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BRIEF ARTICLE

Isomorphism for *All* (but Not *Both*): Floating as a Means to Investigate Scope

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This article investigates the so-called isomorphism effect (Musolino 1998; Musolino, Crain & Thornton 2000) in the comprehension of scopally ambiguous sentences containing negation and floating quantifiers. Given that floating quantifiers can appear in up to three surface positions relative to negation, I propose that they provide us with the ideal methodological tool to test for scope ambiguity resolution while holding constant various factors, including: (i) the associated noun phrase, and thereby the relevant thematic roles in the test stories; (ii) the syntactic position of the associated noun phrase, and thereby the relevant interpretive mechanism for achieving either a wide or narrow scope construal; (iii) the discourse contexts in which the test sentences are presented. Using a truth value judgment task, I show that both 4-year-olds and adults display isomorphic preferences in their interpretation of ambiguous sentences containing the floating quantifier *all*, no matter its surface position. In the case of *both*, children and adults display a preference for isomorphism only when *both* precedes negation. Crucially, for both quantifiers, children and adults display the same interpretive preferences, lending further support to the general view that children and adults do not differ in their grammatical representations of such scopally ambiguous sentences (Musolino & Lidz 2003, 2006; Gualmini 2004; Conroy, Lidz & Musolino 2009).

1. INTRODUCTION

The study of the comprehension of scopally ambiguous sentences has generated a productive line of research with the goal of better understanding whether and how children and adults differ in their representation and processing of such ambiguities. One important point of discussion in the scope literature centers on the so-called *isomorphism effect*. The wide scope (WS) reading of

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the universal quantifier over negation in (1), for example, is isomorphic, as it conforms to the surface word order of the two scope-bearing elements. A widely cited observation has centered on children's apparent preference for the isomorphic interpretation of such sentences, in contrast to adults' strong preference for the nonisomorphic, narrow scope (NS) reading, in which negation takes scope over the universal quantifier (Musolino 1998; Musolino, Crain & Thornton 2000).

(1) Every horse didn't jump over the fence.

Since the so-called isomorphism effect was originally observed, much research has been conducted on children's scope ambiguity resolution, and new findings have been brought to light. For example, contextual manipulations have been shown to facilitate children's access to nonisomorphic readings of scopally ambiguous sentences, in some cases even leading to an apparent preference for nonisomorphic readings (see Gualmini & Crain 2005; Musolino & Lidz 2006; Zhou & Crain 2009; Crain et al. 2013; Moscati & Crain 2014). Additionally, adults have sometimes been shown to display a similar preference for isomorphic readings. Musolino & Lidz (2003), for example, demonstrated that when presented with sentences such as (2) and (3) in contexts that are compatible with both isomorphic and nonisomorphic readings, adults too can be shown to display a preference for the isomorphic interpretation; moreover the contextual manipulations that enable children to override their preference for isomorphism are shown to similarly affect adults.

(2) Donald didn't find two frogs.
(3) Two frogs didn't jump over the rock.

Musolino and Lidz argue that the isomorphism effect actually reflects an exaggerated preference that is also present in adults. Importantly, on their proposal, observed differences between children and adults lie in the operation of the parser rather than in their respective grammatical systems (see also Musolino & Lidz 2006; Gualmini 2004; Conroy, Lidz & Musolino 2009).

I take as the starting point of this article the observation that the findings of previous scope studies have been somewhat heterogeneous, in great part due to the variability in method and stimuli of previous studies. Different studies have made use of different quantifiers, occupying different syntactic positions (i.e., subject or object), necessitating different test scenarios designed to make the different test sentences felicitous; moreover, the types of sentences that have been investigated have not always been the same in studies with adults and studies with children. I will argue, along the lines of Musolino & Lidz (2003), that children and adults are essentially alike in their interpretive preferences, but these differences can sometimes be obscured by other factors, such as sensitivity to discourse context. I will argue that when we hold these factors constant, we observe the same preferences in children and adults.[1] To accomplish this, I will use the floating quantifier *all* as a methodological tool that allows us to test for scope while holding constant the test scenarios and associated noun phrase (NP) (and consequently its syntactic position and thematic role). In short, we will manipulate only the surface position of the quantifier. When this is the case, I show that both 4-year-old children and adults display a preference for isomorphic readings. This strengthens the claim in Musolino & Lidz (2003) that the isomorphism effect, when

[1] Note that I do not argue for the isomorphism effect as a constant across all quantifiers; rather my goal is to show that when various factors are held constant, children and adults essentially pattern alike—whether their baseline preferences reflect isomorphic readings or not.

observed, is indeed an exaggerated manifestation of an interpretive preference also observable in adults. Importantly, however, this observation of isomorphism is made on the basis of data from the same quantifier, in the same test sentences, presented under the same discourse conditions, for both children and adults.

