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Reduction vs. Direct Analysis of English Comparatives:
Children See More Than Adults

Qualifying Paper

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1. Introduction

The ability to form comparisons between the objects of the world, as well as the ability to establish orderings between those objects according to the degree to which they possess a given property is one of the crucial parts in the process of human development. In order to be able to map a comparative relationship onto language and to grasp the very concept of comparison, i.e. eventually produce and interpret it in an adult-like manner, a child has to achieve several different goals. One is to acquire an understanding of the comparative relationship between two objects or individuals; the other is to learn the specific linguistic expression of this relationship. Specifically, the child must be capable of determining the individual(s)/object(s) that constitute the associate of the comparative, relate this set to a degree to which it possesses a property under consideration, figure out the standard of comparison and create a relevant connection between the associate and the standard in terms of the given property. Indeed, all this knowledge is not obtained simultaneously, but takes time. A broad range of research has covered children’s production of comparatives, and described how children proceed on their path to adult-like competence and performance; however, surprisingly little research has taken the existing syntactic and semantic theory as a starting point and tried to draw conclusions regarding the abstract representations behind comparatives that children have.

This paper presents an investigation into the acquisition and processing of nominal comparative constructions by English-speaking preschoolers. Particularly, the primary goal of this study has been to test a specific theoretical claim regarding
the semantics and syntax of English comparatives as proposed in Lechner (2001, 2004) and Bhatt and Takahashi (2007, 2011) against children acquisition data in order learn more about the abstract representations behind comparative constructions that children have. Parallel studies in children and adults were designed to provide new knowledge about age-specific patterns of comparison processing: the question was whether either age group would treat phrasal comparatives as underlyingly reduced clausal ones and display evidence of the use of a two-place comparative degree head. This goal, in its own turn, required the investigation of the nature of children’s understanding of comparatives by incorporating a binding relationship based on Principle C into the comparative (a potentially co-referential personal pronoun and an R-expression in a c-command relationship). This way, we used the theoretical claims presented in Lechner (2001, 2004) and Bhatt and Takahashi (2007, 2011) to probe children’s representations and gain experimental support for their proposal.

The second major goal of this investigation was to provide additional experimental support for a discussion regarding children’s ability to process complex comparative relationships at a rather early age (4-5 years). Such ability has been questioned in some of the existing developmental literature (cf. Bishop & Bourne 1985; Clark 1970; Donaldson & Wales 1970; Gathercole 1985, 2009; Moore 1999; Piaget 1928; Riley & Trabasso 1974; Wales & Campbell 1970); and it was our objective to design an experiment where young children could have an opportunity to show their ability with this particular type of construction. We have also provided experimental data that fuels the discussion regarding the underlying structures
behind English comparative constructions in general, and the English comparative morpheme in particular.

Section 2 of this paper presents theoretical background on the syntax and semantics of comparative constructions. In section 3, we lay out the developmental background crucial for our study. The experiment design and results are discussed in section 4. Section 5 details the theoretical implications of the experimental results and outlines directions for further investigation. Section 6 concludes the paper.

2. Theoretical Background

As Bresnan (1973) puts it, “the comparative clause construction in English is almost notorious for its syntactic complexity”. And judging by the amount of publications on the subject, the same can be stated about the semantics of comparative constructions in general, and English comparatives in particular. In this section we well present a brief overview of the key components of a comparative construction and than proceed to the discussion of the existing approaches to the analysis of syntax and semantics of English comparatives. Consider the following sentence:

(1) John is more self-assured than Bill (is).

The fundamental components of an English comparative construction are as follows: the clausal structure preceding ‘than’ in the surface form (‘John is more self-assured’) is a main clause, while the part following it (‘than Bill (is)’) is a comparative clause or a standard clause. ‘Than’ itself is recognized as a comparative marker. Consequently, such a sentence expresses a comparative relationship between two values/degrees: one provided by the main clause, and the other
provided by a subordinate comparative clause. The main clause contains the reference to an individual or an object that is compared (‘John’), which is known as the associate, and the comparative morpheme, or a degree head, which in English can be instantiated through the use of ‘-er’ or ‘more’. The comparative clause is headed by a comparative marker ‘than’ and contains reference to the second individual or object compared known as the standard of comparison (‘Bill’).

The literature on comparative constructions often involved references to clausal and phrasal comparatives: the term ‘clausal comparatives’ is used to refer to comparatives that explicitly involve clausal structure in the standard part, while the term ‘phrasal comparatives’ is used to refer to structures that lack an overt subject-verb sequence following the comparative marker ‘than’, cf. (2)-(5) and (4)-(5).

(2) Mike has more dollars [than he has friends].
(3) Mike has more dollars [than you].
(4) Mike is taller [than Bob is].
(5) Mike is taller [than Bob].

In a different use, these terms can refer to the structures underlying the surface comparative: while in case of (2) the underlying structure of the standard clause obviously includes both IP and VP projections, the syntactic status of cases like (5) has been the subject of much theoretical discussion: specifically, the question asked was whether such constructions are underlyingly phrasal, or they should be analyzed as elliptical variants of clausal constructions.

Schwarzschild (2008) notes, following much of the syntax literature (e.g. Bresnan 1973, 1975; Kennedy 2002; Lechner 2004), that all adjectival comparatives (constructions where a property compared is expressed by an adjective flanked by a comparative morpheme in the main clause) require some form of ellipsis in the
complement clause. Comparative deletion (CD) is the term introduced by Bresnan (1973, 1975) to describe constructions in which adjectival, adverbial or nominal constituent is eliminated from the surface structure of the complement of the comparative marker ‘than’. Bresnan’s analysis of CD constructions proposed that the underlying structure of the comparative clause in such cases includes constituents identical to the corresponding overt structure in the main clause, the only difference being that the comparative morpheme is replaced by a variable that ranges over degrees. Bresnan (1973, 1975) further suggested that an unbounded deletion operation eliminates the repeated lexical material in the standard clause under identity with the respective material in the main clause (further developed in Borsley 1981). Later research reformulated Bresnan’s analysis in terms of quantifier raising of a degree term: the comparative morpheme –er is assumed to have the semantics of a degree quantifier that takes two sets of degrees as arguments. Its internal argument is given by the than-clause, while its external argument is provided by the main clause after the degree quantifier – base-generated in the argument position of ‘many’ – has raised to a clausal position to yield an interpretable structure. A further syntactic operation is required for the deletion/recovery of the content of the elided lexical material (Hackl 2000, 2001; Heim 1985; Klein 1980; von Stechow 1984, and many others).

Much of subsequent research was carried out on the basis of cross-linguistic data, which turned out to be of great importance for the formation of the generative theory of comparatives. Working with English, Polish, Czech, Greek, and Bulgarian data, Kennedy and Merchant (2000) claimed that ellipsis necessarily must be
analyzed as deletion of material from PF representation: elided material has to be part of the syntactic representation of the sentence prior to deletion (and therefore included into the LF representation). In other words, ellipsis must involve syntax and is not just a recovery of a constituent meaning. More recent linguistic analyses of comparatives have also highlighted the cross-linguistic variability and the possible implications for syntactic and semantic accounts of comparatives (Beck et al. 2009; Beck, Oda, & Sugisaki 2004; Kennedy 2009, etc.)

What cross-linguistic studies have shown was that no single account could describe the semantics and syntax of comparatives universally: it was apparent that different languages behave distinctly in terms of formation of surface phrasal vs. clausal comparatives. Looking at the surface structures alone, one can observe that what overtly looks like clausal comparatives has to involve a 2-place degree head, which combines with two degree descriptions, while phrasal comparatives have to be formed using a 3-place degree head, which combines with two individual arguments and a predicate of degrees and individuals.

Figure 1. Two-place degree head: P, Q are degree predicates (sets of degrees)
John is taller than [Bill is].
-er(P)(Q) ↔ 3d [Q(d) ∧ ~P(d)]
-er [λd. Bill is d-tall] [λd. John is d-tall]
This observation has raised a question regarding the crosslinguistic and intralinguistic distribution of those two types of degree heads, which was addressed in a number of research papers including Lechner (2001, 2004) and Bhatt and Takahashi (2007, 2011).

On the basis of English and German data, Lechner (2001, 2004) claimed that the direct analysis, i.e. the interpretation of phrasal comparatives as underlyingly phrasal with their structures based on a three-place degree head, may not be relevant for these languages. According to Lechner (2001, 2004), both English and German allow for a syntactic reduction operation in the standard clause of a comparative construction, i.e. all the comparatives in these languages, including overtly phrasal comparatives, are underlyingly clausal and use a 2-place degree head. In cases where reduction operations are unavailable, as was further argued by Bhatt and Takahashi (2007, 2011) for the case study of Hindi-Urdu, a 3-place ‘-er’ has to be a part of the language semantic inventory. At the same time, the availability of a reduction operation does not fully correspond to the presence/absence of a three-place degree head in the language: as Bhatt and
Takahashi (2007, 2011) further show, in Japanese reduction operations are available, but 3-place ‘-er’ is still attested, as a result of complex interaction between the morphosyntactic properties of comparative markers like ‘than’ and a preference for minimal structure.

Following Lechner (2001, 2004), Bhatt and Takahashi (2007, 2011) claim that the Reduction Analysis and the Direct Analysis differ in the predictions they make about the binding properties of the standard of a comparative structure. Particularly, following the Reduction Analysis, the standard occurs inside a larger clausal structure which is syntactically and semantically parallel to that of the main clause. In particular, the standard occupies a position within the comparative clause that is structurally identical to the position occupied by its associate in the main clause. This leads to the expectation that the binding properties of the standard will be related to the structural position of its associate.

The Direct Analysis makes a very different prediction: there is no reduced clause under the Direct Analysis; and since the standard does not form a constituent with the associate, there should be no dependency between the binding properties of the standard and those of the associate. The standard has the external syntax of a PP; and one would expect it to have the binding properties of a PP in the same structural position (Lechner 2001, 2004; Bhatt and Takahashi 2007, 2011). This claim is illustrated by the following crucial contrast:

(6) *More people talked to him about Sally than about Peter’s sister.

Direct Analysis LF: [Sally [[-er [than Peter’s sister]] λd.λx. [d-many people talked to him about x]]]
(7) More people talked to Sally about him, than to Peter’s sister.

Direct Analysis LF: [Sally [\(-\)er than Peter’s sister]] \(\lambda d. \lambda x. [d\text{-}many \text{people talked to } x \text{ about } him.]\)]

Direct Analysis cannot account for the binding properties observed in (6)-(7). In neither of the LF representations above does the pronoun in the matrix clause c-command the standard, so the contrast is unattested for. On the contrary, Reduction analysis, which requires the reconstruction of the elided clausal structure and raising at LF, accounts for the observed contrast in judgments (cf. Figure 3 and Figure 4).

Figure 3. *More people talked to him, about Sally than about Peter’s sister.

Figure 4. More people talked to Sally about him, than to Peter’s sister.
Figure 3 provides the LF for (6), and Figure 4 is the LF for (7). Clearly, according to the Reduction Analysis, in Figure 3 the pronoun c-commands the R-expression in the reconstructed part of the ellipsis site, which is not the case in Figure 4. This accounts for the observed binding violation in Figure 3 and serves as an argument for the Reduction Analysis of English comparatives (Lechner 2004; Bhatt and Takahashi 2011).

This theoretical claim has laid the basis for the experimental project presented in this paper: as one can see, the argument in favor of Reduction Analysis in English presented above rests primarily on the observations regarding the behavior of English comparatives with respect to binding Principle C. At the same time, the contrasts proposed in Lechner (2004), and further adopted and used in Bhatt and Takahashi (2011), are rather complex. For this reason, our goal within this project was to test the applicability of the Reduction Analysis for English against acquisition data obtained from English-speaking preschoolers, as well as to find experimental evidence regarding adults’ judgments that served as a foundation for claims put forth in Lechner (2001, 2004), Bhatt and Takahashi (2007, 2011).

3. Developmental Background

As we have mentioned in the beginning of this paper, children’s production of comparatives has been covered in a broad range of research which pointed out the stages through which children proceed on their path to adult-like competence and performance. At the same time, little research has taken the existing syntactic and semantic theory as a starting point. In the previous section we outlined the theoretical background. This section consists of three subparts: (i) the discussion of
the literature on comparatives acquisition, (ii) acquisition of ellipsis and covert movement, and (iii) the research related to acquisition of binding relationships.

3.1. Comparatives in Child Language

If we look at the literature on the acquisition of comparative constructions, we will see that there is absolutely no shortage of such. Just like semantics and syntax of comparatives, the acquisition path has attracted the attention of researchers for a long time now. Still, surprisingly little is known about abstract linguistic representation of comparative constructions in children.

The reason behind this contradiction could be the following: the existing literature on comparatives acquisition falls into three main classes.

The first group largely focused on cognitive development and mainly used language as an instrument to access the stage where the child stands (Bishop & Bourne 1985; Clark 1970; Donaldson & Wales 1970; Ehri 1976; Gitterman & Johnston 1983; Piaget 1928; Sinclair de Swart 1967, 1969).

The second group also did not look at linguistic representations as a starting point, and instead turned to spontaneous production and backtracked their conclusions from there (Feider 1973; Finch-Williams 1981; Gathercole 1985, 2009; Graziano-King & Cairns 2005; Layton & Stick 1979; Moore 1999).

