Journal of Experimental Child Psychology 116 (2013) 105–119

Contents lists available at SciVerse ScienceDirect

Journal of Experimental Child Psychology

journal homepage: www.elsevier.com/locate/jecp

The cost of selective attention in category learning: Developmental differences between adults and infants

Catherine A. Best [a], Hyungwook Yim [b], Vladimir M. Sloutsky [b,*]

[a] Department of Psychology, Kutztown University, Kutztown, PA 19530, USA
[b] Department of Psychology, The Ohio State University, Columbus, OH 43210, USA

ARTICLE INFO

Article history:
Received 6 January 2013
Revised 6 May 2013
Available online 14 June 2013

Keywords:
Selective attention
Categorization
Learning
Cognitive development
Infancy
Eye tracking

ABSTRACT

Selective attention plays an important role in category learning. However, immaturities of top-down attentional control during infancy coupled with successful category learning suggest that early category learning is achieved without attending selectively. Research presented here examines this possibility by focusing on category learning in infants (6–8 months old) and adults. Participants were trained on a novel visual category. Halfway through the experiment, unbeknownst to participants, the to-be-learned category switched to another category, where previously relevant features became irrelevant and previously irrelevant features became relevant. If participants attend selectively to the relevant features of the first category, they should incur a cost of selective attention immediately after the unknown category switch. Results revealed that adults demonstrated a cost, as evidenced by a decrease in accuracy and response time on test trials as well as a decrease in visual attention to newly relevant features. In contrast, infants did not demonstrate a similar cost of selective attention as adults despite evidence of learning both to-be-learned categories. Findings are discussed as supporting multiple systems of category learning and as suggesting that learning mechanisms engaged by adults may be different from those engaged by infants.

* Corresponding author.
E-mail addresses: sloutsky@psy.ohio-state.edu, sloutsky.1@osu.edu (V.M. Sloutsky).

0022-0965/$ - see front matter © 2013 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jecp.2013.05.002

Introduction

Category learning is critically important for making sense of the world. Through categorization, individuals can organize existing knowledge and make predictions about new instances and events. For example, on observing a bouncing ball, an infant may expect a novel ball to bounce as well. Obviously, in most categorization tasks, some properties of stimuli are important for the task at hand, whereas others are not. For example, in the example above, the material of the ball (e.g., rubber vs. wooden) is predictive of whether or not it will bounce, whereas the ball's color is not. Therefore, efficient category learning may include the ability to attend selectively to what is relevant, and most theories of category learning involve a selective attention component (e.g., Kruschke, 1992; Love, Medin, & Gureckis, 2004; Medin & Schaffer, 1978; Nosofsky, 1986; see also Kruschke, 2001, for a review). Selective attention supports efficient category learning because it allows individuals to focus on category-relevant information while discarding category-irrelevant information. Selective attention is particularly advantageous when category members have few common features, with many features being irrelevant (i.e., not predictive of category membership). In this case, selective attention helps focusing on the few relevant dimensions while ignoring multiple irrelevant dimensions (e.g., when the task is to sort objects by color and ignore variance in shape, size, and texture). The advantage of selective attention is particularly noticeable when the task is to generalize—determine category membership of a novel item that has a particular value on the relevant dimension. The ability to shift attention to relevant information and inhibit attention to irrelevant has been demonstrated in both human and non-human animals (e.g., Dixon, Ruppel, Pratt, & De Rosa, 2009; Mackintosh, 1965).

Although selective attention results in multiple benefits for category learning (because some categories cannot be learned without it), it also leads to certain costs. One key consequence of attending selectively during learning is the phenomenon known as learned inattention (e.g., Kruschke, 1992), namely, a tendency to continue ignoring information that was previously irrelevant and, thus, was learned to be ignored. Furthermore, learned inattention can constitute a cost of selective attention when a learning situation requires one to shift attention back to previously ignored information.

The cost of selective attention is particularly evident in multi-phase category learning when, after learning a particular category, participants are expected to learn another category that is defined by formerly unattended dimensions (i.e., in the situation of an extra-dimensional shift between categories). For example, participants may first learn to sort by color (e.g., red objects vs. green objects), with shape varying randomly within and across colors. After learning the category-relevant dimension, they are presented with another category-learning problem in which shape becomes a relevant dimension, whereas color is not.

In contrast to the situation above, the cost of selective attention is minimized when the shift is intra-dimensional (i.e., when two categories are defined by different values of the same dimension). For example, in an intra-dimensional shift, the first to-be-learned category is defined by one color (e.g., red objects), but the second to-be-learned category is defined by a different color (e.g., green objects). During an extra-dimensional shift participants need to switch between different dimensions (e.g., from color cues to shape cues), whereas during an intra-dimensional shift participants only need to switch between values of the same dimension. Empirical evidence indicates that adults indeed exhibit learned inattention to a dimension that was irrelevant for their learning of the first category but then became relevant for their learning of the second category (e.g., Dopson, Esber, & Pearce, 2010; Hoffman & Rehder, 2010; Kruschke & Blair, 2000). These findings suggest that participants attended selectively when learning the first category, thereby incurring costs of selective attention when learning the second category.

Although selective attention plays an important role in adult category learning, less is known about the role of selective attention in early category learning. Two facts are worth considering. First, it has been demonstrated that very young infants can learn visual categories. For example, 3- and 4-month-old infants are able to form basic-level categories of natural kinds, such as dogs and cats (Quinn, Eimas, & Rosenkrantz, 1993; Quinn, Eimas, & Tarr, 2001), and artifacts, such as chairs; global-level categories, such as animals and furniture (Behl-Chadha, 1996); and categories consisting of abstract dot patterns (Bomba & Siqueland, 1983). Second, early in development, infants and young children have difficulty