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When Does an Ostrich Become a Bird? The Role of Typicality in Early Word Comprehension

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Which objects and animals are children willing to accept as referents for words they know? To answer this question, the authors assessed early word comprehension using the preferential looking task. Children were shown 2 stimuli side by side (a target and a distractor) and heard the target stimulus named. The target stimulus was either a typical or an atypical exemplar of the named category. It was predicted that children first connect typical examples with the target name and broaden the extension of the name as they get older to include less typical examples. Experiment 1 shows that when targets are named, 12-month-olds display an increase in target looking for typical but not atypical targets whereas 24-month-olds display an increase for both. Experiment 2 shows that 18-month-olds display a pattern similar to that of 24-month-olds. Implications for the early development of word comprehension are discussed.

In their 2nd year of life, infants learn names for a variety of common object categories: *dog, cup, shoe,* and so forth. There is considerable evidence that young children, like adults, do not establish categories on the basis of a strict set of necessary and sufficient conditions. Instead, they construct categories with fuzzy boundaries around central exemplars or prototypes (Rosch, 1973, 1978). Yet it is still unclear how infants integrate their acquisition of object categories with the learning of names for members of the category. In particular, we have little information about whether typicality effects can be detected in early word comprehension at the beginning of the 2nd year of life when infants are first starting to build up their vocabulary. For example, do infants associate names with typical rather than atypical exemplars of a category at the outset of word comprehension? And when do infants extend names to more peripheral members of the category?

Research has shown that young preverbal infants can structure their environment into categories and respond differentially to objects that fall into the same category compared with those that fall outside it. Thus, infants display habituation to category members and dishabituation to nonmembers, both for natural and familiar categories (Eimas & Quinn, 1994; Quinn, Eimas, & Rosenkrantz, 1993) and also for artificial categories (Younger, 1985). In addition, preverbal infants are sensitive to the typicality of a given category member (Oakes, Coppage, & Dingel, 1997; Roberts & Horowitz, 1986). Tests of categorization have shown that children treat prototypical members of a category, even if they are objectively novel, as more familiar (as indexed by inspection time) than exemplars that they have previously seen but that are less representative of the category (Strauss, 1979; Younger & Gotlieb, 1988).

There is also evidence that typicality effects reveal themselves in naming tasks. For example, if adults are presented with a set of exemplars that vary in their typicality, they are usually quicker to name the more typical items (Rosch, 1973). Similarly, when children are asked to evaluate categorical statements (e.g., "a robin is a bird" or "a chicken is a bird"), they are faster and more accurate in evaluating statements that include typical as opposed to atypical category members (Rosch, 1973). When either adults or children are asked to learn the names of members of a novel category, they are usually faster to learn the names of the more typical items (Heider, 1971, 1972). In addition, descriptive data concerning children's early vocabulary growth suggest that labels are used to name the prototypical members of a category before they are extended to peripheral members (Barrett, 1986, 1995; Bowerman, 1978; Nelson, 1974).

However, the research on early typicality effects in children's naming is almost exclusively based on the longitudinal observation of production by a small number of children. Naturalistic studies may underestimate children's willingness to treat atypical as well as typical instances as members of a category because children may encounter and name typical instances more often in their everyday environment. A more reliable way to establish whether there are early typicality effects is to present children with a range of instances and to assess the extent to which they treat the name as appropriate across the range of instances. With this objective in mind, we investigated the early development of children's willingness to accept atypical as well as typical instances as members of a named category. The present study made use of the *preferential looking paradigm*. A major advantage of this technique is that it is well suited to infants throughout the 2nd year. It relies on infants' ability to look selectively at one of two concurrently presented visual stimuli.

Previous findings have established that infants invited to look at a named target will look preferentially at that target as compared with the distractor (Golinkoff, Hirsh-Pasek, Cauley, & Gordon, 1987; Thomas, Campos, Shucard, Ramsay, & Shucard, 1981). Baseline preferences for the target versus the distractor, if any, can

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be established in a premessage period, when the infant is free to look at the two stimuli with no verbal instruction. Thus, comprehension of the target word is indexed not by any absolute preference for the target over the distractor, but rather by a measurable increase in selective looking at the target (relative to the premessage baseline) once the message naming the target has been presented.

In Experiment 1, we tested infants age 12 and 24 months. The younger age group was chosen to examine typicality effects at the onset of language acquisition. The older group was selected to establish whether typicality effects, if they exist at all, persist into the period when the infant's productive vocabulary has undergone rapid expansion. We tested the prediction that 12-month-olds would display an increase in selective looking at the target when it was typical but not when it was atypical. We also tested the prediction that 24-month-olds would show selective looking at atypical as well as typical items. In Experiment 2, we asked whether this pattern is already in place among 18-month-olds.

Experiment 1

The experiment was carried out in two phases. In the first phase, adult participants assessed the typicality of the visual stimuli to be used in the infant experiment. In the second phase, infants were tested on these stimuli in a preferential looking task. We describe each phase below.

