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Searching for Absolute and Relative Readings of Superlatives: A Second Experiment

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1. Introduction

In this paper, we consider the acquisition of complex superlative expressions such as (1) and (2), which contain a *by*-phrase modifying the superlative object noun phrase (NP). Such sentences have been claimed to have up to three possible readings, the distribution of which varies across languages.

- (1) Sam bought the tallest painting by Nick.
- (2) Billy painted the smallest sculpture by Jill.

In this paper, we are interested in whether young children are sensitive to the ambiguity of such expressions. We begin by introducing the possible readings of sentences such as (1) and (2), as well as the basic derivations that we assume for these readings. We then examine some spontaneous production data, to see what kinds of superlatives young children and their caregivers produce. Moving on to children's comprehension of superlatives, we then present the results of an experiment designed to test English-speaking children's interpretations of such superlative expressions.

2. The ambiguity of superlatives

Sentences containing superlative expressions such as (3) are ambiguous. Up to three readings can be found cross-linguistically, and these differ in what is taken to be the relevant comparison class (Pancheva & Tomaszewicz 2012). For the ab-

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solute (ABS) reading in (3a), the comparison class contains paintings produced by Picasso. For the so-called relative reading with NP-external focus (REX) in (3b), the comparison class contains individuals who purchased paintings by Picasso. Finally, for the relative reading with NP-internal focus (RIN) in (3c), the comparison class contains individuals who produced paintings purchased by Sally.

(3) Sally bought the biggest painting by Picasso.

- a. *Absolute reading* (ABS):
Of the paintings produced by Picasso, Sally bought the biggest one.
- b. *Relative reading with NP-external focus* (REX):
Of the people who bought paintings by Picasso, it was Sally who bought the biggest one (and not some other buyer).
- c. *Relative reading with NP-internal focus* (RIN):
Of the paintings purchased by Sally, the biggest one was produced by Picasso (and not by some other painter).

In English, both the ABS and REX readings are available; in contrast, the RIN reading is unavailable. In a language such as Polish, however, all three readings are attested (Pancheva & Tomaszewicz 2012). The generalization appears to be that the ABS and REX readings are universally available, while the RIN reading is available only in languages without articles, i.e. NP-languages.

Let us consider the basic derivations for each of the readings in (3). Rather than fully spelling out the analyses that have been proposed, we will simply provide the basic ingredients, and direct the reader to Heim (1999), Pancheva & Tomaszewicz (2012), and Shen (2014, to appear) for details.

Consider first the ABS reading. Heim (1999) proposes the following denotation for the superlative morpheme *-est*:

$$(4) \quad \llbracket \text{est} \rrbracket = \lambda C_{\langle e, t \rangle} \cdot \lambda D_{\langle d \rangle} \cdot \lambda x_e \cdot \exists d [D(d)(x) \& \forall y [y \in C \& y \neq x \rightarrow \neg D(d)(y)]] \\ \text{est}(C)(D)(x) \text{ is defined iff (i) } x \in C \text{ and (ii) } \forall y [y \in C \& \exists d [D(d)(y)]]$$

Based on this, the denotation of a phrase like *the biggest painting by Picasso* is as in (5).¹

$$(5) \quad \llbracket \text{the biggest painting by Picasso} \rrbracket = \lambda x \cdot \exists d \text{ s.t. } x \text{ is } d \text{ big } \& \forall y. y \in C \text{ and } y \neq x \rightarrow y \text{ is not } d \text{ big } \& x \text{ is a painting } \& x \text{ is by Picasso.} \\ \text{Presupposition: (i) } x \in C; \text{ (ii) } \forall y [y \in C \& \exists d [BIG(d)(y)]]$$

The contextual variable C corresponds to the set of paintings by Picasso, and the absolute reading follows straightforwardly.

Next, consider the REX reading. Szabolcsi (1986) and Heim (1999) propose a movement/scope account, on which the REX reading is derived from the movement of the DegP and of the focused element. The focused element (i.e. the

¹For simplicity, we will assume that the definite article in superlative expressions functions as an existential quantifier.

subject NP *Sally* in our example) moves to a higher position, before the *DegP* moves to tuck in below the focused subject, as shown in (6).² Here, the value of *C* corresponds to the set of individuals who bought a painting by Picasso.

