Remarks and Replies

There Began to Be a Learnability Puzzle

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One of the fundamental puzzles language learners must solve is the mapping of a string of words onto a particular (correct) syntactic structure. In this article, I examine the problem of how learners should resolve the ambiguity presented by a string that could have either a raising or a control structure. I provide both logical and empirical arguments against the view that children should be biased to assume that such a string has a control structure. Instead, I propose two families of cues, based on a psycholinguistic experiment with adults, which can be used in a probabilistic manner to parse an ambiguous string and to categorize raising and control verbs.

Keywords: raising, control, language acquisition, learnability

1 Introduction

It is well known that both raising and control verbs can occur in the string environment in (1) in English.

(1) a. Janine tends [*t* to eat sushi]. (raising)
b. Janine likes [PRO to eat sushi]. (control)

The structures of (1a) and (1b) differ accordingly: (1a) involves NP-movement of the subject from the subject position inside the infinitive, while (1b) involves no NP-movement, and the subject of the infinitive clause is PRO.[1] These two classes of verbs can be distinguished in various ways—for example, by their ability to occur with an expletive subject.

(2) a. There tend to be storms at this time of year.
b. *There like to be storms at this time of year.

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[1] Although I assume a Government-Binding-style derivational approach, this assumption is rather irrelevant to the question I am addressing. Regardless of whether or not one assumes that (1a) and (1b) differ with respect to movement, in all frameworks I am aware of there is a difference between (1a) and (1b) in the semantic relationship between the matrix verb and the matrix subject. This is the issue of interest here.

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If a child encounters a novel verb in the context in (1)—for example, the sentence in (3)—how should she determine whether the verb is a raising or a control verb?

(3) Janine gorps to eat sushi.

One strategy a learner could adopt is to assume that *gorp* is a control verb. Given the grammatical distinction in (2), the control bias strategy offers a way to distinguish the two verb classes. Expletive constructions permit raising verbs but not control verbs, so the logic entails that if a learner supposes that *gorp* is a control verb and has guessed incorrectly, there will be input like (2a) that forces her to change her hypothesis. On the assumption that a verb cannot be a member of both verb classes, evidence that a verb can occur with an expletive subject implies that the verb does not assign an external θ-role and therefore is a raising verb, not a control verb. If, on the other hand, the learner first assumes that the novel verb in (3) is a raising verb, a wrong guess will not be met with counterevidence, as information that (2b) is ungrammatical is not present in the input. That is, there is no negative evidence in the input that would restrict a grammar that is too large (Chomsky 1959).

In fact, the relationship between raising verbs and control verbs is not quite this simple, as there are some environments that permit control verbs but not raising verbs. Many control verbs (though not all of them) can take a *for NP* complement, as in (4a), but raising verbs cannot.

(4) a. I like/prefer for Sam to do the dishes.
b. *I seem/tend/happened for Sam to do the dishes.

Likewise, many control verbs can take a progressive verbal complement, but raising verbs cannot.

(5) a. I like/hate eating sushi.
b. *I seem/tend eating sushi.

Nevertheless, there are reasons one might predict children to be biased to assume that a sentence like (3) is a control sentence. Frank (1998) has argued that a raising structure is computationally more complex than a control structure. Since, by hypothesis, learners should assume a structure that is computationally simpler than one that is more complex, they should be inclined to first suppose a control structure for a sentence like (3). Furthermore, the notion that children have a control bias is required on the view that raising (A-movement) is not acquired or does not mature until children are at least 5 years old (Borer and Wexler 1987, Wexler 2004).

I will refer to the supposition that children have a control bias when encountering data like (3), and therefore could use evidence like (2) to distinguish raising from control verbs, as the *expletive-driven* learning strategy. What I will argue here is that this learning strategy is insufficient on both logical and empirical grounds. A class of verbs that are ambiguous between a raising and a control analysis poses a problem for the logical soundness of the expletive-driven learning approach; evidence from children's actual interpretations of raising and control sentences suggests that children may initially permit control verbs to have a raising interpretation, rather than the other way around.

I will suggest an alternative learning strategy that uses multiple types of linguistic cues to achieve the correct categorization of raising and control verbs.

2 The Two Verbs *Begin*, Again

There are verbs that are ambiguous between being raising and control verbs. As noted by Perlmutter (1970), verbs like *begin* and *start* (also *fail*, *continue*, *manage*) can be raising verbs, as in (6), but they can also function as control verbs, as in (7).

(6) It began to rain.

(7) John began to eat a sandwich.

Begin is a control verb in (7) in the sense that *John* is the agent of beginning the event; that is, *John* is thematically related to *begin*. A syntactic argument that *begin* is a control verb is that it can be embedded under another control verb, as in (8a). Raising verbs are ungrammatical if embedded under a control verb, as in (8b).

(8) a. John tried to begin to eat his sandwich.
b. *John tried to tend to eat sushi.