The third group features studies of what children understand about the semantics and syntax of comparatives (Hohaus & Tiemann 2009; Tiemann, Hohaus, & Beck 2010; Hohaus et al. 2014). However, to the extent that this research involves corpus studies, and not experimental work, the focus remains on spontaneous production (Beck et al. 2004, 2009).
Thus existing research on the acquisition of comparatives has neither deconstructed comparatives and degree constructions to identify the specific components of these constructions that children need to acquire, nor taken these components as a starting point of investigations of children’s competence. As noted in Syrett (to appear), while we have fairly good understanding of the relationship between linguistic and non-linguistic tasks of comparison and perceptual factors influencing performance in response to comparative language, there is still much to be said about children’s developing semantic comprehension of the full range of comparatives and degree constructions and the universal and language-specific factors underpinning the acquisition of these constructions.

Children under 6-7 years of age systematically produce comparative constructions that are markedly different from the patterns observed in adult production. While some studies claim that as early as at 3- and 4-years of age children already demonstrate a good understanding of positive, comparative and superlative forms of adjectives (Carrow 1973, Layton & Stick 1979), others suggest that the majority of 4- and 5-year-olds do not process comparatives in an adult-like, and it is not until the ages of 6-7 that the children can approach systematic adult-like competence and performance. Even then, it is generally agreed upon in the literature that the acquisition of comparatives proceeds in a stage-like manner; however, there has been a significant divergence of opinion in terms of the timing of these stages and their sequence.
Certain deviations from adult-like patterns observed in children’s production, as well as specific ways in which children interpret comparatives, have led a number of researchers to conclude that initially children might interpret the phrase ‘John is taller than Bill’ as ‘John is tall’ without necessarily realizing that John’s height exceeds Bill’s height (cf. Bishop & Bourne 1985; Clark 1970; Donaldson & Wales 1970; Gathercole 1985, 2009; Moore 1999; Piaget 1928; Riley & Trabasso 1974; Wales & Campbell 1970). To provide some specific examples, Piaget (1928) argued that children do not understand such comparatives until a very late age, and instead apply the adjective to both nouns. Riley & Trabasso (1974) claimed that, given a single comparative, 4-year-old children were unable to reverse the comparative relationship (i.e. deduce “Red pencil is shorter than blue pencil” from “Blue pencil is longer that red pencil”). Similarly, Bishop & Bourne (1985) concluded that 4- and 5-year-olds only used two basic strategies to interpret comparative sentences: the non-linguistic strategy of selecting the object with the highest degree of a given property (e.g. the longest of the given items), and the linguistic strategy of interpreting the adjective as the property of the very first noun in the comparative.

More crosslinguistic data comes from Hohaus & Tiemann (2009), Tiemann, Hohaus, & Beck (2010) and Hohaus et al. (2014), who argued that children should not make productive use of a new grammatical construction until they have identified that this construction is licensed in adult language and that there is a grammatical basis for it. In their corpus studies, the authors found that clausal comparatives were highly infrequent, as were measure phrases. In English, other constructions largely followed their expectations (mean age of acquisition:
comparatives: 3;1, phrasal comparatives: 3;8, superlatives: 4;3), but in German, the phrasal comparatives were observed markedly later than comparative and superlative morphology (mean age of acquisition: comparatives: 3;1, phrasal comparatives: 6;4, superlatives: 3;3). This led the authors to argue that the German/English contrast may show that phrasal comparatives in English and German are underlyingly different: English ones are underlyingly phrasal and require Direct Analysis, while German ones are underlyingly clausal and require Reduction Analysis. This data is highly relevant to the goals of the current study, since the abovementioned papers so far seem to be the only ones that suggest the possibility of a Direct Analysis for English comparatives.

Summing up, in the developmental literature there is little consensus regarding children’s competence in the acquisition of comparatives. Our second goal within this project was to provide additional data to support the claim that children’s ability in this area has often been underestimated. Possible reasons behind this could be that the tasks in some of the experiments involved increased cognitive load (which ended up masking children’s linguistic knowledge), or that children began to respond to the question as the comparative was still being delivered (and therefore only appeared to parse the main clause, and did not pay attention to the standard clause) (Syrett to appear). For this very reason, it remains a challenging task to test the children’s understanding of comparative constructions in a comprehension-based experiment that would rely primarily on the knowledge available from syntactic and semantic linguistic theory about specific aspects of comparative constructions.
3.2. Ellipsis and Quantifier Raising

Both ellipsis and quantifier raising are essential components needed for the adult-like competence in comparatives. Syrett and Lidz (2009) have studied children’s interpretations of sentences based on antecedent-contained deletion. Based on earlier research, the authors judged that without the QR mechanism in their grammars, children should not be able to interpret ACD constructions as adults, but would treat them as coordinated conjunctions (cf. (8)-(9)).

(8) Lola jumped over every frog that Dora did.
(9) Lola jumped over every frog, and Dora did, too.

In a truth value judgment task, Syrett and Lidz (2009) compared four-year-olds’ interpretation of both sentences in two distinct contexts: one in which Lola and Dora jumped over the same set of frogs, and one where they each jumped over a different set. The results showed that at this age children treated the two sentences distinctly and showed adult-like resolution of ACD. Other work by Syrett and Lidz (2011), as well as Kiguchi and Thornton (2004), showed that in the majority of cases children interpret ACD structures like adults, suggesting that they invoke the binding principles at LF, and target vP, rather than IP as the landing site for QR, as claimed for adults by Fox (2000) and others.

In fact, there is a number of publications suggesting that children’s ability to process ellipsis emerges at a rather early age: Postman, Foley, Santelmann and Lust (1997) show that children between 2;7 and 3;11 are able to produce VP ellipsis in English when responding to an imitation task. Analyzing comprehension, Foley, Prado, Barbier and Lust (1997, 2003) present results of act-out and truth value
judgment tasks and show that children between 3;0 and 7;11 are able to understand VP ellipsis. Thornton and Wexler (1999) confirm that children between 4;0 and 5;1 are able not only to recover the meaning, but also the syntactic structure of the elided material. Their work focuses on the interpretation of pronouns in VP ellipsis contexts and shows that children are sensitive to a “structural parallelism” restriction on VP ellipsis, which is defined as following: “NPs in the elided and antecedent VP must both be bound variables or both be referential pronouns” (Thornton and Wexler, 1999: 117) – this finding is relevant to our project, since our goal was to see whether the children would be able to reconstruct a binding relationship in the (possibly) elided part of a comparative construction.

Further, research on children’s understanding of ellipsis and anaphora has been presented in Matsuo and Duffield (2001). The authors focused on subtle contrasts between VP-ellipsis and VP-anaphor. Hankamer and Sag (1976) argued that VPE is a type of surface anaphora, while VPA is deep anaphora: the former is subject to structure parallelism constraint and is an essentially syntactic process, whereas the latter recovers its antecedent from conceptual, rather than syntactic representations. In their study, Matsuo and Duffield (2001) showed that children as young as 3;11 correctly distinguish VPE from VPA and respect the constraints on each: specifically, they are sensitive to the structural constraints on VPE constructions in English and can successfully distinguish between appropriate (parallel) and less appropriate (nonparallel) antecedents in two separate constructions, which is crucial for the adult-like processing of comparatives.
Thus, there is significant amount of evidence showing that, if the Reduction Analysis is the valid analysis for English, then children should have no troubles resolving ellipsis and quantifier movement associated with the underlying structures proposed for the standard of comparison: a significant body of research shows that they have a good grasp of syntactic and semantic machinery required for this particular goal. In this way, these findings prove rather optimistic in terms of the theoretical premises chosen as a basis for the experimental study discussed in the current paper.

3.3. Children’s Knowledge of Principle C and c-command

Similarly, research on the acquisition of binding Principle C, which was a part of the argument put forward by Lechner (2001, 2004) and Bhatt and Takahashi (2007, 2011) for the Reduction analysis of English comparatives, shows that children reveal adult-like comprehension and performance in regards to Principle C at least by age four.

For example, Kiguchi and Thornton (2004) assessed 4- and 5-year-olds’ knowledge of Antecedent Contained Deletion (ACD) Constructions, where binding Principle C is relevant and applies at LF. The experiment showed that children interpret these ACD structures just like adults, successfully invoking binding principle C at LF.

Similar findings have been presented in a number of other papers, including Grodzinsky and Reinhart (1993) and Crain and McKee (1986), both focused on the acquisition of Principle C. In the latter paper, during the experiment children were
presented with a truth value judgment task to distinguish between a deictic interpretation of a pronoun and a background anaphora reading:

(10) While he was dancing the ninja turtle ate the pizza.
(11) He ate the hamburger, when the Smurf was inside the fence.

The results showed that 4-year-olds already did have the background anaphora reading, and rejected the co-reference between the R-expression and the pronoun. The conclusion repeatedly proposed in the papers mentioned above was that Principle C is a linguistic universal, which needn’t be mastered by children on the basis of their linguistics experience. The acquired data were taken to provide support for the view that this binding principle is part of the innate human endowment for language. For our purposes, the crucial point is that by the age of 4 the understanding of this binding relationship is already a part of children’s grammar, so it is possible to set up an experiment based on a binding relationship incorporated in a comparative construction and to expect that the former should be interpreted in an adult-like manner.

Summing up, the review of research relevant for this paper leaves two crucial questions open. The first one is to what extent children between the ages of 4 and 6 are, in fact, capable of processing a comparative construction; and, which is most important, whether there is evidence that they are doing so not only conceptually, but applying their linguistic knowledge to it. The question is whether this study can provide evidence that children process the structure of a comparative: determine the associate, relate it to a gradable property, figure out the standard of comparison and create a relevant connection between the associate and the standard in terms of the given property taking linguistic cues into account.
The second question is whether adults and children recognize binding Principle C when the relevant c-commanding relationship emerges in the (possibly) elided part of a comparative construction; and consequently, can this data provide further evidence for a discussion regarding Reduction vs. Direct Analysis of comparatives for English. A number of studies reviewed in this section provide rather favorable background for our research: children show good command of multiple aspects crucial for a comparative interpretation (including VP-ellipsis, VP-anaphora, Quantifier Raising), plus by the age of 4 they have a good grasp of binding principle C as well. In the experiment presented in the next section we have put all those aspects together and introduced the resultative task to both adults and children.

4. **Experiment**

The purpose of this task was to test the prediction regarding the Reduction Analysis of English comparatives; to determine to which extent children are able to interpret complex comparative sentences possibly involving syntactic ellipsis; and whether they would rule out meanings that violate binding Principle C based on Lechner (2004) and Bhatt and Takahashi (2011).

4.1. **Method**

4.1.1. **Participants**

26 children (8 boys and 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 adult controls who were
undergraduates of Rutgers, The State University of New Jersey, and received course credit for their participation.

4.1.2. Materials and Procedure

In the experiment the scenarios were presented as stories acted out with toys and props by one experimenter, while a puppet animated by the second experimenter was listening to the story along with the child. At the end of the story, the puppet tried to summarize what had just happened. The children were told during the training session that the puppet (Baby Bunny) is learning and so sometimes she gets the story right, but sometimes she is wrong, so she needs help and explanation in order to understand what the story was about and what actually happened.

There were two types of experimental trials: 3 were truth value judgment tasks (following the procedure presented in Crain and McKee (1986) and Crain and Thornton (1998)), where children were asked to judge the truth or falsity of a statement; 6 were act-out tasks where children were given the test sentence and asked to move the props on the table in accordance with how they interpreted the test sentence. For both tasks, children received training at the start of the experimental session (one training truth value judgment scenario, and one training act-out scenario).

4.1.2.1. Truth Value Judgment Task

In the truth-value judgment task, text ‘context’ was designed in the form of a story acted out with toys and props by one of the two experimenters. The test sentence was presented at the end of the scenario by a puppet in her attempt to
summarize the story. Having uttered the summary and the test sentence, the puppet would ask the child whether her understanding of the story was correct: a test sentence was directly followed by the question “Am I right?” A basic assumption of the task was that children would judge the sentence to be false if their grammars ruled out the interpretation otherwise supported by the context.

The illicit meaning that was associated with violating the constraint was designed to be true in the story; and therefore, if a child permitted this interpretation, they were expected to say ‘Yes’ to the puppet delivering the test sentence. The meaning associated with adult grammar was false, and therefore, children responding as adults were expected to say ‘No’ to the puppet’s version of events. When the child thought that the puppet was correct, the child would give the puppet a reward (a cookie). If the child judged the puppet’s statement to be wrong, the child would give the puppet a smaller reward (milk). Both rewards were presented as desirable, so that the puppet would be happy every time regardless of the correctness of her answer. In case of both “yes” and “no” response, the child was asked to justify their answer.

Two of the truth value judgment tasks were designed to test for children’s understanding of binding principle C in different syntactic settings. The third truth value judgment task tested children’s ability to process a simple object comparative.

4.1.2.2. Act-Out Task Procedure

The act-out trials proceeded in a similar fashion up until the very end of the story. Then the puppet requested the child to finish the story by acting-out the test sentence, i.e. by moving the props in accordance with the instruction provided in the
test sentence. Each of the test sentences in the act-out tasks featured a personal pronoun. Each scenario allowed for two possible interpretations depending on the referent assigned to this pronoun (there were two possible referents in each scenario, none of which was favored by the context). In some sentences, only one referent assignment was grammatical from the point of view of the adult grammar. In other sentences, reference was ambiguous. A basic assumption in this task was that in the former case the child would chose the interpretation in accordance with the restrictions imposed by their grammar, and act it out moving the props on the table accordingly.

Several measures were taken to guarantee that the experiment was not biased and that Type 1 errors (the rejection of a null hypothesis in favor of research hypothesis, when the former is true) were avoided. The two suggested referents for the pronoun (both of the same gender) were mentioned in an *and*-conjunction phrase, where the referent associated with the violation of the constraint was placed second, immediately before the delivery of the test sentence. It is generally assumed that the last mentioned referent is more salient and therefore more likely to be accessible to the child. In this way the illicit meaning is given a minimal advantage, so that the child would have to actively show the command of the adult-like grammar to reject it. Both referents had equal roles in the scenario in terms of volume of their participation: none was made more prominent or more in control of the situation. We also avoided the use of closely related characters within any particular scenario (e.g., Sleeping Beauty and Prince Phillip), so that the background
story behind the characters would not prompt children to act out the task based on
the relationship between the characters.

