15 Who's the Subject? Sentence Structure and Verb Meaning

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Even very young children use the syntax of sentences to interpret new words. In many experiments, children between the ages of 2 and 5 assigned different interpretations to made-up verbs, depending on the sentence structure in which the verb was presented (e.g., Fisher, 1996, 2000, 2002; Fisher, Hall, Rakowitz, & Gleitman, 1994; Naigles, 1990, 1996; Naigles & Kako, 1993). Such findings tell us that observed events are not the only influence on verb interpretation even for very young children; sentence structure provides useful cues as well. The proposal that sensitivity to sentence structure guides the acquisition of verb meaning is known as syntactic bootstrapping (Gleitman, 1990; Landau & Gleitman, 1985).

But how could syntactic bootstrapping work? What aspects of sentence structures are informative to young children, and what semantic information is conveyed to young children by the structure of sentences?

The meaning conveyed by a sentence structure must necessarily be very abstract (e.g., Fisher, Gleitman, & Gleitman, 1991; Pinker, 1994). The sentences in (1) are all transitive yet contain verbs differing greatly in their meanings, ranging from action on an object (*kicked*) to perception (*saw*) and abstract causation (*justified*, *pleased*).

(1) a. Emma kicked John.
    b. Emma saw John.
    c. The conversation justified all their hopes.
    d. John's sincerity pleased Emma.

The diversity of meanings of transitive verbs should be no surprise. Sentence structures vary principally in the number and type (e.g., noun phrases versus sentence complements) of arguments and the positioning or marking of those arguments (e.g., subject versus object). Therefore, by its very nature, sentence structure yields information about aspects of a verb's meaning that affect the number

and type of arguments—essentially its semantic structure rather than its semantic content (e.g., Fisher et al., 1991; Grimshaw, 1990).

Elsewhere we have proposed a simple procedure for one form of early syntactic bootstrapping (Fisher, 1996; Fisher et al., 1994; Gillette, Gleitman, Gleitman, & Lederer, 1999), which capitalizes on the relational nature of both sentences and verb meanings (e.g., L. Bloom, 1970; Braine, 1992; Fisher et al., 1991; Gentner, 1982). For example, transitive verbs have two noun phrase arguments and describe semantic two-place predicates—relationships between the referents of those noun phrases. Intransitive verbs have only one noun phrase argument and denote semantic one-place predicates—states, activities, or properties of the single named referent. Once children can identify some nouns, they could assign different meanings to transitive and intransitive verbs by aligning a sentence containing two noun phrases with a conceptual predicate relating the two named entities in the current scene, and a sentence containing one noun phrase with a conceptual predicate centrally involving the single named entity in the current scene.

Consistent with this proposal, a series of experiments has yielded evidence that the number of noun phrases in the sentence is meaningful to young preschoolers. In several studies, 3- and 5-year-olds (Fisher, 1996) and 2.5-year-olds (Fisher, 2002) learned transitive or intransitive made-up verbs used to describe unfamiliar agent-patient events. The identity of the subject and object referents was hidden by using ambiguous pronouns, yielding sentences that differed only in their number of noun phrases (e.g., "She's pilking [her] over there!"). Children were asked to choose the participant in each event whose actions were described by the verb ("Which one pilked [the other one] over there?"). Children more often chose agents as the subjects of transitive than intransitive verbs. A similar sensitivity to argument number has been found in a preferential-looking task with children 21 and 26 months old (Fisher & Snedeker, 2002).

These findings suggest that children might achieve an early separation of the input sentences by transitivity and interpret these sentences in line with their argument number, simply by counting the nouns in each sentence. To the extent that this early separation of transitive from intransitive depends simply on identifying some nouns, it could provide a guide to sentence interpretation and verb learning before the child has learned crucial syntactic features of the native language (e.g., Fisher et al., 1994).

In this chapter, we address a further question: Can sentences tell children more than simply how many and what participants are involved? Once a learner knows enough about the native language to identify one noun phrase in a sentence as its grammatical subject, she might use that information to guide sentence interpretation. This type of knowledge shows its influence quite early in development. For example, English-learning children as young as 16 to 18 months old interpreted word order appropriately in transitive sentences such as "Big Bird is tickling Cookie Monster" (Hirsh-Pasek & Golinkoff, 1996). Very young children pick up on language-specific cues like word order and use them in sentence interpretation.

But can this information be used, in principle and in practice, in interpreting sentences with unknown verbs? To address this question, we need to ask, essentially, what it means to be the subject of a sentence.

The Semantics of Subjects (Versus Nonsubjects)

The subjects of sentences can be of many semantic kinds, as shown by the italicized phrases in (1): transitive subjects include animate agents (1a), experiencers (1b), events (1c), and abstract stimuli (1d), to name just a few. The semantic diversity of subjects might lead us to believe that the transitive subject category has no unified meaning (e.g., Marantz, 1982; Pinker, 1994). In principle, the semantic role played by the subject could be determined entirely by the semantics of individual verbs with no abstract semantic information that spans the set of transitive verbs conveyed by placement in subject position. If so, then no semantic information could be retrieved based on word order or other cues to subject identity until the meaning of the verb is known; the verbs themselves, in this view, would be learned by observation of world events constrained by the set of arguments in the sentence.

On the other hand, despite the manifest variety of subject meanings, the intuition that subjects share some abstract semantic similarity has long held sway in psycholinguistics and linguistic theory. Proposed semantic descriptions of what it means to be the subject fall into two general (and not mutually exclusive) classes: those based on roles in events, and those based on the perspective adopted by the speaker (e.g., Dowty, 1991; Talmy, 1983).

Event-Dependent Roles

The traditional linguistic view of the linking of each verb's arguments with grammatical positions in sentences relies on the notion of thematic roles. Thematic roles represent the abstract similarity among roles in different events, such as the agents and patients of various causal actions (e.g., Jackendoff, 1990). Despite persistent lack of agreement on a common set of roles, thematic roles or something very much like them help to explain striking cross-linguistic similarities in the linking of semantic argument types with grammatical positions (see papers in Wilkins, 1988).

An influential characterization of thematic roles was advanced by Dowty (1991). He proposed a contrast between a prototype concept of agent and patient and a simple subject selection principle: The argument of a transitive verb with more of the semantic entailments of a protoagent is linked to subject position, while the argument with more of the semantic entailments of a protopatient is linked to direct object position. Entailments of protoagency include volitional involvement, sentience, causation, and movement. Protopatient entailments include undergoing a change of state. Dowty's protorole proposal raises the possibility that children might learn new verb meanings "by 'semantic default,' i.e. by taking it

for granted that the subject and object arguments have the full complement of possible proto-role entailments appropriate to each of these grammatical relations" (p. 605).

Similar proposals have been advanced in psycholinguistics. Clark and Begun (1971) investigated the semantics of transitive subjects by asking people to rate the semantic naturalness of sentences whose subjects had been replaced by noun phrases taken from a hierarchy ranging from humans (e.g., *Fred*) to abstract mass nouns (e.g., *sincerity*). Noun phrases higher on this hierarchy could nearly always sensibly replace subject nouns lower on the hierarchy, while the reverse arrangement—replacement of higher subject noun phrase types by lower—tended to lead to semantic anomaly. Clark and Begun suggested that the default interpretation of a transitive subject includes the features [+*human*], [+*animate*], and [+*concrete*]. A related conclusion was reached by Osgood and Bock (1977), based on spontaneous picture descriptions: Multiple features of various entities and their roles in a situation determined which would be mentioned as the subject of a sentence; these included agency and concreteness.

In sum, grammatical subjects tend to denote entities of certain types (human, animate, concrete) playing a subset of roles in events (e.g., causation, volitional involvement, motion). These findings are consistent with the longstanding consensus in linguistic theory that roles that are more prominent in a hierarchy of event-dependent thematic roles are linked to subject position (e.g., Fillmore, 1977; Grimshaw, 1990; Jackendoff, 1990).

Perspective-Dependent Views

Other accounts suggest that features of the events denoted by verbs, including categories of participants and the roles they play, do not entirely predict the linking of semantic arguments with grammatical roles. For example, in (2), *give* and *receive* differ, not in the event participants required by the two verbs (both require a giver, a receiver, and an object given), but in which role the verb treats as more prominent and thus which role is assigned to subject position. Such verbs are troublesome for a view that attempts to predict argument linking entirely from characterizations of roles in events. Either the giver or the recipient can be chosen as grammatical subject, depending on whether the speaker intends to talk about giving or getting.

(2) Phil gave a book to Lenny.
Lenny received a book from Phil.

