

Acquisition of Singular–Plural Morphology

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A manual search paradigm explored the development of English singular–plural comprehension. After being shown a box into which they could reach but not see, infants heard verbal descriptions about the contents of the box (e.g., “There are some cars in the box” vs. “There is a car in the box”) and were then allowed to reach into the box. At 24 months of age, but not at 20 months, infants’ search patterns were influenced by verbal number markings. However, verbal number marking did not influence search behavior when plurality was signaled by noun morphology alone. These data converge with parental reports and preferential looking studies concerning the developmental course of mastery of English plural marking and show that infants can create a mental model of the number of objects on the basis of singular–plural morphology alone.

Keywords: singular–plural distinction, noun morphology

The distinction between individuals and sets of individuals is expressed in all languages, in lexical quantifiers, and often in singular and plural morphology of nouns, verbs, adjectives, and determiners (Chierchia, 1998; Link, 1983). One of the earliest developing reflections of set-based quantification in English learners is singular–plural marking (Ferenz & Prasada, 2002). According to parental report, toddlers begin *production* of plural morphemes around 22 months of age (Barner, Thalwitz, Wood, & Carey, 2007; Fenson, Dale, Reznick, Bates, Thal, & Pethick, 1994), a finding corroborated by diary studies (Clark & Nikitina, in press; Mervis & Johnson, 1991). A recent study adapted the preferential looking paradigm to address the onset of *comprehension* of plural marking (Kouider, Halberda, Wood, & Carey, 2006). Infants were simultaneously shown two displays, one with eight novel objects and the other with one novel object, and were told either singular or plural sentences containing multiple linguistic cues to singularity or plurality (“Look, there ARE SOME blicketS” vs. “Look, there IS A bicketØ”). Twenty-four-month-olds looked at the matching array on both singular and plural trials; in contrast, 20-month-olds did not. Further, 24-month-olds did not look at the

matching array when plurality was marked on the noun alone (“Look at the bicketS” vs. “Look at the bicketØ”), suggesting that plurality is marked lexically before it is marked by bound morphemes (see also Clark & Nikitina, in press).

The use of novel objects and labels in Kouider et al. (2006) circumvented several problems intrinsic to comparisons of the same set of real objects (e.g., one car vs. eight cars are both compatible, as a whole, with plural sentences such as “Look at the cars”). However, the use of novel nouns might also explain why noun morphology alone failed to unambiguously specify plurality; a novel noun may simply end in an “s” sound in its singular form. In addition, this paradigm places considerable demands on the child because young toddlers’ unfamiliarity with both the words and the objects may have distracted them. Thus, the data from Kouider et al. (2006) may have underestimated the age at which English-learning children first comprehend the singular–plural distinction. In order to assess plural comprehension with familiar nouns, we used a manual search paradigm in which infants searched for objects in a box after being given a verbal description of its contents with either singular or plural cues (e.g., “There are some cars in the box” vs. “There is a car in the box”). Xu, Cote, and Baker (2005) recently showed that 10- and 12-month-olds can use language to establish a representation of the number of objects in a box (e.g., “There’s a bicket; there’s a tova” leads to the search for two objects in the box). We hypothesized that verbal information marking plurality would influence manual search performance as a result of representing one versus several objects in the box.

Research with a nonlinguistic manual search task suggests that young infants fail to distinguish conceptually between *one* and *more than one* (Feigenson & Carey, 2003; 2005). After seeing two balls placed into a box and having retrieved one ball, infants search more compared with when they see one ball initially placed into the box. A similar pattern has been found for three balls versus one ball and three balls versus two balls.

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However, when infants see four balls placed into a box, they are satisfied after recovering just one ball. This failure to distinguish four balls from one suggests not only that infants have a set-size limit of three items in working memory but also that, under these testing conditions, they are unable to encode the set of four as *some* or *plural*, for if they were so coded, infants would search for more than one object in the box. Barner et al. (2007) extended the age of failure to 18- and 20-month-old infants and found that as a group, infants succeed at the non-verbal four-versus-one comparison at 22 months, the age at which the literature on parental report indicates mastery of explicit singular-plural marking. In addition, Barner et al. also found that among 22- to 24-month-olds, success on the non-verbal task was correlated with production of plural morphology, according to parental report. Interpreting this correlation requires confidence that parental report and diary studies do not underestimate the age of mastery of linguistic plural marking. The present study brings further evidence to bear on the age of first comprehension of English plural marking.

