Universal quantification in children's English

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Abstract

Researchers since Inhelder and Piaget (1964) have replicated a curious finding. When using a picture-verification task (e.g., a picture of four elephants, three of them being ridden by boys), children have been shown to supply a non-adult answer in response to a question such as '*Is every boy riding an elephant?'*, e.g. *'no, not that one'* (pointing to the extra elephant). The question we will address here is whether or not this response by children reflects a non-adult linguistic semantic representation of the meaning of the universal quantifier. Non-adult accounts of children's interpretation of the universal quantifier ('*every*') suggest that children answer 'no' to questions like *'Is every boy riding an elephant?'* because they may not initially interpret the subject set of 'boys' as the restrictor of *every*. By contrast, adult-like accounts of children's interpretation of *every* maintain that children do correctly interpret the set of 'boys' as the restrictor of *every* in such sentences, suggesting that children's non-adult responses can be eliminated by satisfying contextual demands on the use of the universal quantifier. In this paper, we present longitudinal data from 4 two-year-old children, children far younger than have previously been studied experimentally. We show that even from the earliest stages of language acquisition, so long as sentences are presented in felicitous discourse contexts, children's interpretation of universal quantification appears adult-like. The data therefore support the adult-like accounts of children's acquisition of universal quantification.

1. Introduction

Young children's interpretation of the universal quantifier (e.g., *every* in English) has been the subject of much debate over the last 40 years. In 1964, Inhelder and Piaget reported a study of French-speaking children around age 5, who were presented with a display of blue circles, blue squares and red squares, and asked *'Are all the circles blue?'*. In response, children often produced non-adult answers like *'No, there were circles and squares* [blue]*'* (1964: 61). Researchers have replicated this finding in several different languages, using picture-verification tasks such as that in Figure 1 (e.g. Donaldson & Lloyd 1974; Philip 1995, 1996; Crain et al. 1996; Drozd & van Loosbroek 1999, 2006; Philip & Lynch 2000).

Test question:
Here are some boys and some elephants.
Is every boy riding an elephant?

Child response:
No, not that one
[pointing to the extra elephant]

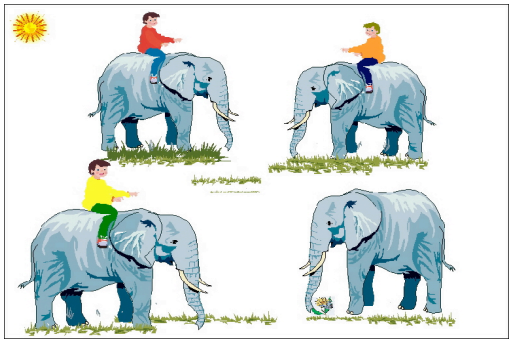

Figure 1: Children's Non-Adult Response in a Picture Verification Task

Children's negative responses illustrated in Figure 1 have been called ‘symmetrical responses’ or ‘over-exhaustive search errors’ because children seem to require a one-to-one correspondence between elements of the set denoted by the subject phrase (*boys*) and the set denoted by the object phrase (*elephants*). The question we will address here is whether or not this response by children reflects a non-adult linguistic semantic representation of the meaning of the universal quantifier.

First it will be useful to explicate the syntax and semantics of universal quantification in human languages, using English *every* as an example. In adult English, *every* is a Determiner in the syntax. In the semantics, it defines a two-place relation between its restrictor (in the case above, the subject noun phrase) and its nuclear scope (the predicate phrase). The quantificational phrase, *every boy,* is said to ‘live on’ the set denoted by the restrictor, *boy,* in the sense that it is valid to infer from the statement ‘*Every boy is riding an elephant’* to the statement ‘*Every boy is a boy who is riding an elephant’* (Barwise & Cooper 1981). In the conversational context, there is a simple test of the 'lives on' relation. This relation holds if the truth or falsity of ‘*Every boy is riding an elephant’* can be established by checking the intersection of the set of boys and the set of boys riding elephants to see whether every boy is in the intersection of these two sets. Crucially, the entire set of elephants may not need to be checked. As long as every boy is riding an elephant, there can be elephants 'left over', i.e., ones not being ridden by boys. Unlike adults, children who produce the 'symmetrical response' reject the sentence ‘*Every boy is riding an elephant’* if there are 'extra' elephants.

There are two basic types of proposal about these non-adult responses by children. On one, these responses occur because children pass through a stage when, in addition to an adult-like linguistic analysis, children assign a non-adult analysis to sentences with the universal quantifier. The non-adult analysis requires children to check the entire set denoted by the object NP in assessing the truth or falsity of these sentences (Philip 1995; Geurts 2003). We call such proposals *non-adult* accounts. Another kind of proposal is that children have adult-like knowledge of the semantics of the universal quantifier, but they have difficulty interpreting *every* when it is used in infelicitous discourse contexts (Crain et al. 1996; Drozd & van Loosbroek 1999, 2006). We call these proposals *adult-like* accounts. To contribute to this debate, we present findings from an experimental investigation conducted with children who were far younger than those tested before. Our aim in conducting this study was to uncover children’s earliest hypotheses about the syntax and semantics of universal quantification. If children entertain a non-adult linguistic representation of universal quantification at some point during language development, it would presumably be most likely to occur at an early stage of development. However, the data from the study we conducted show that even 2-year-old children respond in an adult-like manner to sentences with the universal quantifier, at least when these sentences are presented in felicitous discourse contexts. The data therefore support the adult-like accounts of children’s acquisition of universal quantification.