Cases like *receive* could be viewed as simple exceptions to an otherwise general tendency to link the (more agentlike) *giver* with the subject role. On the other hand, some observers have argued that the fundamental asymmetry between subject and nonsubject positions in sentences signals a focus- or perspective-dependent semantic asymmetry that is independent of event-dependent thematic roles (Gleitman, Gleitman, Miller, & Ostrin, 1996).

For example, Talmy (1983) suggested, based on an analysis of spatial descriptions, that the subject's role could be described as the conceptual figure, whose location or role relative to a reference or ground object is the main issue of the sentence (see also Clark, 1990; Kuno, 1987). Appeals to the prominence or importance of various aspects of an event for the meanings of particular verbs crop up in other analyses: For example, Pinker (1989) described the semantic difference between *give* and *receive*, or *hit* and *be hit by*, in terms of which part of a complex conceptual-semantic representation is construed as the "main event" of the sentence; Dowty (1991) suggests that assignment of theme and goal roles to direct versus indirect object position depends on whether the meaning of the verb is more centrally concerned with the theme's motion or the resulting effect on the goal location (see also Gropen, Pinker, Hollander, & Goldberg, 1991).

This view suggests a subtly different default interpretation of the subject role: the subject of a sentence could be interpreted not as playing a particular event-dependent role but as playing a role construed as more prominent for a particular verb. Both *give* and *receive* entail the same event roles but focus on different aspects of the same events.

The role of speaker perspective in subject choice can be seen in descriptions of spatial arrays: the same array tends to be described as a circle above a square if the speaker's eye is cued to fall first upon the circle, but as a square below a circle if the speaker's eye is cued to fall first upon the square (Forrest, 1996; Osgood & Bock, 1977). Nappa, January, Gleitman, and Trueswell (2004) reported similar findings for descriptions of pictures in which people give and receive, for example. In language production, the choice of subject is influenced by the direction of the speaker's attention.

The Semantic Prominence of Subjects

Notice the similarity of these two views. In both, grammatical subjects are linked to whichever argument is more prominent in a ranking of conceptual-semantic roles. Prominence can be predicted in part based on the participant roles themselves: languages have many verbs for describing the actions of animate causal agents on patients, for example. In addition, however, evidence for the role of speaker or verb perspective in subject choice suggests that the nature of conceptual-semantic representations allows at least some flexibility in which participant role is represented as more prominent. Various event-dependent and perspective-dependent accounts of subject selection differ greatly in their theoretical assumptions but share the fundamental insight that the syntactic prominence of subjects corresponds to an abstract semantic or conceptual prominence.

For our present purposes, if either of these views is correct, then it means something to be the subject of a sentence, after all. Might children make use of this default interpretation of subjects—as the more prominent argument in a

conceptual-semantic structure—in their interpretations of sentences? If so, then once children can identify which noun phrase in a sentence is the subject, they will know not only which participants the verb relates but which participant's role should be construed as more prominent.

To address this question, the empirical strategy taken in this chapter is to explore two complementary predictions of the notion that listeners interpret sentence structures as encoding the conceptual-semantic prominence of a verb's arguments. First, many properties of events that make one participant's role more prominent than another should influence the interpretation of sentences that comment on those events. Some participants in events will make better conceptual figures than others (Talmy, 1983) or have more of the mobile, sentient, active, causal, properties that suggest proto-agency (Dowty, 1991; see also Clark & Begun, 1971; Osgood & Bock, 1977). These factors should affect sentence interpretation by influencing what conceptual structures are readily available to be mapped onto a sentence. Second, if the subject-object asymmetry provides a clue about semantic prominence, it should be possible to induce the listener to adopt a particular perspective on an event by specifying a sentence subject. A subject clearly given in a sentence should lead the hearer to select a conceptual-semantic relation in which the subject referent is the most prominent.

Both predictions are confirmed for adult listeners, who assume that the subject referent plays a more prominent role even where the verb specifies an inherently symmetrical relationship between its two arguments (Gleitman et al., 1996). For example, the verbs in (3) and (4) denote symmetrical relations—two objects match each other and two people meet to the same degree. Nevertheless, adults judged the first member of each pair, in which the subject referent was smaller, more mobile, or less famous than the object referent, as more natural than the second (Gleitman et al., 1996). The role of the participant that was seen as more dynamic or potentially changeable made a more plausible sentence subject. Other things being equal, one is more likely to seek a button to match a dress than the reverse, and ordinary citizens are more likely to try to meet movie stars than the reverse. Importantly, however, sentences with a less obvious subject choice (as in 3b or 4b) are interpretable; they simply suggest a less ordinary prominence ordering of the verb's arguments. Sentence (3b), for example, might be appropriate for a fancy jeweled button, a family heirloom.

(3) a. The button matches the dress.
    b. The dress matches the button.
(4) a. My sister met Meryl Streep.
    b. Meryl Streep met my sister.

The experiments reported here began to explore what preschool children think it means to be the subject of a sentence, testing both predictions of the semantic prominence interpretation of the subject role. Experiment 1 used a novel verb learning task to assess children's default interpretations for new transitive

verbs. Children interpreted made-up transitive verbs describing displays in which the dynamic properties of two participants varied. If children interpret the subject/object asymmetry as a cue to the relative semantic prominence of the verb's arguments, then properties of event participants that suggest they play dynamic roles in events should make them good conceptual figures, thus plausible subjects of verbs. Experiment 2 pits explicit subject choice in a sentence against a strong bias in sentence interpretation, to test the hypothesis that properties that make an event participant a very plausible subject can be overridden by the mention of a different participant in subject position in a sentence.

In the final section of this chapter, we will relate these findings to recent evidence that even young children treat grammatical subject referents as more prominent entities in their representation of a multisentence story and therefore as more likely antecedents for a pronoun (Song & Fisher, 2005).

Experiment 1

This experiment manipulated two properties of participants in an event—motion and animacy. Many studies have documented an influence of animacy on the production and comprehension of sentences with known verbs by both adults and children. Animate nouns more often appear as sentence subjects than inanimate ones (e.g., Bock, Loebell, & Morey, 1992; Clark & Begun, 1971). A bias toward animate subjects can be seen in children's earliest sentences (e.g., L. Bloom, 1970; Bowerman, 1973; Brown, 1973). Sentences with animate rather than inanimate subjects are rated as more natural by adults (e.g., Clark & Begun, 1971; Corrigan, 1986); similarly, 2-year-olds more readily learned to place a token on the actor in a picture described by a transitive sentence when the subjects of action verbs were animate (Corrigan, 1988; Corrigan & Odya-Weis, 1985). Childers and Tomasello (2001) reported that 2.5-year-olds were better able to learn new transitive verbs when the verb was presented with pronoun arguments that signaled an animacy contrast (e.g., "He's pilking it"). In sum, animates tend to be subjects in production and are easily interpreted as subjects in comprehension.

However, neither for adults nor for young children are all subjects animate (e.g., Bloom, Miller, & Hood, 1975; Pinker, 1984). The preference for animate subjects in production and comprehension depends on the fit of an animate noun with roles that could be assigned by a particular verb. For example, 2-year-olds identified inanimate subjects of stative verbs such as *hide* and *hurt* as easily as animate subjects (Corrigan, 1988; Corrigan & Odya-Weis, 1985). At least in English, animacy effects on sentence interpretation may be due not to a direct link between subjects and animates but to the potential of animate entities to take on more prominent roles in conceptual-semantic structures (Bloom, Miller, & Hood, 1975; Bock et al., 1992).

Similarly, motion itself should make a participant in a situation a likely prominent argument (Gleitman et al., 1996; Talmy, 1983). Animacy and motion can be thought of as components of the kind of active causality that is prototypical agency (e.g., Dowty, 1991; Slobin, 1985). By manipulating animacy and mobility in noncausal events, this experiment explored whether these dynamic properties make event participants good conceptual figures and thus good subjects for novel verbs.

In Experiment 1, children interpreted novel transitive verbs with ambiguous pronoun arguments (e.g., "It's pilking it" or "It pilks it"). Interpretation of the novel verbs was assessed in a forced-choice task: children were asked to choose the participant in each event that was the subject of the novel verb (e.g., "Which one's pilking/pilks the other one?"). This task provided a simple way of determining which participant in each event was considered to be the most likely subject. The use of nonsense verbs and ambiguous pronouns in these sentences gave the children no information about which participant's perspective the new verb promoted. Their only recourse in interpreting these sentences was therefore to fall back on default assumptions about the interpretation of sentences.