(6) $[\text{Sally}_1 [[\text{DegP EST C}] [\neg \text{S} [t_1 \text{ bought the } [\text{AP } t_{\text{DegP}} \text{ big}] \text{ painting by Picasso}]]]]$
 ‘Sally is *x* such that there is a degree *d*, such that *x* bought the *d*-big painting by Picasso, and no one else bought a *d*-big painting by Picasso’

Finally, consider the *RIN* reading. On Pancheva & Tomaszewicz’s (2012) analysis, relative readings require movement of both the focused element and the *DegP* out of the NP. For the *RIN* reading, it is the PP *by Picasso* that is focused, and thus both the PP and *DegP* must move out of the NP, as in (7).

(7) $[[\text{PP}_F \text{ by Picasso}] [[\text{DegP EST-C}] [\neg \text{S} [\text{Sally} \text{ bought the } [\text{NP } [\text{AP } t_{\text{DegP}} \text{ big}] [\text{NP } [\text{NP painting}] t_{\text{PP}}]]]]]]$

Recall that this last reading is available only in NP languages. Shen (2014, to appear) derives the cross-linguistic variation in the availability of the *RIN* reading by appealing to the interaction between locality constraints and the nominal structure of a language. While we will not go into the details of the analysis here, the crux of the proposal is the following. In order to derive the LF for the *RIN* reading, movement of the focused PP is required. The relevant difference between NP and DP languages comes down to the possibility of this movement: extraction of the PP violates locality constraints in DP languages, but not in NP languages (see Bošković 2005, among others, for the details of the relevant constraints). Since the movement required to derive the *RIN* LF is impossible in English, the *RIN* reading is unavailable.

3. Acquisition of superlative adjectives

Most acquisition studies examining the development of superlatives have focused on when superlative morphology emerges, either compared to other degree constructions (Hohaus & Tiemann 2009; Berezovskaya 2013) or to other grammatical suffixes like plural marking (Warlaumont & Jarmulowicz 2012).³ Such corpus studies reveal that superlatives emerge relatively late in spontaneous production. Hohaus & Tiemann (2009) report that superlatives emerged between 4;01 and 4;08 for three English-speaking children, and between 3;07 and 4;05 for three German-speaking children. Berezovskaya (2013) reports the emergence of superlatives at 4;06 and 5;04 for two Russian-speaking children. These stud-

²See Heim (1999), Farkas & Kiss (2000), and Sharvit & Stateva (2002) for an alternative in situ account that derives the *REX* reading without movement.

³We do not address the acquisition of quantity superlatives such as *most*; see Wellwood et al. (To appear) and Wellwood et al. (2012) for work on how children acquire the quantity-based meanings of such superlative determiners.

ies also reveal that superlatives emerge after comparative morphology has already been acquired, and that there are generally few errors in children's spontaneous production of superlatives.

As suggested by the data we discussed in the last section, however, there is more to be acquired than target-like production of the superlative morphology. In particular, given the different readings that are available cross-linguistically, it is worth asking what interpretations children are capable of assigning to the superlative.

We might first look to spontaneous production data for an answer. An examination of the Brown corpus (Brown 1973) on the CHILDES database (MacWhinney 2000) reveals instances of the absolute reading for superlatives.⁴ Examples include the following:

(8) he's the funniest baby I ever had. *(Adam, 4;02,17)*
(9) he's just the silliest boy in de [: the] whole wide world *(Adam, 4;06,24)*

An examination of the caregiver input within the Brown corpus also reveals what is primarily evidence for the absolute reading of superlatives. It may therefore not be surprising that children's first superlatives involve the absolute reading.

Given the absence of relative readings in the children's production, however, these corpus data cannot tell us anything about children's knowledge with respect to the REX and RIN readings. We therefore set out to investigate experimentally whether English-speaking children are capable of accessing the ABS and REX readings of superlatives, while simultaneously disallowing the RIN reading.

4. Experiment

4.1 Participants

Sixteen English-speaking children (3;06-6;04, M=4;09) participated in our experiment. They were recruited and tested in local daycares near the University of Connecticut. Thirty-eight English-speaking adults also participated in the experiment. The adult participants were undergraduate students at the University of Connecticut, and received course credit for participating.