2. Possible Child Hypotheses about Universal Quantification

2.1. Non-adult Accounts

One non-adult account is by Philip (1995). We call this the Event Quantification Account. This account suggests that children interpret universal quantifiers as quantifying over events rather than individuals, similar to quantificational adverbs. On this account, the non-adult analysis children assign to the sentence *Every boy is riding an elephant* puts a disjunction of events in the restrictor of *every*, along the lines of (1), where 'e' is a variable ranging over events.

(1) Every(e) [Boy(e) or Elephant(e)] [is a Boy-riding-an-Elephant(e)]
'For every event *e* in which a boy participates or in which an elephant participates (or both), a boy is riding an elephant in *e*.'

The Event Quantification Account has two shortcomings. First, it attributes to children a reading of the universal quantifier which violates the 'lives on' relation of determiner meanings proposed by Barwise and Cooper (1981). No determiner in adult languages violates this relation, so the proposal that the determiner *every* does not adhere to this relation for children is a threat to the continuity assumption -- the proposal that children's linguistic analyses are restricted to ones that characterize adult languages (e.g., Crain 1991; Pinker 1984). Second, the account faces a learnability problem. To account for the fact that children who produce non-adult responses are also capable of giving adult-like answers in situations like the one depicted in Figure 1, Philip assumes that children have both an adult-like reading and an event quantificational reading available to them. This is problematic, given that adults also accept a symmetrical response in situations where the subject and object set are in a one-to-one relation. The problem is how children can expunge the non-adult reading from their grammars. Without overt negative evidence, in order to expunge the non-adult linguistic analysis children would need to keep a mental record of the absence of certain adult responses to *every*. For example, children would need to note that adults do not reject sentences like '*Every boy is riding an elephant'* in situations like Figure 1 where there is no one-to-one correspondence between boys and elephants. Unless children are excellent record keepers, it is unclear how they could ever 'unlearn' their non-adult analysis.

Another non-adult account is the Weak Mapping account advanced by Geurts (2003). To explain children's non-adult responses to universally quantified sentences, Geurts draws on the distinction between strong and weak quantifiers. He argues that the semantic representation of weak quantifiers is less complex than that of strong quantifiers and that children adopt a weak quantifier syntax-semantics mapping rule, in order to ease the demands on their working memory and attention. To understand the proposal, it is worth noting first that weak quantifiers like *some* are intersective. To verify the sentence '*Some boys are riding an elephant'* one only needs to check the intersection of the set of boys and the set of elephants, to see whether or not something is in the intersection. Strong quantifiers, on the other hand, are relational. To verify the strong quantificational expression, *every*, one has to check both the set of boys and the set of boys riding elephants and verify whether or not every boy is in the intersection. Geurts suggests that children have an adult-like underlying semantic representation for *every,* and children know that *every* is a strong

quantifier. However, he contends that the domain of quantification (the restrictor) is syntactically underdetermined for children. This leaves room for contextual factors to influence the child to adopt a syntax-semantics mapping rule that is appropriate for weak quantifiers, which is cognitively simpler than the syntax-semantics mapping rule for strong quantifiers. In Geurts' view, the weak quantifier syntax-semantics mapping rule allows material from the nuclear scope of the quantifier to determine the domain of quantification. For example, in a sentence like '*Most people visit Berlin in the spring'*, it is suggested that the domain of quantification for the quantifier *most* is restricted, not just by the subject NP *people*, but by the backgrounded material in the VP *visit Berlin*. The quantifier is thus evaluated against a domain of quantification that is defined contextually, so the restrictor of *most* is understood to be 'people who visit Berlin'. Geurts' suggests that, in a similar fashion, children can be led to contextually determine the domain of quantification of a strong quantifier like *every*, so that the content of the restrictor will include whatever entities are most salient to the child at the time. In cases like Figure 1 above, the extra elephant makes the set denoted by the object NP highly salient, so this set can sometimes enter into the restrictor for children. In contexts where the elephants are highly salient, therefore, children tend to consider the set of elephants as the restrictor of the universal quantifier.

