

Learning Verbs that Lack Argument Structure

The case of raising verbs

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1. Introduction: How do children learn raising verbs?

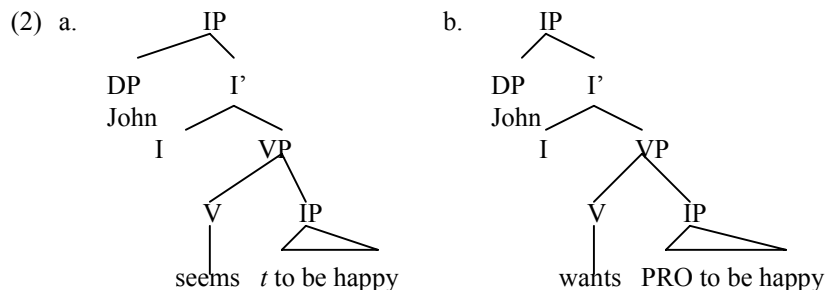
In this paper, I address the question of how language learners come to distinguish the class of ‘raising’ predicates from other kinds of predicates. The class of raising predicates is a small class, containing verbs such as *seem*, *appear*, *tend* and a few others. What distinguishes these predicates from other main verbs is that while they share the morphosyntactic properties of main verbs (for example, they take regular verbal inflection, they follow negation, they do not invert in questions), raising verbs are auxiliary-like in their argument structure. In particular, they do not select a subject argument, or any other thematic arguments. The first question I pose is how a learner could figure out the syntactic properties of raising predicates so as to define them as a class. The second question I pose is: once we identify a good learning strategy, is there evidence that children make use of this strategy, and if so, at what age? To clarify, I am not concerned in this paper with how children acquire the syntactic operation of raising, or A-movement. Rather, what I am interested in is how learners come to identify this particular class of predicates, given their shared property of not selecting any NP arguments.

1.1 Learning raising verbs

To make the learning problem more concrete, let us consider a construction in which raising verbs can occur (1a), noticing that this example is string-identical to a different construction in which a control verb appears (1b):

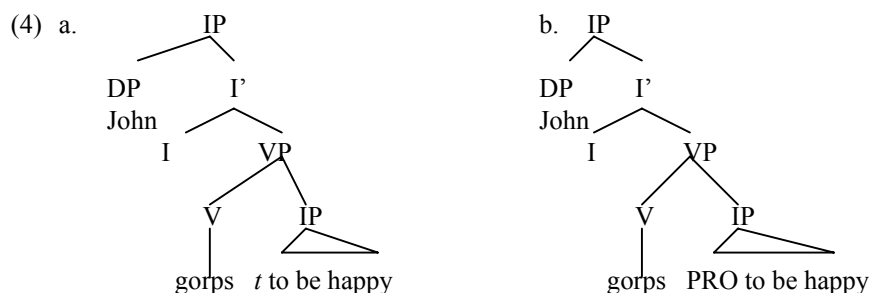
- (1) a. John seems to be happy. (raising)
b. John wants to be happy. (control)

The corresponding structures are given in (2).



Unlike in the raising sentence in (1a), the subject of the control sentence in (1b) is an argument of the main clause verb, so it stands in a semantic relationship with the verb (*want*). Learners have to determine the correct structure for a given string: given an unknown verb, as in (3), is the main clause subject an argument of the main verb or not?

(3) John gorps to be happy.



The learner may be biased to hypothesize one structure rather than the other. As Borer and Wexler (1987) argue, A-movement may take time to mature, and so the learner may be constrained to first hypothesize only the control structure. Or as Frank (1998) shows, there may be learnability theoretic reasons why a learner should consider first the control structure: namely, the raising structure is computationally more complex. Moreover, having a bias to first assume a control structure allows the learner to revise her hypothesis if she is wrong: upon hearing a given verb with an expletive, the learner can reanalyze the verb as a raising verb. But if the learner first assumes a raising structure, there is no positive evidence that would force the learner to reanalyze the verb as a control verb. In any event, in order to converge on the adult grammar, the learner still must entertain both structures and must learn which lexical items occur in which structures; in other words, the learner still has to solve the mapping problem. How the learner solves this mapping problem is the focus of the experiments described here.

2. Experiments with adults

In previous work (Becker, to appear, 2002) (CLS talk), I discussed the results of a series of experiments I had conducted with adult English speakers. The aim of these experiments was to find out what assumptions adults make about whether a novel sentence might contain a raising verb. Here I will briefly review the main findings of those experiments.

