Picking up after Sloppy Children:
What Pronouns Reveal about Children's Analysis of
English Comparative Constructions

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1. Introduction and Background

The ability to form comparisons between the objects of the world is a basic aspect of human cognition. Natural languages reflect this fact: all languages have syntactic categories that express gradable concepts, and all have designated comparative constructions. However, languages differ in the morphosyntax dedicated to expressing comparisons (Beck et al. 2009; Dixon 2008; Dryer & Haspelmath 2013).

Since Bresnan's (1973, 1975) seminal work on the syntax of the comparative clause construction in English, much research has been done in cross-linguistic investigations of the syntax and semantics of comparatives, such as the examples in (1).

(1) a.   Lady Edith has had fewer suitors than Lady Mary.
     b.   More gentlemen came calling for Lady Mary than for Lady Edith.

Some of this research has addressed comparative morphology (e.g., the English bound morpheme *-er*, the Spanish free morpheme *mas*, or the lack thereof in Japanese), some has addressed the underlying syntactic structures of comparatives, while still other research has addressed interpretational differences in comparatives (Hackl 2000; Heim 1985; Kennedy & Merchant 2000; Lechner 2001; Merchant 2009; Schwarzschild 2008; among many others). The picture that has emerged is that while there may be a core set of principles for making comparisons, there is not one unified representation or morphosyntactic inventory that exists for encoding comparisons across languages—far from it.

Thus, the challenge that the language learner confronts is to learn how to form comparatives in the specific language(s) s/he is acquiring. This challenge is similar to the one posed by event representations: while all languages allow speakers to talk about events that have already occurred, those that are currently transpiring, and those that have yet to occur, as well as how events relate to each other, they have different morphology and structures for expressing these distinctions. Thus, just as children experience a learning curve in expressing tense and aspect when describing events, we might also expect for them to have similar difficulty when making comparisons, since in both cases, there is a language-specific overlay on top of a (presumably universal) linguistic and conceptual core.

Indeed, a number of developmental studies over the years probing children's comprehension and production of comparative constructions have documented a prolonged developmental process in the acquisition of adult-like comparative forms, chock-full of surprising deviations along the way (Arii, Syrett, & Goro 2014; Bishop & Bourne 1985; Donaldson & Wales 1970; Finch-Williams 1981; Gathercole 1979, 2009; Graziano-King & Cairns 2005; Hohaus et al. 2014; Layton & Stick 1979; Syrett *to appear*, a.o.) These studies have provided us with invaluable information about how children diverge from adults in their interpretation and formation of comparatives (mostly in English, although some studies have probed languages such as German and Japanese).

For example, records of children's *production* of comparatives in English spontaneous speech have shown that children differ markedly from adults in a variety of ways, including double-marking in which both the comparative morpheme and the periphrastic *more* appear, as in (2); the use of the comparative standard marker *than* without an adjective marked with a comparative morpheme, as in (3); an incorrect form of the standard marker, as in (4), and so on.

(2) And then I grow **more** older, and **more** older, and **more** older.
    Olga 3;7 (Feider 1973)
(3) Yeah, and Joey will get there **first than** Jason. Jason is a slowpoke.
    Abe 3;8 (Kuczaj 1976)
(4) She's just a silly dog **that you ever saw**.
    Adam, 4;7 (Brown 1973; cited in Moore 1999)

Children's *interpretations* of English comparatives also diverge from those of adults' in rather peculiar ways. This deviation appears to stem primarily from their non-adult-like command of certain components of a comparative construction. For example, several studies have shown that children may overlook or fail to integrate an explicitly provided linguistic standard of comparison (Arii, Syrett, & Goro 2014; Bishop & Bourne 1985; Donaldson & Wales 1970, a.o.).
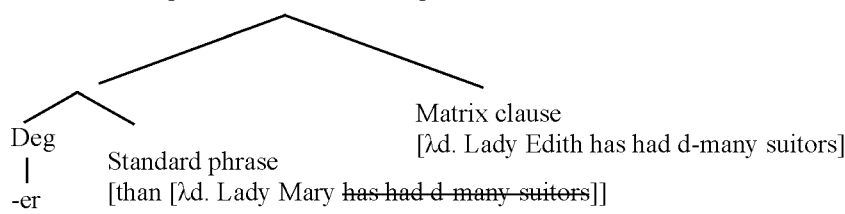
It is perhaps not surprising that children might arrive at a non-adult interpretation, given the inventory of key components that are claimed by

theoreticians to be involved in the formation of an English comparative. We note four main components here. Each of these areas presents an opportunity for children's production and/or interpretation to break down.

