

Learning Verbs Without Arguments: The Problem of Raising Verbs

Misha Becker¹

This paper addresses the problem of learning the class of raising verbs (e.g. seem). These verbs are potentially problematic for learners in that unlike typical main verbs, these verbs do not stand in a semantic relation with any Noun Phrase (NP) arguments. Moreover, a second class of verbs, known as control verbs, shares certain distributional properties with raising verbs, but the two verb classes differ in important structural properties. The central problem addressed here is that of how a learner would distinguish raising verbs from control verbs, given their partial overlap in distribution. A series of experiments with English-speaking adults using a fill-in-the-blank questionnaire revealed two main types of cues that led participants to distinguish the two verb classes: inanimate NPs and semantically empty subjects (“it’s raining”) yielded the highest proportion of raising verb responses from adults, while animate NPs paired with eventive predicates yielded a high rate of control verb responses. On the basis of these results, suggestions are made as to how one should study the learning of these verbs in children.

KEY WORDS: language acquisition; verb learning; raising verbs; syntax.

INTRODUCTION: THE LEARNING PROBLEM

Previous research on children’s learning of verb meanings has demonstrated that children attend to the Noun Phrases (NPs) that are semantically related to a verb (the verb’s NP arguments) in narrowing down the

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¹Linguistics Department, 318 Dey Hall, CB #3155, University of North Carolina, Chapel Hill, NC 27599-3155, USA; email: mbecker@email.unc.edu

possible meanings of novel verbs (Gleitman, 1990). More specifically, children have been shown to analyze the subject of a transitive sentence as an agent (the “do-er” of an action), and they analyze the verb’s meaning accordingly. In an experiment by Fisher *et al.* (1989, unpublished), four-year-olds were given a scene in which a skunk is chasing a rabbit, accompanied by one of two sentences.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 the verb’s NP arguments can provide good cues to the meaning of the verb.

Naigles (1990) showed that when presented with an intransitive sentence (*The duck and the bunny are gorp*ing), children 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 gorp*ing 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 a causative action on the bunny, such as forcing the bunny to squat). Transitive, but not intransitive, verbs can have a causative type of meaning. Thus, children use the number of arguments a verb takes to infer a possible meaning of the verb.

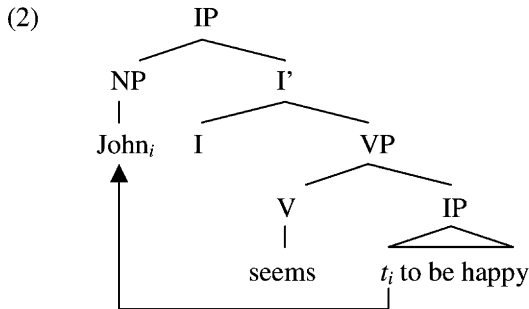
The reason children are able to use information from a verb’s argument to infer something about the verb’s meaning is that there is a regular relationship between the number of NP arguments a verb takes, or “selects” (also called its “subcategorization frame”) and the types of meanings the verb can and cannot have. For instance, a verb that selects only one argument could mean something like “sleep” but not “hug” or “give”. A verb that selects two arguments could mean something like “hug” or “kill” but not “sleep” or “give”.

In this paper, I discuss a class of verbs that do not select any NP arguments at all. If a verb’s arguments provide crucial clues for learning the meaning of a verb, how are these verbs learned? These verbs, known as “raising verbs”, are exemplified in (1).

- (1) a. John *seems* to be happy
- b. It *appears* that Susan left
- c. There *tend* to be storms at this time of year
- d. Bill *happens* to be a trombone player
- e. Gordon *used* to chew tobacco
- f. Donald *is likely* to be guilty

The term “raising verb” derives from the fact that these verbs do not select their subject. Therefore, the NP that appears as the subject of the

sentence is generated in a lower part of the sentence and must “raise” up to the subject position. Thus, the subject of the sentence is semantically related to (selected by) the predicate inside the lower infinitive clause, but not to the main verb. In a Government-Binding style syntactic framework (Chomsky, 1981) we can illustrate the structure of (1a) in the following way:^{2,3}



In addition to the fact that these verbs do not select any arguments, there is another way in which raising verbs are potentially problematic for learners. There is a class of verbs, known as control verbs (e.g. *want*, *try*, *decide*) which are superficially similar to raising verbs but differ in an important property. They are like raising verbs in being able to occur in sentences like (1a) above (they can take an infinitive clause complement), but are unlike raising verbs in that they *do* select the NP subject of the sentence. Thus, in (3) *John* is an argument of the verb *want*.

- (3) a. John wants to be happy
 b. [_{IP}John_i [_{VP}wants [_{IP}PRO_i to be happy]]]

The difference between the structures in (2) and (3) is that in (3) the verb *want* selects the subject *John*. *John* is base-generated in the main clause and is said to “control” the silent subject of the infinitive, called PRO, (Chomsky, 1986; that is, PRO refers to *John*). Thus, whereas John could not be said to be a “seemer” in (1a), John could be said to be

² The label Inflectional Phrase (“IP”) corresponds to the node label S in the *Aspects*-style tree notation.