The basic design was a fill-in-the-blank task, modeled after the Human Simulation Paradigm (Gillette et al., 1999). In each target sentence the main verb was replaced with a blank, and subjects were asked to fill in the blank with an appropriate word. (Twenty undergraduates at the University of Pennsylvania participated in each experiment.) I take subjects' responses to be indicative of the structure they assigned to the sentence. Thus, if someone wrote the verb *seem* in the

sentence *John ___ to be happy*, then I assumed the person parsed the sentence as having a raising structure. If someone wrote the verb *want* in the same sentence, then the person parsed the sentence as a control structure.

There were two kinds of sentences that led adults to write a raising verb in the blank. One kind was sentences with an expletive subject, *it* or *there*. Examples of the sentences used are given in (5).

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

Results are given in Table 1.¹

Response Type	<i>It</i>	<i>There</i>
Raising	90.0	97.5
Control	0.0	0.0
Ambiguous	5.0	0.0
Other	5.0	2.5

Table 1: Percent Raising/Control Responses to Sentences with Expletive *It* and *There*

Before we consider the problem solved (i.e. children need only to hear a verb with an expletive to know it's a raising verb), it should be noted that when the subject *it* was either a referential pronoun as in (6a) or was ambiguous between being an expletive or a pronoun (as in (6b)), subjects did not give a raising verb response nearly as often. For these sentences participants gave a raising verb response only 55% of the time.

- (6) a. It ___ to be an uncommon shade of purple.
 b. It ___ that Barry knew the answer even before she finished the question.

Thus, only *unambiguous* expletives serve as strong cues that the main verb is a raising verb. In order for them to serve as cues for learners, learners have to know that they are expletives.

The other kind of sentence that led adults to write a raising verb in the blank were those like (3) (*John ___ to be happy*), in which the subject of the main clause was inanimate. Examples of sentences used in this experiment are given in (7-8).

- (7) *Animate subject*
 The driver to hit the car on the passenger's side.

- (8) *Inanimate subject*
 The boulder to hit the car on the passenger's side.

¹ In Tables 1 and 2, I give the proportion of raising verb, control verb, ambiguous and other responses for each type of test item (here: expletive *it* vs. expletive *there*). 'Ambiguous' responses are verbs such as *begin*, which, as discussed by Perlmutter (1979) are sometimes raising and sometimes control verbs.

Results are in Table (2).

Response Type	Subject Type	
	Animate Subject	Inanimate Subject
Raising	18.8*	43.8*
Control	52.5**	17.5**
Ambiguous	17.5	23.8
Other	11.3	15.0

* $t(19) = -4.359, p \leq 0.003$

** $t(19) = 7.054, p < 0.001$

Table 2: Percent Raising/Control Responses to Sentences with Animate vs. Inanimate Subjects

We can see that there is a significant effect of subject animacy on the choice of a raising vs. a control verb.

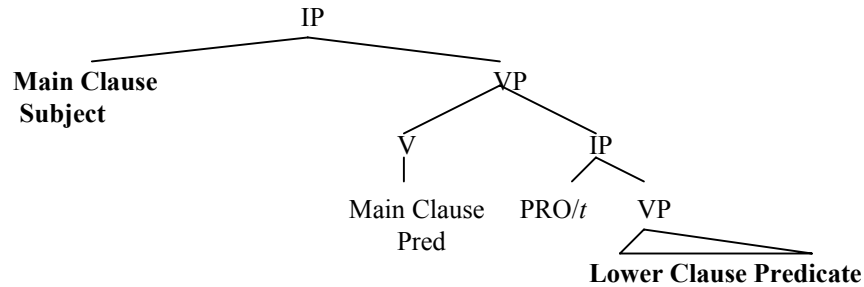
Before moving on to discuss experiments with children, let us consider why inanimate subjects should trigger raising verbs so frequently. The answer seems to be that control verbs generally involve volition, intention, effort, decision, and other things that require a sentient, or at least animate agent/experiencer. Inanimate subjects make poor agents/experiencers of predicates like *try*, *want*, *decide* and so forth. Thus, it is not that inanimate subjects are somehow selected by raising predicates, but rather that they cannot occur with control predicates, and so participants are forced to choose some other kind of predicate to go with them. Raising verbs are a good choice, as they place *no* semantic restrictions on the subject they occur with.