4.2 Procedure

We used a Truth Value Judgment Task (Crain & Thornton 1998, 2000) to test participants' comprehension of sentences containing adjectival superlatives. Participants were presented with a series of short stories made up of clipart images and presented in Powerpoint. A puppet would appear in pre-recorded videoclips throughout the presentation, to create the ruse that she was participating live via

⁴We examined the preceding and following discourse context of the superlatives in order to determine the intended reading.

webcam. At the end of each story, the puppet was asked to describe what had happened, and participants had to decide whether she was right or wrong. In addition to providing verbal responses, all participants also filled out a scorecard. Children indicated their responses by placing a stamp in the ‘happy face’ column vs. the ‘sad face’ column of their scorecard. Each participant saw two training items, followed by a total of eighteen test trials, presented in pseudo-randomized and counterbalanced order.

4.3 Materials

Stories revolved around a set of animal characters preparing for an arts fair. There were two recurring builder characters, Penguin and Monkey, whose job was to build a variety of objects to be painted (walls, windows, guitars, boxes, fences, doors, violins, pianos, houses, coatracks, vases, bowls, tables, chairs, lamps, and benches). There were also three painter characters, Giraffe, Ladybug, and Bunny, whose job was to paint some of the objects that the builders produced. In each story, the painters would paint a select subset of the objects; we manipulated which objects were painted to make the various readings of the superlative true or false.

ABST.REXF trials

Each participant saw a total of two ABST.REXF trials. In this condition, the stories made the ABS reading true and the REX reading false. As an example, in one story, the three painters had to paint some guitars produced by the two builders. Of the entire set of six guitars, all three painters painted the same guitar, namely the smallest one produced by Monkey (see Figure 1). In this scenario, the sentence *Giraffe painted the smallest guitar by Monkey* is true on the ABS reading, because he did indeed paint the smallest guitar that was made by Monkey. The REX reading is false, however, because of all the painters, it is false that Giraffe painted the smallest guitar (they all painted the same one).

ABST.RINF trials

Each participant saw a total of two ABST.RINF trials. In this condition, the stories made the ABS reading true and the RIN reading false. As an example, in one story, Giraffe had to paint some walls built by the two builders. Of the entire set of six walls, three of which were built by Penguin and three of which were built by Monkey, Giraffe painted two of Penguin’s and one of Monkey’s (see Figure 2). In this scenario, the sentence *Giraffe painted the shortest wall by Penguin* is true on the ABS reading, because he did indeed paint the shortest wall that was produced by Penguin. The RIN reading is false, however, because of the walls that he painted, the shortest was not built by Penguin (rather, it was built by Monkey).

RINT.ABSF trials

Each participant saw a total of three RINT.ABSF trials. In this condition, the stories made the RIN reading true and the ABS reading false. As an example, in one story, Ladybug had to paint some fences built by the two builders. Of the entire set of six fences, three of which were built by Penguin and three of which were built by Monkey, Ladybug painted two of Penguin's and one of Monkey's (see Figure 3). In this scenario, the sentence *Ladybug painted the shortest fence by Monkey* is true on the RIN reading, because of the fences she painted, the shortest one was indeed produced by Monkey. The ABS reading is false, however, because Ladybug did not paint the shortest fence that was built by Monkey.

REXT.ABSF trials

Each participant saw a total of three REXT.ABSF trials. In this condition, the stories made the REX reading true and the ABS reading false. As an example, in one story, the three painters had to paint some pianos built by the two builders. Of the entire set of six pianos, four of which were built by Penguin and two of which were built by Monkey, each painter painted one of Penguin's pianos (see Figure 4). In this scenario, the sentence *Bunny painted the smallest piano by Penguin* is true on the REX reading, because of all the painters who painted pianos by Penguin, Bunny painted the smallest one. The ABS reading is false, however, because Bunny did not paint the absolute smallest piano that was built by Penguin.

Control trials

In addition to the ten test trials, participants also saw four control trials. Two corresponded to sentences containing the superlative without the *by*-phrase, e.g., *Bunny painted the shortest table*. The other two corresponded to sentences containing the *by*-phrase but no superlative, e.g., *Ladybug painted a vase by Penguin*.⁵ The purpose of these trials was to control for children's knowledge of the superlative and the *by*-phrase independently of each other. Participants had to answer correctly on at least three of these four control trials to be included in the analysis.

4.4 Results

Control conditions

Adults and children performed well on control trials. All participants answered correctly on at least three of four control trials. Adults' and children's accuracy on ABS and *by*-phrase controls are reported in Figure 5.