Next, I turn my attention to the floating quantifier *both* and present results suggesting that floating quantifiers are not all interpreted alike. I show that in the case of *both*, adults and 4-year-olds display a preference for isomorphic readings when *both* precedes negation, but not when it follows it. While it remains unclear what relevant difference between the two floating quantifiers might explain the difference in scope preferences, the crucial finding is that children and adults display the same patterns of interpretation, whether these patterns reflect a preference for isomorphism or not. In other words, here too the data support the general claim that children and adults do not differ qualitatively in their grammatical representation of such scopally ambiguous sentences.[2]

2. THE USE OF FLOATING QUANTIFIERS

Across different investigations of scopally ambiguous sentences, a range of quantifiers have been examined, including the universal *every*, numeral quantifiers, and indefinites such as *some* and *a*, both those occupying subject position and those occupying object position (Gualmini 2004; Gualmini et al. 2008; Miller & Schmitt 2004; Kwak 2010; Zhou & Crain 2009, among many others). To make different scope construals felicitous, different test scenarios have been designed accordingly for each case. Generalizations about scope preferences have been somewhat heterogeneous across different studies, likely due to the following factors. First, the quantifiers that have been shown to evoke WS preferences have been different across experiments with children and adults; for example, Musolino & Lidz (2006) and Musolino (1998) reported that children displayed a preference for WS readings of sentences containing universal quantifiers in subject position, while Musolino & Lidz (2003) reported that adults displayed WS preferences for sentences containing numerals in subject position. Second, different studies have varied in whether the quantifier of choice occupies subject position, generally preceding negation, or object position, generally following negation. As pointed out by Musolino & Lidz (2003), the grammatical mechanisms that yield WS and NS readings are different for subject and object quantifiers (i.e., reconstruction vs. quantifier-raising). This means that assigning a WS construal to a universal quantifier in subject position, for example, may not rely on exactly the same interpretive mechanisms as assigning a WS construal to the same universal quantifier in object position. Third, to make different scope construals felicitous, different scenarios must be presented to accommodate the thematic relations that underlie the different surface word orders; for instance, while (2) and (3) can both be used to test for the relative scope of *two*-NPs and negation, one relates the numeral

[2]As pointed out by an anonymous reviewer, many models of children's resolution of scope ambiguities have been proposed since the original observation of the isomorphism effect (see, for example, Crain, Ni & Conway's [1994] and Notley et al.'s [2012] Semantic Subset Principle, as well as Gualmini et al.'s [2008] Question Answer Requirement model). The focus of the present article will not be to provide evidence for or against these models. Rather, the goal is simply to show that when we test the same quantifier while keeping constant various unrelated factors, children and adults are alike in their interpretive preferences of scopally ambiguous sentences. The question of how these baseline preferences are derived (e.g., under competing models of scope ambiguity resolution) is beyond the scope of this article.

to the theme (i.e., how many objects did Donald fail to carry out the relevant action with?), while the other relates the numeral to the agent (i.e., how many frogs failed to carry out the relevant action?). Even though we are examining the same quantifier and its scope relative to negation, the stories that are constructed necessarily differ depending on whether the quantifier occupies subject or object position.

To uniformly test for the scope of a quantifier relative to some other scope-bearing element, e.g., negation, it would be ideal to hold the scenario constant, to keep the associated NP constant (for example, to always associate the quantifier with the subject NP), and to manipulate only the surface position of the quantifier relative to negation. This is impossible with the quantifiers tested to date. As we have seen, interpreting *every* or *two* in subject position is not the same as interpreting *every* or *two* in object position, and different stories must be presented in order to make the agent-theme/patient relations felicitous in each case. In order to overcome the issue of variability with respect to these multiple factors across many previous studies, I turn to the use of floating quantifiers, which can appear in multiple different positions relative to an associated subject NP and negation. *All*, for example, can appear prenominally, as in (4); postnominally but before negation, as in (5); and finally, in a position following negation, as in (6).

(4) All the boys didn't climb the tree.
(5) The boys all didn't climb the tree.
(6) The boys didn't all climb the tree.

Relevant for our purposes is one of the fundamental observations that initially motivated a transformational analysis of floating, namely that the quantifier, when floated, appears to quantify over its associated NP much in the same way as the unfloated version does (Kayne 1975; Sportiche 1988; Bobaljik 2003). In other words, each of (7) and (8) could be paraphraseable in terms of the other.

