Won't Somebody Think of *the Children*:
Beyond Maximality with Plural Definite Descriptions

Morgan Moyer, Zehra Husnain, and Kristen Syrett

1. Introduction

Plural definite descriptions (PDD) such as the italicized phrase in (1) are claimed to refer to the maximal element of a set (Link, 1983; Löbner, 2000; Sharvy, 1980).

(1) a. *The children* are asleep.
    b. Pick up *the children* from school.

In other words, *the children* in (1) should refer to <u>all</u> contextually salient children. This maximal plural individual is represented as the union or sum of all atomic individuals in a join semilattice, a type of partially ordered set. Previous research has shown that young children do not seem to appreciate this maximality aspect of PDD interpretation.

For example, Karmiloff-Smith (1979) presented preschoolers with two types of situations—one where not all of the toy cars were placed in the garage, and the experimenter uttered (2), and another where the experimenter provided the children with the instructions in (3). In the first case, children allowed for the situation given (2), and in the second, they did not always place all of the cars in the garage.

(2) Il faut mettre les voitures dans le garage.
     'One must put the cars in the garage.'

(3) Mets les voitures au garage.
     'Put the cars in the garage.'

Likewise, Caponigro et al. (2012) presented children with a plate of fruit, and asked them the question in (4). Not until age 6-7 did children retrieve all of the fruit on the plate to present to the experimenter. They did, however, do so when the request had a universal quantifier in it (*all the things*).

(4) Can you give me the things on the plate?

Finally, Simon-Pearson & Syrett (2018) showed preschoolers a scene in which a set of red dinosaurs all went to a bookstore, while a set of green were split on where they went. Some green dinosaurs went to the library, while some went to the bookstore. Children then heard a puppet utter the sentence in (5). Children frequently accepted such utterances, even though homogeneity had been violated with the green set; not all of them went to a single location. By contrast, when the first conjunct was true and the second conjunct was entirely false (e.g., when none of the characters when to the specified location), children either rejected the utterances or did not commit to assign a single truth value.

(5) The red dinosaurs went to the bookstore, and the green dinosaurs went to the bookstore, too.

This pattern of results seems to strongly suggest that children's semantic representations of PDDs are underdeveloped, in that they lack a key component present in the adult grammar. For example, maximality is not thought of as part of the asserted content, but rather as a presupposition tied to a PDD (Heim, 1991; Kadmon, 1990; Roberts, 2003). Thus, one explanation could fall out from children's difficulty with presupposed content more generally.

However, there are reasons to think that there may be alternative explanations for the behavioral patterns observed. Specifically, adult judgements of PDDs give rise to a wider range of interpretations than allowed by the traditional maximality semantics. Here we highlight some important cases which illustrate the felicity of non-maximality in PDDs.

First, context-dependent implicit domain restriction and familiarity or uniqueness often allow for PDDs to refer to a salient subset rather than the entire set (Abbott, 2003; von Fintel, 1994; Heim, 1982; Lewis, 1979; Malamud, 2012; Roberts, 2003; Stanley and Szabo, 2000). For example, in (1b), the parent need not pick up *all* of the children from the world or even from the school. Rather, the speaker is referring to a salient subset, likely just the ones that they are responsible for.

As further illustration, consider (6), from Malamud (2012).

(6) The windows are open.

The speaker's discourse goals will modulate whether the italicized PDD is interpreted maximally or non-maximally. For example, if there is a thunderstorm coming, or if one is ensuring that the house is thief-proof, then as long as any windows are open (that is, when some but not all of the windows are open), the PDD will be interpreted non-maximally (see also, Yoon, 1996), and (6) will be considered to be true. In contrast, if the goal is to prepare the windows to be painted, then (6) will be true as long as the PDD is interpreted maximally.

