

# Before and After the Acquisition of Adjunct Control

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## 1. Introduction

In this paper we investigate children's acquisition of adjunct control, in (1):

- (1) John<sub>1</sub> called Mary<sub>2</sub> before PRO<sub>1/\*2</sub> running to the store.

In (1), the adjunct subject is not pronounced, but the sentence can only mean that *John* ran to the store, and not that *Mary* or anyone else ran to the store. Here PRO is used to represent the silent adjunct subject, but the experiments in this paper do not depend on this representation in particular.

Although adults typically only allow PRO to refer to the main clause subject ("subject control"), children have consistently exhibited non-adultlike behavior in previous studies, accepting a much wider range of interpretations (Goodluck, 1981; Hsu, Cairns, & Fiengo, 1985; McDaniel, Cairns, & Hsu, 1991; Goodluck & Behne, 1992; Cairns, McDaniel, Hsu, & Rapp, 1994; Broihier & Wexler, 1995; Goodluck, 1998, 2001; Adler, 2006). These studies have focused on identifying a grammatical source for children's non-adultlike interpretations; however, the rates of non-adultlike behavior have varied widely across studies, as have the different response patterns and the individual variation between subjects. With different tasks used in different studies, this variation suggests that children's interpretations were at least partly influenced by the specific task. In this paper, we aim to tease apart the roles of the task and incomplete linguistic knowledge as sources of non-adultlike behavior, with a direct comparison between tasks.

## 2. Adjunct control tasks

At a minimum, an adjunct control task needs to identify children's interpretations of adjunct PRO. It is then down to the specific task to set up a discourse context for sentences with adjunct control.

Three different tasks have been used in previous studies on the acquisition of adjunct control, which have taken different approaches for identifying children's

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interpretations. Most studies have used the act out task, which prompts children to act out their interpretation of a sentence with toys (Goodluck, 1981; Hsu et al., 1985; McDaniel et al., 1991; Goodluck & Behne, 1992; Cairns et al., 1994; Goodluck, 1998, 2001). One advantage of the act out task is that for sentences with adjunct control, it can offer a clear sense of children's interpretations: if a single character is clearly used to act out the adjunct clause, that character was very likely interpreted as the antecedent of PRO. At the same time, this type of response may not be as clear depending on how (or whether) the main clause is also acted out. This highlights one difficulty with the act out task with adjunct control: to act out both clauses, first the second clause must be held in memory while the first clause is planned and acted out, and then the second clause is retrieved from memory, planned, and acted out. If the representation gets degraded at some point, then the initial parse of the test sentence may not be the same as in the response.

To address concerns with the act out task, studies by McDaniel and Cairns included a judgment of reference task (McDaniel & Cairns, 1990; McDaniel et al., 1991; Cairns et al., 1994), which prompted children to choose possible referents in sentences with adjunct control (along with other sentence types). In addition to the greater metalinguistic awareness needed for this type of task, children were asked to give further judgments after their initial response: if just one referent was selected as an antecedent, children were asked whether the others could also be interpreted as the antecedent, to which they often agreed. Children's responses to this type of follow-up prompt may have been based on their original parse of the test sentence, held in memory while they gave their initial response. However, it is also possible that children's representations at the time of the follow-up prompt were no longer the same as their initial parse, and were inconsistent with their linguistic knowledge. Further concerns with the judgment of reference task involve the potential for pragmatic pressure to accept additional referents, overriding a grammatical constraint.

Finally, two studies on the acquisition of adjunct control have used a Truth Value Judgment Task (TVJT; Crain & Thornton, 1998) to probe different interpretations individually (Broihier & Wexler, 1995; Adler, 2006). In both studies, contexts were set up with different characters, and a test sentence with adjunct control was either a true description of the context or a false description, depending on which character was interpreted as the antecedent of PRO.

For example, Boihier and Wexler's (1995) context was set up with the three events in (2) and the test sentence in (3):

- (2) a. Bert drinks a gulp of water.
- b. Bert scratches Wonder Woman.
- c. Wonder Woman drinks a gulp of water.
- (3) Bert scratched Wonder Woman before PRO drinking a gulp of water.