(7) All the boys climbed the tree.
(8) The boys all climbed the tree.

Wherever the quantifier *all* appears in (4)–(6), it is associated with the same NP, namely the subject NP *the boys*. Given the agent/action/theme relations are the same in all three sentences, and given the rough equivalence of floated and nonfloated *all*, we can present the test sentences against the same test stories. Finally, the same test sentences will be tested with children and adults.[3]

[3]There has not been a great deal of previous research on children's acquisition of the floating quantifiers *both* and *all*. Labelle & Valois (2001), for instance, examined the French floating quantifier *chacun* 'each,' but their study was concerned with whether children correctly allowed the floating quantifier to quantify over the subject but not the object. Our test sentences will all involve quantification of *both*/*all* over the subject noun phrase, and children's responses, in particular their justifications, will reveal that they have no problems quantifying over the subject NP. As another example, Roeper et al. (2007) discussed English *all* and German *alles*, but specifically in the context of triggering exhaustive interpretations of *wh*-questions; thus their findings are not directly relevant to the present study. The fact that there is little previous work on children's knowledge of *both* and *all* makes it all the more important to have floating quantifier control trials; as we will see in Experiments 1 and 2, these provide a basic measure of children's ability to interpret the floating quantifiers, particularly without any interfering interactions with negation. Success on these control trials, i.e., targetlike interpretation of sentences such as *All the girls fed the pandas* and *The girls all fed the pandas*, will provide a general measure of children's knowledge of the floating quantifier and give us an objective criterion for including the children's data in the analysis.

In sum, using the floating quantifier *all* as in (4)–(6), I will keep constant the following factors: (i) the associated NP and thereby the relevant agent/action/theme relations; (ii) the syntactic position of the associated NP and thereby the relevant interpretive mechanisms for achieving either WS or NS construals; (iii) the contexts in which the test sentences are presented.

3. EXPERIMENT 1

3.1. Method

3.1.1. Participants

The participants were 45 English-speaking children and 42 adult native speakers of English. Adult participants were undergraduate linguistics and psychology students at the University of Connecticut, and were paid $10 or received course credit for participating. Seven child participants failed to pass at least three of the four control trials, and were excluded from the analysis. I report here the data from the remaining 38 children (3;10–5;08, $M = 4;04$) and the 42 adults.

3.1.2. Procedure

I tested participants' interpretation of negative test sentences containing the floating quantifier *all*, using a Truth Value Judgment Task (TVJT; Crain & Thornton 1998, 2000). The task was carried out by a single experimenter using a laptop computer. Stories were told by the experimenter using cartoon pictures and animations created out of clipart images and displayed in PowerPoint. Prerecorded video clips of a puppet created the pretense that the puppet was participating in the task live via webcam. Participants were told that the puppet was not very good at paying attention to stories. They were given a scorecard to fill out, with the goal of helping the puppet to learn how to pay better attention. At the end of each story, the puppet was asked a question about the story. The participant's task was to determine whether the puppet's statement was "right," in which case s/he was instructed to put a stamp under the 'smiley face' column of the scorecard. If the puppet was "wrong," the participant was instructed to put a stamp under the "sad face" column of the report card. Follow-up justifications were elicited following acceptances and rejections, in order to ascertain participants' reasons for providing *yes* or *no* responses. All participants were tested individually. Sessions were videorecorded for subsequent coding and analysis.

3.1.3. Materials

Critical test stories all involved three characters who considered carrying out some action; while the first character ultimately carried out the action, the other two found some reason not to do so (see (9) for an example test item and Figure 1 for the accompanying final image). The puppet's descriptions pertained to whether or not the characters all carried out the action. The critical test sentence contained the floating quantifier *all* in one of three possible positions (prenominal/floated prenegation/floated postnegation). With the quantifier in any of these three positions, the sentence was false on the WS reading of *all* (i.e., it was false that every character failed to carry out the action, as one of them did carry out the action), and true on the NS reading

FIGURE 1 Final image accompanying the puppet's utterance of the test sentence *All the boys didn't climb the tree/The boys all didn't climb the tree/The boys didn't all climb the tree*.

(i.e., not all of the characters carried out the action, as only one did).[4] Note that it was not possible to test sentences that were true on the WS reading but false on the NS reading; since the WS reading entails the NS reading, any contexts that made the WS reading true (i.e., where none of the characters carried out the action) necessarily made the NS reading true as well.