We note here that Munn, Miller, & Schmitt (2006) present convincing evidence that children *can* access domain-restricted, maximal interpretations, at least under certain circumstances. However, the PDDs in their experimental items

included explicit restrictors (e.g., *the frogs next to the barn*), and the context clearly and physically contrasted two possible locations with frogs lined up next to each. Thus, there are aspects of the linguistic and visual stimuli that could have supported an interpretation of maximality within domain restriction.

Second, PDDs allow for *kind* or *attributive* readings, in which they can refer to an object property or kind without obligatorily referring to a maximal element of a set. For example, a speaker shopping at a grocery store may utter (7) felicitously without it necessarily being true that the speaker has surveyed every single strawberry and that every single strawberry looks delicious.

(7) The strawberries look delicious.

In this situation, the speaker may refer to strawberries as a *kind* of object, rather than making reference to particular strawberries in the store. Thus, ostensible non-maximality may be a kind reading in disguise.

A third instance of acceptable non-maximality arises because speakers often say things which are not strictly speaking 'true', yet their utterances are nonetheless felicitous because we can allow a certain amount of slack or imprecision. Consider the examples in (7) from Lasersohn (1999).

(7) a.   Mary arrived at 3 o'clock.
     b.   The townspeople are asleep.
     c.   The subjects are asleep.

A speaker may felicitously utter (7a) even if Mary arrived at 3:02. Likewise, a speaker may felicitously utter (7b) even with "one or two odd townspeople burning the midnight oil" (Lasersohn, 1999, pg. 523). Both the temporal expression in (a) and the PDD in (b) allow a degree of pragmatic slack in their interpretation (Lasersohn's idea of 'pragmatic halos'). That slack regulation is determined by the situation or context of utterance can be seen by contrasting (7b) with (7c). In the context of an experiment on the nature of sleep, where every last one of the subjects must be asleep before the experiment can proceed, Lasersohn says, exceptions are not tolerated, and the PDD must be interpreted maximally. Thus, it is frequently necessary to appeal to contextual information and a speaker's goals or intentions to arrive at the interpretation of a given PDD.

In this paper, we explore two instances of semantically- and pragmatically-licensed non-maximality, comparing the performance of young children to that of adults for a baseline. Our results reveal two key findings. First, while some children and many adults flexibly restrict the domain of quantification with PDDs, applying maximality to a salient subset of set members rather than the entire set, others appear to rigidly adhere to strict maximality applied to the whole set, treating PDDs the same as universal quantifiers. Second, both children and adults are able to arrive at a kind or attributive interpretation of PDDs in linguistic and discourse contexts that license it, treating PDDs similar to bare plurals. Our research thus demonstrates that seemingly non-maximal responses exhibited by

children in previous research could (at least in part) be explained by grammatically-licensed mechanisms and interpretations that children share with adults, and young children's semantic representations may indeed encode maximality in plural definite descriptions (following Munn, Miller, & Schmitt, 2006; contra Wexler 2011).

2. Experiment 1
2.1. Participants

Participants were 56 adults recruited from undergraduate-level courses in Linguistics or Cognitive Science at Rutgers University – New Brunswick. All participants provided informed consent under an IRB protocol and received extra credit for their participation. 9 adults were excluded due to non-native status. Participants were randomly divided into four between-subject experimental conditions.

2.2. Stimuli and Procedure

Experiments 1 and 2 were designed as a Truth Value Judgment Task (Crain & Thornton, 1998). The stimuli were the same for Experiments 1 and 2. There was one training trial, 6 control trials assessing universal quantification, 2 control trials assessing domain restriction via local accommodation, and 9 target experimental trials. For each trial, images were created on PowerPoint slides, with an accompanying narration in a script.

