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Children's Developing Knowledge of *Wh*-/Quantifier Question-Answer Relations

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ABSTRACT

In response to questions in which a *wh*-term interacts with a universal quantifier in object position, such as *Who picked every toy?*, children as old as 5 years of age often provide a list, pairing toys with the people who picked each of them. This response pattern is unexpected, it has been claimed, because children appear to overproduce such pair-list answers in comparison to what would otherwise be expected in adults, therefore suggesting a non-adult grammar. However, not only have such comparisons been made to a hypothetical baseline of adult responses, but they also fail to take into account the range of possible answers that may be available for such questions, once certain syntactic and lexical manipulations are accounted for. We therefore lack sufficient evidence to fault the grammar for this response pattern. This article investigates this phenomenon from a fresh methodological and theoretical perspective, uncovering a more complex picture. We show, on the one hand, that children *do* overproduce pair-list readings to *which* questions with *every*, in comparison to adults. On the other hand, they also "underproduce" pair-list answers in response to similar questions with *each*. However, children are also sensitive to the syntactic position of the quantifier in the direction expected by a subject-object asymmetry. We therefore argue that a key part of the explanation for children's performance lies in immature lexical entries for the participating quantifiers.

Introduction

Structurally ambiguous sentences and questions pose a challenge from the acquisition point of view, since input is almost never sufficient to indicate that those structures are ambiguous: in natural environment, only one of the readings can be verified at a time. Moreover, even questions that appear quite similar on the surface, such as (1a) and (2a), differ in their ability to give rise to multiple readings.

(1) a. **Which toy** did **every child** pick?
b. Every child picked Mickey Mouse.
c. Jane picked a plastic dinosaur, Mary picked Lincoln Logs, Alex picked a train.

(2) a. **Which child** picked **every toy**?
b. Jane.(=Jane picked every toy.)
c. *Jane picked a plastic dinosaur, Mary picked Lincoln Logs, Alex picked a train.

The question in (1a) allows at least two possible answers: a single answer, as in (1b), and a pair-list answer (PLA), as in (1c).[1] In contrast, (2a) lacks a pair-list reading. Pair-list answers have been claimed to be possible

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[1](1a) also allows for a "functional" answer (e.g., *her favorite character*), which we leave aside in this research in order to focus on the contrast between single and pair-list answers.

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for questions with a quantifier in subject position, as in (1a), but not for questions where the quantifier is in object position, as in (2a) (see May, 1985, a.o.).[2] A complex interaction of structural and lexical factors regulates the availability of certain readings for questions with universal quantifiers. (See in particular proposals by Agüero-Bautista, 2001; Beghelli, 1997; Chierchia, 1993; May, 1985, 1988; Szabolcsi, 1997a). Such questions—and children's interpretation of them are the focus of this article.

Because question-answer exchanges are a fundamental part of human communication, researchers in acquisition and development have long been interested in children's ability to answer questions appropriately. One line of research has specifically investigated how children understand questions with quantifiers such as (1a) and (2a), and whether they are at once aware of the ambiguity of (1a) and the lack of ambiguity and the barring of PLAs for (2a). At present, however, no consensus has been reached among experimenters concerning children's knowledge of these question/answer interactions: while some have argued that three- to five-year-olds *overproduce* PLAs relative to adult intuitions (Lewis, 2000; Roeper & de Villiers, 1993), others (notably Yamakoshi, 2002) have argued that children at that age *do* have adult-like grammars, and that their production of PLAs does not differ from adults'. However, as we point out in the developmental background section to follow, some core aspects of the previous experimental designs could well have contributed to these conflicting results and claims about children's production or acceptance of PLAs. Once we remove these confounds and incorporate recent linguistic theoretical approaches to *wh*-/quantifier questions, we are in a much better position to evaluate the state of children's command of *wh*-/quantifier interactions.

Accordingly, the goals of this article are as follows. First, we aim to clearly spell out theoretical accounts of *wh*-/quantifier questions and the corresponding predictions for the range of possible interpretations. Second, we identify aspects of the experimental methodology that must be addressed in order to properly assess children's knowledge of the linguistic constraints on PLAs. Third, we experimentally establish a proper adult baseline, a feature that was conspicuously missing in previous studies. In order to do so, we take certain key syntactic and lexical factors for question-answer relation into account. Finally, we obtain child data for the same stimuli in order to determine whether children do, in fact, overgenerate pair-list answers. We conclude with a discussion of why children differ from adults with respect to the frequency of PLAs observed, and the shape of the developmental trajectory.

Theoretical background

Structural constraints on the availability of PLAs

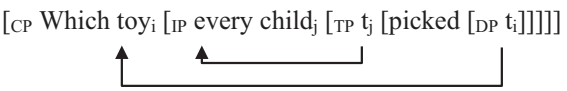
We begin by reviewing three main accounts that predict, albeit for different reasons, that structural constraints prohibit a PLA when a universal quantifier such as *every* occurs in object position. According to May (1985, 1988), for a PLA to be available, a quantifier has to be able to take scope over an interacting *wh*-phrase at Logical Form (LF). This scopal relation allows for an interpretation of (2) that reads something like "for every child, which toy did s/he pick?". A quantifier would achieve this position via a covert movement operation termed Quantifier Raising (QR), which occurs after the *wh*-phrase has moved overtly, and surface scope is determined. Thus, once the *wh*-phrase has moved, a single answer is always licensed, but the availability of a PLA is made possible when the quantificational phrase undergoes QR at LF. If QR is possible, the *wh*-phrase and the quantifier phrase form a special unit—a Sigma-sequence in May's terms. Members of the Sigma-sequence can freely take scope over each other. QR is governed by the Path Containment Condition (PCC) (Pesetsky, 1982)—a requirement that the paths of movements must nest, and never cross. When

[2]Notice that in (2a), the quantificational phrase is in subject position, although it is not sentence-initial. This is because the *wh*-word has moved overtly from its base position (a) as object of the verb *pick* to Spec, CP in the sentence-initial position, accompanied by *do* insertion (b):
(a) every child picked which toy
(b) Which toy did every child pick *t*?

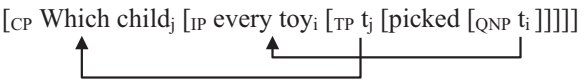
the path of QR crosses the path of *wh*-movement, the PCC is violated, and a PLA is ruled out, leaving a single answer as the only option available. It is here, then, that the structural difference between questions with subject quantifiers ("subject-quantifier questions") and questions with object quantifiers ("object-quantifier questions") carries implications for the availability of PLAs.

This difference between the occurrence of a quantifier in subject or object position and the corresponding paths of movement is illustrated in (3)–(4). In (3), when the quantificational phrase *every child* undergoes QR from the subject position, its path is nested within the path of the *wh*-phrase, which has undergone movement from the object position to the Specifier of the Complementizer Phrase (CP). In (4), however, because QR takes place from an object position to a higher adjoined position after the subject *wh*-movement has taken place, the two paths cross, resulting in a violation of the PCC and making a PLA unavailable. Thus, a PLA is *possible* with a subject-quantifier question (as in (3)), but it is *blocked* for object-quantifier questions (as in (4)).

(3) **Which toy** did **every child** pick?



(4) **Which child** picked **every toy**?



Based on May's account, one would have to say that if children produce PLAs in response to object-quantifier questions, this behavior would indicate the lack of knowledge of (or inability to apply) the PCC, since it has independently been demonstrated that children are otherwise capable of deploying QR to interpret quantificational sentences (Guasti & Chierchia, 1999/2000; Kiguchi & Thornton, 2004; Lidz et al., 2004; Syrett & Lidz, 2009, 2011).