(9) Story: In this story, Jack, John, and Jim are outside on the playground, and they see a great big tree with lots of branches. It looks like it would be a lot of fun to climb. Jack climbs the tree all the way to the top. John and Jim say that it looks like a lot of fun, but they don't want to fall and hurt themselves, so they won't climb the tree.
EXPERIMENTER:So we know the boys wanted to climb the tree. Parrot, what happened in the story?
   a. PUPPET: All the boys didn't climb the tree. *Prenominal condition*
   b. PUPPET: The boys all didn't climb the tree. *Floated prenegation condition*
   c. PUPPET: The boys didn't all climb the tree. *Floated postnegation condition*

Follow-up justifications for *no*-responses (WS) were expected to make reference to the character who had carried out the action, while justifications for *yes*-responses (NS) were expected to make reference to the characters who had not carried out the action. Notice that in the prenominal and floated prenegation conditions, a WS reading corresponded to an isomorphic interpretation, while in the floated postnegation condition, it corresponded to a nonisomorphic interpretation.

[4]Prosody likely has the potential to bias toward one reading over another (I thank Kamil Ud Deen for raising this point). In particular, whether or not the floating quantifier is stressed, and whether there is a small pause following the noun phrase, both appear to influence one's judgments about which reading is more plausible. This is likely tied to issues of focus, which are orthogonal to the goals of the present study. To avoid these potential complications, the researcher who recorded the puppet's lines was instructed to do so using as neutral (but natural) an intonation as possible, in particular without stressing the floating quantifier, and without any marked pauses within the sentences.

I used a 2 × 3 design with group (child vs. adult) and quantifier position (prenominal vs. floated prenegation vs. floated postnegation, between-subject) as factors. Participants were randomly assigned to one of the three test conditions. Each participant received four test and four control items, which were randomized and counterbalanced. Two of the control items corresponded to affirmative sentences containing the floating quantifier (prenominally in the prenominal condition, e.g., *All the girls fed the pandas*; postnominally in the floated pre- and postnegation conditions, e.g., *The girls all fed the pandas*); the other two control trials corresponded to negative sentences that did not contain any floating quantifier (e.g., *The brothers didn't ride the skateboard*). The control items could be associated with a *yes*-target or a *no*-target; this allowed us to balance the overall number of *yes*- and *no*-responses from each participant. A list of all test and control sentences is provided in the appendix.

3.2. Results

The dependent measure in the following analysis was the proportion of *no*-responses, which corresponded to isomorphic readings in the prenominal and floated prenegation conditions, and to nonisomorphic readings in the floated postnegation condition. The results are reported in Figure 2. A two-way ANOVA revealed no effect of group, $F(1, 74) = .20$, $p = .65$, a significant main effect of quantifier position, $F(2, 74) = 48.18$, $p < .001$, and no significant interaction, $F(2, 74) = 1.01$, $p = .37$. Participants provided significantly fewer *no*-responses overall in the floated postnegation condition than in the prenominal and floated prenegation conditions (Tukey HSD, both $p < .001$). Given that *no*-responses corresponded to isomorphic readings in the prenominal and floated prenegation conditions, while *yes*-responses corresponded to isomorphic readings in the floated postnegation condition, we observe that adults and children generally preferred isomorphic readings in all three conditions.[5]

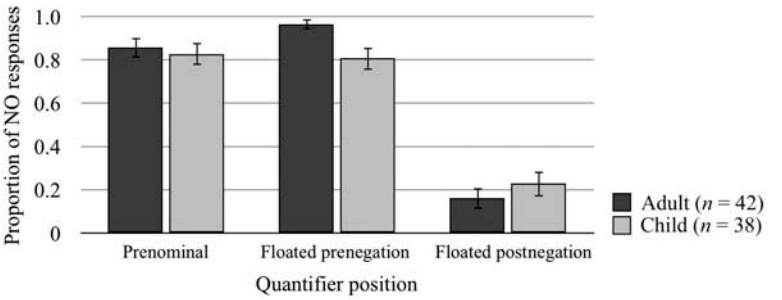

FIGURE 2 Proportion of *no*-responses by position of the quantifier *all*. Note that *no*-responses corresponded to isomorphic readings in the prenominal and floated prenegation conditions, and to nonisomorphic readings in the floated postnegation condition.