Each trial (with the exception of the two accommodation controls) had the same initial structure, as shown in Figure 1.
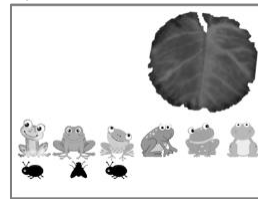
Figure 1: Structure of the first half of one experimental trial in Experiments 1 and 2

A. Set of characters is introduced in location 1

B. Objects are distributed to set members one by one
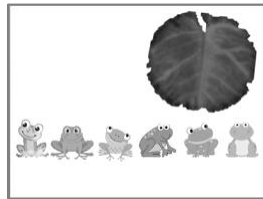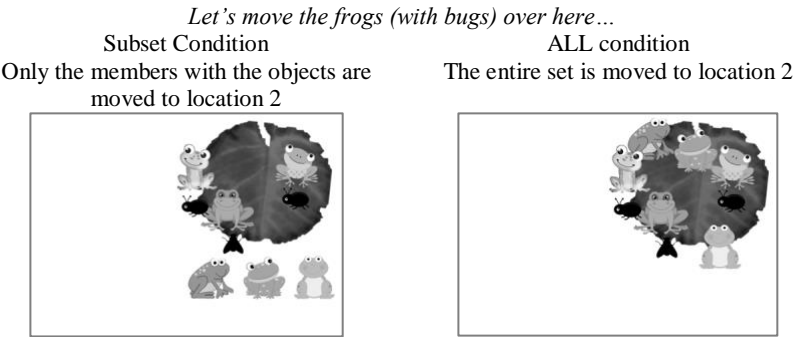

Look at these frogs!
The frogs would like a bug.

This frog gets a bug… (x3)

First, a set of characters was introduced, and the idea of distributing objects to them was mentioned (A). Then, the objects were distributed to the characters one at a time, thereby ensuring that the 1-1 mapping was highlighted and creating suspense over how many and which ones would receive an object. The idea of

moving either a subset or the whole set to a new visible and salient location was introduced (B). Then, the idea of moving some or all of the characters was introduced, and either a proper subset or the entire set was moved from location 1 to location 2, as shown in Figure 2.

Figure 2: Structure of the second half of one experimental trial in Experiments 1 and 2

Let's move the frogs (with bugs) over here…

Subset Condition	ALL condition
Only the members with the objects are moved to location 2	The entire set is moved to location 2

After the movement, the target sentence was delivered, as in (5). There were two versions of the target sentence, depending on which condition the participants were assigned to.

(5) a.   The frogs are enjoying their bugs.   PDD
       b.   Every frog is enjoying its bug.   QUANT

In the control trials, either all of the characters received an object and or all but one character did. All controls featured *every*.

The stories were told by an experimenter according to the script, who advanced through the slides for each trial. At the end of each trial, adults in Experiment 1 were asked to circle their response to the target statement on the response sheet, and to provide a brief justification for their yes/no answer.

2.3. Results

The results for all trial types for the adults are presented in Figure 3, separating the two between-subject conditions based on the subject, and within them, the two between-subject conditions based on movement of the set/subset. A Kruskal-Wallis test revealed a significant difference among the four conditions ($H(3) = 14.46$, $p = .002$), which appears to be driven by the difference between the 'sub' and 'all' conditions in the PDD condition ($U_A = 59$, $z = 2.2$, $p = .028$), and by differences between the PDD and QUANT conditions ('sub': $U_A = 46.5$, $z = 2.53$, $p = .01$; 'all': $U_A = 44$, $z = 2.22$, $p = .03$). There was no difference *within* the QUANT condition ($U_A = 72.5$, $z = .57$, $p = .57$). Thus, the movement of the

set/subset and the type of subject played a role for adult.