According to the expletive-driven learning strategy, if a learner hears a sentence like (6), he should analyze *begin* as a raising verb. But the learner must not prevent *begin* from being a control verb in appropriate contexts. Perhaps the learner then hears (8a) and allows *begin* to be both a raising and a control verb. However, what prevents the learner from analyzing all raising verbs as optional control verbs, on par with *begin*? In other words, what prevents the learner from letting *tend* be a control verb, in the absence of evidence that (8b) is ungrammatical?

Perlmutter argues that what distinguishes raising *begin* from control *begin* is the animacy of the subject: (7) involves control *begin* because John is animate; (9) involves raising *begin* because water is inanimate (thus a poor agent).

(9) Water began to gush from the sewer.

It is true that control verbs generally do not occur with inanimate subjects, since the lexical meanings of control verbs predominantly have to do with properties of sentient beings, such as decision, effort, emotions, and desire; compare #*The rock likes to lie on the ground*. (A notable exception is *serve*; see Rudanko 1989.) However, subject animacy is not an unambiguous cue: raising verbs can certainly occur with an animate subject. Thus, the concern is that learners should not adopt the strategy that a verb that occurs with both an expletive subject and an animate subject is ambiguous. In other words, the learner must not misanalyze *tend* in *John tends to be happy* as a control verb.

Acquiring a class of verbs with ambiguous meanings should not in itself present a problem for language learners. Although Perlmutter does not spell out the nature of the lexical relationship between the two verbs *begin*, their relationship is reminiscent of that between the two versions

of causative alternation verbs like *sink* (*The ship sank*/*The missile sank the ship*). Control *begin* has a causative meaning in that the subject causes the event of the lower predicate to begin. For example, John causes the sandwich-eating event to begin in (7). Water, on the other hand, does not cause the gushing event to begin in (9).[2] Since there are many verbs in English that involve a causative meaning (with zero morphology), children are unlikely to have difficulty permitting these verbal meanings (e.g., 'cause to begin'), but they may have difficulty defining exactly the class of verbs that permit these meanings. In other words, children may have difficulty precisely with the caveat mentioned above, that of preventing *tend* from being a control verb when it occurs with an animate subject.

In a nutshell, we have the following question: how does a learner analyze pure raising verbs (*tend*) as only raising, pure control verbs (*like*) as only control, and ambiguous raising/control verbs (*begin*) as raising or control in the appropriate clauses?

One possible source of disambiguation can be ruled out: namely, that because a verb's classification as raising or control is linked to its meaning (in the sense that a verb's thematic structure bears some relation to its lexical meaning, along the lines of the θ-Criterion), children could use information about the lexical meanings of these verbs to determine whether they are raising or control verbs. Information about verbs' meanings in the absence of syntactic cues is unreliable, even for relatively ''concrete'' verbs such as *run* (Gleitman 1990). Particularly in the case of highly abstract verbs, such as *seem*, it should not be possible to infer the verb's meaning prior to having syntactic cues—that is, on the basis of visual or other nonlinguistic evidence. The meanings of these verbs must be deduced on the basis of syntactic structure. The question remains, then, how learners determine that structure.

Thus, the premise of the expletive-driven learning strategy, that verbs can be raising or control but not both, is problematic. The strategy itself, that children should first assume a control structure, should be examined empirically. This is discussed in the following section.

3 Children's Interpretations

To my knowledge, the hypothesis that children assume a control structure for sentences like (3) has not previously been tested empirically. If children do in fact initially assume a control structure, we may identify a stage in development at which children erroneously analyze verbs like *seem* as control verbs, but we would not expect to find a stage at which children erroneously analyze *try* as a raising verb.

[2] The suggestion that the semantic relationship between raising *begin* and control *begin* is similar to that between the versions of causative alternation verbs may be overly simplistic. The intuition holds for the examples in the text, but note that whether *begin* has a causative or a noncausative meaning also interacts with the eventivity of the infinitive predicate: *John began to feel tired* does not have a causative meaning (with an animate subject), whereas *The sun began to melt the ice* does (inanimate subject). See section 4 for discussion of the role of eventive and stative predicates in raising and control constructions. Nevertheless, the semantic relationship between the two meanings of these verbs is clearly along the lines of this sort of alternation, rather than, for example, homophony, which would predict no regular similarity between the two meanings.

Table 1
Test items in Experiment 1

Item	Type
The flower wants to be pink	control/compatible
The flower wants to fly away	control/incompatible
The hay seems to be on the ground	raising/compatible
The hay seems to be excited	raising/incompatible

3.1 Experiment 1

Recall that one of the hallmarks of raising verbs is that they do not select the subject of the sentence; control verbs, by contrast, do select the subject. One way to see whether children are analyzing verbs as raising or control is to see whether they look for a semantic relationship between the matrix verb and the matrix subject. To determine this, 43 children ages 3–5 years were asked to listen to a puppet's comment about a picture and to report whether the puppet's comment was ''OK'' or ''silly'' (a modified grammaticality judgment task; McDaniel and Cairns 1990). Participants were fifteen 3-year-olds, sixteen 4-year-olds, and twelve 5-year-olds.