Method for Adult Typicality Rating

Participants. Twenty graduate and undergraduate participants (10 female and 10 male) at the University of Oxford provided stimulus ratings. They were between 20 and 27 years of age. Two were excluded from the analysis because they used the scale in an inverted fashion.

Stimuli. Each stimulus was presented to the participants on a computer monitor with its name and a typicality rating scale that ranged from 1 (*very typical*) to 7 (*very atypical*) directly under the displayed object. Figure 1 shows typical and atypical examples of two animate and two inanimate stimuli. Participants made their typicality rating using the number keyboard on the computer.

We used 256-color (320 × 200 pixel) displays of photographs of concrete objects and animals. All images were presented against a 5% gray background. First, the object image was presented. After 500 ms, the name was added, and after a further 500 ms, the typicality rating scale appeared. The full image only disappeared after the student had made his or her judgment. The object image, the name, and the scale were centered horizontally, with the object image in the vertical center of the screen.

Procedure. The participants received written instructions very much like those used by Rosch (1973). Thus, to clarify the difference between typical and atypical stimuli, we asked participants to think of a "true red" as compared with an "orangish red" or a "purple red" and reminded them that certain dogs (e.g., a Chihuahua) do not necessarily represent good examples of a dog. Participants were asked to make their decision as quickly as possible. Participants had no difficulty in understanding the instructions. The experimenter started the first trial, but all other trials were launched 500 ms after the participants had made a keystroke to indicate their judgment. They were presented with a total of 126 images; half had been preassessed by the experimenters as typical and half as atypical. The order of presentation of the 126 images was randomized across participants.

The results of the typicality ratings confirmed the validity of the preassessment of the images. The overall mean rating was 1.85 (SD = 0.68) for the 63 typical images and 4.16 (SD = 1.08) for the 63 atypical images.

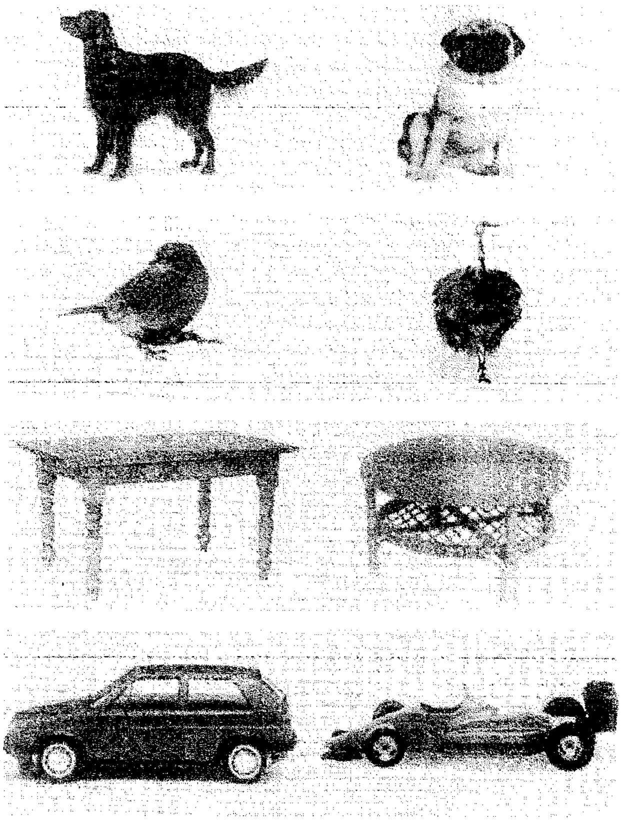

Figure 1. Typical and atypical examples of two animate and two inanimate stimuli.

These ratings are comparable with those obtained by Rosch (1973): To check on the extent to which this rating difference was stable across all pairs of typical and atypical images, we coded each member of a pair in terms of whether the rating difference was in the direction expected (i.e., a lower rating for the typical as compared with the atypical image) or reversed. Of the 63 pairs, the rating difference was in the direction expected for 60 pairs and reversed for 3 pairs. A binomial test confirmed that this distribution differed markedly from chance expectation (p < .0001).

Method for Infant Study

Participants. A total of twenty-one 12-month-olds (9 girls and 12 boys) and twenty-three 24-month-olds (13 girls and 10 boys) participated in the assessment of infant comprehension. Their mean ages were 12.91 months (range = 11–15 months) and 23.72 months (range = 22–25 months), respectively. Parents had previously replied to booklets sent out to doctors, nurseries, and health care workers. All children were born full term and were in good health. All had learned English as their first language, and none had been exposed at home to another language.

Each infant's vocabulary was assessed using a British version of the American Communicative Development Inventory (CDI; Fenson et al., 1994). Parents completed this questionnaire, and as described below, each set of trials was tailored to the comprehension vocabulary of each infant. Only words known to the infant as judged by the parents were used.