⁵There were two additional 'REX' control trials, but these were problematic and yielded unexpected responses from adults, so we excluded them from the analysis and do not discuss them here.



Figure 1: Example ABST.REXF item: image accompanying the test sentence *Giraffe painted the smallest guitar by Monkey*.



Figure 2: Example ABST.RINF item: image accompanying the test sentence *Giraffe painted the shortest wall by Penguin*.



Figure 3: Example RINT.ABSF item: image accompanying the test sentence *Ladybug painted the shortest fence by Monkey*.

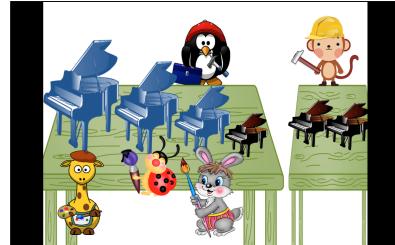


Figure 4: Example REXT.ABSF item: image accompanying the test sentence *Bunny painted the smallest piano by Penguin*.

REX-ABS conditions

Results from the ABST.REXF and REXT.ABSF conditions are reported in Figure 6. A two-way ANOVA on the REX/ABS data revealed a significant main effect of condition ($F(1, 104) = 52.42, p < .001$), no effect of group ($F(1, 104) = .04, p = .84$), and a significant interaction ($F(1, 104) = 21.09, p < .001$). Adults provided significantly more *yes*-responses in the ABST.REXF condition than in the REXT.ABSF condition (Tukey HSD, $p < .001$). In other words, they showed a strong preference for the ABS reading, accepting the test sentences when the ABS reading was made true, but rejecting the test sentences when the ABS reading was made false. Children's performance, on the other hand, did not differ significantly between the two conditions.

Adults were also significantly more accepting than children in the ABST.REXF condition (Tukey HSD, $p < .05$). This appears to be due in part to some children ignoring the *by*-phrase, and accessing an ABS reading where the comparison set included all six objects rather than just the three by the relevant builder, e.g., *Ladybug painted the biggest box (of all six boxes)*. This reading was supported by justifications for *no*-responses such as the following, with the child gesturing to

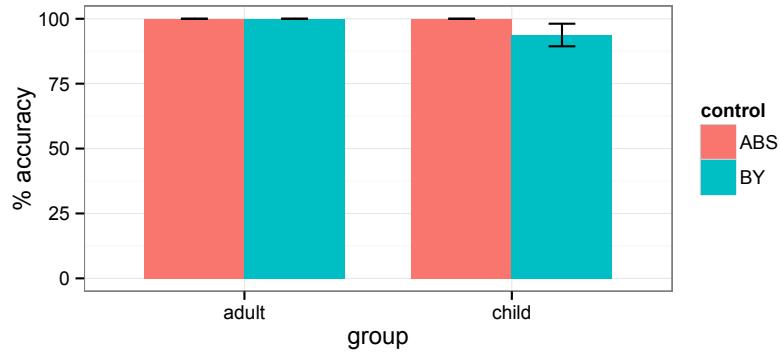


Figure 5: Performance on ABS and *by*-phrase controls.

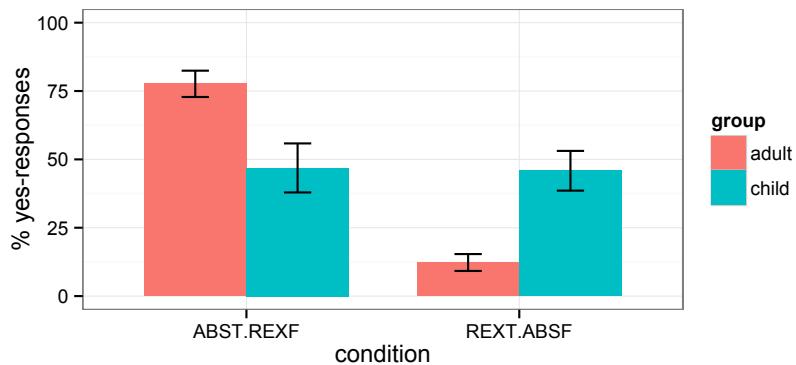


Figure 6: Percentage of *yes*-responses on ABST.REXF and REXT.ABSF conditions.

