Verbs on the Fringe: Raising Verbs as Lexical Hazards*

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Abstract

This paper explores the learning of raising verbs (e.g. *seem*), verbs which present particular problems for the language learner. In addition to having highly abstract lexical meanings, these verbs fail to provide some of the cues that guide learners to the meanings of other verbs. The central problem explored here is that discovering the syntactic structure of a raising expression (in particular, discovering that the main clause subject is *not* an argument of the raising verb) is not straightforward. Raising sentences like *John seems to be happy* are string-identical to control sentences, such as *John wants to be happy*, but the two have very different structures. The focus of this paper is the question of how a learner could determine the syntactic structure of raising expressions, and thus determine the syntactic and semantic properties of raising verbs. The results of a series of experiments with English-speaking adults are presented, as well as preliminary evidence from two on-going experiments with children. The experiments suggest that good cues to raising verbs or a raising structure come from expletive subjects (*it, there*) and from the pairing of an inanimate subject with a stative lower predicate (*the rock* ⟨*verb*⟩ *to remain ...*).

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1 Introduction

This paper begins with the puzzle of how children learn the meanings of a class of particularly hazardous verbs, the so-called RAISING VERBS (e.g. *seem*). These verbs, whose lexical meanings are highly abstract, do not give the learner access to their meaning through some of the usual means. For instance, unlike more concrete actions such as 'hitting' or 'eating', 'seeming' (as such) cannot be observed in the world. Also, raising verbs do not select any NP arguments and so do not stand in a semantic relationship with the syntactic subject of the sentence (or any other NPs for that matter). Both of these sources of information (observation of the environment, knowing the meanings of a verb's arguments) are used by language learners as part of the strategy of figuring out the meanings of verbs.

For learning the meanings of raising verbs, one hopes that the solution comes from a third type of information source that learners exploit in learning the meanings of verbs: the syntactic structure of the sentences in which raising verbs occur. However, once again raising verbs present a challenge to the learner: raising structures contain empty categories (the trace of the raised subject)—the learner must parse this silent structure correctly. The bulk of this paper explores the challenge of determining the syntactic structure of sentences involving raising verbs. At the end of the paper we will return to the question of how, if a learner solves the syntactic puzzle, she might begin to solve the semantic puzzle.

The class of raising predicates has few members, some of which are given in (1).

(1)

seem	appear
tend (to)	used (to)
happen (to)	be likely

These predicates are defined as a class by their failure to select (assign a θ-role to) any arguments. Underlyingly, these verbs take an empty subject and select a propositional complement.

(2) $[_{\text{IP}}\ e\ [_{\text{VP}}\ \text{seem}\ [_{\text{CP/IP}}\ \ldots]]]$

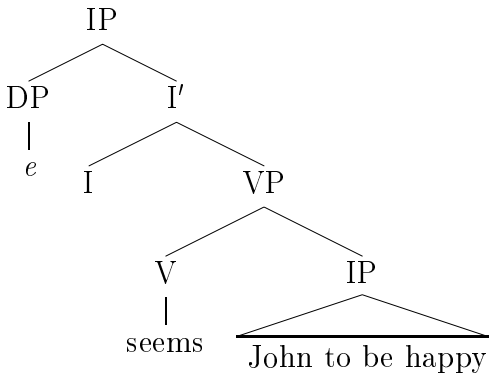
In languages that require the subject of the main clause to be overt (such as English), the subject of the complement clause must raise to matrix

SpecIP, or else an expletive is inserted.[1]

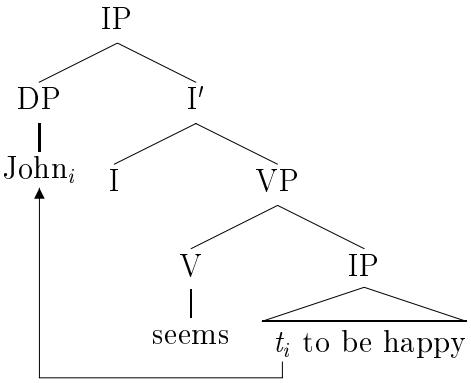
(3) a. $[_{\text{IP}}$ John$_i$ $[_{\text{VP}}$ seems $[_{\text{IP}}$ t_i to be happy $]]]$

b. $[_{\text{IP}}$ It $[_{\text{VP}}$ seems $[_{\text{CP}}$ that John is happy $]]]$

(4) a.

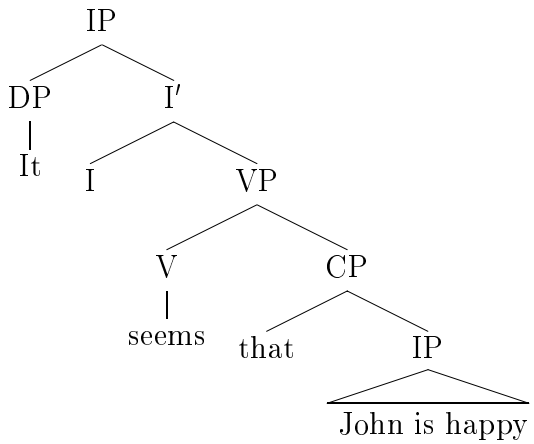


b.



[1]As is evident in the syntactic structures here, I assume a derivational syntactic framework, i.e. one that involves movement and raising. However, it is worth noting that the assumption of movement is not crucial to the problems I am concerned with in this paper, since in derivational and non-derivational frameworks alike, the main clause subject is semantically related only to the lower predicate and not to the raising verb. Thus, if I were to adopt a framework without movement (LFG, HPSG), the learning problems remain the same.

c.



Before getting to the heart of the matter, let me first put aside some important problems associated with learning raising verbs that I will not address in this paper. Two of the problems stem from the abstractness of the lexical meanings of these verbs; the others relate to difficulties associated with the syntax of raising. One problem is the impoverishment of observable information. In other words, how could you observe *seeming*? It should be noted that while observation of the world is never enough to learn the meaning of any verb, as demonstrated most pointedly in Landau and Gleitman's (1985) study of the blind child's learning of verbs (see also Gillette et al. (1999) and arguments in Gleitman (1990)), it quite plausibly provides some information toward the learning of some verbs. Children are keen observers of the world around them, and they are able to draw inferences between objects and events they observe in the world and the words people use to refer to those objects and events. On at least some occasions, a child might observe an eating event and hear the verb "eat" uttered and draw an inference that the two are related. (For experimental evidence, see Brown (1957); also, on-going experimental work by Jeffrey Lidz directly addresses the ability of children to map novel verbs onto events.) In the case of highly abstract verbs like *seem*, *appear*, *tend* and so forth, observation of the world will help even less than usual.

Related to their abstract meaning, there may be complex cognitive factors involved in learning the meanings of these verbs. *Seem* and *appear* may (though need not) imply *false* appearance. Concepts such as false appearance and false belief are reported to be acquired relatively late in development, after age four or so (Wimmer and Perner, 1983; Flavel, 1986; Perner et al., 1987). These conceptual factors, thus, may add to the linguistic difficulties

in acquiring these verbs. However, I will abstract away from these cognitive factors, because even if the child has a concept of false appearance or belief, there is still an interesting mapping problem that remains: how does the child map the verb *seem* to its meaning? Moreover, not all raising predicates have meanings associated with false appearance or belief. Predicates like *tend* and *used to* are related to aspect, and aspectual markers and knowledge of aspectual distinctions are observed in the grammars of children younger than four (Wagner, 1998; Hyams, to appear).

