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Does object naming aid 12-month-olds' formation of novel object categories?

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ABSTRACT

An experiment with 64 twelve-month-olds investigated the influence of object naming on their formation of novel object categories. Stimuli were constructed to represent 2 broad categories consisting of 3 narrow categories each. Objects representing the same narrow or broad category were presented with either a labelling or non-labelling phrase in a modified word extension procedure. Only infants in the narrow category-level condition who heard labelling phrases demonstrated categorization, and categorization performance in the narrow label condition was superior to that in the narrow no-label condition. Consistent with studies utilizing conventional objects, results indicate that object naming can facilitate infants' formation of novel object categories early in the process of lexical acquisition.

KEYWORDS

Categorization; infancy; novel objects; object naming; word extension task

One of the fundamental tasks of development is to organize the myriad objects in the environment into efficiently-structured categories that permit the rapid identification of new objects. Research on early category development has demonstrated that infants have rather sophisticated categorization skills and are particularly adept at forming categories at an intermediate level of breadth or abstraction, known as the basic level (e.g., dogs). Basic-level categories are especially salient because they are organized around shape and are characterized by a high degree of within-category similarity (e.g., dogs are perceptually similar to one another) and between-category dissimilarity (e.g., dogs are perceptually dissimilar to fish; Rosch, Mervis, Gray, Johnson & Boyes-Braem, 1976). Categories at the more abstract global level (e.g., animals) are less distinct because they are characterized by a high degree of both between- and within-category dissimilarity (e.g., animals are perceptually different from furniture, but different kinds of animals are also perceptually dissimilar to one another). Several studies have demonstrated infants' competence in categorizing at the basic level. For example, infants are able to form basic-level categories within just a few months of life (Eimas, Quinn & Cowan, 1994; Quinn & Eimas, 1996; Quinn, Eimas & Rosenkrantz, 1993). In addition, several studies have found that infants form basic-level categories more readily than categories at the broader, global level of abstraction (Fulkerson & Haaf, 2003; Ross, 1980; Waxman & Markow, 1995; but see Mandler, Bauer & McDonough, 1991, and Mandler & McDonough, 1993, for evidence of infants' global categorization skills).

A second developmental task is to learn the words that communicate the various categories that have been formed. Research investigating the relationship between categorization and word-learning has demonstrated that these two abilities are not distinct, but linked at the very onset of the lexical acquisition process. Naming different objects from the same category (e.g., pig, frog, deer) with the same word (e.g., 'animal') facilitates the formation of object categories in infants who are just beginning to understand and produce their first words (Balaban & Waxman, 1997; Fulkerson & Haaf, 2003; Fulkerson, Waxman & Seymour, 2006; Waxman & Booth, 2001; Waxman & Braun, 2005; Waxman & Markow, 1995). Several studies have found an effect of object naming on infants' formation of global categories. For example, in a study by Waxman & Markow (1995), 12-month-olds formed a basic-level category regardless of whether category members were presented with a labelling phrase (e.g., 'See the fauna?', 'See the faunish one?') or a non-labelling phrase (e.g., 'See here?'). However, infants formed a global category only when category members were named. Similarly, in a study by Fulkerson & Haaf (2003), 9- and 15-month-olds formed basic-level categories when objects were introduced with a labelling phrase or a non-labelling sound (e.g., melody). However, infants formed global categories only when category members were labelled.

Although object naming has been found to facilitate infants' formation of global categories, it can also facilitate the formation of basic-level categories under some task circumstances. For example, in a study by Balaban & Waxman (1997), 9-month-olds were visually-familiarized to simple line-drawn exemplars of objects from the same basic-level category (e.g., rabbits) with either a labelling phrase or a tone. Infants who heard the labelling phrase detected the category, but infants who heard the tone did not. Likewise, in a study by Fulkerson et al. (2006), 6- and 12-month-olds were able to categorize a set of line-drawn dinosaurs or fish only when the category exemplars had

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been labelled. In both the Balaban & Waxman and the Fulkerson et al. studies, perceptually very simple stimuli were used. The lack of perceptual detail in the stimuli may have made the categorical relationship among the basic-level exemplars difficult to detect, providing an opportunity for a facilitative effect of naming to occur.

Findings from the studies reported above provide strong evidence that object naming promotes object categorization in infants who are at the earliest stages of lexical acquisition. However, at least two issues remain unresolved, the second of which is the focus of the present experiment. First, the precise conditions under which object naming influences different levels of categorization (e.g., basic-level, global) remain unclear. Several studies suggest that basic-level categories are easier for infants to detect than are global categories (Fulkerson & Haaf, 2003; Ross, 1980; Waxman & Markow, 1995; but see Mandler et al., 1991; Mandler & McDonough, 1993), and that object naming is especially effective in facilitating categorization at the more difficult global level. However, other studies suggest that object naming *can* facilitate infants' formation of basic-level categories when the category is otherwise difficult to detect (Balaban & Waxman, 1997; Fulkerson et al., 2006). Furthermore, it is reasonable to suspect that object naming might *fail* to facilitate infants' formation of a global category if the stimulus characteristics or other task demands make the category particularly difficult to form.

