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Acquisition of Singular-plural Morphology

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Abstract

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 *producing* 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, 2008; 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 8 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 blicketO”). 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 blicketS” vs. “Look at the blicketO”), suggesting that plurality is marked lexically before it is marked by bound morphemes (see also Clark & Nikitina, 2008).

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The use of novel objects and labels in Kouider et al. (2006) circumvented several problems intrinsic to comparing the same set of real objects (e.g., one car vs. 8 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 a –s sound in its singular form. In addition, this paradigm places considerable demands on the child because young toddler’s 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 where 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, & 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 blicket; there’s a tova” leads to the search of 2 objects in the box). Here, we hypothesized that verbal information marking plurality would influence manual search performance as a result of representing one vs. several objects in the box.

Research using a non-linguistic manual search task suggests that young infants fail to distinguish conceptually between “one” and “more than one” (Feigenson & Carey, 2003;2005). After seeing 2 balls placed into a box and having retrieved 1 ball, infants search more compared to when 1 ball was initially placed into the box. A similar pattern was found for 3 vs. 1 balls and 3 vs. 2 balls. However, when infants see 4 balls placed into a box, they are satisfied after recovering just 1 ball. This failure to distinguish 4 from 1 suggests not only that infants have a set-size limit of 3 items in working memory, but also that under these testing conditions they are unable to encode the set of 4 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 4 vs. 1 comparison at 22-months, the age at which the literature on parental report indicates mastery of explicit singular/plural marking, and among 22- to 24-month-olds, success on the non-verbal task was correlated with production of plural morphology, also 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 findings that 24-month-old children understand the semantic distinction between ARE SOME ×S and IS AN × and that 20-month-olds do not. As described above, we were particularly interested in familiar nouns, so the first two trials used “car” and “cat,” both nouns known to children of this age (Fenson et al., 1994). The second two trials used unfamiliar nouns (“blicket, klog”) and unfamiliar objects. We also investigated whether the manual search paradigm provides convergent results with those of Kouider et al. (2006) in a second respect— whether 24-month old infants fail to construct representations of “one” and “more than one” when number marking targets the noun alone (“carS/car” or “klogS/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, primarily non-Hispanic white, with around 7% total African-American, Hispanic and 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: range 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) and parental interference (n=2). Condition 2 *(Multiple marking – 20-month-olds*) included 26 toddlers (mean age 19 months, 27 days: range 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: range 23 months, 3 days to 24 months, 28 days). Seven additional infants were excluded from the final analyses because of fussiness (n=6) and parental interference (n=1). Samples were roughly balanced for sex of participants (*Multiple marking – 24-month-olds*: 10 boys, 12 girls; *Multiple marking – 20-month-olds*: 11 boys, 15 girls; *Noun marking only – 24-month-olds*: 12 boys, 10 girls.)

Material and Apparatus

A box in which infants could reach but not see was constructed from black foam core (26X43X13 cm). The front face of the box had a 13X9 cm opening covered by red spandex material with a horizontal slit across its width. The back face 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, multi-colored object (4.5 cm in diamater), called a “blicket” for some subjects and a “tivet” for others, and an amorphous blob-like object with 4 legs (3 cm in diameter), 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

All conditions followed the same procedure with the exception of the verbal descriptions that described the contents of the box. Each infant participated in 4 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 child to the box, and to show them that they could reach inside of it to retrieve objects. A multi-colored ball was inserted into the box, and the child was encouraged 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, blicket, klog) in the box. I am going to put a (car, cat, blicket, 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, blicket, klog) in my box! There is a (car, cat, blicket, klog) in my box!” The experimenter then pushed the box towards the child, and said “Could you get the (car, cat, blicket, klog) for me?”

Toddlers were then allowed to retrieve the object. After having done so, 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. Searching was measured when the child's hand was inside of 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 subject. After 10 s, or until the infants 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. Ø). 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 they should expect at least one more object in the box, and should search longer on plural compared to 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 subject, secretly added another identical object through the opening in the back of the box with their 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 be 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. 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?" 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-second measurement period after the first object had been removed from the box. For each condition, a 2 X 2 ANOVA examined 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 non-words (*M*=1.58 s, *SD*=1.25 s). No other main effects or interactions were significant (all *Fs*<1). Most importantly, 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 (n.s.). An ANOVA examining the effect of Age (24-month-olds versus 20-month-olds) and trial type (plural versus 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., 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 importantly, 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 (n.s.). An ANOVA examining the effects of marking (multiple marking versus noun marking only) and trial type (singular versus 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., 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 2nd 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 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, cat”) as opposed to an unfamiliar word (“blicket, 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.

