Cognitive Psychology 82 (2015) 1–31

Contents lists available at ScienceDirect

Cognitive Psychology

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

Conceptual influences on induction: A case for a late onset ☆

Vladimir M. Sloutsky [a,*], Wei (Sophia) Deng [a], Anna V. Fisher [b], Heidi Kloos [c]

[a] The Ohio State University, United States
[b] Carnegie Mellon University, United States
[c] University of Cincinnati, United States

ARTICLE INFO

Article history:
Accepted 24 August 2015
Available online 5 September 2015

Keywords:
Induction
Categorization
Similarity
Learning
Cognitive development

ABSTRACT

This research examines the mechanism of early induction, the development of induction, and the ways attentional and conceptual factors contribute to induction across development. Different theoretical views offer different answers to these questions. Six experiments with 4- and 5-year-olds, 7-year-olds and adults ($N = 208$) test these competing theories by teaching categories for which category membership and perceptual similarity are in conflict, and varying orthogonally conceptual and attentional factors that may potentially affect inductive inference. The results suggest that early induction is similarity-based; conceptual information plays a negligible role in early induction, but its role increases gradually, with the 7-year-olds being a transitional group. And finally, there is substantial contribution of attention to the development of induction: only adults, but not children, could perform category-based induction without attentional support. Therefore, category-based induction exhibits protracted development, with attentional factors contributing early in development and conceptual factors contributing later in development. These results are discussed in relation to existing theories of development of inductive inference and broader theoretical views on cognitive development.

☆ This research is supported by the NSF grant BCS-1323963 and by NIH grant R01HD078545 to VMS. We thank Keith Apfelbaum, Allison O'Leary, Tasha Posid, and Samuel Rivera for helpful comments.

* Corresponding author at: Department of Psychology, 247 Psychology Bldg., 1835 Neil Avenue, The Ohio State University, Columbus, OH 43210, United States.
E-mail address: sloutsky.1@osu.edu (V.M. Sloutsky).

http://dx.doi.org/10.1016/j.cogpsych.2015.08.005
0010-0285/

1. Introduction

The reported research focuses on the development of induction. It was conducted within a framework of a long-standing debate about the origins of early inductive generalization, its mechanism, and development (see, Booth, 2014; Gelman, 1988; Gelman & Davidson, 2013; Gelman & Heyman, 1999; Gelman & Markman, 1986; Gelman & Medin, 1993; Gelman & Waxman, 2007; Graham, Booth, & Waxman, 2012; Keates & Graham, 2008; Noles & Gelman, 2012a 2012b; Waxman & Gelman, 2009; for one side of the debate; see also Badger & Shapiro, 2012; Deng & Sloutsky, 2012, 2013; Fisher, 2010, 2011; Fisher, Matlen, & Godwin, 2011; Fisher & Sloutsky, 2005; Jones & Smith, 1993; Napolitano & Sloutsky, 2004; Robinson & Sloutsky, 2004; Sloutsky, 2009; Sloutsky, 2010; Sloutsky & Fisher, 2004a, 2004b, 2008, 2012a, 2012b; Sloutsky, Kloos, & Fisher, 2007a, 2007b; Sloutsky & Lo, 1999; Sloutsky, Lo, & Fisher, 2001; Sloutsky & Napolitano, 2003, for another side of the debate). In the broadest possible terms, the two positions differ on whether induction (as well as categorization and word learning) is guided by *a priori* domain-specific knowledge exhibiting an early onset, or whether it is a product of domain-general learning, with domain-specific knowledge being a product rather than precondition of development. In this research we intended to move the field forward by providing insights about the development of induction and adjudicating between these broad views.

1.1. Theoretical approaches to induction and its development

Inductive generalization is a key cognitive ability: it enables generation of new knowledge on the basis of limited data and extension of this knowledge to novel situations. For example, upon observing a red-tailed hawk preying on small birds, one may expect other hawks (and perhaps falcons and eagles) to be predators as well.

Although it is well established that induction appears early in development (Gelman, 2004b, 1988; Gelman & Markman, 1986; Mandler & McDonough, 1996; Sloutsky & Fisher, 2004a; Welder & Graham, 2001), many important questions remain. What is the mechanism of induction and does it change over the course of development? If induction undergoes development, what changes, how, and why? And what is the role of language in this process? Answers to these questions are theoretically consequential for understanding the development of inductive generalization as well as for a more general theory of cognitive development. Two broad classes of answers have emerged, reflecting two different views on cognitive development.

According to one class of answers (often referred to as the *knowledge-based* approach), when the task is to generalize properties of some natural kind categories (such as animal kinds), induction is driven by conceptual knowledge. This knowledge is implemented as a set of conceptual assumptions, whose origin is unknown: it has been argued that these assumptions do not stem from parental input (Gelman, Coley, Rosengren, Hartman, & Pappas, 1998; see also Gelman, 2004; Murphy, 2002, for reviews). Two of these assumptions are critical for inductive inference. First, there is a category assumption: young children are said to believe that individuals belong to more general categories, with members of the same category sharing many important properties, especially if the category is a natural kind. And second, there is a linguistic assumption: young children are said to believe that count nouns denote categories (e.g. the word *dog* refers to a class rather than to a single individual). Therefore, when performing inductive generalizations, people, including young children, first identify the category of an entity (using either provided or self-generated labels) and then generalize properties of the entity to other members of the identified category. In short, according to this view, induction is based on prior categorization of presented entities, and is thus category-based.

According to another class of answers (often referred to as the *similarity-based* approach), conceptual knowledge (e.g., knowledge that members of the same category share important properties and that these properties may differ for natural kinds and artifacts) is a product rather than a precondition of development and learning. Therefore, conceptual knowledge is not *a priori* and it does not explain the development of induction, but rather itself needs an explanation. The development (including acquisition of conceptual knowledge) is grounded in powerful learning mechanisms, such as statistical, attentional, and associative learning (French, Mareschal, Mermillod, & Quinn, 2004;