The events described by these verbs involved no causal act of one participant on the other but merely the motion or location of one participant relative to another. This feature was important: a simple agent-patient event would invite observers to represent a particular relationship between the two participants even in the absence of a verb description. Thus children might interpret a novel verb as a translation of a familiar verb suggested by the scene (e.g., Pinker, 1994). The motion and location events used in Experiment 1 were designed to suggest no particular relation between the two participants. To evaluate the success of this manipulation, responses in the transitive verb interpretation task were compared to a control condition in which children were simply asked to pick one of the two participants in each event. The novel verb in its ambiguous transitive sentence frame should direct observers to represent a relationship between the two participants and thus to any asymmetry in the roles each could play; this asymmetry should be less evident in the absence of a sentence to interpret.

Method

Participants

The participants were 60 3-year-olds (mean age 3 years, 3 months; range 2 years, 10 months to 4 years, 0 months), 30 boys and 30 girls, all native speakers of English. Participants were recruited through a database compiled from birth announcements in the local newspaper. Twenty children were assigned to each of the three conditions described below (sentence-progressive, sentence-present, and no sentence). An equal number of boys and girls were assigned to each condition, with mean age balanced across groups. Four children did not complete the task

and were replaced in the design. A comparison group of 30 adults (22 women and 8 men), also native speakers of English, was included; 10 were assigned to each condition. The adults were undergraduates at the University of Illinois, who received course credit or a small payment for their participation.

Stimuli

Simple location or motion displays involving puppets and toys were videotaped. The displays were of five different types, designed to systematically vary the mobility and animacy of two participants. The item types are defined in table 15.1. Motion displays were those in which one object moved and the other was still. All four possible combinations of animate and inanimate items were included, as shown in the top of table 15.1. The same pattern was established for displays in which one character was animate and the other inanimate; these are shown in the lower part of table 15.1. All combinations of mobile and immobile participants were included, with one exception: there were no events in which both participants moved because of difficulties making these appear noncausal. Given the overlap between the animacy and motion displays so defined, this resulted in 5 different item types; four brief (5–6 seconds in length) events of each type were constructed, for a total of 20 videotaped scenes.

The use of pretend animates allowed animacy and motion to vary separately. While children can of course tell the difference between toy animals and real ones, many studies have found consistent animacy effects on children's language comprehension and production using pseudo-animates (e.g., Bates et al., 1984; Lempert, 1984), and even some objects whose only animate-like properties were pasted-on eyes (Jones, Smith, & Landau, 1991). Nevertheless it must be kept in mind that the motion in these events was real, but the animacy was not.

Table 15.1 Examples of motion and location events, Experiment 1

	Object 1	Object 2	
Motion Displays	Moving	Not Moving	Example Event
Both animate	+animate	+animate	A raccoon walks behind a lion.
Both inanimate	–animate	–animate	A toy car rolls up to a flashlight.
Animate moves	+animate	–animate	A penguin moves past a watering can.
Inanimate moves	–animate	+animate	A fire truck rolls up to a giraffe.
Animacy Displays	Animate	Inanimate	
Both immobile	–moving	–moving	A bear leans against a chair.
Animate moves	+moving	–moving	A penguin moves past a watering can.
Inanimate moves	–moving	+moving	A fire truck rolls up to a giraffe.

The animate creatures were all animals rather than humans, so that the pronoun *it* could be used to refer to both animates and inanimates. Inanimate objects that moved included vehicles and other objects that could roll, and these were always set in motion off screen; half the time they rolled to a natural stop on screen, and half the time they continued out of sight. Inanimate objects that did not move were all static inanimates (e.g., a wrapped present, a plastic watering can). Animate objects that moved were manipulated by a hidden puppeteer. All objects, animate and inanimate, were selected to be familiar to children. Each object appeared in only one event, and the left-right position of the dynamic (animate and/or mobile) object was counterbalanced within event type. Care was taken to match the two objects in each event for size, brightness, and complexity. The events were arranged in a random order with the constraint that no more than two events of the same type appeared in a row. This order and its reverse were each presented to half of the subjects in each condition. An 8.5" by 11" picture of each event was used in the forced-choice task (see below). Pictures were selected to avoid focusing attention on either participant: each object was roughly centered in its half of the picture page, and took up about the same amount of space.

Procedure

All participants were tested individually in a quiet lab room under one of the conditions described below. When parents accompanied their children into the room, they sat behind the children and were asked not to speak during the task.

Sentence Conditions Transitive sentences containing novel verbs were presented to children as descriptions of each event. Twenty nonsense syllables were used as the novel verbs (e.g., *trab*, *crast*, *gluff*), randomly assigned to events for each child. Children in the sentence-progressive condition heard the verbs in the progressive aspect (e.g., *trabbing*, *crasting*, *gluffing*), and those in the sentence-present condition heard the verbs in the simple present tense (e.g., *trabs*, *crasts*, *gluffs*). Only ambiguous pronouns were used (e.g., "It's crasting it" or "It crasts it"). The progressive is frequently used in novel verb learning studies to unambiguously identify a nonsense syllable as a verb (Brown, 1957) but also imposes additional semantic restrictions. Action or process predicates occur in the progressive (e.g., "John is walking") while stative terms cannot (e.g., "Steve is resembling Bill"). Thus the sentence-present condition was included to determine whether any focus on dynamic participants in Experiment 1 was due to the use of the progressive aspect or to a more general preference for dynamic subjects. The *-s* ending is ambiguous between a present-tense verb and plural noun reading of a novel word; however, children should be able to use the sentence frame itself to identify a verb as an argument-taking predicate (Landau & Stecker, 1988; McShane, Whitaker, & Dockrell, 1986). The use of the two sentence conditions also provided an opportunity for a replication of the effect of a transitive sentence within Experiment 1.

The procedure for the two sentence conditions was as follows: An unfamiliar doll was introduced, who sometimes used "funny new words" when telling about what he saw on a TV screen. On each trial, the experimenter first said the new verb in its sentence and encouraged the child to repeat the sentence. The experimenter then played the videotaped scene twice, repeating the sentence just before each showing of the event, and finally revealed the still photograph of the videotaped event, asking "Which one is (verb)-ing the other one?" or "Which one (verb)-s the other one?" This process was repeated for each of the 20 scenes.

No-Sentence Condition The no-sentence condition was included to assess the children's baseline tendency to choose animate or moving objects in these events. The experimenter introduced the unfamiliar doll and told the children that they would see pictures on the TV and their job was to pick pictures for the doll. Each scene was presented twice with no preceding sentence other than an instruction to watch the screen. The experimenter then revealed the still picture and asked the child, "Which one do you want to pick?"

Children in all three conditions usually pointed without hesitation; if the response was unclear, the experimenter prompted the child to point again. The procedure took about ten minutes. Adult subjects were also tested individually; in the adult version of this task the story involving the unfamiliar doll was omitted, but all other instructions were the same.

Results and Discussion

Children's and adults' interpretations of novel transitive verbs were systematically influenced by the animacy and mobility of the objects in each display. Table 15.2a shows the proportion of moving object choices across all four item types (16 events) in which one object moved and the other did not. Table 15.2b shows the proportion of animate choices across the three item types (12 events) with one animate and one inanimate participant. Note again that these sets of events overlap somewhat (see table 15.1); thus tabulations of moving and animate choices are partially intersecting characterizations of the tendency to make dynamic choices. The events in which animacy and motion were in conflict are also reported separately in table 15.2c. The near-chance performance of children and adults in the no-sentence condition suggests that the stimuli and procedure contained no covert hints as to which item in each scene the observer was intended to choose. The ambiguous sentences, however, did provide a hint: both children and adults systematically chose moving or animate participants as the subjects of the novel transitive verbs. The difference between sentence and no sentence conditions emerged in the same way whether the verbs were progressive (*crasting*) or not (*crasts*).