A somewhat different recourse to structural constraints limiting the availability of PLAs has been proposed by Chierchia (1993). However, his account appeals to constraints on pronominal binding. Chierchia argues that a moved *wh*-phrase leaves a doubly-indexed trace at the site from which it moved. One of the traces acts as a pronominal element that is subject to standard restrictions on the interpretation of pronouns. Quantifiers generated in the object position have to cross over the pronominal trace in order to enable the pair-list reading of a question. A movement operation over a pronominal element generally gives rise to a Weak Crossover (WCO) effect (Lasnik & Stowell, 1991; Postal, 1971; Wasow, 1972), preventing a pronoun from being bound by a quantifier. A quantifier generated in the object position would have to cross over the pronominal trace in order to enable a PLA. However, the resulting WCO violation would mean that the quantifier could not bind the pronominal trace left by wh-movement, and thus no PLA would be available.

In a more recent analysis, Agüero-Bautista (2001) has developed an account based conditions on reconstruction. Under this account, an object quantifier can take scope over a *wh*-phrase only if this *wh*-phrase can reconstruct to a position below the quantifier. While this configuration trivially obtains for subject-quantifier questions, since the *wh*-phrase can easily reconstruct to any position that the subject quantifier c-commands, things are different for object-quantifier questions. In these questions, a subject *wh*-phrase could only end up lower than an object quantifier if it could reconstruct to its original thematic position inside the VP, while the object quantifier QRs to a position above it (e.g. *v*P, VP, etc.). According to Agüero-Bautista, this possibility crucially depends on the features of the lexical items themselves. The strongly distributive quantifier *each* is claimed to QR to a position higher than *every*, and *who* can reconstruct lower than the presuppositional *wh*-term *which*. Thus, there is an inherent interplay between structural and lexical

information. In the process of language acquisition children have to determine how abstract syntactic operations interact with the meaning of quantifiers and question-words.

In summary, all of the accounts outlined above appeal to structural factors (e.g., movement, binding, reconstruction) to explain why PLAs are not licensed for object-quantifier questions. Thus, children who generate PLAs in response to such questions would presumably lack knowledge of these structural constraints (or would be unable to deploy whatever knowledge they have). However, it would be an oversimplification to assume that only syntactic constraints are at play. In Agüero-Bautista (2001) we already see that structural factors interact in complex ways with lexical factors. In the next section, we review in greater detail how the semantics and pragmatics affect the ability of quantifiers to target certain structural positions and give rise to PLAs.

Lexical constraints on the availability of PLAs

All of the acquisition studies that we review in the next section tested children's knowledge of the *wh*-/quantifier interactions using the quantifier *every*. However, not all quantifiers show similar behavior in questions. Unlike *every, each* is a universal quantifier that requires a distributive event structure in which each member of the set introduced by the quantifier phrase is associated with a sub-event in the event structure, and further, requires that these sub-events should be differentiated on some dimension (e.g., space or time) (Schwarzschild, 1994; Tunstall, 1998; see also Vendler (1962) for a comparison of universal quantifiers). *Every*, while still a universal quantifier, is less restrictive.

Similarly, *wh*-questions can differ in the licensing of PLAs depending on the type of universal quantifiers occurring in object position. As it turns out, it has been argued that PLAs are licensed, only if the quantifier in object position is *each*. See, for example, the question-answer pair in (5).

(5) Q: **Which friend** played **each game**?
A: Woody played *Candy Land*, Jessie played *Sorry*, and Buzz played *Monopoly*.

The PLA is assumed to be felicitous here precisely because *each* presupposes a distributive event structure. Consequently, for each member of the plurality of games, it is understood that someone played it. Note that a PLA is available here, because of a lexical feature of *each*, which is distinct from any structural considerations. According to certain theoretical predictions (Beghelli, 1997; Beghelli & Stowell, 1997; Szabolcsi, 1997a), when the object quantifier *every* undergoes QR, it remains within IP, in a position too low to take scope over the reconstructed *wh*-term. However, *each* moves to an even higher position in the syntactic tree, landing in the Specifier of a Distributive Phrase above the IP node. Consequently, *each* is able to take scope over a subject *wh*-phrase at LF, even when it originates in object position, thereby allowing for a PLA.

A summary of the predicted availability of single answers and PLAs for each of the target question types we have considered in this section is presented in Table 1.

Table 1. Summary of predictions of answer type availability based on linguistic theory.

Question type	Example question	Single answer	PLA
Subject quantifier			
every	**Which** toy did **every** child pick?	yes	yes
each	**Which** toy did **each** child pick?	yes	yes
Object quantifier			
every	**Which** child picked **every** toy?	yes	no
each	**Which** child picked **each** toy?	yes	maybe*

*Chierchia's (1993) account would predict that PLAs are not available for object-quantifier questions, regardless of whether the quantifier is *each* or *every*.

Because the comparison of *every* and *each* is fundamental to our design, here we take some space to briefly review what is known about children's understanding of *each* as a baseline going in to our experiments.

Distributivity and each

Three recent lines of work investigating children's comprehension of *each* collectively demonstrate that preschool-age children lack a proper understanding of the distributivity property of this quantifier. Brooks and Braine (1996) presented adults and children (ranging from 4–10 years of age) with a series of pairs of pictures: one with a subject-exhaustive scenario, and one with an object-exhaustive scenario, and asked them to choose between them when given a target sentence. For one set of their target sentences, *Each man is carrying a box*, and *There is a man carrying each of the boxes*, they were shown a contrast such as the one in Figure 1, with the subject-exhaustive picture in (A) (where each of the men is carrying a box) and the object-exhaustive scene in (B) (where each of the boxes was being carried by a man).

It was not until children were 10 years of age that they consistently selected the correct picture for the *each* sentences. Four- and five-year-olds were only at 40–47% correct for both sentences. Moreover, relevant to the current research is their finding that beginning at 6 years of age, success with the subject-quantifier sentences noticeably exceeded that of the object-quantifier sentences. For example, 7-year-olds choose the correct picture for subject-quantifier sentences 90% of the time compared to 46.7% in 4-year-olds. However, 4-year-olds and 7-year-olds showed comparable levels of accuracy on object-quantifier trials (43.3% and 33.3%, respectively). In a follow-up task, in which children were asked of each individual picture whether the sentence could be paired with it, four- and five-year-olds accepted the subject-quantifier sentence as a description of (B) (80% and 60%, respectively), whereas the older children did not.

More recently, Syrett and Musolino (2013) investigated the interpretations children and adults access for sentences with plural subjects (e.g., *Two girls completed a puzzle*), which permit a collective reading (two girls working together to complete one puzzle) and a distributive one (two girls each completing her own puzzle). Syrett & Musolino found that while children were largely adult-like in their acceptance ratings of these sentences, they differed from adults when the sentence contained *each* (e.g., *Two girls* ***each*** *completed a puzzle*). While adults did not typically allow the *each* sentences to be descriptions of a collective context, children did (31.9% vs. 86.7% acceptance, respectively). That is, when asked if this sentence was true of a scene in which multiple girls worked together to complete one puzzle, children said "yes", seemingly indicating that the sentence only required that each of the girls had participated in some puzzle completion event—not that each girl participated in her own puzzle completion event. Thus, they did not predicate the property "complete a puzzle" of each girl, as the distributive aspect of this quantifier's semantics would dictate.