3. Raising Verbs in Development

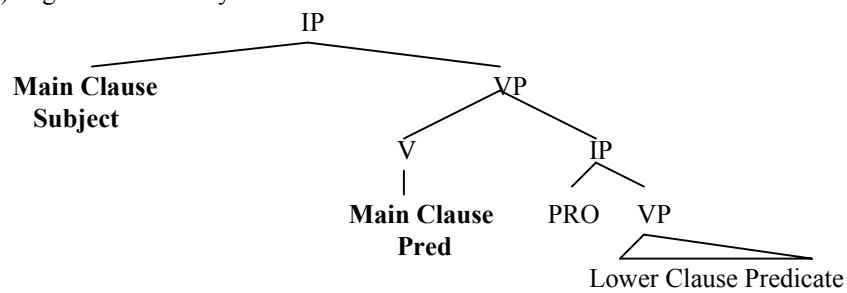
We have seen that there are cues in sentences that lead adult English-speakers to assume that a given sentence contains a raising verb or has a raising structure, such as expletive subjects or inanimate subjects. The next question is: at what age do children attend to these cues? What should the learning strategy look like?

Firstly, to the extent that unambiguous expletives are available as cues, children should use them. But how should children parse sentences like (3) (*John gorps to be happy*)? To learn normal verbs, children should (and do) attend to local relationships between verbs and argument NPs within the clause (Gleitman 1990, Naigles 1989). However, for sentences like (3) I propose that children should first attend to the long-distance relationship between matrix subject and lower predicate. This is because this semantic relationship (between matrix subject and downstairs predicate) matters, regardless of whether *gorp* is a raising or a control verb. Although this strategy will not tell the learner whether *gorp* is a raising or a control verb, it will allow the learner to parse most of the sentence correctly. At a later point the learner should focus on the local relationship between subject and matrix verb, as this will distinguish raising from control predicates (control verbs have a relationship with the matrix subject, raising verbs do not).

(9) stage 1: parse as raising/control



(10) stage 2: control only



Do children follow this strategy? Results from two experiments with 3 to 5-year-olds suggest that they do.

3.1 Experiment 1

The first experiment involves a Grammaticality Judgment task, in which children are shown a picture, a puppet says something about the picture, and the child judges whether the puppet's comment was "good" or "silly". Participants were 15 3-year-olds, 16 4-year-olds and 12 5-year-olds. Test items included raising and control sentences with inanimate subjects. Thus, all control sentences were "silly", but not all raising sentences were. Some test items are illustrated in Table 3.

Item	Type	Predicted Response if Child Attends to...	
		local (door-try)	long-distance (door-purple)
The door is trying to be purple	control/compatible	*	√
The door is trying to be friendly	control/incompatible	*	*
The hay seems to be on the ground	raising/compatible	n/a	√
The hay seems to be excited	raising/incompatible	n/a	*

Table 3: Test Items in Experiment 1

This experiment involved a 2x2 design: the factor of main verb (raising vs. control) was crossed with the factor of lower predicate type (compatible vs. incompatible with the matrix subject). We see in Table 3 that predicates like *be purple* and *be on the ground* are compatible with the inanimate subjects *door* and *hay*, while *be friendly* and *be excited* are incompatible with these inanimate subjects.

The prediction is the following: if children are attending only to the long distance relationship between matrix subject and lower predicate, children should accept sentences with compatible lower predicates, regardless of main verb type (doors can be purple), and they should reject sentences with incompatible lower predicates, regardless of main verb type (doors cannot be friendly). On the other hand if children are attending to the local relationship between matrix subject and matrix verb, they should reject all control sentences regardless of whether the lower predicate is compatible or incompatible with the subject (doors cannot try to do anything).

Let us first look at children's responses to the control sentences. The proportion of correct responses to control sentences with a compatible vs. incompatible lower predicate, broken down by age, is given in Table 4. For all control sentences a response is correct if the child rejects the sentence as being "silly".

Age (mean)	Compatible Predicate (door-be purple)	Incompatible Predicate (door-be friendly)
3-4 (3;6)	36	70*
4-5 (4;5)	53	84**
5-6 (5;5)	88**	100**

* $p \leq 0.05$

** $p \leq 0.01$

Table 4: Percentage of Correct (Rejection) Responses to Control Sentences, by Age

We can see that children in all age groups were better than chance in rejecting control sentences with an incompatible predicate, but only 5-year-olds were better than chance in rejecting control sentences with a compatible predicate. This result appears to support the notion that older children attend to the local relationship between the subject and matrix verb, while younger children fail to attend to this relation.