A second unresolved issue is whether object naming simply highlights categories that infants are already familiar with, or whether it encourages the formation of new categories (Markman & Hutchinson, 1984). To date, evidence in support of object naming on infants' categorical responding has come almost exclusively from studies utilizing relatively common stimulus materials that many infants already have a great deal of familiarity with (e.g., animals, vehicles, food). The only exception that we are aware of is a recent study by Booth & Waxman (2002). In that study, infants were familiarized to a set of exemplars from a novel category. For infants in the label condition, familiarization objects were named with a novel word (e.g., 'This one is a dax'); for infants in the no-label condition, familiarization objects were presented with a phrase that did not contain an object name (e.g., 'Look at this one'). Following the familiarization phase, infants in both conditions were asked to select which one of two previously unseen objects was from the familiarized category. Results indicated that 18-month-olds in the label condition formed the novel category while those in the no-label condition did not. These findings suggest that object naming can facilitate the formation of novel categories in infants who are at least 18 months of age and whose lexical acquisition is fully underway. However, as mentioned above, several studies have demonstrated a naming effect on the categorization of familiar objects in much younger infants, infants who are just beginning to comprehend and produce their first words (Balaban & Waxman, 1997; Fulkerson & Haaf, 2003; Fulkerson et al., 2006; Waxman & Booth, 2001; Waxman & Braun, 2005; Waxman & Hall, 1993; Waxman & Markow, 1995). One possibility is that, as is the case with familiar object categories, object naming facilitates the formation of novel object categories in infants who are at the very onset of lexical acquisition. However, another possibility is that the linkage between object naming and categorization is initially specific to familiar object categories and only later becomes more general to include both familiar and novel categories.

The purpose of the present study was to investigate whether object naming aids



the acquisition of novel object categories in infants less than 18 months of age. Twelve-month-olds were selected for study because: (a) the effect of object naming on infants' formation of familiar categories is well established at this age level (Fulkerson et al., 2006; Waxman & Braun, 2005; Waxman & Markow, 1995), and (b) 12 months is the typical age when infants are just beginning to produce their first words (Fenson, Dale, Reznick, Bates, Thal & Pethick, 1994). As shown in Fig. 1, a set of novel objects was constructed to represent different narrow categories within each of two broad categories. Members from the same narrow category had the same overall shape and three perceptual features that were unique to that narrow category; the broad categories were more inclusive and perceptually diverse, consisting of exemplars with either angular or curvilinear features. These two category levels were included in the present study because, as was mentioned earlier, previous studies have found that object naming may highlight categories at different levels of abstraction under various task circumstances. Although stimuli were constructed to be analogous to basic- and global-level categories, we use the terms narrow and broad, respectively, since it is unknown whether our categories are represented at the basic- and global-levels for infants (for discussions regarding the appropriateness of the terms 'basic-level' and 'global' to refer to infants' categorization, see Mandler & Bauer, 1988; Mandler et al., 1991; Rakison, 2000).

In a modified word extension procedure, similar to that used by Booth & Waxman (2002) and Waxman & Booth (2001), infants were introduced to two different objects representing either the same narrow category (narrow category-level condition) or the same broad category (broad category-level condition) during an initial familiarization phase. Familiarization objects were introduced with a labelling phrase for half of the infants in each category-level condition and with a non-labelling phrase for the other half. During a subsequent test phase, infants were shown a novel object from the familiarized category along with an object from a contrasting category and were asked to select the object from the familiarized category. The question of interest was whether object naming promotes 12-month-olds' formation of novel object categories at either a narrow or broad level of abstraction.

METHOD

Participants

Participants included 64 full-term 12-month-old infants; they ranged in age from 355 to 378 days ($M = 365.1$ days, $SD = 5.8$). There were 28 males and 36 females. Participants were identified from county birth records and were predominantly from white, middle-class families: 89% were White-Caucasian, 5% were from a mixture of racial-ethnic backgrounds, and 6% did not provide information on race and ethnicity; 92% of mothers and 75% of fathers had at least some college education; 70% of mothers and 81% of fathers were employed (employment information was not available for 20% of mothers and 14% of fathers). Verbal and written informed consent was obtained from a parent of each participating infant. All infants included in the final sample: (a) were learning English as their first language, (b) were free from

any known vision or hearing problems, and (c) did not currently have a diagnosed ear infection. One additional infant was tested but excluded from the final sample due to experimenter error.