(5) a. The Comparative Morpheme
    b. Ellipsis
    c. Quantifier Raising (QR)
    d. Structural relations within the comparative

First, it has been proposed (Bhatt & Takahashi 2011, Lechner 2001, 2004) that the comparative morpheme –er in English is a two-place argument that takes two clauses and requires the reduction (i.e., deletion) in one of them. Thus, all English comparatives are claimed to be clausal (rather than phrasal) in terms of their underlying structure. Second, within this elided material, there is claimed to be lambda abstraction with a degree variable, allowing for a comparison of degrees (or amounts) between the content in the main clause and the content in the standard (the material from *than* onward). Importantly, this degree phrase must undergo Quantifier Raising (QR) for interpretation at Logical Form (LF). QR is the covert counterpart of *wh*-movement, responsible not only for covert displacement of quantifiers in the abstract structure of a sentence, but also – relevant to our present purposes – the obligatory displacement of degree phrases. These components are illustrated in (6) for the comparative presented earlier in (1a).

(6) Abstract representation of the comparative in (1a)

Deg

|

-er

Standard phrase
[than [λd. Lady Mary ~~has had d-many suitors~~]]

Matrix clause
[λd. Lady Edith has had d-many suitors]

Finally, because of the structural relation between the main clause and the standard and relations that subsequently hold at LF, structural principles such as Principle C may apply, constraining the possibly interpretations, notably coreferentiality.

Taken together, these aspects of a comparative feed into judgments of comparative constructions in which there is pronominal reference, as in (7)-(8) (where (a) is the sentence itself, (b) shows the elided material, and (c) shows the position of the degree phrase after QR).

(7) a. *More people introduced **him**$_i$ to Sally than to **Peter**$_i$**'s** sister.
    b. Ellipsis under identity
       *More people introduced **him**$_i$ to Sally
       than ~~λd. d-many people introduced~~ **him**$_i$ to **Peter**$_i$**'s** sister
    c. QR of degree phrase
       [-er than ~~λd. d-many people introduced~~ **him**$_i$ to **Peter**$_i$**'s** sister]
       λd. d-many people introduced him$_i$ to Sally
(8) a. More people introduced Sally to **him**$_i$ than **Peter**$_i$**'s** sister
    b. Ellipsis under identity
       More people introduced Sally to **him**$_i$
       than ~~λd. d-many people introduced~~ **Peter**$_i$**'s** sister ~~to **him**$_i$~~
    c. QR of degree phrase
       [-er than ~~λd. d-many people introduced~~ **Peter**$_i$**'s** sister ~~to **him**$_i$~~]
       λd. d-many people introduced Sally to him$_i$

Both of these examples involve a pronoun and a proper name that are intended to stand in coreference. However, there is a contrast between the examples, as a result of the position in which the pronoun *him* and the name *Peter* occur in the structure. (7) is claimed to involve a Principle C violation in the reconstructed elided part of a comparative (Bhatt & Takahashi 2011).

This set of elements that forms the basis for the grammatical mechanisms implicated in comparatives, paired with the above contrast in judgments claimed in the theoretical literature, are the motivation for the current investigation. In this work, we seek to determine whether children are able to interpret comparative constructions such as those above, and whether they are constrained by the same set of grammatical elements that constrain adults' interpretation of these comparative expressions. Before moving on, however, we should first establish what we know about children's competence with respect to (5b-d) (Ellipsis, QR, structure and Principle C) outside of comparatives.

With respect to ellipsis, studies have shown that by the age of 4, children correctly interpret instances of Verb Phrase Ellipsis, and are sensitive to structural constraints on the elided material (Foley et al. 1997, 2003; Kiguchi & Thornton 2004; Matsuo & Duffield 2001; Postman et al. 1997; Syrett & Lidz 2009, 2011; Thornton & Wexler 1999, a.o). However, one important question that this previous line of work has not addressed is how familiar children are with identity constraints on the elided material in comparatives. The answer to that question is relevant to the current research. We have robust evidence by now that children display competence with respect to the QR operation by age four, in tasks with other constructions that involve this operation (e.g., interpretation of the universal quantifier, scopal interaction among operators, Antecedent Contained Deletion, etc.) (Kiguchi & Thornton 2004; Lidz et al. 2004; Sugawara et al. 2013; Syrett *under review*; Syrett & Lidz 2009, 2011). Thus, we have reason to think they can deploy this operation with comparatives, and that this might not be the source of the difficulty—although we are not aware of any study that has systematically compared children's ability to

perform QR in comparative and non-comparative constructions. Finally, children demonstrate an understanding of c-command and the consequences it has for the application of binding Principle C (Crain 1991; Crain & McKee 1986; Crain & Thornton 1998; Grodzinsky & Reinhart 1993; Guasti & Chierchia 1999/2000; Kazanina 2005; Lidz & Musolino 2002; a.o.).