One might object that the apparent failure of the younger children to reject control sentences with an inanimate subject reflects a conceptual difference between them and adults, not a linguistic difference. It might be that 3-year-olds and some 4-year-olds ascribe to inanimate objects the ability to have desires or intentions. In fact, the question of how children conceptualize animacy (what it means for something to be alive) is a fascinating domain of research and debate. Without delving too deeply into it for now, let us note that the control incompatible sentences involved lower predicates that were typical of animate things (*be friendly*, *play in the sandbox*), and the younger children were better than chance in rejecting these sentences. Moreover, if we look at children's proportion of correct responses to the raising sentences, we find further evidence that children know that inanimate objects cannot have animate properties: note that the "silly" raising sentences were ones in

which the predicate expressed a property typical only of sentient beings (e.g. being sad, excited, afraid, etc.). This is given in Table 5.

Age	Compatible Predicate (correct = accept)	Incompatible Predicate (correct = reject)
3-4	77*	73*
4-5	91**	88**
5-6	79*	100**

* $p \leq 0.05$

** $p \leq 0.01$

Table 5: Percentage of Correct Responses to Raising Sentences, by Age

Here it appears that all of these children, younger and older alike, had little or no trouble with raising sentences: that is, they largely reject raising sentences such as *the hay seems to be excited* and accept sentences such as *the hay seems to be on the ground*. This pattern suggests that 3-year-olds' acceptance of the control/compatible sentences is not due to a conceptual difference from adults, but a linguistic one.

Some examples of children's responses are given in (11-12):

(11) *Attention to the main clause predicate*

- a. # The door is trying to be purple
Child: No, because doors don't be purple except if you paint them purple (4;10)
- b. # The bucket wants to be in the sandbox
Child: No, because [buckets] can't move unless somebody carries them (5;4)
- c. # The flower wants to be pink
Child: It has to be pink because it grewed pink (5;1)
Child: No, because it's not magic and it's not a person (5;4)
- d. # The paint is trying to drip on the ground
Child: [No,] because paint can't drip by itself (4;11)

(12) *Attention to the lower clause predicate*

- a. # The door is trying to be purple
Child: Good. (3;4)
- b. # The bucket wants to be in the sandbox
Child: I think the bucket should be in the sandbox
Inv: But do you think the bucket could want to be in the sandbox?
Child: I think so. (3;11)
- c. # The flower wants to be pink
Child: And the bees want to eat them!
Inv: Do you think the flower could want to be pink?
Child: Yes, and green too! (3;1)

Thus, it appears that before age 5 children do not consistently attend to the local relation between matrix subject and the control verb.

3.2 Experiment 2

In the second experiment I explored children's representation of expletive subjects. Participants were 12 3-year-olds, 16 4-year-olds and 12 5-year-olds (most also participated in Experiment 1). This experiment involves a Truth-Value Judgment Task. Two characters are introduced, a monster and a dinosaur. The dinosaur is blindfolded so that it can't see anything. The two characters are presented with a series of small plastic or wooden shapes and are asked to identify the shapes. The monster always identifies the shapes correctly, but the dinosaur, who can't see them, always guesses incorrectly. The two characters argue back and forth about their answers. They are consistently referred to either by their NP names (*monster*, *dinosaur*) or by the pronoun *it*. Moreover, when pragmatically felicitous, the *it* pronoun is emphasized (as in, "Let's ask the monster what IT thinks"). After they argue, a puppet tells the child what just happened, and the child's task is to say whether the puppet was right or wrong. An example is given in (13).

(13) (Shape is a star)

Experimenter: Let's ask the dinosaur what IT thinks that is.

Dinosaur: Umm, I guess it's a ball.

Experimenter: Let's ask the monster what IT thinks.

Monster: It's a star!

Dinosaur: No! It's a ball!

Monster: No! It's a star! (continues)

Experimenter: Let's ask the puppet what just happened.

In half of the trials the puppet's utterance is true, as in (14a), and in half the puppet's utterance is false, as in (14b).

- (14) a. Puppet: I know! It *said* to the dinosaur that the shape was a star. (✓)
 (it = monster)
 b. Puppet: I know! It *seemed* to the dinosaur that the shape was a star. (*)
 (it = expletive)

The proportion of correct responses is given in Table 6.

Age (mean)	Percentage	Correct
	<i>say</i>	<i>seem</i>
3-4 (3;7)	56	65**
4-5 (4;5)	55	66*
5-6 (5;5)	59	73**

* $p \leq 0.05$

** $p \leq 0.01$

Table 6: Percentage Correct Responses in Expletives Task

Interestingly, children in all age groups were at chance for *say* items but significantly above chance for *seem* items.

