On the Origins of Perceived Sameness in Shape

Linda B. Smith (smith4@indiana.edu)
Psychology and the Program in Cognitive Science, Indiana University,
1101 East 10th Street, Bloomington, IN 47405

Background

What defines sameness in shape? A precise definition has proved elusive despite considerable theoretical and empirical efforts across several disciplines. However, a theory of shape is crucial to explaining human object recognition. The theoretical problem is that real instances of real categories are rarely ever the exact same shape. For example, rocking chairs, stuffed chairs, and desk chairs are the "same shape" only under some highly abstract description of shape. The present paper reports developmental evidence suggesting that this abstract description of object shape is a product of early category learning. The experiments focus on the period between 18 and 24 months of age, a period in which children progress from producing few object names (less than 100) to producing many (on average more than 200).

.

Experiment 1

There were two types of test stimuli: 3 dimensional lifelike replicas and 3-dimensional shape caricatures of the same things as illustrated in Figure 1. There were also two dependent measures of object recognition: (1) Recognitory play -- a child would be credited with recognizing an object as a phone if the child pretended to dial a number and/or talk on the object and (2) Name comprehension -- a child was credited with recognition if the child could select the target from among distractors given the name of the object. The children were divided into two groups according to noun vocabularies --- those with less than 100 nouns in their vocabulary and those with more than 100 nouns. Both groups of children recognized the Lifelike objects -- both by the play measure and the name comprehension measure. However, only the children with larger vocabularies recognized the Shape Caricatures. The fact that young children with few names for common do not recognize shape caricatures despite their accuracy in recognizing richly detailed instances of the same category indicates that the abstract representation of shape is a developmental product. The fact young children who are only slightly more advanced in their category knowledge recognize these shape caricatures suggests that early category learning plays a role in forming the processes of shape recognition.

Experiment 2

One possibility is that children learn to recognize shape caricatures, category by category. Alternatively, the developmental changes may be more general, changing how children perceive shape similarities for novel as well as known objects. This question was addressed in a second experiment. Children were introduced to a lifelike but (for young children) novel object, for example, an artichoke. The children were taught the object's name. On the critical test trial, three shape caricatures were presented to the child, one of which was a shape caricature of the originally named exemplar. The child was asked to indicate the named object, for example, "Where's the artichoke here?" If children must master the relevant shape properties category by category, then this task should be very hard because the caricatured artichoke only preserves some aspects of the original shape. If, however, children, are developing general perceptual skills that apply to novel shapes, then children who recognize the caricatures of familiar objects might also recognize the caricatures of novel ones. The results support this second possibility. Children with more than 100 object names in their productive vocabulary readily recognized the caricature of the newly learned noun. Children with fewer than 100 object names did not. These results strongly suggest that children are learning something general about the shape similarities relevant to object recognition and categorization.

Conclusion

The findings indicate that a complete theory of shape and object recognition will be a developmental theory. The relation of these results to contemporary theories of object recognition will be discussed.

Figure 1: A Lifelike and Caricature phone.

Acknowledgments

This research was supported by NICHD R01 HD 28675-08.