Another issue I will not be concerned with in this paper is the possible difficulty associated with acquiring a raising structure because of the structure itself. In other words, assuming a movement-based syntactic framework, the process of raising itself may be difficult to acquire for various reasons. Borer and Wexler (1987) have argued that structures that involve A-movement such as passives are acquired relatively late because A-chains take time to mature. Frank (1998) has also claimed that a cluster of constructions that are acquired late (again including passives) are acquired late precisely because the operation of adjunction (in Tree Adjoining Grammar), which underlies passive and other kinds of NP-movement is computationally complex and costly. While both of these accounts offer interesting insights into possible reasons for the lateness of acquisition of some constructions that are related to raising, in this paper I am less concerned with accounting for *why* raising verbs might be acquired late, and more concerned with accounting for *how* they are acquired at all. And in fact, not all raising predicates are acquired so late. While it is true that the verbs *seem* and *appear* are vanishingly infrequent in the speech of children younger than 5, the raising predicate *used to* is used by children as young as 3 years old.[2] Moreover, copular constructions (*John is a boy*), which involve the same sort of NP-movement as in a *seem* sentence, are produced by 2-year-olds (Becker, 2000).

In the remainder of the paper, I will focus on the problem of acquiring (the syntactic and semantic properties of) raising predicates on the basis of linguistic input. The next section will set up the problem of learning raising verbs by laying out what we know about learning normal, or non-hazardous verbs.

[2]These facts come from my own searches of the speech of 6 children in the CHILDES database (MacWhinney and Snow, 1985).

2 Background: Learning the meanings of verbs

Recent experimental work on verb learning indicates that language learners exploit a variety of information sources to learn verb meanings. One source of information children can use is the meanings of the NPs that co-occur with a verb. If the child knows the meaning of the NP *man* and the meaning of the NP *cake*, she might hypothesize that the unknown verb *gorp* means something like "eat" or "bake", but it is unlikely to mean something like "kiss" or "hit".

(5) The man gorped the cake
gorp → eat, bake, #kiss, #hit

More specifically, children have been shown to analyze the subject of a transitive sentence as an agent, and they analyze the verb's meaning accordingly. In an experiment by Fisher et al. (1989), four-year-olds were given a scene in which a skunk is chasing a rabbit, accompanied by one of two sentences. Given the sentence "The skunk zarps the rabbit," all eight children said that *zarp* means "chase"; given the sentence "The rabbit zarps the skunk," six of the eight children said *zarp* means "run away (from)". Thus, the meanings of a verb's arguments can provide good cues to the meaning of the verb.

Another way in which the arguments of a verb provide cues to the verb's meaning is by their number, i.e. how many arguments a verb selects. There are regularities in the mapping between syntax and semantics (Chomsky, 1981; Jackendoff, 1983; Fisher et al., 1991) that allow a learner to draw inferences about a verb's possible meaning based on the verb's subcategorization frame(s). For example, a verb that takes two arguments as in (5) *cannot* mean something like "sleep". Formally, these regularities fall out from the Projection Principle and the Theta Criterion: each NP argument is assigned one and only one θ-role, and each θ-role is assigned to one and only one argument (Chomsky, 1981). The number of θ-roles a verb assigns is directly related to what the verb can and cannot mean.[3]

There is a large body of work, largely inspired by Landau and Gleitman (1985), showing that children exploit these regularities in the syntax-semantics mapping of argument structure in learning about the possible

[3]Please note that the subcategorization frames of a verb will not tell a learner what the verb *does* mean; rather, they perform the important function of narrowing down the possible meanings of the verb, i.e. what the verb *can* and *cannot* mean.

meanings of verbs. For example, Naigles (1990) showed that when children are presented with an intranstive sentence (*The duck and the bunny are gorping*), they interpret the novel verb as *not* having a causative meaning (they look longer at the action in which the duck and bunny are each doing some non-causative activity, such as arm-wheeling). But if presented with a transitive sentence (*The duck is gorping the bunny*), children analyze the novel verb as having a causative sort of meaning (they look longer at the action in which the duck is performing some causative activity on the bunny, such as forcing the bunny to squat).

Adults make use of these regularities too. Gillette et al. (1999) showed that when adult English-speakers are given sentences of English with one "mystery verb" (a verb changed to a nonsense form), they are able to correctly guess the verb at least 75% of the time (they are correct on average 90% of the time when also shown an audio-less video clip of the situation in which someone is uttering the sentences). Other evidence comes from experimental work by Kako (1998), who showed that adults can give quite specific and uniform predictions about what a novel verb *could* mean, based only on syntactic frame, i.e. sentences in which all content words have been changed to nonsense forms.

3 The hazards of learning *seem*

The reason raising verbs are so problematic for the learner is that the usual sorts of cues and information used by learners to learn verb meanings are impoverished in many respects. For instance, since raising verbs do not select a subject argument, they do not stand in a semantic relationship with the subject of the sentence.

To see why this is a problem, consider the pair of sentences in (6). The problem with sentence (6b) is that unlike in (6a), the subject *the rock* is not a plausible subject of the verb *bake*, since rocks are not the sort of thing that can bake. In order for this information to be useful to a learner, the learner must assume that the subject and the main verb stand in a local semantic relationship to one another.

(6) a. The chef baked a cake.
b. ?? The rock baked a cake.

Now consider the pair in (7). The problem with (7a) is not that rocks

can't seem, since rocks can, for example, seem to be heavy (as in (7b)). The semantic incompatibility in (7a) is between the rock and artichoke-liking. Thus, the subject of (7a–b) is not in a local semantic relationship with the main verb, but rather it is in a non-local semantic relationship with the predicate of the lower clause.

(7) a. ?? The rock seems [to like artichokes.]
b. The rock seems [to be heavy.]

In other words, the learner must figure out that the subject NP is an ARGUMENT of the verb in (6) but not in (7). But perhaps the more important consequence of this fact is that knowing something about the meaning of the subject of a raising verb will not in any way restrict (i.e. point to or exclude) the possible meaning of the raising verb.

The other main source of information about verb meanings comes from the syntactic frame itself, i.e. the subcategorization frame(s) of the verb. We hope, then, to find good cues for the learner from this type of information. In fact, the problem of determining the syntax of raising constructions might not be so hard: the learner might, for instance, assume that a sentence with the frame

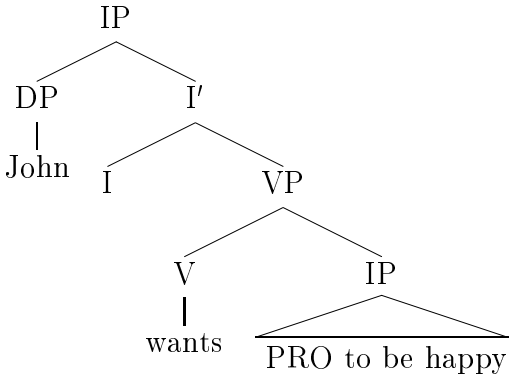
(8) NP_{subj} ⟨verb⟩ [to . . .]

contains a subject that is semantically related only to the lower predicate. The problem with this strategy is that the learner will fail to correctly parse a sentence containing a control verb, such as (9).

(9) John wants to be happy

The control sentence in (9) is string-identical to the raising sentence *John seems to be happy*, but the two sentences are derived by very different structures. The difference between the two structures is that the subject of (9) is selected by *want*; it is assigned an (Experiencer/Agent) θ-role by the matrix verb. Thus, the structure of (9) is:

(10)



where the thematic subject *John* is base-generated in the upper clause, and PRO is a non-overt NP that bears its own θ-role.