The context in (2) introduces two characters (*Bert* and *Wonder Woman*). This allows both of them to be possible antecedents of adjunct PRO. With the adult

grammar of adjunct control, the antecedent of adjunct PRO in (3) must be *Bert* (the main clause subject), making the sentence false. However, with a non-adultlike grammar that allows object control, the antecedent of adjunct PRO in (3) can be *Wonder Woman*, making the sentence true.

An advantage of the TVJT is that clear predictions are made for children's true/false responses based on which interpretations are available in their grammars: if children's grammars are adultlike, they will reject the sentence in (3). In contrast, if their grammars allow an object control interpretation then they will accept the sentence in (3). Importantly, this includes grammars that allow either character as antecedent of PRO. A key assumption of the TVJT is that – all things equal – if both the true interpretation and the false interpretation are available, then children will select the true interpretation (the Principle of Charity; Crain & Thornton, 1998).

In practice, however, there are often challenges with setting up the context so that both interpretations are *equally* available. Furthermore, the indirect format of the response – whether the test sentence is true or false – adds an extra step between the initial parse of the test sentence and the behavioral response. This can make it difficult to reconstruct children's representations, even if they also give justifications to their true/false answers. In many cases, this extra step is minor, and children's representations are clear from the pattern of true/false responses. For the test sentence in (3), though, the process starting from parsing the test sentence to producing a true/false answer is more complicated.

First, parsing the test sentence involves retrieving an antecedent for adjunct PRO, which should be identified by the grammar and available in the discourse context. Identifying an antecedent determines which events are mentioned in the test sentence (*Bert drinking* or *Wonder Woman drinking*), which can then be compared to the events in the story. Since the true/false answer to give as a response depends on the order of events in the test sentence in (3) compared to the order of events in the story in (2), the event orders in both the sentence and the story must be held in memory to compare with each other. A true/false answer can then be given, depending on whether the event orders match each other. Importantly, this true/false answer is the dependent measure for children's interpretation of adjunct PRO.

Even if both referents are equally available in the discourse context, the distance between retrieving antecedent and giving a true/false answer introduces various opportunities for error, and the final response may not be an accurate representation of the initial parse of the test sentence.

In the current study, we consider the concerns outlined above and ask about the role of the task effects in children's non-adultlike behavior for adjunct control. We first reproduce children's non-adultlike behavior for adjunct control using the TVJT setup described above (Broihier & Wexler, 1995; Adler, 2006), with the extra step of holding events in memory (Experiment 1). Next (Experiment 2), we use a new task to show a higher rate of adultlike responses without the need to remember event order (Pinto & Zuckerman, 2015; Zuckerman, Pinto, Koutamanis, & van Spijk, 2016). Finally, we adapt the new task into a TVJT with

no need to remember event order (Experiment 3), to show the same higher proportion of adultlike behavior with a direct comparison between tasks.

### 3. Experiment 1: TVJT with event order contrast

In Experiment 1 we developed contexts similar to those used in previous TVJT studies on the acquisition of adjunct control (Broihier & Wexler, 1995; Adler, 2006) to establish a baseline for children's interpretations of adjunct PRO. This baseline can then be used to compare with children's responses with different tasks, to identify the influence of the task in children's interpretations.

#### 3.1. Participants and procedure

Thirty-four children ages 4;0-5;3 ( $M = 4;7$ ) participated in the study. They were recruited through the University of Maryland Infant and Child Studies Database or participated at their local preschools. Twenty adults also participated, who were undergraduate students in an introductory Linguistics class at the University of Maryland, College Park. The adults received course credit for their participation.

Materials were based on the contexts from the TVJT studies by Broihier & Wexler (1995) and Adler (2006), and followed the format described above. Contexts were designed to set up three events, where the order of the events was a relevant factor in the stories (4). The test sentences, in (5), had the same format as in (3), where the true/false answer depended on (i) the interpretation of adjunct PRO and (ii) the order of events in the sentence compared to the order of events in the story:

- (4) a. Diego puts a bandaid on his knee.  
 b. Dora carries Diego.  
 c. Dora puts a bandaid on her foot.  
 (5) Dora carried Diego *after* PRO putting on a bandaid.

Test sentences varied by Context (*object-true/subject-true*). In the *object-true* sentences, the event order in the sentence made the subject (adultlike) interpretation false and the object (non-adultlike) interpretation true; for example, the adultlike interpretation of PRO in (5) is that *Dora* put on a bandaid, which makes the sentence false in the context in (4). The non-adultlike interpretation in (5), however, is that *Diego* put on a bandaid, which makes the sentence true.