Auditory stimuli. To generate the auditory stimuli, we recorded a female voice for the set of stimuli using the schema, "Look, look at the (*target*)," where the target was the name of an animal or object. The speaker was asked to use infant-directed speech. All auditory stimuli were digitally recorded at 22.05 KHz into unsigned, 8-bit files. Recordings were made on the same day to maximize equivalence of production patterns by the speaker. Each utterance was edited to remove head and tail clicks and was inspected to control for duration, intensity, and pitch amplitude. The first "Look" of the sentence "Look, look at the x" was copied and used for all of the stimuli to guarantee a maximum of similarity. Stimuli were then matched for length and scaled to a maximum peak-to-peak amplitude that was identical for all speech samples.

Visual stimuli. Visual stimuli included the same color displays of photographs of concrete objects and animals used in the typicality ratings. Visual stimuli were produced by scanning photographs, using Adobe Photoshop 2.01™ and photographs from a CD-ROM children's picture dictionary. A broad range of animate and inanimate object names was selected from the CDI (Fenson et al., 1994) to create an image library. The library comprised images of 75 pairs: 28 animals and 47 objects (8 images of clothes, 4 of food, 22 of furniture, 3 of outside things, 4 of toys, 6 of vehicles); for each item there was a typical and an atypical version. The complete set of 75 stimuli is listed in Table 1.

This pool of 75 items included 62 items[1] rated by the adult participants, together with a further 13 pairs. The latter pairs were included because unanticipated individual variation in infants' receptive vocabularies meant that the choice of experimental stimuli was overly restricted if confined to the original pool of 62 pairs. The supplementary pairs were preassessed with respect to which was the more typical item of the pair by one of the experimenters and at least one other independent researcher.

All visual stimuli used with a given infant depicted items for which the infant knew a name (i.e., the parent had judged that the infant understood the word in question). To avoid the possible impact of a preference for looking at animals versus objects, only animal-animal or object-object pairs were used as target-distractor pairs. In addition, animals and objects of similar size, color, or both were paired. The stimuli presented to any given infant were tailored to that infant's vocabulary. Despite this matching at the individual level, inspection of Table 1 shows that the frequency of presentation of each stimulus was correlated across the two age groups. A Spearman's rho correlation confirmed this conclusion (.556, $p < .01$, two-tailed).

Procedure. Within the constraints imposed by the difference in the scope of their vocabulary, children in the two age groups were tested in the same way. They were seated on the parent's lap facing two monitors. On any given trial, the monitors displayed pictures of objects or animals—for example, a cow and a pig—where the target could be either of the objects displayed.

Following the onset of the trial, children heard a verbal message inviting them to "Look, look at the (*target*)." One of the two images matched the auditory stimulus (the target) whereas the other did not (the distractor). The monitors were at eye level for the child and at a distance of about 80 cm. The screen of each monitor measured 30 cm diagonally, and the screens were 44 cm apart from each other (from center to center). Each screen subtended a visual angle of approximately 20°. The loudspeaker presenting the auditory stimulus was positioned centrally above the monitors.

Before trial onset, the infant was "centered," that is, the gaze of the infant was attracted to a small flashing red light between the two monitors. During the task, the experimenter was not visible. The overall order of all trials shown to a given infant was pseudorandomized by a computer program, and the experimenter was unaware of the type of trial. Intertrial intervals varied with the infant's attention on the task. A new trial was not launched until the infant had centered his or her attention either spontaneously or when attracted by the flashing red light. However, a minimum of 0.5 s elapsed between trials.

Parents were asked to close their eyes and to listen to instructions played over headphones. These instructions reminded parents to sit quietly and to keep the infant seated in a central position. The instructions were recorded using the same female voice as for auditory stimuli presented to the infants. To shield the parents from the infants' auditory stimuli, we accompanied the instructions with white noise.

During the experiment, the room was almost dark, so that the only visible items of interest were the monitors. The light from the monitors enabled subsequent analysis of eye fixations. Two miniature cameras were used to record the infants' eye and head movements. The miniature cameras were placed immediately above each monitor and were connected to a video mixer that permitted recording of a split screen "twin-image" of the infant during the experimental session.

Experimental design. The presentation of the auditory stimulus started 600 ms after the onset of the visual stimulus, and the onset of the target word occurred at 2,100 ms after the onset of the visual stimulus (1,500 ms after the onset of the auditory stimulus). The visual stimulus then remained visible for a further 3,400 ms after the onset of the target word, so that the whole trial lasted 5,500 ms. For purposes of analysis, the trial phase was divided into two parts: a period of 2,100 ms before the onset of the target word and a period of 3,400 ms following the onset of the target word.

The status of the target item was systematically varied across trials: It could be either a typical or an atypical member of the target category. The status of the concurrently presented distractor item (i.e., the object that was not named in the verbal message) was also independently varied across trials and could be either a typical or an atypical member of the category. Thus, trials were of four different types, depending on whether the target was typical versus atypical, and depending on whether the distractor was typical versus atypical.