Figure 3: Experiment 1 results illustrating adults' acceptance across two control types and target items in four conditions (PDD-all/sub and QUANT-all/sub)
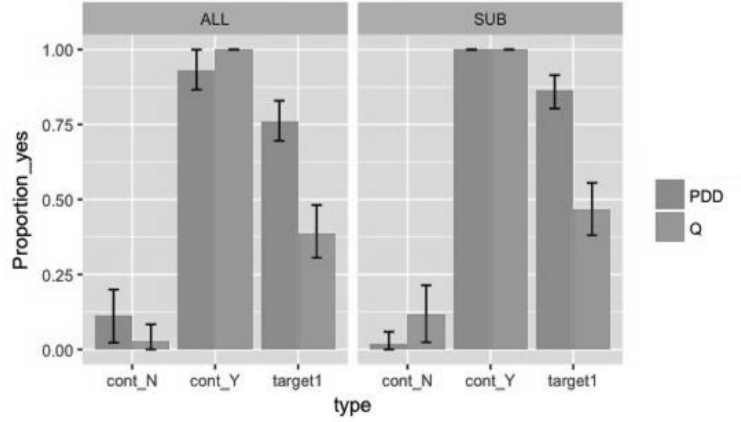
This pattern and the mid-level performance in the QUANT condition led us to probe the data further. When we analyzed the distribution of the participants' acceptances to the trials, and focused in on polar acceptances and rejections, as shown in Table 1, we found a marginally significant difference in the distribution of responses (χ^2 (3) = 6.96, p = 0.073).

Table 1: Experiment 1 results illustrating adults' acceptance of none or all of the items across four conditions (PDD-all/sub and QUANT- all/sub)

	Accept 0	**Accept All**
PDD-all	0	5
PDD-sub	0	13
QUANT-all	3	5
QUANT-sub	2	9

2.4. Discussion

The results of Experiment 1 reveal that adults were indeed willing to restrict the domain of quantification, and were most likely to do so when the subject was a plural definite description (PDD) and a subset of items were highlighted or made salient via their movement to a second location. Given this pattern of results, we turned to testing children in Experiment 2 with the best case scenario to encourage domain restriction: conditions in which a proper subset of items (those that have been given an object) moves to a different location. If children recognize that

PDDs are 'maximal' but that maximality is relative to what is salient in the context, then they should, like adults, be willing to accept the PDD statements in the 'sub' condition. They may also be more willing to restrict the domain with PDDs than with universal quantifier statements, which may be taken by default to quantifying over the entire set of items visible on the screen.

3. Experiment 2
2.1. Participants

Participants were 32 children (3;10-6;9, M:4;10) recruited from and run in local preschools. All children were monolingual speakers of English, and their parents reported a second language being spoken less than 20% of the time in the home setting. Parents provided informed consent, and children provided verbal assent. 6 additional children were excluded from the data for a 'yes'-bias (5) and for non-native speaker status (1).

2.2. Stimuli and Procedure

The stimuli were the same as in Experiment 1. However, the main difference was that here, only two conditions were run (PDD-sub, and QUANT-sub), since these were the conditions where adults were most likely to accept the target statements, thereby demonstrating that a seemingly non-maximal interpretation of the PDD was, nevertheless, maximal relative to a proper subset. The procedure was for the most part the same as in Experiment 1. The main difference was in the way that the task was administered. Children were run in preschools by two experimenters. One narrated the slides according to the script while the other played the role of the puppet. The child's task was to determine whether what the puppet said was correct or incorrect, in which case he was given a nibble of a cupcake or a drink of milk, respectively.

Children's sessions were recorded using Photobooth on the laptop. Their responses were transcribed by hand by the experimenter playing the puppet, then later recorded in an Excel spreadsheet and checked for accuracy in the lab by two separate research assistants. The session took approximately 15 minutes.

2.3. Results

The results for Experiment 2 are presented in Figure 4. Children performed as expected with the control items, and were significantly more likely to accept the target sentences in the PDD condition than in the QUANT condition ($U_A = 200$, $z = -2.69$, $p = .007$).