Stimuli

Stimuli included 14 different three-dimensional objects representing two different levels of category abstraction modelled after novel categories used by Mervis & Crisafi (1982). The 14 novel object stimuli could be classified into two broad categories, each consisting of seven members. One broad category included objects with angular features; the other included objects with curvilinear features. Within each broad category, there were exemplars representing three different narrow categories. There was one angular T-shaped, three angular X-shaped and three angular H-shaped objects, and also one curvilinear U-shaped, three curvilinear S-shaped and three curvilinear G-shaped objects. Stimuli from the same narrow category had the same overall shape and three identical internal features (for example, all three X-shaped objects had green parallel lines, an orange zigzag and a red triangle); they differed only in their outside contour and placement of detail. Two of the three members from the X-, H-, S- and G-shaped categories served as familiarization stimuli; the remaining objects were used as test stimuli. The test stimuli were grouped into five pairs. The X- vs. T-shaped, H- vs. T-shaped, S- vs. U-shaped and G- vs. U-shaped pairs were used to assess narrow categorization; the T- vs. U-shaped pair was used to assess broad categorization. Line-drawn examples of the stimuli, along with the relationship among the categories, are depicted in Fig. 1.

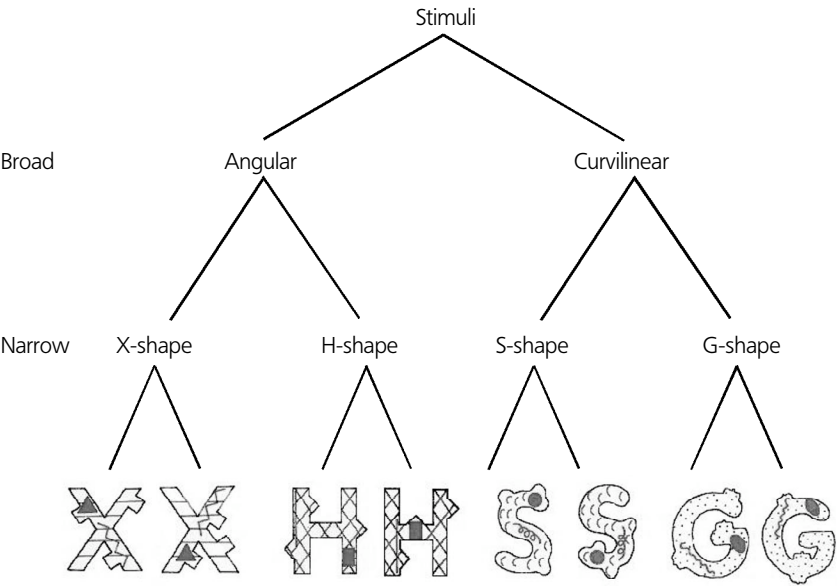


Figure 1 Sample stimuli



Each stimulus was constructed of wood, was painted with gloss white enamel, and contained green, red and orange features. Although the exact sizes of the stimulus objects varied, their average size was 7.9 x 6.6 x 1.9 cm. In addition to the 14 novel objects, two objects were used as contrast objects; one was a pink pig made of hard plastic (6.0 x 9.0 x 2.8 cm) and the other was a green turtle made of rubber (2.2 x 11.4 x 11.2 cm).

Novelty of the stimuli

Because stimuli resembled letters, participating parents were asked to rate how much experience their infant had with the letters X, H, T, S, G and U on a 1 (no experience) to 5 (a lot of experience) scale. Parents were asked to base their judgements on toys the infant plays with such as blocks, magnetic letters, computers or alphabet picture books and on home furnishings such as comforters, crib mobiles or lettered wallpaper. The average letter experience score was low ($M = 1.47$, $SD = 0.85$), suggesting that even though the stimuli resembled letters, they were novel for infants.

Verifying the structure of the stimuli

A preliminary study was conducted to ensure that objects defined as belonging to the same narrow category were perceptually more similar than objects defined as belonging to the same broad category. Fifteen adults were asked to rate the perceptual similarity of all possible pairs of the 14 novel object stimuli on a 1 (very similar) to 9 (very different) scale. A one-way repeated measures ANOVA revealed that mean similarity scores differed between pairs of objects belonging to the same narrow category ($M = 1.18$), different narrow categories ($M = 5.26$), and different broad categories ($M = 7.27$), $F(2, 28) = 239.36$, $p < 0.001$. Post-hoc Tukey tests indicated that mean similarity scores for all three types of object comparisons were significantly different from one another ($p < 0.01$ for all Tukey tests). These results demonstrate that stimuli defined as belonging to the same narrow category are perceptually more similar to one another than stimuli defined as belonging to different narrow categories.