Further, we closely controlled for even spatial distribution of toys and props
on the table in front of the child. There was no favoring of either possible referent in
the positioning of the toys on the table: both available referents were symmetrically
equidistant from the child. We also controlled closely for the prosody with which the
test sentence was delivered: the experimenters were trained to avoid salient pitch
accent on the pronoun, or contrastive stress between the pronoun and the possible
referent, since contrastive stress on a pronoun signals that a speaker intends a non-
default reading (Hirschberg and Ward 1991; van Hoek 1997; Lakoff 1971).

4.1.2.3. Stimuli

The target stimuli were modeled after key examples presented in Lechner
in (23), the authors present the following contrasts that support the need for
Reduction Analysis in English:

(12) *More people talked to him, about Sally than about Peter’s sister.

Direct Analysis LF: [Sally [[-er [than Peter’s sister]] $\lambda d.\lambda x. [d$-many
people talked to him$_i$ about $x$]]]

(13) More people talked to Sally about him$_i$ than to Peter’s sister.

Direct Analysis LF: [Sally [[-er [than Peter’s sister]] $\lambda d.\lambda x. [d$-many
people talked to $x$ about him$_i$]]]

when the pronoun c-commands the associate (12), it cannot co-refer to an R-
expression inside a standard. If a pronoun does not c-command the associate (13),
then co-reference is possible. As one can see from the corresponding LF structures in (12)-(13), the Direct Analysis does not account for the reported contrast in judgments.

All the crucial contrasts presented in Lechner (2001, 2004) and Bhatt and Takahashi (2007, 2011) involved subject nominal comparatives. In order to be comprehensive, we decided to use the same logic and model two pairs of target stimuli: two subject and two object comparatives. Within each pair, one of the examples had to involve a possible Principle C violation that arose in the reconstructed standard clause, as in (12), while the other was supposed to be grammatical with either co-indexation, thus allowing for ambiguous interpretation, as in (13).

Figure 5. Target Stimuli: Type of Comparative and Principle C status

<table>
<thead>
<tr>
<th>Stimulus</th>
<th>Type of comparative</th>
<th>Principle C Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>More blocks connected him\textsubscript{i/j} to Minnie than to Flynn\textsubscript{i}'s horse.</td>
<td>✓ Subject ✓</td>
<td>✓ violation with co-reference ✓ ambiguity, no violation</td>
</tr>
<tr>
<td>More lambs walked from Belle to him\textsubscript{i/j} than from Harris\textsubscript{i}'s brother.</td>
<td>✓ Object ✓</td>
<td>✓</td>
</tr>
<tr>
<td>Nemo delivered more presents from him\textsubscript{i/j} to Flounder than to Eric\textsubscript{i}'s dog.</td>
<td>✓ Subject ✓</td>
<td>✓</td>
</tr>
<tr>
<td>King Triton gave more lizards to her\textsubscript{i/j} than Olivia\textsubscript{i}'s mother.</td>
<td>✓ Object ✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

As a result, the following target stimuli were designed:

(14) More blocks connected him\textsubscript{i/j} to Minnie than to Flynn\textsubscript{i}'s horse. (act-out)
(15) More lambs walked from Belle to him$_{i/j}$ than from Harris$_i$’s brother. (act-out) (subject comparative, no principle C violation, ambiguity)

(16) Nemo delivered more presents from him$_{i/j}$ to Flounder than to Eric$_i$’s dog. (act-out)

(17) King Triton gave more lizards to her$_{i/j}$ than Olivia$_i$’s mother. (act-out) (object comparative, no principle C violation, ambiguity)

As an illustration of how these target stimuli were presented during the experiment, consider target sentence (16): “Nemo delivered more presents from him$_{i/j}$ to Flounder than to Eric$_i$’s dog.” The experimenter presented the stimulus after a brief summary mentioning the characters in a conjunction phrase: ‘And Nemo started delivering presents from Buzz Lightyear and Prince Eric’, with the
last-mentioned character, Prince Eric, being the one associated with the illicit interpretation of the sentence. Further the target sentence was introduced: “And after a while... Nemo delivered more presents from him*ij to Flounder than to Eric’s dog.” Assuming that underlying structures for phrasal comparative proposed in Lechner (2004) and Bhatt and Takahashi (2011) are observed in children’s grammar, Eric, who is mentioned last in the scenario, should not be a possible grammatical referent for the pronoun in the target sentence, since it is c-commanded by a co-indexed pronoun in the reconstructed standard clause (see the respective tree structure Figure 7 in (H) above). After this the second experimenter acting as a puppet repeated the test sentence encouraging the child to use the props to act out the test sentence and explain what had happened in the story to the puppet. For this stimulus, the puppet’s line was: “Oh, I see. Can you show me that? Can you make it so that Nemo delivered more presents from him to Flounder than to Eric’s dog?” With these measures in place, children had every opportunity to consider the meaning that is in violation of binding Principle C, and either accept or reject it depending on their grammar.

The control sentences in this experiment were designed to test for specific individual semantic and syntactic aspects associated with the target stimuli. The first two controls ((18) and (19)) were designed to test for children’s understanding of simple subject (18) and object (19) nominal comparatives.

(18) More cars drove into town than into the woods.
(19) Sherriff Woody fed more bear cubs than Jessie.
(18) was presented as an act-out task, while (19) was presented as a truth value judgment task.

Two additional controls tested for children’s knowledge of binding Principle C. The first was adopted from Crain and McKee (1986), and tested children’s ability to reject the co-reference between a pronoun in the subject position of the matrix clause and an R-expression it c-commands.

(20) He*i/j ate the cake, when the Smurf*i was dancing. (TVJ)

The second tested for children’s sensitivity to binding principle C, when the pronoun does not directly c-command the R-expression, but is a part of a prepositional phrase that c-commands the latter. In this example, the index associated with the inner DP ‘her’ percolates to the outer maximal projection thus causing a principal C violation. This syntactic structure was chosen as one of the controls because one of the target sentences involved a comparative with an analogous incorporation of prepositional phrases.

(21) Sebastian found a present from her*i/j to Ariel’s sister. (TVJ)

Finally, control sentence (22) incorporated both grammatical aspects crucial for the current study: a binding relationship based on principal C, and a comparative construction. At the same time, the application of binding principle C in this case did not depend on the possible underlying structure of the comparative, i.e. the possible use of either 2- or 3-place degree head.

(22) She*i/j gave more cones to Winnie-the-Pooh than to Sleeping Beauty*i’s godmother. (act-out)
In the proposed control either possible underlying structure is supposed to cause a principle C violation: building on Lechner (2004) observations, Bhatt and Takahashi (2011) presented the following generalization regarding the status of the standard in terms of c-command:

(23) Everything that c-commands the associate c-commands the standard.

Accordingly, the pronoun ‘she’ in the subject position of the matrix clause has to c-command both the associate and the standard regardless of whether the standard is interpreted as a prepositional phrase or a reduced clause by the child. This way, this sentence was intended just as control for the simultaneous processing of two grammatical phenomena (principle C and comparative relationship) without testing the theoretical premises under consideration yet.

All the training, control and target stimuli along with the relevant scenarios are presented in Appendix (page 71).

4.2. Results

Recall that for both age groups we were primarily interested in the way participants would resolve a pronoun reference in the target sentence: if they showed a consistent preference for the observation of Principle C, that would serve as a strong experimental support for the Reduction Analysis, as proposed by Lechner (2004) and Bhatt and Takahashi (2011).

For each truth value judgment task, we expected one of the two possible responses (Yes or No) followed by the reasoning behind the given response to verify its relevance to the task. For act-out tasks, we predicted one of the two possible responses to the accompanying request, based on the grammaticality judgments
suggested above ((14)-(17)). The choice of referent was expected to show whether the participants recognized the application of binding Principle C at LF. We present the results from the adults first, followed by the results from the children.

4.2.1. Adult Data

Overall, adults who participated in this study did not display awareness of grammaticality contrasts proposed in Lechner (2004) and Bhatt and Takahashi (2011): on average, their resolution of pronominal reference in comparatives did not pattern with the judgments presented above. Adults performed successfully on the majority of control sentences reaching the rate of 100% on three of them (two simple comparatives and a simple Principle C control (24)). As for the other two control stimuli (more complex Principle C controls), although many did recognize a principle C violation in both sentences, the success rate was only 36% for (25) and 71% for (26).

(24) He ate the cake, when the Smurf was dancing.
(25) Sebastian found a present from her to Ariel’s sister.
(26) She gave more cones to Winnie-the-Pooh than to Sleeping Beauty’s godmother.

The crucial distinction between control (24) and controls (25)-(26) is that the R-expression which is expected to cause the principle C violation corresponds to a participant in the scenario in the former (Smurf in (24)), while in the latter it is incorporated in a possessive phrase (Ariel’s sister in (25) and Sleeping Beauty’s Godmother in (26)). Further, scenario (25) involves a more complex c-commanding relationship between the pronoun and the R-expression, where the index percolates
through the Prepositional phrase (‘from her’) and c-commands the R-expression from there.

It is also worth noting that adults who turned out to be sensitive to principle C violation in control (26), performed overwhelmingly better on control (25) as well, while those who failed control (26) were three times as likely to fail control (25).

Figure 8. Correlation of adults’ responses on control stimuli (25) and (26)

<table>
<thead>
<tr>
<th></th>
<th>Principle C observed in (26)</th>
<th>Principle C violated in (26)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principle C observed in (25)</td>
<td>12 (43%)</td>
<td>2 (21%)</td>
</tr>
<tr>
<td>Principle C violated in (25)</td>
<td>8 (29%)</td>
<td>6 (7%)</td>
</tr>
</tbody>
</table>

The responses to target sentences in adults were, in general, mixed: the majority of the participants (58%) failed to recognize Principle C violation in the subject comparative (27), and though 58% did observe Principle C in the object comparative (28), this still cannot be considered an overwhelmingly positive result.

(27) More blocks connected him\(_ij\) to Minnie than to Flynn’s horse.
(28) Nemo delivered more presents from him\(_ij\) to Flounder than to Eric’s dog.
Those participants who recognized a principle C violation in all three controls ((24)-(26)) (8 adults (29%)) performed stably better on the target stimuli that involved a principle C violation. In fact, they were almost twice as likely to rule out a principle C violation in both subject and object target comparative (in each case 5 adults out of those 8 recognized and observed Principle C). On the contrary, the participants who only passed the straightforward control (24) and failed more complex ones (25) and (26) (4 adults (14.5%)) were far more likely to fail to recognize a principle C violation in both target stimuli (all 4 failed to recognize Principle C in a subject comparative, and 3 failed to recognize it in an object comparative).
In target sentences that allowed for ambiguous interpretation, i.e. in cases where there were two possible choices of referents, both of which were made possible by the context and did not contradict grammaticality judgments, adults presented the following distribution of answers:

(29) More lambs walked from Belle to him_i/i than from Harris_i’s brother.

<table>
<thead>
<tr>
<th>(29)</th>
<th>20 (71.5%)</th>
<th>8 (28.5%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>‘him’ = Harris_i</td>
<td>‘him’ = Ian_i</td>
</tr>
</tbody>
</table>
(30) King Triton gave more lizards to her than Olivia's mother.

<table>
<thead>
<tr>
<th></th>
<th>17 (61%)</th>
<th>11 (39%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>'her' = Aquata</td>
<td>'her' = Olivia</td>
<td></td>
</tr>
</tbody>
</table>

Summarizing results obtained in the adults' part of the presented experiment, we emphasize that, as expected, adults responded 100% uniformly in terms of tasks that required comparative structure resolution. However, their responses to test sentences that involved a potential Principle C revealed different degrees of sensitivity towards this constraint in different syntactic environments. Overall, the results of this experiment (particularly, Figure 9) do not support the judgments presented in Lechner (2004) and Bhatt and Takahashi (2011) suggesting that the reported contrasts are not so clear-cut and alone cannot serve as a solid foundation for the Reduction Analysis in English.

4.2.2. Children Data

Children's responses to control stimuli (31) and (32) which involved simple subject and object comparatives were remarkably uniform.

(31) More cars drove into town than into the woods.
(32) Sheriff Woody fed more bears than Jessie.

Figure 12. Distribution of children's responses (control stimuli (31) and (32))

<table>
<thead>
<tr>
<th></th>
<th>☑ Comparative</th>
<th>☐ Comparative</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>(31)</td>
<td>26 (100%)</td>
<td>0</td>
<td>26 (100%)</td>
</tr>
<tr>
<td>(32)</td>
<td>26 (100%)</td>
<td>0</td>
<td>26 (100%)</td>
</tr>
</tbody>
</table>

Of the 26 children whose answers were used for the analysis in this study, all 26 (100%) successfully passed the control sentences designed to assess their ability
to interpret subject and object comparatives. There was no confusion or incorrect interpretations in either the act-out task (31) or the truth value judgment task (32). Each time after receiving the response from the child in a truth value judgment task, one of the experimenters requested the child to give the reasoning for such answer (regardless of whether the answer was positive or negative), and the elicited argumentation confirmed that all children understood the scenario correctly and were responding to the control stimuli accordingly. Let us now turn to the pronoun reference resolution in target sentences.

