Children Seem to Know Raising: Intervention Effects in Child Language

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1. Introduction

This paper investigates intervention effects in children's comprehension of raising, arguing for the role of Performance-based Intervention Effects (PIE) over grammatical deficits in children's difficulty with the interpretation of this pattern.

2. Raising with an experiencer

The term 'raising' is often used to refer to patterns like (1), in which the NP *John* is semantically linked to the embedded VP *to be working* (from which it receives its thematic role), even though it is syntactically realized as the subject of the matrix clause.

(1) John seems [_ to be working].

One piece of evidence for the special status of this pattern comes from the fact that some raising sentences have an unraised counterpart as in (2), in which the raised NP John appears as the subject of the embedded clause, and a non-referring expletive serves as the matrix subject.

(2) It seems [that John is working].

Since the NP *John* in (1) appears to move from one argument position (the subject of the embedded clause) to another argument position (the subject of the matrix clause), raising structures are considered to be a classic example of A-movement, along with passives and unaccusatives. Some examples of raising predicates include *seem*, *appear*, and *tend* – all of which are verbs that lack an external argument.

Although the majority of raising predicates do not permit an experiencer argument, a subset of these items, including *seem* and *appear*, do allow such an argument (e.g., *Mary* in (3)) to occur between the raising predicate and the embedded clause.

(3) a. Raised: John seems to Mary [_ to be working].
     b. Unraised: It seems to Mary [that John is working].

Of course, even when there is an experiencer, the relationship between the NP *John* and the embedded clause *to be working* remains the same in that the raised NP receives its thematic role from the embedded VP.

3. Previous studies

Several acquisition studies (Choe, 2011; Hirsch, 2011; Hirsch, Orfitelli, & Wexler, 2007; Hirsch & Wexler, 2007) report that while young children comprehend unraised patterns, as in (4a), they have difficulty comprehending their raised counterparts, as in (4b).

(4) a. Unraised: It seems to Mary that John is happy.
    b. Raised: John seems to Mary _ to be happy.

This difficulty has often been interpreted as evidence for a deficit in child grammar (Borer & Wexler, 1987). Proposals along these lines include the Universal Phase Requirement (UPR; Wexler, 2000), the Universal Freezing Hypothesis (UFH; Hyams & Snyder, 2005) and the Argument Intervention Hypothesis (AIH; Orfitelli, 2012). All three accounts propose that certain syntactic representations are not permitted by child grammar, thus attributing children's difficulty with raising to a grammatical deficit.

An alternative hypothesis, which we endorse, posits the existence of Performance-based Intervention Effects (PIE; Choe, 2012). On this view, the difficulty of raising patterns with an experiencer is attributed neither to a deficit in child grammar nor to the operation of raising *per se*. Rather, it is explained in terms of performance limitations that are independently manifested in a variety of other constructions.

It is well known that children have difficulty processing structures in which an NP intervenes between a filler and the associated gap (e.g., Avrutin, 2000; de Vincenzi et al., 1999; Friedmann, Belletti, & Rizzi, 2009; Friedmann & Lavi, 2006). These structures include object relatives, object topicalizations, and object *wh*-questions.

(5) a. Object relative: The boy who the girl kissed _
    b. Object topicalization: The boy, the girl kissed _.
    c. Object *wh*-questions: Which boy did the girl kiss _?

Notice that raising patterns resemble these constructions in that the experiencer NP *the girl* in a sentence such as (6) intervenes between the raised NP *the boy* and its original position.

(6) Raising: The boy seems to the girl _ to be happy.

A signature property of intervention effects is that their difficulty can be modulated by manipulating the features of the intervener (Arnon, 2010; Friedmann et al., 2009; Kidd, Brandt, Lieven, & Tomasello, 2007). For example, Arnon (2010) found that Hebrew-speaking children were better at comprehending object relatives with pronominal interveners (*the nurse that **I** am drawing _*) than ones with lexical NP interveners (*the nurse that **the girl** is drawing _*).

