

## REPORT

# On the relation between the acquisition of singular–plural morpho-syntax and the conceptual distinction between one and more than one

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### Abstract

*We investigated the relationship between the acquisition of singular–plural morpho-syntax and children's representation of the distinction between singular and plural sets. Experiment 1 tested 18-month-olds using the manual-search paradigm and found that, like 14-month-olds (Feigenson & Carey, 2005), they distinguished three objects from one but not four objects from one. Thus, they failed to represent four objects as 'plural' or 'more than one'. Experiment 2 found that children continued to fail at the 1 vs. 4 manual-search task at 20 months of age, even when told, via explicit morpho-syntactic singular–plural cues, that one or many balls are being hidden. However, 22- and 24-month-olds succeeded both with and without verbal cues. Parental report data indicated that most 22- and 24-month-olds, but few 20-month-olds, had begun producing plural nouns in their speech. Also, the success among the older children was due to those children who had reportedly begun producing plural nouns. We discuss a possible role for language acquisition in children's deployment of set-based quantification and the distinction between singular and plural sets.*

### Introduction

Set-based representations are essential to human language and cognition. In English, they support the distinction between concepts like *all* and *some* and the morpho-syntactic distinction between singular and plural nouns. While singular nouns (e.g. *a bear*) denote single individuals, plural nouns (e.g. *some bears*) denote sets of individuals with an unspecified magnitude (see Bloom, 1999; Barner & Snedeker, 2005). Thus, plural nouns and quantifiers allow us to think about multiple individuals using a single mental symbol. Recent studies of cognitive development suggest that the conceptual distinctions that underlie these linguistic representations may be absent in pre-linguistic infants, and that infants as old as 14 months fail to spontaneously deploy the simple conceptual distinction between singular and plural sets.

Pre-linguistic infants have a rich capacity to track small sets of objects and to represent the approximate cardinal value of large sets. When tracking individuals, infants have been shown to discriminate sets of one, two and three (Carey, 2004; Feigenson & Carey, 2003, 2005; Feigenson, Carey & Spelke, 2002; Feigenson, Dehaene & Spelke, 2004; Wynn, 1998). When representing large sets, 6-month-olds distinguish 4 vs. 8, 8 vs. 16, and 16 vs. 32 (Xu, 2003; Xu & Spelke, 2000; Lipton & Spelke, 2003). However, no infant studies have found evidence for a distinction between singular sets, on the one hand, and plural sets, on the other. In fact, evidence from two paradigms suggests that pre-linguistic infants may lack this distinction. In their investigation of object-based attention in human infants, Feigenson and Carey (2005) demonstrated that 10- to 14-month-old infants can track up to three objects in parallel, but cannot resolve comparisons like 1 vs. 4. When shown sets of crackers hidden

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one-at-a-time into two containers, 10- and 12-month-old infants crawl reliably to the larger set for comparisons of 1 vs. 3, 1 vs. 2, or 2 vs. 3. However, they choose at chance for 1 vs. 4 comparisons (Feigenson, Carey & Hauser, 2002; Feigenson & Carey, 2005). Similarly, upon seeing two or three objects hidden in a box, infants search longer after retrieving one ball than if only one object is originally hidden. However, they do not search significantly longer if four objects are originally hidden, indicating that they do not distinguish between one and four (Feigenson & Carey, 2005). This 1 vs. 4 failure suggests that 14-month-olds lack a distinction between singular and plural sets, and cannot represent sets of four as 'more than one'.

Sometime between 20 and 24 months children learning English begin to comprehend singular-plural morpho-syntax. This has been established with two paradigms: preferential-looking (Kouider, Halberda, Wood & Carey, 2006), and a verbal manual-search task (Wood, Kouider & Carey, under review). Both methods find that 20-month-olds learning English do not distinguish the meaning of 'is a blicket' from 'are some blickets', but that 24-month-olds do. Consistent with this, studies of singular-plural production find that children learning English produce plural nouns by around their second birthday (Brown, 1973; Cazden, 1968; Fenson, Dale, Reznick, Bates, Thal & Pethick, 1994; Mervis & Johnson, 1991).