First, we observe that children were proficient in resolving the comparative relationships presented in all the act-out tasks. In most cases children were able to identify the two characters in the scenario that were relevant for the comparative in the target sentence and move the props so that the comparative relationship between the two sets instantiated by the target stimulus was observed.

Figure 13. Distribution of children’s answers in terms of comparative recognition

<table>
<thead>
<tr>
<th>Target Stimuli #</th>
<th>Comparative Relationship Observed Correctly</th>
<th>Confusion about the Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject Comparative (27)</td>
<td>16 (61.5%)</td>
<td>10 (38.5%)</td>
</tr>
<tr>
<td>Subject Comparative (29)</td>
<td>22 (84.5%)</td>
<td>4 (15.5%)</td>
</tr>
<tr>
<td>Object Comparative (28)</td>
<td>23 (88.5%)</td>
<td>3 (11.5%)</td>
</tr>
<tr>
<td>Object Comparative (30)</td>
<td>22 (84.5%)</td>
<td>4 (15.5%)</td>
</tr>
</tbody>
</table>

Target stimulus (33) below was designed as a subject comparative with an ambiguous interpretation: according to Bhatt and Takahashi (2011), the sentence
was intended to have a grammatical reading regardless of whether the child accepted the suggested co-indexation or ruled it out. One of the options was to co-refer the pronoun ‘him’ with the R-expression ‘Harris’, the other was to assign the value of the pronoun as the second available male character in the scenario – ‘Ian’.

(33) More lambs walked from Belle to himi/j than from Harris’s brother.

Analogously, target stimulus (34) was designed as an object comparative with an ambiguous interpretation: it had to have a grammatical reading regardless of the choice of co-indexation on the pronoun. One of the options was to co-refer the pronoun ‘her’ with the R-expression ‘Olivia’, the other was to assign the value of the pronoun as the second available female character in the scenario – ‘Aquata’.

(34) King Triton gave more lizards to heri/j than Olivia’s mother.

Since both of those target stimuli allowed for ambiguity without a constraint violation, we expected to get a close to 50% distribution in children’s answers in terms of the pronoun referent that they picked. Below is the distribution of children’s answers in terms of the referent choice on these scenarios.

Figure 14. Distribution of children’s answers in terms of pronoun reference resolution (target stimuli (33)-(34))
Thus, the distribution was exactly 50% in case of target stimulus (33), and 59% vs. 41% for the target stimulus (34), which shows that in both cases there was no significant asymmetry in the scenario itself: as we have emphasized in the ‘Method’ section, our goal was to make both referents equally prominent both in terms of their scenario participation, and the positioning of the relevant toy on the table in terms of its availability to the child. The distribution presented in Figure 14 suggests that this goal was achieved.

At the same time, children did display an unexpected pattern of responses. Recall that, since all the target sentences involved an act-out task, we predicted one of the two possible responses: a participant would choose one of the two contextually available referents for the pronoun in the target stimulus (e.g. Ian or Harris for target sentence (33), who were both calling for the lambs), and then move the props (lambs) to the chosen referent from Belle and from Harris’s brother in accordance with the instructions provided in the scenario, i.e. making it so that more lambs arrive from Belle. However, the range of answers given by the participants to this particular control exceeded our predictions.

Of the 26 children whose answers were used for the analysis in this study, 13 children (50%) interpreted this control stimulus as a three-participant event, i.e., as we expected, they chose a male referent for the pronoun ‘him’ in the associate clause, and moved the lambs to this referent from the two distributor characters Belle and Harris’s brother. 4 children (15%) did not provide an interpretation.

Further 9 (35%) children treated this control as a 4-participant event: particularly, they chose one male referent for the pronoun in the associate clause,
and the other male referent for the parallel unpronounced pronoun in the standard clause. To be more specific, judging by the way they distributed the cones in the act-out task and the comments that they provided after doing so, they displayed one of the two following options in interpreting the control stimulus:

(35) More lambs walked from Belle to him\textsubscript{j} than from Harris\textapos;s brother.

(a) More lambs walked from Belle to Ian than from Harris\textapos;s brother to Harris.
(b) More lambs walked from Belle to Harris than from Harris\textapos;s brother to Ian.

Scenario (36) also revealed this peculiar 4-participant resolution on behalf of children; and again, the participants split between the two options of resolving the target stimulus. Of the 26 children whose answers were used for the analysis in this study, 9 children (35%) interpreted this test sentence as a three-participant scenario. 4 children (15%) did not provide an interpretation. Further 13 (50%) children treated this control as a 4-participant scenario with one of the two following interpretations:

(36) King Triton gave more lizards to her\textsubscript{j} than Olivia\textapos;s mother.

(a) King Triton gave more lizards to Aquata than Olivia\textapos;s mother to Olivia.
(b) King Triton gave more lizards to Olivia than Olivia\textapos;s mother to Aquata.

We will leave a theoretical discussion of the semantic and syntactic status of a 4-participants comparative interpretation till the Discussion section; while at this point we will only say that such unexpected interpretations were observed in all the act-out tasks where children were asked to pick a referent for a pronoun in a comparative construction (for the convenience of the reader we repeat the relevant stimuli below). Figure 15 below presents the distribution of children\textapos;s responses in
terms of the strategy of scenario resolution in each particular case. Note that we’re providing the percentage of the valid responses here, excluding the children who did not provide an interpretation.

(37) She gave more cones to Winnie-the-Pooh than to Sleeping Beauty’s godmother.
(38) More blocks connected him to Minnie than to Flynn’s horse.
(39) More lambs walked from Belle to him than from Harris’s brother.
(40) Nemo delivered more presents from him to Flounder than to Eric’s dog.
(41) King Triton gave more lizards to her than Olivia’s mother.

Figure 15. Distribution of 3- vs. 4- participant interpretations across control and target stimuli

With the exception of target stimulus (38), which turned out to be rather challenging for the participants, the remaining four sentences approached equal or close to equal distribution between the number of participants who chose 3- vs. 4- participant interpretations. This suggests that the 4-participant interpretation was not accidental or caused by a possible flaw in the experiment design, but is a systematic reflection of a specific aspect of children’s grammar. Even target stimulus (38) had a small number of participants who interpreted the stimulus as a 4-
participant event. At the same time it is crucial to mention that the majority of children did not systematically prefer one or the other strategy of resolving the scenarios throughout the experiment. Figure 16 below shows how many times out of possible 5 each individual participant used a 4-participant scenario resolution strategy.

Figure 16. The distribution of 4-participant scenario resolution for individual participants

<table>
<thead>
<tr>
<th># of 4-participant interpretations</th>
<th>Children</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>7</td>
<td>28</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>28</td>
</tr>
</tbody>
</table>

The majority of children 19 (73% - all shaded area) interchangeably displayed both options in the way they resolved the tasks suggested by the experimenter, and as has been shown in Figure 15 above, no scenario revealed any bias toward one or the other interpretation. This is also the case with 8 children who approached adult performance and only gave one or two 4-participant responses (darker shaded area): those, as well, were distributed across different scenarios. Finally, there was no noticeable correlation between the age of the participants and the strategy they chose for the scenario interpretation.

All adults, as expected, offered 3-participant answers. At the same time, at least 4 adults responding to the task attempted at moving the props instantiating a
4-participant interpretation. Then they all would stop, ask to repeat the target sentence, and correct themselves interpreting the scenario as a 3-participant event. This suggests that whatever mechanism of interpretation children have, it is not unique to children only: adults marginally resort to the same processing schema. It could be the case that in adults this mechanism is blocked by processing efficiency; however, when the adults are not concentrated, and their processing is not functioning as accurately, this child-like interpretation can marginally emerge.

It is crucial to note here that it was due to the very nature of the act-out task chosen to test this particular judgment that we were able to observe such an unexpected linguistic behavior in the participants of the study. If the choice of task had been a truth value judgment, it would not be possible to elicit the responses of such kind.

As for children's responses in terms of binding Principle C violations, it is crucial to consider target sentences (42)-(43), which were designed as subject and object comparative respectively and contextually allowed for two possible pronoun referent assignments; however, only one choice of referent was possible in terms of grammaticality judgments presented in Lechner (2004) and Bhatt and Takahashi (2011). The other was considered ungrammatical.

(42) More blocks connected him_{i/j} to Minnie than to Flynn’s horse.
(43) Nemo delivered more presents from him_{i/j} to Flounder than to Eric’s dog.

Children's responses to these target stimuli did not show preference to the reading that observed binding Principle C. Within both strategies of scenario resolution (3- vs. 4-participant interpretations), the choice of pronoun referent did
not support the judgments presented in Lechner (2004) and Bhatt and Takahashi (2011).

Figure 17. The distribution of children’s answers in terms of Principle C observation (target stimuli (42)-(43))

Further we will discuss the specifics of each of the two target stimuli individually.

Target stimulus (43) was designed as an object comparative with a possible principle C violation in case if the child associated the pronoun ‘him’ with the R-expression ‘Eric’. Of the 26 children whose answers were used for the analysis in this study, 11 children (42.5%) interpreted this test sentence as a three-participant scenario. Of those, 5 (19.5%) children observed principle C choosing Buzz Lightyear as a referent for the pronoun; and 6 (23%) did not do so associating the pronoun with Eric. Further 11 (42.5%) children treated this control as a 4-participant scenario. The two possible interpretations in this case were the following:

\[(44) \quad \text{Nemo delivered more presents from } \text{him}^{\text{i/j}} \text{ to Flounder than to Eric’s dog.}\]

(a) Nemo delivered more presents from Eric to Flounder than from Buzz to Eric’s dog.
Reduction Analysis LF:
\[[] \quad \text{[-er [than [} \lambda d \text{ (Nemo delivered d-many presents from Buzz to Eric’s dog)]]] }\]
\[\lambda d[\text{Nemo delivered d-many presents from Eric to Flounder}]\]
(b) Nemo delivered more presents from Buzz to Flounder than from Eric to Eric’s dog.
Reduction Analysis LF:
[[[-er [than [λd (Nemo delivered d-many presents from Eric to Eric’s dog)]]]
λd[Nemo delivered d-many presents from Buzz to Flounder]]

Of those 11 (42.5%) children who treated this target stimulus as a 4-participant situation, 4 (15%) chose the interpretation (a) and 7 (27.5%) – interpretation (b).

Figure 18. Distribution of children’s responses (target stimulus (44))

Again, leaving a theoretical discussion of the possibility of such answers for the Discussion section, at this point we will only say that, according to Bhatt and Takahashi (2011), interpretation (a) observes Binding Principle C (see the LF above), since it suggests a co-reference between the pronoun in the associate clause with the R-expression in the standard clause (this way at LF after the raising of the standard the pronoun no longer c-commands the R-expression). In its own turn, interpretation (b) supposedly violates Principle C, since the giver of presents associated with the standard clause (Eric) was co-referred with a syntactically dominated R-expression. As shown in Figure 19 below, children did not favor the
pronoun reference that observed binding Principle C in either 3-participant, or 4-participant scenario interpretation.

Figure 19. Distribution of children’s answers to target stimulus (44) in respect to Principle C

Analogously, target stimulus (45) was designed as a subject comparative with a possible principle C violation in case if the child associated the pronoun ‘him’ with the R-expression ‘Flynn’.

(45) More blocks connected him\textsubscript{i/j} to Minnie than to Flynn\textsubscript{i’s} horse.

This particular task required children to use the building blocks provided by the experimenter and split these blocks placing them on both sides of the chosen referent to connect him to the other two toys (Minnie Mouse and Flynn’s horse). This turned out to be a challenging task for the selected age group, since it involved significant confusion associated with the way the blocks should be used to “build bridges”, as had been described in the scenario. As a result 10 children (38%) did not provide an interpretation.

Of the 26 children whose answers were used for the analysis in this study, 14 children (54%) interpreted this test sentence as a three-participant scenario. Of
those 14 (54%) children, 5 (19%) observed principle C associating the pronoun ‘him’ with Batman; and 9 (35%) violated principle C associating the pronoun with Flynn, which was the c-commanded R-expression. Further 2 (8%) children treated this control as a 4-participant scenario, where one of the constructed bridges linked Flynn and Minnie Mouse, while the other connected Batman to Flynn’s horse.

(a) More blocks connected Flynn to Minnie Mouse than Batman to Flynn’s horse. Reduction analysis LF:
[[\text{-er [than } \lambda d ((d-many blocks connected Flynn to Minnie Mouse))] \lambda d[(d-many blocks connected Batman to Flynn’s horse)]]

According to Bhatt and Takahashi (2011), such an interpretation observes binding principle C, since the pronoun in the associate clause does not c-command the R-expression in the standard clause at LF after the raising of the standard has taken place. None of the children went for an interpretation where the referent assignment was reversed and bridges connected Batman to Minnie and Flynn to Flynn’s horse.
Unfortunately, this target sentence did not prove informative enough in terms of the response analysis, since a significant percentage of children found the task too challenging. Nevertheless, judging by the children who responded to the experimenter’s request successfully (and the majority of those treated the stimulus as a 3-participant event), principle C was not consistently observed by this group of respondents. Prevalence of 3-scenario responses in this particular case could be also attributed to the fact that experimenters, faced with the child’s confusion, provided a generalized example of how bridges could be built linking characters to one another: this instruction could have possible enhanced a 3-participant reading.
Summing up the results of children’s study, we can make two important observations: the first one is that our findings do not show any preference for binding Principle C observation in the selected age group; and second, that children systematically display a peculiar non-adultlike 4-participant interpretation in case of each of the four target scenarios.

Appendix B (page 85) provides further details on both children’s and adults’ responses to individual control and target stimuli, some correlations between the two, as well as data on answers distribution in terms of the age of participants and experiment running orders. We will now turn to the discussion of the results reported in this section.