³ It should be noted that although I assume a derivational syntactic framework, i.e. one that involves movement, the assumption of movement is not crucial to the problems I am concerned with in this paper. 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.

a “wanter” in (3a). For our purposes the crucial point is that given the surface similarity between (1a) and (3a), a language learner faced with a novel verb in such a sentence (as in (4)) will not necessarily know whether the verb is a raising verb or a control verb. Thus: does *gorp* in (4) mean something like “seem” or something like “want”?⁴

(4) John *gorps* to be happy

The rest of the paper is structured as follows. In “Experiments with Adults” section I discuss a series of experiments in which adults were asked to provide a verb to complete a sentence. By systematically varying different aspects of the sentence, I sought to find out which types of sentences and lexical items were more likely to yield a raising verb response as opposed to a control verb or another kind of verb. The overall result is that semantically empty subjects, such as *it*, and inanimate subjects strongly evoke a raising verb response from adults. Based on this result, in “Summary and Proposals for Further Work” section I propose some ways in which to examine children’s learning of raising verbs.

EXPERIMENTS WITH ADULTS

What information in the linguistic input could tell a learner that a particular sentence contains a raising verb, as opposed to another kind of verb? We saw in “Introduction: The Learning Problem” section that children make use of information about a verb’s arguments in figuring out what the verb might mean. Adults make use of this information, 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, based only on the other words in the sentence and the sentence structure. Other evidence comes from 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. in sentences in which all content words have been changed to nonsense forms.

Although raising verbs do not select any NPs, there may be other kinds of information in sentences that could serve as a cue that the sentence involves a raising verb. For instance, raising verbs, but not control

⁴ Even more problematic, the string in (4) 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 (4) is quite complex.

verbs, can occur with semantically empty (henceforth “expletive”) subjects, such as *it* and *there*.

- (5) a. It seems to be raining
- b. *It tried to be raining

Thus, occurrence with an expletive subject may serve as a good cue that the verb is a raising verb. The purpose of the experiments described here was to test this conjecture empirically, and to find out what other properties of sentences (particular sentence structures or types of lexical items within sentences) would cause adult English-speakers to guess that the missing verb was a raising verb.

General Method

The general method and procedure for all experiments was the same: adults were asked to read a list of 40 sentences (including fillers), distributed in a paper-and-pencil questionnaire format. Each sentence was missing one word, and participants were asked to fill in the blank with a word that would complete the sentence. Test items involved a missing verb, while filler sentences called for nouns, adjectives, verbs, adverbs and modal auxiliaries (*can*, *will*, etc.). The part of speech was provided after the sentence. 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. An example of a test sentence and a filler sentence follow, and all test items are given in the Appendix A.

- (6) Warren ____ to hate rutabagas, but his mom made him eat them anyway. (verb)
- (7) On a ____ Saturday in April, Megan hauled the lumber over to the toolshed. (adjective)

Design

There were four experiments in all. Each experiment was presented in four versions, each of which tested the same condition(s) within an experiment, and each participant saw one version of one experiment. The purpose of using different versions within each experiment was to test multiple exemplars of each sentence type. Filler sentences remained the same across versions and across experiments; only test items were different. Within each experiment, the “a” experiment (versions 1 and 2 in the

Table I. Design of Experiment 1: 30 participants

Experiment 1a: 20 participants		Experiment 1b: 10 participants	
Version 1: 10 partic.	Version 2: 10 partic.	Version 3: 5 partic.	Version 4: 5 partic.
each partic. saw	each partic. saw	each partic. saw	each partic. saw
36 fillers	36 fillers	36 fillers	36 fillers
2 NP subj (#1–2)	2 NP subj (#5–6)	2 NP subj (#9–10)	2 NP subj (#13–14)
2 <i>it</i> subj (#3–4)	2 <i>it</i> subj (#7–8)	2 <i>it</i> subj (#11–12)	2 <i>it</i> subj (#15–16)

Appendix A) was seen by 20 participants (10 participants per version; half saw a forwards order of items, and half saw a reverse order of items). The “b” experiment (versions 3 and 4) was seen by 10 participants (5 participants per version; items were presented in a pseudorandom order). A schematic of the design for Experiment 1 is given in Table I.

The numbers in the table refer to the item numbers in the Appendix A. Experiments 1–3 had the same design; Experiment 4 differed in having a 2×2 design, which yielded 4 sentence types instead of 2.

Participants

Participants who saw version 1 or 2 of each experiment were students or employees of the University of Pennsylvania and received either course credit or payment for their participation (80 participants in all). Participants who saw version 3 or 4 of each experiment were students at the University of North Carolina and received course credit (40 participants). All participants were monolingual native English speakers. A total of 120 people participated (56 males and 64 females).

Experiment 1

Although raising and control verbs can both occur in the context in (8), only raising verbs can occur in the context in (9) in which the subject is an expletive.

- (8) John seems/wants to be happy.
 (9) It seems/*wants that John is happy.

We can predict, then, that the sentence frame in (9) would serve as a good cue that the main verb is a raising verb.⁵ This is what was tested in Experiment 1.