These patterns were tested in separate ANOVAs examining the proportion of moving and animate choices. Analyses by subjects took age group (child vs. adult) and condition (sentence-progressive, sentence-present, and no-sentence) as

Table 15.2 Pointing responses, Experiment 1

a. Mean (SD) proportions of moving choices in motion displays (16 events)

	Sentence			
Group	Progressive	Present	No Sentence	Mean
3-year-olds	.70 (.16)	.63 (.21)	.48 (.14)	.60 (.19)
Adults	.81 (.17)	.76 (.22)	.62 (.19)	.73 (.21)
Mean	.74 (.17)	.67 (.22)	.52 (.17)	

b. Mean (SD) proportions of animate choices in animacy displays (12 events)

	Sentence			
Group	Progressive	Present	No Sentence	Mean
3-year-olds	.58 (.15)	.57 (.15)	.44 (.17)	.53 (.17)
Adults	.76 (.14)	.69 (.08)	.52 (.18)	.66 (.17)
Mean	.64 (.16)	.61 (.14)	.46 (.18)	

c. Mean (SD) proportions of moving object choices in conflict displays (4 events)

	Sentence			
Group	Progressive	Present	No Sentence	Mean
3-year-olds	.65 (.22)	.62 (.24)	.55 (.28)	.61 (.24)
Adults	.58 (.37)	.60 (.32)	.70 (.28)	.62 (.32)
Mean	.62 (.28)	.62 (.26)	.60 (.28)	

between-subjects factors; item analyses examined the same variables as within-items factors.

Presentation condition had a significant effect on choices of moving objects, $F1(2, 84) = 9.51$, $p < .001$; $F2(2, 30) = 17.77$, $p < .001$, and adults chose moving objects significantly more often than children did, $F1(1, 84) = 10.83$, $p < .001$; $F2(1, 15) = 9.85$, $p < .01$; age and condition did not interact, $F1(2, 84) < 1$; $F2(2, 30) < 1$). The effect of sentence condition remained significant when only the 3-year-olds were tested: Moving choices were reliably more frequent in both sentence-progressive, $t1(38) = 4.70$, $p < .001$; $t2(15) = 4.70$, $p < .001$, and sentence-present conditions, $t1(38) = 2.70$, $p < .01$; $t2(15) = 2.88$, $p < .05$, than in the no-sentence condition.

Similarly, presentation condition had an effect on choices of animate objects, $F1(2, 84) = 12.28$, $p < .001$; $F2(2, 22) = 9.57$, $p < .001$, and adults chose animates more frequently overall than children did, $F1(1, 84) = 14.13$, $p < .001$; $F2(1, 11) = 5.83$, $p < .05$; these two factors again did not interact, $F1(2, 84) < 1$; $F2(2, 22) < 1$). The tendency to choose animates more often in each of the two sentence conditions than in the no sentence condition remained significant for the 3-year-olds

alone in a subjects analysis and was marginally reliable in the items analysis; sentence-progressive: $t1(38) = 2.90$, $p < .01$; $t2(11) = 1.82$, $p = .096$; sentence-present: $t1(38) = 2.58$, $p < .05$; $t2(11) = 1.78$, $p = .103$.

Thus children and adults tended to select moving rather than still objects and animate creatures rather than inanimate things as likely subjects of transitive verbs in both sentence conditions. The age difference, unrelated to the influence of the sentence, appears to reflect a simple tendency for children to be less consistent than adults in this task.

What about the subset of events in which animacy and motion are in conflict? In these cases, an animate creature stood immobile while an inanimate object moved. Choices for these items are shown in table 15.2c. There was no effect of age or condition on the proportion of moving object choices ($F < 1$), and the interaction between the two factors was not significant, $F(2, 84) = 1.24$, $p > .25$. In these conflict events, animacy and motion seem to have been weighted roughly equally.

Children and adults systematically preferred dynamic—moving or animate—participants in events as subject referents in the absence of information from a familiar verb or from the placement of a familiar noun in subject position as to what kind of relation was described by the verb. Children and adults were less likely to choose moving or animate objects when there was no sentence to be interpreted. This suggests that the sentence directed observers' attention to aspects of each video clip that were not obvious without a sentence—a situation involving the two participants in which the dynamic participant's role becomes more prominent. This effect of a novel transitive verb did not depend on the use of the progressive aspect. Given no sentence to interpret, on the other hand, the choice of participants depended not on the prominence of possible roles, but on visual salience in the picture, which was carefully matched for these items.

In their own speech, young children tend to make dynamic entities the subjects of sentences, including animates or pseudo-animates and objects that appear, disappear, and change in the child's environment (e.g., L. Bloom, 1970; Bowerman, 1973; Brown, 1973; Lempert, 1984; Tomasello, 1992). The results of Experiment 1 provide evidence that they do the same when interpreting a novel verb: Not being told which participant was the subject and not knowing the verb, children assumed that the subject of a transitive sentence referred to the participant they saw as the more central player in the event. Animacy and motion should have similar effects on this mapping process. A moving object is clearly playing a dynamic role, and while animacy is not itself a role in a relation, it is a categorization that has consequences for what roles are possible (Bock et al., 1992; Fillmore, 1977).

Experiment 2

Experiment 1 documented biases affecting children's interpretations of novel verbs in transitive sentences. If these biases were the only influence on children's

acquisition of verbs, then children might take all verbs to be action words. But nonactional predicates like *want*, *see*, *hear*, *have*, or *get* (in the sense of *receive*) appear among the first verbs used by many children (e.g., Bowerman, 1973, 1990; L. Bloom, 1970; Bloom, Lightbown, & Hood, 1975; Landau & Gleitman, 1985), and children just under 3 years old can learn to produce passives appropriately with unfamiliar verbs (Brooks & Tomasello, 1999). Experiment 2 pits the bias toward dynamic subjects against a verb's attested subject in a sentence, asking children to interpret sentences that make less obvious assignments to the subject role. These sentences violate documented preferences in children's interpretation of events, but should be interpretable if children can use subject selection as a cue to verb meaning even when it violates these preferences.

As mentioned in the introduction to this chapter, even 16- to 18-month-olds know that the subject of *tickle* plays a different role from its object and use that knowledge to interpret sentences (Hirsh-Pasek & Golinkoff, 1996). Bates et al. (1984) have found that 2-year-olds interpreting sentences with familiar verbs can use clear evidence of assignment to subject position (word order in English) to override plausibility, tending to act out sentences like "The rock kicked the dog" in accord with their word order. Knowing what *kick* means, young children adapt the role of the kicker to fit a rock, as adults do in interpreting sentences with odd subject-verb combinations (Gentner & France, 1988).

Previous results also reveal that placement of a familiar noun in subject position influences preschoolers' interpretation of novel verbs. Fisher et al. (1994) showed 3- and 4-year-olds and adults videotaped scenes of familiar actions with two participants. Each scene was described with a nonsense verb presented in one of two different sentence contexts, as shown in (5), or in isolation (e.g., "Pilking!"). Listeners were asked to paraphrase the novel verb. When novel verbs were presented in isolation, children and adults tended to agree that one participant's role in each scene was more prominent than the other's. For example, observers preferred to describe one scene as chasing rather than running away; similar biases were found for other events. Despite such preferences, assignment of one participant to subject position appropriately affected children's interpretations. However, the scenes presented to children by Fisher et al. were designed to be fairly balanced in the salience of the two participants' roles. In the event described in (5), for example, while observers agreed that the chaser's role was more prominent, the fleeing rabbit moved on its own, and was easy to see as also playing a dynamic role.

(5) a. The skunk is pilking the bunny. (*chasing*)
    b. The bunny is pilking the skunk. (*fleeing*)

The goal of Experiment 2 was to determine whether children could take assignment to subject position, without the aid of a familiar verb, as a cue to what relation the verb describes and do so even if the subject choice demands a quite nonobvious view of an event. Experiment 2 combined the pronoun

disambiguation task of Experiment 1 with the novel verb paraphrasing method introduced by Fisher et al. (1994) to examine this question. Four- and 5-year-olds watched videotaped events showing a human agent acting on a passive human patient in some novel way. Causal events like these are most likely to be described by transitive verbs with agent subjects (e.g., Braine, Brody, Fisch, Weisberger, & Blum, 1990; Fisher et al., 1994; Naigles & Kako, 1993; Slobin, 1985).

Novel transitive verbs, with either the agent or the patient participant named in subject position, were used to describe these scenes. The children first watched two training examples of each causal event. In these examples, people dressed as animal characters enacted the event, and the sentences assigned one of them to subject position (e.g., "The pig pilks the bunny!" vs. "The bunny pilks the pig!"). At the end of the second training trial, the child was asked "Which one pilked the other one?" to ensure that he or she had attended to the sentence, and accepted its assignment of event participants to argument positions. Following this training procedure for each event, the children watched a third enactment of the event, this time with people in ordinary clothing. The events were described for a third time with a transitive sentence ("She pilks her!"), and the child was asked (a) to point out which one pilks the other one and (b) to paraphrase what the sentence might mean.