There were four kinds of test sentences, illustrated in table 1. Sentences had either a raising or a control matrix verb, and this factor was crossed with the factor of whether the lower predicate was semantically ''compatible'' or ''incompatible'' with the matrix subject. All test sentences had an inanimate subject. The purpose of varying the semantic ''compatibility'' of the lower predicate was twofold: one, so that the raising/control distinction was not confounded with OK/silly, and two, so that we could see on what basis children judged a particular sentence to be silly. By asking children to justify their negative responses, we could see whether a child who judged the sentence *The flower wants to fly away* as silly did so because flowers cannot want or because flowers cannot fly away.

Test sentences used two different raising verbs (*seem*, *appear*) and two different control verbs (*want*, *try*). Filler sentences with nonraising, noncontrol predicates were interspersed. Each child heard two exemplars of each sentence type, for a total of eight test sentences and eight filler sentences.

The prediction is that if children are analyzing these sentences as control sentences (and if they assume that control verbs require an intentional/sentient subject), they should respond that all sentences are ''silly.'' If children are analyzing these sentences as raising sentences, they should reject only those sentences with an ''incompatible'' lower predicate. Finally, if children have correctly categorized raising and control verbs, they should respond as would adults. These predictions are summarized in table 2.

The outcome of this experiment was that 5-year-olds behaved in an adultlike manner, attending to the semantic relation between the subject and the matrix verb for control verbs, but between the subject and the lower predicate for raising verbs. However, 3- and 4-year-olds showed a different pattern. They behaved in an adultlike manner for the raising verbs, rejecting sentences

Table 2
Predicted responses depending on child's assumptions

		All control		All raising		Adultlike	
Type	Item	OK	Silly	OK	Silly	OK	Silly
Control/compatible	The flower wants to be pink						
Control/incompatible	The flower wants to fly away						
Raising/compatible	The hay seems to be on the ground						
Raising/incompatible	The hay seems to be excited						

with an incompatible lower predicate (*The hay seems to be excited*) but accepting those with a compatible lower predicate (*The hay seems to be on the ground*). But the same children often responded to the control sentences as if they were raising sentences, accepting sentences with a compatible lower predicate but rejecting those with an incompatible lower predicate. That is, 3-year-olds and some 4-year-olds incorrectly accepted sentences like *The flower wants to be pink* about half the time or more, while correctly accepting or rejecting all other types of sentences. The results are summarized in tables 3 and 4 (table 4 gives the percentages on which table 3 is based).

Logistic regressions were performed on the number of correct (adultlike) versus incorrect responses. Asterisks in table 3 indicate means that were significantly different from chance (.5). Additionally, the means in each cell were compared with one another. The overall test of the general hypothesis that all means are equal was rejected ($\chi^2 = 26.74$, $df = 11$, $p = .005$). Testing the three variables of age, verb type, and predicate compatibility revealed that there was no significant three-way interaction ($\chi^2 = 3.10$, $df = 2$, $p = .212$). There were two significant two-way interactions: age by compatibility was highly significant ($\chi^2 = 266.71$, $df = 2$, $p = .0$; the extreme outcome here is most likely due to the fact that 5-year-olds were 100% correct in the incompatible condition), and verb type by compatibility was significant ($\chi^2 = 5.82$, $df = 2$, $p = .016$). Age by verb type was not significant ($\chi^2 = 4.55$, $df = 2$, $p = .103$).

Comparing the age groups with each other for all items revealed that there was a significant contrast between 3-year-olds and 5-year-olds ($\chi^2 = 10.43$, $df = 4$, $p = .0338$), but not between

Table 3
Results of Experiment 1: relative proportion of OK/silly responses

		3-year-olds		4-year-olds		5-year-olds	
Type	Item	OK	Silly	OK	Silly	OK	Silly
Control/compatible	The flower wants to be pink						**
Control/incompatible	The flower wants to fly away		*		**		**
Raising/compatible	The hay seems to be on the ground		*		**		*
Raising/incompatible	The hay seems to be excited		*		**		**

*$p \leq .05$, **$p \leq .01$

Table 4
Results of Experiment 1: percentage of OK/silly responses

		3-year-olds		4-year-olds		5-year-olds	
Type	Item	OK	Silly	OK	Silly	OK	Silly
Control/compatible	The flower wants to be pink	67	33	47	53	17	83
Control/incompatible	The flower wants to fly away	30	70	16	84	0	100
Raising/compatible	The hay seems to be on the ground	77	23	91	9	79	21
Raising/incompatible	The hay seems to be excited	27	73	12	88	0	100

4- and 5-year-olds or between 3- and 4-year-olds. The only type of item on which 3- and 5-year-olds did not differ significantly from each other was the type with a raising main verb and a compatible lower predicate (*The hay seems to be on the ground*).