There were up to six different stimulus pairs for each trial type. Depending on the size of their vocabulary, infants viewed a minimum of 8 trials (and 16 images) and a maximum of 24 trials (and 48 images). Twelve-month-olds were presented with an average of 15.9 trials, and 24-month-olds were presented with an average of 24 trials. Each infant was presented with all four trial types, with targets occurring equally often on the left and right monitors to counter any effects of right or left preference. To prevent possible priming effects, we ensured that infants saw no image on more than one trial and did not hear the auditorily presented target word on more than one trial. In addition, individual infants saw any given object in either the typical or the atypical version. Nevertheless, across infants, all images were presented in both versions with approximately equal frequency, and each object appeared as both target and distractor with approximately equal frequency.

Data analysis. The video recording of infants' looking behavior was used to assess direction of eye gaze during an experimental trial. The recording allowed an assessment of whether the infant was looking at either of the stimuli displayed on the two monitors. The assessment of the video recording (played back at standard speed) was carried out after data collection was completed. The scorer used a button box to trigger a data-registration program, synchronized with the video recording. Each trial was scored twice by the same coder for the infants looking at the stimulus on the left side and twice for the infants looking at the stimulus on the right side. Note that the coder did not know the left-right location of the target. The two scores for each side were then averaged, which yielded two measures for each trial. Previous measurements of inter- and intrajudge reliability of this scoring technique have consistently yielded agreement of at least 90% (Schafer & Plunkett, 1998). Likewise, inter- and intrajudge reliability measures yielded correlations (r) of .96 and .97, respectively, in the present experiment.

Results

All of the infants completed the experiment. Only 1 infant in the younger group (age 13 months) had to be excluded from subse-

[1] A total of 62 items (rather than the original pool of 63 items) was used because no child tested was judged to know the item *pony*.

Table 1
Number and Percentage of Children in Each Age Group Seeing Each Image

	12 months (n = 22)		18 months (n = 38)		24 months (n = 23)			12 months (n = 22)		18 months (n = 38)		24 months (n = 23)	
Stimulus	n	%	n	%	n	%	Stimulus	n	%	n	%	n	%
apple	15	68.18	33	86.84	23	100.00	lamp	2	9.09	25	65.79	0	0.00
ball	18	81.82	38	100.00	23	100.00	lamb	2	9.09	1	2.63	8	34.78
balloon	8	36.36	30	78.95	23	100.00	lion	6	27.27	28	73.68	22	95.65
banana	22	100.00	37	97.37	23	100.00	monkey	6	27.27	23	60.53	23	100.00
bear	6	27.27	28	73.68	23	100.00	motorbike	3	13.64	16	42.11	0	0.00
bee	7	31.82	29	76.32	23	100.00	mouse	7	31.82	27	71.05	23	100.00
bicycle	10	45.45	28	73.68	0	0.00	nappy	18	81.82	16	42.11	23	100.00
bird	10	45.45	37	97.37	23	100.00	owl	3	13.64	9	23.68	22	95.65
bottle	13	59.09	25	65.79	0	0.00	pen	9	40.91	24	63.16	3	13.04
bowl	10	45.45	17	44.74	22	95.65	penguin	2	9.09	4	10.53	15	65.22
bread	4	18.18	1	2.63	0	0.00	pig	14	63.64	37	97.37	23	100.00
brush	11	50.00	33	86.84	0	0.00	airplane	11	50.00	25	65.79	23	100.00
butterfly	1	4.55	16	42.11	19	82.61	plate	9	40.91	24	63.16	22	95.65
car	19	86.36	37	97.37	23	100.00	pony	0	0.00	0	0.00	0	0.00
cat	21	95.45	38	100.00	23	100.00	puppy	0	0.00	7	18.42	3	13.04
chair	13	59.09	36	94.74	23	100.00	rabbit	12	54.55	35	92.11	23	100.00
chicken	3	13.64	1	2.63	2	8.70	radio	2	9.09	5	13.16	0	0.00
clock	9	40.91	31	81.58	23	100.00	sheep	10	45.45	35	92.11	23	100.00
coat	10	45.45	35	92.11	0	0.00	shirt	1	4.55	12	31.58	1	4.35
cow	18	81.82	36	94.74	23	100.00	shoe	16	72.73	38	100	23	100.00
cup	18	81.82	35	92.11	23	100.00	soap	4	18.18	16	42.11	0	0.00
dog	20	90.91	18	47.37	23	100.00	sock	22	100.00	37	97.37	23	100.00
doll	9	40.91	32	84.21	1	4.35	spider	1	4.55	3	7.89	0	0.00
donkey	5	22.73	14	36.84	18	78.26	spoon	21	95.45	36	94.74	23	100.00
door	9	40.91	12	31.58	0	0.00	squirrel	0	0.00	9	23.68	4	17.39
dress	2	9.09	13	34.21	0	0.00	stone	7	31.82	4	10.53	0	0.00
duck	21	95.45	37	97.37	23	100.00	table	11	50.00	32	84.21	22	95.65
egg	4	18.18	7	18.42	4	17.39	teddy bear	16	72.73	30	78.95	22	95.65
elephant	7	31.82	14	36.84	22	95.65	telephone	16	72.73	36	94.74	5	21.74
fish	16	72.73	32	84.21	23	100.00	television	10	45.45	35	92.11	23	100.00
flower	11	50.00	34	89.47	23	100.00	tiger	1	4.55	21	55.26	23	100.00
fork	2	9.09	15	39.47	22	95.65	toothbrush	11	50.00	13	34.21	23	100.00
frog	7	31.82	19	50.00	23	100.00	train	10	45.45	29	76.32	0	0.00
glass	1	4.55	2	5.26	0	0.00	tree	11	50.00	28	73.68	23	100.00
hat	16	72.73	35	92.11	23	100.00	truck	8	36.36	18	47.37	23	100.00
horse	12	54.55	34	89.47	23	100.00	watch	7	31.82	13	34.21	17	73.91
jumper	4	18.18	3	7.89	1	4.35	zebra	0	0.00	1	2.63	0	0.00
key	18	81.82	35	92.11	0	0.00							