Finally, Roeper, Pearson, and Grace (2011), following Brooks and Braine (1996) and Brooks et al. (2001), also asked children and adults to pair sentences with pictures, and explicitly compared their performance with *every* and *each* with visual displays such as Figure 2.

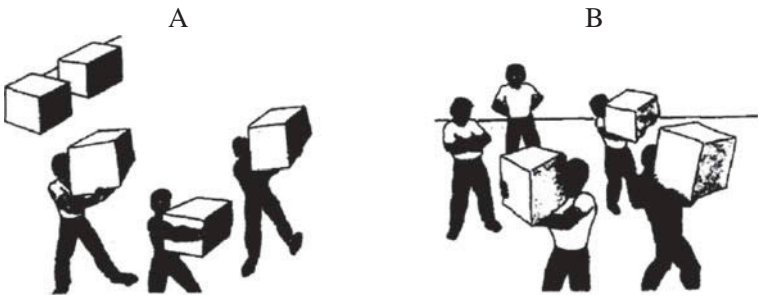


Figure 1. Sample experimental stimuli from Brooks and Braine (1996).

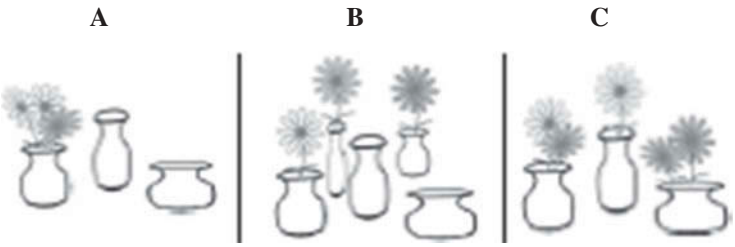


Figure 2. Example stimulus from Roeper et al. (2011) adapted from Brooks and Braine (1996) and Brooks et al. (2001).

Participants were presented with the images in A, B, and C, and asked which image(s) matched the target sentences. 94% of adults reported that all of the images were acceptable for *Every flower is in a vase*, although they had a slight preference for B. Only 17% said that all of the images were acceptable for *Each flower is in a vase*, and they overwhelmingly preferred B (90%). In contrast to adults, over 60% of the children preferred C for the *every* sentence, but were evenly distributed across A, B, and C in their choice for the best match for the *each* sentence. These results seem to indicate that while adults are acutely aware of the strong distributivity property of *each* (relative to *every*), and require that each member of the plurality have the property in question (e.g., "be in a vase"), children lack this requirement, and more loosely require that the property hold true of the object for the sentence to be true. Additional evidence that adults differentiate *every* and *each* comes from Brasoveanu and Dotlačil (2015), who showed in binary forced-choice and self-paced reading tasks that adults accept the inverse scope interpretation of a statement more readily when the quantifier is *each* as opposed to *every*.

Thus, across three different tasks, we see that children differ from adults in their treatment of the distributivity and scopal properties of *each*. What we might predict, then, is the following. Adults may uniformly bar PLAs for object-quantifier questions when *which* interacts with *every*, but allow PLAs when *which* interacts with *each*. For children, the degree to which PLA production varies according to the syntactic position of the quantifier is an open question. However, if their PLA production is indeed dampened when the quantifier is in object position, it is by no means clear that the choice of quantifier (*every* or *each*) will have an effect on the frequency of PLA production, because children do not yet seem to possess full knowledge of the distributivity requirement of *each*, which would open the door to PLAs.

Summary

Taking these theoretical proposals into account, we see that there is a subtle interleaving of structural and lexical factors that have been claimed to determine whether or not a PLA is licensed for a *wh*-/quantifier question. Therefore, there are both grammatical and lexical reasons why a child might behave differently from an adult when responding to such questions. Our review of the theoretical literature illustrates that it is impossible to make claims about why children overproduce PLAs, and therefore about the status of their linguistic competence as it relates to this issue, until the structural and lexical constraints we reviewed above are controlled for in the experimental design.

Child language background

In this section, we review the previous work investigating children's production of single answers and PLAs in response to *wh*-/quantifier questions, and their judgments concerning the acceptability of PLAs in response to such questions. We also take space to review what they know about the distributivity requirements of the quantifier *each* as compared to *every*. Given conflicting results across tasks, as well as methodological and theoretical concerns, we conclude that the question of whether children overgeneralize PLAs remains open, and transition to introducing our experimental research designed to address this question.

PLAs and wh-/quantifier questions

Roeper and de Villiers (1993) were the first to report that children not only produce PLAs in response to subject-quantifier *wh*-/quantifier questions, but also over-produce them (relative to adults) in response to object-quantifier questions. In their experiment, children were shown pictures accompanied by stories like the one in (6). For this example, the picture showed the sister pulling the boy, the Daddy pulling the sister, and the horse pulling the dad.

(6) A little boy got stuck in the mud. He called his sister for help. She tried pulling him, but was unable to get him out. Then they called Daddy, who could not help either. Finally, a horse came and pulled the Daddy, and look, out came the boy!

Each picture-story pairing was followed by questions such as (7) (featuring a subject quantifier) or (8) (featuring an object quantifier). Note incidentally (relevant to what we reviewed in the theoretical background section above), that the question had *who*, and not *which*, as the *wh*-term, making a PLA more likely.

(7) **Who** did **everyone** pull?
(8) **Who** pulled **everyone**?

The percentage of answers reported by Roeper & de Villiers is presented in Table 2.

Unsurprisingly, children allowed single answers, as one might have expected. However, they appeared to prefer PLAs in response to both question types. On the basis of these findings, Roeper & de Villiers argued that children do not display a subject-object asymmetry, and therefore have an immature grammar, because they are not sensitive to structural constraints on movement.

However, the use of *who* in the test questions (which is not marked for number, as opposed to *which*) may have contributed to the high percentage of PLAs, since this expression could have been interpreted as plural (Chierchia, 1993). Following Srivastav (1992) and Krifka (1992) who argue that plural questions license a particular kind of pair-list reading, Chierchia predicts that exceptional PLAs that may occur in response to object-quantifier questions with *who* do not arise from quantificational interactions *per se*, but from the plural nature of *who*. Agüero-Bautista's account (2001) makes similar predictions about *who* while he appeals to Pesetsky (1982)'s concept of D-linking to account for differences between *who* and *which*. He predicts that PLAs *may* be licensed for those questions in which *who* interacts with object *every* since a non-D-linked *who* can reconstruct below the quantifier and therefore rise to a PLA.

Another aspect of Roeper and de Villiers' (1993) experiment might have triggered a high number of PLAs. The single answer for the object-quantifier question required a particular understanding of the scenario: the child had to recognize that there was *someone* who pulled everyone. However, although the chain of pulling ultimately links the horse to the boy, the horse has no direct "pulling" relation to the sister or the boy. So to access a single answer, children had to deduce via transitivity that the horse was pulling not just the Daddy, but also the sister, and the boy. If children failed to recognize that this was the case—and were faced with a conversational scenario in which they were under pressure to produce an answer to the salient question in the discourse—they may have supplied the only answer available to them: a PLA. Thus, while children in Roeper & de Villiers' study *did* overproduce PLAs, the study design and the use of *who* in the test questions may have contributed to the high percentage of PLAs.

Table 2. Children's answers to *wh*-/quantifier questions in Roeper and de Villiers (1993).

Wh-/quantifier question type		Single answer	PLA
Subject quantifier	**Who** did **everyone** pull *t*?	11.2%	72.9%
Object quantifier	**Who** *t* pulled **everyone**?	25.5%	69.1%*

*This percentage is unexpected if PLAs are not possible for questions with object quantifiers.