⁵ Although not all raising verbs can occur in this frame (e.g. *tend*, *used to*; **It tends that John is happy*) the important point is that no control verbs can occur in this frame.

Method

The design of Experiment 1 had 1 factor (sentence type) with 2 levels (*it* subject + *that* complement, NP subject + infinitive complement); the sentence type factor was manipulated within subjects. Each participant was presented with 4 test sentences interspersed among 36 filler sentences. The 4 test sentences included 2 exemplars of each of the 2 sentence types. Each of the 4 versions of Experiment 1 presented different exemplars of the sentence types, so that a total of 8 different sentences of each type were used (versions were between subjects; each subject saw a single version). Twenty participants (from the University of Pennsylvania) saw Experiment 1a (versions 1 and 2; 10 saw each version) and 10 participants (from the University of North Carolina) saw Experiment 1b (versions 3 and 4; 5 saw each version).

The 4 test sentences included 2 sentences of the type in (10a) and 2 sentences of the type in (10b).

(10) a. *It* subject + *that* complement

It _____ that Barry knew the answer even before she finished the question.

b. NP subject + infinitive complement

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

Results

Subjects' responses were categorized according to whether the response was a raising verb, a control verb, ambiguous between raising and control (verbs like *begin*), or other (such as a purpose construction, e.g. *John runs to stay in shape*). The results of Experiment 1a and 1b will be presented separately since each had a different number of participants (20 in Experiment 1a and 10 in Experiment 1b; results will be presented in this manner for all subsequent experiments).

The results of Experiment 1a are given in Table II. In this and subsequent tables, the number on the left of the column indicates the percentage of responses to a sentence type (here: NP or *it* subject) that were raising verbs, control verbs, etc. The number in parentheses gives the number of such responses. Columns total to 100% ($N = 40$).⁶

Because the data are categorical, the data were analyzed using a logistic regression. Standard errors of estimates were corrected for multiple

⁶ In all tables, * indicates significance at the 0.05 level; ** indicates significance at the 0.01 level.

Table II. Percent Responses with *It* vs. NP Subjects: Experiment 1a

Response type	Sentence type			
	NP Subject	(N)	<i>It</i> Subject	(N)
Raising*	32.5	(13)	55	(22)
Control**	52.5	(21)	0	
Ambiguous	15	(6)	0	
Other	0		45	(18)

* $p \leq 0.05$; ** $p \leq 0.01$

Table III. Percent Responses with *It* vs. NP Subjects: Experiment 1b

Response type	Sentence type			
	NP Subject	(N)	<i>It</i> Subject	(N)
Raising**	20	(4)	65	(13)
Control**	75	(15)	0	
Ambiguous	5	(1)	0	
Other	0		35	(7)

observations within subjects using generalized estimating equations (Liang and Zeger, 1986). There was a significant main effect of sentence type: a raising verb response was offered significantly more often given an *it*-subject sentence than an NP-subject sentence ($p = 0.0324$, one-tailed), and a control response was offered significantly more often given an NP-subject sentence than an *it*-subject sentence ($p \leq 0.0001$). No significant effects of version ($p = 0.5580$) or order ($p = 0.3333$) were found.⁷ Familywise error rate by experiment was maintained using Hochberg's method (Hochberg, 1988).

Two additional versions (3 and 4) of the experiment were run in order to test additional test items (Experiment 1b). Results of Experiment 1b are given in Table III. The proportions of responses are slightly different from those in Experiment 1a, but the effects are the same. (Because half as many subjects saw versions 3 and 4, the total N for each column is 20).

As in Experiment 1a, both raising and control responses in Experiment 1b showed a significant main effect of sentence type ($p = 0.006$ for raising, $p = 0.00$ for control).

⁷ In all tables, it is the raising and control responses that are of interest; ambiguous and other responses will therefore be excluded from statistical analyses.

Discussion

The results confirm the intuition that context (10a) is not a possible context for control verbs, as no control verbs were offered in this sentence frame. Interestingly, however, raising verbs were only marginally more frequent than “other” kinds of verbs in the *it* frame (10a) (this difference in Experiment 1a, between 55% and 45%, is non-significant; $p = 0.5$ on a binomial test, one-tailed). Thus an *it* subject is not an unambiguous cue that the sentence contains 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 ungrammatical in the *it*-subject sentence type (**It started that...*), and they were occasionally offered in the NP-subject type. Please see the discussion of these verbs in “Experiment 4: Animacy of the Subject” section.

Some of the “other” kinds of responses offered were factive predicates, such as *suck*, *stink* or *help*, as in (11).

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

Another kind of “other” response included verbs such as *say*, *know* or *assume*. These verbs select a subject argument; thus, participants who offered these responses analyzed the *it* subject as a pronoun that refers to something (not an expletive).

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

Experiment 2: Expletive *it* vs. Referential *it*

One of the chief distributional differences between raising and control verbs is that raising verbs can occur with an expletive subject (*it* or *there*), but control verbs cannot.

- (13) a. It seems to be raining
 b. *It tried to be raining
- (14) a. There appears to be a problem
 b. *There decided to be a problem

Since *it* is ambiguous between being an expletive and a referential pronoun in the test items in Experiment 1, in Experiment 2 I controlled for this difference. Experiment 2 measured participants’ rates of raising

verb responses in sentences with expletive *it* versus referential (pronoun) *it* subjects.