quent analysis because that infant looked only at the left-hand monitor for more than 30% of the trials.

For the purposes of analysis, each trial was scored using two measures of target preference: (a) *the longest look* to the target relative to the distractor both before and after the onset of the target word (at 2,100 ms)—the difference (t − d) between longest looking time at the target (t) and at the distractor (d) was calculated for each of the two trial phases; (b) the proportion of *total looking* directed to the target both before and after the onset of the target word (at 2,100 ms)—the proportion (t/t + d) was calculated for each of the two trial phases.

For each measure, a 2 × 2 × 2 × 2 analysis of variance (ANOVA) of Age (12 vs. 24 months) × Trial Phase (before vs. after onset of target word) × Target Status (typical vs. atypical) × Distractor Status (typical vs. atypical) was calculated with repeated measures on the last three variables. A main effect of trial phase would indicate that infants' looking behavior is influenced by hearing the target name. We planned to examine the generality of such an effect for each combination of age and target status.

With respect to longest look, a significant main effect of trial phase, $F(1, 42) = 20.07$, $p < .0001$, confirmed that infants displayed an effect of target naming: They looked longer at the target than at the distractor after the onset of the target name. A main effect of distractor status, $F(1, 42) = 6.30$, $p < .016$, showed that infants looked longer at targets when the distractor was atypical. No other effects reached significance. The planned comparisons of trial phase showed that 12-month-olds displayed an effect of target naming for typical stimuli, $F(1, 42) = 4.56$, $p < .038$, but not for atypical stimuli, $F(1, 42) = 0.22$, $p < .638$, whereas 24-month-olds displayed an effect of target naming for typical stimuli, $F(1, 42) = 9.67$, $p < .003$, and also for atypical stimuli, $F(1, 42) = 13.50$, $p < .0006$. This pattern of findings is displayed in Figure 2.

With respect to total looking, an equivalent pattern emerged: A significant main effect of trial phase, $F(1, 42) = 8.33$, $p < .006$, confirmed that after hearing the target name, infants showed increased looking at the target compared with the distractor. A main effect of distractor status, $F(1, 42) = 8.24$, $p < .006$, showed that infants looked longer at targets when the distractor was atypical. No other effects reached significance. Planned comparisons of trial phase again showed that 12-month-olds displayed an effect of target naming for typical stimuli, $F(1, 42) = 6.30$, $p < .015$, but not for atypical stimuli, $F(1, 42) = 0.18$, $p < .670$. For 24-month-olds, the effect of target naming fell just short of significance for typical stimuli, $F(1, 42) = 3.30$, $p < .07$, and proved significant for atypical stimuli, $F(1, 42) = 3.97$, $p < .05$. This pattern of findings is displayed in Figure 3.

Discussion

The analyses revealed two distinct effects. First, the pattern of infants' looking altered across the two phases of the trial. Before infants heard the name, their looking preference was equivalent for both images so that the index of target preference registered approximately zero; after the onset of the target name, however, looking at the target increased. Despite this overall pattern, planned comparisons showed that the two age groups responded differently depending on the status of the target. After hearing the name, 12-month-olds displayed more target looking for typical but not for atypical targets. By contrast, 24-month-olds displayed a similar pattern of looking for both typical and atypical targets. The question then arises as to when this age change occurs. We examined this question by testing infants of approximately 18 months.