To put the learning problem in perspective, adults should consider what interpretation they would give to the following sentence:

(11) John gorps to be happy

What does *gorp* mean? Does it mean something like 'seem' or something like 'want'? Is *John* the semantic subject (as Agent or Experiencer) of the matrix verb, or is *John* the semantic subject only of the lower predicate?[4]

In the next section I present the results of a series of experiments designed to find out how a learner might figure out the structure of a sentence like that in (11).

4 Experiments with adults

Let us focus on the question of how the language learner could distinguish the class of raising verbs from the class of control verbs. What information in the linguistic input could tell a learner that a particular sentence contains one structure vs. the other, and thus one type of verb as opposed to the other type of verb?

The general method employed in all experiments was a version of the "human simulation" paradigm (Gillette et al., 1999). The format was to ask

[4]Even more problematic, the string in (11) is multiply ambiguous: it could also be a purpose construction, as in *John eats to be happy*, or *John runs to stay in shape*. I will not deal further with these constructions, but it is useful to bear in mind that the problem of parsing a string like that in (11) is quite complex!

adults to read a list of 40 sentences in which each sentence was missing one word. In Experiments 1 and 2, 36 of the sentences were fillers and 4 were test items, yielding a 9:1 filler:item ratio. In Experiments 3 and 4 there were 8 test items, yielding a 4:1 ratio. The ratio was determined after piloting indicated that the 4:1 ratio was sufficient for the type of sentence used in Experiments 3 and 4, but was insufficient for the type of sentence used in Experiments 1 and 2 (in Experiments 1 and 2, a 4:1 ratio led participants to guess what the "real" test items were; this was not the case for Experiments 3 and 4). In each experiment each participant saw exactly 2 exemplars of each type of test sentence.

Participants were asked to fill in the blank with a word that would make the sentence sound natural and were provided with the part of speech of the missing word. Filler sentences called for nouns, adjectives, transitive or other kinds of verbs, adverbs and modals. The different parts of speech were reviewed with participants prior to the experiment, and examples were given. Participants were told that the part of speech information was there to guide them; if they found it distracting or otherwise unhelpful, they were free to ignore it and fill in any *word* that made the sentence sound good.

Twenty subjects participated in each experiment, for a total of 100 adult participants (50 males and 50 females); all were students or employees of the University of Pennsylvania, and all received either course credit or payment for their participation.

In interpreting the results, I take a participant's response to be an indication of the structure that person assigned to the sentence. Thus, given a sentence like (11) above (but with a blank in place of *gorp*), if someone writes a verb like *seem* in the blank, then I assume that he or she assigned to the sentence a raising structure; if someone writes a verb like *want* in the same sentence, then I assume that person assigned to the sentence a control structure. Subjects' responses were then categorized according to whether the response was a raising verb, a control verb, ambiguous between raising and control (verbs like *begin*), or something else (e.g. a purpose construction, etc.).[5]

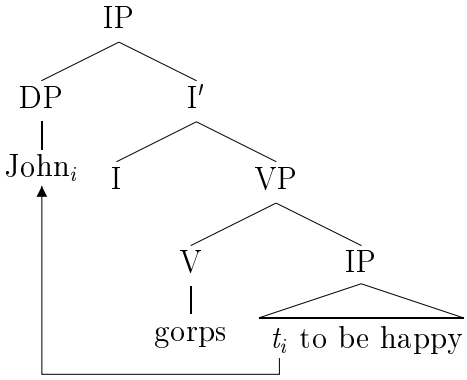
[5]In pilot studies, participants were given sentences just like (11), i.e. containing a novel verb, and they were asked what the novel verb meant. The problem with this methodology was that participants frequently suggested an English word that sounded like the novel verb, even if their suggestion did not necessarily make sense in the sentence. For this reason, subsequent versions of the experiments used the fill-in-the-blank method.

4.1 Experiment 1: *It* vs. NP subject

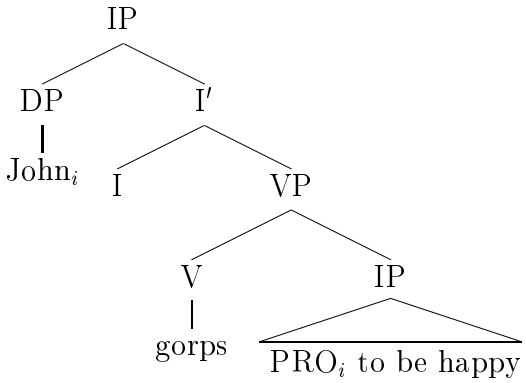
We have seen that the classes of raising and control verbs overlap in the frame in (11), repeated here in (12).

(12) John gorps to be happy.

a.



b.



However, there are disambiguating contexts: for example, control verbs cannot occur with an expletive subject (**It wants that John is happy*). We might predict, then, that a sentence frame such as *It* ⟨*verb*⟩ *that . . .* would serve as a good cue that the main verb (*gorp*) is a raising verb.[6]

In this experiment, subjects were given two kinds of test sentences: the ambiguous frame as in (12) and the disambiguating frame, i.e. with an *it* subject and a *that* complement. Examples are given in (13).

(13) a. unraised frame
It _____ that Barry knew the answer even before she finished the question.

[6]Of course, not all raising verbs can occur in this frame, e.g. *tend, used to*.

b. raised frame
Barry _____ to know the answer even before she finished the question.

The results of Experiment 1 are given in table 1. In this and subsequent tables, the percent indicates the percentage of responses to a sentence type (here: raised or unraised frame) that were raising verbs, control verbs, etc. The number in parentheses gives the number of such responses. Columns total to 100% (N=40).

Table 1: Responses in Raised and Unraised Frames

response type	raised	(N)	unraised	(N)
Raising	32.5%*	(13)	55%*	(22)
Control	52.5%**	(21)	0%**	
Ambiguous	15%	(6)	0%	
Other	0%***		45%***	(18)

* $t(19) = -2.13, p = 0.0464$
** $t(19) = -4.723, p = 0.0001$
*** $t(19) = 6.185, p < 0.0001$

Paired t-tests were performed on subjects' responses for each of the different types of responses, comparing the rate of each type of response in the two sentence (frame) conditions. Thus, asterisks mark the significance of the difference between the two rates on a row in the table.

The results confirm the intuition that context (13a) is not a possible context for control verbs, as no control verbs were offered in this sentence frame. However, raising verbs were only marginally more frequent than "other" kinds of verbs in the unraised frame (13a) (this difference, between 55% and 45%, is non-significant; $p = .6058$). Moreover, the difference between the rate at which raising verbs were offered in the unraised as compared to the raised frame is only just barely significant ($p = .0464$). Thus, the unraised (*it*) frame is perhaps not such a strong or unambiguous cue to a raising verb.

"Ambiguous" responses include verbs such as *begin* and *start*, which in some cases are raising verbs (*It started to rain*), but in other cases are control verbs (*John started to eat a sandwich*). These verbs are not grammatical in

the unraised frame, but they are occasionally offered in the raised frame. Since I am not sure I have a fool-proof way of determining when they are used as control verbs, I have kept them separate in all tabulations. (Please see the discussion in section 4.4.)

Some of the "other" kinds of responses subjects offered were factive predicates, like *suck*, *stink* or *help*, as in (14).

(14) a. It sucked that Diane was sick and running a fever.
b. It helped that the principal believed her excuse for being late.

Participants who offered these responses analyzed the sentence as involving extraposition. What sets these sentences apart from true raising sentences is that the *that*-clause can be fronted:

(15) a. That Diane was sick and running a fever sucked.
b. That the principal believed her excuse helped.
c. * That Diane was sick and running a fever seemed.