Two-year-olds' ability to comprehend linguistic singular-plural cues requires that they represent the conceptual distinction between 'one' and 'more than one'. However, studies of language comprehension leave open whether this representational capacity emerges earlier than its linguistic expression, or whether language might play a role in acquiring or deploying the conceptual distinction. If the conceptual distinction emerges prior to learning singular-plural morpho-syntax, then we might expect children aged 20 months or younger to succeed on the 1 vs. 4 manual search paradigm. Accordingly, Experiment 1 explored 18-month-olds' ability to do so. Experiments 2 and 3 explored the relationship between the conceptual distinction and children's acquisition of singular-plural morpho-syntax.

## Experiment 1

We tested 18-month-olds' ability to distinguish sets of one from four using the manual search task. To confirm the validity of the method with children of this age, we also tested children with a 1 vs. 3 comparison, which younger infants resolve using object-based attention (Feigenson & Carey, 2003).

## Method

### Participants

Participants were 18 children aged 17 months, 13 days to 18 months, 17 days (mean 17.26). Six additional children were excluded due to fussiness.

### Stimuli

Children watched the experimenter place orange ping-pong balls inside a black foam-core box (25 cm wide  $\times$  31.5 cm deep  $\times$  12.5 cm high). The face of the box had a 14  $\times$  7.5 cm opening covered by red spandex material with a horizontal slit across its width. Four metal washers were attached to the top of the box to stabilize balls as they were displayed.

To retrieve balls from the children at the end of each trial, the experimenter encouraged children to place them in a plastic chute (Ball Party, by TOMY).

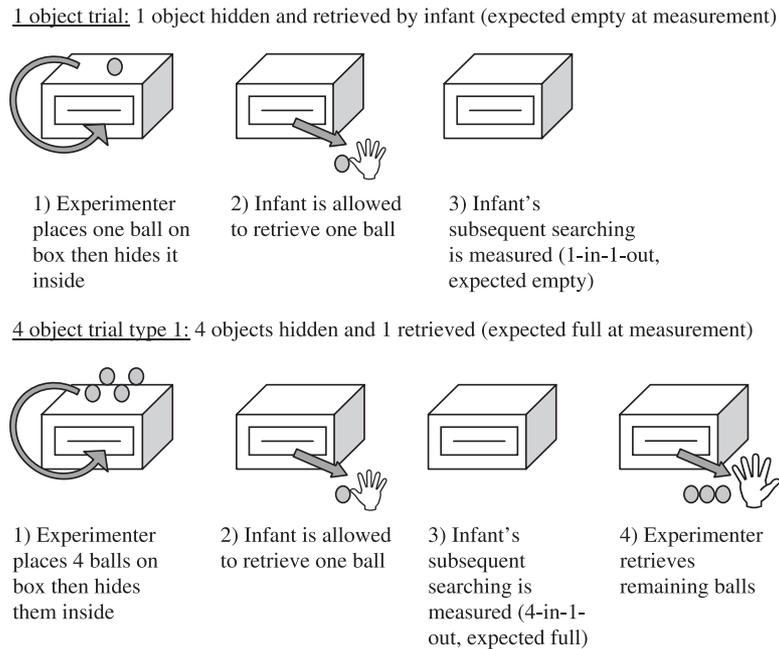
### Design and procedure

Children received two blocks of four trials each. One block included a 1 vs. 4 comparison, and the other a 1 vs. 3 comparison. The order of the blocks and trials within blocks were counterbalanced, resulting in eight possible combinations. For example, in 1 vs. 3 blocks children saw either the larger number of balls presented first (e.g. 3-1-1-3) or the smaller number presented first (e.g. 1-3-3-1). Half of the children received the 1 vs. 3 block first, and half received the 1 vs. 4 block first.

Children sat on their parent's lap in front of a small table. The experimenter sat across from the child with the box between them. The experiment comprised three phases: familiarization, the 1 vs. 4 test phase and the 1 vs. 3 test phase.

*Familiarization:* A large, multi-colored ball was used for familiarization. The experimenter showed the child the box and hid the ball inside it, saying, 'Look, look what I have. See? What's in the box?' The child was encouraged to reach into the box and retrieve the ball. Familiarization was complete once the child successfully retrieved the ball and placed it into the chute once.