Putting all of these pieces together, then, it seems that children have the piecemeal grammatical capacity to interpret these comparatives, although as of yet, no study has investigated children's interpretation of comparative constructions, which require them to work in concert to constrain the set of possible interpretations. We therefore decided to target constructions analogous to those put forward in Lechner (2004) and Bhatt and Takahashi (2011), similar to those in (7)-(8), in which the identity relations based on pronominal reference in the elided material constrain the interpretation of the pronoun. Our goal was to determine if both children and adults obeyed these constraints, and if they shared the same interpretation of these constructions. If not, then a further goal is to identify the source of the deviation between the two groups, based on (5).

We present the results of an experiment that reveals that while children are capable of assigning an interpretation to basic comparatives without coreferential pronouns in the elided material, they diverge from adults precisely in the assignment of reference to a pronoun appearing in the standard. This study therefore sheds new light on the components of children's linguistic representations and their developing interpretation of comparatives. We close by discussing possible account for this set of results appealing to binding principles and the representation of the elided pronoun.

2. Experiment
2.1. Participants

26 children (8 boys, 18 girls) participated (range: 4;6-6;5, mean: 5;2). Children were recruited from area preschools and tested in a quiet room on the premises. Children were compared with 28 English-speaking adult controls (undergraduates at Rutgers University who received course credit for their participation). All participants were native speakers of English.

2.2. Design

The procedure involved a combination of a TVJT (Crain & Thornton 1998) and an Act-Out Task. Control items were either one or the other, while test items had the structure of a TVJT right up until the end of the story plot, and then called upon the participant to act out the remainder of the story, as described below. The participants were first presented with a brief training session that consisted of one TVJT and one Act-Out Task, familiarizing them with the testing procedure. Following the training session, they proceeded to the test session proper, which consisted of 4 controls and 5 target stimuli presented in a pseudorandomized order. Stimuli involved toys and small props representing

characters familiar to preschoolers. One experimenter manipulated the objects, while a second experimenter played the role of a puppet, who watched the stories alongside the child, and asked the child to respond to the target sentences (either by acting out the scenario ending or rendering a judgment). Each experimental session lasted approximately 30-40 minutes.

Control items were designed to elicit judgments of simple subject and object comparatives ((9)-(10)), as well as judgments of a binding relationship based on Principle C in a non-comparative clause ((11)-(12)), as a baseline.

(9) More cars drove into the town than into the woods.
(10) Sheriff Woody fed more bear cubs than Jessie.
(11) *He$_i$ ate the cake, while the Smurf$_i$ was dancing. (Crain & Thornton, 1998)
(12) *Sebastian found a present from her$_i$ to Ariel$_i$'s sister.

Test items resembled (7) and similar comparatives discussed in the theoretical literature (cf. Bhatt and Takahashi 2011). These included two subject (13)-(14) and three object comparatives (15)-(17). Each sentence included a personal pronoun (*she*, *her*, *him*) and a proper name, which was either allowed or not allowed to be coreferential with the pronoun, based on c-command.

(13) More lambs walked from Belle to him$_{i/j}$ than from Harris$_i$'s brother.
(14) More blocks connected him$_{i*/j}$ to Minnie than to Flynn$_i$'s horse.
(15) King Triton gave more lizards to her$_{i/j}$ than Olivia$_i$'s mother.
(16) Nemo delivered more presents from him$_{i*/j}$ to Flounder than to Eric$_i$'s dog.
(17) She$_{i*/j}$ gave more cones to Winnie-the-Pooh than to Sleeping Beauty$_i$'s godmother.

Each test sentence appeared at the end of a scenario with the following structure. An experimenter first positioned a set of props on the table in front of the child and the puppet, then proceeded to tell a story with them. Because our interest was in the resolution of pronominal reference, each story involved two salient candidate referents, each of the same gender. In two stories, there were no structural constraints on coreference between the pronoun and referring expression in the standard phrase, while in three others, there were, based on a Principle C violation (cf. the * marking on indexing in the above examples).

