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ABSTRACT

The ability of 5-month-old infants to recognize two-dimensional (pictorial) representations of three-dimensional objects was investigated. Subjects were 24 5-month-old infants. The novelty preference technique was employed: all infants were familiarized with a three-dimensional object--a doll. Following familiarization, three novelty tests were administered, pairing (1) the familiar doll with a novel doll, (2) color photographs of the two dolls, and (3) black-and-white photographs of the dolls. The infants significantly preferred (looked longer at) the novel three-dimensional doll. This novelty preference was also present for the color photographs of the dolls, and male infants preferred the novel black-and-white photograph. Thus, 5-month-old infants are capable of transferring the information they extract from a three-dimensional object to a two-dimensional representation of the object. These data suggest that, at least for representations of relatively simple objects, pictorial perception does not have to be learned through experience with two-dimensional stimuli. (Author/RS)

Infants' Recognition of Pictorial Representations of Real Objects[1]

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Paper presented at the meeting of the Society for Research in Child Development, New Orleans, March 17-20, 1977.

This study examined the ability of infants to recognize two-dimensional, or pictorial, representations of real objects. According to one major point of view, picture recognition depends on learned associations between real objects and pictures of the objects (Goodman, 1968). This position has been advanced by cross-cultural investigators, who attribute the failure of certain cultural groups to recognize pictured objects or persons to a lack of experience with pictorial representations (Segall, Campbell, & Herskovits, 1966). However, in a variety of studies on the development of face perception (reviewed by Gibson, 1969), infants have often appeared to respond similarly to live faces and to photographs or drawings of faces, a finding which challenges the necessity of experience for recognition of two-dimensional representations.

According to the Gibsons (E. J. Gibson, 1969; J. J. Gibson, 1971), much of the information found in a stationary three-dimensional object is also contained in a two-dimensional representation of the object. Many of the distinctive features and the arrangement of features which permit recognition of the real object are also present in a picture of it. Thus, learning to recognize pictures should involve essentially the same processes as learning to recognize real objects, and the recognition of pictured objects should not depend on extensive prior experience with pictorial material (Gibson, 1969).

This view predicts that as long as an individual is capable of extracting distinctive features from an object, he or she ought to be able to recognize a picture or a photograph of the object which contains those distinctive features. Thus, if infants are able to extract the information that remains invariant in an object and a picture of it, then they should be able

to transfer from one version to the other. One recently published study by Dirks and Gibson (1977) supports this view. Five-month-old infants responded similarly to a person and a color photograph of that person, but reacted differently to a photograph of a different individual. Evidently, prior experience with pictures was not required for those infants to recognize a highly realistic photograph of a familiar real person.

In the two experiments reported here we were interested in investigating further infants' recognition of two-dimensional representations. In the first study we examined to what extent infants could perceive the similarity between an object and representations of varying fidelity to it. While a color photograph of an object retains most of the distinctive information present in the object itself, black-and-white photographs, as well as line drawings, have different subsets of cues. Since we knew that five-month-old infants are capable of perceiving and responding on the basis of color, form, and a variety of stimulus variables, including configurational information, we predicted that they would be able to recognize both color and black-and-white photographs of an object.

To test these predictions we employed the novelty-preference technique with fixation time as the dependent measure. All subjects were first familiarized to a real, three-dimensional object--a small doll. On the subsequent test trials each infant was presented with three different versions of the original doll and a novel doll. Infants of this age generally prefer novel stimuli. Therefore, if an infant recognizes the original doll, he or she may be expected to look longer at the other, novel doll.

The important feature of the test trials was that on some trials the familiar doll itself and a novel doll were presented, but on other test trials photographs of the two dolls were presented. One could confidently predict a novelty preference for the test with the real dolls, since the subjects were simply required to discriminate between the stimulus they had actually seen before and a new one. The question of interest was what they would do when photographs of the familiar and novel dolls were presented. A novelty preference on the tests with these two-dimensional stimuli would indicate recognition of the photographic representation of the original doll, i.e., perception of the similarity between the information extracted from the real object and from the photograph.