This study sought to confirm Kouider et al.'s (2006) findings that 24-month-old children understand the semantic distinction between the phrases "ARE SOME xxxxS" and "IS A xxxx" and that 20-month-olds do not. As described earlier, we were particularly interested in familiar nouns, so in the first two trials, we used *car* and *cat*, both nouns known to children of this age (Fenson et al., 1994). In the second two trials, unfamiliar nouns (*bicket* and *klog*) and unfamiliar objects were used. We also investigated whether the manual search paradigm would provide results convergent with those of Kouider et al. (2006) in a second respect—whether 24-month-old infants would fail to construct representations of one and more than one when number marking involved the noun alone (*carS* vs. *car* or *klogS* vs. *klog*).

Method

Participants

Infants were recruited through mailings sent to addresses obtained from birth records from local town halls. This volunteer subject pool was primarily middle-class and primarily non-Hispanic White, with around 7% of the total sample identifying as African American, Hispanic, or Asian American. All infants were exposed to English as the primary language in their home. Condition 1 (multiple marking–24-month-olds) included 22 toddlers (mean age, 24 months 2 days; age range, from 23 months 3 days to 24 months 25 days). Nine additional infants were excluded from the final analyses because of fussiness (i.e., failure to participate in the task, $n = 7$) or parental interference ($n = 2$). Condition 2 (multiple marking–20-month-olds) included 26 toddlers (mean age, 19 months 27 days; age range, from 18 months 29 days to 21 months 3 days). Five additional infants were excluded from the final analyses because of fussiness. Condition 3 (noun marking only–24-month-olds) included 22 toddlers (mean age, 24 months 6 days; age range, from 23 months 3 days to 24 months 28 days). Seven additional infants were excluded from the final analyses because of fussiness ($n = 6$) or parental interference ($n = 1$). Samples were roughly balanced for sex of participants (multiple marking—24-month-olds: 10 boys and 12 girls; multiple marking—20-

month-olds: 11 boys and 15 girls; noun marking only—24-month-olds: 12 boys and 10 girls.)

Material and Apparatus

A box into which infants could reach but not see was constructed from black foam core (26 cm \times 43 cm \times 13 cm). The front of the box had a 13 cm \times 9 cm opening covered by red spandex material with a horizontal slit across its width. The back of the box had an identical opening covered by a black felt flap, through which objects could be removed or added unbeknownst to the child. We used a small car (4 cm in length) and a small cat (3.5 cm in height) as familiar objects and two novel objects consisting of an octagonal, multicolored object (4.5 cm in diameter), called a *bicket* for some participants and a *tivet* for others, and an amorphous bloblike object (3 cm in diameter) with four legs called a *klog*.

Infants sat on their mother's lap in front of a table, and the experimenter sat on the opposite side of the table from the infant. A video camera recorded a side view of the session.

Design and Procedure

The procedure was the same in all conditions with the exception of the verbal descriptions that described the contents of the box. Each infant participated in four experimental trials. One half received the trials in the following order: plural, singular, singular, plural; this order was reversed for the other half (i.e., singular, plural, plural, singular). Infants were always presented with the two familiar nouns in the first and second trials, and the two novel nouns in the third and fourth trials. The experiment began with a familiarization trial to accustom the children to the box and to show them that they could reach inside it to retrieve objects. A multicolored ball was inserted into the box, and the experimenter encouraged each child to retrieve the object by saying, "What's in my box? Can you reach?" Once the toddler retrieved the object, the familiarization trial was considered complete.

Singular search trials with multiple marking. The experimenter picked up the box from the table and said, "Now, I am going to put a [car/cat/bicket/klog] in the box. I am going to put a [car/cat/bicket/klog] in my box. OK, here I go!" The experimenter then moved the box behind a curtain out of view of the child and put one object in the box, making sure to reduce any noise made by placing the object within the box. The experimenter then moved the box up to eye level, looked inside the box, and said, "Wow! There is a [car/cat/bicket/klog] in my box! There is a [car/cat/bicket/klog] in my box!" The experimenter then pushed the box toward the child and said "Could you get the [car/cat/bicket/klog] for me?"

Toddlers were then allowed to retrieve the object. After the child had retrieved the object, the experimenter reached across the table with a large cup and encouraged the child to put the object in the cup. If the toddler did not put the object in the cup immediately, the experimenter took the object from the child.