*1 vs. 4 test phase:* In the 1-ball vs. 4-ball condition (see Figure 1), we compared trials where the experimenter initially placed one ball in the box with those where the experimenter initially placed four balls in the box. On one-ball trials, the experimenter held up the ball and said, 'Look!', then placed the ball on top of the box and repeated, 'Look, (baby's name)!' The ball was then placed in the box via the opening in the front. Next, the



**Figure 1** One-object and four-object trials in Experiment 1.

experimenter moved the box within reach of the child and asked, 'What's in the box?' Once the child retrieved the ball and placed it into the chute, the experimenter pulled the chute back and slid the box forward again. Next, a 10-second measurement period began during which the experimenter averted gaze to the floor and did not engage with the child. This was called a '1-in-1-out, expected empty' trial, because one ball was hidden and one ball was retrieved.

The four-ball trials were nearly identical to the one-ball trials. Children saw four balls hidden in the box and were allowed to retrieve one (the other three were surreptitiously removed by the experimenter). After the ball was dropped into the chute, the 10-second measurement began. This was called a '4-in-1-out, expected full' trial, because four balls had been hidden and only one had been retrieved.

*1 vs. 3 test phase:* The 1 vs. 3 test phase was identical to that used for the 1 vs. 4 comparison except that three balls were hidden on the multiple-ball trials. Thus, on half of the trials children saw three balls go in the box, were allowed to retrieve one (the remaining two were surreptitiously removed by the experimenter), and then were allowed to search for remaining balls. These were called '3-in-1-out, expected full' trials. On the other half of trials, children saw one ball go in the box, were allowed to retrieve one, and then were allowed to search

the box. These were called '1-in-1-out, expected empty' trials.<sup>1</sup>

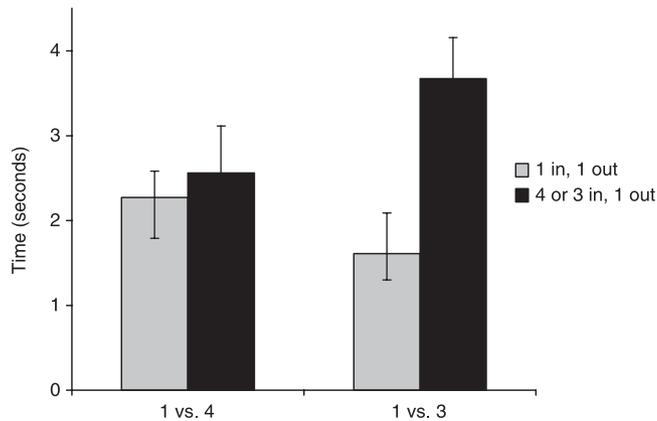
Search times were coded from videotape by two observers, whose agreement averaged 93%.

### Results

The dependent measure was search time in the empty box.<sup>2</sup> Children were considered to be searching if their hand passed through the slit beyond the second set of knuckles and they were actively attending to the box.

<sup>1</sup> One additional measurement period followed the 'expected full' trials to address a question not relevant to the present study. After the first measurement, the experimenter retrieved either one or all of the remaining objects and gave children a second 10-second measurement period. This allowed us to determine whether children track the exact number of remaining balls. Previous studies have concluded that a failure to reach after all balls are removed indicates knowledge that *exactly* none remain. For details, please consult online supporting materials at: <http://www.wjh.harvard.edu/~lds/pdfs/barner2005dsupport.html>. Here, our interest is whether children represent three or four as more than one, and so we only consider the first measurement period.

<sup>2</sup> Trial pairs in which one of the search times was 2 standard deviations greater than the average for trials of that type were removed from the analysis. Five pairs (10 trials of 144) were removed.



**Figure 2** Eighteen-month-olds' average searching times for 1 vs. 4 and 1 vs. 3 trials on first measurement period (after retrieving one ball).