The subjects were 24 five-month-old infants (22 weeks, $\pm$ 1 week), half males and half females. The same infants participated in both studies reported here, and they were randomly assigned to be in one experiment or the other first. Two identical dolls were presented simultaneously for a 60-second familiarization period, and the infants' fixations were recorded. Following familiarization, three novelty tests were administered to each subject, pairing (1) the familiar doll with a novel doll, (2) color photographa of the familiar and novel dolls, and (3) black-and-white photographs of the dolla. Each novelty test consisted of two ten-second presentations of the stimuli, with the left-right positions reversed between trials. Males and females were randomly assigned to one of the six possible presentation orders for the novelty tests. Half of the infants in each test order received Doll 1 as the familiarization stimulus, while the other half of the subjects were familiarized to Doll 2.

Fixation times on the test trials were converted into percentage fixation of the novel stimulus for each test, and t-tests (one-tailed) were carried out comparing the proportion of fixation time for the novel doll to the 50 percent expected by chance. As Figure 1 shows, the expected significant novelty preference was found for the real dolls $t(23) = 3.53$, $p < .001$. Of more interest is the fact that the same result was obtained for both the color photographs $t(23) = 2.88$, $p < .01$, and the black-and-white photographs of the dolls $t(23) = 2.36$, $p < .025$. In other words, the infants responded similarly regardless of whether the novel and familiar stimuli were real objects or photographs of them.

An analysis of variance was performed on the novelty preference scores, examining the factors of sex, test order, and test condition (i.e., real dolls, color photographs, black-and-white photographs.) No difference was obtained for the degree of novelty preference in the three conditions. The only significant effect was for sex, $F(2,54) = 6.73$, $p < .05$, with males showing greater novelty preference (62.8%) than females (54.3%). This result can be observed in Figure 1.

These results indicate that five-month-old infants are capable of perceiving the similarity between the information they extract from a three-dimensional object and a two-dimensional version of the object. The data clearly support the position that picture perception does not have to be learned through experience with two-dimensional stimuli, at least for representations of relatively simple objects. As long as infants can extract some distinctive features from real objects, they can recognize two-dimensional representations containing those same features.

One aspect of our findings which surprised us somewhat was the fact that the percent fixation of the novel stimulus was so similar across all test conditions.

At least in this forced choice situation, the infants appear to have treated the photographic representations as equivalent to the real object. The infants in the Dirks and Gibson (1977) study seem to have behaved in the same way.

A second experiment was performed to investigate further the ability of infants to extract and transfer pictorial information. In this study, rather than examining recognition of photographs of real objects, we investigated infants' recognition of different types of two-dimensional representations. Specifically, we looked at their ability to recognize a face originally presented as a color photograph when it was presented as a black-and-white photograph or a line drawing.

The novelty preference procedure was again employed with the same 24 five-month-old infants. Two identical color photographs of a woman's face were presented for the 60-second familiarization period, followed by three novelty tests, pairing (1) the original color photograph with a color photo of a different woman's face, (2) black-and-white versions of the same photographs, and (3) line drawings of the two faces. The two color photographs of women's faces used as familiarization and novel stimuli had been found in an earlier experiment (Cohen, DeLoache, & Pearl, 1977) to be discriminable by five-month-olds. Which face served as familiarization stimulus was counterbalanced across sex and test order.

The results are presented in Figure 2. The expected novelty preference for color photographs was obtained $t(23) = 3.81$, $p < .001$, as was a significant preference for the line drawing of the novel face $t(23) = 1.99$, $p < .05$. The novelty preference for the black-and-white photograph approached but did not quite achieve significance ($.05 < p < .10$). It is possible that the relevant

distinctive features may actually be more salient in line drawings than in black-and-white photographs.

These results support those from the first study in showing that five-month-old infants are capable of extracting distinctive features from two-dimensional stimuli. They imply further that at least part of what is extracted from visual stimuli is higher order or structural information (e.g., the configuration of features common to a color photograph and a line drawing of the same face). Similarly, these experiments show that as early as five months of age the basis for infants' recognition memory is this abstract, higher order information, not simply some encoding of the visual array per se.

