.

The state that results from the action of the verb is also important in event perception in another way. Smiley and Huttenlocher (1995) state that *outcome* is a very important factor to children when they generalize verbs. Compared to *agent changes*, *changes of event appearance*, including *changes of manner*, are more likely to inhibit children's generalizations of verbs. In the present experiment, the outcomes differed in each count/mass pair, whereas the verbs stayed identical. Some items were also accompanied by a change of manner (e.g., *eating an apple* by biting vs. *eating ice cream* by scooping). Therefore, one may wonder whether children might have regarded each pair as actually consisting of two different verbs. One objection against this possibility is that children aged 2;2 revealed to have learned to recognize instances of the same verb even when they occur with different agents and manners (Forbes and Poulin-Dubois 1997). Wagner and Carey 2003 helped control for this possible variable by showing the same picture stimuli for both telic/atelic conditions (varying linguistic cues alone). In any case, the present study focused on how children individuate events, regardless of whether they consider a given pair to be instances of the same event. Future research could address the question of whether differences in telicity that do not include change of the resulting state, such as that examined in Wagner and Carey 2003, can affect verb extension.

4. CONCLUSION. This paper described and analyzed children's sensitivity to telicity due to the count/mass distinction of the object noun. The results showed that (1) children showed sensitivity to the count/mass contrast (i.e., counting fewer sub-events with count nouns than with mass nouns), but that (2) children preferred the use of spatio-temporal criteria (i.e., counting sub-events) when individuating events. Our report would seem to indicate that children know how to count events when a telic boundary is presented in either the linguistic cue or in the form state that results from the action of the verb.

APPENDIX. Stimuli for experiment

A complete list of event stimuli for the experiment. (Correct answer under each description given in parentheses; number of sub-actions provided in the form of "*X sub*" for the telic description)

Item	Telic description	Atelic description
	"How many times…"	"How many times…"
fold	does she fold a paper crane? (3);*3sub*	does she fold paper? (4)
eat	does he eat an apple? (3);*2sub*	does she eat ice cream? (5)
dig	does he dig a hole? (2);*3sub*	does he dig mud? (7)
draw	does he draw a flower? (2);*3sub*	does he draw rain? (8)
make	does she make a sandwich? (3);*3sub*	does she make café au lait? (6)
knit	does she knit a scarf? (2);*3sub*	does she knit wool? (6)

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