Another kind of response was verbs like *say*, *know* or *assume*, verbs which select a thematic subject argument and take a sentential complement.

(16) a. It knew that Barry knew the answer even before she finished the question.
b. It assumed that Barry ...

Thus, participants who offered this kind of response were analyzing the *it* subject as a referring pronoun, not an expletive.

4.2 Experiment 2: Expletive subjects

Since an *it* subject is not unambiguously an expletive in the test items in Experiment 1, in Experiment 2 I measured participants' rates of raising verb responses in sentences with expletive subjects.

4.2.1 Experiment 2a: Expletive vs. Referential *It*

In Experiment 2a I compared expletive *it* with referential *it*. Some examples of test items are given in (17).

(17) a. expletive *it*
It _____ to be raining for most of the morning.
b. referential *it*
It _____ to be an uncommon shade of purple.

Results are given in table 2.

Table 2: Responses with Expletive and Referential *it* Subjects

response type	expletive	(N)	referential	(N)
Raising	85%*	(34)	55%*	(22)
Control	0%		7.5%	(3)
Ambiguous	10%	(4)	15%	(6)
Other	5%**	(2)	22.5%**	(9)

* $t(19) = 3.943, p = 0.0009$
** $t(19) = -2.666, p = 0.0153$

There were only a few responses to sentences with expletive *it* that were not raising verbs. A few of these were ambiguous, e.g. *begin* (here they were surely raising verbs, but as with the other experiments, I kept these verbs separate). Two responses were ungrammatical: participants gave a modal verb instead of a main verb, shown in (18).

(18) a. It **will** to be too foggy to drive safely.
b. It **may** to be too foggy to drive safely.

In a previous version of this experiment, other ungrammatical responses were offered:

(19) a. It **pays** to be sunny.
b. It **rocks** to be sunny.
c. It **sucks** to be raining.

In sentences in which the subject was referential *it*, just over half of the responses were raising verbs. A large portion of the responses fell into the "other" category, exemplified here:

(20) a. It scrambled to scurry along the edge of the field, as if pursued by something.
b. It paid to have stripes, polka-dots and very pointy horns.
c. It sucked to have stripes, polka-dots and very pointy horns.

Thus, the results of Experiment 2a show that expletive *it* almost unambiguously yields a raising verb response. As in Experiment 1, an *it* subject that is not (or not necessarily) an expletive prompts a raising verb response only a little more than half of the time (55% in both experiments).

4.2.2 Experiment 2b: *It* vs. *There*

Unlike *it*, *there* is not lexically ambiguous between an expletive and a referential pronoun. It's true that *there* has a life as a non-expletive, in its so-called deictic use (*John's over THERE*). But deictic *there* differs from expletive *there* in various ways: it is not obligatorily sentence-initial, it can be stressed (*Oh, THERE's my book*), it does not always trigger subject-aux inversion, in particular with pronoun subjects (*THERE they are*, **THERE are they*), and it has no definiteness effects, unlike expletive (existential) *there*. We don't find these sorts of differences between expletive and referential *it*. Therefore, we might expect expletive *there* to serve as an even better cue to raising verbs than expletive *it*. This is what I investigated in Experiment 2b.

Some examples of test items are given in (21).

(21) a. It _____ to be raining for most of the morning.
b. There _____ to be no end to his complaints about the situation.

The results are given in table 3.

Table 3: Responses to Sentences with Expletive *It* and *There*

response type	*it*	(N)	*there*	(N)
Raising	90%	(36)	97.5%	(39)
Control	0%		0%	
Ambiguous	5%	(2)	0%	
Other	5%	(2)	2.5%	(1)

Indeed, expletive *there* is a near-perfect indicator that the main verb is a raising verb, although there is not a significant difference between the rate of raising verb responses to expletive *it* and *there* in this experiment. The single "other" (non-raising) response to a *there* sentence is given in (22).

(22) There **was laughter** to follow a long silence among the people gathered.

4.3 Experiment 3: Predicate Eventivity

Experiment 2 showed that adults can identify raising verbs on the basis of sentence frame information (i.e. occurrence with an expletive).[7] But returning to our original problem, the learner has to determine the structure of the ambiguous frame *John gorped to be happy* on the basis of string input. There is evidence that children reason across frames (Naigles et al., 1989; Naigles, 1996) and might be able to use information about a verb's occurrence with an expletive to make a guess about that verb's syntactic properties upon hearing it in another frame. Even so, it would still be nice if there were information from the single ambiguous frame to suggest to a learner that the structure is a raising or a control structure. Is there such information?

In section 1 I claimed that raising verbs don't select any arguments, and this is true. But they do select *something*: they select a propositional complement. And certain raising verbs appear to have preferences about some aspects of that complement. In particular, some raising verbs prefer a stative predicate inside their complement, as opposed to an eventive one.[8]

(23) a. ?? John seems to eat an apple (right now).
b. John seems to be eating an apple (right now).
c. John seems to know the answer (right now).

In this experiment, I gave participants the ambiguous sentence frame but manipulated the eventivity of the lower predicate. There are different kinds

[7]Two important caveats should be borne in mind: first, as we saw, *it* is ambiguous between being an expletive and a referential pronoun. Second, even in the case of *there*, which I consider unambiguous—or more easily disambiguated than *it*—expletives provide useful cues *only to the extent that they are known to be expletives*. That is, the learner must have first learned that English has expletives and that *it* and *there* are expletives.

[8]I don't think this relation should properly be considered a case of selection. But I'm not sure what to call it.

of stative predicates: an eventive verb put in the progressive becomes stative, and there are bare stative predicates that denote mental or physical states. I gave participants exemplars of each type. First let us contrast just bare eventive verbs with their progressive counterparts.

(24) a. bare eventive
James _____ to eat a triple-decker club sandwich with cole slaw.

b. progressive (stative)
James _____ to be eating a triple-decker club sandwich with cole slaw.

Results are given in table 4.

Table 4: Responses to Ambiguous Frame with Eventive/Progressive Predicate

response type	eventive	(N)	progressive	(N)
Raising	2.5%*	(1)	40%*	(16)
Control	60%	(24)	52.5%	(21)
Ambiguous	30%	(12)	5%	(2)
Other	7.5%	(3)	2.5%	(1)

*$t(19) = -4.682; p \leq 0.001$

In fact, subjects gave almost no raising verbs as responses when the lower predicate was eventive (*to eat*), but gave a raising verb 40% of the time when it was stative (*to be eating*). As mentioned above, in addition to testing responses to progressive verbs, in the same experiment I also gave sentences in which the downstairs predicate contained a bare stative predicate such as *know* or *love*. In those items the predicate varied between denoting a mental state (*know, love*) or a physical state (*be tall, be sick*). The responses to those items are given in table 5.

Although subjects offered a raising verb significantly more often given a stative lower predicate than an eventive lower predicate, they still offered a control verb more often than a raising verb in all sentence types. But in all of the test items the subject was animate. Animate things have volition and intention, so they are capable of *wanting* and *trying*. Inanimate things are

Table 5: Responses to Ambiguous Frame with Stative Predicates

response type	mental state	(N)	physical state	(N)
Raising	37.5%	(15)	22.5%	(9)
Control	55%	(22)	65%	(26)
Ambiguous	7.5%	(3)	7.5%	(3)
Other	0%		5%	(2)

(No differences between columns were significant.)

not. In the final experiment, I manipulated both the animacy of the subject and the eventivity of the lower predicate.