Comparisons of interest were between 1-in-1-out, expected empty trials and either the 3-in-1-out, expected full trials or the 4-in-1-out, expected full trials. Since three is within children's object-tracking capacity, we expected them to succeed at the 1 vs. 3 comparison. If children can represent sets of four as 'more than one' then they should also succeed at the 1 vs. 4 comparison.

As previously found in studies of younger infants, children searched more on the 3-in-1-out, expected full trials (3.66 seconds) than on the 1-in-1-out, expected empty trials (1.61 seconds). In contrast, the 18-month-olds failed on comparisons of 1 vs. 4, and searched no longer on 4-in-1-out, expected full trials (2.64 seconds) than on 1-in-1-out, expected empty trials (2.31 seconds; see Figure 2). Like 14-month-olds (Feigenson & Carey, 2005), 18-month-olds failed to deploy a conceptual singular-plural distinction in this task.

This finding was confirmed with a  $2 \times 2 \times 2$  ANOVA, which examined the effect of Block type (1 vs. 3 or 1 vs. 4), Trial type (3- or 4-in-1-out, expected full or 1-in-1-out, expected empty), and Block order (1 vs. 3 or 1 vs. 4 block first) on search time. A main effect of trial type,  $F(1, 16) = 5.49$ ,  $p < .05$ , indicated that infants reached longer on expected full trials (3.15 seconds) than on expected empty trials (1.96 seconds). Importantly, there was a marginal interaction between block type and trial type,  $F(1, 16) = 4.17$ ,  $p = .058$ , reflecting a difference between 1 vs. 3 and 1 vs. 4 comparisons (Figure 2). There were no other main effects or interactions. Planned comparisons found that on 1 vs. 3 blocks children reached significantly more on expected full trials than on expected empty trials,  $t(17) = 3.21$ ,  $p < .01$ . However, on 1 vs. 4 blocks infants did not differentiate the expected full and expected empty trials,  $t(17) = .47$ ,  $p > .6$ .

## Conclusions

Eighteen-month-olds searched longer after retrieving one of three hidden balls than after retrieving one of one hidden balls. Also, they did *not* distinguish sets of four balls from sets of one. Thus, like 12- and 14-month-olds, 18-month-olds can represent no more than three objects in parallel under these testing circumstances and do not deploy a summary representation to encode sets as 'more than one'.

## Experiment 2

Experiment 2 tested whether 20- to 24-month-old children can distinguish four objects from one in the manual search paradigm. Previous studies indicate that English-speaking children begin to comprehend singular-plural morpho-syntax between 20 and 24 months of age (Kouider *et al.*, 2006; Wood *et al.*, under review). Also, norms provided by the MacArthur Communicative Development Inventory (MCDI; Fenson *et al.*, 1994) indicate that while 25% of children produce plural morphology by 18 months, 50% produce it by 22 months and 75% by 25 months. To explore the relationship between success on the manual search task and production of plural morphology, we gathered parental report data regarding children's production of plural nouns in speech. Also, we explored whether linguistic singular-plural cues help children to distinguish singular and plural sets by making the distinction explicit for use in the task. To do this, we created two types of 1 vs. 4 blocks. The first type was identical to the 1 vs. 4 blocks of Experiment 1. In the second block type sets were described using explicit singular-plural cues. We reasoned that children who comprehend singular-plural morpho-syntax may not spontaneously deploy the conceptual distinction in the manual search task, but may do so only when the distinction is primed explicitly by language. Also, this method permitted us to examine whether children at each age comprehend singular-plural morpho-syntactic cues.

## Methods

### Participants

Participants were 47 children aged between 19 and 25 months. They were split into three groups: 20-month-olds (19.3–20.26; mean 20.1;  $n = 15$ ), 22-month-olds (21.1–22.28; mean 22.2;  $n = 16$ ), and 24-month-olds (23.11–25.9; mean 24.0;  $n = 16$ ). Twelve additional subjects were excluded due to fussiness (nine) or failure to reach for first ball (three).

## Stimuli

Stimuli were identical to those used in Experiment 1.