Meanwhile, the event order in the *subject-true* condition made the subject (adultlike) interpretation true and the object (non-adultlike) interpretation false:

- (6) Dora carried Diego *before* PRO putting on a bandaid.

The expected responses for (6) are reversed compared in (5), and the predictions by condition and interpretation of PRO are spelled out in Table 1.

**Table 1: Predictions for Experiment 1, by condition and interpretations**

Context: <i>Dora carried Diego...</i>	Interpretation of PRO	
	subject ( <i>adultlike</i> )	object ( <i>non-adultlike</i> )
<b>object-true</b> <i>...after putting on a bandaid</i>	false	true
<b>subject-true</b> <i>...before putting on a bandaid</i>	true	false

Since the true/false answers to the test sentences depended on the order of events, measures were taken to direct children's attention to this contrast in particular throughout the task. First, a training session confirmed that children could correctly judge statements about event orders and also established the relevance of event order in the task. Next, control sentences also used temporal adjuncts, but without syntactic control:

(7) Dora hugged Diego *before/after* the plane landed.

Finally, at the end of each story, the three main events appeared on the screen in the correct order, as a memory aid during the test sentence.

To balance the salience of the characters in the story, a preamble was presented directly before each test sentence, which included both potential antecedents of PRO:

(8) Dora and Diego were both going hiking, and oh, I know: [test sentence]

Adults and children saw 4 test items, 3 control items, and 2 training items about event order, which were all narrated with animations on an iPad2. In addition to true/false answer, trials were balanced for complementizer (*before/after*), main clause subject (*Dora/Diego*), and preamble order (*Dora* first or *Diego* first) across items and lists.

### 3.2. Predictions

The predicted responses outlined above assume that the characters introduced in the stories are equally salient and available throughout, and that the context does not introduce any significant pragmatic pressure on children to override their linguistic knowledge in favor of a non-adultlike interpretation. We designed the contexts with these assumptions in mind, and if no other factors interfere with children's interpretations, then the following responses are predicted for an adultlike or non-adultlike grammar:

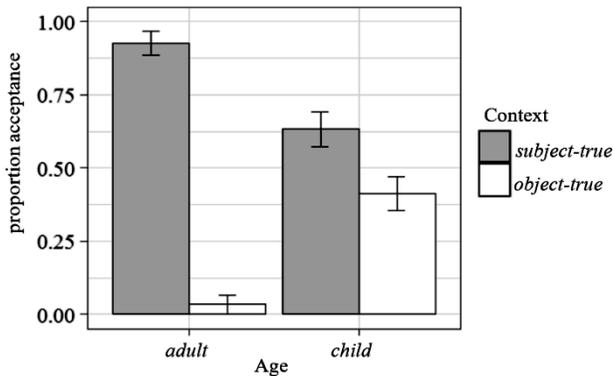
(a) if children have an **adultlike** (subject control) grammar, then they should **reject** *object-true* sentences and **accept** *subject-true* sentences.

- (b) if children have a non-adultlike **object control** grammar, then they should **accept** *object-true* sentences and **reject** *subject-true* sentences.
- (c) if children have a non-adultlike **free reference** grammar – which allows either subject control or object control – then they should **accept** *object-true* sentences and **accept** *subject-true* sentences.

However, if any factors interfere with children’s interpretations of adjunct PRO or their comparison of event orders, then the pattern of responses may not be consistent with these predictions, and further manipulations will be needed to identify specific factors.

### 3.3. Results and discussion

While adults showed the expected response pattern for a strict subject grammar (a), the results for children are not as clear (Figure 1).



**Figure 1: Experiment 1 results: proportion acceptance by Context and Age**

To analyze these results, we used a mixed effects logistic regression, with Age and Context as fixed effects and subjects and items as random effects. The model revealed a main effect of Context ( $\beta = 5.48$ ,  $Z = 5.57$ ,  $p < .001$ ), a main effect of Age ( $\beta = 2.64$ ,  $Z = 3.41$ ,  $p < .001$ ), and a significant interaction between Context and Age ( $\beta = -4.62$ ,  $Z = -4.49$ ,  $p < .001$ ).