4.4 Experiment 4: Animacy × Eventivity

Examples of the test sentences given in Experiment 4 are given in (25-26). Unlike the other experiments, this one had a 2×2 design; each participant saw two sentences of each type, and there were four types.

(25) *Animate subject*

a. eventive
The driver _____ to hit the car.

b. stative
His campaign manager _____ to remain a problem for the mayoral candidate.

(26) *Inanimate subject*

a. eventive
The boulder _____ to hit the car.

b. stative
The extramarital affair _____ to remain a problem for the mayoral candidate.

In viewing the results of this experiment, let us first look only at the subject animacy factor and collapse across predicate type. These data are shown in table 6.

These results indicate that an animate subject yields more control verbs than raising verbs, and an inanimate subject yields more raising verbs than

Table 6: Responses to Ambiguous Frame with Animate vs. Inanimate Subject

response type	animate	(N)	inanimate	(N)
Raising	18.75%*	(15)	43.75%*	(35)
Control	52.5%**	(42)	17.5%**	(14)
Ambiguous	17.5%	(14)	23.75%	(19)
Other	11.25%	(9)	15%	(12)

* $t(19) = -4.359, p \leq 0.003$;
** $t(19) = 7.054, p < 0.0001$

control verbs (there was a significant main effect of subject for raising and control verb responses). But let us now break down the results according to both subject type (animacy) and predicate type (eventivity). These figures are given in table 7.

Table 7: Responses by Subject Animacy and Predicate Eventivity

response type	animate subject		inanimate subject	
	eventive	stative	eventive	stative
Raising	5% (2)	32.5% (13)	17.5% (7)	70% (28)
Control	65% (26)	40% (16)	32.5% (13)	2.5% (1)
Ambiguous	15% (6)	20% (8)	25% (10)	22.5% (9)
Other	15% (6)	7.5% (3)	25% (10)	5% (2)

Sig. interaction only for raising verb responses ($p = 0.0375$)

As in Experiment 3, when the subject is animate, an eventive lower predicate yields almost no raising verbs, while a stative lower predicate yields some (around 30%). But when we look at sentences with an inanimate subject, we see an interesting outcome: an eventive lower predicate still yields less than 18% raising verb responses, while a stative lower predicate yields a full 70%. Thus, it is not simply the animacy of the subject that affects the proportion of raising verb responses, as would be apparent from table 6, rather the combination of an inanimate subject and a stative lower predicate

provides a strong cue that the sentence is likely to be a raising sentence.[9]

In addition to raising and control verb responses, there were quite a number of "ambiguous" responses as well as "others". Recall that the ambiguous responses are those like *begin*, *start* and so forth which may function either as raising or as control verbs. Interestingly, Perlmutter (1979) argues that these verbs are raising verbs when the subject is inanimate, but control verbs when the subject is animate. For instance, John might be said to be a "beginner" in (27a) (and thus a controller for PRO), but the water could not really be said to be a "beginner" in (27b).

(27) a. John began to write a paper.
b. Water began to gush from the sewer.

If this is true, then the ambiguous responses in sentences with an inanimate subject should be added to the tally of raising verb responses, while the ambiguous responses in sentences with an animate subject should be added to the tally of control verb responses. This division of responses would yield the following picture.

Table 8: Redistributing "Ambiguous" Responses

response type	animate subject		inanimate subject	
	event.	stat.	event.	stat.
Raising	5%	32.5%	42.5%	**92.5%**
Control	**80%**	60%	32.5%	2.5%
Other	15%	7.5%	25%	5%

Reassigning the ambiguous responses in this way has the effect of making an animate subject plus eventive predicate a *very* good cue to a control verb, and an inanimate subject plus stative predicate a *very* good cue to a raising verb—in fact, the inanimate subject plus stative predicate combination appears to rival an expletive *it* subject as a cue to a raising verb.

It may be hasty, however, to reassign the ambiguous responses based solely on the criterion of subject animacy. There were cases in which I believe

[9]Note also that the significant interaction between the two factors shows that the effect is not merely additive.

the sentence is truly ambiguous, and we cannot determine the exact structure the participant had in mind. Some examples illustrate:

(28) a. His campaign manager **proved** to remain a problem for the mayoral candidate.

b. The driver **had** to hit the car on the passenger's side.

I think the sense of *prove* in (28a) that is most likely intended is the raising sense: "the manager turned out to remain ...", and yet the subject is animate (*campaign manager*). Similarly, the sense of *have* in (28b) that is most probable is the sense of non-controlled necessity, i.e. the driver was forced (e.g. by the way in which the accident unfolded) to hit the car on the passenger's side. However, it is possible that the participant intended the meaning of *have* such that the driver had some internal necessity or desire to hit the car on the passenger's side. Of course, it is the sentences with an animate subject that remain truly ambiguous in this way; if inanimate things cannot be the subject of a control predicate, then it may be safe to lump the ambiguous responses with raising responses for those items. But for the sentences with an animate subject, I think it is best at this point to keep such responses separate.

Almost two-thirds of the "other" responses in this experiment were purpose verbs (e.g. *The boulder* ***dropped*** *to hit the car ...*), there were two null responses, and the remaining third or so were either ungrammatical or nonsensical (e.g. *The salesman* ***languished*** *to advertise a new product*). Certain passives were included in this category if they could not occur naturally with an expletive subject (e.g. *Amy* ***was forced*** *to depend on Eric ...*, cf. ?**It was forced to rain*; ?**There was forced to be a resolution*).

In summary, (in)animacy is a strong cue, but it is not definitive: an inanimate subject paired with an eventive predicate still evokes a raising verb response only 17% of the time; less frequently than it evokes a control verb response. The reason for the animacy effect is intuitively clear: control verbs imply desire (*want*), effort (*try*), or some other agentive/experiential property of the subject, and inanimate objects don't have those properties. What's puzzling though is why inanimate subjects strongly cue a raising verb only when the lower predicate is stative.

It is, in fact, puzzling that eventivity matters so much. Although I do not have a good answer for why this is, I suspect it is due to an interaction between the aspect of the matrix clause and that of the embedded clause.

Certain matrix clause verbs have preferences as to whether the embedded predicate can be eventive or stative:

(29) a. I saw John drunk.
b. * I watched John drunk.

(30) a. I saw John eat a banana.
b. I watched John eat a banana.

Watch appears to require its embedded clause predicate to be eventive (it's unclear whether this is due to *watch* itself being eventive), while *see* places no such restriction. Raising verbs appear to require a stative downstairs predicate, or they require that an eventive predicate have a habitual meaning:

(31) a. It seems to be raining/??rain (right now).
b. It appears to be raining/??rain (right now).
c. It tends to rain (on Tuesdays).

Want doesn't seem to have this restriction, but *try* prefers an eventive predicate.

(32) a. John wants to eat an apple (right now)/be tall.
b. John is trying to eat an apple (right now)/(?)like math.

The nature of the relationship between raising and control verbs and the aspect of their lower predicates is something that should be further investigated in the future.

4.5 Summary of Experiments

The purpose of the experiments reported here was to find out what cues are available from sentences to suggest to a learner that the main verb of the sentence might be a raising verb. Of course, the "learners" in these experiments were not actual language learners but rather adult speakers of English. Nevertheless, adult intuitions have proven to be helpful indicators of the intuitions real (child) learners might have about the meanings of novel verbs (Gillette et al., 1999). Though surely not the whole story, I take this approach to be a good starting point for these kinds of investigations into language learning.