Discriminability of familiarization and test stimuli

In order to interpret infants' behaviour as categorization, it is important to determine whether the novel object stimuli are discriminable for 12-month-old infants. An unpublished master's thesis (Fulkerson, 1997) conducted with the same set of stimuli, but using a different methodology, indicated that the stimuli are discriminable for 12-month-olds. In that study, 48 infants were habituated to two objects from either the same narrow or the same broad category with either a labelling- or a non-labelling phrase. Following habituation, infants were presented with three previously unseen test objects in silence: one from a familiar narrow category, one from a different narrow category and one from a different broad category. Infants in both category levels and both labelling conditions dishabituated to all three test objects. Infants' recovery of attention to all three test objects demonstrates that infants could discriminate the test objects from the habituation objects.

Testing for pre-existing preferences among the test stimuli

A preliminary study was conducted with an independent sample of 32 12-month-olds

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($M = 362.9$ days, $SD = 20.6$) to determine whether infants have any pre-existing preferences among the test stimuli. Infants were given one of the five test pairs of objects to manipulate simultaneously for a total of 30 s. The 30-s trials included 5 s to record infants' responses and 25 s to maintain infants' interest in the task. Half of the infants heard a labelling phrase with the introduction of the test objects (i.e., 'Look at the mot' or 'Look at the fep'); the other half heard a non-labelling phrase (i.e., 'Look at one more'). The left-right placement of the objects was counterbalanced. The total length of infants' examining of each test object was recorded (see 'Coding' section for a description of how examining was defined). Two mixed-model ANOVAs were conducted on infants' examining times of the test objects: one for test sets used to assess narrow categorization (i.e., the X- vs. the T-shaped object, the H- vs. the T-shaped object, the S- vs. the U-shaped object, and the G- vs. the U-shaped object) and one for the test set used to assess broad categorization (i.e., the T- vs. the U-shaped object). The ANOVA assessing the narrow category test sets compared infants' examination of the object used as the familiar test object in the experiment proper (i.e., the X-, H-, S- or G-shaped object) with the object used as the novel test object (i.e., the T- or the U-shaped object) for each of the two labelling conditions. This analysis failed to reveal any significant effects. The ANOVA assessing the broad category test set also compared infants' examining of the familiar and novel test object for the two labelling conditions. However, because the T- and U-shaped objects were each used to represent the novel and familiar test object in the experiment proper, the definition of these two objects as familiar or novel was randomly assigned to an equal number of infants in the preference control study. This ANOVA also failed to reveal any significant effects. Consequently, it can be concluded that infants did not have any pre-existing preferences among the test objects.

Apparatus

Infants were seated on a parent's lap at a small table in a laboratory playroom. Stimuli were presented by one of four female experimenters who sat across from the infant. A video camera, hidden by a curtain, was centred 1.4 m in front of the infant so that an observer located behind the curtain could view the infant's face and hands on a video monitor. A computer equipped with an input/output buffer system timed trial durations and recorded examining times. A light that was hardwired to the computer and positioned within the experimenter's view but out of the infant's view signalled the end of each trial.

Procedure

The modified word extension task, similar to the one used by Booth & Waxman (2002) and Waxman & Booth (2001), consisted of three phases. Parents were asked not to talk during any phase of the experimental session and not to influence their infant's attention to any of the stimuli.

Familiarization phase

During the familiarization phase, each of two objects from a common category was



presented twice, one at a time, over the course of four 30-s trials. The two objects represented either the same narrow category (e.g., two X-shaped objects; narrow category-level condition) or the same broad category (e.g., an X- and an H-shaped object; broad category-level condition). Half of the infants in each category-level condition were assigned to one of two between-participants labelling conditions. In the label condition, the experimenter labelled each familiarization exemplar with one of two labelling phrases (i.e., 'Look, a mot', 'Look, a fep'). In the no-label condition, each familiarization object was introduced with a non-labelling phrase (i.e., 'Look, here's one'). After the infant was introduced to the object, the experimenter placed the object directly in front of and within reach of the infant. Approximately 10 s into each familiarization trial, the experimenter repeated the labelling- or non-labelling phrase. After a total of 30 s had passed, the experimenter removed the object from the infant's view and began the next trial. An equal number of infants in each condition was familiarized to angular and curvilinear stimuli, and the specific pair of familiarization objects presented (e.g., X1 and X2 or H1 and H2) was selected randomly.

Contrast phase

During the contrast phase, the experimenter held up a new object (i.e., a turtle or a pig selected at random) that was unrelated to the familiarization objects, solemnly shook her head, and said either, 'Uh oh! This is not a mot (fep)' in the label condition or 'Uh oh! This is not one more' in the no-label condition. Infants were not given an opportunity to manipulate the contrast object. The experimenter then re-presented one of the two original familiarization objects and excitedly exclaimed, 'Yeah, this is a mot (fep)!' (label condition) or 'Yeah, this is one more!' (no-label condition). She placed this object in front of the infant, and with an outstretched palm asked, 'Can you show me the mot (fep)?' (label condition) or 'Can you show me one more?' (no-label condition).