For example, in the scenario for target sentence (17), Sleeping Beauty and Hello Kitty were on a playdate. They decided to play a game with some toy cones they had, which were color coded to perceptually coordinate with these characters (yellow: Sleeping Beauty, pink: Hello Kitty). Each girl had the same number of cones (3). The game they decided to play involved distributing the cones to two other characters: Winnie-the-Pooh and Sleeping Beauty's Godmother. The latter was not given a name, to make the use of the possessive felicitous.

At the end of each story (which incorporated key elements of the TVJT, such as plausible dissent), the experimenter closed with the target sentence, and

the puppet then asked the child, "Can you show me that? Can you show me that [target sentence]?" thus prompting the child to act out the target sentence with the props.[1, 2] We were interested in determining whether participants would resolve reference in accordance with the restrictions imposed by an adult-like grammar, and act out the target sentence accordingly. For (17), because the pronoun appears in subject position, it cannot be coreferential with the name in the standard, which it c-commands.

We hypothesized that participants who abided by binding Principle C would rule out the reading where the pronoun refers to Sleeping Beauty, and would instead interpret it as referring to Hello Kitty. They would therefore distribute Hello Kitty's pink cones accordingly, so that Winnie-the-Pooh received two and the Godmother received one. A participant failing to obey Principle C might instead interpret *she* as Sleeping Beauty, and distribute her cones to Winnie-the-Pooh and the Godmother, so that Pooh bear got more. These possible act-out scenarios are presented in Figure 1.
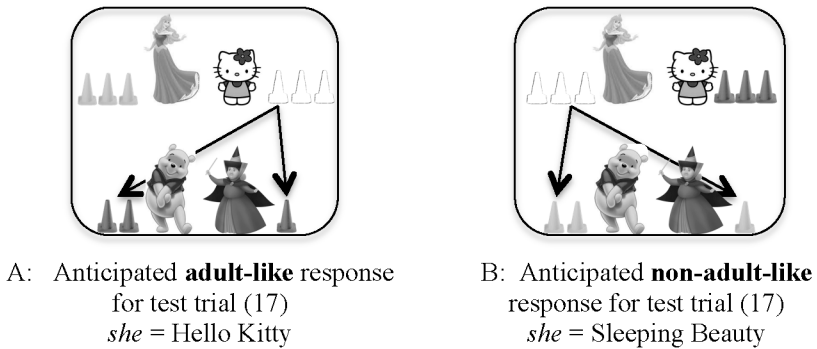

A: Anticipated **adult-like** response
for test trial (17)
she = Hello Kitty

B: Anticipated **non-adult-like**
response for test trial (17)
she = Sleeping Beauty

Figure 1. Anticipated responses for test item (17)

2.3. Results

Participants (children and adults alike) had no difficulty interpreting the control comparatives without pronominal reference: performance was at or near ceiling. Average percentage of adult-like responses on control comparatives was more than 83% for children and more than 99% for adult controls. Responses to test stimuli, however, were notably less uniform. Not only did we observe both anticipated types of responses (Figure 1: A and B) across test scenarios[3], but there was a third type of response that lay outside our predictions.

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1. Experimenters were trained to avoid placing a salient pitch accent on the pronoun or using contrastive stress, to avoid favoring non-default pronominal reference.

2. The more open-ended nature of the Act-out task invited the opportunity for a wider range of possible interpretations than a task that pits two pre-selcted interpretations against each other allows. See, e.g., Grimshaw & Rosen (1990) for discussion.

3. We note here that we observed responses such as A and B in Figure 1. Of these, only 45% of children's and 57% of adults' responses obeyed Principle C.

In a number of cases, when presented with a target sentence, children distributed the props from both givers. We term this the "two-giver" response. For example, for test item (17) some children took two or three pink cones from Hello Kitty and give them to Winnie-the-Pooh, and then take fewer yellow cones from Sleeping Beauty and give them to Sleeping Beauty's Godmother. (See Figure 2.)
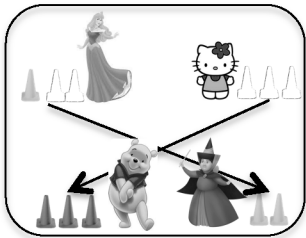

Figure 2. Unanticipated "two-giver" response for test trial (17)

While adults never demonstrated this response pattern, such "two-giver" responses were not rare among children, as captured in Table 1 below.