A silent 10-s measurement period (labeled *singular search trial*) then followed in which we recorded the total amount of time that the infant searched in the box. The time spent searching was measured when the child's hand was inside the box past the fingers

(i.e. to the third knuckle) and was active (i.e., clear movement).¹ During the entire 10-s period, the experimenter kept her head down and did not engage with the child. After 10 s, or until the child stopped searching after that period, the experimenter removed the box, and the trial ended.

Plural search trials with multiple marking. The plural search trials were identical to the singular search trials except that the sentences denoted plurality in the verb (*are* vs. *is*), the quantifier (*some* vs. *a*), and the plural morpheme (*S* vs. \emptyset). Here also, there was in fact only one object in the box, and after the child retrieved it and handed it over to the experimenter, the crucial 10-s measurement period ensued. If the child understood the full quantificational semantics of the linguistic description, then he or she should have expected at least one more object in the box and should have searched longer on the plural than on the singular search trial.

After this 10-s measurement period, the experimenter said, "Let me see if I can help you out." She then reached into the box with one hand and, unbeknownst to the participant, secretly added another identical object through the opening in the back of the box with her other hand. After pretending to search for approximately 2 s, she retrieved the second object from within the box, showed it to the child, and then placed it in the container. This served to ensure that all of the entities that should have been in the box were eventually found. A second 10-s measurement period then followed. This additional measurement period was merely exploratory, assessing whether children thought that plural morphology entails more than two objects. Of course, it is also likely children would not search further on these trials, assuming that the experimenter had retrieved all of the objects in the box. These trials are called *exploratory trials*.

Singular and plural search trials with noun marking only. This condition was identical to Conditions 1 and 2 except that the sentences were marked by noun morphology alone. We used the following sentences for singular: "Now, I am going to put my car in the box"; "Wow! I see my car in my box!" and "Could you get my car for me?" We used the following sentences for plural: "Now, I am going to put my cars in the box"; "Wow! I see my cars in my box!" and "Could you get my cars for me?" As before, the nouns were *car/cat/blicket/tivet/klog*.

Results

Figure 1 presents the duration of search during the 10-s measurement period after the first object had been removed from the box. For each condition, a 2×2 analysis of variance (ANOVA) was used to examine the effects of trial type (plural search versus singular search) and noun type (familiar nouns versus novel nouns). In the multiple marking–24-month-olds condition, there was a significant main effect of trial type, $F(1, 23) = 5.41, p = .03, h_p^2 = .21$. Infants searched longer during plural search trials ($M = 2.97$ s, $SD = 2.35$ s) than during singular search trials ($M = 1.95$ s, $SD = 1.45$ s). Sixteen of the 22 subjects showed this pattern (binomial probability: $p = .03$). The main effect of noun type was not significant ($F < .5, p = .65$). There was also a significant interaction between trial type and noun type, $F(1, 23) = 6.98, p = .02, h_p^2 = .25$. Infants differentiated the plural search trials from the singular search trials when the nouns were familiar, but not when they were unfamiliar.

In the multiple marking–20-month-olds condition, there was a significant main effect of noun type, $F(1, 25) = 14.37, p = .004, h_p^2 = .29$. Infants reached longer during trials with familiar objects with known labels ($M = 2.33$ s, $SD = 1.3$ s) than during trials with novel objects labeled with nonwords ($M = 1.58$ s, $SD = 1.25$ s). No other main effects or interactions were significant (all $Fs < 1$). Most important, infants did not reach longer during plural search trials ($M = 1.98$ s, $SD = 1.34$ s) than during singular search trials ($M = 1.93$ s, $SD = 1.40$ s). Twelve of the 26 infants searched longer on plural trials than on singular trials (*ns*). An ANOVA examining the effect of age (24-month-olds vs. 20-month-olds) and trial type (plural vs. singular trials) revealed a significant main effect of trial type, $F(1, 47) = 4.27, p = .04, h_p^2 = .09$, and a significant interaction, $F(1, 47) = 3.39, p = .04$ (1-tailed test), $h_p^2 = .07$. Confirming the pattern found in Kouider et al. (2006), we found that 24-month-olds showed sensitivity to the number marking in the sentences, whereas 20-month-olds did not.