Test phase

During the test phase, the experimenter simultaneously presented infants with two novel test objects, one from the familiarized category and one from a novel category. For infants in the narrow category-level condition, the out-of-category test object was from a different narrow category within the same broad class (e.g., a T-shaped object); for infants in the broad category-level condition, the out-of-category test object was from the other broad category (e.g., a U-shaped object). After infants had played freely with the test objects for a total of 30 s, the objects were placed out of view. The experimenter then held up one of the original familiarization objects, saying either 'Look a mot (fep)' (label condition) or 'Look, here's one' (no-label condition) and placed the object on the table outside the infant's reach. With the familiarization object still in view to the infant, she then placed the two test objects directly in front of the infant and asked 'Can you show me the mot (fep)?' (label condition) or 'Can you show me one more?' (no-label condition). The left-right position of the test objects was counter-balanced between participants.

Coding

Coders recorded the total length of infants' examining of each object during

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familiarization- and test-trials. Each infant was observed by one of seven coders who were blind to the hypotheses of the experiment. Infants were viewed as the session was in progress from a video monitor hidden behind a curtain in the testing room. The total amount of time that infants spent examining each object on each trial was recorded via a hand-held push button that was connected to a computer. Examining was defined as infants' looking at an object in either the presence or absence of touching (Ruff, 1986). A word extension score was calculated based on infants' examining during the first 5 s after the experimenter asked the infant to select between the two test objects.¹ This score was computed by dividing the amount of examining of the within-category test exemplar by the within-category and out-of-category exemplars combined. Therefore, a score greater than 0.50 reflects a preference for the within-category object and indicates categorization.

An independent coder re-rated 50% of the infants, an equal number from each condition. Separate Pearson correlations were computed for total examining times during the familiarization phase, and for word extension scores. Reliability between coders was $r = 0.92$ for the familiarization phase, and $r = 0.93$ for word extension scores.

RESULTS

Familiarization phase

The primary questions asked of the familiarization phase data were whether infants in each labelling and category-level condition had different amounts of exposure to the familiarization stimuli and whether they showed differential amounts of response decrement over familiarization trials. To answer these questions, total examining times were submitted to a 2 Labelling condition \times 2 Category level \times 4 Trial mixed ANOVA, with trial as the repeated measure. This analysis revealed a significant trial main effect ($F(3, 180) = 11.91, p < 0.0001, \eta = 0.41$), which reflected a significant linear decline in examining across familiarization trials ($F(1, 180) = 33.64, p < 0.001, r = 0.40$). Because no other main effects or interactions were significant, results from this analysis provide no evidence to indicate that infants had different amounts of exposure to the familiarization stimuli or showed different amounts of attentional decline across the conditions.

Word extension test phase

One-tailed t -tests were conducted comparing infants' word extension scores against a chance value of 0.50. As can be seen in Fig. 2, word extension scores were significantly above chance in the narrow label condition but did not differ from chance in any other condition (all p s > 0.10 , all r s < 0.33).

To determine whether performance differed between conditions, a 2 Labelling condition \times 2 Category level ANOVA was conducted on infants' word extension scores. This analysis yielded only a significant interaction ($F(1, 60) = 4.97, p = 0.03, r = 0.28$). To interpret the interaction, separate follow-up analyses were conducted to