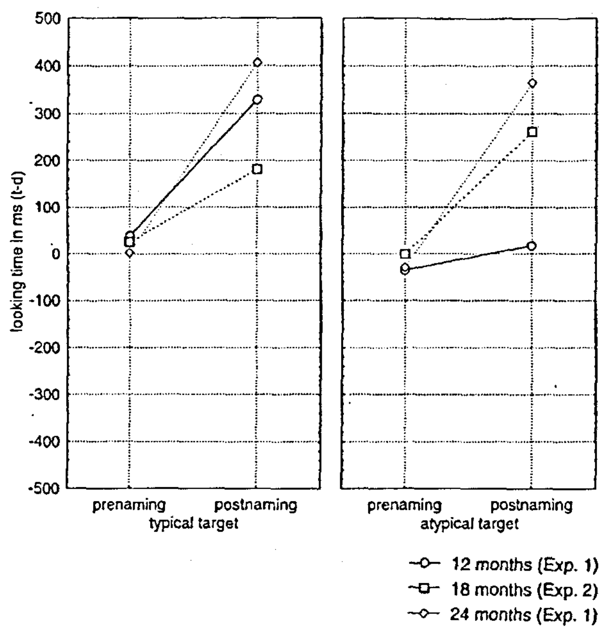

Figure 2. Mean target preference for longest look (t − d; longest target look minus longest distractor look) as a function of age, trial phase, and target status: typical (left) and atypical (right).

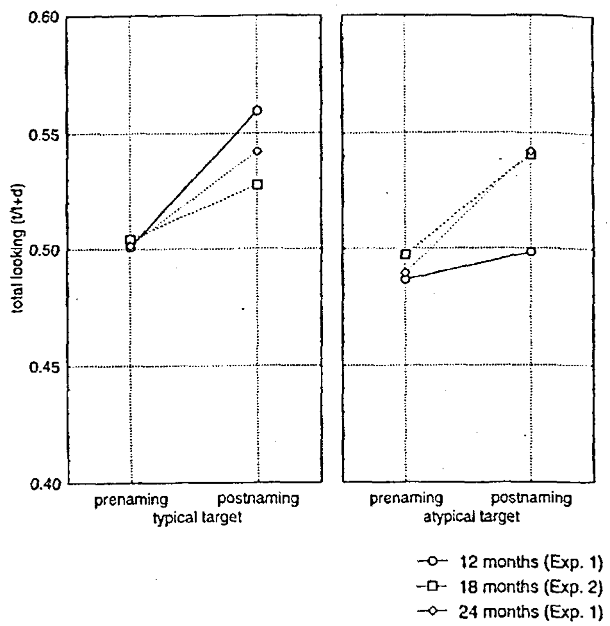

Figure 3. Mean target preference for total looking (t/t + d; total looking at target divided by total looking at target and distractor) as a function of age, trial phase, and target status: typical (left) and atypical (right).

The other effect occurred across the entire trial. Infants showed a stronger target preference (with respect to each measure) when the distractor was atypical rather than typical. This result suggests that infants readily distinguish between typical and atypical stimuli. Furthermore, 24-month-old infants do so, even when they recognize both typical and atypical stimuli as associated with the target word. However, we will not pursue a more detailed explanation of the effect because it did not recur in Experiment 2.

Experiment 2

Method

Participants. In the second study, 38 eighteen-month-olds (17 girls and 21 boys) participated.[2] The mean age was 18.50 months (range = 16–21 months). The method of recruitment and the criteria for inclusion were the same as in Experiment 1.

Procedure. The procedure was identical to that used in Experiment 1. In particular, the visual stimuli were again tailored to individual infants. Nevertheless, as inspection of Table 1 confirms, the frequency of presentation of the stimuli to the 18-month-olds was correlated with the frequency for the 12-month-olds (Spearman's rho = .815, $p < .01$) and the 24-month-olds (Spearman's rho = .593, $p < .01$) tested in Experiment 1. Infants were presented with an average of 23.1 trials.

Results

Each trial was again scored using a measure of longest look and total looking. For each measure, a 2 × 2 × 2 repeated measures

[2] The data for 25 of these children were gathered together with the data from Experiment 1. Because of ambiguities in these data, a further 13 children were tested.

ANOVA of Trial Phase × Target Status × Distractor Status was calculated. With respect to longest look, a significant main effect of trial phase, $F(1, 37) = 21.622$, $p < .00004$, confirmed that infants displayed an effect of target naming: They looked longer at the target than at the distractor after the onset of the target name. No other effects reached significance. Planned comparisons of trial phase showed that there was an effect of target naming for typical stimuli, $F(1, 37) = 5.88$, $p < .02$, and for atypical stimuli, $F(1, 37) = 14.02$, $p < .0006$. This pattern of data is displayed in Figure 2.

With respect to total looking, a similar pattern emerged. A significant main effect of trial phase, $F(1, 37) = 13.04$, $p < .0009$, confirmed that infants' looking behavior changed after hearing the target name: Infants showed increased looking at the target compared with the distractor. No other effects reached significance. Planned comparisons of trial phase showed a nonsignificant tendency of target naming for typical stimuli, $F(1, 37) = 2.02$, $p < .16$, and a significant effect of target naming for atypical stimuli, $F(1, 37) = 9.05$, $p < .005$. This pattern of data is displayed in Figure 3.