The experiments showed that there are a couple different kinds of cues that point to raising verbs or a raising structure. As we saw in section 4.1, raising verbs can be distinguished from control verbs by the frame of the sentence: (most) raising verbs can occur in the frame *It* ⟨*verb*⟩ *that* . . . , while control verbs cannot. However, Experiment 1 showed that this frame provides only a moderate cue: raising verbs were offered as a response to fill in the blank only marginally significantly more than in the ambiguous frame. Thus, this frame does not strongly cue a raising verb response, because there are non-raising verbs that are compatible with this frame (e.g. *It knew that . . . /It helped that . . .*).

Experiment 2 showed that expletive subjects (weather *it* and *there*) serve as strong cues that the sentence involves a raising verb. This is hopeful, but it requires that the learner *know* that they are expletives. In answering the question of how a child might know that something is an expletive, we risk falling into the circular argument that "they know it's an expletive because it occurs with raising predicates." At this point, I will leave this as a caveat (and see discussion of on-going work in section 5.2).

Apart from sentence frame, there are cues within an ambiguous string (*NP* ⟨*verb*⟩ *to . . .*) to indicate that the sentence might involve a raising verb (and therefore a raising structure). Experiment 3 showed that the aspect of the lower predicate (whether the predicate in the lower clause was stative or eventive) affected the choice of the main verb: when the lower predicate was eventive, virtually no raising verbs were offered (only 1 out of a possible 40)[10]; when the lower predicate was stative, raising verbs were offered between 22.5% and 40% of the time. It is unclear exactly why this is so, but it appears to follow from a dispreference that certain raising verbs have for occurring with an eventive downstairs predicate (*John seems to ??eat/be eating . . .*).

This relationship between the choice of raising vs. control verbs in the main clause and the eventivity vs. stativity of the lower clause was seen in Experiment 4 to interact in an interesting way with the animacy of the main clause subject. In brief, an inanimate subject paired with a stative predicate yields a high rate of raising verb responses, and an animate subject paired with an eventive predicate yields a high rate of control verb responses, while neither inanimacy nor stativity alone evokes raising verbs more than 50% of the time.

What is remarkable about this interaction is that since raising verbs do

[10]In a previous run of this experiment, no raising verbs were offered in this condition.

Table 9: Summary of Responses in Experiment 4

	eventive	stative
animate	*control verbs*	*mixed*
inanimate	*mixed*	*raising verbs*

not actually select anything (other than a propositional complement), raising verbs cannot *select* an inanimate subject. The raising verb does not stand in any sort of semantic relationship with that subject at all. Nevertheless there is a kind of "negative" selection: control verbs, by virtue of their meaning, generally require a sentient subject and therefore cannot normally select an inanimate subject.[11]

If we can use the adult data as a suggestion about what cues a child learner might notice and exploit, there are potential cues in the syntax of certain constructions to lead a learner to think that a sentence involves a raising verb (expletive subjects), and there are cues in the semantics of syntactically ambiguous sentences as to whether the sentence is likely to be a raising or a control structure (subject animacy, predicate eventivity). The next question is at what age children attend to these very cues.

5 Conclusions and Further Directions

Before getting into the ways in which this work can be extended, let us come back to the question we started with: how do children learn the *meanings* of raising verbs? We saw that the best hope for learning to identify the class of raising verbs is via the syntax of the constructions in which these verbs occur. The rest of the paper dealt with why that path itself is tricky and suggestions were made, on the basis of experiments with adults, for how a learner might go about solving the syntactic puzzle. But let's say that the learner achieves all that: the learner is able to figure out what the expletives

[11] Please note that there are counterexamples to this generalization, few though they are. The verb *serve* can take an inanimate subject in a control structure, as in *This pamphlet serves to dictate the rules of proper behavior in the office.* Other counterexamples are *suffice*, *deserve* and *fail* (Rudanko, 1989), although I consistently counted the response *fail* as ambiguous since it can also be a raising verb (*There failed to be any resolution*). I thank Carson Schütze for discussion on this issue.

in the language are and to use subject animacy and predicate eventivity as cues that a potentially ambiguous string has a raising or a control structure. Then what? How can this knowledge lead the learner to figure out the abstract meanings of raising verbs?

I propose that the answer lies in the Theta Criterion: if a verb does not select any NP arguments and can occur with expletive and inanimate subjects, then its meaning cannot have to do with desire or effort or decision (things that require a sentient being as experiencer). Instead, the verb should have the sort of meaning that modal or auxiliary verbs do: it should mean something about aspect (cf. *tend, used to*), evidentiality (cf. *seem, appear*), or it should qualify a state of affairs (cf. *happen to, be likely, turn out*). How a learner figures out the precise meanings of these verbs I don't know, but I would venture that we are not in a position to say how a child learns the precise meaning of any verb.

There are various ways in which this work can be continued. Perhaps the least urgent (and probably the simplest) is to do further manipulations with adults. One could, for example, give adults a sequence of sentences (rather than individual, unrelated sentences), and ask them to fill in the same word in each sentence. One could vary the sentence frames through the series and measure how their guesses change at each sentence, or measure how long it takes them to come up with a raising verb. A more urgent, and probably more interesting route to take is to study children (the "real" learners) directly.

How should we investigate children's knowledge and learning of raising verbs? The experiments with adults tell us that (at least) two things are important in identifying raising verbs: expletive subjects, and inanimate subjects paired with stative downstairs predicates. Thus, some first steps would be to examine children's understanding of expletives, and their interpretations of inanimate subjects as subjects of control verbs.

At present I have begun two studies with children to examine exactly these things. Neither study is complete, so here I report only the preliminary results.

5.1 Experiment 1: Animacy

Recall that in a raising structure the main clause subject is semantically related only to the lower predicate, while in a control structure the main clause subject is semantically related to both the main clause and lower predicates. Thus, perhaps a good learning strategy would be to first pay

attention to that long-distance semantic relationship (and possibly ignore the local semantic relationship between the main clause verb and subject). This strategy would be good in allowing the learner to correctly parse raising sentences, and it would not harm the parsing of control sentences since the long-distance semantic relationship matters for control sentences too.[12] Then at a certain point the learner will need to distinguish raising from control structures, and so at that point the learner will need to pay attention also to the semantic relationship between the main clause verb and the main clause subject (i.e. the local relationship). This will help distinguish raising from control sentences, because in raising sentences there is no semantic relationship between the verb and subject in the main clause, but in control sentences there is. One measure of attention to this relationship, then, would be rejection of inanimate subjects as subjects of control verbs.

In short, this experiment is designed to examine children's interpretation of the semantic relationship between the main clause subject and the upstairs and downstairs predicates in raising and control sentences, and to find out whether children allow inanimate subjects to be subjects of control verbs (and at what age they stop allowing this relation).[13]

The method employed is a version of the Grammaticality Judgment task (De Villiers and De Villiers, 1974; McDaniel and Cairns, 1990). Children are shown a series of pictures, a puppet comments on each picture, and the child is asked to judge the puppet's comment to be "good" (acceptable) or "silly". Some examples of target items are given in (33). In each target sentence, the main clause subject is *inanimate*, and it is either compatible or incompatible (semantically) with the *lower* predicate. Children were given 8 test sentences (4 raising and 4 control) plus 8 filler sentences.

(33) a. The door is trying to be purple. (compatible)
b. The door is trying to be friendly. (incompatible)
c. The hay seems to be on the ground. (compatible)
d. The hay seems to be excited. (incompatible)

Thus, all control sentences are "silly" because all contain inanimate subjects (cf. (33a): doors can be purple, they just can't *try* to be purple; doors can neither be friendly nor try to be friendly). Half of the raising sentences

[12]Thanks to Robin Clark for discussion about this point.