4.3. Discussion

The first important finding of the experiment presented in this paper is that children of the age of 4;6 to 6;5 were highly successful in processing and interpreting simple subject and object comparatives. The success rate in both cases was 100%, which is remarkable considering a significant amount of literature suggesting that children cannot fully understand the concept of comparison (cf. Bishop & Bourne 1985; Clark 1970; Donaldson & Wales 1970; Gathercole 1985, 2009; Moore 1999; Piaget 1928; Riley & Trabasso 1974; Wales & Campbell 1970). It is also important to say that in the experimental design we made additional effort to make sure that children were comparing numeral quantities of objects and not volumes: for example, during an act-out task in the training session, they were requested to put “more pebbles than shells” in a box, while shells provided for the task were significantly bigger than pebbles in size. Nevertheless, all the children
interpreted the sentence perfectly in terms of numeric quantities. Finally, in all the control and target sentences that had a comparative stimulus, even when children interpreted the comparison in a non-adultlike way, in the majority of cases they had no problems acting-out a requested comparative relationship correctly. They picked a character for an associate; they chose a corresponding character to represent the standard; and they established a relevant comparative relation between them. This strongly suggests that the ability of children to interpret comparatives has been largely underestimated.

As for the results on the recognition of binding principle C, neither children, nor adults showed any noticeable preference towards the judgments presented in Lechner (2004) and Bhatt and Takahashi (2011). We will return to the theoretical consequences of these findings in the General Discussion section, while here we will only state once more that the predicted distribution was not observed in any of the target stimulus that involved a possible constraint violation in both children’s and adults studies.

The surprising finding of the experiment was that a significant number of children displayed a non-adultlike 4-participant interpretation of both control and target sentences. Most children who participated offered both interpretation options (only 7 out of 26 children (27%) displayed completely adult-like behavior treating all relevant scenarios as 3-participant ones). The remaining majority (73%) displayed both options across different scenarios without noticeable preference for either interpretation given in any particular scenario. This suggests that these two mechanisms of interpreting comparatives are indeed a part of children's grammar:
not the consequence of a possible flaw or ambiguity in the experimental design. This finding reveals a new remarkable feature of children’s grammar and requires further analysis and investigation.

5. General Discussion

We have begun this paper by outlining the major goals behind this investigation: to research young children’s understanding of complex nominal comparative constructions; to explore children’s abstract representations corresponding to such comparatives relating those to the existing account of the underlying structure of comparatives in English (Bhatt & Takahashi 2011, Lechner 2004); and to provide experimental support for a discussion regarding the two possible analyses (Reduction vs. Direct) of the structure of comparatives in general and a degree morpheme in particular. In this section, we summarize how the experimental results address each of these goals and present an account of the findings within the framework of both Reduction and Direct analyses of comparative constructions.

First, the results of the experiment have shown that by 4;6 years of age children have significant knowledge and understanding of conceptual, lexical and structural platforms underlying the use and formation of comparative constructions. More specifically, they understand what it means for two entities to differ in terms of the degree to which they possess a given property; they can correctly order sets of objects/individuals in terms of this scale; they identify both the associate and the standard of comparison and relate those two adequately in terms of their position on the scale. It has also been shown that at times the
interpretation that children have is similar to that of adults; while in other cases the abstract representation that they have behind the comparative structure is distinct from the adult one, and as a result children interpret such structures differently.

5.1. Lechner (2004) and Bhatt and Takahashi (2011) Revisited

Our primary goal was to look for experimental evidence for the Reduction Analysis of English comparatives, as proposed in Lechner (2004) and Bhatt and Takahashi (2011). We were expecting that comparing acquisition data to that of adults will help shed light on the path of acquisition process and the status of English in terms of its degree head inventory. As has been mentioned earlier in the literature review section, the judgments on sentences with putative principle C effect reported in both papers were difficult to process. As Merchant (2012) pointed out, the presented contrasts are difficult to confirm, since the judgments are not so easily accessible to a native speaker. In fact, as Merchant further suggests, the explanation of the suggested contrast contradicts the well-formedness of cases where overt movement or quantifier raising bleeds binding Principle C (e.g., Fox 1999):

(46) Sami’s dad, he i ’s always respected.

(47) I expected himi to overtake the same people Peteri’s sister did <expect himi to overtake>.

And, since those specific judgments served as the foundation for the choice of Reduction analysis for English, it was the more interesting to test them in an experimental setting. In this section we would like to discuss what our findings suggests for the initial theoretical premises: Reduction Analysis of English
comparatives. In fact, the experimental results of either children’s or adults’ studies do not support this analysis.

Judging by just the adults’ results, one can see that the findings of the presented experiment have not supported the judgments contrast reported in Lechner (2004) and Bhatt and Takahashi (2007, 2011). Comparing adult’s performance on the control stimulus that involved a principle C violation regardless of the comparative resolution strategy (control (49) with the overt pronoun in the subject position of the main clause) and their performance on target stimuli that involved a potential principle C violation, should the sentence be analyzed within the framework of Reduction analysis (target sentences (50) and (51) with pronouns reconstructed in the elided standard clause), one can see that while adult’s mostly showed recognition of Principle C in Control (49) (71%), in Target sentences (50) and (51) the success rate was significantly lower (43% for the subject comparative, and 57% for the object comparative).

(48) He_{i} ate the cake, when the Smurf_{i/j} was dancing. (TVJ)
(49) She_{i} gave more cones to Winnie-the-Pooh than to Sleeping Beauty_{i/j}’s godmother. (act-out)
(50) More blocks connected him_{i} to Minnie than to Flynn_{i/j}’s horse. (act-out)
(51) Nemo delivered more presents from him_{i} to Flounder than to Eric_{i/j}’s dog. (act-out)

Also, recall that adults were 100% successful in tracking principle C violation in a control sentence that did not involve a comparative (control (48))). This leads to two crucial conclusions: firstly, the application of principle C in a sentence that does not involve LF movement and/or reconstruction of elided material proves to be
different from the application of principle C in comparatives; and secondly, Principle C violation that emerges in overt material (control (49)) in this study is perceived as more prominent than Principle C violation that emerges at LF as a result of raising and reconstruction of ellipsis site (target sentences (50) and (51)). Indeed, there has been a general agreement in the literature that Principle C applies at LF (Fox 1999, 2000; Saito 2003; Safir 2004 and many others); however, it is not so clear whether the same limitations apply to overt material moved at LF and unpronounced material.

Recall that the formulation of binding Principle C only acts on the basis of a c-commanding relationship between the pronoun and the R-expression; while, from what we observed in the experiment, the judgments are much more diverse than that. Specifically, participants displayed different sensitivity to binding Principle C violations depending on the specific syntactic relationship between the pronoun and the R-expression. From what we observed during the study, we can also state that when adult participants did not get a 100% grammaticality judgment (as in case with simple Principle C control), they were at times looking for another strategy of scenario resolution. When their linguistic judgment was not strong enough, they resorted to discourse anaphora resolution (several adult participants asked to repeat the scenario trying to see which character was more prominent there).

Thus, we have by no means ruled out the possibility of Reduction Analysis; however, our findings have clearly demonstrated that the observed uncertainty of the participants, as well as the general answers distribution raise further concerns
regarding the choice binding relationships as an argument for the underlying comparative structures.

A further question arises if we apply the Direct Analysis to the observed results and try to account for our findings in terms of a three-place degree head. As Lechner (2004) and Bhatt and Takahashi (2007, 2011) report, the Direct Analysis does not recognize the reported contrast in judgments between sentences like target stimuli (52) and (53): in both sentences both referent assignments should be treated as grammatical within the framework of Direct Analysis (cf. examples in (6)-(7) on page 10).

(52) More blocks connected him\textsubscript{i/j} to Minnie than to Flynn\textsubscript{i}'s horse.
(53) More lambs walked from Belle to him\textsubscript{i/j} than from Harris\textsubscript{i}'s brother.

On the one hand, this seems to be in concord with the findings of the reported experiment: the participants did not display a noticeable contrast in terms of the grammaticality of either referent assignment. However, it is also crucial to consider the comparative control sentence as well.

According to Bhatt and Takahashi (2007, 2011), the application of a three-place degree head requires the predicate of individuals and degrees. This predicate has to be created by movement of the associate and the degree phrase: first, the associate moves crating the predicate of individuals, and next the degree phrase moves and targets the predicates of individuals created by the movement of the associate (overt in Hindi-Urdu and Japanese and covert in English). This is an instance of ‘parasitic scope’ – a case where a movement targets a position created by a preceding movement. As the authors suggest, the clearest motivation for the
movement of the associate comes from cases like Figure 22, where the relevant predicate of individuals and degrees does not exist on the surface at all. As they claim, movement of the associate is necessary to create such a predicate. Consider the following comparative that they suggest as an illustration of the process described above.

Figure 22. More students read LGB than the MP

\[
\exists d \left[ \exists x \left( \text{students}(x) \land \text{card}(x) = d \land \text{read}(x, \text{LGB}) \right) \right.
\]
\[
\left. \land \lnot \exists x \left( \text{students}(x) \land \text{card}(x) = d \land \text{read}(x, \text{MP}) \right) \right]
\]

Now, if we apply the same logic to the structure in the control (54) that we used in the experiment, we will obtain the following:

(54) She gave more cones to Winnie-the-Pooh than to Sleeping Beauty’s godmother. (act-out)

Figure 23. LF for Control Sentence (54)
Given the suggested LF, Principle C violation should never arise if the co-indexed R-expression is found in the standard of comparison: it is moved and at LF it occurs in a position no longer c-commanded by the pronoun. Thus, Direct Analysis cannot be used even to account for the case where Principle C violation seems most prominent.

At this point we have to conclude that using binding relationships as the key to the structures underlying the formation of English comparative construction may not be an optimal choice. Neither analysis on its own can be applied to the findings of the current study; and there is definitely a need for further investigation.

The results of the children’s study also pose a question for both Reduction and Direct Analyses of English comparatives. We will consider those closer in the following subsection.

5.2. E-type Pronoun in Children’s Grammars

One of the most peculiar findings of the current study was the way some children interpreted the comparative constructions with the incorporated a personal pronoun. As we have reported earlier, in many cases children treated the suggested comparatives as 4-participant events, as opposed to adult-like 3-participant interpretation (cf. the difference in indexes in the two possible interpretations of target sentence (55) presented in (56)-(57)).

(55) More blocks connected him/i/j to Minnie than to Flynni’s horse.

(56) More blocks connected himi (Flynn) to Minnie than \( \lambda d \) [ d-many blocks connected himi (Batman) to Flynni’s horse]

(57) More blocks connected himi (Batman) to Minnie than \( \lambda d \) [ d-many blocks connected himi (Flynn) to Flynni’s horse]
In other words children, unlike adults, in many cases ignored the requirement that the referent of the pronoun in the main clause had to be the same as the referent of the parallel pronoun in the standard clause, and assigned different values to those two personal pronouns as a result. This way, children allowed for an indices mismatch on the pronouns, where the adult grammar imposed obligatory co-indexation.

This phenomenon has not been previously reported in the acquisition literature: at first sight it looks like, when interpreting such constructions, adults only allow for a strict reading, while children in many cases allow for a sloppy identity. Just to recall briefly, the terms ‘strict’ and ‘sloppy’ identity are typically confined to anaphors, the prototypical elliptical interpretation stemming from an anaphoric dependence between a pronoun in the source clause and its antecedent, where the latter is a parallel element (Elbourne 2001, 2002; Fiengo and May 1994; Rooth 1992; Safir 2004; Sag 1976 and many others). Particularly, Fiengo and May (1994) argue that sloppy identity is possible because Dependency theory contains a notion of identity-i-copy which allows β-occuences of indices to be non-distinct if they manifest identical patterns of indexical behavior. At the same time, sloppy identity is a phenomenon most typically observed with possessive pronouns and anaphors, but not with personal pronouns, which is the case in (56)-(57).

Fortunately, generative literature provides us a piece of machinery that has the properties similar to those observed: what we are dealing with in the case of children’s 4-participant interpretation is not a bound variable and not a referential pronoun, it is much more similar to a definite description. In other words, it behaves
like a functional pronoun that allows for the denotation to vary with the assignment. This is very similar to what Heim (1990) and Heim and Kratzer (1998) referred to as ‘E-type pronouns’, noting that those can be always paraphrased by a definite description. This is the type of phenomenon that is observed in the well-know donkey-anaphora sentences (Cooper 1979; Evans 1977).

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

The necessary truth conditions for sentences of such kind can be obtained if the pronoun is interpreted in the semantics as the value of a contextually salient function $f$ applied to an argument $x$ (Heim 1990). In such an approach $x$ will be bound and $f$ would be that function that maps each individual $x$ in the domain to the unique individual associated with $x$. The difference between the donkey-anaphora sentences and the examples that we have considered is being the source of multiple function application: in the former it results from the application of the universal quantifier, while in the latter – from the structural parallelism between the main and the comparative clause. For example, for control sentence (60) we would have the following:

(60) She gave more cones to Winnie-the-Pooh than to Sleeping Beauty’s godmother.