## Design and procedure

Children received two blocks of four trials each. Each block contained a 1 vs. 4 comparison, and differed only with respect to the presence or absence of verbal cues. The order of blocks was counterbalanced, as were the order of trials within each block, resulting in two combinations of trials: 1441-4114 and 4114-1441. Half of the participants were given singular-plural morpho-syntactic cues during only the first block and half heard these cues during only the second block.

*Familiarization:* Familiarization was identical to Experiment 1.

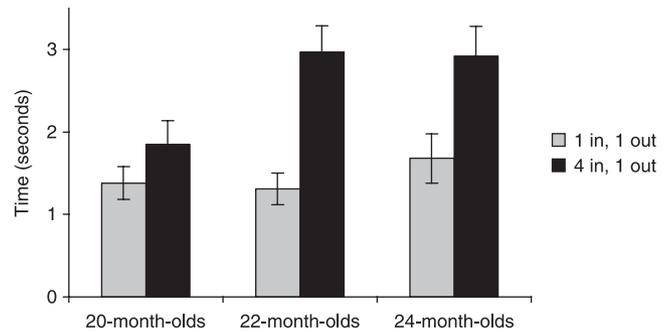
*Non-verbal trials:* Non-verbal trials were identical to the 1 vs. 4 comparison in Experiment 1.

*Verbal trials:* On one-ball trials, the experimenter held up one ball and said, 'Look, this is a ball', then placed it on top of the box and repeated, 'Look, this is a ball', and finally placed it inside the box, saying 'I'm going to put a ball in the box.' The experimenter then slid the box toward the child and said, 'What's in the box?' The child was allowed to remove the ball, place it in the chute, and a 10-second measurement period began (1-in-1-out, expected empty trial).

On four-ball trials, when presenting the set of four balls, the experimenter said, 'Look, these are some balls. Look, these are some balls', then 'I'm going to put some balls in the box' and finally, 'What's in the box?' As in the four-ball trials in the non-verbal condition, three balls were surreptitiously removed from the back of the box before the child was allowed to search. Again, the 10-second measurement period followed the child's removal of one ball (4-in-1-out, expected full trials). After the 10-second measurement period, the experimenter reached in and 'found' the missing balls.

Search times were coded from videotape by two observers, whose agreement averaged 94%.

*Vocabulary checklist:* Parents completed a partial MCDI (Fenson *et al.*, 1993), which included a question regarding their child's production of plural nouns (Part II, Section A, question 1): 'To talk about more than one thing, we add an "s" to many words. Examples include *cars* (for more than one car), *shoes*, *dogs*, and *keys*. Has your child begun to do this?' Possible responses were 'Not Yet', 'Sometimes' and 'Often'. To engage parents in the task and mask our interest in plural production we also included a subset of the vocabulary checklist.



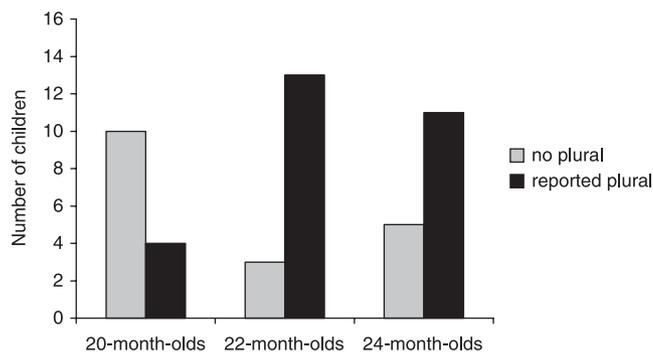
**Figure 3** Twenty-, 22- and 24-month-olds' average searching times as a function of trial type (for verbal and non-verbal trials combined).

## Results

The dependent measure was search time in the empty box.<sup>3</sup> By 22 months, but not before, children represented four objects as different from one, as measured by the manual search task (Figure 3). A  $2 \times 2 \times 2 \times 3$  ANOVA assessed the effects of Block type (verbal vs. non-verbal), Trial type (4-in-1-out, expected full vs. 1-in-1-out, expected empty), Block order (verbal block first vs. non-verbal block first), and Age (20 months vs. 22 months vs. 24 months) on search times. A main effect of Trial type,  $F(1, 40) = 28.00$ ,  $p < .001$ , indicated that infants searched longer on the expected full trials (2.58 seconds) than on the expected empty trials (1.45 seconds). There was no effect of Block type; explicit singular-plural cues failed to improve children's ability to represent hidden sets. There was a marginal interaction of trial type and age,  $F(1, 40) = 2.8$ ,  $p = .07$ . Planned comparisons found a significant effect of trial type for 22-month-olds,  $t(15) = 4.00$ ,  $p < .01$ , and for 24-month-olds,  $t(15) = 3.6$ ,  $p < .005$ , but not for 20-month-olds,  $t(14) = 2.04$ ,  $p > .05$ .