Intervention effects have also been identified in studies of adult sentence processing, which have documented longer reading times and higher error rates in the comprehension of direct object relative clauses than subject relatives (e.g., Caplan & Waters, 2002; Carpenter et al., 1994; Gibson, 1998; Wanner & Maratsos, 1978 among others). Here too there is a well-documented pronoun advantage: the processing difficulty associated with object relatives has been shown to diminish and/or disappear when the subject inside the relative clause is pronominal, as in (7) (e.g., Gordon, Hendrick, & Johnson, 2001; Reali & Christiansen, 2007).

(7) a. Object relative with lexical NP intervener: the barber that the customer admired
    b. Object relative with pronoun intervener: the barber that you admired _

As the PIE hypothesis rests on the proposal that children's difficulty with raising patterns reflects an intervention effect, it predicts a pronoun advantage in children's comprehension of raising. Indeed, such a prediction was confirmed by Choe (2013), who found that children's comprehension of raising

sentences significantly improved with a pronominal experiencer, as in (8a), compared to a lexical NP experiencer, as in (8b) (81.5% accuracy with raised sentences with a pronominal intervener vs. 40.9% accuracy with a lexical intervener).

(8) a. Bart seems to her to be studying.
    b. Bart seems to Lisa to be studying.

These results indicate that children's difficulty with raising patterns is sensitive to the same factor as other structures for which intervention effects have been posited, lending support to the hypothesis that features of the intervening experiencer NP make the pattern in (8b) difficult for children.

Different theories have been put forward as to the exact nature of intervention effects in language acquisition and processing, including one that is based on the grammatical principle of Relativized Minimality (RM; Rizzi, 1990) and a processing-based explanation referred to as the Dependency Locality Theory (DLT; Gibson, 2000).

Relativized Minimality invokes a syntactic locality principle, proposed by Rizzi (1990), which states that in the configuration, … X … Z … Y …., Y cannot be related to X if Z intervenes and Z bears a certain similarity to X. Extending this idea to language acquisition, Friedmann, Belletti, and Rizzi (2009) argue that children require the relevant features of X (the target) and Z (the intervener) to be entirely distinct in order to move an element over an intervener. In other words, the child's principle allows only patterns in which there is no overlapping feature between the moved element and the intervener. Thus, extraction in object relatives like (9) is disallowed in the child system, as the relative head the boy and the intervener the girl share the same "+NP" feature, since both have a lexical head noun.

(9) Object relative: The boy that   the girl   kissed   _
                      [+R, +NP]   [+NP]   [+R, +NP]
                      (where "+R" designates a relative pronoun feature, "+NP" designates a full
                      lexical noun phrase.)

In turn, this account predicts that if the relative head and the intervener are made sufficiently different, then extraction should be possible even in the child system. This explains the pronoun advantage that has been observed in object relatives, where pronominal object relatives, as in (10a), are easier than those with a lexical NP, as in (10b).

(10) a. Pronominal object relative: the nurse that I am drawing _
     b. Lexical NP object relative: the nurse that the girl is drawing _

While the RM account focuses on the similarity of the two NPs – the target and the intervener –, the Dependency Locality Theory (Gibson, 1998, 2000) places an emphasis on the referential accessibility of the intervening NP. Under this account, processing cost is said to increase with the number of "new discourse referents" that intervene between the elements that make up a dependency. Thus, this account explains not only why object relatives are harder to process than subject relatives but also why pronominal object relatives are easier than those with a lexical NP – since the referent of the pronoun is already present in the discourse, it is not considered a new discourse referent, and thus, incurs less processing cost.

4. Current study and predictions

Extending these accounts to raising patterns, both the Relativized Minimality and Dependency Locality Theory-based accounts predict a pronoun advantage in raising. As mentioned earlier, just such an advantage has been reported by Choe (2013), who found that having a pronominal intervener, as in (11), facilitates children's comprehension of raising sentences.

(11)   Bart seems to her to be studying.

As such, raising patterns with a pronominal experiencer cannot tease apart the two accounts. However, the predictions from the two accounts diverge in the following raising pattern in which the matrix subject is a pronoun and the intervening experiencer is a lexical noun:

(12)   He seems to Lisa to be studying.

On the one hand, the RM account predicts no increase in difficulty, compared to the pronominal experiencer case, since the raised NP and the intervening NP are still of different types – one being a pronoun and the other being a lexical NP. On the other hand, the DLT-based account predicts an increase in difficulty, compared to the pronominal experiencer case, since the intervener is a lexical NP and hence a new discourse element. In order to tease apart the two accounts, the current study examines the comprehension of patterns such as (12).