the largest of the six boxes in the picture:

(10) “She’s being silly. ‘Cause that’s the biggest box.” (*SUP4-C09, age 3;06*)

On the REXT.ABSF condition, however, children were significantly more accepting than adults (Tukey HSD, $p < .01$). When children gave *yes*-responses in this condition, they provided justifications such as the following:

(11) “Cause that– Bunny painted that one and it’s smallest by Penguin.” (*SUP4-C02, age 4;09*)

When we compare the ABST.REXF and REXT.ABSF conditions, children as a group

do not appear to distinguish the two conditions. Indeed, seven of the 16 children showed an inconsistent response pattern, providing both *yes*- and *no*-responses in both conditions. Some consistent response patterns can be observed, however, based on the individual responses; these are summarized in Table 1.

Response pattern (ABST.REXF – REXT.ABSF)	Characterization	n
<i>yes – yes</i>	charity	3
<i>no – yes</i>	REX preference	2
<i>yes – no</i>	ABS preference	1
<i>no – no</i>	ABS (of 6)	3
mixed	inconsistent	7

Table 1: Patterns of children’s responses to ABST.REXF and REXT.ABSF trials. *Yes* and *no* characterizations were based on consistent responses to both ABST.REXF trials and to at least two of the three REXT.ABSF trials. For example, a child who said *yes* on both ABST.REXF trials and *yes* on at least two of the three REXT.ABSF trials was characterized as *charitable*.

RIN-ABS conditions

Results from the ABST.RINF and RINT.ABSF conditions are reported in Figure 7. A two-way ANOVA on the RIN/ABS data revealed a significant main effect of condition ($F(1, 104) = 176.16, p < .001$), no effect of group ($F(1, 104) = 2.00, p = .16$), and a significant interaction ($F(1, 104) = 47.54, p < .001$). Adults generally disallowed the RIN reading, accepting the test sentences only when the ABS reading was made true.

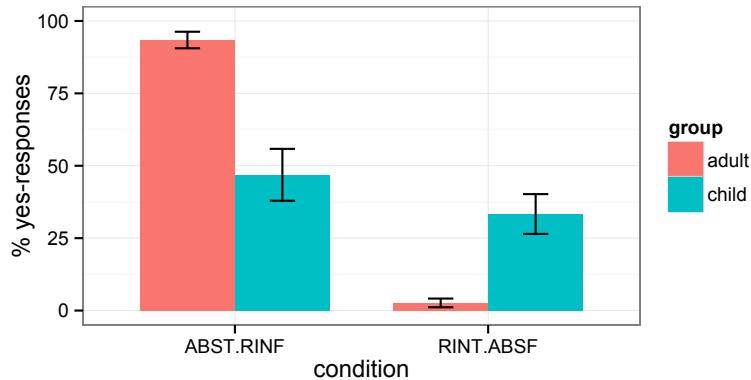


Figure 7: Percentage of *yes*-responses on ABST.RINF and RINT.ABSF conditions.

Some children were adult-like in rejecting the RINT.ABSF trials. These children provided justifications that were consistent with the ABS reading. For example, the child who provided the justification in (12) pointed out that the tallest door by Penguin that Giraffe had painted was not in fact the absolute tallest produced by Penguin:

(12) “That’s the mediumest.” (SUP4-CHI-C02, age 4;09)

Despite some adult-like responses, however, children as a group provided significantly more *yes*-responses than adults in the RINT.ABSF condition (Tukey HSD, $p < .01$). Moreover, five of the 16 children accepted on at least two of the three RINT.ABSF trials.

Children also gave fewer *yes*-responses than adults on the ABST.RINF condition (Tukey HSD, $p < .001$). However, this was due again in part to some children disregarding the *by*-phrase and accessing an ABS reading of the superlative where the comparison set included all six objects.

Comparing these two conditions, we see that children as a group show no particular preference for one reading over the other, unlike adults. Indeed, five of the 16 children showed an inconsistent response pattern, providing both *yes*- and *no*-responses in both conditions. Individual responses, however, also reveal some consistent response patterns, summarized in Table 2.