We also found a significant interaction between block type and order,  $F(1, 40) = 10.94$ ,  $p < .005$ , and a three-way interaction between trial type, block type and order,  $F(1, 40) = 7.64$ ,  $p < .01$ . The interaction between block type and order revealed that when participants had a verbal block first, they searched more overall on those trials, while participants who had a non-verbal block first searched more overall on those trials (i.e. participants searched more on early blocks). The three-way interaction suggested that the decrease in searching for later blocks was due mainly to the trials in which the

<sup>3</sup> Trial pairs in which one of the search times was greater than 2 SD more than the average for trials of that type were excluded from analysis. Fifteen pairs (30 trials out of 376) were removed.



**Figure 4** Parental report of plural morpheme usage by 20-, 22- and 24-month-old children (no plural = number of children for whom parents checked 'Not Yet' regarding their plural production; reported plural = number of children for whom parents checked either 'Sometimes' or 'Often').

**Table 1** Percentage of children who produce plural nouns at 18, 20, 22, 24 and 25 months (Exp. 2 parental report compared to MCDI norms of Fenson *et al.*, 1994)

	18- months	20- months	22- months	24- months	25- months
Fenson <i>et al.</i> (1994)	>25%	n/a	>50%	n/a	>75%
Experiment 2	n/a	29%	81%	69%	n/a

box was expected to be full. No other main effects or interactions were found. These order effects suggest that children came to doubt the likelihood of retrieving balls on test trials as the experiment progressed.

Success at the 1 vs. 4 comparison was strongly related to children's reported production of plural nouns. An analysis of parental report indicated that most children aged 22 months and older had begun producing plural nouns 'sometimes' or 'often' (13/16 and 11/16 for 22- and 24-month-olds respectively, or 72% overall), though almost no 20-month-olds had (4/14 or 29% of children for whom parental report data were available; see Figure 4). This corresponds closely to MCDI norms, which report that at 22 months at least 50% of children produce plural morphology, while at 18 months only 25% do (Fenson *et al.*, 1994; see Table 1).

Overall, there was a significant correlation between the use of singular-plural morphology in language production and systematic success (i.e. success in both blocks) in manual search,  $p < .04$  (Fisher's exact test; Table 2). Within 22- and 24-month-olds there was also a significant relationship between 1 vs. 4 success and plural production,  $p < .04$ . Thus, success at the manual search task among older children was accounted for by those who had begun to produce plural nouns.

**Table 2** Relation between use of plural morpho-syntax (parental report) and success at the 1 vs. 4 manual search task

		Plural not used	Plural used
20-, 22- & 24-month-olds	Failure	13	11
	Success	5	17
22- and 24-month-olds	Failure	6	7
	Success	2	17

### Conclusion

Experiment 2 indicates that children in our study distinguish sets of four from one by 22 months. Like 18-month-olds in Experiment 1, 20-month-olds failed the task as a group and did so even when provided with verbal singular-plural cues. In contrast, 22- and 24-month-olds successfully distinguished four from one both with and without verbal cues. Finally, we found that 1 vs. 4 success was significantly correlated with reported production of plural nouns.