An interesting pattern surfaced in some of the 4-year-olds: 3 of the 16 subjects responded correctly to all *seem* sentences, but incorrectly to all *say* sentences. The exact reason for this pattern of response is unclear, but one hypothesis is that these children incorrectly parsed the sentence as having an expletive *it* subject, rather than a referential *it* subject. If they misparsed *it* as an expletive, they would have interpreted the verb (*say*) as meaning what a verb would have to mean if it occurred with an expletive subject, namely, something like ‘seem’. Thus, they responded to the sentence *as if* it had been a sentence of the form *It seemed to the dinosaur that* More work on this issue is needed to determine whether there might be other reasons for this pattern. Currently a different Truth-Value Judgment task is being carried out to determine whether children correctly distinguish pronoun *it* from expletive *it*. In the new task we compare children’s interpretation of sentences like (15a) with that of (15b).

- (15)a. It surprised the lizard that was sleeping. (*it* = thunder)
- b. It surprised the lizard that the thunder was so loud. (*it* = expletive)

4. Conclusions

We began with the question of how learners come to define the class of raising verbs, verbs that are morphosyntactically like normal main verbs but are auxiliary-like in their argument structure. Previous experiments with adults pointed toward the use of expletive and inanimate subjects as possible cues that a given verb might be a raising verb. Subject animacy provides a cue because inanimate subjects are typically incompatible with control verbs. The prediction for children was that children should use animacy as a cue for distinguishing raising from control verbs, but before they do that, children should attend to the long-distance relationship between the subject and the lower clause predicate, since this relationship matters for both raising and control structures. It is important to note that this is a different strategy from the one that learners employ in learning other verbs, where local semantic relations are the crucial ones to attend to: they tell the learner about the verb’s subcategorization frames and the types of arguments the verb selects.

Experiment 1 with 3-5-year-olds suggested that children do use animacy to distinguish raising from control sentences but not until almost age 5. Prior to that point, children fail to consistently reject control sentences with an inanimate subject. It remains unclear, however, precisely how children are parsing these sentences. One hypothesis is that children parse these sentences as raising structures, i.e. they misparse *want* and *try* as raising verbs. (Recall that children performed very well on the raising sentences.) But this hypothesis would be at odds with proposals by Borer & Wexler and by Frank (noted in section 1 above) who argue that children parse control structures prior to parsing raising structures. It would also go against the learnability constraint on negative evidence: if you first assume a raising structure, there is no positive evidence to tell you that you were wrong. A second hypothesis is that children are simply not parsing the middle chunk of the sentence, attending only to the beginning and ending of the sentence and parsing those parts as if they formed a single clause. In a new experiment we are currently attempting to tease these hypotheses apart.

Experiment 2 was meant to investigate the age at which children correctly distinguish expletive from referential *it* subjects. While the results showed that children as young as 3 were significantly better than chance in parsing sentences with expletive *it*, the results are puzzling in that children appear to be unable to parse referential *it*, a result that seems dubious. One possibility is that this unexpected result stems from a felicity problem in the design of the experiment. Another possibility is that children are overextending expletive *it*, misanalyzing referential *it* in these sentences as an expletive. Ongoing studies described above should shed some further light on this issue.

If it turns out to be correct that children misparse *want* and *try* as raising verbs at first, this raises an interesting problem concerning the learning strategy. First, the results of Experiments 1 and 2 imply that at the age of 3 children can correctly parse sentences of the form *it seemed to the dinosaur that...*, yet they cannot distinguish raising from control sentences of the form *John verbs to be happy*. If expletives are the key to distinguishing raising from control verbs, why is there a lag of a year (or more) between correctly interpreting expletive *it* and correctly distinguishing raising from control structures?

One possible solution is the following: children hear raising verbs occurring with expletives and (since they somehow know they are expletives) set aside those verbs as ones that do not take a subject argument. Then children hear these same raising verbs occurring in the frame *John seems to be happy* and know that the subject cannot be an argument of *seem*. But then they hear *John wants to be happy* and have already decided that this frame is one in which the matrix subject is not an argument of the main verb. Thus, control verbs get incorrectly lumped together with the raising verbs. This scenario fits with the results from the two experiments described above. But it also introduces a learnability problem: how does the learner undo the error of lumping raising and control verbs together, in particular, the error of misanalyzing control verbs as raising verbs? Recall that the learner will not receive positive evidence that will force her to change her mind. This problem is further compounded by the presence of ambiguous verbs, such as *begin*, which are sometimes raising and sometimes control verbs.

However, presumably the learner will also hear these verbs in various other contexts: *Mary wants an apple*, *Mary tried the potato salad*, *Mary wants John to leave* (and not **Mary seems an apple*, **Mary seems John to leave*). Hearing control verbs in transitive main clauses may provide the necessary cue that these verbs do select NP arguments, while raising verbs do not.

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