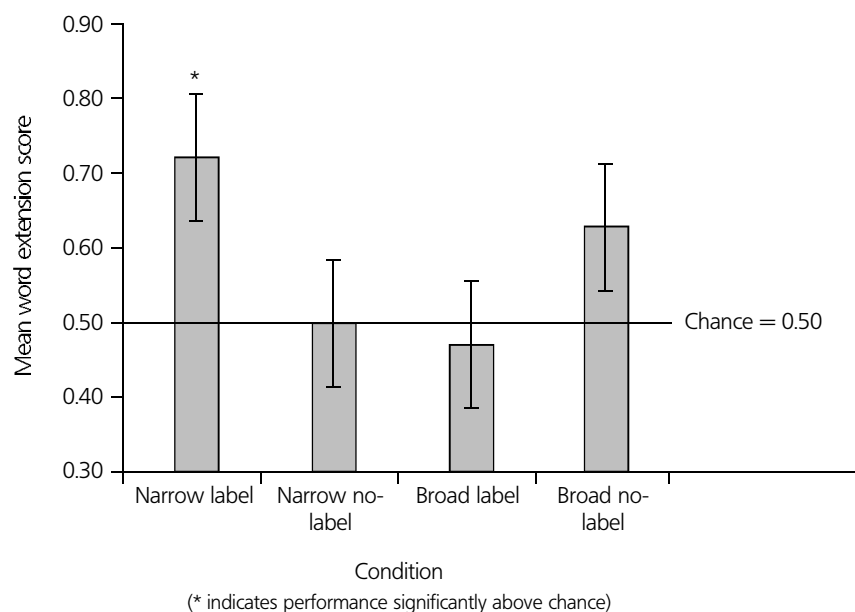


Figure 2 Mean word extension scores ($\pm SE$) for each condition

compare labelling conditions for each category level. These analyses revealed that word extension scores were higher in the narrow label condition than in the narrow no-label condition ($F(1, 30) = 4.31, p = 0.047, r = 0.35$), but did not differ between the broad label and broad no-label conditions ($F(1, 30) = 1.37, p = 0.25, r = 0.21$).

DISCUSSION

Previous research on the interplay between early word-learning and categorization has documented that object naming facilitates the formation of familiar object categories in infants at the very threshold of lexical acquisition (Balaban & Waxman, 1997; Fulkerson & Haaf, 2003; Fulkerson et al., 2006; Waxman & Booth, 2001; Waxman & Braun, 2005; Waxman & Markow, 1995). The purpose of the present research was to examine whether object naming also facilitates the formation of novel categories in infants who are at the age of first-word production, 12 months. Infants were familiarized to a set of objects from a novel category representing either a narrow or broad level of abstraction. Category exemplars were either named with a novel word or presented with a non-labelling phrase. During a word-extension test phase, infants were presented with a new test object from the familiarized category along with a test object from a different category and asked to select the object from the familiarized category. The duration of infants' examination of the test objects was analysed, and this revealed that infants formed a narrow category only when they had

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been familiarized to exemplars that had been named. Results also indicated that infants showed no evidence of forming a broad category regardless of labelling condition.

Results have important implications for understanding the early relationship between language and categorization as well as the ease with which infants are able to form categories at different levels of abstraction. First, results are consistent with previous studies to indicate that object naming facilitates infants' formation of familiar object categories early in the process of lexical acquisition (Balaban & Waxman, 1997; Fulkerson & Haaf, 2003; Fulkerson et al., 2006; Waxman & Booth, 2001; Waxman & Markow, 1995). However, the present findings add to the existing literature by demonstrating that object naming not only highlights what may be familiar object categories for infants but can highlight novel ones as well. One previous study has demonstrated an effect of object naming on infants' acquisition of novel categories (Booth & Waxman, 2002). However, in that study, the effect was found with much older infants, 18-month-olds. Because object naming promotes infants' detection of familiar object categories much earlier in development (Balaban & Waxman, 1997; Fulkerson & Haaf, 2003; Fulkerson et al., 2006; Waxman & Booth, 2001; Waxman & Braun, 2005; Waxman & Markow, 1995), the question remained as to whether object naming might also affect infants' early acquisition of new categories or whether the linkage between naming and categorization might initially be specific to familiar categories and only later come to include novel categories. Results from the present experiment confirm that as early as 12 months of age, when infants are typically just beginning to produce their first words, object naming highlights commonalities among objects and helps infants to learn new categories. Upon hearing a new word, it may be that infants attempt to identify a category to attach to the new label. If a familiar one is not available, infants activate a search for a new category. In this way, infants may construct categories to fit new words.

Another important implication of the present research has to do with the specific features of labelling phrases that lead to their facilitation of categorization at 12 months. Although this issue was not the focus of the present study, results suggest that the effect is not simply due to the presence of sound, the presence of language, or even infant-directed language. Despite the fact that infants in the no-label condition were introduced to category exemplars with a non-labelling language phrase spoken in the infant-directed speech register, they failed to demonstrate reliable categorization. Therefore, we suggest that the effect of naming on 12-month-olds' categorization was due to the presence of content words. This conclusion is consistent with work by Waxman & Markow (1995). In that research, infant-directed language containing either a noun or an adjective facilitated 12-month-olds' category formation while infant-directed language lacking a content word did not. Previous research has also shown that even newborn infants can categorically discriminate content words from function words on the basis of perceptual information (Shi, Werker & Morgan, 1999). Moreover, by 6 months of age, infants prefer to attend to content words (Shi & Werker, 2001). This early sensitivity to content words may serve to bootstrap infants' acquisition of words, grammatical categories and syntactic structure (Shi et al., 1999; Waxman, 2002) and underlie the facilitative effect of naming on infants' object categorization.