Noting this confound in Roeper and de Villiers (1993)'s experimental design, Yamakoshi (2002) ran an experiment that was designed to avoid the "indirect force scenario", involving a narrative acted out with props by the experimenter. An example story appears in (10) below, along with two possible questions, one of which was presented to the participant.

(10) Pooh, Snoopy, and Mickey went to the kitchen to eat vegetables. In the kitchen, there were 2 tomatoes, 2 carrots, and 1 potato. Pooh took a tomato. Snoopy thought, "I want to have a tomato, a carrot, and a potato, but if I eat too much, I will get fat," so Snoopy took a carrot. Mickey loves vegetables, so he took a tomato, a carrot, and a potato.
(11) **What** did **everyone** take?
(12) **Who** took **every vegetable**?

Notice that in the story, every character took at least one vegetable, and there was one character who took one token of every type of vegetable. The distribution of answers for each question type in Yamakoshi (2002) is presented in Table 3.

The percentage of PLAs obtained in response to object-quantifier questions (the bottom right cell) was not just lower than in subject-quantifier questions, it was close to zero. This pattern diverges from those reported by Roeper & de Villiers, and appears to indicate that children are indeed sensitive to the relevant structural constraints.

However, these percentages may not necessarily arise due to children's linguistic competence, but from an experimenter coding strategy. The answer types presented in Table 3 do not sum to 100%, because children often provided answers that could not, strictly speaking, be classified as single answers or PLAs. For example, some children provided answers such as "Pooh took a tomato, Snoopy took a carrot," without stating what Mickey took. While this answer has the flavor of a PLA, Yamakoshi did not categorize it as such, but rather as a "partial" pair-list answer. Likewise, some children provided a list involving one pair member. For example, in response to (11), some children listed just the objects (e.g., "a tomato, a carrot, and a tomato, a carrot, and a potato"—the items that each character took), and in response to (12), some children listed just the characters (e.g., "Pooh, Snoopy, and Mickey"). Again, this kind of response seems more like a PLA than a single answer because the participant did not simply supply the name of one individual, but rather, listed a series of individuals. However, responses like (12) were not tallied as PLAs. If we revisit the children's responses, adopting a less stringent criterion and consider these not as "other" responses but rather as a variety of PLAs, then the percentage of combined PLAs for subject-quantifier questions increases to 97.4%, and the percentage for object-quantifier questions increases to 28.2%. We note here that we actually find these "partial" answers to be perfectly felicitous. In the course of our experiments, we also observed such partial answers, with children pointing to the characters and objects without providing a verbal response, and therefore take such answers into account in the course of our coding, which we describe in detail in our results section.

Immediately following this experiment, Yamakoshi attempted to replicate the Roeper & de Villiers findings with the same group of children, and obtained a lower percentage of PLAs (perhaps because of the influence of the first experiment). As part of this experiment, Yamakoshi explicitly asked children whether or not the horse pulled the boy. 73.8% of the children replied "no", leading her to reason that children were unable to access the single answer, and therefore supplied a PLA, because it would have been false that there was someone—the horse—who pulled everyone. Summarizing, then, Yamakoshi's study yielded results that diverged from Roeper & de Villiers, suggesting that children *do* have a subject/object asymmetry, since their production of PLAs was greater with subject quantifiers than with object quantifiers, and single answers were more likely with object quantifiers. However, aspects of the experimental paradigm raise questions about the conclusions we can draw about children's grammar based on the experimental findings.

Table 3. Production of PLAs in Yamakoshi (2002).

Wh-/quantifier question type		Single answer	PLA
Subject quantifier	**What** did **everyone** take *t*?	0.0%	61.5%
Object quantifier	**Who** *t* took **every vegetable**?	69.2%	7.7%

Finally, Lewis (2000) also investigated children's knowledge of possible answers to *wh*-/quantifier questions, but employed a Truth Value Judgment Task, rather than a story followed by a Q&A. 43 of the 59 child participants (73%) accepted a pair-list response for a statement where *every* is in object position. However, as with the other studies, there are reasons to revisit this conclusion in light of certain elements of the experimental design. When the target sentence was delivered, it appeared as an indirect embedded question (Example: *And I think I know who put on every cowboy hat*). This is problematic, because some researchers have argued that this structural position changes the syntax of the question and the acceptability PLAs (Szabolcsi, 1997b).

Our review of the previous developmental investigations on this topic makes clear that any attempt to link children's performance in an experimental task to their knowledge of structural constraints on possible answers to *wh*-/quantifier questions must carefully control for certain aspects of the experimental design (e.g., whether all readings are indeed supported), syntactic contexts (the position of the question), and the lexical status of the *wh*-phrase (whether it is headed by *who* or *which*) and the quantifier (*every* or *each*). Once these factors are controlled for, we will be in a much better position to assess children's linguistic knowledge. In our experiments presented below, all readings are supported in the stories and are equally salient, the target questions are never embedded, the *wh*-phrase is always headed by *which*, and the type of quantifier is a between-subject factor. Once we control for the *wh*-word and make it consistently *which*, PLAs are predicted to be unavailable for object-quantifier questions—but only those in which *every* appears as the quantifier. When the quantifier is *each*, PLAs are anticipated to occur.[3] If children produce PLAs in response to *every* object-quantifier questions (and adults do not), then we have good reason to claim that children do indeed overgenerate PLAs, and are unaware of the structural and semantic constraints on their availability. However, if children do not produce PLAs in response to object-quantifier questions with *each* (and adults do), then we have good reasons to conclude that children are unaware of lexical constraints on the availability of PLAs.

Experiments

Our concerns with certain methodological aspects of the previous studies as reviewed above and lack of convergence in the reported results motivated us to revisit children's comprehension of *wh*-/quantifier questions, taking into account the theoretical claims reviewed earlier, and using them to generate predictions about how task performance reflects linguistic knowledge. Like others, we sought to assess the rate of PLA production by children and adults in response to subject- and object-quantifier questions. However, ours only involved *wh*-phrases headed by *which*, which should only license PLAs when the quantifier is in subject position. We also compared *every* to *each*, since—as we noted—it has been claimed the distributivity requirements of *each* could override this structural constraint, and pave the way for an increased percentage of otherwise unacceptable PLAs for object-quantifier sentences.

Experiment

Participants

Participants included 28 undergraduates, all native speakers of English, who received course credit for participation, and 50 children between the ages of 3;6 and 6;7 years (Mean 4;11 years). In order to ensure a comparison of children in this age range, children were evenly divided into two age groups: a younger group of 24 participants ranging from 3;6 to 4;11.5 (Mean 4;6), and an older group of 26 children ranging from 5;0 to 6;7 years (Mean 5;4). Data from eight additional children who did not successfully complete the practice trials were excluded from the analysis.

[3]Chierchia's (1993) analysis might predict that since both quantifiers *each* and *every* are subject to Weak Crossover effects, PLAs are unavailable for questions with either quantifier in object position. However, we must balance this prediction with the fact that other theoretical accounts (e.g., Beghelli, 1997; Szabolsci 1997a) report judgments suggesting the possibility that PLAs are indeed available with *each* in object position, and present formalism that predicts would predict such a possibility.

Methodology

The experimental methodology we adopted was the Question-After-Story paradigm (de Villiers & Roeper, 1996; Roeper & de Villiers, 1993; for recent use, see Omaki et al., 2014). In this paradigm, participants are told a series of brief stories, accompanied by pictures on the computer screen. At the end of each story, they are asked a question, which is the target construction (in our case, a *wh*-/quantifier question).