[13]N.B. Throughout this section, I use the term "control sentence" to mean a sentence with a control structure/control verb, not an experiment control.

are "silly" and half are "good". The reason for including both compatible and incompatible predicates for the control sentences is to find out whether the child is attending to the local or non-local semantic relationship. Whenever a child judged a sentence to be silly, the child was asked why it was silly. This allows us to determine, on the basis of the child's reasoning, whether she had rejected it because of incompability with the control verb itself (the upstairs verb) or with the downstairs predicate. So as not to bias children to answer "silly" all the time, most of the filler sentences were "good", and some of the fillers were control sentences with animate subjects. Each child completed four practice items before beginning the experiment.

I have grouped the children into three groups, roughly by age. The mean performance (% correct) for raising and control sentences is given in table 10.

Table 10: Percent Correct for Raising and Control Sentences

	% correct	
mean age (N)	raising	control
5;5 (5)	95.8^a	95.8^a
4;9 (7)	87.5^b	83.3^c
3;3 (5)	70^d	20^e

$^a t(4) = 9.0, p = 0.008$; $^b t(5) = 4.332, p = 0.0075$
$^c t(5) = 6.708, p = 0.0011$; $^d t(4) = -2.40, p = 0.0743$
$^e t(4) = 2.236, p = 0.0890$

There is some variation across the different age groups in the proportion of correct responses to raising sentences (the older children performing better), but all children performed quite well. However, with the control sentences only the 4- and 5-year-olds were more than 50% correct. The performance of the 3-year-olds is almost, but not quite, significantly different from chance, while the 4- and 5-year-olds are significantly above chance for both raising and control sentences. However, given that the study is not complete and sample size is accordingly quite low, we should not place too much weight on significance at this point.

Turning now the the children's interpretations of control sentences, the most interesting test items are the ones in which the main clause subject is *compatible* with the lower clause predicate: these sentences should be rejected

if children are paying attention to the relationship between the main clause verb (the control verb) and the main clause subject. If children are instead paying attention only to the long-distance relationship between the subject and the lower clause predicate, they should accept the sentence. Thus, the predictions for responses to a sentence like *The door is trying to be purple* are summarized in table 11.

Table 11: Predictions for Control Sentences

if child attends to ...	response should be ...
door–try	reject
door–purple	accept

Moreover, the reason children give for their rejection of a sentence should indicate that they rejected the sentence because of an incompatibility between the subject and the control verb (e.g. "Doors can't try to do anything"). The result of this analysis of the data reveals an interesting pattern.

Table 12: Attention to Compatibility with Upstairs vs. Downstairs Predicate

mean age	door–try	door–be purple	unclear
5;5	90%	0%	10%
4;9	42.9%	42.9%	14.3%
3;3	0%	100%	0%

Children in the 5-year-old group uniformly attend to the relationship between the subject and the control verb, thus rejecting these sentences for an appropriate reason 90% of the time.[14] Children in the 3-year-old group uniformly attend to the relationship between the subject and the downstairs predicate, incorrectly accepting these sentences 100% of the time. Children in the 4-year-old group show a mixed pattern, attending to the subject's relationship with the downstairs predicate and with the upstairs predicate each 42.9% of the time.

Some examples of children's responses follow:

[14]The one "unclear" response by a 5-year-old was correct (i.e. she rejected the sentence), but the reason for her rejection was not clear from her response.

(34) a. # The door is trying to be purple
→ "No, because you have to paint it" (age 5;6)

b. # The bucket wants to be in the sandbox
→ "No, because [buckets] can't move unless somebody carries them" (age 5;4)

(35) # The door is trying to be purple
→ "Good." (age 3;4)

Sometimes children (especially in the 4-year-old group) correctly rejected a sentence like (34a/b) but did so for an alternative reason, as seen in the following exchange:

(36)

Puppet:	The flower wants to be pink.
Child (4;1):	Silly. It already IS pink!
Experimenter:	Well, could it want to be another color?
Child:	Yeah.

These responses were counted as indicating attention to the relationship between the subject and the lower predicate, because the child stated that the flower (or door) could want or try to do something (be another color). Not all children responded this way, even those who were not sure exactly why flowers or doors could not want or try to do anything:

(37)

Puppet:	The flower wants to be pink.
Child (4;8):	Silly, because the flower IS pink!
Experimenter:	Well, could it want to be another color?
Child:	No.
Experimenter:	How come?
Child:	I don't know.

From these preliminary data, it appears that until almost age 5, children (at least sometimes) permit an inanimate thing to be the subject of a control verb. This could support the hypothesis that children are attending only to the semantic relationship between the subject and the downstairs predicate and are ignoring its relationship to the upstairs predicate. It could also mean that children until about age 5 do not know that inanimate things cannot have volition or make effort. It is unlikely that these 4-year-olds fail to understand the difference between animate and inanimate things. Experimental work by Spelke et al. (1995) (and work cited there) indicates that

infants as young as 7 months of age appreciate central differences between inanimate objects and people (for example that people are self-propelled but inanimate objects are not) and reason differently about the behavior of animate vs. inanimate things. By age 2;6 children understand that people have intentions and that their actions are often goal-directed. What is less certain at this point is at what age children understand that inanimate things do not have intentions. That is, children know that inanimate things do not typically cause events to occur, but it is difficult to test conclusively for the knowledge that inanimate things do not have intentions (C. Massey, personal communication). Thus, although children understand many important differences between inanimate and animate things well before age 5, there may still be some conceptual differences that are acquired later in development.

5.2 Experiment 2

The second experiment is aimed at finding out at what age children discriminate between expletive and referential *it*. The method is a version of the Truth-Value Judgment task (Crain and McKee, 1985). Two characters are introduced, a bird and a dinosaur. The dinosaur is blindfolded so that it cannot see anything. The bird and the dinosaur (who, the child is told, argue a lot) have to identify a series of small plastic shapes. The bird is always right (since the bird can see), and the dinosaur is always wrong (since it can't see, so it has to guess). The bird and dinosaur are consistently referred to either by the NP labels (*the bird, the dinosaur*) or by the pronoun *it*. Finally, when they are done arguing, the puppet makes a statement about what just happened, and the child's task is to respond to the puppet's comment. Here is an example:

(38)

	⟨Shape is a star⟩
Experimenter:	Let's ask the bird what IT thinks that is.
Bird:	Chirp chirp! It's a star!
Experimenter:	Let's ask the dinosaur what IT thinks.
Dinosaur:	(touches the side of it) I think it's a ball.
Bird:	No! It's a star!
Dinosaur:	No! It's a ball! (continues)
Experimenter:	Let's ask the puppet what just happened.
Puppet:	I know! It chirped to the dinosaur that it was a star. ($\surd$)
—or—	
Puppet:	I know! It seemed to the dinosaur that it was a star. ($*$)

There were a total of 8 test sentences (and no fillers), 4 *seem* sentences and 4 *chirp* sentences. The test items were balanced so that for 2 of the *seem* sentences the correct answer was "yes" and for 2 of them the correct answer was "no"; the same for the *chirp* sentences. Items were presented in a pseudo-random order.