Our predictions were as follows. If preschoolers interpret subject choice in a sentence as evidence about the relative semantic prominence of the verb's two arguments, then sentences that place less dynamic participants in subject position should nevertheless be systematically interpretable. This should be true whether the subject participant is the agent of a causal action or not. Simply put, children should interpret each verb as describing an event or relation in which the subject participant is treated as playing the more prominent role. When the subject participant is the agent of the action, this should be easy: the novel verb can be interpreted as literally describing that participant's causal actions. In contrast, when the chosen subject participant is the passive recipient of the videotaped action, children should be guided toward less literal, more abstract interpretations. For instance, children might interpret the verb as referring to the inferred mental states or motives of the participants. If so, then this result could provide a hint as to how children acquire their early abstract verb vocabulary (e.g., *like* and *want*) despite a powerful bias toward dynamic subjects.

Method

Participants

Twenty-four 4- and 5-year-old children (mean age = 4 years, 11 months, range 4 years, 1 month to 5 years, 7 months), 12 girls and 12 boys, participated in this experiment. All of the children were native speakers of English. The participants

were assigned to one of two sentence conditions described below (agent subject vs. patient subject) as well as to one of two orders in which stimulus events were presented. An equal number of boys and girls were assigned to each condition/order group.

Stimuli

Experimental Events Four action scenes were videotaped, each approximately 7–10 seconds long. Each scene depicted one person moving another in some novel way. In one event, for example, the agent repeatedly rotated the patient on a tall swivel stool by pulling on a scarf wrapped around the patient's waist. In each case, the patient's role in the event was entirely passive: In the same event, for example, the swivel stool was too tall for the patient's feet to touch the floor, making it clear that she could not cause her own motion. Three enactments of each action were filmed, differing in the identity of the participants. Each action was shown first carried out by people costumed as a monkey and a duck, then by people costumed as a pig and a rabbit, and finally by two women in everyday clothes. The versions with animal actors were training events, and those with people in ordinary clothes were test events.

The left-right positioning of the agent and patient in the training and test events was counterbalanced, and the agent never appeared on the same side in the second training event and the test event for the same action. Each actor appeared in only one test event. The events were shown in two orders, one the reverse of the other.

Familiarization Items The experimental items described above were preceded by four familiarization video clips to ensure that the children identified the costumed animal characters by name. Each scene showed one of the animal pairs (monkey and duck, pig and rabbit) standing side by side waving. Each pair was shown twice with the left-right positions of the pair counterbalanced. These items were presented in an invariant order.

Sentences Each action was described by a nonsense verb in a transitive sentence. In the training sentences, the identity of subject and object in each sentence was made clear by the use of familiar animal names. For children in the agent-subject condition, the agent of the salient causal event was also the subject of the sentence. For children in the patient-subject condition, the passive patient of the depicted causal event was the subject of the sentence. For example, if one group of children heard "The bunny [verb]s the pig," the other group heard "The pig [verb]s the bunny." All test sentences were of the form "She [verb]s the other girl." These test sentences were ambiguous, and identical in the agent-subject and patient-subject conditions. Four nonsense syllables (*gish*, *pilk*, *braff*, *stipe*) were randomly assigned to the four actions, separately for each subject.

Procedure

Children were tested individually in a quiet room in their preschool or in the laboratory. Handwritten records of the child's responses were kept by the experimenter; verbal responses were checked for accuracy against audiotapes of the sessions. After a few minutes of warm-up interaction with the experimenter, the task was introduced as follows: An unfamiliar doll who sometimes used "words we don't know" was introduced, and the child was asked to help figure out what the doll meant. The task began with the familiarization events in which children identified the animals (e.g., "Which one's the monkey? Point!"). The two training versions of each action were then shown in a standard order—the monkey-duck pair and then the pig-rabbit pair. On each training trial the experimenter said the nonsense verb in its sentence context while playing the associated scene. The linguistic context of each verb included an initial instruction to look at the subject of the sentence before the action began (e.g., "Look at the monkey!" or "Look at the duck!"), followed by the stimulus sentence (e.g., "The monkey [verb]s the duck" or "The duck [verb]s the monkey") uttered while the action was underway. The stimulus sentence was repeated in a second repetition of the training event. At the end of the second training event, the child saw a still frame of the midpoint of the event and was asked to indicate, by pointing on the video screen, which participant's role was described by the novel verb: "Which one [verb]ed the other one? Point!" Since the subject of the sentence had just been named, this served to ensure that the children had noted the argument assignment of the novel verb. At this point the child's choice was corrected if it mismatched the subject choice of the stimulus sentence: The experimenter repeated the original sentence, reminding the child that this was what the doll had said, and pointed to the correct subject.

Each trial ended with the test event for the novel verb item. The experimenter simply said "Now look!" before the action began, and then said the test sentence ("She [verb]s the other girl") during the action. This sequence was repeated, and after the second presentation of the test event, the child saw a still frame of the midpoint of the event and was asked "Which one [verb]ed the other girl? Point!" The child's choice was recorded, with no correction. Since the subject of the sentence for the test event had not been named, children's responses provided a measure of whether they had learned which role in the event was designated subject by the novel verb. Finally, the experimenter asked the child what she or he thought the sentence meant, encouraging guessing if no answer was forthcoming. In pilot testing, children's paraphrases were often ambiguous as to which participant's actions or reactions were described (e.g., "helping her," with no spontaneous pointing to either character). Therefore, unless the child spontaneously pointed, the experimenter always followed up the paraphrase with an immediate probe: "Which one is?" or "Who is?" and asked the child to point. This enabled the experimenter to determine the intended subjects of nearly all

paraphrases. The experimenter kept handwritten notes of the child's verbal and pointing responses.

Coding Children's attempts to paraphrase the nonsense verbs were taken from the experimenter's notes, checked for each child against the audiotape of the session. Paraphrases were first sorted into categories based on which participant the paraphrase focused on—the agent or the patient of the action event. Responses in which the causal agent was the grammatical subject were coded as agent-perspective responses, and those in which the patient was the grammatical subject were coded as patient-perspective responses. Most paraphrase subject choices were explicitly marked in the experimenter's notes based on the child's pointing responses when prompted "Who is?" Importantly, paraphrases that take the patient as subject did not describe the causal action itself; the designation "patient" was chosen simply to yield a uniform classification of paraphrases. There were no passive sentences such as "getting pulled [by her]" among the children's responses.

Children often used more than one sentence in their paraphrases, with different subject choices given. Clauses presented as separate sentences or conjoined with *and*, *then*, or *when* were coded separately, as it was not possible to tell which the child intended as the primary paraphrase. Examples are shown in (6), with separate clauses italicized. Example (6a) has two paraphrases, the first coded patient-perspective and the second coded agent-perspective; (6b) has three paraphrases, the first two agent-perspective and the third patient-perspective. Clauses or verb phrases that were complements of a main verb were not coded as separate paraphrases. Examples are shown in (7): example (7a) was coded as a single agent-perspective paraphrase, and (7b) was coded as a single patient-perspective paraphrase. A few responses mentioned only one participant and were coded as taking that participant's perspective even though the participant was not mentioned in subject position. For example, the response, "There's a bag on her [patient's] back" would be coded as a patient-perspective response.

(6) a. She's [patient] trying to stay there. And then she [agent] tried to pull.
    b. She (agent) put her in that wagon that's all. You push and pull her and she (patient) sits right there.
    c. Someone's putting a rope around the other girl, and the other girl sits in a chair.

(7) a. She [agent] did something that the other girl didn't want her to do.
    b. Means helping; this girl [patient] is helping that girl get across.

The responses were further classified as either a literal or an extended description of the event. These categories were designed to capture semantic differences in the paraphrases beyond choice of focus on the causal event's agent or patient, and to assess directly the possibility that "patient-subject" stimulus sentences would draw

children's attention away from literal action descriptions of the causal event. Literal descriptions were those that mentioned only actions and objects that were visible in the event: Two examples are shown in (6b): the actions of pushing and pulling and "sitting right there" are clearly visible in the video. All of the other examples shown in (6) and (7), however, include extended elements, not limited to physical or mechanical descriptions of the observed events. These include inferences about events that may have occurred prior to the videotaped event ("putting a rope around" and "putting her in that wagon"), about the motives or covert actions of the participants ("helping," "didn't want her to," "trying to stay there"), or introduce elements not visible in the video. This coding system resulted in four response categories: literal or extended descriptions taking the agent's or the patient's perspective. As the examples in (6) show, these four categories are not mutually exclusive. Children could and did generate more than one kind of response within a single trial and across the four trials.