Figure 4: Experiment 2 results illustrating children's acceptance across two control types and targets in two conditions (PDD-sub and QUANT-sub)
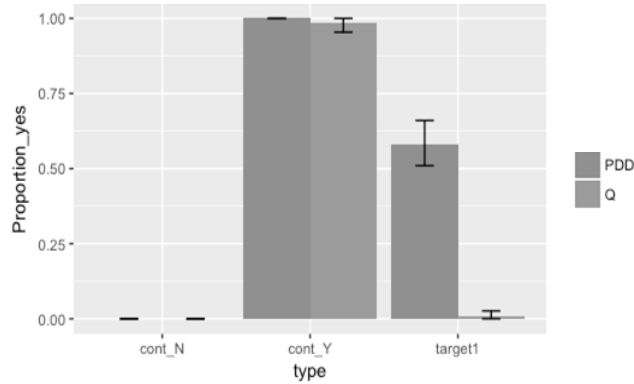
As with adults, given the mid-level performance in the PDD condition, we returned to the distribution of responses, which in this case were more categorical than with the adults in Experiment 1: children either flat-out accepted or rejected the target items. What's more, they consistently rejected them in the QUANT condition, but the group was split on their response type in the PDD condition, as indicated in Table 2. A Fisher's exact test reveals a significant difference in distribution (p = .0008).

Table 2: Experiment 2 results illustrating children's acceptance pattern across two conditions (PDD-sub and QUANT-sub)

	Accept 0	Accept All
PDD-sub	7	9
QUANT-sub	16	0

2.4. Discussion

The results of Experiment 2 demonstrate that children treat statements with a plural definite description (PDD) in subject position differently that those with a universal quantifier. While every child interpreted the universal quantifier as quantifying over the *entire* set of characters, some children took the PDD as performing the same function, while others restricted its reference to the proper subset. This different behavior should not be taken as an indication that children do not recognize the maximality aspect of a PDD interpretation; rather, adults performed in a similar way, accepting the PDD statement when it could be taken as maximally true of a proper subset, in essence arriving at an interpretation of the PDD that had an implicit restriction (e.g., *the X that have objects*) made salient by the visual display. Experiment 2 expanded upon this finding by investigating pragmatically-licensed non-maximal interpretations associated with kind-level interpretations of PDDs.
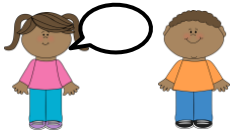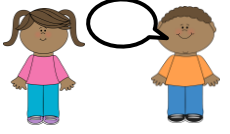
4. Experiment 3

4.1. Participants

43 children (3;9-6;4, *M*:5;1) and 40 adults participated. They were recruited and consented in the same way as in the previous experiments. Participants were evenly and randomly divided into two between-subject experimental conditions.

4.2. Stimuli and Procedure

11 trials were created as before, using animations in PowerPoint, which were this time accompanied by pre-recorded dialogues. Each trial had the same structure, as depicted in Figure 5. The premise was that a character (A) was going shopping at a store with a friend, and had a list of things they needed to get. The character asks someone at the store (person B) about the location of these items. B then looks in multiple locations, and then reports to A about one or more locations, mentioning some or all of the locations (Report Condition). Finally, a puppet delivered the target sentence concerning B's knowledge, using an embedded question (e.g., *Johnny knows where to find (the) carrots*).

Figure 5. Sample structure for an experimental trial in Experiment 3.

A: *We need to find (**the**) carrots*. *Where can we find (**the**) carrots?*	B proceeds to area with boxes and looks in some/all of the boxes. Some/all of the boxes have the target object.	*(A reminder: Where can we find (**the**) carrots?)* B: *The blue box.* ***Johnny knows where to find (the) carrots.***

There are a few aspects of the discourse context to highlight. First, in the trial, the speaker/questioner's goals are made clear. Second, by the virtue of the fact that the characters are in a store, there is an inherent contrast among types of items that customers can locate and subsequently purchase. Further, aspects of the linguistic utterances in the trial which enhance the non-maximal interpretation of the PDD. First, A asks a root *where*-question with a modal verb (*can*), both of which support a non-exhaustive, mention-some answer to the question (Asher & Lascarides, 1998; Moyer & Syrett, *to appear*; Xiang, 2016, a.o.). The puppet's utterance features an embedded question of similar form to A's question. We replaced the modal with an infinitival clause, which is claimed to still encode a covert modal (Bhatt, 1999). Both the explicit and implicit modal align with the goal-orientation of the context. Finally, participants were either assigned to a condition where they heard a Bare Plural (BP) (e.g., *carrots*) or a PDD (Noun Condition). A BP unambiguously supports a kind interpretation (Dayal, 2004,

2011).