Next let us look at the other two variables: verb type and predicate compatibility. Conditioned on compatible predicates, the overall test of differences among means is significant ($\chi^2 = 15.96$, $df = 5$, $p = .0069$), with no significant interactions between age and verb type. There was a significant main effect of verb type in this condition ($\chi^2 = 3.9$, $df = 1$, $p = .0483$), but not of age ($p = .0880$). Children's responses were more adultlike for the raising items than the control items. Conditioned on incompatible predicates, the overall test was not significant. Children's responses in all age groups and with both verb types were mostly adultlike for these predicates.

Conditioned on control verbs, the overall test was significant ($\chi^2 = 23.08$, $df = 5$, $p = .0003$), with no significant interactions. There was a significant main effect of both predicate type ($\chi^2 = 5.07$, $df = 1$, $p = .0243$) and age ($\chi^2 = 9.93$, $df = 2$, $p = .0070$). The younger children's responses were not largely adultlike in this condition, so there was much variation among the age groups. Specifically, both 3- and 4-year-olds differed significantly from 5-year-olds, but not from each other (age 3 vs. age 4: $\chi^2 = 2.0$, $df = 1$, $p = .157$; age 4 vs. age 5: $\chi^2 = 11.22$, $df = 1$, $p = .0008$; age 3 vs. age 5: $\chi^2 = 20.16$, $df = 1$, $p < .0001$). Also, children's responses were generally more adultlike with incompatible than with compatible predicates. Conditioned on raising verbs, the overall test was not significant. Children's responses in all age groups and with both predicate types were largely adultlike.

One might wonder whether the 3- and 4-year-olds in this experiment responded as they did, not because they analyzed control verbs as nonthematic, but because they failed to parse the middle of the sentence (i.e., the matrix verb). Perhaps they instead parsed only the matrix subject and the lower predicate (e.g., *The flower . . . pink*; *The basket . . . on the blanket*). To see whether children do in fact parse the matrix verb, a second experiment was carried out.[3]

[3] Another potential concern is that children might actually think that the inanimate objects in the test sentences (the basket, the flower, etc.) are animate, or that inanimate things can have the same properties as animate things. Two observations argue against this conclusion: (a) children rejected predicates like *be hungry*, *be excited*, *be friendly* for these subjects (note the high rate of ''silly'' responses for sentences with incompatible lower predicates), and (b) children's justifications often included comments like ''Flowers aren't alive'' or ''The tree doesn't have any eyes,'' suggesting that children do distinguish ontologically between animate and inanimate objects.

3.2 Experiment 2

In the second experiment, 52 children ages 3–4 years were told a series of stories, and each story was followed by a comment from a puppet. The puppet's comment was either true or false given the story (truth-value judgment task; Crain and Nakayama 1987). Test sentences included raising and control sentences, such as *The pig wanted to eat the doughnut*, *The dog seemed to be purple*. The stories were constructed so that in order to respond correctly to the sentence, the child would have to parse the matrix (raising or control) verb. For example, in the story about the dog, the dog was actually white but stood under a black light and so appeared to be purple. A child parsing only *The dog . . . be purple* should respond ''false,'' since the dog was not in fact purple; but a child parsing *The dog seemed to be purple* should respond ''true,'' since the dog did seem to be purple when standing under the lamp. The control sentence stories were constructed similarly: in the story about the pig, the pig wanted to eat the doughnut but actually ate a banana, so a child parsing only *The pig . . . eat the doughnut* should respond ''false,'' since the pig did not eat the doughnut; but a child parsing the verb *want* in the test sentence should respond ''true,'' since the pig had wanted to eat the doughnut.

The results are given in table 5. The overall test of the means being equal to chance (.5) was rejected ($\chi^2 = 55.12$, $df = 4$, $p < .0001$), as was the overall test of the equality of the means ($\chi^2 = 9.78$, $df = 3$, $p = .0205$). Each of the means was also compared individually with chance (in a binomial test corrected for multiple observations within participants); these tests revealed that both age groups were significantly above chance in both conditions (age 3 raising: $\chi^2 = 5.28$, $p = .0216$; age 3 control: $\chi^2 = 4.97$, $p = .0258$; age 4 raising: $\chi^2 = 28.37$, $p < .0001$; age 4 control: $\chi^2 = 16.5$, $p < .0001$; all with $df = 1$). There was no significant interaction between type (raising vs. control) and age ($\chi^2 = 0.94$, $df = 1$, $p = .3299$). There was a significant main effect of age ($\chi^2 = 10.24$, $df = 1$, $p = .0014$) but not of type ($\chi^2 = 1.17$, $df = 1$, $p = .2789$).

The significance of this result is that children do not appear to ignore the main verb in the kinds of sentences used in Experiment 1. The result of Experiment 1, then, is explained not by children's failure to parse the main verb, but by their willingness to assign these sentences a raising structure rather than a control structure.