Geurts' account avoids the problem of violating the 'lives on' relation associated with determiner meanings, by only allowing a single set, the most salient one, to be interpreted as the restrictor of *every*, however his account faces other questions. In addition to the inherent problem of deciding when a set of objects is salient for children, it is not clear whether the difference in processing complexity between weak and strong quantifiers would be enough to push children to use weak quantifier syntax-semantics mapping rules with *every*, especially given there is independent evidence that 3–5-year-old children know that *every* is a strong determiner, in the sense that it shares certain semantic properties with the strong determiner *the* (Meroni, Gualmini, & Crain 2007). The Weak Mapping account must also explain how children eventually converge on a completely adult-like grammar. Geurts' answer to this is that, because children are assumed to have the correct underlying relational semantic representation for *every*, there is nothing to 'learn' or 'unlearn'. As children's working memory capacity and attention increase (with maturation), they will achieve the processing resources necessary to begin using the strong quantifier syntax-semantics mapping rules that go along with the semantic representation they already have (in which the domain of quantification is strictly limited to the syntactic restrictor). This explanation, however, depends on the assumption that children have less working memory capacity than adults. And, again, the experimental finding that children interpret *every* as a strong determiner casts doubt on an account of children's non-adult responses based on limitations in working memory capacity (Meroni et al. 2007).

2.2. Adult-Like Accounts

In contrast to non-adult accounts, other researchers have concluded that children's interpretation of '*every'* is essentially adult-like. Using picture-verification tasks, Sugisaki and Isobe (2001) found that 4- and 5-year-old children's performance is greatly improved when there are several extra objects in the context. For others, over-exhaustive search errors are seen as an experimental artifact, resulting from infelicitous test conditions. For Crain and colleagues, who support the Full Competence account, the infelicity stems from the fact that

when asking someone to judge the truth or falsity of a sentence, a different possible outcome from the actual outcome should have been under consideration at some point. A felicitous context for the question '*Is every boy riding an elephant*?' requires that, at some point, the possibility exists that not every boy will be riding an elephant. To satisfy this requirement, at least one of the boys might consider riding something else, a donkey say. This is called the 'condition of plausible dissent'. In the case of Figure 1, where the answer to the question has never been in doubt, children might infer that a different question is intended, a question about the presence of the 'extra' elephant. Crain et. al suggest that, while adults and older children can accommodate infelicity of this type, younger children cannot. Children's non-adult response, therefore, are due to children's failure to accommodate an unsatisfied felicity condition, one which adults can accommodate.

Interestingly, it has been shown that although adults do not make errors on trials like Figure 1, they are sensitive to the infelicity of the task. Eye-tracking results show that adults fixate significantly longer on the extra elephant in trials like Figure 1, as compared to pictures which depict both an extra elephant and some other animal that the boys might have ridden (Meroni, Crain, & Gualmini 2001). Moreover, if pragmatic felicity is deliberately sabotaged, so that the wrong set is established as the topic of discourse, adults too show breakdowns in accessing the correct meaning of *every*, committing errors similar to children, though to a lesser extent (Philip & Lynch 2000). Adults also commit errors if the 'extra' object is part of a natural pairing of objects such as saucers and tea cups (Freeman, Sinha, & Stedmon 1982).

In further support of their account of children's non-adult responses, Crain and colleagues tested 34 3–5-year-old children using trials like that in Figure 1. They found non-adult responses occurred 35% of the time, and the non-adult responses were concentrated in a group of 14 children who produced errors 82% of the time. These 14 children were then tested using test trials similar to Figure 1, but in contexts that satisfied the condition of plausible dissent. Twelve of the 14 children no longer made a single symmetrical response. Two children still rejected the target sentences, but their justifications showed that their rejections were not due to the extra objects in the story. Rather, they prohibited the use of *every* to refer to a set of only 3 members. These 2 children were retested with stories in which 5 characters made up the quantified NP set, and they accepted the test sentences (Crain et al. 1996).

Other adult-like accounts include Drozd & van Loosbroek's Presuppositionality Account (1999, 2006) and Philip's Relevance Account (2004). Both propose that children correctly represent the set of boys as the restrictor of the universal quantifier. Children's non-adult responses are hypothesized to arise in contexts like Figure 1 because one of the presuppositions associated with the universal quantifier has not been satisfied. Strong quantifiers like *every* carry a presupposition of existence about the speaker's intended domain of quantification. In tasks like Figure 1 the set of visible boys is intended as the domain of quantification. However, given the minimal discourse context of such tasks, children may not always take this set to be presupposed. Rather, children may use other aspects of the context (in this case the extra elephant) to determine the set of boys that are being referred to. Philip (2004) suggests that children do this because they may lack knowledge of a pragmatic rule restricting verification to visible objects in the context.

All of these adult-like accounts concur that children correctly interpret the set of boys as the restrictor of *every* in cases like Figure 1 under normal discourse circumstances (when the object set has not been deliberately established as the discourse topic). All these accounts also agree that errors can be minimised by presenting children with a richer context. The accounts differ in what aspects of the context have to be manipulated to prevent symmetrical responses. Sugisaki & Iobe (2001) suggest that providing a large set of extra objects is sufficient to improve child performance on tasks like that in Figure 1. Drozd & van Loosbroek (2006) maintain that satisfying the presuppositionality demands of the universal quantifier, by making the set corresponding to the restrictor clear in the context, is a sufficient condition to reduce children's error rates. They point to data showing no significant difference in 4–5-year-old Dutch-speaking children's performance on test trials like Figure 1 in which only the presuppositionality demands of the context were met, as compared to trials in which both the presuppositionality demands and the condition of plausible dissent were met. Nonetheless, although not statistically significant, their results clearly show that children's performance on trials in which the condition of plausible dissent was also met was better than in trials in which it was not (see Crain (2000) for a critique of Drozd & van Loosbroek's analysis of their 1999 results). Drozd & van Loosbroek (2006) admit this aspect of their results remains to be explained.