We therefore predicted that in the BP condition, participants would accept the target utterance delivered by the puppet. The open question was whether or not participants would agree when the target featured a PDD. If participants interpret PDD targets maximally, they should reject the puppet's utterance. The manipulations of discourse context/goals and *wh*-question form allow both non-exhaustive answers and interpretations of embedded *wh*-questions. These same factors should also license non-maximality with PDDs. If indeed participants interpret PDD targets non-maximally, then they should agree with the puppet's utterance (at least to some degree).

4.3. Results

The results are presented in Figure 6.

Figure 6: Experiment 3 results from adults and children in two experimental conditions (Bare Plural (BP) and PDD)
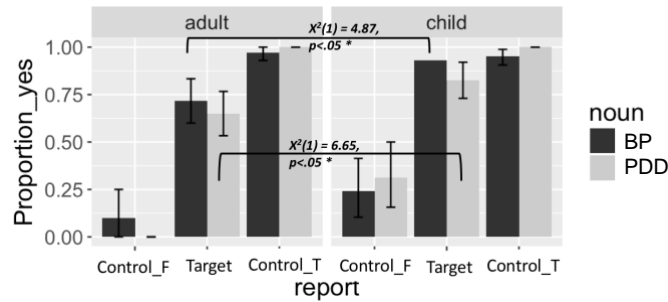
Results from a Kruskal-Wallis rank sum test revealed significant main effects of Age ($\chi^2(1) = 15.628$, p<0.0001) and Report ($\chi^2(3) = 297.99$, p<0.0001). We found no main effect of Noun ($\chi^2(1) = 0.087$, p>0.05): neither children nor adults treated PDDs significantly differently from BPs. Looking closer at the Age effect, we see that the results are driven by the target condition ($\chi^2(1) = 10.892$, p<0.001), reflecting the fact that children accepted targets significantly more than adults.

4.4. Discussion

The results from Experiment 3 show that salient non-exhaustive discourse goals can license non-maximal kind interpretations of PDDs. Neither adults nor children differentiated PDDs from BPs in target utterances. While adults' non-maximal interpretations were not accepted at ceiling, they were accessed well above chance. This pattern suggests that non-maximal interpretations of the PDD were licensed. Children accepted targets near ceiling, showing that they, too, were sensitive to these non-maximal PDD meaning. They are more permissive than adults, but this permissiveness indicates their sensitivity to both the multiple

possible interpretations of PDDs, as well as to the aspects of context which license these interpretations.

5. Conclusions

Across experiments, we have shown that in cases where children appear to access a non-maximal of plural definite descriptions (PDD) in a way that flies in the face of semantics, (a) there are semantic mechanisms or contextually-supported readings of definite descriptions that license such interpretations, and (b) adults robustly access them as well. In Experiments 1-2, we showed that both adults and children are able to interpret PDDs as quantifying over a restricted domain, and that the PDD can, in turn, be maximally true of either the proper subset that was generated, or of the entire set. In this way, they diverge from universally quantified statements. In Experiment 3, we showed that both children and adults treat PDD statements comparable to Bare Plural statements, in a linguistic context that supports a non-maximal answer and a discourse context that supports a kind reading.

The experiments presented here thus suggest that children's apparent non-adult-like behavior in performance-based methodologies that call upon them to assign a meaning on the fly in order to comply with task demands may underestimate how adult-like their underlying semantic representation is. The results of the present research indicate that adult-like sensitivity to aspects of the linguistic and discourse context may, ironically, give rise to the appearance of non-maximality. However, the theory-based explanation for this behavior and the documented similarity between children's and adults' responses is a reminder that it is hasty to judge a book by its cover.

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