Method

The method was the same as in Experiment 1. The design had 1 factor (sentence type) with 2 levels (expletive *it* subject, referential *it* subject) (within subjects), and 4 versions were presented (between subjects) in order to test multiple exemplars of sentence types. Examples of test items are given in (15).

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

Results

Results for Experiment 2a are given in Table IV.

The results of the logistic regression showed that raising verbs were offered significantly more often given an expletive *it* subject than a referential *it* subject ($p \leq 0.001$). Control verbs were not offered at all given an expletive *it* subject, and only four were offered in the referential *it* condition (this difference was not quite significant, $p = 0.0578$). There was no effect of order. There was a main effect of version for the raising verb responses, as overall subjects offered more raising verbs in version 1 than version 2. However, there was no interaction between version and sentence type; thus raising verbs were offered significantly more given an expletive *it* subject than a referential *it* subject in both versions.

Experiment 2b tested the same condition as 2a with different test items. The results were substantially the same as in Experiment 2a, shown in Table V.

Table IV. Percent Responses with Expletive and Referential *it* Subjects: Experiment 2a

Response type	Sentence type			
	Expletive	(N)	Referential	(N)
Raising**	85	(34)	55	(22)
Control	0		10	(4)
Ambiguous	10	(4)	15	(6)
Other	5	(2)	20	(8)

Table V. Percent Responses with Expletive and Referential *it* Subjects: Experiment 2b

Response type	Sentence type			
	Expletive	(N)	Referential	(N)
Raising**	80	(16)	40	(8)
Control*	0		25	(5)
Ambiguous	20	(4)	25	(5)
Other	0		10	(2)

A logistic regression showed that raising verbs were given significantly more often given an expletive *it* than a referential *it* subject ($p = 0.0044$), and control verbs were given significantly more often given referential *it* than expletive *it* ($p = 0.02$).

Discussion

In Experiment 2a, there were only 6 responses (out of 40) to sentences with expletive *it* that were not raising verbs. Four of these were ambiguous, e.g., *begin*. Two responses were ungrammatical: participants gave a modal verb instead of a main verb, shown in (16).⁸

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

In Experiment 2b there were 4 responses (out of 20) to sentences with expletive *it* that were not strictly raising verbs; however, all of these responses fell into the ambiguous category and therefore may have been parsed as raising verbs by the participants.

In sentences in which the subject was referential *it*, 40%–55% of the responses were raising verbs. Ten to twenty percent of the responses fell into the “other” category, exemplified here:

- (17) 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.

In sum, the results of Experiment 2 show that expletive *it* frequently yields a raising verb response. As in Experiment 1, an *it* subject that is

⁸ In a pilot version of this study, other ungrammatical responses were offered: *It pays to be sunny*, *It rocks to be sunny*, *It sucks to be raining*.

not (or not necessarily) an expletive prompts a raising verb response only about half of the time.

Experiment 3: Expletive *it* vs. Expletive *there*

Unlike *it*, *there* is not lexically ambiguous between an expletive and a referential pronoun. Although *there* also occurs as a locative form (also called “deictic”, e.g. *John’s over THERE*), locative *there* differs from expletive *there* in various ways, shown in (18–21):

- (18) Locative *there* can be stressed, expletive *there* cannot be
- a. THERE’s my book (locative *there*)
 - b. *THERE’s a man in the garden (expletive *there*)
- (19) Locative *there* is not obligatorily sentence-initial; expletive *there* is obligatorily sentence-initial
- a. John’s over there (locative)
 - b. *A man is (there) in the garden (there) (expletive)
- (20) Locative *there* does not always trigger Subject-Auxiliary Inversion, especially with pronominal subjects; expletive *there* does
- a. *There are they/There they are (locative)
 - b. There is a man in the garden/*There a man is in the garden (expletive)
- (21) Locative *there* may occur with a definite NP; expletive *there* cannot⁹
- a. There’s my book (locative)
 - b. *There’s my book on the table (expletive)

We do not find these sorts of differences between expletive and referential *it*. Therefore, we can predict that expletive *there* will serve as an even better cue to raising verbs than expletive *it*. This is what was investigated in Experiment 3.

Method

The method was the same as in Experiments 1 and 2. Some examples of test items are given in (22).

⁹ *My book* is a definite NP; it contrasts with an indefinite NP such as *a book*.

Table VI. Percent Responses with Expletive *It* and *There*: Experiment 3a

Response type	Sentence type			
	<i>it</i>	(N)	<i>there</i>	(N)
Raising	90	(36)	97.5	(39)
Control	0		0	
Ambiguous	5	(2)	0	
Other	5	(2)	2.5	(1)

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

Results

The results of Experiment 3a are given in Table VI.

Although expletive *there* yielded slightly more raising verb responses than expletive *it*, no significant differences were found between the two sentence types; participants were at ceiling in both conditions. There were no main effects of version or order. The single “other” (non-raising) response to a *there* sentence is given in (23).

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

Experiment 3b tested two additional version of the experiment. The results are given in Table VII.