Although the source of the main effect of Age is unclear, the main effect of Context is evident from Figure 1, with children showing a trend towards the same subject control pattern as observed in adults. Importantly, the interaction between Age and Context reflects that although this trend is in the same direction, it is not the same as the adult pattern (and is not an average of a bimodal distribution with one adultlike group and one non-adultlike group). That is, the process of generating a true/false answer for the children was different in some way from the process in adults, such that children were more likely to accept an object control interpretation *and* to reject a subject control interpretation. Neither the predictions for the adult grammar nor the predictions for the non-adultlike grammars are

consistent with this result, suggesting that additional factors were involved in children's responses.

To examine how these additional factors may have influenced children's interpretations of adjunct control, in Experiments 2 and 3 we manipulated the working memory load in the task by removing the extra step of evaluating event ordering. This manipulation makes clear predictions for the adult grammar compared to non-adult grammars, and offers a direct comparison of children's responses across tasks.

#### **4. Experiment 2: Coloring book task without event order contrast**

In Experiment 1, children's interpretations of adjunct PRO were revealed indirectly, with an antecedent needed first before being able to give a true/false answer about event order. Although children also gave justifications that often revealed their interpretation of PRO, the central focus on event order is not a necessary feature of an adjunct control task. In Experiment 2, we used a different contrast, based on the adjunct object rather than the *before/after* complementizer, that still depended on children's interpretation of adjunct PRO. Instead of a TVJT, in Experiment 2 we used a coloring book task developed by Pinto and Zuckerman (2015; Zuckerman et al., 2016). Children revealed their interpretation by coloring in one of two items on a touchscreen computer, which corresponded to two possible antecedents for adjunct PRO. This task has various advantages; importantly, with a contrast that does not depend on event order, it involves a context with a lower memory load compared to Experiment 1.

##### **4.1. Participants and procedure**

Thirty-two children ages 4;0-5;3 ( $M = 4;9$ ) participated in the study. They were recruited through the University of Maryland Infant and Child Studies Database or participated at their local preschools.

Six adults also participated. The adults were undergraduate students in an introductory Linguistics class at the University of Maryland, College Park, and they received course credit for their participation. The adults performed at 100% accuracy for all items with no variation, and their results are not included in further analysis.

The coloring book task allows children to reveal their interpretation of a test sentence by coloring in an item in a black and white picture. For a test sentence that is ambiguous between two different interpretations (for example, subject control and object control), a picture can be designed for the coloring book task to match either interpretation, depending on how the picture is colored in.

To reveal children's interpretations of adjunct PRO, the task involved two-picture sequences (Figure 2) on a touchscreen computer, with one picture corresponding to the main clause of the test sentence in (9) and one picture corresponding to the adjunct clause:

(9) Dora fanned Diego after PRO hugging the brown bear.

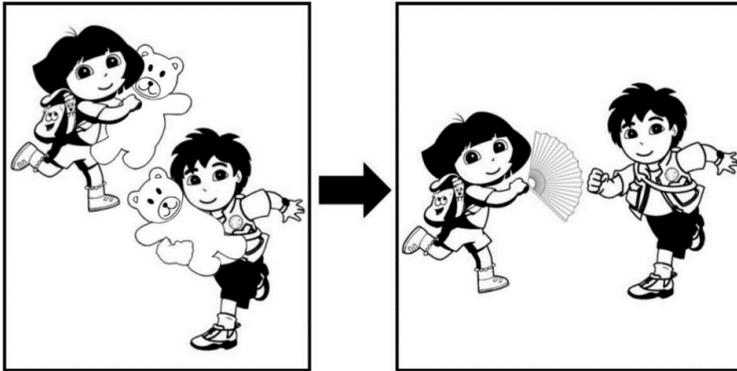


Figure 2: Example item for Experiment 2, to go with (9)

The adultlike (subject) interpretation of the test sentence in (9) is that *Dora* hugged the brown bear; children indicated this interpretation by first choosing the correct color from an array of colored squares below the pictures, and then coloring Dora's bear in Figure 2 – the *subject* item. Alternatively, children could show that they had accessed the non-adultlike (object) interpretation by coloring Diego's bear – the *object* item. This meant that instead of a true/false answer like in Experiment 1, children's responses were measured as the proportion of *subject* items colored, compared to *object* items.