In summary, 18-month-olds displayed a main effect of trial phase for both looking measures. On hearing the name of the target, infants' selective looking at the target rather than the distractor increased. Planned comparisons of trial phase confirmed that for atypical stimuli, the effect of trial phase was significant for each looking measure; for typical stimuli, the effect proved significant for longest look but fell short of significance for total looking.

General Discussion

Taken together, the results of Experiments 1 and 2 show that infants ranging in age from 12 to 24 months behave systematically when they hear a target stimulus named. They display an increment in preferential looking toward the target as opposed to a distractor. In keeping with earlier results (Schafer, 1998; Schafer & Plunkett, 1998), this incremental pattern is especially clear when the dependent variable is longest look rather than total looking. Accordingly, we base our conclusions and the ensuing discussion primarily on longest look, although similar trends emerged for total looking. Planned comparisons showed that the magnitude of the increase in preferential looking depends on the status of the target and the age of the child. Twelve-month-olds display an effect of target naming for typical instances but not for atypical instances. On the other hand, among 18- and 24-month-olds there is no sign of this restriction. They display a clear effect of target naming for atypical as well as typical instances.

These results raise two linked questions. First, why do 12-month-olds restrict the scope of their object and animal names to typical exemplars of the category? Second, how is that restriction removed among 18- and 24-month-olds? Below, we examine two answers to these interrelated questions: the *category-based* account, which focuses on the way that infants construct categories independent of naming, and the *exemplar-based* account, which focuses instead on the naming practices that infants will likely encounter.

In the category-based account, both the initial restriction at 12 months and its disappearance between 12 and 18 months can be understood in terms of the way that infants construct and extend categories independent of naming. This account implies that infants bring preestablished categories to the task of language comprehension. Admittedly, these categories need not be fully formed. Nevertheless, when a novel label is encountered, it is not simply associated with the particular instance named. Rather it is extended to all members of the established category. According to this account, the failure of 12-month-olds to extend the label to atypical instances of a category shows that they do not yet include peripheral instances in their object and animal categories. On the other hand, the willingness of 18- and 24-month-olds to make such extensions shows that their object and animal categories have been enlarged to include both typical and atypical instances. The basic assumption underlying this account—namely, that 18- and 24-month-olds but not 12-month-olds include atypical instances in their categories—is open to empirical investigation. As discussed in the introduction, measures of habituation and looking time have shown that even preverbal infants will respond to category instances in a selective fashion, depending on their perceived category membership. Accordingly, using these same measures, we may check whether category structure shows the pattern of change between 12 and 18 months described above.

In the exemplar-based account, infants initially attach a label only to the particular named instance of the category. Infant usage of the name is then gradually extended on the basis of additional pairings of the label with instances, as experienced in the input (see Barrett, 1986). The failure of 12-month-olds to extend the label to atypical instances of a category can be explained by assuming that only typical instances have been named for them. Similarly, the success of 18- and 24-month-olds can be explained by assuming that these infants increasingly hear atypical instances named. We know of no systematic evidence that corroborates these two related suggestions concerning a shift in naming practices between 12 and 18 months. A stringent test of the exemplar-based account would require careful examination of the conditions under which infants learn object names. One possible route is to keep systematic diary data concerning the usage of individual labels by caregivers and their infants. However, given the failure of even extremely detailed diary studies such as that of Dromi (1987) to provide the required naturalistic data, the experimental study of name learning (see, e.g., Schafer & Plunkett, 1998) is probably the most fruitful way to assess the basic assumptions of the exemplar-based account. In particular, it would permit an assessment of whether infants—even at 12 months—will learn names for atypical instances provided they hear such instances named. Note that this prediction runs counter to what would be expected according to the category-based account, which assumes that the restriction of the category to typical instances derives from the preexisting structure of the category (prior to any naming experiences) and does not reflect the particular naming practices that caregivers adopt.

Finally, we may consider an unexpected pattern of results among the 18- and 24-month-olds. Both age groups showed a stronger tendency (as indicated in the F values for both longest look and total looking) to orient to atypical targets after naming than to typical targets. Although this difference did not lead to a significant interaction between trial phase and target status, it is consistent across both experiments and both dependent measures and is worthy of comment. At first blush, it may seem odd that atypical targets attract longer looks than typical targets, particularly when there was no naming effect at all for atypical targets at 12 months. However, if we interpret looking time as an index of the time required to check that an image is indeed an appropriate referent for a label, then the pattern of looking in 18- and 24-month-old children may be readily explained. Suppose that atypical instances are less robustly associated with their labels than typical instances. Image processing of atypical instances for which infants have begun to acquire a label may require more checking time to determine appropriateness of fit. Hence, infants look longer at atypical than typical instances when labeled. This interpretation concurs with earlier work with older children and adults (Heider, 1971, 1972; Rosch, 1973). It is also consistent with the finding that the difference in inspection time between typical and atypical instances diminishes from the 18-month-olds to the 24-month-olds investigated in this study. Presumably, infant efficiency in checking atypical instances improves once such instances have been included in the scope of the category name.