A third implication of the present findings relates to the ease with which infants are



able to form categories at different levels of abstraction. As mentioned in the introductory section, numerous studies have shown that infants are skilled in forming basic-level categories at a very early age and are able to form basic-level categories more easily than global categories (Eimas et al., 1994; Fulkerson & Haaf, 2003; Quinn & Eimas, 1996; Quinn et al., 1993; Ross, 1980; Waxman & Markow, 1995). Results of the present experiment are consistent with these findings. Infants demonstrated formation of a novel narrow category when exemplars from that category were named. However, infants failed to form a broad category regardless of their labelling condition. The fact that infants in our experiment were able to form a narrow category, but not a broad one, suggests that the narrow categories were within infants' range of acquisition but that the broad categories were not. Although it is not known whether infants actually represent the novel categories employed in the present research at a basic and global level (thus our use of the terms narrow and broad, respectively), the perceptual similarity ratings that we obtained from adults indicate that our narrow categories are similar in structure to basic-level categories and our broad categories are similar in structure to global categories. Thus, present results are consonant with previous findings to suggest that basic-level categories are easier for infants to form than are global categories.

It is important to note that while present results suggest that narrower categories may be easier for infants to form than broader ones, it is not our argument that infants are unable to form broad categories or that there might not be some task circumstances in which broad categories are easier for infants to form than narrow ones. Indeed, numerous studies have demonstrated that infants *can* form relatively broad categories, such as animals and vehicles, (e.g., Behl-Chada, 1996; Fulkerson & Haaf, 2003; Oakes & Spalding, 1997; Waxman & Markow, 1995) and a few have even shown that, under certain conditions, broader categories are easier to form than narrower ones (Fulkerson & Haaf, 2004; Mandler & Bauer, 1988; Mandler & McDonough, 1993; Mandler et al., 1991). In our experiment, the novelty of the stimuli or small number of familiarization exemplars may have made the formation of a broad category particularly difficult, even in the presence of object names. The point is that, within the present experimental conditions, infants were able to form a narrow category but not a broad one; this pattern of results is consistent with the widely held notion that categories approximating the basic-level are typically easier to form than are categories approximating a global level.

Present results also raise a methodological issue. The novelty preference task has been the procedure of choice in studies of categorization and word learning with infants less than 12 to 18 months of age. However, there may be some circumstances in which this task is undesirable either (a) because it can result in procedural artefacts that cloud interpretation of results (for example, in habituation procedures, regression to the mean effects or recovery of attention to all test exemplars; in familiarization procedures, no decrease of attention over familiarization trials or lack of novelty preference on test), or (b) because it provides an indirect assessment of categorization (i.e., categorization is inferred if more attention is devoted to out-of-category test objects than within-category ones). Although forced-choice word extension tasks do not possess some of these drawbacks and have been used successfully with infants as young as 13 to 14 months of age (Booth & Waxman, 2002; Campbell & Namy, 2003; Waxman & Booth, 2001; Woodward

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& Hoyne, 1999), they may not be well suited for younger infants who have difficulty making a clear selection among a set of choice objects. In the present experiment, infants' categorization was assessed by measuring the length of infants' visual attention to the test object from the familiarized category. A visual dependent measure was used in lieu of a haptic one, because in our experience 12-month-olds rarely hold up or point to an object when asked to make a two-choice selection. What was demonstrated here is that the word extension task *may* be used successfully with infants less than 13 to 14 months of age if infants' visual response is measured.

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A portion of these data was presented at the biennial meeting of the Society for Research in Child Development, Tampa, Florida, April 2003.

NOTE

1. Preliminary testing included a 30-s word extension test trial. However, there appeared to be a disparity between infants' word extension scores that were calculated based on 30 s of examining and observers' judgements of infants' behaviour immediately after they were asked to make a selection among the test objects. For example, many infants had a word extension score based on a 30-s trial near chance, but immediately pointed to or looked at the familiar object. Therefore, the trial length was shortened to 5 s, a trial length that has successfully been used in other studies involving a two-choice naming task (Houston-Price, Plunkett & Harris, 2005).

REFERENCES

- Balaban, M. T. & Waxman, S. R. (1997). Do words facilitate object categorization in 9-month-old infants? *Journal of Experimental Child Psychology*, 64, 3–26.
- Behl-Chada, G. (1996). Basic-level and superordinate-like categorical representations in early infancy. *Cognition*, 60, 105–141.
- Booth, A. E. & Waxman, S. R. (2002). Object names and object functions serve as cues to categories for infants. *Developmental Psychology*, 38, 948–957.
- Campbell, A. L. & Namy, L. L. (2003). The role of social-referential context in verbal and nonverbal symbol learning. *Child Development*, 74, 549–563.
- Eimas, P. D., Quinn, P. C. & Cowan, P. (1994). Development of exclusivity in perceptually-based categories of young infants. *Journal of Experimental Child Psychology*, 58, 418–431.
- Fenson, L., Dale, P. S., Reznick, J. S., Bates, E., Thal, D. J. & Pethick, S. J. (1994). Variability in early communicative development. *Monographs of the Society for Research in Child Development*, 52 (5, Serial No. 242).
- Fulkerson, A. L. (1997). *New words for new things: The relationship between novel labels and twelve-month-olds' categorization of novel objects*. Unpublished master's thesis, University of Toledo, Toledo, OH.