Participants were tested individually in a quiet room, either in the laboratory (adults) or in a preschool (children). For adults, the narration and question were pre-recorded by a female native speaker of English. Their responses were recorded on video and later coded by the experimenter. For children, the narration was delivered live, and the children interacted with the experimenter. A second experimenter recorded the child's answers verbatim. Sessions were also video recorded for later transcription support.

The experiment began with a 2-item practice session, which was followed by a test session consisting of 12 items (6 critical trials and 6 control trials, pseudorandomized). The design was 2x2, with syntactic position of the quantifier (subject vs. object) manipulated within subjects, and universal quantifier type (*each* vs. *every*) manipulated between subjects. Thus, the six critical items included three object-quantifier questions and three subject-quantifier questions. Participants heard sentences with either with the universal quantifier *every* or the universal quantifier *each*. The *wh*-phrase was always headed by *which*.

Test stories followed one of two story templates, one preceding subject-quantifier questions and the other preceding object-quantifier questions. Control trials were aimed at determining whether children are able to produce PLAs and single answers in response to questions without quantifiers, and whether children understand the universal quantification of *every* and *each*.

The narrative and question from a sample story accompanied by a subject-quantifier question is presented in (13). Each test story had the same structure: there were three characters and three objects. Each of the characters interacted first with one of the objects, thereby supporting a single answer. Then two of these characters each interacted with another object, thereby supporting a PLA. A scene from the part of the narrative supporting a single-answer (*Candy Land*) and one supporting a PLA (*Woody played Candy Land, Jessie played Sorry, and Buzz played Monopoly*) are presented in Figure 3. For each story, we used visual aids, such as the footprints in this example, to provide a record of events in the story. A full list of scripts is provided in the Appendix 1.

(13) Buzz, Jessie, and Woody are playing board games. There's *Candy Land, Sorry*, and *Monopoly*. I wonder what they'll play! Woody, Jessie, and Buzz play *Candy Land*. Then, Buzz decides to play another game. He plays *Monopoly*. Jessie wants to play another game too, so she plays *Sorry*.

Which game did [**every/each**] friend play?

The narrative and question from a sample story accompanied by an object-quantifier question is presented in (14). A scene from the part of the narrative supporting a single-answer (*Big Bird*) and one supporting a PLA (*Big Bird got a tiger, Elmo got a jump rope, and Cookie monster got a bouncy ball*) are presented in Figure 4.

Which friend received [**every/each**] toy?[4]

(14) The friends are waiting for a surprise! Wow! There are the boxes! Big Bird gets 3 boxes to open. He opens the boxes and finds a jump rope, a bouncy ball, and a toy tiger. He shares the jump rope with Elmo, and the bouncy ball with Cookie Monster.

[4]A reviewer wondered whether some children may have misunderstood this story since in the beginning one of the characters receives all the toys, but then two of the toys move to other characters. Adults did not report any difficulties with the story design. We also tested children on control items which contained the verb "receive". All children performed as expected answering the question: *Did every friend receive a dog?*

Figure 3. Two images accompanying an example subject-quantifier story.

Figure 4. Two images accompanying an example object-quantifier story.

Coding

While adults produced model answers (prototypical single answers and PLAs), children produced a range of answer types. These included single answers and PLAs, but also partial PLAs (in which one member of each pair was listed, or in some cases where a proper subset of the pairings was produced), and other answers that could not be classified (e.g., *every game, none of them, both, all of them, different games*). In addition, children occasionally did not verbally produce a response, but instead pointed to a single character or object, or pointed in a manner that indicated PLA pairings. We therefore instituted a coding strategy for the child responses.

Two coders who were blind to the original experiment and its design reviewed the children's responses and coded them according to whether they were single answers, partial answers, PLAs, or other. There was 84% agreement among the two coders, with conflicts distributed evenly across item types. Items for which there was disagreement were coded by a tiebreaker coder who was familiar with the range of interpretations and design. 20 of these 50 conflicts were coded as "other". The remaining 30 were coded as follows: Single: 6, Partial: 18,[5] PLA: 6. Only 13.3%, of all total responses were coded as "Other".

We employed two strategies for summarizing the coding results: a conservative strategy similar to the one employed by Yamakoshi (2002) (described in Child language background section) in which "partial" and "full" PLAs were treated separately, and a less conservative one, in which "partial PLAs" were binned into a general "PLA" category. The latter strategy allowed answers listing only characters or only objects, such as "Belle, Jasmine, and Cinderella," to count as PLAs. Our reason for considering these answers as PLAs is twofold.

First, although such answers are not canonical PLAs, they are most certainly not single answers. Second, we think it is not unreasonable to think that children may be constrained by the pressures of

[5]For many of these, one coder had opted to code these as "partial" and the other coder as "other".

production in such a way that a full PLA does not get uttered as an exhaustive list, and takes on a truncated form. All other clear "single answers" (e.g., *Candy Land*) were treated as such. Relevant to this point about constraints on production is the fact that 41 out of 300, or 13.7%, of children's answers involved non-verbal, pointing responses. Of these, 32 were single answers, distributed evenly across item types.

Results

Analysis of full canonical PLAs

Let's take a moment to recall our predictions. Single answers should be permissible for all question types, regardless of the syntactic position of the quantificational phrase or the type of quantifier. What is under scrutiny is the occurrence of PLAs in response to these questions, and here the linguistic theory to date predicts acceptability of PLAs for subject-quantifier questions, but not for object-quantifier questions, unless perhaps the quantifier is *each*. See Table 1.

Note that where a PLA is licensed, we have no basis for making a prediction about which reading (single answer or PLA) would be preferred. This also means that lack of PLA production could be interpreted as meaning that a PLA is, in principle available, but dispreferred. Given the open-ended nature of our task, this possibility is inevitable. However, we are not as concerned about this possibility for children, since that the debate in the developmental literature has centered around children's possible *over*production of PLAs.

We used mixed effects logistic regression to model our data (*lme4* package, Bates, Maechler, Bolker, & Walker, 2014). We treated production of a full canonical PLA as a binomial dependent variable. The quantifier position (within-group), type of quantifier, and age group acted as independent variables. Random effects included random intercepts for items and subjects and random slopes for within-subject factors given that the models still converged, as suggested in Barr, Levi, Scheepers, and Tily (2013). The *p*-values were adjusted for multiple comparisons wherever necessary.

We turn first to our adult participants. Overall, adults produced little to no PLAs for questions with *every* (Table 4), but produced PLAs at a significantly higher rate for questions with *each* ($\beta = 120.179$, $SE = 8.476$, $p < 0.01$). We comment on the low percentage of PLAs for *every* questions (which should otherwise license them) in the discussion section.

We turn now to the responses from the child participants. We will start the analysis by looking at canonical PLAs for the quantifier *every* first. Recall that we expect children to produce no PLAs in response to questions with object quantifiers if they follow the same constraints as adults. Indeed, children's rate of PLAs (3.8%) is not different from that of adults who never produce PLAs (See Table 5, Full PLAs; Pearson's chi-squared test, χ^2 (1, $n = 123$) = 0.486, $p = 0.485$).[6] For subject-quantifier questions where both single answers and PLAs are allowed, children produce more PLAs ($\beta = 1.67$, $SE = 0.001$, $p < 0.01$). Thus, adults largely refrained from producing PLAs, even when they were licensed, while children produced a higher number of PLAs in a situation when they are possible.

Table 4. Production of PLAs in adults.