Trials with the complementizer *after* had the adjunct clause picture on the left, as in Figure 2 (*hugging the brown bear*), while trials with *before* had the adjunct clause picture on the right. Although event order was not a central focus in the task, the use of the temporal adjunct was supported with an arrow between the two pictures that was always pointed to the right. The pictures were also introduced as ordered with respect to each other, starting with the main clause:

(10) In this picture we have Dora fanning Diego, (**but first/and then**) there's Dora hugging a bear, and there's Diego hugging a bear too.

Directly before the test sentence, children heard a preamble to balance the salience of the potential antecedents:

(11) So here's how we should color this picture of Diego and Dora: [test sentence]

To confirm that both the subject interpretation and the object interpretation were available, we included control sentences with an overt subject, that referred to either the subject or the object of the main clause.

- (12) a. Dora fanned Diego after **she** hugged the brown bear (**subject** antecedent)  
 b. Dora fanned Diego after **he** hugged the brown bear (**object** antecedent)

In total, children saw 3 training items with no features of control (on how to use the touchscreen, and to show that only one item should be colored in for each trial), 4 test items, 4 control items with a pronoun subject antecedent (12a) and 4 control items with a pronoun object antecedent (12b). Children were not included in the analysis if they answered incorrectly to more than one control item with a subject antecedent (12a) or to more than one with an object antecedent (12b).

## 4.2. Predictions

With both subject and object interpretations available, any preference in the test trials will be due to a grammatical constraint on interpretation. In particular, if the preference for a subject interpretation in Experiment 1 was the result of an adultlike grammar with a high memory load, then reducing that memory load in Experiment 2 should cause an increase in subject responses.

Note that the prediction is not for *only* subject responses but rather for significantly *more* of them; although the coloring task has a reduced memory load, there are still some task demands. For example, between parsing the test sentence and coloring in one of the bears, children needed to retrieve the antecedent of PRO, identify a bear, hold the bear in memory while selecting a color, and finally retrieve the bear from memory before coloring it in. These steps are very different from the process described in §2 for the TVJT, however, and suggest that children's responses in the coloring task will be a more direct representation of their linguistic knowledge.

## 4.3. Results and discussion

Children's responses in Experiment 2 were much more adultlike compared to Experiment 1, with 85% subject responses overall. If children's true/false answers in Experiment 1 are recoded as *subject* or *object* responses, there were significantly more *subject* responses in Experiment 2 ( $t(58.26)=4.55$ ,  $p < .001$ ), although this comparison should be treated with caution, given the change in dependent measure. Most children gave only *subject* responses (17/32) or a showed a *subject* preference (10/32), with the remaining children at chance (5/32).

With two different patterns of responses in Experiments 1 and 2, the results show that children's behavior for adjunct control can vary depending on the task. This suggests that task effects have played a role in children's behavior in previous studies. At the same time, the two designs do not identify the source of children's improvement. With various differences between the two tasks – not just the relevant contrast, but also the response type, the predictions for different grammars, the pragmatic assumptions, and more – the increase in rate of adultlike responses might be due to a combination of factors, which may also interact with each other depending on the setup of the task. In Experiment 3, we control for some of these differences by adapting the coloring task into a TVJT.

### 5. Experiment 3: TVJT without event order contrast

In Experiment 3, we used the same contrast from Experiment 2 based on the color in the adjunct object. This made the difference between true/false dependent on the specific color, instead of the order of events in the sentence. For both versions, an antecedent of PRO is still needed to make a true/false judgment, and the true/false judgment serves as an indication of how PRO was interpreted. Thus, the design of Experiment 3 provides the most direct comparison between two different adjunct control tasks, to identify a specific feature of the task that influences children's interpretations of adjunct control.

#### 5.1. Participants and procedure

Thirty-two children ages 4;0-5;2 ( $M = 4;6$ ) participated in the TVJT adapted from the coloring task. To directly compare the two TVJTs, we also repeated the original TVJT design from Experiment 1 with another thirty-two children ages 4;0-5;6 ( $M=4;9$ ). Both groups were recruited through the University of Maryland Infant and Child Studies Database or participated at their local preschools.

To adapt the design from Experiment 2 into a TVJT, a context was set up for each sentence with the same pictures from Experiment 2, except that all of the items that could be colored in in Experiment 2 were presented as already filled in with different colors. For example, in Experiment 2, either of the bears in Figure 2 could both be colored brown. In Experiment 3, both bears were filled in already, with one bear colored red and the other colored blue.