5. Experiments

Experiment 1 (Choe, 2013) served as a control experiment to test the comprehension of raising sentences in which a lexical NP is raised across a pronominal experiencer. Experiment 2 tested the interpretation of raising sentences in which a pronoun is raised across a lexical NP experiencer.

5.1. Participants

We initially tested 19 children for Experiment 1 and 20 children for Experiment 2, but excluded a total of eleven children on the basis of their failure to complete the experiment or to properly interpret the filler items. Thus, 14 native English-speaking children (age 3;6–6;8, mean = 4;6) were included in Experiment 1 and another (different) 14 native English-speaking children (age 3;0–5;11, mean = 4;3) in Experiment 2. The children were recruited from the UH Mānoa Children's Center, Montessori Community School and Kaimuki Christian School in Honolulu, Hawai'i.

5.2. Procedure

A Truth-Value Judgment Task (Crain & McKee, 1985; Crain & Thornton, 1988) was employed in the current study. Children were shown illustrated stories on a laptop computer. At the end of each story, a puppet appeared on the screen and made a one-sentence statement about what she thought had happened in the story. Children were then asked to determine whether the puppet's statement was a true or false description of what happened in the story and to provide a justification for their choice. The whole experiment took no more than thirty minutes for each child.

5.3. Materials

Each child was shown 10 stories in total, of which two were warm-up items, two were fillers, and the rest were critical items, divided into Unraised and Raised conditions. For the Raised condition in Experiment 1, a lexical NP was raised across a pronominal experiencer as in *Donald seems to him to be short*. In Experiment 2, a pronoun was raised across a lexical NP as in *He seems to Mickey to be short*. A lead-in sentence was used by the puppet right before the test sentence to establish the antecedent of the pronoun and to increase the naturalness of the pronoun (e.g., This is a story about Mickey, and … [test sentence]). The items were balanced for match and mismatch, and the critical test sentences were counterbalanced across four different lists in order to minimize any item effects. The complete script of a sample story and the corresponding pictures shown to children are presented below in Figure 1. A sample set of test sentences (match condition) for each experiment is presented in Tables 1 and 2.

This is a story about three friends: Donald, Daisy, and Mickey. One day, Donald and Daisy are playing outside, digging a big hole. Just then Mickey appears and comes close to Donald and Daisy. Mickey sees Donald who is inside the hole and thinks that Donald is very short. Mickey says, "Hey, Donald, I thought you and I are the same height, but I was wrong." Without looking at Mickey, Donald says, "What do you mean? We are the same height." Then, Mickey says, "No, you are so short!" Daisy, who is standing next to Donald, says "No, that's because you are looking at him from up there. Donald is not short." But Mickey says, "What do you mean? Donald is so short." Still without looking at Mickey, Donald says, "Well, if I'm short, then you are short, too." Mickey says "Yeah? Turn around and look then." Donald turns around to look at Mickey, and Donald says, "Uh-oh, you are not short. I was wrong." Mickey says, "See? We are not the same height, after all. You are so short, haha"

Figure 1: A sample story and pictures

Table 1: A sample set of test sentences (match) in Experiment 1

	Exp. 1: Raising a lexical NP across a pronoun
Unraised	It seems to him that Donald is short.
Raised	Donald seems to him to be short.

Table 2: A sample set of test sentences (match) in Experiment 2

	Exp. 2: Raising a lexical NP across a pronoun
Unraised	It seems to Mickey that he is short.
Raised	He seems to Mickey to be short.