[5]An anonymous reviewer points out that the age range of children tested was relatively large (3;10–5;08). In particular there were nine children under the age of 4 years, 10 children between 4;00–4;05, 14 children between 4;06–4;11, and five children over the age of 5 years. A two-way ANOVA on the children's data revealed a significant main effect of quantifier position, $F(2, 32) = 14.28$, $p < .001$, no effect of age, $F(1, 32) = .06$, $p = .81$, and no significant interaction, $F(2, 32) = .30$, $p = .74$.

Follow-up justifications from the participants allowed us to ascertain their reasons for accepting or rejecting the puppet's statements. Follow-up justifications from both adults and children supported WS readings in the prenominal and floated prenegation conditions, and NS readings in the floated postnegation condition. Some examples of the children's justifications are provided in (10) and (11).

(10) Justifications for *no*-responses
   a. "Because that guy climbed the tree and those guys didn't." (AL-C14-2A, age 3;10, prenominal condition)
   b. "One of them climbed the tree." (AL-C18-2B, age 4;07, prenominal condition)
   c. "Just one did." (AL-C04-1B, age 5;02, floated prenegation condition)
   d. "This, he climbed." (AL-C15-1A, age 4;08, floated prenegation condition)
   e. "The, one boy, Jack, Jack climbed the tree." (AL-C17-1B, age 4;00, floated prenegation condition)
   f. "One boy did." (AL-C08-3B, age 4;08, floated postnegation condition)

(11) Justifications for *yes*-responses
   a. "His friends didn't wanna climb the tree, they were afraid to fall and hurt themselves." (AL-C07-2A, age 4;11, prenominal condition)
   b. " 'Cause those boys didn't. See the blue one and the green one didn't." (AL-C20-2A, age 3;06, prenominal condition)
   c. "They didn't wanna get hurt, and one wanted to climb the tree." (AL-C19-3B, age 5;02, floated postnegation condition)
   d. "Because not all of them climbed the tree." (AL-C21-3A, age 5;08, floated postnegation condition)
   e. " 'Cause they don't want to and he does." (AL-C22-3A, age 3;07, floated postnegation condition)
   f. "They don't wanna fall." (AL-C23-3B, age 4;06, floated postnegation condition)

3.3. Summary

Experiment 1 allowed us to test for scope while manipulating only the relative surface word order of the quantificational element and sentential negation. Through the use of the floating quantifier *all*, we were able to hold constant the associated NP (in this case, the subject NP) as well as the test stories. When we hold constant these factors, we find that both adults and children display a preference for the isomorphic reading, whether the quantificational element precedes or follows negation. This finding of a preference for isomorphism in all three conditions for both children and adults is reminiscent of the findings reported in Musolino (1998) and Musolino & Lidz (2003). When all else is equal then, it appears that children and adults display a preference for the isomorphic reading. Note also that our finding cannot be explained by a general response strategy such as a preference for charitability, since the isomorphic reading corresponded to *yes*-responses in the prenominal and floated prenegation conditions, but to *no*-responses in the floated postnegation condition. Finally, the finding that children did not differ from adults in their interpretation of *all* (in any of the three positions) lends further support to the view that children and adults do not differ in their grammatical representations of such sentences.

4. EXPERIMENT 2

To investigate whether the finding for *all* could be generalized to other floating quantifiers, I conducted a modified version of Experiment 1 using the floating quantifier *both* instead of *all*. *Both* is generally grouped with *all* in discussions of floating quantifiers and is like *all* in that it can also appear in the three positions tested in Experiment 1, as shown in (12)–(14).

(12) Both the boys didn't climb the tree.
(13) The boys both didn't climb the tree.
(14) The boys didn't both climb the tree.

One difference between *both* and *all* is that *both* triggers a presupposition on the cardinality of the quantified NP, requiring exactly two members in the restrictor set (Barwise & Cooper 1981; Brisson 1998; Glanzberg 2008). To keep the method parallel with Experiment 1 while satisfying *both*'s presupposition in the test scenarios, I reduced the number of characters in each story from three to two. Control stories and test sentences were likewise modified to be about two characters rather than three.

4.1. Method

4.1.1. Participants

Participants in Experiment 2 were 47 English-speaking children and 56 adult native speakers of English. Adult participants were undergraduate linguistics/psychology students at the University of Connecticut and were paid $10 or received course credit for participating. Five child participants failed to pass at least three of the four control trials and were excluded from the analysis. I report here the data from the remaining 42 children (3; 10–6; 08, $M = 4$; 08) and the 56 adults.[6]

4.1.2. Procedure

This was a modified version of the TVJT used in Experiment 1. Participants listened to stories presented through pictures on a laptop computer, and had to judge the puppet's description of the sequence of events by filling out a scorecard. Follow-up justifications were again elicited following both *yes*- and *no*-responses. All participants were tested individually. Sessions were videorecorded for subsequent coding and analysis.

