Journal of Experimental Child Psychology 126 (2014) 198–212

Contents lists available at ScienceDirect

Journal of Experimental Child Psychology

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

Selective effects of explanation on learning during early childhood

Cristine H. Legare [a,*], Tania Lombrozo [b]

[a] Department of Psychology, The University of Texas at Austin, Austin, TX 78712, USA
[b] Department of Psychology, University of California, Berkeley, Berkeley, CA 94720, USA

ARTICLE INFO

Article history:
Received 11 August 2013
Revised 1 March 2014

Keywords:
Causal explanation
Causal reasoning
Self-explanation
Learning
Generalization
Cognitive development
Early childhood

ABSTRACT

Two studies examined the specificity of effects of explanation on learning by prompting 3- to 6-year-old children to explain a mechanical toy and comparing what they learned about the toy's causal and non-causal properties with children who only observed the toy, both with and without accompanying verbalization. In Study 1, children were experimentally assigned to either explain or observe the mechanical toy. In Study 2, children were classified according to whether the content of their response to an undirected prompt involved explanation. Dependent measures included whether children understood the toy's functional–mechanical relationships, remembered perceptual features of the toy, effectively reconstructed the toy, and (for Study 2) generalized the function of the toy when constructing a new one. Results demonstrate that across age groups, explanation promotes causal learning and generalization but does not improve (and in younger children can even impair) memory for causally irrelevant perceptual details.

Introduction

A growing literature suggests that young children's explanations play a crucial role in learning (Bonawitz, van Schijndel, Friel, & Schulz, 2012; Legare, 2012, 2014; Legare & Gelman, 2014; Roy &

* Corresponding author. Fax: +1 512 471 6175.
E-mail address: legare@austin.utexas.edu (C.H. Legare).

http://dx.doi.org/10.1016/j.jecp.2014.03.001
0022-0965/

Chi, 2005; Siegler, 2002; Singer, Golinkoff, & Hirsh-Pasek, 2006; Sobel & Sommerville, 2009; Wellman & Liu, 2007). For example, generating explanations can improve acquisition of new material and its extension to novel cases (Crowley & Siegler, 1999; Lombrozo, 2006; Wellman, 2011) and can even accelerate difficult conceptual transitions such as acquiring an understanding of false beliefs (Amsterlaw & Wellman, 2006) or number conservation (Siegler, 1995). Despite the acknowledged importance of explanation during early childhood, however, little is known about how effects of explanation differ—if at all—from mere verbalization or general attention and whether and how effects of explanation are selective to particular kinds of learning. Here we explored whether prompting 3- to 6-year-old children to explain a mechanical device fosters causal–mechanical understanding more effectively than does observation or verbalization and, if so, whether such understanding comes at the expense of other kinds of learning.

Educational research comparing self-explanation—that is, explaining to oneself or another person—with other activities suggests that explaining can be more effective for learning than alternative activities such as thinking aloud and reading study materials twice, especially when it comes to generalizing from study material to new cases (see Fonseca & Chi, 2011, and Lombrozo, 2012, for reviews). Although most research on self-explanation has focused on older children and adults, the limited research with younger children suggests similar effects. For example, research on problem solving among elementary school children comparing the effectiveness of self-explanation with alternative activities (e.g., solving practice problems) found that self-explanation was associated with greater conceptual and procedural knowledge (McEldoon, Durkin, & Rittle-Johnson, 2012). Rittle-Johnson, Saylor, and Swygert (2008) also demonstrated that explanation prompts facilitate transfer in children as young as 5 years relative to repeating problem solutions in problem-solving tasks. Notably, however, children in these previous studies of self-explanation were asked to explain why a particular solution or strategy was correct; that is, they explained some task-relevant *feedback* (see also Amsterlaw & Wellman, 2006; Crowley & Siegler, 1999; Rittle-Johnson et al., 2008). It could be that effects of explanation in young children result from the interplay of feedback with their explanations. For example, explaining could draw attention to the feedback and encourage children to rephrase it in their own words, thereby facilitating belief revision. Thus, it is an open question whether simply explaining one's observations—in the absence of feedback of this type—can similarly improve young children's learning and, if so, whether its impact results from the general use of language or from explanation per se. This question is especially important in understanding the role of children's spontaneous explanations on learning throughout development (Legare, 2014).

Another open question concerns the selectivity of explanation's effects, especially during early childhood. In particular, are effects of explanation restricted to some kinds of learning, or do they extend more broadly? And do the benefits of explanation have any associated costs? Evidence from older children and adults suggests that effects of explanation can indeed be selective, improving some kinds of learning over others. For example, explanation can foster analogical transfer at the expense of memory for previous problems (Needham & Begg, 1991), privilege causal mechanisms over consistency with previous data in justifying causal judgments (Berthold, Roder, Knorzer, Kessler, & Renkl, 2011; Kuhn & Katz, 2009), and encourage learning about patterns instead of individual examples (Williams, Lombrozo, & Rehder, 2013). When it comes to effects of explanation during early childhood, however, comparable studies have not been performed and two distinct stories are quite plausible. On the one hand, explaining could boost general engagement or attention (e.g., Siegler, 2002), which might lead to relatively widespread benefits across wide-ranging measures of learning. On the other hand, consistent with research on older children and adults, explaining could privilege some kinds of learning (e.g., causal learning) at the expense of others (e.g., perceptual learning), leading to more selective effects and potentially even to impairments (see also Walker, Lombrozo, Gopnik, & Legare, 2014). Identifying whether and how effects of explanation are selective, therefore, is of both practical value (for informing educational practice) and of theoretical value (for helping to isolate the mechanisms by which explanation influences learning during early childhood).

Building on prior work, we propose that explanation generates selective effects and that it does so by encouraging young learners to consider particular kinds of hypotheses, namely those that support good explanations (Legare, 2012; Lombrozo, 2012; Williams & Lombrozo, 2013). If explanations are typically judged as better when they invoke causal mechanisms or broad generalizations (for reviews,