$\lambda d [\text{she gave } d \text{ many cones to Sleeping Beauty’s godmother}].
\text{f(x)}$ is a contextially salient function from individuals to individuals domain of $f \rightarrow \{x: x \text{ is the recipient of cones}\}$
value of $f \rightarrow$ the individual giving cones to $x$

Further, applying this function to the comparative under consideration, we obtain the comparison between the following two sets, which is what children
participating in this study have been doing when proposing 4-participant interpretations for the suggested test sentences:

(61) \( \lambda d (\lambda x (f(x) \text{ gave } d\text{-many cones to } x)) \) (Winnie-the-Pooh ))
(62) \( \lambda d (\lambda x (f(x) \text{ gave } d\text{-many cones to } x)) \) (Sl. Beauty's Godmother ))

The proposal regarding the use of an e-type pronoun by children in the comparatives under consideration has a number of positive effects. Firstly, it successfully accounts for the observed interpretations; secondly, it does not require the introduction of a new entity: e-type pronouns have known to be a part of adult grammar, so here we are only dealing with a new syntactic/semantic environment of their application. Finally, as we have mentioned earlier, adults marginally attempted at interpreting the test comparatives as 4-participant events when their concentration was lowered: thus, again, the suggested analysis does not require the creation of a boundary between children’s and adult’s grammars.

In fact, there is remarkably little research on acquisition that touches upon children’s use and understanding of functional pronouns. Particularly, we have found that children’s understanding of relative-clause (58) and conditional (59) donkey sentences was investigated in a series of experiments reported in Conway (1997); Conway and Crain (1995) and Crain, Conway and Thornton (1994). Their findings suggested that children did not behave like adults in their representations: as a group, children rejected the weak reading of conditional sentences (where the farmer must beat/feed at least one of the donkeys that he owns, not necessarily all of them) more often than they rejected the weak reading of relatives; and as individuals, some children consistently rejected the weak reading of conditional, but no child behaved in this way in response to relative-clause donkey sentences. The
authors interpret these finding as evidence that children’s earlier hypothesis regarding such structures corresponds to the dispreferred option by adults (if we accept the claim generally made in the literature that adults generally prefer a strong reading where every farmer has to beat/feed every donkey that he owns). Further, Conway and Crain suggest that the nature of the relation between the entity associated with the domain of the function and entity designated by the function value significantly influence the judgments that children present. When this relationship is that of inalienable possession (e.g. f(x) is the child of x), children respond differently to relative-clause donkey sentences, as compared to the relationship of alienable possession (e.g. f(x) is the object that belongs to x). No contrast of such kind was observed with conditionals. The control study with adults showed that they seem to be totally unaware of the alienable/inalienable distinction.

These findings can be useful in terms of research presented in the current paper in two possible ways: firstly, they provide data on children’s use of functional pronouns and show how it differs noticeably from that of adults. Conway and Crain (1995) show that children do have e-type pronouns in their semantic inventories; however, their application at the level of syntax and interpretation deviates from that of adults, which is also the case that we observe within the current study. Secondly, they show that when designing experimental settings for children, it is crucial to take into account the nature of relationship between the characters as well (e.g. alienable/inalienable possession): they suggest that adult can rely on real world knowledge in making decision regarding the interpretation of ambiguous
sentences, and having this experience they lose certain syntactic and semantic distinctions available to children. Children, who have less real world knowledge, have judgments that appear to be more revealing with respect to underlying syntactic/semantic principles in the derivation of linguistic representations. Thus, they can at times manifest grammatical distinctions that are masked in adult performance by the wealth of extralinguistic knowledge. This shows that designing a study that incorporates both children’s trial and adults’ trial is, indeed, the best way to draw conclusions regarding underlying linguistic representations.

Also, thinking about the directions for further research in the suggested direction, one can consider the following: the traditional e-type analysis treats functional pronouns as skolem descriptions.

\[(63)[\text{the } [\mathcal{R}_{<7,\text{e,et}>, \text{ pro}_{<1,e}>]}] \quad \text{Evans (1977), Cooper (1979)}\]

This means that the e-type pronoun is i-(individual)-bound. As has been suggested in recent literature this traditional analysis raises several questions including the uniqueness presupposition, conflict between i-binding and the availability of sloppy reading, and the question of coordinated antecedents (Heim 1990; Elbourne 2001, 2002; Buring 2004). Heim (1990) points out that the uniqueness presupposition rest on the premise that quantification happens over worlds, while in case with the case of e-type pronouns it has to vary with something smaller, i.e. situation. Elbourne (2001, 2002) show that i-binding also has to be ruled out, since in terms of strict/sloppy reading e-type pronouns pattern with pure descriptions (e.g. ‘the donkey’), not the skolem descriptions (e.g. ‘the donkey that hei owns’). Finally, considering sentence with multiple coordinated antecedents, like
(64), Leu (2004) arrives to the conclusion that the descriptive content of e-type pronoun at LF must be less specific than the denotation of the antecedent, particularly, it cannot have just any NP-meaning at LF, but must not be specified beyond phi-features.

(64) Every man who owns a donkey or a goat, beats it.

This claim seems interesting in terms of a possible further investigation: the study presented in the current paper in each case provided scenarios where the two available referents were entities of a similar nature with all phi features matching. It would be interesting to see whether the same e-type readings would arise in children, should there be a gender/number or type of entity mismatch. Such results could prove rather informative for the status of an e-type pronoun in children’s grammar.

The question that we ask ourselves at this point is whether the fact that children apply an e-type pronoun in such interpretations can support/rule out either analysis for English language.

Let us first consider applicability of an e-type pronoun to Reduction Analysis: recall that in this case the structure has to incorporate a 2-place degree head that takes two clausal arguments and requires reconstruction of ellipsis at LF. Specifically, for sentence (65) we will have the following:

(65) She gave more cones to Winnie-the-Pooh than to Sleeping Beauty’s godmother.
As one can see, according to this analysis, the functional pronoun, as defined in (60) above, is reconstructed in the elided part of the standard of comparison, and thus it applies twice to two different members of the domain (here Winnie the Pooh and SB’s Godmother). This LF is consistent with the reading that many children were getting and allows for the interpretation of the scenario as a 4-participant event.

With Direct Analysis, the structure has to incorporate a 3-place degree head that combines two individual arguments and a predicate of individuals and degrees. There is no requirement for a reduction operation, and the necessary configuration is achieved only by movement at LF:
Figure 25. Direct Analysis LF for control (65):
\[
[Winnie-the-Pooh [[-er [than Sleeping Beauty's Godmother]] \lambda d \lambda x f(x) \text{ gave } d\text{-many cones to } x]]
\]

Again, no contradiction is observed: 3-place degree head also allows the functional pronoun to apply twice and assign two givers to two recipients (e.g., Hello Kitty giving more cones to W-t-P than Sleeping Beauty to her own Godmother), which was the essence of the interpretation that children were getting.

Thus, the non-adultlike 4-participant interpretations that involve the use of an e-type pronoun can be compatible with either underlying structure. Further, recall that the binding judgments obtained from both children and adults did not support either analysis conclusively. Consequently, our findings leave the question of the status of English in terms of its degree head inventory open and emphasis the need for a further detailed investigation.

6. Conclusions

The goal of this study was twofold: first, we aimed at providing some additional information of children's ability to process complex comparative relationships; and second, we aimed to shed light on the abstract representations behind comparative constructions that children and adults have and whether they
display any evidence regarding the use of a two-place vs. three-place comparative degree head.

As we have found out children between the ages of 4 and 6 are capable of processing and interpreting nominal comparatives: they showed remarkable uniformity in their performance on simple comparatives, and they were very successful in interpreting comparatives of higher structural complexity involving a binding relationship. Although, children processed such comparatives differently from adults, they were never confused about relevant numerical quantities; they were able to recover the associate and the standard of a comparative successfully (though, again, at times they did so in a non-adultlike manner), and they recreated a relevant comparative relationship between the two in an act-out task. This way we have shown that children’s ability to process linguistic comparative emerges at a rather early age and achieves high proficiency by the age of 4.

The crucial distinction between children’s and adults’ performance was observed, when children offered 4-participant interpretations of the scenarios perceived as 3-participant by adults. The consistency with which most children used such interpretations in all the experimental scenarios showed that this mechanism was a systematic part of children’s grammar. Particularly, participants had two options available to them: they either treated pronouns as referential, or as functional, i.e. e-type. This finding poses a number of questions for the upcoming research, since the use of e-type pronouns by children has not been studied much previously, and the mechanism of children’s evolution from the observed deviant linguistic behavior to adult like performance are still to be researched.
Finally, at this point we have to conclude that using binding relationships as the key to the structures underlying the formation of English comparative construction may not be an optimal choice. Our findings in both groups of participants provided no definitive support for the Reduction Analysis, as suggested by Bhatt and Takahashi. We have not ruled out the possibility that children, as well as adults, could have both 2- and 3-place degree heads in their semantic inventories. We have also emphasized that the role of binding relationships vs. the role of co-reference in comparatives interpretation remains unclear, suggesting that there is a definite need for further scrupulous investigation.
7. References


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Appendix A: Training Session, Control Stimuli, Target Stimuli and Scenarios

Training Session

1. Ariel swam from Ursula to her sister for help. (TVJ)
2. Hello Kitty bought more pebbles than shells. (act-out)

Control Stimuli

3. More cars drove into town than into the woods. (act-out)
4. Sherriff Woody fed more bear cubs than Jessie. (TVJ)
5. He ate the cake, when the Smurf was dancing. (TVJ)
6. Sebastian found a present from her to Ariel’s sister. (TVJ)
7. She gave more cones to Winnie-the-Pooh than to Sleeping Beauty’s godmother. (act-out)

Target Stimuli

8. More blocks connected him to Minnie than to Flynn’s horse. (act-out)
9. More lambs walked from Belle to him than from Harris’s brother. (act-out)
10. Nemo delivered more presents from him to Flounder than to Eric’s dog. (act-out)
11. King Triton gave more lizards to her than Olivia’s mother. (act-out)
Figure 26. Materials for the Experiment

<table>
<thead>
<tr>
<th>Stimulus</th>
<th>Characters</th>
<th>Props</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Training Session</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ariel swam from Ursula to her sister for help.</td>
<td>Mermaid Ariel Mermaid Attina Ursula, the Witch Dori, the Blue Fish</td>
<td></td>
</tr>
<tr>
<td>Hello Kitty bought more pebbles than shells.</td>
<td>Hello Kitty</td>
<td>shopping basket 3 pebbles 3 shells</td>
</tr>
<tr>
<td><strong>Control Stimuli</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More cars drove into town than into the woods</td>
<td>5 multicolor cars</td>
<td>Houses for town Trees for woods</td>
</tr>
<tr>
<td>Sherriff Woody fed more bear cubs than Jessie.</td>
<td>Sherriff Woody Jessy 3 bear cubs</td>
<td>3 apples two cupcakes</td>
</tr>
<tr>
<td>He ate the cake, when the Smurf was dancing.</td>
<td>Tigger Smurf</td>
<td>cake banana</td>
</tr>
<tr>
<td>Sebastian found a present from her to Ariel’s sister.</td>
<td>Ariel Rupunzel Sebastian</td>
<td>Two presents (color-coded) Two boxes to hide the presents</td>
</tr>
<tr>
<td>She gave more cones to Winnie-the-Pooh than to Sleeping Beauty’s godmother.</td>
<td>Hello Kitty Sleeping Beauty Winnie the Pooh Sleeping Beauty’s godmother</td>
<td>Two sets of color-coded cones (3 yellow ones for SB, 3 pink ones for HK)</td>
</tr>
<tr>
<td><strong>Target Stimuli</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More blocks connected him to Minnie than to Flynn’s horse</td>
<td>Batman Flynn Minnie Mouse Flynn’s Horse</td>
<td>7 building blocks</td>
</tr>
<tr>
<td>More lambs walked from Belle to him than from Harris’s brother</td>
<td>Belle Harris Ian Harris’s Brother</td>
<td>Two sets of color-coded lambs (3 with pink bows for Belle, 3 white ones for Harris’s brother)</td>
</tr>
<tr>
<td>Nemo delivered more presents from him to Flounder than to Eric’s dog</td>
<td>Prince Eric Buzz Lightyear Flounder</td>
<td>Two sets of color-coded presents (3 blue ones from Eric,</td>
</tr>
<tr>
<td>King Triton gave more lizards to her than Olivia’s mother</td>
<td>Eric’s Dog Nemo</td>
<td>3 green ones from Buzz)</td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
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<td>----------------------</td>
</tr>
<tr>
<td>Olivia Aquata Olivia’s Mother King Triton</td>
<td>Two sets of color-coded toy lizards (3 green ones from Olivia’s Mom, 3 from King Triton)</td>
<td></td>
</tr>
</tbody>
</table>
1. Ariel Running Away
   (training, truth value judgment)

Narrator: Once, Ariel and her sister Attina were playing outside their father's castle. They were swimming around, playing tag and looking at the flowers in the beautiful underwater garden. Then they decided to play hide-and-seek. Ariel was the first to hide.

Ariel: I’m going to hide so well, Attina will never find me! Oh, no – here comes Ursula, the witch! If she sees me all alone, she’s going to do something evil.

Narrator: Ariel’s sister was far away. But suddenly Ariel saw Dory, a little blue fish, and she swam to Dory for help.

Ariel: Dory, Dory, help me. Ursula is after me!

Puppet: Oh, this is scary! Meeting the witch when you’re all alone... So, let me tell you what’s happened: Ariel was playing with her sister and then she decided to hide. And then Ariel saw Ursula the witch. She got scared, and then I know:

   **Ariel swam from Ursula to her sister for help.**

Am I right?
2. Shells and Pebbles.
(train, act-out)

**Narrator:** This is Hello Kitty. I’m sure you know her very well. On day Hello Kitty went for a walk on the beach. It was a beautiful day and she was really enjoying herself. Then she went into the souvenir store: Hello Kitty wanted to buy something to bring home with her.

**Kitty:** Oh, they have so many beautiful things in here! They have sea shells for sale. Oh, how pretty they are. And here they have pebbles! I wish I could buy them all, but I don’t have enough money. I know: I should buy several shells and several pebbles to take home with me.