4.1.3. Materials

The stories and test sentences were parallel to those from Experiment 1, except that they involved two characters rather than three. In the critical test sentences, the plural subjects from

[6]Twenty-one of the 42 children also participated in Experiment 1. There was a temporal overlap in the two experiments, such that some children participated in the *both* experiment first, while others participated in the *all* experiment first. To minimize any contaminating effects between the two experiments, the two sessions were always spaced apart by at least five weeks (the average time elapsing between the two experiments was 9.5 weeks).

Experiment 1, e.g., *the boys*, were changed to conjunctive NPs, e.g., *Jack and Jill*. In each test story, only one of the two characters carried out the action, e.g., only Jack climbed the tree (15). The critical test sentences contained the floating quantifier *both* in one of three possible positions (prenominal/floated prenegation/floated postnegation). Just as in the case of *all*, with the quantifier in any of the three positions, the sentence was false on the WS reading of *both* but true on the NS reading.[7] As in Experiment 1, a WS reading corresponded to an isomorphic interpretation in the prenominal and floated prenegation conditions, but to a nonisomorphic interpretation in the floated postnegation condition.

(15) Story: In this story, Jack and Jill are outside on the playground, and they see a great big tree with lots of branches. It looks like it would be a lot of fun to climb. Jack climbs the tree all the way to the top. Jill says that it looks like a lot of fun, but she doesn't want to fall and hurt herself, so she won't climb the tree.
EXPERIMENTER: So we know that Jack and Jill wanted to climb the tree. Parrot, what happened in the story?
a. PUPPET: Both Jack and Jill didn't climb the tree. *Prenominal condition*
b. PUPPET: Jack and Jill both didn't climb the tree. *Floated prenegation condition*
c. PUPPET: Jack and Jill didn't both climb the tree. *Floated postnegation condition*

As in Experiment 1, I used a 2 × 3 design with group (child vs. adult) and quantifier position (prenominal vs. floated prenegation vs. floated postnegation, between subject) as factors. Participants were randomly assigned to one of the three test conditions. Each participant received four test and four control items, which were randomized and counterbalanced. Two of the control items corresponded to affirmative sentences containing the floating quantifier (prenominally in the prenominal condition, e.g., *Both Bo and Sue fed the pandas*; postnominally in the floated pre- and postnegation conditions, e.g., *Bo and Sue both fed the pandas*); two of the control trials corresponded to negative sentences that did not contain any floating quantifier (e.g., *Bo and Sue didn't feed any pandas*). Again, the control items could be associated with *yes*- or *no*-targets, which were chosen in such a way as to balance the overall number of *yes*- and *no*-responses from each participant. The list of test sentences is provided in the appendix.

4.2. Results

The dependent measure in the following analysis was the proportion of *no*-responses (which corresponded to isomorphic readings in the prenominal and floated prenegation conditions, and to nonisomorphic readings in the floated postnegation condition). The results of Experiment 2 are reported in Figure 3. A two-way ANOVA revealed no effect of group, $F(1, 92) = .005$, $p = .94$, a significant main effect of quantifier position, $F(2, 92) = 14.08$, $p < .001$, and no significant interaction, $F(2, 92) = 2.96$, $p = .057$. Participants gave significantly fewer *no*-responses overall

[7]Here it was slightly less clear that follow-up justifications would allow us to unambiguously tease apart the two readings. We expected follow-up justifications for *no*-responses (WS) to make reference to the character who had carried out the action (e.g., it's false that both of them failed to carry out the action because one of them did carry out the action). On the other hand, justifications for *yes*-responses (NS) might also make reference to the character who had carried out the action but highlight the fact that he was the only one who had done so (e.g., it's true that it's not the case that both of them carried out the action because only one of them did so).

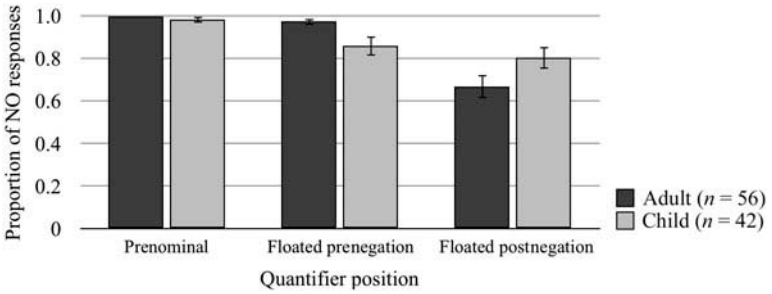

FIGURE 3 Proportion of *no*-responses by position of the quantifier *both*. Note that *no*-responses corresponded to isomorphic readings in the prenominal and floated prenegation conditions, and to nonisomorphic readings in the floated postnegation condition.

on the floated post-negation condition than on the prenominal and floated pre-negation conditions (Tukey HSD, both $p < .001$).