Experiment 3b yielded a slightly different result than Experiment 3a: only 50% of the responses to expletive *it* sentences were raising verbs (cf. 90% in Experiment 3a). However, this difference resulted from a high proportion of “ambiguous” responses (30%) and ungrammatical responses (20%). As in Experiment 3a, the difference between the raising verb responses to *it* vs. *there* sentences was non-significant ($p = 0.0679$, one-tailed).

Table VII. Percent Responses with Expletive *It* and *There*: Experiment 3b

Response type	Sentence type			
	<i>it</i>	(N)	<i>there</i>	(N)
Raising	50	(10)	75	(15)
Control	0		0	
Ambiguous	30	(6)	25	(5)
Other	20	(4)	0	

Discussion

The results of Experiment 3 revealed that both *it* and *there*, when unambiguous expletives, provide a very robust cue that the missing verb is a raising verb.

Experiment 4: Animacy of the Subject

Experiments 1–3 suggest that although an *it* subject by itself does not provide a very strong cue that the main verb is a raising verb, unambiguous expletive subjects do provide this cue. Thus, if children are able to identify expletives in the input, they may be able to exploit this information to determine which verbs in their language are raising verbs. However, given the presence of ambiguous verbs like *begin*, we should ask whether there are any cues in the input that might aid learners in parsing sentences like (4) above (*John gorps to be happy*) as raising or control structures.

Perlmutter (1979) claimed that what distinguishes raising *begin* from control *begin* is the animacy of the subject: if the subject is inanimate, *begin* is a raising verb; if the subject is animate, *begin* is a control verb. For instance, John might be said to be a “beginner” in (24a), but the water could not really be said to be a “beginner” in (24b).

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

Experiment 4, then, pitted animate against inanimate subjects, keeping the frame of the sentence the same (that in (4)). One further manipulation of this experiment was to vary whether the predicate was eventive or stative. The reason for this was that a previous experiment (not described here, but see Becker (2002)) revealed that sentences like (4) in which the lower predicate was stative (e.g. *John _____ to be tall*) yielded a raising verb response more frequently than an eventive predicate did (e.g. *John _____ to eat a sandwich*).

Method

Similar to the first 3 experiments, in Experiment 4 participants were presented with a list of 40 sentences and were asked to fill in the missing word in each sentence. The design of this experiment differed slightly since there were 2 factors with 2 levels (2 (animate vs. inanimate subject) × 2 (eventive vs. stative predicate)) (both factors were manipulated within subjects). Because each sentence type had 2 exemplars in each version, the list of 40 sentences contained 8 test sentences and 32 fillers. Four versions were run with different test sentences in each, for a total of 32 differ-

ent test sentences across versions. Examples of the test sentences used in Experiment 4 are given in (25–26).

(25) *Animate subject*

- a. eventive lower predicate

The driver ____ to hit the car on the passenger's side.

- b. stative lower predicate

His campaign manager ____ to remain a problem for the mayoral candidate.

(26) *Inanimate subject*

- a. eventive lower predicate

The boulder ____ to hit the car on the passenger's side.

- b. stative lower predicate

The extramarital affair ____ to remain a problem for the mayoral candidate.

As in Experiments 1–3, each participant in Experiment 4a saw two exemplars of each sentence type (for a total of 8). Participants in Experiment 4b also saw 8 test items. Due to experimenter error, the items in versions 3 and 4 of Experiment 4b were not balanced within lists (in version 3 participants saw 3 sentences of type animate-stative and 1 of type inanimate-stative, while in version 4 participants saw 1 sentence of type animate-stative and 3 of type inanimate-stative). However, sentence types were balanced across the two versions and thus the statistics were not affected.

Results

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 VIII.

Table VIII. Percent Responses to Ambiguous Frame with Animate vs. Inanimate Subject: Experiment 4a

Response type	Sentence type			
	Animate	(N)	Inanimate	(N)
Raising**	18.8	(15)	43.8	(35)
Control**	52.5	(42)	17.5	(14)
Ambiguous	17.5	(14)	23.8	(19)
Other	11.3	(9)	15	(12)

A logistic regression on the raising responses revealed a significant effect of subject type (animate vs. inanimate subjects): raising verbs were offered significantly more often given an inanimate than an animate subject ($p < 0.0001$); there was no effect of version ($p = 0.1585$) or order ($p = 0.7783$).

The control responses also showed a significant effect of type: control verbs were offered significantly more often given an animate subject than an inanimate subject ($p < 0.0001$). There was no effect of order ($p = 0.6656$); there was a significant main effect of version for the control responses ($p = 0.0001$), however there was no significant interaction between version and type ($p = 0.6488$). Thus, as in Experiment 2, the version effect shows that subjects offered more control verbs given version 1 than version 2, but the pattern is the same across versions, and the magnitude of the effect is the same for each version.

In Table IX we see the results broken down according to both subject type (animacy) and predicate type (eventivity).

A logistic regression on the raising responses revealed a significant main effect of both subject type (animate/inanimate; $p < 0.0001$) and predicate type (eventive/stative; $p < 0.0001$). There was no significant interaction effect between subject type and predicate type (and no effects of either order or version).

