

## A lower boundary for category formation in preverbal infants\*

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(Received 13 October 1986)

In this journal Roberts & Horowitz (1986) have recently reported the acquisition of the category 'bird' from a series of prototypical exemplars by infants at 0;9, but not at 0;7. In their study, infants were visually habituated to exemplars of the category and then tested for categorization through sequential presentations of novel in-category and out-of-category examples. Recent data from our laboratory have shown that infants' attentional responses in such single-presentation, sequential test phases do not provide a stable or reliable index of visual processing (Colombo, Mitchell, O'Brien & Horowitz forthcoming), while infants' paired-comparison performance does (Colombo, Mitchell & Horowitz 1986). Furthermore, other data suggest that paired-comparison phases, in which test stimuli are simultaneously presented in a forced-choice procedure, may provide a more sensitive measure of infants' cognitive processing (Mitchell, Colombo, Horowitz & O'Brien 1986). In the studies reported here we sought to corroborate the Roberts & Horowitz (1986) results with their original procedures (Experiment 1) and to extend the lower age boundary for categorization by using the methodological refinements mentioned above (Experiment 2).

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[\*] J.C. and M.O.B. share primary authorship. This work was supported by PHS Biomedical Research Resources (University of Kansas Biomedical Grant 4309), ADMHA grant (1 RO1 MH41395-01) awarded to J.C., NICHD grant 1 P01 HD18955-01 (M.O.B. and F.D.H. co-investigators), and NICHD grant 1 RO1 HD18290-01A1 to F.D.H. We are grateful to Michelle Knoll and the KU Regents Center staff for their assistance, and for the participation of the parents of the 79 infants tested in these studies. Address for correspondence: John Colombo, Department of Human Development, University of Kansas, Lawrence, Kansas 66045, USA.

## EXPERIMENT 1

Given the demonstration of categorization by Roberts & Horowitz (1986) at 0;9 but not at 0;7, we would expect that infants at 0;8 might show some evidence for categorization. Twenty-six infants aged 0;8 (half male; three additional infants were excluded due to fussiness or experimenter error) were run through the habituation-based categorization paradigm described in Roberts & Horowitz. The habituation stimuli (black-on-white line drawings of a sparrow, robin and bluejay) and procedures were the same as in that study. Following habituation, infants were presented with a novel in-category stimulus (parakeet), an out-of-category stimulus (horse), and a familiar stimulus (sparrow) in a standard order (parakeet, horse, sparrow, horse, parakeet, sparrow). If infants had acquired the category of 'bird' they should attend more to the out-of-category stimulus than to the novel in-category stimulus, despite the fact that both stimuli are new to them. As expected, this group of infants demonstrated some evidence for category formation; their mean duration of fixation to the two test presentations of the horse was significantly greater than that to the parakeet ( $t(24) = 1.8$ ,  $P < 0.05$ , one-tailed). Fixations to the horse were 2.2 sec longer than those to the sparrow and 1.8 sec longer than those to the parakeet.

## EXPERIMENT 2

A second study was run with infants at 0;6 that employed a different type of test phase. Evidence from our laboratory suggests that the paired-comparison paradigm provides a more sensitive (Mitchell *et al.* 1986) and more reliable (Colombo *et al.* 1986) measure of infants' cognitive abilities. We thought that this alternative procedure might yield positive results. Twenty-four infants aged 0;6 completed Experiment 2 (eight additional infants were excluded from data analysis because of fussiness, experimenter error, or maternal interference with infant looking). The habituation phase of the sessions was run in the same manner as described for Experiment 1, except that the habituation criterion was defined as a fixation decrement to 50% of the previous single highest block, rather than the mean of the two previous highest blocks. Additionally, we changed the test phase from a series of single presentations to two 10-sec paired-comparison presentations of the horse and parakeet shown simultaneously on the left and right outer edges of the screen. The initial lateral position of the two stimuli was counter-balanced across subjects, and the positions were reversed for the second 10 sec test trial to control for possible directional-looking bias.

The paired-comparison test-phase data for the infants aged 0;6 clearly and strongly demonstrated categorization. As a group, the infants' fixation time to the horse (collapsed across the two position-reversal choice trials) was

## CATEGORY FORMATION

59.5%, and was significantly greater than chance (i.e. 50%),  $t(22) = 3.7$ ,  $P < 0.01$ .

### DISCUSSION

These results indicate that infants as young as 0;6 were capable of category formation and discrimination as a function of short-term stimulus exposure, and that the demonstration of category formation may be greatly affected by the methods chosen to assess infants' performance. The results of Experiment 1 corroborate and extend Roberts & Horowitz's (1986) observations of categorization in infants at 0;9 but not at 0;7, as we were able to demonstrate the effect with the same procedure at 0;8, and with methodological refinements introduced for the test phase of Experiment 2, we were able to observe positive results with infants at 0;6. Demonstration of the actual lower age boundary for acquisition of visual categories awaits further research. At the very least, however, the present results suggest that the claim made in this journal by Roberts & Horowitz (1986) for the developmental emergence of categorization abilities somewhere between 0;7 and 0;9 should be revised to some time before 0;6.

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