This study does not address the issue of which particular contextual conditions are sufficient to obtain adult-like responses from children. Instead, we present data from younger children than have ever been reported in the experimental literature on this topic. These data support the emerging consensus that children's interpretation of the set relation of *every* is essentially adult-like from the earliest stages of language development.

3. The Experiment

In this section we describe the subjects and design of our study. We then outline the scoring system and review the predictions of the two types of account: non-adult and adult-like.

3.1. Subjects

Four English-speaking children attended our lab for fortnightly 1-hour experimental play sessions over a period of 6–12 months. Each child's alias, age and number of experimental sessions are shown in Table 1, below.

Table 1. Child subject information

Child Alias	Age	Number of sessions
Ruby	1;11–2;5	13
Ian	2;4–3;1	15
Pam	2;1–2;11	21
Liv	2;4–3;0	18

3.2. Tasks and context

We employed two experimental tasks: an act-out and a judgement task. The children were first introduced to different sets of toys making up sets of subjects (e.g., mermaids, turtles) and objects (e.g., strawberries, blankets) in transitive sentences. Both subject and object sets could vary in number from trial to trial, but each set contained at least three members (and

usually more) so that all contexts favoured a distributive universal wide-scope reading. On an act-out trial, children were instructed to distribute the object set in relation to the subject set. A representative example is given in (2). Act-out trials were often, but not always, followed by a judgement trial as in (3). At other times, judgement trials were given independently, in reference to arrays set up by the experimenter in the course of play.

(2) Give every mermaid a strawberry.
(3) Does every mermaid have a strawberry?

For very young children, act-out tasks were easier than judgement tasks. This is because the act-out task doesn't place any verbal demands on the child, while all judgement tasks minimally require a yes/no answer.

Because the tasks were naturalistic, presented in the course of a continuous play discourse with the child, they naturally fulfilled both the presuppositionality demands of *every* and the condition of plausible dissent. By being introduced to real sets of toys, the presuppositional domain of quantification was made clear to children. By being asked to manipulate the toys themselves or by seeing them manipulated in front of them as a task unfolded, many possible outcomes besides the final one were available. We made no special effort to manipulate the saliency of the subject or objects sets or otherwise define the context, although it could perhaps be argued that the object sets were always more salient for children, being the items they were asked to distribute themselves.

3.3. Conditions

There were three conditions which differed in the number of subjects and objects in the experimental play space:

Equal (where number of mermaids = number of strawberries)
Less (fewer strawberries than mermaids)
More (more strawberries than mermaids)

The *More* condition was intended to resemble trials like that in Figure 1 where the presence of extra objects might result in a non-adult response from the children. The *Less* condition was included as a control for the crucial *More* condition (children who appear to be adult-like by answering 'yes' to *More* judgement trials should answer 'no' to *Less* judgement trials). The *Equal* condition was included in case any child only allowed a symmetrical reading of *every*.

In both task types, trials in the *Less* condition were easily the most demanding. To succeed on an act-out *Less* trial, a child had to indicate to the experimenter that the task (e.g. '*Give every mermaid a strawberry'*) could not be completed because there weren't enough strawberries. Similarly, in a judgement *Less* trial (e.g. '*Does every mermaid have a strawberry?'*), the correct answer was always 'no'. This is a difficult answer to give for very young children, who tend to say 'yes' when they are uncertain (even if in some cases they can demonstrate the correct answer to the question in other ways) (Crain & Thornton 1998).

3.4. Scoring

The play sessions were video recorded and transcribed in full. The relevant trials were then isolated for scoring. Trials that were poorly set-up or where the experimenter interfered with the course of the trial were discarded. For each trial, the child's first response was recorded, as well as any subsequent response or justification for their response that they may have given. Trials in which the child's first response was adult-like (and any subsequent response matched their first response) were scored as 'Right'. Trials in which the child's first response was non-adult (and any subsequent response was also non-adult) were scored as 'Wrong'. Trials in which the child's first and subsequent responses differed were scored as 'Mismatch'. In 6 out of 7 'Mismatch' responses across all data sets, the first response was non-adult, but the subsequent response showed adult-like comprehension. These 6 trials were not counted as correct, but added to the final category 'Other', containing trials in which the child was distracted by another toy or not paying attention, and therefore gave no response or a response not related to the test trial. The 7th mismatch trial consisted in an unintelligible response by the child followed by an adult-like response to a follow-up question. This trial was counted as 'Right'.