Half of the children received the sentences as above, and half received an alternative to the "chirp" sentence, namely, *It said to the dinosaur that the shape was a star*. The experiment was originally piloted using the sentence *It said to the dinosaur that it was a star*. But there was concern that this sentence does not contrast enough with the *seem* sentence. Thus, the reason for using the *chirp* sentence was to use a more noticeable word than *say*, and the reason for spelling out the noun phrase *the shape* in the other version was to discourage children from analyzing the first *it* as referring to the shape itself (as opposed to the bird). (Only one child out of 16 consistently analyzed the *it* subject as referring to the shape: that child rejected all four of the *say* sentences and her reason was always "Stars [etc.] can't talk".)[15]

With so little data statistical tests are not especially meaningful, but the responses of the 5-year-olds for both kinds of sentences are significantly above chance, and the responses of the 4-year-olds to the *seem* sentences are likewise above chance. The 4-year-olds' responses to the *say/chirp* sentences are at chance ($p = 0.7$), and there is not enough data for the 3-year-olds to determine significance (but they are correct over 50% of the time).

[15]The same children participated in this experiment as in the animacy experiment. However, one 3-year-old child who completed the animacy experiment did not comprehend this task and did not complete it.

Table 13: Percent Correct Responses in Expletives Task

	% correct	
mean age (N)	chirp/say	seem
5;5 (5)	70[a]	77.8[b]
4;9 (7)	55.6	75[c]
3;3 (4)	73.3	73.3

[a] $t(4) = 3.14, p < 0.05$
[b] $t(4) = 2.83, p < 0.05$
[c] $t(6) = 2.65, p < 0.05$

It is interesting that the group with the lowest percentage correct are the 4-year-olds for the *chirp/say* items. In fact three of the 4-year-olds showed a consistent pattern of responding correctly to the *seem* items but incorrectly to the *say/chirp* items. Their incorrect response was not a failure to respond, rather they responded as if the puppet's sentence had been *It seemed to the dinosaur that ...*, thus they gave what would have been a correct response if the sentence had been a *seem* sentence. My hunch as to why they do this is that these children have parsed the sentence analyzing *it* as an expletive, rather than as a referring pronoun. If they parse *it* as an expletive, then whatever verb occurs with the expletive could not mean something like *say* or *chirp*; it would have to mean something like *seem*. Further work on this is certainly required to find out exactly what children's interpretations of these sentences are.

Given the preliminary nature of these data, it is impossible to draw any strong conclusions. However, I believe they are suggestive of a few things. First, they suggest that three-year-olds consistently attend only to the semantic relationship between the upstairs subject and the downstairs predicate in sentences with an infinitive complement (or that 3-year-olds believe that inanimate things can have intentions), and that only after age 5 do children consistently attend also to the relationship between the upstairs subject and upstairs predicate (control verb). Secondly, they suggest that 3- and 4-year-olds do not show much (if any) difficulty interpreting raising sentences. Children as young as 3 are correct on average 70% of the time in judging the acceptability of raising sentences (*The bicycle seems to be small/*sad*). Young children also give evidence of comprehending sentences containing ex-

pletive *it* plus *seem*, and some of these children show evidence of correctly distinguishing expletive *it* from referential *it* (one child aged 3;4 was 100% correct on all *chirp* and *seem* items in the second experiment). But these interim results raise at least as many questions: do young children merely appear to comprehend raising sentences but instead are simply parsing the upstairs subject and lower predicate, without even parsing the raising verb? Are they doing the same thing with control sentences (hence the apparent lack of attention to the relationship between the subject and main clause verb)? Why do some of the 4-year-olds consistently misinterpret sentences like *It said to the dinosaur that ...*? Hopefully further work will shed light on these questions, and provide more answers as to how children learn raising verbs.

References

Becker, Misha. 2000. The development of the copula in child English: The lightness of *be*. Doctoral Dissertation, UCLA.

Borer, Hagit, and Kenneth Wexler. 1987. The maturation of syntax. In *Parameter setting*, ed. Thomas Roeper and Edwin Williams. Dordrecht: Reidel.

Brown, Roger. 1957. Linguistic determinism and parts of speech. *Journal of Abnormal and Social Psychology* 55:1–5.

Chomsky, Noam. 1981. *Lectures on government and binding: The Pisa lectures*. New York: Mouton de Gruyter.

Crain, Stephen, and Cecile McKee. 1985. The acquisition of structural restrictions on anaphora. In *Proceedings of NELS 15*, ed. S. Berman, J. Choe, and J. McDonough. Amherst, MA: GLSA.

De Villiers, Jill G., and Peter A. De Villiers. 1974. Competence and performance in child language: Are children really competent to judge? *Journal of Child Language* 1:11–22.

Fisher, Cynthia, Henry Gleitman, and Lila R. Gleitman. 1991. On the semantic content of subcategorization frames. *Cognitive Psychology* 23:331–392.

Fisher, Cynthia, Geoffrey Hall, Susan Rakowitz, and Lila Gleitman. 1989. Verb-meaning acquisition is guided by syntactic evidence. Unpublished manuscript, University of Pennsylvania.

Flavel, J. 1986. The development of children's knowledge about the appearance-reality distinction. *American Psychologist* 41:418–425.

Frank, Robert. 1998. Structural complexity and the time course of grammatical development. *Cognition* 66:249–301.

Gillette, Jane, Henry Gleitman, Lila Gleitman, and Anne Lederer. 1999. Human simulations of vocabulary learning. *Cognition* 73:135–176.

Gleitman, Lila. 1990. The structural sources of verb meanings. *Language Acquisition* 1:3–55.

Hyams, Nina. to appear. Clausal structure in child Greek: A reply to Varlokosta, Vainikka and Rohrbacher and a reanalysis. *The Linguistic Review* .

Jackendoff, Ray. 1983. *Semantics and cognition*. Cambridge, MA: MIT Press.

Kako, Edward. 1998. The event semantics of syntactic structures. Doctoral Dissertation, University of Pennsylvania.

Landau, Barbara, and Lila R. Gleitman. 1985. *Language and experience: Evidence from the blind child*. Cambridge, MA: Harvard University Press.

MacWhinney, Brian, and Catherine Snow. 1985. The child language data exchange system. *Journal of Child Language* 12:271–296.

McDaniel, Dana, and Helen Smith Cairns. 1990. The child as informant: Eliciting intuitions from young children. *Journal of Psycholinguistic Research* 19:331–344.

Naigles, Letitia. 1990. Children use syntax to learn verb meanings. *Journal of Child Language* 17:357–374.

Naigles, Letitia. 1996. The use of multiple frames in verb learning via syntactic bootstrapping. *Cognition* 58:221–251.

Naigles, Letitia, Henry Gleitman, and Lila R. Gleitman. 1989. Syntactic bootstrapping in verb acquisition: Evidence from comprehension. In *Language and cognition: A developmental perspective*, ed. E. Drom. Norwood, NJ: Ablex.

Perlmutter, David M. 1979. The two verbs *begin*. In *Syntactic argumentation*, ed. Donna Jo Napoli and Emily Norwood Rando. Washington, D.C.: Georgetown University Press.

Perner, J., S. Leekam, and H. Wimmer. 1987. Three-year-olds' difficulty with false belief: The case for a conceptual deficit. *British Journal of Developmental Psychology* 5:125–137.

Rudanko, J. 1989. *Complementation and case grammar: A syntactic and semantic study of selected patterns of complementation in present-day English*. New York: State University of New York Press.

Spelke, Elizabeth S., Ann Phillips, and Amanda L. Woodward. 1995. Infants' knowledge of object motion and human action. In *Causal cognition: A multidisciplinary debate*, ed. Dan Sperber, David Premack, and Ann James Premack. Oxford: Clarendon Press.

Wagner, Laura. 1998. The semantics and acquisition of time in language. Doctoral Dissertation, University of Pennsylvania.

Wimmer, H., and J. Perner. 1983. Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition* 13:103–128.