A few paraphrases fit none of these categories clearly and were classified as other (9, or 9.4% of trials). These included sentences that mentioned neither of the people in the event (e.g., "the wagon goes and goes"), mentioned both in subject position (e.g., "They wanna drag each other"), or in which the subject of the child's paraphrase could not be determined. Sometimes children failed to produce any paraphrase (on 11, or 11.5% of trials).

All of the children's responses were coded by a second rater who was blind to the sentence condition in which each response was produced. The two raters agreed on 94.4% of coding decisions.

Results and Discussion

Children's pointing responses revealed that they learned which participant each verb assigned to subject position and applied this knowledge to a new use of the verb in an ambiguous sentence. They did so even when this assignment was in conflict with a very strong bias to place the visibly more dynamic participant in subject position. As shown in table 15.3, children in the agent-subject condition were much more likely to choose agents as subjects than were children in the patient-subject condition. An ANOVA on the proportion of agent choices with sentence condition (agent-subject vs. patient-subject) as a between-subjects factor, and trial (training vs. test) as a within-subjects factor, revealed an effect of sentence condition, $F(1, 22) = 81.52$, $p < .001$. There was no difference between proportions of agent choices for the training and test trials, $F(1, 22) < 1$, and no interaction between trial and sentence condition, $F(1, 22) = 1.05$. Thus children accepted the subject choice given in the training trials, remembered it, and extended it to a new enactment described by the same verb.

Following their choice in training trials, children were corrected if they had chosen in conflict with the training sentence. Children in the patient-subject condition were corrected 21% of the time (when they chose agents; see table 15.3),

Table 15.3 Mean (SD) proportion agent choices in pointing task, Experiment 2

	Sentence Condition		
Trial Type	Agent-Subject	Patient-Subject	Mean
Training	.94 (.11)	.21 (.33)	.57 (.44)
Test	1.00 (.00)	.17 (.34)	.58 (.49)

and children in the agent-subject condition were corrected 6% of the time (when they did not choose agents). The trend for children in the patient-subject condition to require correction more often than children in the agent-subject condition was not significant, $t(22) = 1.43$, $p = .17$. The direction of this trend, however, is consistent with the strong bias toward dynamic subjects documented in Experiment 1 and reminds us that semantic and conceptual information and syntactic cues should interact in determining what children learn about a new verb.

Crucially, children's paraphrases indicated that they took the subject assignment in the stimulus sentences as information about the meaning of each novel verb. As shown in table 15.4, children produced agent-perspective paraphrases much more frequently than patient-perspective paraphrases; children also produced many more literal than extended paraphrases. However, both of these preferences were sharply reduced in the patient-subject sentence condition.

An ANOVA with sentence condition as a between-subjects factor and with paraphrase perspective (agent or patient) and paraphrase type (literal or extended) as within-subject variables revealed main effects of both response factors: agent perspective paraphrases were more common than patient-perspective paraphrases, $F(1, 22) = 9.11$, $p < .01$, and literal paraphrases were more common than

Table 15.4 Mean (SD) proportion each paraphrase type, Experiment 2

	Sentence Condition		
Paraphrase Type	Agent-Subject	Patient-Subject	Mean
Agent-perspective			
Literal	.75 (.28)	.27 (.36)	.51 (.40)
Extended	.02 (.07)	.21 (.30)	.12 (.23)
Either	.77 (.25)	.46 (.42)	.62 (.38)
Patient-perspective			
Literal	.17 (.22)	.06 (.11)	.12 (.18)
Extended	.02 (.07)	.31 (.34)	.17 (.28)
Either	.19 (.22)	.38 (.38)	.28 (.32)
Other	.08 (.16)	.10 (.17)	.09 (.16)
No response	.08 (.16)	.15 (.34)	.12 (.27)

extended paraphrases, $F(1, 22) = 8.37$, $p < .01$. Both of these response factors interacted with sentence condition. Agent-perspective paraphrases were significantly more common in the agent-subject than in the patient-subject sentence condition, $F(1, 22) = 4.42$, $p < .05$. Literal paraphrases were significantly more common in the agent-subject than in the patient-subject sentence condition, $F(1, 22) = 19.99$, $p < .001$. The two response variables also interacted: agent-perspective paraphrases were much more likely than patient-perspective paraphrases to be literal, $F(1, 22) = 27.82$, $p < .001$. The three-way interaction between paraphrase subject choice, paraphrase type, and sentence condition was not significant, $F(1, 22) = 2.54$, $p = .125$. Finally, there was no main effect of sentence condition ($F < 1$), indicating that the overall proportion of codable responses did not differ across the agent- and patient-subject sentence conditions.

This pattern of results demonstrates the effect of subject choice in a transitive sentence on children's interpretations of a novel verb. Children are biased to assign the agents of causal actions to subject position, both in their own productions and in their interpretations of others' sentences (e.g., Braine et al., 1990; Fisher et al., 1994; Naigles & Kako, 1993). Moreover, in this experiment, subject assignment in a sentence significantly affected what the children learned about a new verb. When a plausible causal agent appeared in subject position, children assumed that the verb gave a fairly literal description of the causal event itself. When the patient of the salient causal act appeared in subject position, children searched for an interpretation that treated that participant's role in the event as prominent. This led many children to consider more abstract inferences about the scene in view, including the characters' histories and motives. Simply by telling children which character was the subject, we told them which one the sentence (and therefore the novel verb) was about.

The 4- and 5-year-olds tested in Experiment 2 must be considered quite advanced verb learners. This age group was selected for this task because we judged they would be better able to paraphrase the sorts of abstract perspectives on our video stimuli required to sensibly interpret the "patient-subject" verbs. However, several considerations lend plausibility to the prediction that younger children routinely assign a similarly abstract semantic prominence to subject referents. First, the results of Experiment 1 tell us that 3-year-olds tested in a simpler task assume that the more prominent, dynamic participant in an event is referred to by the subject of a novel verb. They did so even in events with no causal action; thus at least by 3, children's preference for dynamic subjects is not limited to the agent subjects of prototypical transitive verbs. Second, a previous study showed that 3- and 4-year-olds can use the choice of subject in a transitive sentence to direct their attention toward one of two perspectives on the same event, and thus interpret an unknown verb as describing something akin to chasing or scaring versus something like running away from (Fisher et al., 1994). The present results with older children extend this finding to a case in which the alternative interpretation is much more abstract and thus less likely to have occurred to children independently of the sentence.

General Discussion

Children's interpretations of novel verbs in these experiments were consistent with the hypothesis that they assigned a prominence-based default meaning to the role of subject in transitive sentences. In Experiment 1, 3-year-olds and adults assumed that ambiguously presented transitive verbs described the role of an animate or mobile participant. This was true even in the absence of a morphological cue (the progressive *-ing*) that the novel verb denoted a continuing process or activity and even though neither participant could easily be construed as a causal agent. The preference for dynamic choices was reduced when listeners were not asked to interpret a sentence, suggesting that the transitive verbs drew listeners' attention to the asymmetry in participants' possible roles.

The tendency of animates and moving objects to make plausible subjects of novel transitive verbs is consistent with findings that children and adults readily interpret noun phrases with dynamic referents as the subjects of familiar verbs (e.g., Bates et al., 1982; Bates, McNew, MacWhinney, Devescovi, & Smith, 1984; Corrigan, 1986, 1988; Corrigan & Odya-Weis, 1985) and that children's earliest relational terms are likely to be those that describe the comings and goings of people and objects (e.g., Bloom, Lightbown, & Hood, 1975; Huttenlocher, Smiley, & Charney, 1983; Lempert, 1984; Tomasello, 1992). Similar biases appear in adults' comprehension and production of sentences and have been interpreted as due to the plausibility of animate or moving objects as the logical subjects of many conceptual predicates (e.g., Bock et al., 1992; Clark & Begun, 1971).

Other things being equal, 3-year-olds, like adults (e.g., Clark & Begun, 1971; Gleitman et al., 1996), consider some participants in scenes more plausible sentence subjects than others. Moving or animate (and thus potentially mobile or changeable) entities make good conceptual figures, thus good sentence subjects.

If unfettered by sentence structure cues, the bias toward dynamic subjects should lead children to systematically misinterpret stative verbs as action verbs. However, the findings of Experiment 2 suggest that children can take subject choice as evidence about the verb's perspective on the scene. In Experiment 2, even quite nonsalient choices of sentence subject in the stimulus sentences influenced interpretations of novel transitive verbs. Four- to 5-year-olds took the subject of a sentence as the more prominent participant in the new verb's semantic structure. Given the nature of the stimulus events, the patient-subject sentence led children toward more abstract interpretations of the verbs. These results provide striking evidence that preschoolers interpret a sentence subject as a semantically prominent argument within the sentence.