- Fulkerson, A. L. & Haaf, R. A. (2003). The influence of labels, non-labeling sounds, and source of auditory input on 9- and 15-month-olds' object categorization. *Infancy*, 4, 349–369.
- Fulkerson, A. L. & Haaf, R. A. (2004, May). Auditory source influences the effect of object naming on 9-month-olds' object categorization. Paper presented in a symposium entitled "The conceptual power of naming: Categorization, individuation, and inductive inference" at the International Conference on Infant Studies, Chicago, IL, organized by S. R. Waxman.
- Fulkerson, A. L., Waxman, S. R. & Seymour, J. M. (2006). Linking object names and object categories: Words (but not tones) facilitate object categorization in 6- and 12-month-olds. *Proceedings of the 30th annual Boston University Conference on Language Development* [Electronic supplement]. Retrieved from: <http://www.bu.edu/linguistics/APPLIED/BUCLD/proc.html>.
- Houston-Price, C., Plunkett, K. & Harris, P. (2005). Word-learning wizardry at 1;6. *Journal of Child Language*, 32, 175–189.
- Mandler, J. M. & Bauer, P. J. (1988). The cradle of categorization: Is the basic level basic? *Cognitive Development*, 3, 247–264.
- Mandler, J. M., Bauer, P. J. & McDonough, L. (1991). Separating the sheep from the goats: Differentiating global categories. *Cognitive Psychology*, 23, 263–298.
- Mandler, J. M. & McDonough, L. (1993). Concept formation in infancy. *Cognitive Development*, 8, 291–318.
- Markman, E. M. & Hutchinson, J. E. (1984). Children's sensitivity to constraints on word meaning: Taxonomic versus thematic relations. *Cognitive Psychology*, 16, 1–27.
- Mervis, C. B. & Crisafi, M. A. (1982). Order of acquisition of subordinate-, basic-, and superordinate-level categories. *Child Development*, 53, 258–266.
- Oakes, L. M. & Spalding, T. L. (1997). The role of exemplar distribution in infants' differentiation of categories. *Infant Behavior and Development*, 20, 457–475.
- Quinn, P. C. & Eimas, P. D. (1996). Perceptual cues that permit categorical differentiation of animal species by infants. *Journal of Experimental Child Psychology*, 63, 189–211.
- Quinn, P. C., Eimas, P. D. & Rosenkrantz, S. L. (1993). Evidence for representations of perceptually similar natural categories by 3-month-old and 4-month-old infants. *Perception*, 22, 463–475.
- Rakison, D. H. (2000). When a rose is just a rose: The illusion of taxonomies in infant categorization. *Infancy*, 1, 77–90.
- Rosch, E., Mervis, C. B., Gray, W. D., Johnson, D. M. & Boyes-Braem, P. (1976). Basic objects in natural categories. *Cognitive Psychology*, 8, 382–439.
- Ross, G. S. (1980). Categorization in 1- to 2-year-olds. *Developmental Psychology*, 16, 391–396.
- Ruff, H. A. (1986). Components of attention during infants' manipulative exploration. *Child Development*, 57, 105–114.
- Shi, R. & Werker, J. F. (2001). Six-month-old infants' preference for lexical words. *Psychological Science*, 12, 70–75.
- Shi, R., Werker, J. F. & Morgan, J. L. (1999). Newborn infants' sensitivity to perceptual cues to lexical and grammatical words. *Cognition*, 72, B11–21.
- Waxman, S. R. (2002). Early word learning and conceptual development: Everything had a name, and each name gave birth to a new thought. In U. Goswami, U. (Ed.), *Blackwell handbook of childhood cognitive development* (pp. 102–126). Oxford: Blackwell.
- Waxman, S. R. & Booth, A. (2001). Seeing pink elephants: Fourteen-month-olds' interpretations of novel nouns and adjectives. *Cognitive Psychology*, 43, 217–242.
- Waxman, S. R. & Braun, I. (2005). Consistent (but not variable) names as invitations to form object categories: New evidence from 12-month-old infants. *Cognition*, 95, B59–68.
- Waxman, S. R. & Hall, D. G. (1993). The development of a linkage between count nouns and object categories: Evidence from fifteen- to twenty-one-month-old infants. *Child Development*, 64, 1224–1241.

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Waxman, S. R. & Markow, D. B. (1995). Words as invitations to form categories: Evidence from 12- to 13-month-old infants. *Cognitive Psychology*, 29, 257–302.

Woodward, A. L. & Hoyne, K. L. (1999). Infants' learning about words and sounds in relation to objects. *Child Development*, 70, 65–77.

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