### Experiment 3

In order to interpret the relation between children's success on the 1 vs. 4 manual search task and their acquisition of singular/plural morphology, we must consider the *basis* of the success on the search task. While it is possible that children come to represent sets of four as plural sets, it is also possible that children's attentional capacity increases to four at around 22 months, and that singular-plural morphology emerges around this age by coincidence. To address this possibility, we tested 21- through 25-month-olds with both 1 vs. 4 and 2 vs. 4 comparisons. If children represent sets using object-based attention with an increased capacity then they should succeed at 2 vs. 4 as well as at 1 vs. 4. However, if they represent multiple-object arrays as plural sets, then they should distinguish 1 vs. 4 but not 2 vs. 4. If both two and four are represented as plural sets with indefinite magnitude, then children should be uncertain of whether more balls remain after retrieving two and fail to distinguish the two quantities.

### Methods

#### Participants

Participants were 18 children aged between 21.4 and 25.17 months (mean 23 months 12 days). Three additional subjects were excluded due to fussiness (two) or failure to pass familiarization (one).

## Stimuli

Stimuli were identical to those used in Experiment 2.

## Design and procedure

Children received two blocks of four trials each. One block contained a 1 vs. 4 comparison, and the other contained a 2 vs. 4 comparison. The order of blocks was counterbalanced, as were the order of trials within each block. As in Experiment 1, there were no verbal cues.

*Familiarization:* Familiarization was identical to Experiments 1 and 2.

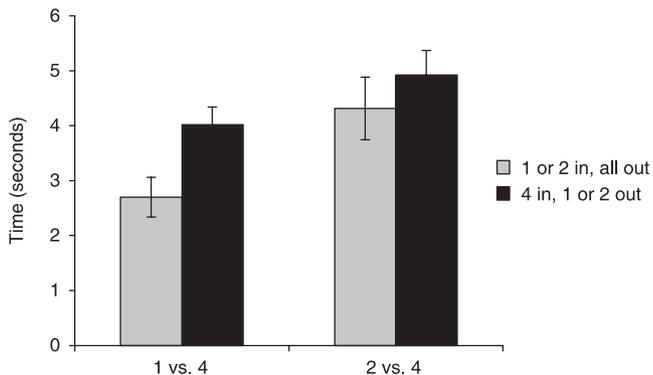
*1 vs. 4 comparison:* These were identical to the non-verbal 1 vs. 4 blocks in Experiments 1 and 2.

*2 vs. 4 comparison:* On two-ball (expected empty) trials, children saw two balls hidden in the box and were allowed to retrieve both balls, one at a time. On four-ball (expected full) trials children saw four balls hidden, and the experimenter surreptitiously removed two before children were allowed to retrieve two balls, one at a time. In each case, children's searching was measured after they retrieved the second ball.

Search times were coded from videotape by two observers, whose agreement averaged 93.5%.

## Results

Children distinguished between one and four, but not between two and four (Figure 5). A main effect of Trial type,  $F(1, 16) = 9.85$ ,  $p < .01$ , indicated that children searched longer on the expected full trials (4.48 seconds) than on the expected empty trials (3.56 seconds). Also, an effect of Block type,  $F(1, 16) = 10.61$ ,  $p < .01$ , indicated that children reached more overall during the 2 vs. 4 block (4.74 seconds) compared to the 1 vs. 4 block (3.31 seconds). There was no interaction between trial and



**Figure 5** Children's (mean age = 23 months) average searching times as a function of trial type.

block type. However, planned comparisons found that children reached significantly longer on four-ball trials (4.02 seconds) than one-ball trials (2.70 seconds),  $t(17) = 4.00$ ,  $p < .01$ , but did not reach longer for four-ball trials (4.93 seconds) than two-ball trials (4.32 seconds),  $t(17) = 1.21$ ,  $p > .2$ . This indicates that children distinguished between 1 vs. 4 but not between 2 vs. 4.

## Conclusion

Experiment 3 confirmed that 23-month-old children distinguish one from four on this non-verbal manual search task. The important finding was their failure to search longer on 4-in-2-out trials than on 2-in-2-out trials. They treated sets of two and sets of four equivalently (i.e. as plural sets with indefinite magnitude). This is consistent with the hypothesis that, in this task and at this age, sets of more than one are treated as pluralities. It also suggests that representing sets as pluralities may come at the expense of exact representations that are deployed in this task earlier in development. Specifically, younger 14-month-old infants do not continue to reach on two-ball trials after two balls have been retrieved, indicating an exact representation of the number of hidden objects (Feigenson & Carey, 2003). Here, children continued to search after retrieving two balls, indicating uncertainty about the exact number of hidden objects, and thus a failure to deploy object-based attention (in favor of plural representations).