The noun marking only–24-month-olds condition revealed a main effect of noun type, $F(1, 21) = 6.28, p = .02, h_p^2 = .23$. Infants reached longer during trials with familiar objects ($M = 1.74$ s, $SD = 1.15$ s) than during trials with novel objects ($M = 1.20$ s, $SD = 1.04$ s). No other main effects or interactions were significant (all $Fs < 1$). Most important, unlike in the multiple marking–24-month-olds condition, infants did not reach longer during plural trials ($M = 1.57$ s, $SD = 1.17$ s) than during singular trials ($M = 1.37$ s, $SD = 1.06$ s; Figure 1). Twelve of the 22 infants reached longer on the plural trials than on the singular trials (*ns*). An ANOVA examining the effects of marking (multiple marking vs. noun marking only) and trial type (singular vs. plural) on search times revealed a significant main effect of trial type, $F(1, 43) = 6.05, p = .02, h_p^2 = .13$, and a significant interaction, $F(1, 43) = 2.73, p = .05$ (1-tailed test), $h_p^2 = .06$. Confirming again Kouider et al. (2006), 24-month-olds used number marking only when it was marked on verbs, quantifiers, and nouns and not on noun morphology alone.

In all conditions, infants failed to search longer on the exploratory trials, after the experimenter retrieved the second object following the plural search trials, than on the singular search trials. This means either that they considered two objects to satisfy the plural marker or that they figured that the experimenter had found all the objects.

All conditions revealed either a main effect of noun type (multiple marking–20-month-olds; noun marking only–24-month-olds) or an interaction between trial type and noun type (multiple marking–24-month-olds). Infants may be more likely to reach into a box in which an object contained therein has been described with a familiar word (*car* or *cat*) as opposed to an unfamiliar word (*blicket* or *klog*). Alternatively, given that familiar trials always preceded novel trials, this effect could equally reflect fatigue. Finally, it is possible that infants may have decreased their searching during the second plural search trial because they expected but failed to find a second object during the first plural search trial.

¹ Search times were coded from videotape by an observer. A second observer coded a subset of the trials (50%); agreement averaged 92% with the first observer.

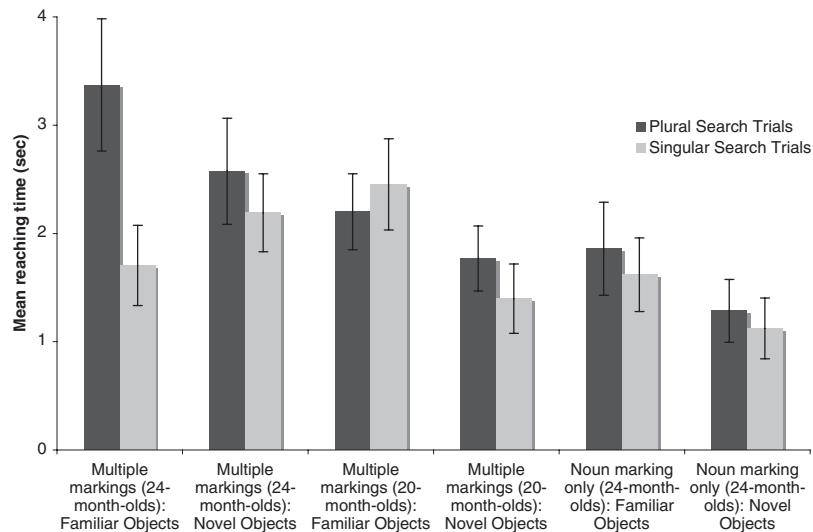


Figure 1. Mean duration of reaching for the trial types across the three conditions. In the multiple marking–24-month-olds condition and the multiple marking–20-month-olds condition, the sentences denoting the singular and plural trials differed in the verb (*is* vs. *are*), the quantifier (*a* vs. *some*), and the morpheme (*S* vs. \emptyset). In the noun marking only–24-month-olds condition, the sentences denoting the singular and plural trials differed in the morpheme only (*S* vs. \emptyset). Error bars denote the standard error.