**Narrator:** And so she did. And Hello Kitty chose several pebbles and several shells, and it happened so that she had more pebbles than shells.

**Puppet:** Oh, yes, ok! Can you show me that? Can you show me that Hello Kitty bought more pebbles than shells?
3. Cars, City and Forest
(control, act-out)

Narrator: Once there were several little cars that wanted to have a race. They all gathered together outside a small town and started talking about the rules of the race.

Car #1: Let’s all start here and race into town. Whoever reaches the town first is the winner!

Car #2: Or we could race to the woods! Racing into town is dangerous: we could hit somebody!

Narrator: And all the cars went like “Let’s race into town! Let’s race into the woods!” And they have been arguing about this for a while. And they couldn’t decide on anything. And when one of them yelled “Ready, Set, Go”, some started racing towards the town, and some – towards the woods. And it happened so that more cars drove into town than into the woods.

Puppet: Oh, I learn so much today! Can you show me that? Can you show me that...

More cars drove into town than into the woods.
4. Woody and Jessie  
(control, truth value judgment, expectation TRUE)

Narrator:  This is Sheriff Woody; and this is his friend Jessie. One fine Sunday morning Sheriff Woody and Jessie went to the zoo. And they had lots of fun!

Woody:  This is great! And you know what? You can not only look at animals here at this zoo, but you can feed them too! Would you like to do that?

Jessie:  Of course! That sound great! Who do you want to go and feed first?

Woody:  Let’s feed someone who is small and cute. Look: there are bear cubs right ahead! Do you have anything to feed them with?

Jessie:  I have two cupcakes. I think they might like those.

Woody:  And I have two apples: apples are healthy, and you know what I like to say: an apple a day keeps the bad guys away!

Narrator:  So Sheriff Woody and Jessie went up to the cage with three cute bear cubs.

Woody:  These bear cubs are really friendly. I’m going to give my apples to those two. Here: one for you and one for you!

Jessie:  And I’m going to give one of my cupcakes to this cute little one. And I’m going to keep the other for myself: I’m a bit hungry.

Puppet:  I love going to the zoo too! This story is great: Sheriff Woody and Jessie went to the zoo, and it was ok for them to feed the bear cubs there. And I know what happened:

Sherriff Woody fed more bear cubs than Jessie.

Am I right?
5. Tigger and Smurf
(control, truth value judgment, expectation FALSE)

Narrator: This is Tigger. You know Tigger! He is lots of fun and he is friends with everyone who lives in the forest. And here comes Chef Smurf. He is friends with Tigger too, and he wants to play with him!

Chef Smurf: Hey, Tigger! How are you? Do you want to have a dancing party? We’ll play our favorite songs and dance and bounce!

Tigger: Sure! This sounds great!

Narrator: So, Tigger and Chef Smurf were taking turns in choosing the songs, and they were dancing so much that they started to feel really hungry.

Chef Smurf: Oh, I’m sooo hungry. I want to have some of this cake right now! But this is my favorite song! What should I do? I know: I am not going to stop. I can dance and I can eat the cake at the same time!

Narrator: And so he did: Chef Smurf decided to have some cake, and he kept on dancing.

Chef Smurf: Tigger, would you like to have some of my cake too?

Tigger: No, thanks. I’ll have a banana instead. Yum-yum-yum.

Puppet: Wow, that was a fun story! Chef Smurf wanted to have a dancing party with his friend Tigger. And they were dancing so much that they felt hungry; and both Tigger and Chef Smurf decided to have something to eat. And I know what happened next:

He ate the cake, when the Smurf was dancing.

Am I right?
6. Ariel, Rapunzel, and the Birthday Present
(control, truth value judgment, expectation F)

Narrator: This is Ariel. And this is her friend Rapunzel, a princess with magical hair. By the way, today is Aquata’s birthday! Do you know Aquata? She’s Ariel’s older sister. Ariel and Rapunzel are both wrapping presents for her now.

Rapunzel: This is my gift for your sister. I’m sure Aquata will like it very-very much!

Ariel: That's great! And this is my present for her! It’s ready now!

Rapunzel: Great! And look, how funny: I have wrapped my present in yellow wrapping paper, just like my hair is; and you have chosen red wrapping paper – just like your hair!

Ariel: Right! This is funny! So, the party is in the evening. Let’s leave out presents here for a while and go for a walk.

Rapunzel: Ok, but I want to hide my present before we go, just in case. I will put it under this box, so that nobody sees it before the party.

Ariel: That's a good idea! I’m going to hide my present as well. Here, I'm done. Let’s go now!

Narrator: And so they did. They hid their presents and went for a walk. Meanwhile, Sebastian was wondering around the castle. He wanted to see if Ariel or Rapunzel would play with him, so he walked into the room.

Sebastian: Oh, the princesses are not here... But what is this? Is it a present? Oh, I guess this is a present from Ariel for Aquata’s birthday. IT says so on the card!

Narrator: So Sebastian found Ariel’s present to her sister Aquata, and he didn’t see the one from Rapunzel.

Puppet: Oh, I love birthdays and presents! This story was nice. It was about Ariel and Rapunzel wrapping presents for Aquata’s birthday. They both wrapped their presents and went for a walk. And then Sebastian walked into the room, he was looking for Rapunzel and Ariel. And now let me tell you what happened:

Sebastian found a present from her to Ariel’s sister.
Am I right?
7. **Hello Kitty, Sleeping Beauty and Cones**  
**(control, act-out, FALSE if ‘she’ is Sleeping Beauty)**

**Narrator:** This is Sleeping Beauty. And this is her friend Hello Kitty! And one beautiful morning they met near the castle and decided to play a game.

**Sleeping Beauty:** What are we going to do? Do you have anything to play with?

**Hello Kitty:** We can play with my cones. Look, I have some pink ones and some yellow ones. And you know what we could do? You could take the yellow ones, since you have such beautiful golden hair. And I will take the pink ones, because I have a pink bow on my head!

**Sleeping Beauty:** Thank you, Hello Kitty! Yellow ones do suit me so well. And you know what? One of my fairy godmothers is in the castle right now. Let’s go there and invite her to play with us!

**Hello Kitty:** Sure! And I think Winnie-the-Pooh is now there too: let’s ask him to play with us.

**Narrator:** And so Sleeping Beauty and Hello Kitty went to the castle, where Sleeping Beauty’s godmother and Winnie-the-Pooh were having their afternoon tea.

**Sleeping Beauty:** Hi, my dear godmother! Hi Winnie! Hello Kitty and I came to share our cones with you.

**Hello Kitty:** We will give our cones to both of you, so that we could play a game together!

**Narrator:** And so they did. Winnie-the-Pooh and Sleeping Beauty’s godmother both received cones to play with. And Hello Kitty and Sleeping Beauty had so much fun. And she gave more cones to Winnie-the-Pooh than to Sleeping Beauty’s godmother.

**Puppet:** Oh, yes, I see. Can you now show me that? Can you show me that ...

She gave more cones to Winnie-the-Pooh than to Sleeping Beauty’s godmother.
8. Batman, Flynn, and Building Blocks
(test, act-out, FALSE if ‘he’ is Flynn)

**Narrator:** This is Flynn Rider. You probably know him very well from the Tangled movie. And this is his horse. In fact, today Flynn and his horse are going to meet their friends from other stories and play a little game with them. Look, here’s Minnie Mouse. And here’s Batman. Let’s see what they are up too today.

**Flynn:** Hey guys! Do you want to play a game? Look we have some building blocks here. Let’s build bridges using those.

**Batman:** That sounds like a good idea, Flynn. And you know what we could do? You and I are stronger, so we are going to build bridges on both sides of us to reach our friends and then we’ll see how many blocks it will take to reach Minnie and your horse.

**Minnie:** This is fun! Flynn, Batman, you start building, and I’m going to stand right here!

**Narrator:** And so they did. Batman and Flynn started taking the building blocks one by one, and building bridges to get from one to the other. And when they were done building, Batman and Flynn counted the blocks. And more blocks connected him to Minnie than to Flynn’s horse.

**Puppet:** I think I got it. But can you show me that? Can you make it so that ...

More blocks connected him to Minnie than to Flynn’s horse.
9. Ian, Harris and Lambs
(test, act-out, both antecedents are grammatical, the desired mentioned last)

Narrator: This is Harris and Ian, the little piglet. It is a beautiful day today, and they are spending it at a farm.

Harris: I like it here! It’s so much fun! Oh, Ian, look: there’s Belle and my brother over there! What are they doing?

Ian: I think they are petting lambs! I didn’t know this farm had a petting zoo. Look, Belle is petting lambs with cute brown faces and pink bows.

Harris: And my brother is petting little white ones! Oh, I want to pet the lambs too! Their fleece must be so soft. You know what, Ian, let’s start calling for the lambs and see what will happen. Maybe they will come to us?

Ian/Harris: Sheepee, sheepee, come here, come, come.

Narrator: And the little lambs heard that Ian and Harris were calling them. And it happened so that more labs went from Belle to him than from Harris’s brother.

Puppet: Oh, this sounds fun! Can you show me that? Please, make it so that...

More lambs walked from Belle to him than from Harris’s brother.
(the puppet should point at the distributors when saying the sentence)
10. Prince Eric, Buzz, and Presents
(test, act-out, False if ‘he’ is Eric)

Narrator: This is Prince Eric, he is a brave prince who loves to travel. And this is Buzz Lightyear. He is good friends with Prince Eric, and he loves travelling too. It happened once that both of them went on a long sea voyage together, and when they came back, they both brought some presents for Flounder and Eric’s dog.

Buzz: Buzz Lightyear here! Hey Eric, look! I wrapped my presents in green wrapping paper, because I have green on my spacesuit!

Prince Eric: Hey Buzz! Great idea! And I have wrapped my presents in blue, because that’s the color of the sea! That’s a great color, and I love wearing it! But you know what: I’m so tired after our journey that I need help to get these presents to our friends.

Buzz: I’m so tired too… Let’s call Nemo and ask him to help us deliver the presents to your dog and Flounder! Nemo, Nemo, come here and help us!

Nemo: Hi, Eric! Hi, Buzz! Good to see you back! What can I do for you?

Eric: Nemo, could you please deliver these presents to my dog and to Flounder? We’re so tired that we cannot walk.

Nemo: Sure! I’d be glad to help.

Narrator: And Nemo started delivering presents from Buzz Lightyear and Prince Eric. And after a while Nemo delivered more presents from him to Flounder than to Eric’s dog.

Puppet: Oh, I see. Can you show me that? Can you make it so that Nemo delivered more presents from him to Flounder than to Eric’s dog?
11. King Triton, Olivia’s Mother and Lizards
(test, act-out, both antecedents are grammatical, the desired mentioned last)

Narrator: This is Olivia, the little piglet. And this is her friend Aquata. She’s a mermaid. They are having a play date at Olivia’s house today! It’s so much fun! They have already been running around for a while, and now they are tired, so they wanted to play quietly.

Aquata: Hey, remember my father King Triton had some toy lizards. Let’s go and ask him to give us some, so that we could play with them.

Olivia: That’s a great idea! And my mom also had some lizards. We could go and ask her too.

Narrator: And so they did. They ran to their parents to talk to them.

Olivia’s mother: Hi girls! You’re looking for toy lizards? I do have some. And look how cute they are: I dressed them all in green, just like the color of the scarf that I’m wearing today! But you will need to share them and be nice. So I am going to give some to both of you.

King Triton: Hi Girls! Look at my toys: I can share them with both of you too!

Narrator: And so Olivia’s mother divided her lizards between Olivia and Aquata, and King Triton did the same thing: he gave some of his lizards to both Aquata and Olivia. And it happened so that King Triton gave more lizards to her than Olivia’s mother.

Puppet: Oh, please, can you show me that? How did it work that...

King Triton gave more lizards to her than Olivia’s mother.
(the puppet can point at the distributors as it is saying the sentence)
Appendix B: Complete Experiment Results Report

7.1.1. Children Data

7.1.1.1. Control Sentences Performance

(66) More cars drove into town than into the woods (act-out)
(67) Sheriff Woody fed more bears than Jessie (TVJ)

Figure 1. Distribution of children's responses (control stimuli (66) and (67))

<table>
<thead>
<tr>
<th></th>
<th>Comparative</th>
<th>Comparative</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>(66)</td>
<td>26 (100%)</td>
<td>0</td>
<td>26 (100%)</td>
</tr>
<tr>
<td>(67)</td>
<td>26 (100%)</td>
<td>0</td>
<td>26 (100%)</td>
</tr>
</tbody>
</table>

(68) He*i/j ate the cake when the Smurf, was dancing (TVJ)

Figure 2. Distribution of children's responses (control stimulus (68))

<table>
<thead>
<tr>
<th></th>
<th>Principle C</th>
<th>Principle C</th>
<th>Confused</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>(68)</td>
<td>12 (46%)</td>
<td>13 (50%)</td>
<td>1 (4%)</td>
<td>26 (100%)</td>
</tr>
</tbody>
</table>

“He” = Tigger

“He” = ‘Smurf’

Figure 3. Distribution of children’s responses to control stimulus (68) in different age groups

<table>
<thead>
<tr>
<th>Age group</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>54-63 months</td>
<td>26 children (100%)</td>
</tr>
<tr>
<td>69-77 months</td>
<td>6 children (23%)</td>
</tr>
<tr>
<td>20 children (77%)</td>
<td></td>
</tr>
<tr>
<td>6 children (23%)</td>
<td></td>
</tr>
<tr>
<td>✓Principle C</td>
<td>✓Principle C</td>
</tr>
<tr>
<td>✓Principle C</td>
<td>✓Principle C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control (68)</th>
<th>✓Principle C</th>
<th>✓Principle C</th>
<th>✓Principle C</th>
<th>✓Principle C</th>
</tr>
</thead>
<tbody>
<tr>
<td>(34.5%)</td>
<td>(42.5%)</td>
<td>(11.5%)</td>
<td>(11.5%)</td>
<td></td>
</tr>
</tbody>
</table>

Figure 4. Distribution of children’s responses to control stimulus (68) in different orders

<table>
<thead>
<tr>
<th>Experiment Order</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order 1</td>
<td></td>
</tr>
<tr>
<td>Order 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>13 children (50%)</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>✅ Principle C</td>
<td>5 (19%)</td>
</tr>
<tr>
<td>✖ Principle C</td>
<td>8 (31%)</td>
</tr>
</tbody>
</table>

(69) Sebastian found a present from her\textsubscript{i/j} to Ariel’s sister. (TVJ)

Of the 26 children whose answers were used for the analysis in this study, 2 (8%) ruled out this control stimuli with the suggested co-reference, thus disallowing the possibility of co-indexation pronoun ‘her’ and the R-expression ‘Ariel’). 24 children (92%) accepted this control sentence as grammatical with a co-reference violating binding principle C. Given a very small number of participants who passed this control and the non-uniform data obtained in the adult pilot study, we have dismissed this particular stimulus from further consideration. The observed results could have followed from a possible flaw in the design of the scenario or insensitivity of both children and adult participants to the particular kind of task. Nevertheless, we will return to the discussion of possible reasons for such a result in the discussion section.