Subjects and Discourse Themes

Further evidence for young children's interpretation of the subject role as the more prominent character in a sentence's meaning comes from our own recent

studies of children's comprehension of pronouns (Song & Fisher, 2005). Responses both in an elicited imitation task and in a looking-preference comprehension task revealed evidence that 3-year-olds preferred to interpret ambiguous pronouns as referring to the subject (or first-mentioned noun phrase) of the preceding context sentences. These findings suggest that placement in subject position in previously-encountered sentences made one character more prominent or accessible in the child's representation of the situation described by the story.

For example, in looking-preference comprehension experiments, 3-year-olds saw pictures on two video monitors as they listened to short stories like the one shown in (8). The final (test) sentence of the critical stories contained an ambiguous pronoun. The stimulus pictures and sentences were designed so that the test pronouns were ambiguous for several seconds: For example, in the test sequence shown in (8), *kite* is the first word that uniquely establishes the referent of the pronoun subject (because only one pictured character has a kite). In half of the trials, the pronoun turned out to refer to the character invoked as subject in the context sentences (continued-subject trials), while in the other half of the trials, the pronoun referred to the nonsubject character (shifted-subject trials). We measured children's visual fixations to the two pictured characters during the test sentence, to determine whether children recruited discourse context cues in their comprehension of an ambiguous pronoun.

(8) Context: See the turtle and the bunny.
The turtle takes the bunny to the store.
Test: What does he have? Look, he has a kite!

In three experiments, children looked longer during the test sequence at the character who had been established as the subject of the context story, and thus were more accurate in continued- than shifted-subject items. For example, in the story shown in (8), children tended to look at the turtle when they heard *he* in the test sentence. Thus children treated as more prominent or important those referents that had been mentioned in grammatical subject position, and were sentence-initial, in the context stories. Note in (8) that this was true even though both characters were mentioned equally often in the context sentences. The more prominent referents made better antecedents for a subsequent pronoun subject.

Ongoing experiments have been designed to tease apart order of mention and grammatical role (Song, 2004). Children participated in the same task, with the exception that in half of the critical trials the two characters appeared in subject and nonsubject position as before (e.g., "The turtle went with the bunny to the store"), while in half both characters jointly served as subject (e.g., "The turtle and the bunny went to the store"). Preliminary findings reveal a preference for the first-mentioned character in later pronoun interpretation following context sentences with a singular subject but not following conjoined-subject context sentences. These findings suggest that sentence-initial position itself was not responsible for the subject continuity preference in our earlier experiments.

Taken together, these findings suggest that children as young as 3 are sensitive to the connection between subjects and discourse topics. Children's comprehension of a sentence is affected not only by their current knowledge of its words and syntactic structure, but also by the prominence of each referent in a representation of the discourse; our findings show that referent prominence is affected by some of the same factors that affect coreference processing in adulthood, including, centrally, assignment to subject position. We have speculated that this connection could arise naturally because of children's default interpretation of the subject of each sentence as its most semantically prominent argument (Song & Fisher, 2005). Upon interpreting each sentence in a story or discourse, children are invited to create a representation of its meaning that takes the grammatical subject referent as the more prominent participant. In a sense, the syntactic asymmetry between subject and nonsubject arguments is one of the cues that determines the listener's attention to various participants' roles in the events under discussion.

Requirements for Syntactic Bootstrapping

Evidence that young children assign a default interpretation to sentence subjects in terms of some sort of semantic prominence further constrains our theories of the relationship between meaning and syntax in acquisition. Here we briefly sketch a theory of verb learning that is consistent with these and other findings.

A Preliminary Division of the Linguistic Data Based on Number of Nouns

Previous findings that children interpret verbs differently given only information about the verbs' number of arguments suggested an initial way in which observable surface properties of sentences could be intrinsically meaningful to young children (Fisher et al., 1994; Fisher, 1996, 2002). Once children can identify some nouns, they could assign different meanings to transitive and intransitive verbs by aligning a sentence containing two referential terms with a conceptual representation relating the two named entities, and a sentence containing one noun phrase with a conceptual representation centrally involving its single referent. Because the number of nouns in the sentence is a probabilistic indicator of the number of arguments of the verb, these preliminary syntactic hints could boost the probability of correct verb interpretations even before the surface markings of subject and object in a particular language are identified (e.g., Fisher et al., 1994).

Prominence in Conceptual-Semantic Representations

The experiments presented here began to explore what semantic information sentences might provide once children can identify the subject noun phrase in a

sentence, and revealed evidence that children can interpret the subject role in terms of the relative semantic prominence of a verb's arguments. As suggested in earlier work (e.g., Fisher et al., 1994; Gleitman, 1990), the choice of subject, in addition to the set of arguments, can serve as a sort of linguistic zoom lens to direct the listener's attention toward a particular perspective on an event.

How does the choice of subject influence children's interpretation of sentences? How do children figure out that the subject noun phrase—as marked in the child's native language—encodes some sort of semantic prominence? It is clear that a significant amount of learning is involved in this step. Most obviously, different languages use different means to formally identify the subject and object in transitive sentences: English relies heavily on word order but also uses subject-verb agreement; other languages use case markers or agreement markers on the verb to mark grammatical roles, and permit freer word order. In addition, languages differ in the relative importance of various conceptual-semantic dimensions for subject selection (e.g., Aissen, 1999).

Event-Dependent and Perspective-Dependent Roles: Reprise In the introduction to this chapter, we argued that multiple linguistic and psycholinguistic accounts of the linking of semantic and grammatical roles suggest that an abstract asymmetry in semantic prominence maps onto the difference between subjects and objects. These include event-dependent roles such as Dowty's protoagent and protopatient and perspective-dependent roles such as Talmy's figure and ground. Thus far for our purposes we have argued simply that both kinds of asymmetries give rise to a useful default interpretation for subjects in acquisition. On either view, a subset of participant roles should make more plausible subjects than others (as in Experiment 1), and an explicit choice of subject will invite the child to interpret the subject referent as playing a prominent role (as in Experiment 2).

This does not require, however, that we collapse the two kinds of roles into a single general notion of semantic prominence. As we pointed out in the introduction, event- and perspective-dependent roles are orthogonal. Thematic roles such as protoagent and protopatient reflect abstract similarities across different verbs' semantic entailments (e.g., *like* requires a sentient being who experiences a certain emotional state [liking] relative to a particular object), and predict how their arguments will be mapped onto grammatical positions. The perspective difference between subject and nonsubject, in contrast, appears to be somewhat independent of the event-dependent meanings of particular verbs—and unlike the link between subjects and agents, applies to all subjects, not just active transitive subjects. Dowty (1991) suggested that subjects are more "in perspective" because of the typical association between subjects and discourse topics; this is essentially the converse of our argument, summarized above, that subject noun phrases might naturally gain discourse prominence because of the semantic prominence of subjects (Song & Fisher, 2005).

Consistent with the logical independence of event roles and perspective on an event, we suspect that multiple independent dimensions of conceptual-semantic prominence determine what aspects of events adult and child observers attend to and which arguments in those relations they prefer as the syntactic subjects of transitive verbs (e.g., Grimshaw, 1990). Aissen (1999) has proposed an optimality theory version of just such a view: Her proposed dimensions of semantic prominence include a thematic role scale on which protoagents outrank protopatients, a discourse topicality or accessibility scale, and a person-animacy scale on which first- and second-person arguments (*you* and *me*; local persons in the discourse) outrank third-person arguments (*them*) and animates (especially humans) outrank inanimates. Aissen argues that these prominence scales tend to be aligned harmonically, with structurally prominent sentence positions (subjects » nonsubjects) expressing arguments that are prominent on relevant conceptual-semantic dimensions.

On this view, multiple semantic prominence scales and a preference for mapping arguments that are prominent on a conceptual-semantic dimension onto structurally prominent positions in sentences, are part of the built-in capacity for language acquisition. This type of account can easily explain our results: Once children have learned enough about the syntax of the native language to identify the subject of a sentence, they should be able to assign a default interpretation to subjects in terms of multiple dimensions of semantic prominence: They should interpret the subject as having as many protoagent properties as possible given the constraints of the situation, as being prominent in the discourse setting, and as being high on a person-animacy scale. Learning a particular language's grammar will include learning how the subject is marked, and determining the relative ranking of the constraints ruling out subjects that are not agents, not topical, or inanimate.