Discussion

We used a manual search paradigm to explore when infants can use plural marking to establish representations of the number of hidden objects. After being shown a box into which they could reach but not see, infants heard verbal descriptions about the contents of the box (e.g., “There are some cars in the box” vs. “There is a car in the box”) and were then allowed to reach into the box. Even though there was always only one object in the box, previous studies have shown that in some contexts, infants search more persistently when they expect more objects to be present within a box—for example, when they have seen two or three objects placed in a box (Feigenson & Carey, 2003; 2005; Van de Walle, Carey, & Prevor, 2000) and when the contents of a box have been described with two nouns (“Look, a blicket”; “Look a klog;” Xu et al., 2005). In this study, we extended these findings to linguistic plurality, which allows infants, at least at 24 months of age and when using multiple markings, to represent whether there is *one* versus *more than one* object in a box.

Furthermore, this study allowed us to assess linguistic singular-plural knowledge with known nouns, using the same linguistic contrast (i.e., “ARE SOME xxxxS” vs. “IS A xxxx”) that had yielded interpretable results with novel nouns in a preferential looking study (Kouider et al., 2006). The results were convergent: Twenty-four-month-olds succeeded and 20-month-olds failed at differentiating the singular and plural trials with regards to quantification. These data also converge with those from diary studies and from parental report (Barner et al., 2007; Clark & Nikitina, in press; Fenson et al., 1994; Mervis & Johnson, 1991) as indicating the period between 20 months and 24 months of age as the time at which the first indications of English plural marking emerge. Apparently, the use of unfamiliar nouns in Kouider et al.’s study did not lead to an underestimate of the onset of plural comprehension. This is, no doubt, due to the fact that the plural information

was carried by the contrast between *are some* and *is a*, rather than between *car* and *cars*. In Kouider et al., infants began to look at the matching display upon hearing *are* or *is*, and in both Kouider et al. and in the noun-marking-only condition of the present study, 24-month-olds failed to differentiate the trials when the singular-plural distinction was marked on the noun alone. Of course, in Kouider et al., this failure could have been due to the fact that the nouns were unfamiliar. The important present finding is that the failure extends to highly familiar nouns (*cars* or *cats*).

Parental report and diary studies indicate that by 24-months, children are marking some count nouns with plural morphology. So why did they fail with the highly familiar nouns *cars* and *cats*? The contrasts between *is* and *are* and between *a* and *some* are lexical contrasts, whereas those between *x* and *xS* are contrasts within bound morphemes. In both the present experiment and in Kouider et al. (2006), the nouns in the noun-morphology-alone conditions were embedded within sentences in normal speech. Perhaps these morphological contrasts are simply not as salient as the lexical ones. Also, it is possible that children benefit from multiple redundant cues to number marking.

Finally, these findings provide support for Clark and Nikitina’s (in press) conclusions from their diary and Child Language Data Exchange System (CHILDES) analyses that toddlers begin marking the distinction between *one* and *more than one* lexically and then learn morphological marking on nouns in a piecemeal manner. Thus, although children of this age are certainly sometimes producing plural-count nouns, they may not have happened to have learned that *cats* and *cars* are the plural forms of *cat* and *car*. Clark and Nikitina found that all of the children they studied used verbal numerals, especially *two*, as plural markers—saying, for instance, *two running shoe* when there were four—before they marked plurality on nouns at all. They also found that *some* was the first quantifier used to refer to sets with more than one (*more x* was

used but in reference to absent sets, as in "I want more cookie" or "No more candies"). Clark and Nikitina's comprehension task failed to find evidence for their proposal; 24-month-old children did no better at indicating an array described with *two cars* than with *cars*, but as Clark and Nikitina noted, the comprehension task they used probably underestimated understanding. Both the present method and the preferential looking method of Kouider et al. should be used to explore additional contrasts to those in the present article ("are some xxxxS" vs. "is a xxxx" and "my xxxxS" vs. "my xxxx"). For example, future studies could explore infants' comprehension of plural morphology with different syntactic markers: as stated earlier, Clark and Nikitina found that infants often use the verbal numeral *two* as a plural marker, raising the possibility that they may comprehend *two* as a plural marker before they comprehend *some* as a plural marker.

In sum, diary studies, analyses of CHILDES corpora, parental report measures, and comprehension studies converge on two conclusions: English-learning toddlers begin to mark the singular-plural distinction after 20 months of age and before 24 months of age, and they initially use what Slobin called an *analytic strategy*, using distinct lexical items rather than bound morphemes to mark the contrast (Slobin, 1973; 1985). When they have mastered some linguistic expression of the singular–plural distinction, they necessarily command the conceptual distinction between *one* and *more than one*.

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