5.4. Results

Figure 2 shows the mean correct percentage for each condition across the two experiments. On the Unraised condition, the accuracy rate is similar between the two experiments (Exp. 1: 88.1% vs. Exp. 2: 78.6%), showing no statistically significant difference. However, on the Raised condition, children's comprehension is significantly better in Experiment 1 (66.7%) than in Experiment 2 (38.1%; $p = 0.037$).
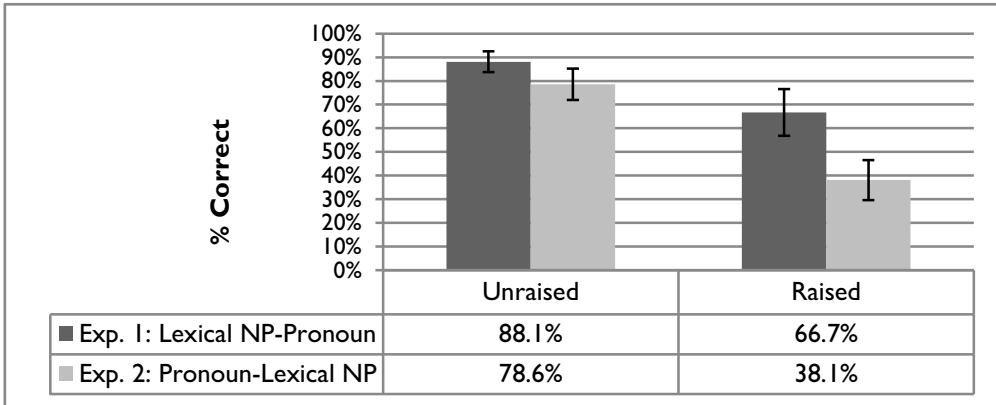
Figure 2: Mean accuracy by condition in each experiment

These results were further analyzed by looking at the mean accuracy of the 16 children (Exp. 1: $N = 9$, Exp. 2: $N = 7$) who scored 100% on the Unraised condition, thus filtering out those children who may have had trouble comprehending the verb *seem* itself. As can be seen in Figure 3, the difference in performance on the two experiments becomes even sharper, with a success rate of 81.5% on the raised condition in Experiment 1, compared to just 38.1% in Experiment 2 ($p = 0.018$).
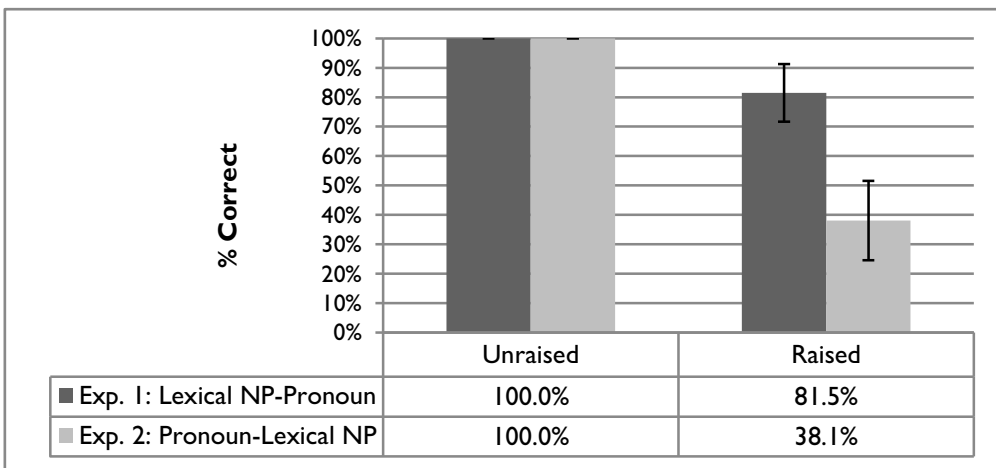

Figure 3: Mean accuracy of children who scored 100% on Unraised

6. Discussion

By comparing the two experiments, we find a highly suggestive asymmetry in the effect of NP type on children's comprehension of raising sentences: an improvement in performance is observed when a lexical NP is raised across a pronominal experiencer, as in (13a), but not when a pronoun is raised across a lexical NP experiencer, as in (13b).

(13) a. Bart seems to her to be studying.
     b. He seems to Lisa to be studying.

The prediction of the DLT-based account was thus confirmed: the observed pattern of results is not expected under the RM account, but is predicted by the DLT-based account of intervention effects, which appeals to the discourse status of the intervening NP. Since the DLT is a theory that relates sentence processing to the available computational resources (Gibson, 2000), it is also in line with the

Performance-based Intervention Effects (PIE) hypothesis, advocated in this paper, which attributes children's difficulty with raising to a performance limitation, rather than a grammatical deficit.

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