In summary, we began this paper by saying that a prominent point of view has been that young children and members of some cultures do not know and have to learn that a picture of an object stands for or is equivalent to the real object. On the contrary, our research and the Dirks and Gibson (1977) study, as well as a recent report by Field (1976) on reaching behavior, suggest that perception of a correspondence between real and pictured objects does not have to be learned through associating objects with their pictures. In all these studies five-month-old infants responded similarly to objects and a variety of representations of them. This similar responding to objects and pictures is almost certainly not based on an inability to discriminate between the two- and three-dimensional representations. There is an abundance of evidence showing infants capable of such discrimination, including visual preference for three- over two-dimensional stimuli (Fantz, Fagan, & Miranda, 1975), and faster learning to recognize real objects than pictures (Ruff, Kohler & Haupt, 1976).

Even in Field's (1976) experiment, showing equivalent reaching to objects and pictures, the infants looked longer at the objects. Thus, we would argue that the infants in the present research responded similarly to the objects and various pictures not because they could not perceive a difference between objects and color photographs, or between photographs and drawings, but because they perceived the similarity between them.

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Footnotes

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[2]The first two authors contributed equally to the research reported here. The paper was presented at SRCD by the second author.

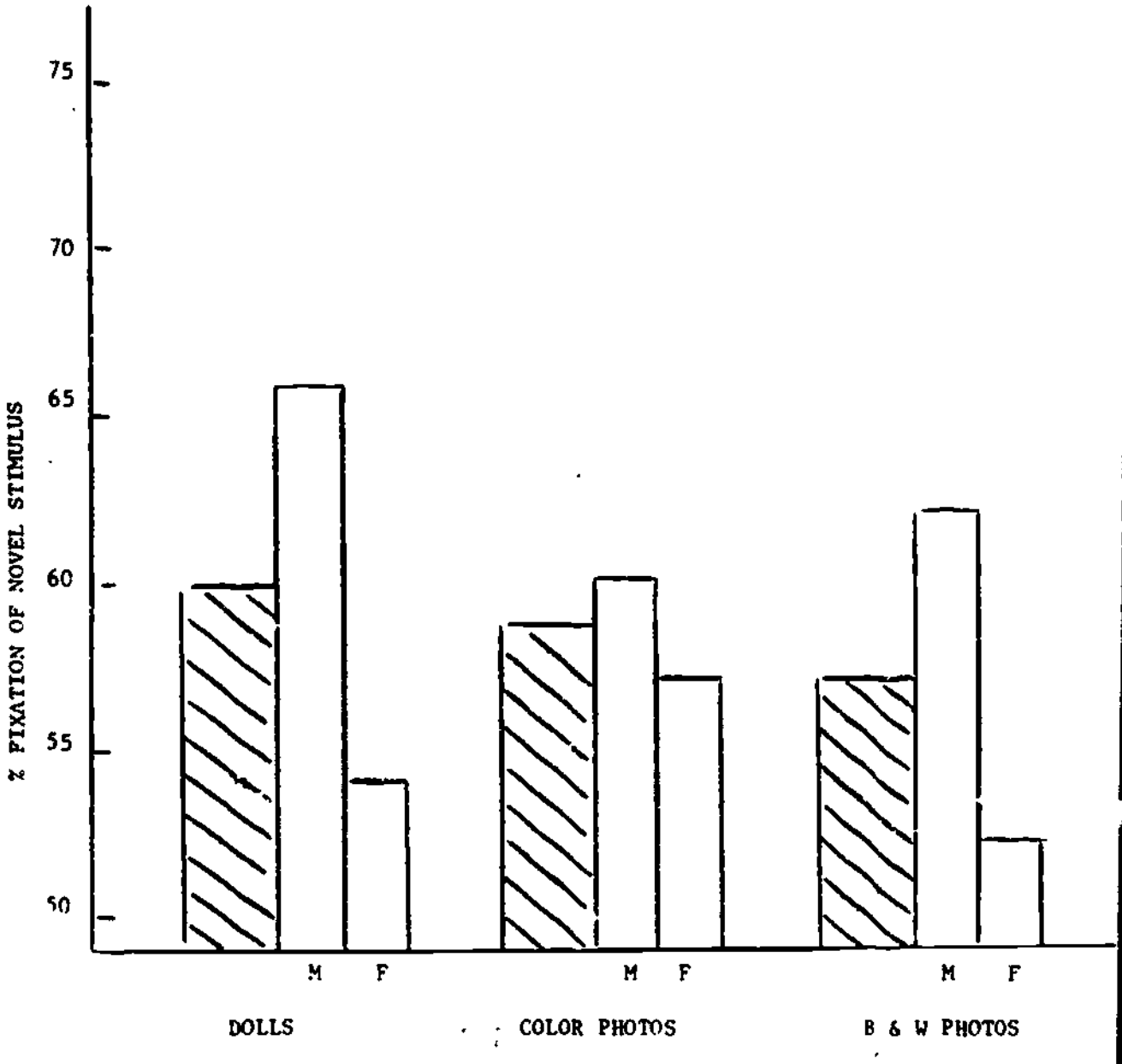
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Figure 1