Response pattern (ABST.RINF – RINT.ABSF)	Characterization	n
<i>yes – yes</i>	charity	2
<i>yes – no</i>	adult-like ABS preference	3
<i>no – yes</i>	non-adult-like RIN preference	1
<i>no – no</i>	ABS (of 6)	5
<i>mixed</i>	inconsistent	5

Table 2: Patterns of children’s responses to ABST.RINF and RINT.ABSF trials. *Yes* and *no* characterizations were based on consistent responses to both ABST.RINF trials and to at least two of the three RINT.ABSF trials. For example, a child who said *yes* on both ABST.RINF trials and *yes* on at least two of the three RINT.ABSF trials was characterized as *charitable*.

5. Discussion

The experimental results from our adult participants show a clear preference for the ABS reading; however the REX reading was also attested, while the RIN reading was generally disallowed. In contrast, children did not display such clearly identifiable interpretive preferences.

It is clear that children can access the ABS reading. This is not a very surprising finding, given the observed evidence for the ABS reading in the caregiver input

samples. Some children also demonstrated access to REX readings. In fact, about a third of the children were either charitable responders, accepting test sentences on the REX reading, or displayed a preference for the REX reading. This is in contrast to the behavior of adults, only one of whom accepted all three REXT.ABSF trials. Our results show that the subset of children who consistently accepted the test sentences on the REX reading are apparently non-adult-like in this behavior. The results moreover suggest that these children must eventually override their preference for the REX reading.

Perhaps even more surprising is the finding that about a third of the children tested also appeared to allow the RIN reading, an interpretation ruled out by the adult grammar. In principle, and based on the caregiver data we examined, children receive no evidence for the availability of a RIN reading in their input. If children do go through a stage where their grammar allows the RIN reading (a relatively late stage, given we tested 4-year-olds), it is not at all clear what evidence they would encounter in the input that could trigger the expunction of this reading.

A further observation may be relevant here. We were able to elicit justifications for children's responses on control trials, as well as on test trials where they appeared to access the ABS reading. Where children gave responses consistent with the RIN reading, however, we were not able to elicit any clear justifications that indicated unambiguously that the child was indeed accessing the RIN reading. For this reason, we take cautiously the finding of RIN readings in the children.

Finally, some of the children we tested consistently accessed an ABS reading where the comparison set contained all six objects. These children essentially ignored the *by*-phrase in the test sentences. Based on performance on the control trials, we know that the children had no problems interpreting the superlative alone and the *by*-phrase alone. However, when the two phrases appeared together, perhaps the resulting sentences were too complex for these children to handle, and thus they simply dropped the *by*-phrase, which appeared last in the test sentences.

Another possibility is that these children used a kind of “conjunctive” strategy according to which a sentence such as *Giraffe painted the shortest wall by Penguin* was re-interpreted along the lines of: “Giraffe painted the shortest wall and it was by Penguin” (see Arii et al. 2014 for a similar suggestion in the domain of comparatives). Evidence for this latter strategy might be seen in the following justification:

(13) “Silly. Because the smallest one is right there. She thought it's by Penguin, but it's not there.” (SUP4-CHI-05, age 5;04)

Regardless of the underlying source of this pattern of behavior, a solution to the problem of the *by*-phrase may be to use a possessive structure such as the following:⁶

(14) Giraffe painted Penguin's shortest wall.

⁶Thanks to Alexis Wellwood for this suggestion.

Such a structure avoids the complication of the *by*-phrase at the end of the sentence, but still exhibits the same interpretive restrictions as the sentences we tested in our experiment. Importantly, it also gives rise to the ABS and REX readings but not the RIN reading. We leave an investigation of children's comprehension of such structures to future research.

6. Conclusion

In this paper, we examined the acquisition of adjectival superlatives such as *the biggest painting by Monkey*. We first saw evidence that children can produce superlatives with absolute meanings around the age of four years. It was not surprising that children could access absolute meanings of such adjectival superlatives, given the corpus data reveal that parental productions of adjectival superlatives also involve absolute meanings. But the spontaneous production data were not sufficient to indicate whether children could also access either of the relative readings. In particular, spontaneous production data don't allow us to determine whether children allow ABS and REX readings while disallowing the RIN reading. We thus designed an experiment to investigate the availability of the three readings, the results of which reveal evidence for all three readings in 4-year-olds.

This experiment has been one attempt to better understand children's sensitivity to the different interpretations of complex superlative expressions. Further investigation is required to better assess whether the RIN reading is genuinely available to children, and if so, how they eventually acquire the restriction against this reading.

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