In Experiment 2, the test sentences prompted children to color in one of the items in the black and white picture – for example, the sentence in (9) identifies one of the bears to color (depending on the interpretation of adjunct PRO). In Experiment 3, the color of the item in the sentence was changed to match one of the filled in items (e.g. the blue bear *or* the red bear):

(13) Dora fanned Diego after PRO hugging the *blue/red* bear.

Importantly, the true/false answer depended on which color was mentioned. However, instead of the process involved in Experiment 1 of comparing the order of events in the test sentence to the order of events in the story context, the true/false answer in Experiment 3 depended on the color of just one of the items in the picture; which item this was depended on the antecedent of PRO.

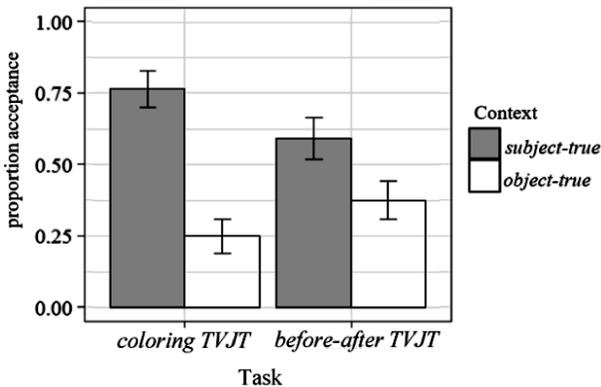
To compare the adapted TVJT that used color as the relevant contrast (*coloring TVJT*), with the original TVJT that used event order as the relevant contrast (*before-after TVJT*), the same factor Context (*object-true/subject-true*) was used in both tasks, with the same predicted pattern of responses (for adultlike and non-adultlike grammars).

## 5.2. Predictions

If children's improvement in Experiment 2 was because of the type of task alone, then they should make as many errors as in Experiment 1 with any type of TVJT, and the same pattern of responses should be observed for the *coloring TVJT* as in Experiment 1. However, if children's improvement in Experiment 2 was due to a reduced demand on working memory from removing the need to keep track of event orders, then the same improvement should be observed in the *coloring TVJT*. This improvement would bring children's responses out closer to the strict subject pattern observed for the adults in Experiment 1, resulting in an interaction between the Task (*coloring TVJT/before-after TVJT*) and Context (*object-true/subject-true*).

## 5.3. Results and discussion

The results for Experiment 3 are displayed in Figure 3. Although children's responses in the *coloring TVJT* are not at the ceiling rates of interpretations of the adults in Experiment 1, the change is in the direction of the predicted interaction.



**Figure 3: Experiment 3 results: proportion acceptance by Context and Task**

To analyze these results, we used a mixed effects logistic regression, with Task and Context as fixed effects and subjects and items as random effects. The model revealed a main effect of Context ( $\beta = 1.18$ ,  $Z = 2.78$ ,  $p = .01$ ) and a significant interaction between Context and Task ( $\beta = 1.64$ ,  $Z = 2.55$ ,  $p = .01$ ), with no effect of Task ( $\beta = -0.68$ ,  $Z = -1.31$ ,  $p = .19$ ).

These results suggest that independent of the type of task (*coloring* or *TVJT*), children's behavior for adjunct control is influenced by the extra memory load imposed by having to keep track of event order. When children's true/false answer did not involve a judgment about event order, their pattern of responses was closer to the adult-like pattern – more *subject-true* responses accepted and fewer *object-true* responses accepted. Meanwhile, when children's true/false answer required

a comparison between event order in the sentence and event order in the context, the pattern from Experiment 1 was replicated: children's responses trended in the direction of a subject preference, but with a large proportion of object responses.

In previous studies on the acquisition of adjunct control, the tasks have generally involved keeping track of events in some way, with the task in Experiment 1 based on previous TVJTs. The results from Experiments 2 and 3 suggest that children's behavior in these tasks may not have been a direct reflection of their linguistic knowledge. In the following sections, we discuss the implications of these results for children's acquisition of adjunct control and the influence of memory load.