Between 20-30% of each child's data set was selected at random to be scored by a second coder (Ruby: 13 trials, Ian: 11 trials, Pam: 24 trials, Liv: 15 trials). Overall inter-rater reliability was high (0.83). Cases in which there was disagreement were discussed with a third coder and a consensus reached. Table 2, below, shows the number of discarded trials and breakdown of scored trials for each subject.

Table 2. All subjects' discarded and scored trials

Subject	Discarded trials	Scored Act-out trials	Scored Judgement trials	Total Scored trials
Ruby	9	22	26	48
Ian	12	17	24	41
Pam	20	30	42	72
Liv	11	18	27	45

3.5. Predictions

The two types of account (non-adult and adult-like) of children's interpretation of *every* make different predictions about their responses to trials in the *More* condition (the condition in which there were more objects than subjects in the experimental play space).
On Philip's EQA, children require every element of the subject set and every element of the object set to be involved in the event in question. On Geurts' Weak Mapping Account, children quantify over elements in the object set if this set is salient. Set salience is a vague notion, but as noted above, the object set would arguably be the more salient set as this set was physically controlled by the child and it contained extra members in relation to the subject set. So, on these non-adult accounts in a *More* act-out task (e.g., (2) '*Give every mermaid a strawberry'*), we could expect to see children distribute all the strawberries, either by sharing them out to the mermaids present, or (perhaps preferably for a one-to-one mapping) by searching for extra mermaids to receive the extra strawberries. In a judgement task (e.g., (3) '*Does every mermaid have a strawberry*?'), we could expect children to reject arrays in which every mermaid has a strawberry, but in which extra strawberries are present.

Adult-like accounts do not predict any difficulty for children in the *More* condition if task felicity demands are met. To minimally complete the act-out task in (2), children must distribute as many strawberries as there are mermaids. Extra strawberries should be irrelevant. However, it is not incorrect on adult-like accounts for the child to distribute all the elements of the object set to the subjects present. What is *not* predicted is that children will search for extra members of the subject set in order to distribute the extra objects. Similarly, in a judgement task such as (3), it is not predicted that children will reject arrays in which every mermaid has a strawberry but in which extra strawberries are present. The different predictions are summarised in Table 3.

Table 3: Predictions of Non-adult vs. Adult-Like accounts

More condition set-up and experimental question	Non-adult	Adult-Like
Context: More strawberries than mermaids in the experimental play space *Give every mermaid a strawberry* (Act-out task)	Distribute all strawberries	Discard extra strawberries
Context: every mermaid has a strawberry; there are extra strawberries *Does every mermaid have a strawberry?* (Judgement task)	Answer *no*	Answer *yes*

4. Results

Due to space limitations, the results of both act-out and judgement task types are treated together in all three conditions (*More, Equal*, *Less*). The most interesting results will be presented in §4.1 (the *More* condition), and the subjects' responses to the extra objects will be discussed. We highlight the trend in responses but do not provide statistical analysis at this stage. The Control conditions (*Equal* and *Less*) are reported in §4.2 and §4.3. Discussion is presented in §4.4.

4.1. More

Results are shown below for all four children in the *More* condition, the condition in which there were more objects than subjects (e.g., more strawberries than mermaids).

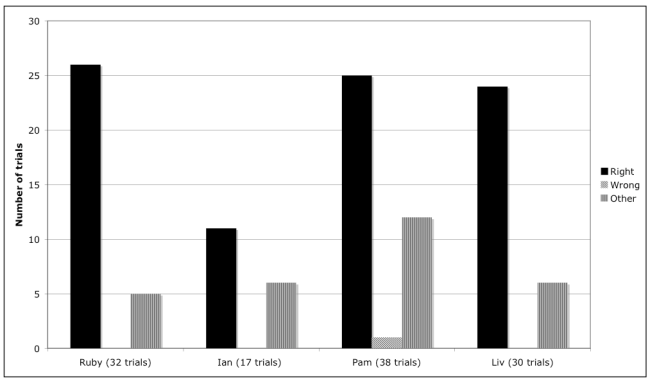

Figure 2: Subjects' responses in More condition

Even at a glance, it is clear that each child responds with a majority of 'Right' or adult-like answers in this condition. The children's first correct answers in the *More* condition are given from the very earliest sessions: Ruby (1;11); Ian (2;4); Pam (2;1); Liv (2;4). Being two-year-olds, each child responds to some trials with an 'Other' response – these are cases in which

the child was distracted or responded in a way not relevant to the trial. Only one child (Pam) ever responds with a 'Wrong' answer, and this is just one trial out of 38. Importantly, Pam responds correctly from her earliest timepoint (2;1); the one 'Wrong' response is given at 2;11, suggesting that it be understood as a mistake rather than an indication of her understanding of *every*.