## General discussion

In the manual search task, 18- and 20-month-old children, like the 14-month-olds in Feigenson and Carey (2005), failed to represent sets of four as more than one, though children around this age do distinguish sets within the limit of object-based attention in this task (e.g. 1 vs. 3, Experiment 1). Importantly, 20-month-olds failed to distinguish sets of one from four even when provided with explicit morpho-syntactic singular-plural cues. These results confirm Feigenson and Carey's finding of a surprising conceptual limitation in early childhood, and also provide additional evidence that 20-month-olds fail to comprehend singular-plural morpho-syntactic cues (see Kouider *et al.*, 2006; Wood *et al.*, under review).

By 22 months, children distinguished one from four in both verbal and non-verbal trial blocks, regardless of which was presented first. Thus, explicit singular-plural morpho-syntax was not necessary for deploying the distinction between one and many. According to parental report, children also began producing plural nouns at around 22 months, indicating that the linguistic and

conceptual abilities became available at around the same time. Furthermore, among the 22- and 24-month-olds, success on the manual search task was due to those children whose parents said they were producing plural morphology.

The plural production data from our study closely resemble that from MCDI norms, though children from our sample began producing plurals slightly earlier than average. Thus, in addition to showing that the conceptual singular–plural distinction is related developmentally to children’s production and comprehension of its linguistic expression, our data also corroborate previous findings that linguistic knowledge of singular–plural morphology is in place at 24 months but not 20 months (e.g. Brown, 1973; Fenson *et al.*, 1994; Kouider *et al.*, 2006; Wood *et al.*, under review).

Overall, these results are consistent with the idea that at 22 months children deploy a conceptual singular–plural distinction in the manual search task of Feigenson and Carey (2003, 2005). Moreover, the new-found success at 22 months cannot be explained by other systems of number representation that have been documented in infancy. If children had used object-based attention or analog magnitude representations to represent the difference between one and four, then they should have been equally adept at distinguishing between sets of two and four. In the case of object-based attention this follows since a set of four would, by hypothesis, be within the range of object-based attention by 22 months. Analog magnitude representations would also support a 2 vs. 4 distinction, since even 6-month-olds are sensitive to comparisons in a 2:1 ratio (Xu & Spelke, 2000; Xu, 2003; Lipton & Spelke, 2003; Wood & Spelke, 2005). Against both hypotheses, Experiment 3 demonstrated that children did not distinguish between two and four. After retrieving two balls, children reached no more when four balls were originally hidden than when only two were hidden.

If 1 vs. 4 success is causally related to acquiring singular–plural morpho-syntax, then the two should co-occur not only in English but also in languages where the linguistic distinction emerges earlier, later, or not at all. Evidence regarding this is currently being collected in a study of children acquiring French (Kouider, Feigenson & Halberda, in prep.), which provides salient pre-nominal singular–plural agreement on determiners (e.g. *le* vs. *les chats*). Studies under way are also investigating whether children learning languages without singular–plural morpho-syntax (e.g. Japanese and Mandarin) are delayed in distinguishing singular and plural sets in the manual search task.

If language learning does play a role in deploying a conceptual singular–plural distinction, there remains the

question of how. One possibility is that the conceptual distinction depends upon representations that are specific to language. Alternatively, children may represent a singular–plural distinction early in infancy, but fail to deploy it in contexts that activate object-based attention. On this account, acquiring singular–plural morphology may make the conceptual distinction more salient to children. Studies in our lab are exploring this question by testing whether we can find any experimental conditions under which pre-linguistic infants or non-human primates are capable of deploying a conceptual singular–plural distinction.

## Acknowledgements

We would like to thank the members of the Lab for Developmental Studies at Harvard for their feedback on this work throughout its development, and all of the parents and children who participated. This research was supported by NSERC Postgraduate Research Scholarship to DB and NIH Grant #R01 HD038338 to SC.

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Received: 28 September 2005

Accepted: 3 May 2006