Table 1. Distribution of "two-giver" responses within participant groups

# test items displaying response	Children	Adults
0	7	28
1	4	0
2	4	0
3	9	0
4	2	0
5	0	0
Total	**26**	**28**

As shown, two-giver responses were observed in the majority of children in all five test items. Only 7 out of 26 participants (27%) resolved all the five Act-Out Tasks in an anticipated manner, distributing only the props belonging to one character, ostensibly assigning the same character as a referent for both the overt and the elided pronoun. The remaining 19 children (~73% of all participants, noted in grey cells in the table) exhibited at least one "two-giver" interpretation. The observed response pattern did not correlate with the age of the participants.

2.4. Discussion

Our findings revealed that while children successfully interpreted comparative constructions that do not involve pronominal reference in the elided material, they faced a challenge when interpreting those that do, as in our test

sentences here. These test sentences are quite complex, even for adults (as attested in our own intuitions and the occasional comment from the adult participants as they settled on an interpretation). However, we did not have any reason to predict that such a challenge would result in the "two-giver" response pattern we witness in the above Experiment.

The children who produced such "two-giver" responses effectively allowed for dual interpretation of the pronoun—allowing multiple indexing simultaneously. If we revisit the target sentence in (18), and fill in the elided material, we can observe two things. First, no matter which pronoun is predicted to stand in the relevant structural relation with the name in the possessive construction in the standard, both c-command this referring expression, and should therefore bar coreference. However, both children and adults allowed *she* to be Sleeping Beauty on occasion. Second, for the two-giver response to be generated, the *she* who gives cones to Winnie-the-Pooh cannot be the same *she* who gives cones to Sleeping Beauty's godmother. Thus, the pronoun in the main clause does not stand in a strict identity relation to the pronoun in the elided material in the standard.

(18) She$_{i/j}$ gave more cones to Winnie-the-Pooh
   than [~~λ d. she$_{i/j}$ gave d many cones~~] to Sleeping Beauty$_i$'s godmother.

The observed mismatch in pronoun reference resolution strongly suggests two conclusions. First, children are working with abstract representations of comparative constructions, and it is those representations that allow them to perform the required QR of the Degree Phrase and to recover the elided material in the standard. Second, while the structure of their representation may be similar to or the same as that of adults', the interpretation of the elided material appears to diverge in a surprising way, which points towards an alternative treatment of the pronoun and corresponding coreference.

Recall that some children appeared to allow for the elided pronoun to be interpreted differently from the pronoun in the main clause. This strategy is analogous to the mismatch in pronominal reference observed in cases of strict vs. sloppy identity (Ross 1967), where the identity of the pronoun in the elided part of the syntactic structure may be the same (strict reading) or not the same (sloppy reading) as that of the overt pronoun. This phenomenon, observed notably in VP Ellipsis (cf. Fiengo and May 1994; Keshet 2013; Reinhart 1983; Sag 1976), as shown in (19)-(20), has not been previously documented in the comparative constructions of interest to us in this paper. This is not to say that sloppy identity cannot be observed in comparatives at all—as we observe in (21). However, for our test sentences as (13)-(17), sloppy identity is not predicted to hold, because of the location of the pronoun in the structure: it is not bound by the referring expression in the standard with which it would stand in a coreference relation.

(19) Sherlock$_i$ saw his$_i$ hat, and Watson$_j$ did ⟨*see his$_{\{i/j\}}$ hat*⟩, too.

(20) The girl who gave John$_i$ an award congratulated him$_i$, and the one who gave Bill$_j$ an award did ⟨*congratulate him$_{\{i/j\}}$*⟩, too.

(21) Sherlock enjoys putting his life in danger more than Watson does ⟨*putting his$_{\{i/j\}}$ life in danger*⟩.

There is evidence from experiments testing sentences such as those in (22)-(23) (Foley et al. 2003) and (24) (Syrett, *under review*) that children can access readings derived from either strict or sloppy identity.

(22) Big Bird$_i$ scratches his arm and Ernie$_j$ does ⟨*scratch his$_{\{i/j\}}$ arm*⟩, too.

(23) Scooter$_i$ moves his penny and Bert$_j$ does ⟨*move his$_{\{i/j\}}$ penny*⟩, too.

(24) Woody$_i$ said he$_i$ jumped over every frog that Jessie$_j$ did ⟨*say she$_j$ jumped over*⟩.