Recall that in these trials, the extra objects are present, visible and controlled by the child. Thus, the extra objects are contextually salient. In several cases, the extra objects are made particularly salient when the experimenter asks about them after completion of a trial. In a *More* trial (e.g. '*Give every mermaid a strawberry'*), after providing every mermaid with a strawberry, there are three possible behavioural responses a child could have to the extra strawberries: (i) expand the subject set (look for more mermaids to give the extra strawberries to), (ii) distribute all strawberries to the mermaids that are present, or (iii) ignore/discard the extra strawberries. Only children who pass through a non-adult stage in their mastery of *every*, in which they quantify over the set in the nuclear scope of the universal quantifier might opt for (i). Option (ii) is possible on all accounts. Option (iii) is predicted by adult-like accounts, and is intuitively the most natural adult response. Consider the case of Ruby. Out of her total of 26 'Right' *More* trials, she was presented 19 times with a different unique set of extra objects (e.g., strawberries, blankets). In the remaining 7 trials, a judgment trial had immediately followed an act-out trial about the same sets of objects. Naturally, for the purpose of examining how extra objects were treated, these trials were not double-counted. Her extra object responses (together with responses from the other children) are presented in Figure 3.

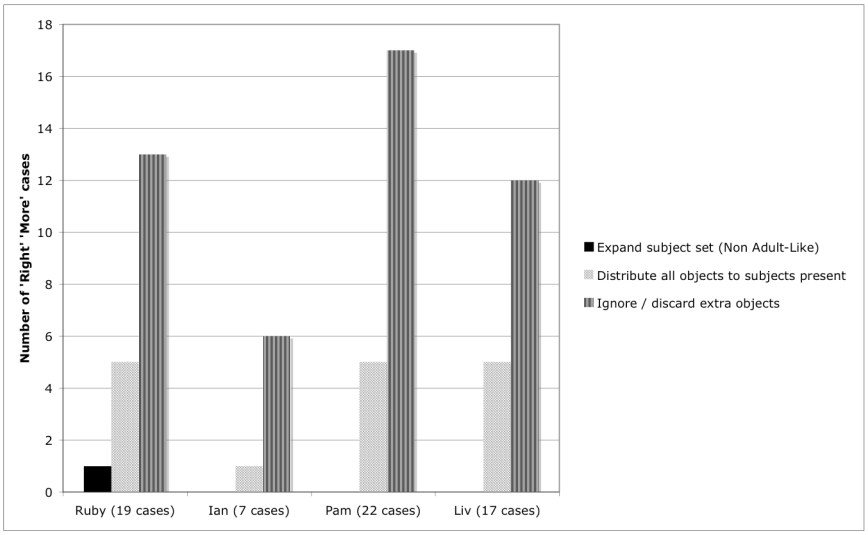

Figure 3. Subjects' responses to extra objects in correct More cases

In the vast majority of all children's 'Right' *More* cases, they respond in an adult-like manner. As shown, the most common response to extra objects is to ignore them. In several cases (4 for Ruby, 1 for Ian, 7 for Pam, 3 for Liv) extra objects are ignored even following an explicit experimenter prompt. Examples from Ruby (2;4) and Pam (2;7) are given in (4)-(5).

(4) [Context: 5 babies, 6 blankets; Ruby gives 1 blanket to each baby, 1 extra blanket]
Experimenter: Now does every baby have a blanket? Let's look.
Ruby: yeah
Experimenter prompt: What will we do with this blanket? [indicating extra blanket]
Ruby: um… it's another blanket

(5) [Context: 4 babies, 6 blankets; 4 babies each under a blanket, 2 extra blankets]
Experimenter: Now is every baby under a blanket?
Pam: yes [nodding]
Experimenter prompt: What about these blankets? [indicating extra blankets]
Pam: no you don't need that blankets

The children's responses to extra objects are correctly predicted only by adult-like accounts of children's understanding of 'every'. Recall that to ignore or discard the extra objects is the most natural adult-like response, and a clear majority of cases were handled this way by each of the subjects. Sometimes, extra objects were distributed to the subjects present in the array, also a possible adult-like response.

Only one child, Ruby, once (in 19 cases) responds in a potentially non-adult way by expanding the intended subject set in order to distribute all the extra objects. In this Act-out trial, her 14th *More* trial, Ruby (2;3) had 6 strawberries to distribute and after giving strawberries to the 4 toy characters in question, she gives one strawberry to a Kermit puppet sitting behind her and keeps one for herself, thus exhausting the object set. It should be noted, however, that she hesitates momentarily in between minimally satisfying the task (handing out the first 4 strawberries) and deciding to continue distributing them. It is thus not clear that the further distribution is actually part of the task for her. Nonetheless, to be objective, this was scored as an instance of 'expand the subject set'. We stress that it was the only case (across all four data sets) that could possibly be interpreted in this way. Even accepting the scoring, Ruby's response can still be accounted for on an adult-like model because the test question was actually '*Can you give everybody a strawberry*?', and Ruby could potentially have defined the subject set *everybody* to include Kermit and herself in addition to the four friends. Roughly half of each child's trials were phrased using the word *everybody* or *everyone* and the other half used *every+N*, as in *every mermaid*. Because the preceding context was designed to satisfy presuppositionality demands of *every*, the set being referred to was generally clear. Nonetheless, it could still be possible for a hearer to entertain a different interpretation from a speaker in this case. In light of Ruby's otherwise consistent adult-like responses (and given the other children's data), it seems likely that her single 'expand the subject set' response should also be accounted for in an adult-like way.