(70) She\textsubscript{i/j} gave more cones to Winnie-the-Pooh than to Sleeping Beauty’s Godmother. (act-out)

(a) Sleeping Beauty gave more cones to Winnie-the-Pooh than Hello Kitty gave to Sleeping Beauty’s Godmother.
(b) Hello Kitty gave more cones to Winnie-the-Pooh than Sleeping Beauty gave to Sleeping Beauty’s Godmother.
Figure 5. Distribution of children’s responses (control stimulus (70))

<table>
<thead>
<tr>
<th></th>
<th>3-participant interpretation</th>
<th>4-participant interpretation</th>
<th>Confused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (70)</td>
<td>13 (50%)</td>
<td>12 (46%)</td>
<td>26 (100%)</td>
</tr>
<tr>
<td>✅Principle C</td>
<td>✅Principle C</td>
<td>✅Principle C</td>
<td></td>
</tr>
<tr>
<td>6 (23%)</td>
<td>7 (27%)</td>
<td>0 (0%)</td>
<td>12 (46%)</td>
</tr>
<tr>
<td>‘She’ = HK</td>
<td>“She” = SB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 (15%)</td>
<td>8 (31%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“She” = SB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7.1.1.2. Target Sentences Performance: Subject and Object Comparatives

(71) More blocks connected him\textsubscript{i/j} to Minnie than to Flynn’s horse.

Figure 6. Distribution of children’s responses in (target stimulus (71))

<table>
<thead>
<tr>
<th></th>
<th>3-participant interpretation</th>
<th>4-participant interpretation</th>
<th>Confused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target (71)</td>
<td>14 (54%)</td>
<td>2 (8%)</td>
<td>26 (100%)</td>
</tr>
<tr>
<td>✅Principle C</td>
<td>✅Principle C</td>
<td>✅Principle C</td>
<td></td>
</tr>
<tr>
<td>5 (19%)</td>
<td>9 (35%)</td>
<td>2 (8%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>‘him’ = Batman</td>
<td>“him” = Flynn</td>
<td>“him” = Flynn</td>
<td></td>
</tr>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(72) More lambs walked from Belle to him\textsubscript{i/j} than from Harris’s brother.

(a) More lambs walked from Belle to Ian than from Harris’s brother to Harris.
(b) More lambs walked from Belle to Harris than from Harris’s brother to Ian.

Figure 7. Distribution of children’s responses (target stimulus (72))

<table>
<thead>
<tr>
<th></th>
<th>3-participant interpretation</th>
<th>4-participant interpretation</th>
<th>Confused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>13</td>
<td>9</td>
<td>4</td>
</tr>
</tbody>
</table>
(72)  |  (50%) |  (35%) |  (15%) |  (100%) |
<table>
<thead>
<tr>
<th></th>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>(23%)</td>
<td>7</td>
<td>(27%)</td>
<td></td>
</tr>
<tr>
<td>‘him’ = Ian</td>
<td></td>
<td>“him” = Harris</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>(19%)</td>
<td>4</td>
<td>(16%)</td>
<td></td>
</tr>
<tr>
<td>“him” = Ian</td>
<td></td>
<td>“him” = Harris</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(73) Nemo delivered more presents from him*_{i/j} to Flounder than to Eric’s dog.

(a) Nemo delivered more presents from Eric to Flounder than from Buzz to Eric’s dog.
(b) Nemo delivered more presents from Buzz to Flounder than from Eric to Eric’s dog.

Figure 8. Distribution of children’s responses (target stimulus (73))

<table>
<thead>
<tr>
<th>Target (73)</th>
<th>3-participant interpretation</th>
<th>4-participant interpretation</th>
<th>Confused</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11 (42.5%)</td>
<td>11 (42.5%)</td>
<td>4 (15%)</td>
</tr>
<tr>
<td>✓Principle C</td>
<td>✓Principle C</td>
<td>✓Principle C</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>(19.5%)</td>
<td>6 (23%)</td>
<td></td>
</tr>
<tr>
<td>’him’ = Buzz</td>
<td>“him” = Eric</td>
<td>“him” = Eric</td>
<td></td>
</tr>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>(27.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“him” = Buzz</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(74) King Triton gave more lizards to her*_{i/j} than Olivia’s mother.

(a) King Triton gave more lizards to Aquata than Olivia’s mother to Olivia.
(b) King Triton gave more lizards to Olivia than Olivia’s mother to Aquata.

Figure 9. Distribution of children’s responses (target stimulus (74))

<table>
<thead>
<tr>
<th>Target (74)</th>
<th>3-participant interpretation</th>
<th>4-participant interpretation</th>
<th>Confused</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9 (35%)</td>
<td>13 (50%)</td>
<td>4 (15%)</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>5</td>
<td>(19.5%)</td>
<td>4 (15.5%)</td>
<td></td>
</tr>
<tr>
<td>‘her’ = Aquata</td>
<td></td>
<td>“her” = Olivia</td>
<td></td>
</tr>
<tr>
<td>(a)</td>
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<td></td>
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</tr>
<tr>
<td>8</td>
<td>(30.5%)</td>
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</tr>
<tr>
<td>“her” = Aquata</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td></td>
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</tr>
<tr>
<td>5</td>
<td>(19.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“her” = Olivia</td>
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</tbody>
</table>
Figure 10. Distribution of 3- vs. 4- participant interpretations across control and target stimuli

<table>
<thead>
<tr>
<th></th>
<th>3-participant interpretation</th>
<th>4-participant interpretation</th>
<th>Total number of valid responses</th>
</tr>
</thead>
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<tr>
<td>Control (70)</td>
<td>Principle C in a comparative</td>
<td>13 (52%)</td>
<td>12 (48%)</td>
</tr>
<tr>
<td>Target (71)</td>
<td>Subject comparative with principle C violation</td>
<td>14 (87.5%)</td>
<td>2 (12.5%)</td>
</tr>
<tr>
<td>Target (72)</td>
<td>Subject comparative with ambiguity</td>
<td>11 (55%)</td>
<td>9 (45%)</td>
</tr>
<tr>
<td>Target (73)</td>
<td>Object comparative with principle C violation</td>
<td>11 (50%)</td>
<td>11 (50%)</td>
</tr>
<tr>
<td>Target (74)</td>
<td>Object comparative with ambiguity</td>
<td>9 (41%)</td>
<td>13 (59%)</td>
</tr>
</tbody>
</table>

7.1.1.3. Control to Target Stimuli Correlation

(75) He\textsuperscript{i/j} ate the cake when the Smurfi was dancing (TVJ)
(76) She\textsuperscript{i/j} gave more cones to Winnie-the-Pooh than to Sleeping Beautyi’s Godmother. (act-out)
(77) More blocks connected him\textsuperscript{i/j} to Minnie than to Flynni’s horse.
(78)
(79) Nemo delivered more presents from him to Flounder than to Eric’s dog.
7.1.2. Adult Data

Just as children, adults performed successfully and uniformly on controls A and B, which were simple subject and object comparatives. Unlike children, they also responded as expected in terms of control C:

(80) He*_{i/j} ate the cake, when the Smurf*_{i} was dancing. (TVJ)

All 28 (100%) of adults ruled out the reading with the suggested co-indexation observing binding Principle C. Recall that only 46% of the children in this study gave the same answer to this control.

As for the other two control stimuli, the adult performance was not so uniform: although many adults did recognize a principle C violation in both controls, the success rate was only 36% for control D and 71% for control E.

(81) Sebastian found a present from her*_{i/j} to Ariel*_{i}’s sister. (TVJ)
Figure 13. Distribution of adults’ responses (control stimulus (81))

<table>
<thead>
<tr>
<th></th>
<th>✔ Principle C</th>
<th>✗ Principle C</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>(81)</td>
<td>10 (36%)</td>
<td>18 (64%)</td>
<td>28 (100%)</td>
</tr>
<tr>
<td>“her” = Ariel</td>
<td>“her” = Rapunzel</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(82) She/*i*/ gave more cones to Winnie-the-Pooh than to Sleeping Beauty’s godmother. (act-out)

Figure 14. Distribution of adults’ responses (control stimulus (82))

<table>
<thead>
<tr>
<th></th>
<th>✔ Principle C</th>
<th>✗ Principle C</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>(82)</td>
<td>20 (71%)</td>
<td>8 (29%)</td>
<td>28 (100%)</td>
</tr>
<tr>
<td>‘she’ = Hello Kitty</td>
<td>“‘she’ = Sleeping Beauty</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 15. Correlation of adults’ responses on control stimuli (81) and (82))

<table>
<thead>
<tr>
<th></th>
<th>✔ Principle C</th>
<th>✗ Principle C</th>
<th>❄ Confused</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>(81)</td>
<td>12 (42.6%)</td>
<td>8 (29%)</td>
<td>2 (7%)</td>
<td>28 (100%)</td>
</tr>
<tr>
<td>(82)</td>
<td>20 (71%)</td>
<td>8 (29%)</td>
<td>0 (0%)</td>
<td>28 (100%)</td>
</tr>
<tr>
<td>‘she’ = Hello Kitty</td>
<td>“‘she’ = Sleeping Beauty</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(83) More blocks connected him/*i*/ to Minnie than to Flynn’s horse. (act-out)

(84) Nemo delivered more presents from him/*i*/ to Flounder than to Eric’s dog. (act-out)

Figure 16. Distribution of adults’ responses in Experiment 1 (target sentences (83) and (84))

<table>
<thead>
<tr>
<th></th>
<th>✔ Principle C</th>
<th>✗ Principle C</th>
<th>Confused</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>(83)</td>
<td>12 (42%)</td>
<td>16 (58%)</td>
<td>0 (0%)</td>
<td>28 (100%)</td>
</tr>
<tr>
<td>(84)</td>
<td>16 (58%)</td>
<td>11 (39%)</td>
<td>1 (3%)</td>
<td>28 (100%)</td>
</tr>
</tbody>
</table>
Figure 17. Distribution of adults’ responses (correspondence between controls involving Principle C and target sentences (83) and (84))

<table>
<thead>
<tr>
<th></th>
<th>Principle C in controls C, D, E</th>
<th>Principle C in controls C, E</th>
<th>Principle C in controls C, D</th>
<th>Principle C in control C only</th>
</tr>
</thead>
<tbody>
<tr>
<td>(83)</td>
<td>5 (17.5%)</td>
<td>6 (21%)</td>
<td>1 (3.5%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td></td>
<td>3 (10.5%)</td>
<td>6 (21%)</td>
<td>1 (3.5%)</td>
<td>4 (14%)</td>
</tr>
<tr>
<td>(84)</td>
<td>5 (17.5%)</td>
<td>8 (29%)</td>
<td>2 (7%)</td>
<td>1 (3.5%)</td>
</tr>
<tr>
<td></td>
<td>3 (10.5%)</td>
<td>4 (14%)</td>
<td>0 (0%)</td>
<td>4 (14%)</td>
</tr>
</tbody>
</table>

Figure 18. More lambs walked from Belle to him/j than from Harris/i’s brother. (act-out)

<table>
<thead>
<tr>
<th></th>
<th>20 (71.5%)</th>
<th>8 (28.5%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>‘him’ = Harris_i</td>
<td>‘him’ = Ian_j</td>
</tr>
</tbody>
</table>

Figure 19. King Triton gave more lizards to her/j than Olivia/j’s mother. (act-out)

<table>
<thead>
<tr>
<th></th>
<th>17 (61%)</th>
<th>11 (39%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>‘her’ = Aquata_i</td>
<td>‘her’ = Olivia_j</td>
</tr>
</tbody>
</table>

Figure 20. Distribution of adults’ an children’s responses in Experiment 1 (target sentences allowing for ambiguity)

<table>
<thead>
<tr>
<th></th>
<th>adults</th>
<th>children</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20 (71.5%)</td>
<td>‘him’ = Harris_i</td>
</tr>
<tr>
<td></td>
<td>7 (54%)</td>
<td>‘him’ = Harris_i</td>
</tr>
<tr>
<td></td>
<td>17 (61%)</td>
<td>‘her’ = Aquata_i</td>
</tr>
<tr>
<td></td>
<td>5 (55.5%)</td>
<td>‘her’ = Aquata_i</td>
</tr>
</tbody>
</table>