4 Using Multiple Cues

The experiments with children show that children do not assume that the sentence in (3) has a control structure. If anything, they are inclined to assume it has a raising structure. Thus, the

Table 5
Results of Experiment 2 (percentage correct)

Age	Raising	Control
3	64.0*	65.9*
4	78.3**	88.4**

*$p < .05$, **$p < .01$, one-tailed

expletive-driven strategy for determining the structures of these sentences is challenged both on a logical basis (the existence of ambiguous verbs like *begin* prevents children from unambiguously categorizing *seem*-type verbs, *try*-type verbs, and *begin*-type verbs) and on an empirical basis (children do not appear to have a control bias). So how do children figure out the structure of (3)? And how do they distinguish these classes of verbs?

I propose that learners need to rely on clusters of cues, none of which is an absolute trigger. There are two families of cues: the first family relates to whether a given *string* should be analyzed as having a raising or a control *structure*; the second family relates to whether a given *verb* is likely to be a raising or a control *verb*.

4.1 Cues to Structure

4.1.1 Subject Animacy I conducted an experiment with adults in a simulated learning environment which showed that the animacy or inanimacy of the matrix subject played a large and significant role in adults' analysis of an ambiguous string as a control as opposed to a raising structure (Becker 2005). In a fill-in-the-blank task, participants were asked to write a verb in the blank to complete the sentence. Participants were significantly more likely to write a control verb in the blank given a sentence like (10) than given a sentence like (11). Conversely, participants were significantly more likely to give a raising verb response in (11) than in (10). Ambiguous verb responses were given in roughly equal proportions in the two types of sentences.[4]

(10) The *salesman* _____ to advertise an interesting new product. (*animate*)

(11) The *banner* _____ to advertise an interesting new product. (*inanimate*)

Because the data are categorical, a logistic regression was carried out on participants' responses, using generalized estimating equations to correct for multiple observations within participants (Liang and Zeger 1986). The contrast of interest here is the one between raising verb and control verb responses, so other responses (ambiguous, such as *begin*, or other, such as purpose constructions) are disregarded in the statistical analyses.[5] The test revealed that participants responded with raising verbs significantly more often given an inanimate than an animate subject ($\chi^2 = 22.94$, $p < .0001$) and that they responded with control verbs significantly more often given an animate than an inanimate subject ($\chi^2 = 22.85$, $p < .0001$).

As discussed above, control verbs typically require a sentient subject, while raising verbs place no semantic restriction on the subject of the sentence. Thus, a kind of ''negative'' selection could take place: given an inanimate subject, the learner should look for a verb that does not place a semantic restriction of sentience on its subject, namely, a verb that does not select the subject. This is not an absolute trigger for two reasons: (a) raising verbs can occur with both animate and inanimate subjects, and (b) there is no reason to suppose, a priori, that the learner

[4] The results reported here come from responses given by 20 adult native speakers of English. An additional 10 adults responded to different items of the same type, yielding the same pattern of results. See Becker 2005 for the full data set and further discussion of the method and test items.

[5] With categorical data, testing hypotheses on a subset of the contrasts in the data is acceptable (Agresti 1990).

Table 6
Responses in subject animacy condition

Sentence	Control (N)	Raising (N)	Ambiguous (N)	Other (N)	Total (N)
The salesman . . .	52.5% (42)	18.8% (15)	17.5% (14)	11.3% (9)	100% (80)
The banner . . .	17.5% (14)	43.8% (35)	23.8% (29)	15% (12)	100% (80)

Table 7
Responses in predicate eventivity condition

Sentence	Control (N)	Raising (N)	Ambiguous (N)	Other (N)	Total (N)
. . . to hit . . .	48.8% (39)	11.3% (9)	20% (16)	20% (16)	100% (80)
. . . to belong . . .	21.3% (17)	51.3% (41)	21.3% (17)	6.25% (5)	100% (80)

might not assume a class of verbs that select an *inanimate* subject. Nevertheless, subject animacy seems to provide a robust cue to the classification of the main verb in this context.

4.1.2 Predicate Eventivity One of the rather surprising results of the simulated learning study with adults was that the eventivity of the lower predicate (infinitive clause) was as strong a cue as subject animacy for adults' judgments about whether a sentence had a raising or a control structure. That is, participants were significantly more likely to fill the blank with a control verb in a sentence like (12) than in a sentence like (13), and their raising verb responses showed the opposite pattern.

(12) The boulder _____ to *hit* the car on the passenger's side. (*eventive*)

(13) These shapes _____ to *belong* to the group on the left. (*stative*)

The participants responded with raising verbs significantly more often given a stative than an eventive lower predicate ($\chi^2 = 29.92$, $p < .0001$), and they responded with control verbs significantly more often given an eventive than a stative lower predicate ($\chi^2 = 29.38$, $p < .0001$). These test items, eventive versus stative predicate, were given in conjunction with the animate versus inanimate subject sentences. That is, a single group of participants received items that were constructed to test two factors in a 2×2 design: subject type (animate/inanimate) crossed with predicate type (eventive/stative). Tables 6 and 7 reflect the means when collapsing across one of the two factors. Table 8 shows the results in their entirety—that is, responses to each of the four sentence types.