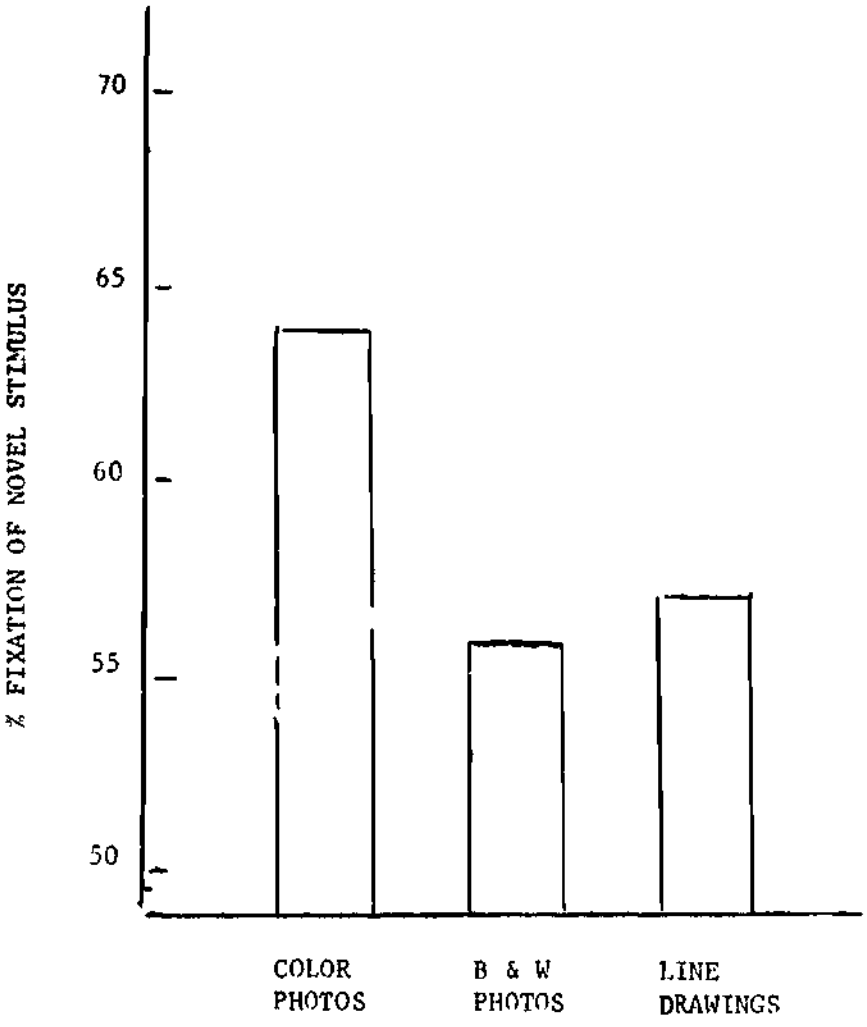
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Figure 2