4.2. Equal

The equal condition – in which there were an equal number of subjects and objects (mermaids and strawberries) – was included in case any child allowed only a symmetrical reading of 'every'. As shown from the *More* condition data in Figure 2, this is not the case for any of the children we studied. In the *Equal* condition, each child gives a majority of 'Right' answers from early on: Ruby (1;11); Ian (2;5), Pam (2;2), Liv (2;4). Again, only one

child (Ruby) gave a 'Wrong' answer one time. Importantly, her first correct answer was given at the earliest session (age 1;11).

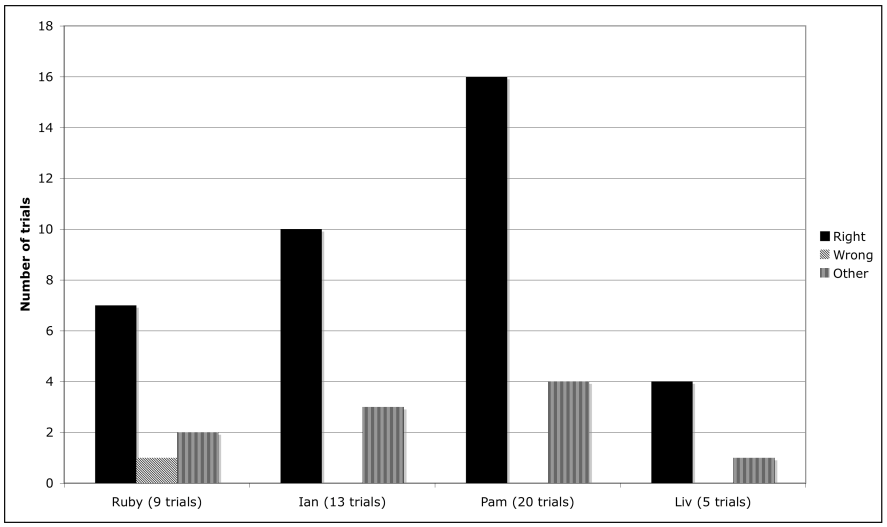

Figure 4. Subjects' responses in the Equal condition

4.3. Less

The *Less* condition (in which there were fewer objects than subjects – fewer strawberries than mermaids) was included as a control for tasks in the *More* condition. Children who appear to be adult-like by answering 'yes' to *More* judgement trials should answer 'no' to *Less* judgement trials. Before we consider the results, however, it is important to recall that in both task types, trials in the *Less* condition were the most demanding as they required the child either to explicitly tell the experimenter that the task could not be completed (in an Act-out task) or answer 'no' to the experimental question (in a judgement task). If after embarking on an Act-out *Less* trial, a child realises that it will be impossible to complete the task, they may simply abandon it and turn to play with other toys. This behaviour was coded in our system as 'Other'.

Though it was the most difficult condition, two children (Ian & Pam) produce a majority of 'Right' responses in the *Less* condition. For Ruby and Liv, the majority of responses are 'Other'. For three of the children, more 'Right' answers are given than 'Wrong' answers. These children also give more 'Other' responses than 'Wrong' responses. Only Ruby, the youngest child, gives an equal number (2) of 'Right' (both age 2;3) and 'Wrong' answers (at age 2;0, 2;1) in response to her 7 *Less* trials, while her earliest *Less* trial produces a mismatch answer (1;11), in which her first answer is non-adult, but her subsequent response demonstrates adult-like knowledge. Nonetheless, Ruby's data are equivalent to the other three children in terms of the time-point at which 'Right' responses in this condition appear: Ruby (2;3), Ian (2;4), Pam (2;2); Liv (2;4).