As before, the raising and control verb responses are of interest. Keeping both factors in the model, a logistic regression on the raising responses showed a significant main effect of both subject type ($p < .0001$) and predicate type ($p < .0001$), but no interaction effects. A test on the control verb responses showed a significant main effect of both subject type ($p < .0007$) and

Table 8
Responses by subject animacy and predicate eventivity

Sentence type	Control (N)	Raising (N)	Ambiguous (N)	Other (N)	Total (N)
Animate + eventive (The driver . . . to hit)	65% (26)	5% (2)	15% (6)	15% (6)	100% (40)
Animate + stative (These students . . . to belong)	40% (16)	32.5% (13)	20% (8)	7.5% (3)	100% (40)
Inanimate + eventive (The boulder . . . to hit)	32.5% (13)	17.5% (7)	25% (10)	25% (10)	100% (40)
Inanimate + stative (These shapes . . . to belong)	2.5% (1)	70% (28)	22.5% (9)	5% (2)	100% (40)

predicate type ($p < .0006$), and there was a significant interaction effect between subject type and predicate type ($p = .0324$). Thus, when we look at subject animacy and predicate eventivity both independently and combined, we find significant effects on participants' responses: animate subjects and eventive predicates yield high rates of control verb responses; inanimate subjects and stative predicates yield high rates of raising verb responses.

It is unclear what gives rise to the effect of predicate type on participants' responses, but it may relate to the fact that complements of control verbs often require an ''unrealized future tense'' (Bresnan 1972), while complements of raising verbs do not. It may be easier to get an ''unrealized future'' interpretation of an eventive predicate than a stative predicate. However, although particular raising and control verbs appear to display preferences regarding the eventivity of the lower predicate, there does not seem to be a general restriction.

(14) a. John wants to [win/be a firefighter/?be winning].
b. John tried to [win/?be a firefighter (without the meaning 'become')/*be winning].

(15) a. John seems to [?win/be a firefighter/be winning].
b. John turns out to [*win/be a firefighter/be winning].

Clearly, these preferences are not robust, nor do they apply uniformly within each class of verbs. *Tend* can take an eventive complement (*John tends to win/*be winning*); *love* can take a stative complement (*John loves to be a firefighter*). Nevertheless, adults consistently used these cues in the simulated learning study, and they were particularly strong for raising verb responses: almost twice as many raising verb responses were given when the subject was animate and the lower predicate stative (13 out of 40) than when the subject was inanimate and the lower predicate eventive (7 out of 40). Control verb responses were evenly split: 16 responses were control verbs when the subject was animate and the lower predicate stative, and 13 responses were control verbs when the subject was inanimate and the lower predicate eventive, that is, when the cues were conflicting.

Ambiguous verbs appear to have a slight preference for eventive predicates, but they are not uniform in this regard. By my judgment, *begin* and *start* prefer an eventive reading of a

be + *NP* complement, but *fail* and *continue* prefer a stative reading. All of these verbs, however, prefer a bare eventive verb to a progressive verb.

(16) a. John began to write a paper/be a fireman (= become)/?be writing a paper.
b. John started to write a paper/be a fireman (= become)/?be writing a paper.

(17) a. Max failed to write a paper/be a fireman (≠ become)/?be writing a paper.
b. Max continued to write a paper/be a fireman (≠ become)/?be writing a paper.

What this means, at minimum, is that raising and control verbs have ''preferences'' about the eventivity of their complement clause. Learners might, then, derive some information about the nature of the matrix verb (thematic or nonthematic) from noticing the aspect of the complement clause.

4.2 Cues to Verbs

4.2.1 Expletive Subjects Although expletive subjects do not provide an unambiguous trigger for pure raising verbs, they do provide information that is useful: they distinguish raising or ambiguous verbs from pure control verbs. In the experiment with adults described above, participants gave significantly more raising verb responses than any other kind of response in sentences with an expletive subject (see (18), (19), and table 9). Participants even showed an asymmetry in their responses to sentences with an unambiguous expletive *it* subject (85% raising verbs) as opposed to sentences like (20) with a nonexpletive *it* subject (55% raising verbs). This difference was significant ($p < .001$); the difference in the proportion of raising verbs given for an expletive *it* subject versus an expletive *there* subject was not significant.

(18) It _____ to be too foggy to drive safely. (expletive *it*)

(19) There _____ to be no end to his complaints about the situation. (expletive *there*)

(20) It _____ to be much heavier than I expected. (referential *it*)

Thus, expletive subjects provide some information that could help learners distinguish these verb classes.