However, the two-giver responses observed on the part of children in this study cannot be fully explained by appealing to sloppy identity, because, as we mentioned above, the pronoun is not bound by the referring expression in those examples, as it is here. We are therefore left in search of an explanation that will allow us to reconcile the fact that children already appear to share with adults the grammatical knowledge of the mechanisms in (5) with their surprising divergence from adults as shown in Table 1. We propose one possible explanation in the General Discussion.

3. General Discussion

Our observation that children seem to share with adults an abstract representation of comparatives, but differ in their resolution of pronominal reference within comparatives leads us to focus on the treatment of the elided pronoun itself. Let us first return to the unanticipated response pattern we observed in order to describe how children appear to be interpreting the pronoun and linking it to candidate referring expressions in the comparative. The so-called "two-giver" response exhibited in children involves a comparison not between the number of cones that one giver gave to one recipient versus another; rather, it involves the number of cones one giver$_1$ gave to her$_1$ recipient with the number of cones another giver$_2$ gave to her$_2$ recipient. The indexation used here shows that the recipient co-varies with the giver. It is almost as if there is a function taking the recipients as the range and returning a giver for each, which is then the value of the pronoun. Interestingly, such a functional interpretation of pronouns is attested, albeit outside of comparatives.

Indeed, this phenomenon was originally observed in the well-know donkey-anaphora sentences (Evans 1977, 1980; Elbourne 2001, 2005), as in (25)-(26), where the resolution of pronominal reference allows for the denotation to vary with the assignment. Subsequent researchers (e.g., Heim 1990) have thus made

reference to so-called *E-type pronouns*: functional pronouns that can be paraphrased by definite descriptions (i.e., *it = the donkey he owns*).

(25) Every man who owns a donkey beats it.
(26) If a farmer owns a donkey, he (always) feeds it.

The proper truth conditions for these sentences can be obtained if the pronoun is interpreted as the value of a contextually salient function *f*, where *f* maps each individual *x* in its domain to a unique individual associated with *x* (Heim 1990). The crucial distinction between the donkey anaphora in (25)-(26) and the pronominal reference in our comparatives is the source of functional reading: the former depends on the presence of a universal quantifier, while the latter depends on the structural parallelism between the two clauses.

Thus, to generate the two-giver response, children might posit a contextually salient function between recipients and givers, as with the men/farmers and donkeys in the above examples. This is illustrated in (27), where *f*(x) is a contextually salient function from individuals to individuals, the domain of *f* is {x: x is the recipient of cones}, and the value of *f* is the individual giving cones to x (the referent for the pronoun).

(27) a. She$_i$ gave more cones to Winnie-the-Pooh than
~~λd. she$_j$ gave d many cones~~ to Sleeping Beauty's godmother.
b. λd (λx (*f*(x) gave d-many cones to x) (Winnie-the-Pooh)) than
λd (λx (*f*(x) gave d-many cones to x) (Sleeping Beauty's Godmother))

What we are proposing, then, is that children might arrive at an interpretation that resembles the sloppy identity attested in VPE, but for different reasons: prompted by the presence of the pronoun in the elided material, they might treat the pronouns as E-type pronouns. In fact, there is some evidence that children may correctly interpret instances of donkey anaphora (Conway & Crain 1995), so it does not seem unreasonable to place this type of representation in their repertoire.

4. Conclusions

The results of the experiment presented here demonstrate that while children display competence in interpreting certain basic comparatives, they diverge from adults in their interpretation of comparatives that involve resolution of pronominal reference in the elided material. Specifically, while adults interpret the elided pronoun as standing in a strict identity relation with a pronoun in the matrix clause, children are more flexible in their interpretation of this pronoun, and allow its reference to co-vary with referring expressions in both the matrix clause and the standard. Despite this surprising pattern, however, the results also seem to indicate that at the same time children have formed abstract representations of the comparative in which they identify the associate

and the standard, place them on the scale in terms of the gradable property introduced by the comparative morpheme and compare amounts correctly, perform the QR of the degree phrase, and recover the elided material in the standard.

We therefore suggest that the source of their non-adult-like behavior lies in their interpretation of the pronoun, and not in other grammatical mechanisms, and propose an account appealing to a functional interpretation of the elided pronoun, incompatible with adult grammar. Thus, on this account, children eventually need to determine the proper identity conditions on ellipsis, and constrain when functional interpretations of pronouns are or are not available.

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