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 show 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 et al., 2000) and when the contents of a box have been described with two nouns (“look a blicket; look a klog;” Xu et al., 2005). Here, we extend 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” vs. “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 ("ARE SOME xS" vs. "IS A x") 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, 2008; Fenson et al., 1994; Mervis & Johnson, 1991) as indicating the period between 20 and 24 months of age as the emergence of the first indications of English plural marking. Apparently, the use of unfamiliar nouns in Kouider et al. 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 present *noun marking only* condition, 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 be due to the fact that the nouns were unfamiliar. The important present finding is that the failure extends to highly familiar nouns (cars, 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 "are" and "is" and between "a" and "some" are lexical contrasts, whereas that 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 the child benefits from multiple redundant cues to number marking.

Finally, these findings provide support for Clark and Nikitina's (2008) conclusions from their diary and 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 ×" 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 indicating an array with "two cars" than with "cars," but as they noted, the comprehension task they used probably underestimates 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 paper ("are some xS" vs. "is an x" and "my xS" vs. "my x"). For example, future studies could explore infants' comprehension of plural morphology with different syntactic markers: as stated above, 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”.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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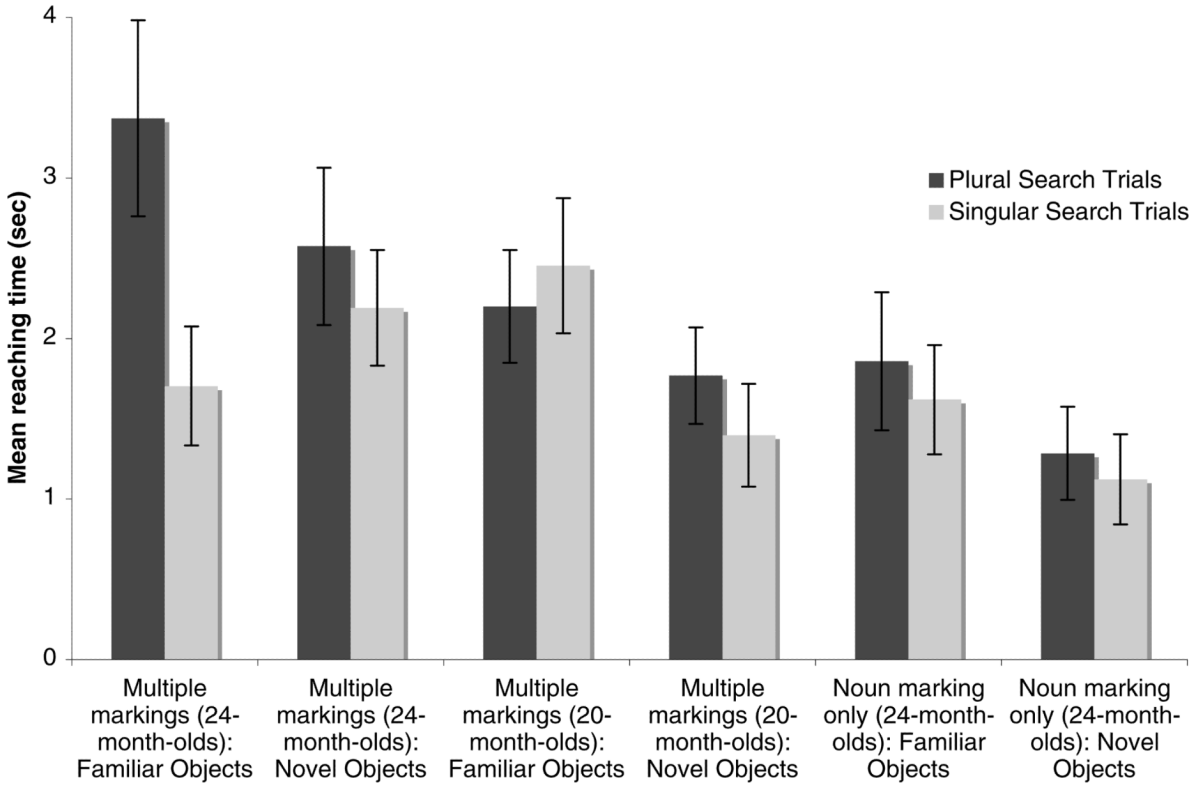

Figure.

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. Ø). In the *noun marking only (24-month-olds)* condition, the sentences denoting the singular and plural trials differed in the morpheme only (“S” vs. Ø). Error bars denote the standard error.