	Partial PLA	Full PLA	Single answer	Other
Subject quantifier				
every	0%	6.7%	91.1%	2.2%
each	0%	92.3%	7.7%	0%
Object quantifier				
every	0%	0%	95.6%	4.4%
each	0%	84.6%	15.4%	0%

[6]Due to zero variance and floor effects in the adult sample we were unable to fit a logistic regression model.

Table 5. Results for children separating and combining 'partial' and 'full' PLAs.

	Partial PLA	Full PLA	Partial+Full PLA	Single Answer	Other
Subject quantifier					
every	34.6%	19.2%	53.9%	39.7%	6.4%
each	37.5%	26.3%	64.8%	27.8%	8.3%
Object quantifier					
every	25.6%	3.8%	29.4%	51.3%	19.2%
each	25%	12.5%	37.5%	43%	19.4%

Let us now switch to the quantifier *each*. Since PLAs are licensed for both subject- and object-quantifier questions, we can look at the total number of PLAs produced. Recall that adults produced significantly more PLAs in response to questions with *each* compared to *every* (Table 4). Here we fit a model with random intercepts only for subjects and items since the random slopes model did not converge. As Table 5 demonstrates, children produced fewer PLAs than adult participants (β = −14.786, SE = 5.948, $p < 0.05$). Neither the quantifier position (β = 5.526, SE = 2.59, p = 0.204), nor its interaction with the factor "Group" were significant (β = −3.462, SE = 4.147, p = 0.403). Unlike adults, children did not produce more PLAs in response to questions with *each* compared to *every* (β = −0.969, SE = 0.813, p = 0.234).

Our results paint a new picture of children's competence in *wh*-/quantifier interactions. While children seem to be aware of the structural constraints on quantifier interpretation, they lack the understanding of how structural factors and distributive properties of quantifiers interact: while adults produce more PLAs in response to questions with *each*, children fail to do so. As an interim conclusion, we could hypothesize that children's grammars in the sphere of *wh*-/quantifier interactions are adult-like, while the syntax-semantics interface in children is not.

Analysis of full and partial PLAs

We adopted two approaches to the coding and summarizing of the data, based on whether we treated 'partial' and "full" PLAs separately or as one category. We present the results from the children in Table 5. Apparent from this table is the fact that disregarding "partial" PLAs leaves out a significant portion of the responses. While these answers may not count as full PLAs, their analysis sheds light on children's understanding of questions with quantifiers in case there are patterns in those responses. Partial PLAs do not appear to be random at all. In fact, many partial PLAs result from children naming only one member of the pairing, instead of listing the individual-object pairing. What is more, these objects or individuals in the list seem to refer to the set corresponding to the *wh*-phrase. For example, children respond by providing a list of flavors and *not* the list of dogs when they hear a question in (15).

(15) Which flavor ice-cream did every dog try?

Note that this "List, correct entities" category makes up 63% of all of these partial PLAs. Indeed, lists with correct entities made up 86% of partial PLAs for subject-quantifier questions. By contrast, "List, incorrect entities" answers were those where children listed the other objects/individuals—for example, listing dogs in response to a question in (15). These accounted for a much smaller percentage of partial PLAs (less than 10%). Even more infrequent were those answers in which children only listed two of the three entities. A full list of categories and examples can be found in the Appendix 2.

Given the systematicity of partial PLAs, we are reluctant to simply ignore them as comprehension errors. While partial PLAs in the "List, incorrect entities" group may indeed stem from misunderstanding of a question, those belonging to the "List, correct entities" seem to indicate that children

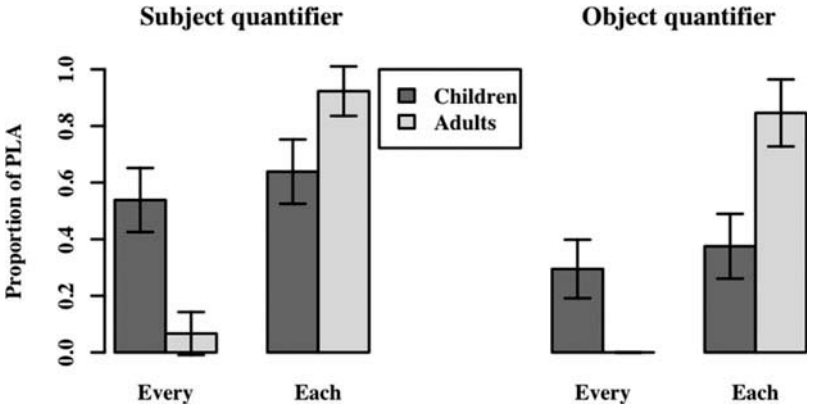


Figure 5. Production of full and partial PLAs together by adults and children for all question types (Error bars represent 95% confidence intervals).

constructed a configuration in which the quantifier takes scope over the *wh*-phrase; otherwise, they would not have provided a list of multiple objects or individuals in response to the question, which contained a singular *which*-phrase. We assume that by age 4–5, children are well aware of the force of plural morphology, or the lack of it. (See, for example, relevant findings on what 3-year-olds know about plural morphology reported by Kouider, Halberda, Wood, and Carey (2006)). Thus, the fact that children frequently produced a list in response to the question—and moreover, a list that corresponded to the *wh*-phrase—is a fact that requires an explanation and seems to indicate that children systematically diverged from single answers for a reason, even if such representations do not result in canonical PLAs.

Moving forward, then, we examine the cases of full PLAs and partial PLAs belonging to the categories "List, correct entities", "List, correct entities, non-exhaustive" and "Paired, non-exhaustive" answers. Lists consisting of incorrect entities were not counted as PLAs and were moved to the category "Other".

Here again we use a binomial logistic regression model with the maximal possible random effect structure justified by the data. Our dependent variable is whether a PLA (now including full canonical PLAs and partial PLAs of the aforementioned categories) was produced. Analysis of the child data revealed no overall significant effect of quantifier type ($\beta = -1.722$, $SE = 1.118$, $p = 0.124$), and no significant interaction between the quantifier type (*every* or *each*) and the structural position of the quantifier ($\beta = 1.01$, $SE = 0.984$, $p = 0.305$).[7] There was, however, a significant effect of quantifier position, in that children produced more PLAs when the quantifier was in subject position than when it was in object position ($\beta = 1.489$, $SE = 0.665$, $p < 0.05$), suggesting knowledge of the subject-object asymmetry in PLA licensing as reviewed earlier.

As shown in Figure 5, children produced more PLAs to questions with *every* than adults (children: 41.6% vs. adults: 3.3%), this difference was statistically significant ($\beta = 5.043$, $SE = 1.303$, $p < 0.01$). This result holds for subject-quantifier questions (children: 53.9% vs. adults: 6.7%, $\beta = 5.386$, $SE = 1.698$, $p < 0.01$), as well as object-quantifier questions (children: 29.4% vs. adults: 0%, Pearson's chi-squared test, χ^2 (1, $n = 123$) = 16.321, $p < 0.01$). Thus while adults appeared to show a strong preference for single answers over PLAs, even in situations where both answers are allowed, children constructed more pair-list configurations in response to object-quantifier questions with *every*.

The situation is much different for the quantifier *each*. Relative to adults, children *under*-produced PLAs in response to questions with *each* (children: 50.7% vs. adults: 88.4%, β =—4.935,

[7]The by-subject random slopes model for the quantifier position did not result in a better fit, so the random intercepts model for subjects and items is reported.

