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Young children's analogical problem solving: Gaining insights from video displays

Zhe Chen [a,*], Robert S. Siegler [b]

[a] Department of Human Ecology, University of California, Davis, Davis, CA 95616, USA
[b] Department of Psychology, Carnegie Mellon University, Pittsburgh, PA 15213, USA

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ABSTRACT

This study examined how toddlers gain insights from source video displays and use the insights to solve analogous problems. The sample of 2- and 2.5-year-olds viewed a source video illustrating a problem-solving strategy and then attempted to solve analogous problems. Older, but not younger, toddlers extracted the problem-solving strategy depicted in the video and spontaneously transferred the strategy to solve isomorphic problems. Transfer by analogy from the video was evident only when the video illustrated the complete problem goal structure, including the character's intention and the action needed to achieve a goal. The same action isolated from the problem-solving context did not serve as an effective source analogue. These results illuminate the development of early representation and processes involved in analogical problem solving. Theoretical and educational implications are discussed.

Introduction

When children encounter a problem to solve, they can tackle the problem using any number of approaches—trial and error, recall of a successful everyday-life experience in a different context, or generalization of an insight gained from a family story, a storybook, or a television program (e.g., Siegler, 1995, 2000; Tomasello, 1999). Although there is evidence of the usefulness of two-dimensional displays, such as those in storybooks, for toddlers' problem solving, the effectiveness of video displays as a source of successful analogical transfer and the components needed to gain such insights remain

* Corresponding author.
E-mail address: zhechen@ucdavis.edu (Z. Chen).

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largely unexplored. The current research, therefore, examined whether toddlers can gain insights from video displays and the conditions under which they use those insights to solve analogous problems.

Analogical transfer of problem-solving strategies involves the retrieval of acquired strategies or solutions and their application to isomorphic tasks (Goswami, 2006). The success of transfer of strategies from familiar to novel problems depends on the distance between the deep structure of the two problems and the degree to which the problems share superficial features; it also reflects how deeply a child represents source strategies and how effectively the child maps source and target problems. Generalization of strategies is a key dimension of change in children's thinking and a critical measure of learning (Chen & Klahr, 1999; Siegler, 2006).

The basic paradigm for examining analogical transfer involves presenting source analogues that illustrate problems and solutions and observing subsequent solutions to isomorphic problems. Even preschoolers have been shown to exhibit analogical transfer on the basis of structural similarity (e.g., Brown, 1989; Holyoak, Junn, & Billman, 1984). For example, Brown, Kane, and Echols (1986) presented preschoolers with the "Genie" problem that required moving jewels over an obstacle by rolling the Genie's magic carpet into a tube through which the jewels could be transferred. The experimenter then presented a different cover story with toy props and asked the children to solve a problem in which a bunny needed to deliver its Easter eggs across a river. The 3- and 4-year-olds were able to transfer the source solution to the structurally similar target problem by rolling the bunny's blanket (a piece of cardboard) into a tube through which the eggs could be transported.

Infants and toddlers also have been shown to be capable of analogical problem solving provided that the source analogues are presented in the form of live demonstrations and the children actively participate in learning the analogues. Both 1- and 2-year-olds can reenact a sequence of modeled actions (e.g., Bauer & Mandler, 1992) and generalize observed live demonstrations of actions to novel materials (Bauer & Dow, 1994; Hayne, MacDonald, & Barr, 1997) and novel contexts (Barnat, Klein, & Meltzoff, 1996). Very young children have also proved to be capable of constructing relatively abstract and flexible mental representations of source problems and transferring a modeled solution strategy across analogous problems (Chen, Sanchez, & Campbell, 1997). For example, 18- to 35-month-olds showed effective transfer of a tool-use strategy across a series of isomorphic problems after observing an experimenter demonstrating, with an appropriate tool, how to solve an analogous problem that differed in several superficial characteristics (Chen & Siegler, 2000). Previous studies, thus, have demonstrated 1- to 3-year-olds' ability to transfer strategies across isomorphic problems if the children observe live demonstrations and actively engage in exploring the source problems (Brown et al., 1986; Chen & Siegler, 2000).

Studies with older children have demonstrated that their problem solving can also be guided by other media and forms of source analogues. For example, 4- and 5-year-olds can extract the meaning of pictures they view and use the experience to solve a physical insight problem analogous to that which the source pictures depicted (Chen, 2003), and 5- to 8-year-olds can effectively use verbal stories as source analogues for problem solving (Chen, 1996; Tunteler & Resing, 2007). However, despite the robust demonstration of children's ability to transfer problem-solving strategies from source analogues in the form of live demonstrations, pictures, and stories, little is known about when children achieve the ability to use video displays or video animation as source analogues to guide their problem solving.

Although analogical transfer in children with this medium is largely unexplored, ample evidence from imitation studies points to infants' and toddlers' ability to imitate gestures and sequential actions demonstrated in a video format (e.g., Barr, 2010; Barr & Hayne, 1999; Meltzoff, 1985, 1988; Troseth, 2003). One reason to suspect that videos would not produce analogical transfer in such young children is that despite their impressive early abilities to imitate gestures and actions displayed on video, infants and toddlers learn significantly less effectively from videos than from live demonstrations (DeLoache & Burns, 1994; Hayne, Herbert, & Simcock, 2003; Troseth, Saylor, & Archer, 2006), a phenomenon referred to as the video deficit effect. Children's performance in the imitation studies tended to occur under optimal experimental conditions with brief delays between viewing and reenacting the observed actions, verbal instructions aimed at facilitating imitation, repeated exposure to the video displays, and/or displays depicting familiar contexts. Whether such young children can show efficient learning from video displays under less optimal conditions was the main issue addressed in the current study.