## **6. General discussion**

In this paper, we compared children's interpretations of sentences with adjunct control across three different tasks. We saw more subject (adultlike) responses in the tasks where children did not need to hold events in memory, without the extra step of comparing event orders in order to give a response in the task. These tasks contrast with those used in previous studies, where events were a greater factor in children's responses.

If children's responses in previous studies (and Experiment 1) were influenced by having to keep track of events, then what can be concluded about children's acquisition of adjunct control? First, the results from this paper speak to the question of a non-adultlike grammar as a source of children's interpretations of adjunct control. Second, we focus on the role of working memory in children's interpretations, with implications for the acquisition of adjunct control and the development of working memory itself.

### **6.1. Grammars and grammatical accounts**

The focus in previous studies has largely been on capturing children's non-adultlike behavior with one or more specific non-adultlike grammars. Individual variation in particular has often been interpreted as evidence for different types of non-adultlike grammars (McDaniel et al., 1991; Cairns et al., 1994), rather than extragrammatical factors.

We suggest that children's grammars for adjunct control are adultlike by age 4, with different patterns of behavior across studies resulting from variation in specific task demands. As discussed above, this conclusion does not arise from the high rates of subject responses in Experiments 2 and 3. Indeed, in both experiments, children still gave some object responses, and for each pattern of results alone, an analysis is available where some children have an adultlike grammar and some children have a non-adultlike grammar, just like in previous studies. This was the motivation for the direct comparison between tasks: if children's grammars are adultlike, but the deployment of their linguistic knowledge may be influenced by task demands, then the rate of adultlike responses is predicted to vary depending on the demands of the task. Meanwhile,

if children's grammars are not adultlike, the rate of adultlike responses is not predicted to *increase* when the demands of the task are reduced (as we observed).

One exception to this second prediction is if children have a non-adultlike grammar with a *preference* for a subject antecedent, as opposed to a strict subject requirement: in both cases, subject responses are predicted to increase with a decrease in task demands. However, a subject preference grammar is problematic if children need evidence from the linguistic input to transition from a non-adultlike grammar to the adult grammar, as the evidence for the adult grammar would also be consistent with the subject preference grammar.

## 6.2. Working memory: acquisition and development

If children's interpretations of adjunct control are influenced by the memory demands in the context, then this has implications for the acquisition of adjunct control, as well as other complex structures that may be similarly affected. Even if children's grammars are adultlike at age 4, it is uncontroversial that they can still access a non-adultlike interpretation until well after that. Therefore, any instances of adjunct control in the linguistic input that may have been intended to have a subject control interpretation might still be interpreted in the *intake* with a different antecedent (Lidz & Gagliardi, 2015; Omaki & Lidz, 2015). This presents a puzzle for how children acquire the adult grammar in the first place: if children need evidence from the linguistic input in order to acquire a strict subject grammar, but the evidence in the intake is inconsistent with a strict subject grammar because children access non-adultlike interpretations of the input, then they will not receive the evidence needed to acquire the adult grammar. Nevertheless, children do acquire the adult grammar of adjunct control. This puzzle is not answered here, and will be addressed in future research.

Another question raised by the results in this paper is how the demand of keeping track of event order would influence children's interpretations of *adjunct control*, in particular. Importantly, children's non-adultlike responses were not due to mixing up events in the story; of the justifications that children gave, the majority of which clearly identified which character had been interpreted as PRO, nearly all used the correct order of events. One possibility is that keeping track of events in memory could have interfered with retrieving an antecedent of PRO. However, with the different steps in between antecedent retrieval and producing a behavioral response (detailed in §2), it is not yet clear exactly how the extra demands from keeping track of events would influence children's responses.

Finally, whatever the source of interference while keeping track of events, it was significant enough to influence children's behavior, but not adults'. That is, the extra demand of keeping track of event orders interfered with how well children could deploy their grammatical knowledge, but it did not cause any problems for adults. Some aspect of the deployment system, which is overwhelmed by this extra demand at age 4, must therefore undergo development at a later age. Specific aspects of this development – the timescale, mechanisms, and domain – will be explored further in future research.

### 6.3. Conclusion

In this paper we compared children's behavior for adjunct control across three tasks. We found that children's responses differ depending on whether the task involved storing multiple events in memory. This demonstrates the role of task effects in children's interpretations of adjunct control, and has implications for the type of memory that is involved for keeping track of events and giving a response to indicate an interpretation of adjunct PRO.

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