For the control verb responses, a logistic regression showed a significant main effect of both subject type ($p < 0.0007$) and predicate type ($p < 0.0006$), and there was a significant interaction effect between subject and predicate type ($p = 0.0324$). There was a version effect, but again no significant interaction between version and either type ($p > 0.5$ for both).

Ten additional subjects were recruited to complete versions 3 and 4 (Experiment 4b). As with the previous experiments, the same results were obtained. Table X shows the results collapsing across predicate type, and Table XI shows the results broken down by subject and predicate type.

Table IX. Percent Responses by Subject Animacy and Predicate Eventivity: Experiment 4a

Response type	Animate subject		Inanimate subject	
	Eventive pred. (N)	Stative pred. (N)	Eventive pred. (N)	Stative pred. (N)
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)

Table X. Percent Responses to Ambiguous Frame with Animate vs. Inanimate Subject: Experiment 4b

Response type	Sentence type			
	Animate	(N)	Inanimate	(N)
Raising**	10	(4)	27.5	(11)
Control**	57.5	(23)	40	(16)
Ambiguous	12.5	(5)	17.5	(7)
Other	20	(8)	15	(6)

Table XI. Percent Responses by Subject Animacy and Predicate Eventivity: Experiment 4b

Response type	Animate subject		Inanimate subject	
	Eventive pred. (N)	Stative pred. (N)	Eventive pred. (N)	Stative pred. (N)
Raising**	5 (1)	15 (3)	5 (1)	50 (10)
Control*	70 (14)	45 (9)	45 (9)	35 (7)
Ambiguous	10 (2)	15 (3)	25 (5)	10 (2)
Other	15 (3)	25 (5)	25 (5)	5 (1)

A logistic regression on the raising verb responses in Experiment 4b revealed a significant main effect of subject type ($p = 0.0074$) and predicate type ($p = 0.0027$) and no interaction effect. The control verb responses likewise showed a significant main effect of subject type ($p = 0.0076$) and predicate type ($p = 0.0419$) and no interaction effect. There were no effects of version.

Discussion

In summary, (in)animacy is a strong cue, but it is not definitive. Although overall inanimate subjects evoke more raising than control verb responses, an inanimate subject paired with an eventive predicate still evokes a raising verb response only 5%–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 do not have those properties. What is puzzling 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. I suspect it results from a restriction placed on the lower clause predicate by the main clause verb. Certain main clause verbs have preferences as to whether the

lower predicate can be eventive or stative. For example, the verb *watch* requires a lower clause predicate to be eventive (*eat a banana*) and disallows a stative predicate (*drunk*), while the verb *see* can take either a stative or an eventive lower predicate.

- (27) a. I saw John drunk.
 b. *I watched John drunk.
- (28) a. I saw John eat a banana.
 b. I watched John eat a banana.

Raising verbs appear to require a stative predicate in the lower clause, or they require that an eventive predicate have a habitual meaning (N.B. *be raining* is stative, *rain* is eventive, and *rain on Tuesdays* is habitual):

- (29) a. It seems to be raining (right now)/??rain (right now)/rain every Tuesday
 b. It tends to rain (on Tuesdays)

Want does not have this restriction, while *try* prefers an eventive predicate.

- (30) 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 should be further investigated in the future. The direct implication of the effect for the learning problem is that if the aspect (eventive vs. stative) of the lower predicate serves as a cue to language learners as to the structure of the main clause, learners should look inside the lower predicate in order to make a hypothesis about the main clause verb.

General Discussion

The purpose of the experiments with adults 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. The experiments showed that there are two main kinds of cues that point to raising verbs or to a raising structure. Experiments 1–3 showed that sentences with an unambiguous expletive (*it* or *there*) subject strongly evoked a raising verb response (between 75% and

Table XII. Summary of Responses in Experiments 1–3

Experiment 1		Experiment 2		Experiment 3	
Item type	Response	Item type	Response	Item type	Response
<i>it</i> subject	<i>mixed</i>	Expletive <i>it</i>	<i>raising</i>	Expletive <i>it</i>	<i>raising</i>
NP subject	<i>control</i>	Referential <i>it</i>	<i>mixed</i>	Expletive <i>there</i>	<i>raising</i>

Table XIII. Summary of Responses in Experiment 4

	Eventive	Stative
Animate	<i>Control verbs</i>	<i>Mixed</i>
Inanimate	<i>Mixed</i>	<i>Raising verbs</i>

97.5%), and never evoked a control verb response.¹⁰ Recall that when an *it* subject is (or could be) a referential pronoun, raising verbs were offered only about half the time, and not significantly more often than control verbs or other kinds of responses.

A summary of the results from Experiments 1–3 is given in Table XII.

The second type of cue came from within the ambiguous string (*John {verb} to be happy*). Experiment 4 showed that 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 not actually select any NP arguments, raising verbs cannot *select* an inanimate subject. The raising verb does not stand in any sort of semantic relationship with the 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

¹⁰ I disregard here the somewhat low result in Experiment 3b of a 50% raising verb response to sentences with expletive *it*, as I believe this was due to an unusually high proportion of “ambiguous” responses. Given that they can be raising verbs, and given that control verbs are ungrammatical in this context, the ambiguous verbs must have been parsed as raising verbs in these sentences. However, to be conservative and consistent across experiments, these responses were kept separate.