SE = 1.492, $p < 0.05$). The percentage of PLAs for *each* subject-quantifier questions was not statistically different among children (64.8%) and adults (92.3%) due to high variance in children's responses (β =—2.164, *SE* = 4.145, $p = 0.624$). The percentage of PLAs with *each* object-quantifier questions was lower for children (37.5%) than for to adults (84.6%) (β =—7.114, *SE* = 2.882, $p < 0.05$). Thus, while adults took the presence of *each* to signal that a PLA answer was not only licensed, but favored, regardless of the structural position of this quantifier and in contrast to performance with *every*, children's production of PLAs was comparable (37.5%) to the proportion observed with *every* (29.4% for object quantifier), and therefore appear to *under*generate pair-list readings in response to object-quantifier questions with *each*.

Recall that children were divided into two age groups: a younger one (3;6–4;11) and older one (5;0–6;7). We chose to examine the production of PLAs in response to object-quantifier questions, since this is the structural position of most interest, to determine if there was evidence hinting at any developmental trend. These results for both child age groups and adults are presented in Figure 6.

For *every* object-quantifier questions, the two groups did not differ from each other statistically due to substantial between-subject variability (mean PLA production rate: 40% in the younger vs. 17% in the older group, $\beta = 2.776$, *SE* = 1.762, $p = 0.115$). Older children differed only marginally from adults (Pearson's chi-squared test, older v. adults χ^2 (1, $n = 81$) = 2.9, $p = 0.08$). However, the younger group was different from the adult controls (χ^2 (1, $n = 87$) = 10.1, $p < 0.01$). A similar trend surfaced for subject-*every* questions where the proportion of PLAs decreased from 64.2% in the younger group to 41.6% in the older group, however, this difference did not reach statistical significance (β = 1.856, *SE* = 1.392, $p = 0.164$). Both groups nevertheless produced more PLAs than adults (older: $\beta = 4.221$, *SE* = 1.685, $p < 0.05$; younger: $\beta = 6.237$, *SE* = 1.99, $p < 0.01$).

For the *each* object-quantifier questions, there was no difference between the two child age groups (older: 28.6% vs. younger: 50%, $\beta = 1.661$, *SE* = 1.237, $p = 0.179$). We see a similar picture in the case of *each* subject-quantifier questions: no difference is found between the older and younger children (66.7% vs. 60%; β =—0.465, *SE* = 3.182, $p = 0.883$). For *each* object-quantifier questions, older as well as younger children produced significantly fewer PLAs than adults (older: β =—5.629, *SE* = 3.753, $p < 0.05$; younger: β =—5.675, *SE* = 2.762, $p < 0.05$). None of the contrasts between child groups and adult controls are significant for *each* subject-quantifier questions. We discuss the developmental consequences of these comparisons in the following section.

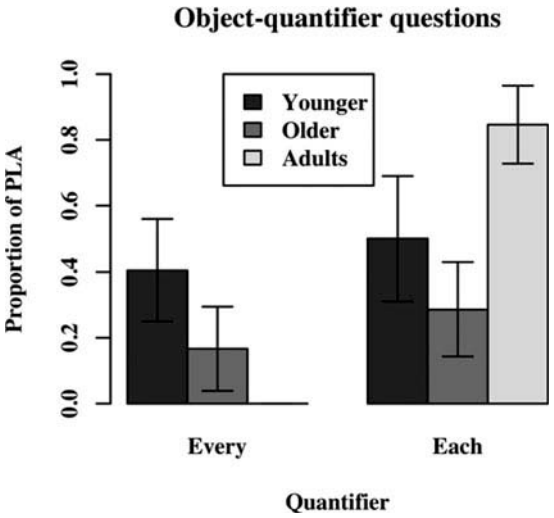


Figure 6. Production of full and partial PLAs together for object-quantifier questions by quantifier type and age group. (Error bars represent 95% confidence intervals).

Discussion and conclusions

This study followed up on a classic observation in the developmental literature that children appear to overgenerate pair-list answers (PLAs) to *wh*-questions involving a universal quantifier, specifically when the quantificational phrase occupies the object position. On the surface, our results seem to indicate that children do not produce significantly more canonical pair-list answers than adults, indicating that the necessary structural constraints have already been acquired. However, an analysis of all the responses, including partial PLAs, reveals that children's understanding of questions with quantifiers is not yet adult-like. In this sense, our conclusions support previous observations by Roeper and de Villiers (1993) that children do appear to overproduce PLAs to *which* questions involving *every*. However, we add to this previous observation by showing that they distinguish between structural positions of the quantifier *every*.

Moreover, we showed that children *under*produce PLAs relative to an adult baseline for *which* questions involving *each*. In stark contrast to their performance for *every* questions, adults frequently supplied a PLA in response to questions with *each*, regardless of the syntactic position of this quantifier. For adults, then, a question with *each* was a call to action to respond with a PLA—a tendency that is in line with theoretical claims concerning the distributivity property in the lexical entry for *each* (Beghelli, 1997; Szabolcsi, 1997a). Thus, children appear to lack the lexical knowledge about *each* that adults possess. At the same time, however, children appear to be aware of a structural asymmetry in PLA production, in that their percentage of PLAs is significantly lower when that quantifier occupied object position. These results therefore reveal a more nuanced picture of this phenomenon in language development than had previously been observed.

One aspect of the findings with the adult group demands an explanation, though: why did adults avoid providing PLAs in response to *every* subject questions, where such responses are indisputably licensed? We think that this pattern may have arisen, because both a single answer and a PLA are licensed in such linguistic environments, and adults may have simply opted to provide the more succinct response. That is, the current results are informative about adults' *preferences*, but not what they find *acceptable* (or not). Alternatively, it could be because the sentence-initial singular-marked *which* phrase led adults to posit reference to a singular entity. A similar pattern has been observed in the sentence processing literature for sentences in which a singular indefinite (e.g., *a boy*) occupies the subject position. In such cases, participants appear to prefer to interpret the indefinite as taking wide scope over a quantifier in object position, rather than the indefinite co-varying with the entities in the quantifier phrase, and therefore as making reference to a single, specific person (see Kurtzman & MacDonald, 1993). The adult tendency to opt for a single answer whenever possible may also shed light on how children chose to phrase their PLAs. Children who produce a partial PLA that is an exhaustive list of the correct entities may be constrained by the similar considerations as those of adults.

The current findings may be complemented by independent evidence from a rating task presented in Achimova, Déprez, & Musolino (2013) that adults find PLAs in response to subject-quantifier questions uncontroversially acceptable, but PLAs in response to object-quantifier questions much less so. In an acceptability judgment task, participants rated PLAs to *every/which* subject-quantifier questions higher than PLAs to *every/which* object-quantifier questions. Thus, both children and adults, albeit in different tasks, exhibit a subject-object asymmetry, producing/accepting more PLAs for subject- than object-quantifier questions.

Taking a bird's eye view of our findings, then, the following developmental picture emerges. By 4 years of age, children are aware of structural constraints that give rise to a subject-object asymmetry in the acceptability and production of PLAs for *wh*-/quantifier questions, and consequently produce more PLAs for subject questions than object questions, regardless of which universal quantifier appears in the question. As children mature, they appear to prune PLA production for object-quantifier questions, but unlike adults, they do this for both *every* and *each*. What they have not yet learned is the strong distributivity component in the semantic representation of *each* that permits PLAs for object-quantifier questions with *each*, but not *every*. Thus, at some age beyond the range targeted in the current study, children acquire this knowledge, and presumably become more like adults in allowing PLAs for such questions. Our results therefore favor an

account of children's performance with PLAs that places more weight on an immature lexicon than on an immature grammar (Roeper & de Villiers, 1993).