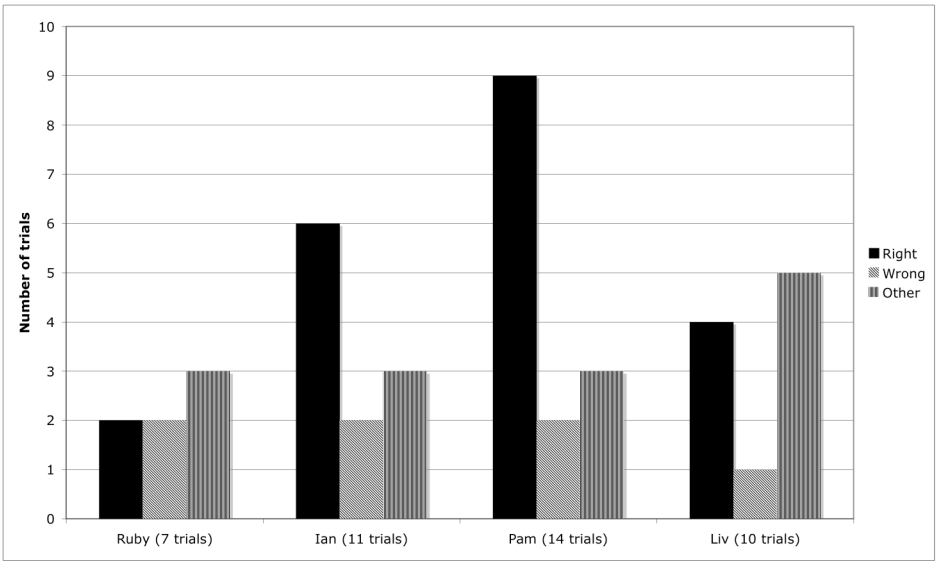

Figure 5. Subjects' responses in the Less condition

Examples of 'Right' (adult-like) responses in the *Less* condition from Liv (2;4) and Ian (2;8) are given in (6) and (7).

(6) [Context: 4 friends, 3 of whom have horses, Winnie the Pooh just has a pot of honey]
Experimenter: Does everybody have a horse?
Liv: no, it's Pooh, has honey
Experimenter: Oh yes, well he has honey
Liv: yes

(7) [Context: 5 babies, 4 have lettuce]
Experimenter: Does every baby have some lettuce?
Ian: that one haven't got lettuce [pointing to baby with no lettuce]

4.4. Discussion of Results

We have shown that, overwhelmingly, two-year-old children (even one child aged 1;11) give adult-like answers to trials similar to that in Figure 1, trials in the *More* condition, when these trials are presented in natural contexts. Each child responded correctly to tasks in the *More* condition from the earliest time point, which indicates that children's earliest responses to these tasks (responses which show adult-like understanding of *every*) have not been learned in the course of the experimental sessions. See Table 4 for a summary of the children's first 'Right' responses in each condition.

Table 4. Subjects' first 'Right' responses in each condition

	More	Equal	Less
Ruby (1;11–2;5)	1;11	1;11	2;3
Ian (2;4–3;1)	2;4	2;5	2;4
Pam (2;1–2;11)	2;1	2;2	2;2
Liv (2;4–3;0)	2;4	2;4	2;4

Moreover, the data clearly demonstrate that even when extra objects are contextually salient (being present, visible, controlled by the child and, in some cases, verbally queried), children are generally satisfied that a *More* trial is complete when the minimal condition for *every* has been fulfilled (every 'subject' has a single 'object'). That is, two-year-olds are content to ignore or discard extra objects in keeping with the most intuitive adult-like analysis of such a situation. These results are consistent with predictions of adult-like accounts, accounts which attribute an adult-like reading of the universal quantifier to children from the outset.

It should be noted that non-adult accounts would also permit an adult-like response in the *More* condition, if it were granted that in these cases the children were using their adult-like semantic model of the universal quantifier or adult-like mapping processes from syntax to semantics (because, even though the set of objects was arguably salient, the overall discourse context ensured the set of subjects was also salient). This would represent a viable alternative, however, only if children displayed some non-adult responses to trials in the *More* condition, either answering 'no' or at least showing a preference for a less typical adult response to extra objects (to distribute all objects to subjects present), see Table 3. Neither non-adult prediction fares very well with the child data presented here. As Figure 2 shows, only one child one time answers 'no' in the *More* condition. As shown in Figure 3, across all the 'Right' *More* cases, children chose to distribute all objects to subjects present relatively rarely, and since this option is not prohibited by adult-like accounts, these responses are not conclusive. Only one child chose once to expand the subject set in order to exhaust the extra objects, an option only predicted by the non-adult account. However, as noted before, this particular case could also be accounted for under the adult-like view, given that the subject set was referred to as *everybody*. Therefore, we feel that the data provide no strong evidence to support non-adult accounts of children's acquisition of the universal quantifier.

5. Conclusion

The conclusion of this study is that children correctly quantify over the subject noun in sentences like '*Every boy is riding an elephant'*, as claimed by adult-like accounts. The data we have presented show that, from some of the earliest stages of child language development, children do not make non-adult responses in trials like Figure 1, our *More* condition. Instead, children quantify over the subject noun and extra members of the object noun set are deemed irrelevant. We feel the simplest explanation for these results is that children have an adult-like model of universal quantification. Indeed, this seems to be the emerging consensus in the field, as even Philip (2004) has recently presented evidence from 3-5-year-old children against his non-adult Event Quantification Account (1995), and has revised his view in favour of an adult-like account. Our data are clearly consistent with the adult-like accounts. It could be argued that they are also consistent with Geurts' Weak Mapping account since he proposes that children have an underlying adult-like semantic representation of the universal quantifier. In the absence of evidence either way, we choose to advocate the theory that offers the highest degree of parsimony, Full Competence, because it introduces only the theoretical machinery that is absolutely necessary to account for children's interpretation of the universal quantifier. Until further data are obtained, we are left with the observation that very young children appear to assign the same meaning to *every* as adults do.

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