Conclusion

Our results provide support for the view that for 12-month-old infants, names are restricted to typical exemplars of a category and that in the course of their 2nd year, infants come to embrace atypical exemplars. Our findings consolidate the claim that the preferential looking technique can be used with infants to study the onset of language comprehension (Hirsh-Pasek & Golinkoff, 1996). An important advantage of this technique is that, in conjunction with parental report, it can be easily tailored to individual infants, as shown in the present study. Moreover, the findings for the 12-month-old infants add support to the claim that parents can make relatively accurate assessments of their infant's language comprehension even when productive vocabulary is quite limited (Fenson et al., 1994). The results suggest, however, that parental assessment of comprehension in 12-month-olds is more likely to be accurate with respect to infants' understanding of names applied to typical instances. The results also raise interesting questions for future experimental study regarding the exact way in which infants enlarge the scope of a named category at the onset of language acquisition.

References

Barrett, M. (1986). Early semantic representations and early word-usage. In S. A. Kuczaj, II, & M. D. Barrett (Eds.), *The development of word meaning* (pp. 39–67). New York: Springer-Verlag.

Barrett, M. (1995). Early lexical development. In P. Fletcher & B. MacWhinney (Eds.), *The handbook of child language* (pp. 362–392). Oxford, England: Blackwell.

Bowerman, M. (1978). The acquisition of word meaning: An investigation into some current conflicts. In N. Waterson & C. E. Snow (Eds.), *The development of communication* (pp. 263–287). New York: Wiley.

Dromi, E. (1987). *Early lexical development.* Cambridge, England: Cambridge University Press.

Eimas, P. D., & Quinn, P. C. (1994). Studies on the formation of perceptually-based basic-level categories in young infants. *Child Development, 65,* 903–917.

Fenson, L., Dale, P. S., Reznick, J. S., Bates, E., Thal, D., & Pethick, S. J. (1994). Variability in early communicative development. *Monographs of the Society for Research in Child Development, 59*(Serial No. 242), 1–185.

Golinkoff, R. M., Hirsh-Pasek, K., Cauley, K. M., & Gordon, L. (1987). The eyes have it: Lexical and syntactic comprehension in a new paradigm. *Journal of Child Language, 14,* 23–45.

Heider, E. R. (1971). "Focal" color areas and the development of color names. *Developmental Psychology, 4,* 447–455.

Heider, E. R. (1972). Universals in color naming and memory. *Journal of Experimental Psychology, 93,* 10–21.

Hirsh-Pasek, K., & Golinkoff, R. M. (1996). *The origins of grammar: Evidence from early language comprehension.* Cambridge, MA: MIT Press.

Nelson, K. (1974). Concept, word and sentence: Interrelations in acquisition and development. *Psychological Review, 81,* 267–285.

Oakes, L. M., Coppage, D. J., & Dingel, A. (1997). By land or by sea: The role of perceptual similarity in infants' categorization of animals. *Developmental Psychology, 33,* 396–407.

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.

Roberts, K., & Horowitz, F. D. (1986). Basic level categorization in seven- and nine-month-old infants. *Journal of Child Language, 13,* 191–208.

Rosch, E. R. (1973). On the internal structure of perceptual and semantic categories. In T. E. Moore (Ed.), *Cognitive development and the acquisition of language* (pp. 111–144). New York: Academic Press.

Rosch, E. R. (1978). Principles of categorization. In E. Rosch & B. B. Lloyd (Eds.), *Cognition and categorization* (pp. 27–48). Hillsdale, NJ: Erlbaum.

Schafer, G. (1998). *Word learning in infancy.* Unpublished doctoral dissertation, Oxford University, Oxford, England.

Schafer, G., & Plunkett, K. (1998). Rapid word learning by 15-month-olds under tightly-controlled conditions. *Child Development, 69,* 309–320.

Strauss, M. (1979). Abstraction of prototypical information by adults and 10-month-old infants. *Journal of Experimental Psychology: Human Learning and Memory, 5,* 618–635.

Thomas, D. G., Campos, J. J., Shucard, D. W., Ramsay, D. S., & Shucard, J. (1981). Semantic comprehension in infancy: A signal detection analysis. *Child Development, 52,* 798–803.

Younger, B. A. (1985). The segregation of items into categories by 10-month-old infants. *Child Development, 56,* 1574–1583.

Younger, B. A., & Gotlieb, S. (1988). Development of categorization skills: Changes in the nature or structure of infant form categories. *Developmental Psychology, 24,* 611–619.

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