4.2.2 Monoclausal Frames One of the noticeable properties of both control verbs and the ambiguous verbs is that many of them can also occur in a transitive or intransitive sentence, that is, in a monoclausal frame.

Table 9
Responses in sentences with expletive subjects

Sentence	Control (N)	Raising (N)	Ambiguous (N)	Other (N)	Total (N)
It ___ to be too foggy . . .	0% (0)	85% (34)	10% (4)	5% (2)	100% (40)
There ___ to be no end . . .	0% (0)	97.5% (39)	0% (0)	2.5% (1)	100% (40)
It ___ to be much heavier . . .	10% (4)	55% (22)	15% (6)	20% (8)	100% (40)

(21) a. Max wants a car.
b. Sally likes math.
c. Bush claimed victory.

(22) a. John started a novel.
b. Mary failed the test.
c. The argument continued.

This information might tell the learner that these verbs can assign an NP θ-role and are therefore not exclusively raising verbs.[6] I take this kind of evidence to be probably very informative for the learner.[7] However, even this evidence does not serve as an unambiguous trigger: *seem* can occur with a simple NP complement, as in (23).

(23) John seems the best candidate.

The raising verbs *appear*, *happen*, and *tend* have other uses as either intransitive or transitive verbs.

(24) a. Suddenly, a monster appeared.
b. Good things happened yesterday.
c. The shepherd tends his flock.

While these meanings are clearly different from the meanings of the raising verbs, many verbs are able to occur in multiple sentence frames, and children will need to determine in which cases the verb's meaning changes significantly according to its occurrence in one frame or another, and in which cases the lexical meaning stays relatively constant across different frames.

Other sentence frames can provide useful information in much the same way. As noted in section 1, many control verbs can take a *for NP* complement or a progressive verbal complement as in (4)–(5), repeated here.

(25) a. I like/prefer for Sam to do the dishes.
b. *I seem/tend/happened for Sam to do the dishes.

(26) a. I like/hate eating sushi.
b. *I seem/tend eating sushi.

Again, caution is needed, as there are control verbs that cannot occur in these environments (**I claim for Sam to do the dishes*/**I want eating sushi*), and some ambiguous verbs can occur with a progressive verbal complement (*Water started/began gushing from the sewer*). The fact

[6] For many of these verbs, their meaning in the control frame and in the transitive frame is about the same: *John wants a car* means about the same thing as *John wants to have a car*. The verb *try* also can occur in a transitive frame (*John tried the apple pie*), but it has a different meaning from its meaning as a control verb: *John tried the pie* does not mean the same thing as *John tried to eat the pie*.

[7] Notice, though, that if a learner takes a transitive occurrence of *want* to mean that *want* selects an object argument, this must not cause the learner to assume that *want* selects an object argument in raising-to-object/exceptional Case-marking constructions (*John wants Bill to leave*).

that the raising, control, and ambiguous verb classes are not neatly divided by these patterns suggests the evidence should be used probabilistically, rather than as an absolute trigger.

5 Conclusion

In this remark, I have presented some logical and empirical challenges to the expletive-driven learning strategy for distinguishing raising from control verbs, and therefore determining the structure of a sentence like (3). The logical challenge is that there are verbs like *begin* that can fit into both categories. If the proposed trigger for learning cannot truly disambiguate the classes it is supposed to, then the learning strategy fails. On the empirical front, the argument that children first assume a control rather than a raising structure for sentences like (3) is not supported: children appear to permit control verbs to have a raising analysis, a situation totally unexpected if children first assume a control analysis only.

I have proposed two families of evidence that could drive the learning of these classes of verbs: evidence about the probable structure of a given string (based on subject animacy and eventivity of the lower predicate), and evidence about the probable nature of a particular verb occurring in some noncontrol context (based on verbs' appearance with expletive subjects and in monoclausal frames). These cues are not absolute triggers but could function in a probabilistic manner. And unlike the expletive-driven strategy, these cues do not run into the problem of being derailed by the existence of verbs that are both raising and control.

Learning strategies based on single triggers are attractive under a principles-and-parameters approach to grammar, since the common assumption is that parameters are set in response to a particular trigger (e.g., Lightfoot 1991). However, recent approaches to modeling learning have pointed to the use of probabilistic cues; an example is work by Yang (2002), which supports a strategy that makes use of multiple sources of evidence in a probabilistic way. This multicue type of approach is also consistent with work in the verb-learning literature (Gleitman 1990 and related work), which suggests that in order to figure out the lexical meanings of verbs, a learner will have to consider not only multiple occurrences of individual verbs, but also multiple sentence frames in which verbs appear.