The proportions of *no*-responses indicate that both adults and children generally preferred isomorphic readings in the prenominal and floated prenegation conditions, but nonisomorphic readings in the floated postnegation condition. Put differently, participants showed a preference for the WS reading of *both* in all three conditions.[8]

Follow-up justifications for *no*-responses generally indicated access to the WS reading of *both*, as in (16). Justifications following *yes*-responses were slightly less clear (17), but one child used the focus particle *only* in her response, which would appear to support the NS reading.

(16) Justifications for *no*-responses
   a. "Well one of them did. So we have to put it on the wrong one." (B1-C39-1A, age 4;09, floated prenegation condition)
   b. "No. Because Jack climbed the tree." (B1-C41-3A, age 4;10, floated postnegation condition)
   c. "No. Jack climbed the tree." (B1-C43-3B, age 5;02, floated postnegation condition)

(17) Justifications for *yes*-responses
   a. " 'Cause that one didn't want to bump her head." (B1-C09-3A, age 4;05, floated postnegation condition)
   b. "Her pet the dinosaur but not the boy." (B1-C16-1B, age 4;10, floated prenegation condition)
   c. "Jack and Jill didn't climb the tree. Only Jack did." (B1-C42-1B, age 4;07, floated prenegation condition)

[8]An anonymous reviewer points out the relatively large age range of the children tested (3;10–6;08). In particular, there were seven children under the age of 4 years, 12 children between 4;00–4;05, 14 children between 4;06–4;11, and 9 children over the age of 5 years. A two-way ANOVA on the children's data revealed no effect of quantifier position, $F(2, 36) = 2.37$, $p = .11$, no effect of age, $F(1, 36) = .002$, $p = .96$, and no significant interaction, $F(2, 36) = .12$, $p = .89$.

5. Discussion

Experiments 1 and 2 demonstrate that it is possible to hold constant various factors such as test scenario and associated NP, while testing the comprehension of scopally ambiguous sentences. Moreover, they reveal that when these factors are held constant, children and adults pattern alike in their response patterns and interpretive preferences.

With respect to floating quantifiers, the findings of Experiment 2 raise further questions, as they suggest that floating quantifiers are not all alike. This may be unexpected; while there is still debate as to the nature of floating quantification, the line is usually drawn between expressions that can float and so-called true quantifiers that cannot (Brisson 1998), and not between *both* and *all*, given their inherent similarities. One question is therefore why adults and children preferred the inverse WS reading when *both* followed negation. Put differently, why do adults and children tend to interpret *both* as taking wide scope, no matter its surface position?

One might object that the finding is in part a consequence of the use of conjunctive NPs. In Experiment 1, we used definite plural NPs, e.g., *the boys*, while in Experiment 2 the test sentences named specific individuals. To further investigate the possibility that the use of conjunction might somehow have biased participants toward a WS reading of *both*, I ran a modification of Experiment 2, replacing the conjunctive NPs with definite plurals such as those used in Experiment 1:

(18) Experiment 2 test sentences, revised version:
   a. Both the boys didn't climb the tree.
      (*cf*. Both Jack and Jill didn't climb the tree.)
   b. The boys both didn't climb the tree.
      (*cf*. Jack and Jill both didn't climb the tree.)
   c. The boys didn't both climb the tree.
      (*cf*. Jack and Jill didn't both climb the tree.)

I conducted this follow-up condition with 32 adults, none of whom had participated in either Experiment 1 or Experiment 2. This modification, however, yielded virtually no change to the results (see Table 1); adults still displayed an isomorphic preference only in the prenominal and floated prenegation conditions.