The Meanings Come First Any form of syntactic bootstrapping assumes that appropriately structured conceptual representations are in place before the acquisition of a language. For our present purposes, we need to document the language-independent existence of multiple dimensions of conceptual-semantic prominence (e.g., animate vs. inanimate, topic vs. nontopic) that are proposed to map onto the difference between subjects and objects.

Considerable evidence suggests that infants naturally factor their representations of events into conceptual predicates and arguments, and systematically discriminate the different roles in events (for reviews, see P. Bloom, 2000; Fisher & Gleitman, 2002). Some of the most striking evidence for this conclusion comes from learners who are isolated from ordinary exposure to a language and therefore have to invent one on their own. Deaf children who are exposed to no sign language model invent gestural communication systems termed *home sign* (Goldin-Meadow, 2003). The sentences of these invented systems show clear evidence of language-like predicate-argument structure: Signs glossed as verbs occur with predictable sets of nounlike arguments (*eat* has two arguments, *sleep* only one); as in

conventional languages, arguments we would gloss as playing the same roles appear in consistent positions across verbs and sentences. Apparently children need not learn from linguistic exposure that there exists a fundamental distinction between arguments and predicates, that eating entails an eater and a thing eaten, or that the agentlike argument of *eat* is importantly similar to the agentlike argument of *give* or *hit*. These findings suggest that abstract categories akin to protoagent and protopatient are likely to be part of the cognitive endowment children bring to the language learning process.

There is also some evidence that agents are treated as prominent participants in events by prelinguistic infants. For example, studies of 10-month-olds' perception of simple collision events revealed that they were more likely to detect a change in the identity of the agent or striking object than of the object that was hit (Cohen & Oakes, 1993). Striking evidence for the attention-grabbing properties of agents or first movers comes from a word-learning study by Grace and Suci (1985): They taught 17.5-month-olds names for puppets in action scenes and found that the infants more readily learned the new words if the referent puppet was the agent of a causal action than when it was the patient. This suggests that the infants gave more of their attention to the agents while watching the scenes; this allocation of attention made it easier to learn a new name for the agent puppet.

Prelinguistic infants develop considerable knowledge about the differences between animate and inanimate motion and causality (see Gelman & Opfer, 2002, for a review). Moreover, infants show a wide variety of perceptual preferences that lead them to pay more attention to animate than inanimate objects. These include a preference for faces (e.g., Johnson & Morton, 1991), for human motion (e.g., Legerstee, Pomerleau, Malcuit, & Feider, 1987), and for human voices (e.g., Glenn, Cunningham, & Joyce, 1981). Children approach language with an unsurprising bias to attend to the actions of humans or other animates.

An interesting hint of the role of animacy in the development of grammar comes from studies of the creation of Nicaraguan Sign Language, a language invented by several generations of deaf children at a school for the deaf in Nicaragua (e.g., Senghas, Coppola, Newport, & Suppalla, 1997). At a particular point in the development of Nicaraguan Sign Language, Senghas et al. found no transitive verbs that permitted animate direct objects. A causal event in which an animate agent acted on an animate patient required two verbs to license the two animate nouns (e.g., *girl push boy fall*). This is not an unusual pattern in the world's languages: Given the strong association of animacy and subjects, it is common for animate direct objects to require special marking (e.g., Comrie, 1981).

Finally, infants develop sensitivity to the direction of others' attention; many have argued that sensitivity to the flow of attention in social interactions, though obviously imperfect in both children and adults, is one of the cognitive foundations of language acquisition (e.g., P. Bloom, 2000; Tomasello, 2000). By the end of the first year of life, infants can share joint attention on an object with a communicative

partner and by 16 to 18 months, interpret a communicative partner's eye gaze and gesture as cues to the likely referents of her words (e.g., Baldwin & Moses, 1996). Joint attention affects early language production as well. For example, Skarabella and Allen (2002) found that 2-year-olds learning Inuktitut were more likely to omit from their sentences the objects of joint attention with their listener, suggesting that they were correctly treating them as situationally "given"; children also omitted nouns for entities just mentioned in the conversation. Such evidence suggests the beginnings of a sensitivity to topicality or givenness in interactions with others.

This brief section merely glances at a vast literature on conceptual development in infancy, and its relationship to language development. Given this sketch of relevant findings, however, it seems plausible that dimensions of conceptual-semantic prominence much like those discussed above precede the acquisition of language and are part of the innate endowment that makes lexical and syntactic acquisition possible.

Final Comments: Verb Learning and Syntax Acquisition

We have argued that once children can identify the subject of a multiargument sentence as structurally prominent, they could assign a default interpretation to sentences containing a novel verb by assuming that the subject referent plays a semantically prominent role in the conceptual relation named by the verb. What counts as prominent will be determined by the situation and by the multidimensional attentional and representational biases of human perceivers.

But how do children identify the subject? Many possibilities exist; one that appeals to us relies on multiple, and individually faulty, sources of constraint to determine the hierarchical structure of sentences (see, e.g., Fisher & Gleitman, 2002; Keenan, 1976; Pinker, 1987). For example, children could identify the subject as structurally prominent in a two-argument sentence based on its association with any of several types of conceptual-semantic prominence (proto-agency, animacy, person, topicality). Other cues include the prosodic structure of the sentence (e.g., Fisher & Tokura, 1996; Gerken, Jusczyk, & Mandel, 1994), and the distributional structure of the sequences of linguistic forms themselves.

This multiple-constraints view comports with recent views of the role of distributional learning in syntax acquisition (see Newport, 2000, for review). A general finding in computational linguistics is that relatively simple assumptions and algorithms can go some distance toward sorting words into grammatical categories (e.g., Mintz, 2003; Redington, Chater, & Finch, 1998), and toward uncovering the hierarchical constituent and dependency structure of the clause (e.g., Klein & Manning, 2002), unaided by semantic or phonological cues. The preponderance of recent evidence suggests that in many domains human learners are intricately attuned to the statistics of their experience, and show great facility in detecting

and using multiple probabilistic indicators of a common underlying structure in the world (see Kelly & Martin, 1994). A multiple-constraints view of syntax and lexical acquisition builds on the possibility that even partial information in each relevant domain (prosody, distributional cues to grammatical categories and phrase structure, and semantics) can reduce error, and that the shortcomings of each information source can be compensated for by others (e.g., Gillette et al., 1999; Hollich et al., 2000; Seidenberg & MacDonald, 1999).

For example, the alignment of partial sentence representations and conceptual representations sketched in our work (e.g., Fisher et al., 1994) would permit a useful probabilistic distinction between transitive and intransitive verbs, giving the child a significantly better chance of interpreting verbs as their speaker intended. Given that working out links between something like thematic roles and grammatical positions plays a key role in both verb and syntax acquisition (e.g., L. Bloom, 1970; Grimshaw, 1981; Pinker, 1989), it may be crucial that children have early access to an approximate division of the linguistic data into transitive and intransitive: it is transitive subjects, not all subjects, that tend to be agents. A probabilistic division of the linguistic data into one- and two-argument sentences could allow the child to begin with the domains within which semantic-syntactic mappings will be most regular.

We have suggested, following Aissen (1999; see also Manning, 2003), that multiple types of conceptual-semantic prominence may play a role in identifying the subject category of the native language and therefore in interpreting sentences. The supposition of "soft" or probabilistic links between syntax and meaning has advantages for theories of both verb and syntax acquisition. In particular, probabilistic links between form and meaning permit cross-linguistic variation. In English, subjects tend to be agents, to be animate, to be first- or second-person, and to be discourse-old. None of these patterns is categorical in English, but all show up as powerful tendencies. For example, passives, which have patient subjects, are more likely if the resulting sentence's subject is animate (Ferreira, 1994; Lempert, 1984), discourse-old (Weiner & Labov, 1983), or first- or second-person (Manning, 2003). Languages differ in how strongly they restrict various pairings of syntactic and semantic prominence; a model in which a single privileged semantic feature triggers the subject category cannot explain such cross-linguistic variation (e.g., Manning, 2003; Pinker, 1987).

To the extent that sentence structures can be roughly interpreted by alignment with conceptual structures, sentences can begin to influence verb interpretation as soon as children can recognize some nouns, and they become more informative as the child learns to identify the subject of the sentence. The sentence structure provides information about which event participants are relevant and which should be interpreted as playing a more prominent role in the conceptual relation named by the verb. What roles count as prominent among a verb's multiple arguments seems to depend on multiple conceptual-semantic dimensions. Recognition of the multiple conceptual-semantic correlates of subject

status may be indispensable to an adequate theory of verb learning and syntax acquisition.

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