It is important to note that a multicue, probabilistic learning strategy in no way treads on the assumption of the poverty of the stimulus: in order to use these families of cues, learners must bring to the task certain restrictions on how grammar can be constructed. Specifically, in order to use the types of cues described above to distinguish raising from control verbs, learners must, at the very least, make the following assumptions. First, learners must assume the existence of empty categories, such as NP-trace and PRO. Regardless of whether one assumes a movement or nonmovement analysis of raising and/or control, if empty categories exist in the grammar, then learners must assume they exist, since they are not part of the auditory input. Furthermore, learners must assume that not all empty categories are created equal; they may differ from one another syntactically. Whether or not one allows or requires movement in these constructions, the silent subject of the infinitive bears its own semantic role independent from that of the matrix subject in one case (control), but it shares the semantic role of the matrix subject in the other case (raising). One way this knowledge might be used in conjunction with the probabilistic cues named above

is the following: a verb that is likely to take an animate subject is also likely to assign a semantic role to that subject; therefore, if an embedded infinitive clause under that verb contains a silent subject, that silent subject is likely to have its own semantic role (i.e., PRO). Thus, statistical patterns in the input might tell a learner what the syntactic nature of an empty category is, but they will not tell the learner that the empty category exists.

Second, learners must assume that the θ-Criterion holds. The essence of the θ-Criterion is that the possible meanings of a verb are restricted by the syntactic frame or frames in which the verb appears. Part of what distinguishes the class of raising verbs from the class of control verbs is the types of meanings the verbs denote. For learners to home in on the lexical meanings of these verbs using the cues argued for here, they must implicitly assume a restrictive relationship between verbs' syntactic frames and their potential lexical meanings. A second way in which the θ-Criterion is relevant for learning the raising/control distinction is that (traditionally, at least) it requires that each argument bear one and only one θ-role. This sort of assumption allows the learner to determine that a nonexpletive NP must get a θ-role from somewhere. If the verb it occurs with can also occur with an expletive subject, then the nonexpletive NP's θ-role is likely to have come from a different predicate.

Finally, and seemingly at odds with the second assumption, learners must assume that a verb may *but need not* stand in a selectional relation with an adjacent NP. This assumption is potentially problematic from the viewpoint of syntactic bootstrapping, since according to that strategy a learner is guided toward restricting a verb's meaning precisely because she assumes that the NPs adjacent to the verb are the verb's arguments (and hence applies the θ-Criterion). But in the case of raising verbs, the learner would be led to the wrong grammar if she assumed that the subject NP is an argument of the verb. How should a learner know when to assume that adjacent NPs are in fact the arguments of a verb, and when to suspect they might not be? I do not have an answer to this conundrum, but I will conjecture that the answer lies in distinguishing monoclausal from multiclausal sentence frames. That is, within a single clause (NP V (NP)), the learner should assume that adjacent NPs are the verb's arguments. In a multiclausal utterance (perhaps particularly when there is an embedded infinitive clause), the learner should be more cautious. This assumption is relevant to the probabilistic strategy proposed here in the following way: a verb that is likely to occur with an expletive subject is also unlikely to take an adjacent nonexpletive NP as its argument. Likewise, evidence of a verb occurring in monoclausal frames could be taken as evidence that adjacent NPs (even in multiclausal sentences) are likely to be the verb's arguments. I leave to future work a more detailed account of how the probabilistic strategy would employ these cues.

References

Agresti, Alan. 1990. *Categorical data analysis*. New York: Wiley.

Becker, Misha. 2005. Learning verbs without arguments: The problem of raising verbs. *Journal of Psycholinguistic Research* 34:165–191.

Borer, Hagit, and Kenneth Wexler. 1987. The maturation of syntax. In *Parameter setting*, ed. by Thomas Roeper and Edwin Williams, 123–172. Dordrecht: Reidel.

Bresnan, Joan. 1972. Theory of complementation in English syntax. Doctoral dissertation, MIT, Cambridge, Mass.

Chomsky, Noam. 1959. Review of *Verbal behavior. Language* 35:26–58.

Crain, Stephen, and Mineharu Nakayama. 1987. Structure dependence in grammar formation. *Language* 63: 522–543.

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

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

Liang, K. Y., and Scott L. Zeger. 1986. Longitudinal data analysis using generalized linear models. *Bimetrika* 73:13–22.

Lightfoot, David. 1991. *How to set parameters: Arguments from language change*. Cambridge, Mass.: MIT Press.

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

Perlmutter, David M. 1970. The two verbs *begin*. In *Readings in English transformational grammar*, ed. by Roderick A. Jacobs and Peter S. Rosenbaum, 107–119. Waltham, Mass.: Ginn.

Rudanko, Juhani. 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.

Wexler, Kenneth. 2004. Theory of phasal development: Perfection in child grammar. In *Plato's problems: Papers on language acquisition*, ed. by Anikó Csirmaz, Andrea Gualmini, and Andrew Nevins, 159–209. MIT Working Papers in Linguistics 48. Cambridge, Mass.: MIT, Department of Linguistics and Philosophy, MITWPL.

Yang, Charles. 2002. *Knowledge and learning in natural language*. New York: Oxford University Press.

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