In other words, *both* appears to give rise to a preference for WS readings, whether its associated NP is a definite plural or a conjoined NP.[9] One hypothesis about the underlying source of the

TABLE 1
Isomorphic Readings for *Both* with Definite Plural NPs

Quantifier Position	*% Isomorphic Reading*
Prenominal ($n = 11$)	100
Floated prenegation ($n = 10$)	100
Floated postnegation ($n = 11$)	29.55

[9] An anonymous reviewer points out that given that contextual manipulations have been shown to influence children's and adults' interpretations of scopally ambiguous sentences, perhaps we might be able to reverse the preferences observed

different scope profiles for *both* and *all* might be found in their discourse properties: Perhaps participants more readily interpreted *both*-NPs as topics, scoping over negation. In studies of indefinites, it has been argued that topicality is correlated with wide scope interpretation (see Endriss 2009 for discussion of topical indefinites). We were able to run parallel experiments using *both* and *all* because superficially they appear quite similar; they both can appear in three different positions relative to sentential negation and in principle should give rise to the same scope ambiguity. But as we have already noted in the discussion of the methodology, *both* is different in that it presupposes that the restrictor set contains exactly two members. It is possible that since the *both* stories contained only two characters, these characters were more likely to be viewed as topical. In the case of *all*, perhaps having three characters made it easier to gloss over the particular identities of the individuals that made up the group.

While identification of the factor responsible for the different scope profiles for *both* and *all* will require further research, the findings reported here indicate that young children are sensitive to this factor. The children we tested were adultlike in their interpretive preferences in the case of *all* and *both*. This finding of adultlike performance provides further evidence that children and adults do not differ in their grammatical representations of scopally ambiguous sentences and moreover suggests that the relevant factor behind the *both*/*all* asymmetry is one that is acquired relatively early.

In sum, I have used floating quantification as a methodological means to investigate scope ambiguity. Using floating quantifiers allows us to test the interpretation of scopally ambiguous sentences while keeping the associated NP and test scenarios constant (as well as the operations required to evoke WS readings of the associated NP). I have shown that when we keep these factors constant, children are very much adultlike in their interpretive preferences for *all*- and *both*-sentences. The observed preference for isomorphism in the case of all three positions of *all* compared to the WS preference for *both* still requires explanation, and I leave this to future work. While the use of floating quantifiers in this study was primarily methodologically driven, I expect that further investigation along these lines will shed light on the debate as to the mechanisms that underlie quantifier floating, as it reveals more fine-grained differences among different floating quantifiers. Crucially, for our purposes here, children do not appear to differ from adults in the representation of either floating quantifier.

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here for *both*. I agree with this speculation that with the right contextual manipulations, we might be able to prompt children and adults to show a preference for the nonisomorphic reading in the prenominal and floated prenegation conditions and for the isomorphic reading in the postnegation condition.

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APPENDIX: TEST ITEMS

Experiment 1

(i) Control sentences

a. The sisters all won a prize. / The sisters didn't win any prizes.
b. The boys all painted a picture. / The boys didn't paint any pictures.
c. The girls all fed the pandas. / The girls didn't feed the pandas.
d. The brothers all rode the skateboard. / The brothers didn't ride the skateboard.

(ii) Prenominal condition

a. All the sisters didn't eat the pizza.
b. All the boys didn't climb the tree.
c. All the girls didn't pet the dinosaur.
d. All the brothers didn't wear mittens.

(iii) Floated prenegation condition

a. The sisters all didn't eat the pizza.
b. The boys all didn't climb the tree.
c. The girls all didn't pet the dinosaur.
d. The brothers all didn't wear mittens.

(iv) Floated postnegation condition

a. The sisters didn't all eat the pizza.
b. The boys didn't all climb the tree.

c. The girls didn't all pet the dinosaur.
d. The brothers didn't all wear mittens.

Experiment 2

(i) Control sentences

a. Joe and Sam both won a prize. / Joe and Sam didn't win any prizes.
b. Jack and Jill both painted a picture. / Jack and Jill didn't paint any pictures.
c. Bo and Sue both fed the pandas. / Bo and Sue didn't feed the pandas.
d. Bill and Mo both rode the skateboard. / Bill and Mo didn't ride the skate-board.

(ii) Prenominal condition

a. Both Joe and Sam didn't eat the pizza.
b. Both Jack and Jill didn't climb the tree.
c. Both Bo and Sue didn't pet the dinosaur.
d. Both Bill and Mo didn't wear mittens.

(iii) Floated prenegation condition

a. Joe and Sam both didn't eat the pizza.
b. Jack and Jill both didn't climb the tree.
c. Bo and Sue both didn't pet the dinosaur.
d. Bill and Mo both didn't wear mittens.

(iv) Floated postnegation condition

a. Joe and Sam didn't both eat the pizza.
b. Jack and Jill didn't both climb the tree.
c. Bo and Sue didn't both pet the dinosaur.
d. Bill and Mo didn't both wear mittens.