Available online at www.sciencedirect.com
ScienceDirect
ELSEVIER
Cognition 102 (2007) 455–463
COGNITION
www.elsevier.com/locate/COGNIT

Brief article

Evidence for kind representations in the absence of language: Experiments with rhesus monkeys (*Macaca mulatta*) ☆

Webb Phillips *, Laurie R. Santos

Department of Psychology, Yale University, USA

Received 10 June 2005; revised 4 August 2005; accepted 20 January 2006

Abstract

How do we come to recognize and represent different kinds of objects in the world? Some developmental psychologists have hypothesized that learning language plays a crucial role in this capacity. If this hypothesis were correct, then non-linguistic animals should lack the capacity to represent objects as kinds. Previous research with rhesus monkeys (*Macaca mulatta*) has shown that this species can successfully individuate different kinds of objects – monkeys who saw one kind of object hidden inside a box searched longer after finding a different kind of object. However, in these studies and the infant studies on which they were based, the objects to be individuated differed both in kind and in properties. Thus, subjects in these experiments may not be representing the kinds of objects per se, but instead only their immediate perceptual properties. Here, we show that rhesus monkeys successfully individuate different kinds of objects even when their perceptual properties are held constant. Although these data provide the best evidence to date that language is not necessary to represent kinds, we discuss our findings in terms of possible associative hypotheses as well.

Keywords: Kind representation; Monkey; Individuation

☆ This manuscript was accepted under the editorship of Jacques Mehler.

* Corresponding author. Tel.: +1 203 668 3982; fax: +1 203 432 7172.
E-mail address: webb.phillips@yale.edu (W. Phillips).

0010-0277/$ - see front matter © 2006 Elsevier B.V. All rights reserved.
doi:10.1016/j.cognition.2006.01.009

1. Introduction

Our minds are constantly bombarded by a flood of perceptual input. Somehow, we manage to sort it all out. We do not experience just a jumble of colors and shapes. Instead we see things like *apples* and *bananas* and *tables* and *chairs*, we effortlessly and automatically parse the world into different kinds of objects. This impressive capacity is also incredibly useful. Knowledge about kinds of objects helps us predict what to expect from objects, and how to interact with them. When we see an apple, for example, we can think back on a lifetime of experience with apples and know that this new instance of an apple will also be white and crunchy on the inside, that it will taste sweet but a little tart, and that it possesses a core that is not good to eat. How is it that we come to represent the objects around us as being of certain kinds?

There is some evidence that infants do not possess the ability to represent objects as kinds from the start, but instead, develop this capacity between 10 and 12 months of age (Xu, 2002; Xu & Carey, 1996; Xu, Carey, & Welch, 1999; Xu, Carey, & Quint, 2004). Xu and Carey (1996), for example, explored when infants begin to use kind information to determine how many objects are present in a scene. They alternately moved two different kinds of toys (e.g., a ball and a duck) back and forth behind a screen such that the two objects were never seen at the same time. In the test event, they removed the screen to reveal either both objects (an expected event), or only one object (an unexpected event). Twelve-month-old infants looked longer at the unexpected event relative to baseline, whereas 10-month-old infants did not. When 12-month-olds see two different kinds of objects, they expect that there are two individuals, whereas 10-month-olds show no evidence of such an expectation. Xu and Carey interpreted this result as evidence that the ability to represent kinds emerges between 10 and 12 months of age.

What happens between 10 and 12 months to enable infants to succeed in these experiments? One hypothesis – offered by Xu and colleagues – proposes that infants' emerging capacity to represent kinds stems from their developing linguistic competence, a capacity that comes online around 12 months of age (see Xu, 2002; Xu & Carey, 1996; Xu et al., 1999; Xu et al., 2004). They have argued that learning a verbal label for an object helps to establish a kind representation for that object. For example, knowing the word "apple" may enable the infant to bind together the relevant information about apples into a coherent kind representation. Several important empirical results seem to support this view. First, infants tested in these individuation experiments begin to succeed around 12 months of age, a period that corresponds with the development of word comprehension (see Xu & Carey, 1996). Second, Xu et al. (2004) showed that 12-month-olds succeeded in individuating two objects when the objects were of different kinds, but failed to individuate objects of the same kind, even when the properties of these objects were very different. Most compellingly, Xu (2002) found that naming the objects during an individuation task enabled younger 9-month-old infants to perform like 12-month-olds and succeed in individuation; in contrast, labeling the same objects with emotional vocalizations, beeps, or other non-linguistic sounds