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.

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 hypothesize 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 have a raising or control structure (subject animacy, eventivity of the lower predicate). The next question is at what age children attend to these very cues.

SUMMARY AND PROPOSALS FOR FURTHER WORK

Given the results of the experiments with adults, what should the strategy for language learners be? An obvious place to start is expletives: children should (somehow) come to distinguish expletives from non-expletive pronouns, and use occurrence with an expletive as a sign that the verb in question is a raising verb. Note that this strategy 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.” Nevertheless, it will be useful to determine at what age children consistently distinguish pronoun *it* from expletive *it*, and locative *there* from expletive *there*.

However, there are two reasons why this strategy alone will be insufficient. One is the presence of factive constructions, illustrated in (31). The subject is an expletive, but the main verb (*suck*) is not a raising verb.¹²

(31) It sucked that Diane was running a fever

The other reason we need a further strategy for learning raising verbs is the existence of verbs that are ambiguous between being raising and control verbs, as discussed above (verbs like *begin*). Hearing the verb *begin* with an expletive should lead a learner to analyze *begin* as a raising verb. But in order to attain the adult grammar, the learner must allow *begin* to also be a control verb in the appropriate contexts, such as *John began to eat a sandwich*. The experiments with adults pointed to subject animacy as a major cue for these sentences. Thus, it would be good to find out at what age children attend to animacy as a cue to sentence structure.

¹² The expletive subject in a factive construction can be replaced with the *that*-clause (*That Diane was running a fever sucked*); this is not possible with raising verbs (**That Diane was running a fever seemed*).

The reason animacy served as a good cue for adults was that animate subjects make poor subjects of control verbs (inanimate things do not have desires, make effort, etc.). One way to determine whether children could use animacy as a cue to sentence structure is to find out whether children permit inanimate subjects to be subjects of control verbs. Preliminary results from an on-going experiment with 3- to 5-year-old children suggest that at the age of 3 children allow control verbs to occur with an inanimate subject, accepting sentences such as *The door is trying to be purple* (doors can be purple), but by the age of 5 children are nearly at ceiling in rejecting such sentences. Four-year-olds fall in the middle. Crucially, even 3-year-olds tend to reject sentences such as *The bicycle seems to be sad* and accept *Elmo seems to be happy*; thus, they are aware that inanimate things cannot have emotions while animate things can.

The issue of children's use of animacy in parsing linguistic contexts raises many important issues regarding children's concept of animacy. A vast literature exists on children's concept of animacy, and caution is necessary in this domain as it has been suggested that children do not form an adult-like concept of animacy (e.g. what it means for something to be alive) until after age 7 (Piaget, 1929). However, more recent work has shown that four-year-olds are able to distinguish living things from non-living things (Carey, 1985), three- and four-year-olds are able to reason in an adult-like manner about the movement of unfamiliar animate vs. inanimate objects (Massey and Gelman, 1988), and children as young as 2;6 are aware that human action is goal-directed and intentional (reported in Spelke *et al.* (1995)). While this early discrimination of living and non-living, or animate and inanimate things does not necessarily mean that children know that rocks cannot want or try to do anything, it suggests that children perceive an animacy distinction early on and can use this distinction reliably to make predictions about what things can and cannot do. This ability may extend to an understanding of the intentional capabilities of animate vs. inanimate things.

CONCLUSIONS

This paper addressed the question of what cues in the linguistic input might lead learners to define the class of raising verbs, in particular to distinguish them from the superficially similar control verbs. There is a further mystery associated with these verbs: if a verb's arguments typically give a clue to the possible meaning of a verb, and if raising verbs select no arguments, how are the abstract meanings of these verbs determined?

I propose that the answer lies in the very fact that these verbs fail to select any arguments. Just as a verb that selects two arguments may have a causative meaning (e.g. *kill*), a verb that selects three arguments may have a meaning related to transfer (e.g. *give*), and a verb that selects a sentence complement may have a meaning related to mental states (e.g. *think*), so too do verbs that do not select any arguments have a particular range of possible meanings. Such verbs cannot have meanings related to desire or effort or decision (things that require a sentient being as experienter). Instead, these verbs should have the sort of meaning that modal or auxiliary verbs do: they should mean something about aspect (e.g. *tend*, *used to*), evidentiality (cf. *seem*, *appear*), or they should qualify a state of affairs (cf. *happen to*, *be likely*, *turn out*). Although we are not able to say how a learner figures out the precise meanings of these verbs, the research reported here points toward a route for learning more about this particular aspect of language acquisition.

APPENDIX A

Experiment 1 (*It* vs. NP subject)

Version 1

1. Barry ____ to know the answer even before she finished the question.
2. James ____ to be eating a triple-decker club sandwich with cole slaw.
3. It ____ that the principal believed her excuse for being late.
4. It ____ that Diane was sick and running a fever.