If indeed one main reason that children deviate from adults lies in the lexical entries for universal quantifiers (or at least the entry for *each*), then it is important to consider what these entries look like in the child's mental lexicon, and when the entries for *every* and *each* begin to deviate from each other. At some point in development, children must acquire the knowledge that *each* is strongly distributive, and therefore raises to a certain level in the syntactic structure and requires properties to apply at the individual level.

Here a look at the theoretical literature provides some insights into what components of the semantics of *each* might be challenging for children. Champollion (2015), in his formalism of universal quantifiers' meaning, suggests that the semantics of *each* includes two parameters: a dimension parameter and a granularity parameter. The former is set to the thematic role, while the latter is set to atoms for *each*. Syrett (2015) hypothesizes that both of these components (which are part of the presupposition of the quantifier) may be problematic for children. Setting the dimension parameter to an incorrect thematic role may result in identifying the object as the agent of an event (and therefore may result in errors of quantifier spreading). The inability to define the granularity parameter may surface as unusual distributivity patterns because children fail to recognize that *each* obligatorily applies to atomic level of a plurality. Thus, in the case of the questions that were the target of this investigation, children may fail to recognize that *each* is strongly distributive and allows for PLAs in both subject and object position precisely because they lack the knowledge of these important semantic and pragmatic components of the lexical entry of this quantifier. For Champollion, the granularity parameter is encoded in the presupposition of the quantifier. Therefore, non-adult like behavior with *each*, Syrett suggests, may not be a result of syntactic or semantic misanalysis, but rather the immaturity of the pragmatic component of child language. Once the presupposition for *each* is refined, children should, like adults, permit PLAs for object-quantifier questions with *each*.

We would predict, then, that we would observe a U-shaped trend in development, hinted at in the current data. Aware of structural constraints, children produce fewer PLAs in response to object-quantifier questions for all universal quantifiers, but still produce a higher level of PLAs than adults do. Over time, they should prune these PLAs for *both* quantifiers. But as they do so, they acquire the correct lexical components for *each*, and gradually allow PLAs back in for these questions. Thus, what we observe in the developing understanding of *wh*-/quantifier questions is a subtle interleaving of syntactic, semantics, and pragmatic factors in children's linguistic development.

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Appendix 1

Full scripts

Test practice

(1) Diego, Boots, and Dora are winning prizes. There's a hat, a balloon, and a Teddy Bear. I wonder what they'll win? Wow!
What did Diego, Boots, and Dora win?

(2) Big Bird, Elmo, and Cookie Monster are waiting for snacks. Let's see what there is to choose from. Yum! Our friends are hungry today. Let's see what they get.
What did Big Bird, Elmo, and Cookie Monster get?

Subject-quantifier questions

(3) Buzz, Jessie, and Woody are playing board games. There's Candy Land, Sorry, and Monopoly. I wonder what they'll play. Woody, Jessie, and Buzz play Candy Land. Then, Buzz decides to play another game. He plays Monopoly. Jessie wants to play another game too, so she plays Sorry.
Which game did every/each friend play?

(4) Dori, Nemo, and Bruce are about to go swimming! But there are three pools for them to choose from! Dori, Nemo, and Bruce swim in the red pool first. Then, Nemo decides to swim in the blue pool, and Bruce decides to swim in the yellow pool.
Which pool did every/each fish use?

(5) Clifford, T. Bone, and Cleo are tasting ice cream! Yum! Clifford, T. Bone, and Cleo taste the vanilla ice cream. But T. Bone wants to find another flavor. Oh! There's strawberry. Cleo wants to try the chocolate ice cream too! Yum!
Which flavor ice cream did every/each dog try?

Object-quantifier questions

(6) The friends are waiting for a surprise! Wow! There are the boxes. Big Bird gets 3 boxes to open. He opens the boxes and finds a jump rope, a bouncy ball, and a toy tiger. He shares the jump rope with Elmo, and the bouncy ball to Cookie Monster.
Which friend received every/each toy?

(7) Princess Belle, Princess Jasmine, and Princess Cinderella are playing. Wow! Princess Jasmine finds 3 goody bags. She looks inside and finds, a Crunch candy bar, a Snickers candy bar, and a Kit Kat candy bar. She shares the Crunch candy bar with Cinderella, and the Kit Kat candy bar with Belle.
Which princess received every/each candy bar?

(8) Sponge Bob, Patrick, and Squidward are feeding their pets. Oh! What cute puppies! Patrick gets with white puppy, the brown puppy, and the black puppy to feed. He feed them all. But the white puppy is still hungry, so he goes over to Squidward who feeds him also. The black puppy is still hungry too, so he goes over to Sponge Bob, who feeds him also.
Which character fed every/each dog?

Control items

(9) Chuckie, Suzie, and Angelica are picking prizes from the carnival. Wow! There are so many prizes for them to choose from! Suzie picks an Oreo cookie, a chocolate chip cookie, and a chocolate fudge cookie. Angelica picks a blue balloon, popcorn, and a chocolate chip cookie. Chuckie picks a red balloon, popcorn, and a chocolate fudge cookie.
Which child picked every/each cookie?

(10) Its snack time for Jessie, Buzz, and Woody! Let's see what they have to choose from. Yum! Jessie chose an orange and an apple, Buzz chose and orange, and Woody chose and orange and an apple.
Did every/each friend choose an orange?

(11) The lions are out to play! There's Nala, Simba, and Scar! What toys will they play with? Scar gets an apple and a scratching post, Simba gets the ball of yarn and a carrot, and Nala gets the toy mouse and a bottle of water.
Which toy did no lion pick?

(12) Diego, Boots, and Dora are looking for pets! Wow! There are so many pets for them to choose from! Let's see what pets the friends receive. Boots receives a parrot and a dog, Diego receives a dog and a cat, and Dora receives a cat and fish.
Did every/each friend receive a dog?

(13) Mr. Fox, Mr. Chicken, and Mr. Horse are going to have some snacks. Let's see what they have to choose from. Yum! Mr. Fox chose a bottle of water and a bagel. Mr. Chicken chose a muffin and a bottle of water. Mr. Horse chose a bottle of water and a bowl of cereal.
Which drink did every/each animal pick?

(14) The animals are out to play! There's Mr. Cat, Mr. Dog, and Mr. Mouse. I wonder if they'll pick any flowers. Mr. Dog picks the red flower. Mr. Cat picks the blue flower. Mr. Mouse wanted to look at flowers too! So he picks the yellow flower.
Which flower did no animal pick?

Appendix 2

Classification of partial pair-list answers

Type	Overall	Subject quantifier	Object quantifier	Subject quantifier: Test question and example answer	Object quantifier: Test question and example answer
List, correct etities	68%	86%	45.7%	Which flavor ice-cream did every dog try? *Vanilla, chocolate and strawberry.*	Which character fed every dog? *Squidward, Sponge Bob, and Patrick.*
List, correct entities, non-exhaustive	17.4%	5.3%	32.6%	Which flavor ice-cream did every dog try? *Strawberry and vanilla.*	Which character fed every dog? *Sponge Bob and Squidward.*
List, incorrect entities	6.8%	0%	15.2%	none	Which friend received every toy? *A jump rope, a ball and a little toy tiger.*
List incorrect entities, non-exhaustive	3.9%	5.3%	2.2%	Which pool did every fish use? *Nemo and Bruce*	Which friend received every toy? Jumping rope and ball.
Paired, non-exhaustive	3.9%	3.4%	4.3%	Which pool did every fish use? *Nemo went into the blue pool, Dory went into the red pool.*	Which friend received every toy? *Elmo got the jump rope, the ball to the Cookie Monster.*
Total	100%	100%	100%		