Version 2

5. The principal ____ to believe her excuse for being late.
6. Diane ____ to be sick and running a fever.
7. It ____ that Barry knew the answer even before she finished the question.
8. It ____ that James was eating a triple-decker club sandwich with cole slaw.

Version 3

9. Warren ____ to hate rutabagas, but his mom made him eat them anyway.
10. Sally ____ to be climbing through the window.
11. It ____ that Naomi was skating faster than she had ever skated before.
12. It ____ that Henry had flaming red hair.

Version 4

13. Naomi ____ to be skating faster than she had ever skated before.
14. Henry ____ to have flaming red hair.
15. It ____ that Warren hated rutabagas, but his mom made him eat them anyway.
16. It ____ that Sally was climbing through the window.

Experiment 2 (Expletive vs. Referential *It*)*Version 1*

1. It ____ to be raining for most of the morning.
2. Dale discovered upon opening the blinds that it ____ to be sunny.
3. It ____ to be an uncommon shade of purple.
4. It ____ to scurry along the edge of the field, as if pursued by something.

Version 2

5. It ____ to be too foggy to drive safely.
6. It ____ to be about to snow, so we better bring our mittens.
7. It ____ to have stripes, polka-dots and very pointy horns.
8. It ____ to be about 100 feet tall.

Version 3

9. It ____ to be warmer this winter than last winter, or at least we've had less snow.
10. It ____ to be so windy that the sign kept falling over.
11. It ____ to dart from one side of the room to the other.
12. It ____ to be much heavier than I had expected.

Version 4

13. It ____ to be too dark to take a good picture.
14. It ____ to be colder in Asheville than in the Piedmont.
15. It ____ to crawl through the narrow passageway as quietly as possible.
16. It ____ to have enough fur to stay warm through the long night.

Experiment 3 (*It* vs. *There*)*Version 1*

1. It ____ to be raining for most of the morning.
2. Dale discovered upon opening the blinds that it ____ to be sunny.

3. There ____ to be five dozen cartridges strewn about the floor.
4. There ____ to be no end to his complaints about the situation.

Version 2

5. It ____ to be too foggy to drive safely.
6. It ____ to be about to snow, so we better bring our mittens.
7. Suddenly, there ____ to arrive three men wearing dark masks.
8. There ____ to follow a long silence among the people gathered.

Version 3

9. It ____ to be warmer this winter than last winter, or at least we've had less snow.
10. It ____ to be so windy that the sign kept on falling over.
11. There ____ to be a terrible storm approaching.
12. There ____ to be a lot more people involved in the club this year than last.

Version 4

13. It ____ to be too dark to take a good picture.
14. It ____ to be colder in Asheville than in the Piedmont.
15. There ____ to be no easy way to resolve this complicated situation.
16. There ____ to be about ten ducks following the old woman who was throwing bread crumbs.

Experiment 4 (Subject Animacy × Predicate Eventivity)

Version 1

Animate + Stative

1. John ____ to appeal to Alice's parents, but not to her brother.
2. His campaign manager ____ to remain a problem for the mayoral candidate.

Inanimate + Stative

3. This car ____ to need a good washing!
4. Their decision ____ to depend on Eric, who for a long time has resisted taking the initiative.

Animate + Eventive

5. The driver ____ to hit the car on the passenger's side.
6. The clown ____ to excited the children at the party.

Inanimate + Eventive

7. The banner _____ to advertise an interesting new product.
8. The pamphlet _____ to dictate the rules of proper behavior in the office.

Version 2

Animate + Stative

9. This child _____ to need a good washing!
10. Amy _____ to depend on Eric, who for a long time has resisted taking the initiative.

Inanimate + Stative

11. The painting _____ to appeal to Alice's parents, but not to her brother.
12. The extramarital affair _____ to remain a problem for the mayoral candidate.

Animate + Eventive

13. The salesman _____ to advertise an interesting new product.
14. Philip _____ to dictate the rules of proper behavior in the office.

Inanimate + Eventive

15. The boulder _____ to hit the car on the passenger's side.
16. The balloons _____ to excite the children at the party.

Version 3

Animate + Stative

17. The school director _____ to support the decision to reduce the amount of testing each term.
18. Those students _____ to belong to the group on the left.
19. Patrick _____ to deserve the prize for first place!

Inanimate + Stative

20. That cloud _____ to resemble a tiger.

Animate + Eventive

21. The child _____ to fall from the top of the stairs.
22. The general _____ to destroy the enemy's secret hideout.

Inanimate + Eventive

23. The pattern of errors _____ to establish a motive for the murders.
24. The advertisement _____ to persuade shoppers to buy the new product.

Version 4

Animate + Stative

25. That cat _____ to resemble a tiger.

Inanimate + Stative

26. The pecan pie _____ to deserve the prize for first place
 27. The facts cited by the committee _____ to support the decision to reduce the amount of testing each term.
 28. These shapes _____ to belong to the group on the left.

Animate + Eventive

29. The chief of police _____ to establish a motive for the murders.
 30. The salesman _____ to persuade shoppers to buy the new product.

Inanimate + Eventive

31. The ball _____ to fall from the top of the stairs.
 32. The grenade _____ to destroy the enemy's secret hideout.

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