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Journal of Experimental Child Psychology

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



Observational learning of tool use in children: Investigating cultural spread through diffusion chains and learning mechanisms through ghost displays

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ARTICLE INFO

Article history:

Received 27 November 2009

Available online 12 January 2010

Keywords:

Observational learning

Ghost condition

Diffusion chain

Imitation

Emulation

Culture

ABSTRACT

In the first of two experiments, we demonstrate the spread of a novel form of tool use across 20 “cultural generations” of child-to-child transmission. An experimentally seeded technique spread with 100% fidelity along twice as many “generations” as has been investigated in recent exploratory “diffusion” experiments of this type. This contrasted with only a single child discovering the technique spontaneously in a comparable group tested individually without any model. This study accordingly documents children’s social learning of tool use on a new, population-level scale that characterizes real-world cultural phenomena. In a second experiment, underlying social learning processes were investigated with a focus on the contrast between imitation (defined as copying actions) and emulation (defined as learning from the results of actions only). In two different “ghost” conditions, children were presented with the task used in the first experiment but now operated without sight of an agent performing the task, thereby presenting only the information used in emulation. Children in ghost conditions were less successful than those who had watched a model in action and showed variable matching to what they had seen. These findings suggest the importance of observational learning of complex tool use through imitation rather than only through emulation. Results of the two experiments are compared with those of similar experiments conducted previously with chimpanzees and are discussed in relation to the wider perspective of

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human culture and the influence of task complexity on social learning.

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Introduction

Interest in the observational learning abilities of infants and children has a long history (Bandura, Ross, & Ross, 1961; Meltzoff & Moore, 1977; Meltzoff & Prinz, 2002; Piaget, 1962). Only recently, however, has serious effort been devoted both to experimentally testing whether observational learning between children allows the spread of behaviors among them (Horner, Whiten, Flynn, & de Waal, 2006) and how such learning occurs, with researchers aiming to tease apart different forms of observational learning (Gleissner, Meltzoff, & Bekkering, 2000; Huang & Charman, 2005; McGuigan, Whiten, Flynn, & Horner, 2007; Whiten, McGuigan, Marshall-Pescini, & Hopper, 2009). In the first experiment presented here, we assessed how well children would learn a complex tool-use task via observational learning and how far such socially learned behaviors would spread along a series of “cultural generations” or transmission episodes.

Positive results in this first experiment were followed up in a second experiment where we went on to assess which forms of observational learning could explain the social transmission observed. In part through integration with work in comparative psychology, a number of observational learning mechanisms, or underlying cognitive processes, have been distinguished (Want & Harris, 2002; Whiten, Horner, Litchfield, & Marshall-Pescini, 2004). Recent studies have begun to focus on whether children replicate the actions of others (imitation) or, instead, the environmental changes that occur as a result of actions (emulation). Several studies have concluded that young children are primarily imitators (Bornstein & Bruner, 1989; Horner & Whiten, 2005; Meltzoff & Moore, 1977; Meltzoff & Prinz, 2002; Zentall & Galef, 1988), even blindly imitating actions that are visibly ineffective, recently labeled “overimitation” (Lyons, Young, & Keil, 2007; McGuigan et al., 2007). However, few studies have yet tested the emulation alternative directly in the manner we do here. In the following, we offer overviews of the research literature relevant to each of our two experiments in turn.

Extending social learning experiments to multiple cultural transmissions

A limitation of many social learning studies with children is that they have focused on only dyadic learning scenarios, often with an (unfamiliar) adult as the demonstrator (e.g., Gergely, Bekkering, & Kiraly, 2002; Tennie, Call, & Tomasello, 2006; Thompson & Russell, 2004). Yet culture is, by its nature, a group-level phenomenon that requires fidelity across a series of social transmission events (Mesoudi & Whiten, 2004; Mesoudi & Whiten, 2008). In real life, this may be intergenerational, notably between parent and child (Guglielmino, Viganotti, Hewlett, & Cavalli-Sforza, 1995), but many day-to-day learning experiences for children are also through interactions with other children, such as siblings or friends, offering the prospect of “horizontal” transmission. Experimental studies have shown that children can be reliable models for their peers (Flynn & Whiten, 2008a; Hanna & Meltzoff, 1993; Hopper, Lambeth, Schapiro, & Whiten, 2008; Horner et al., 2006). Such child–child interactions, the focus of our first experiment, may be multiple and additive, in contrast to the dyadic designs of most prior experimental studies. Recognizing this contrast between dyadic tests and the richer nature of group-level traditions, comparative psychologists have begun to employ a method of “serial reproduction” derived from the early work of Bartlett (1932); see also Bangerter, 2000; Kashima, 2000; Mesoudi & Whiten, 2004, 2008). One version of this paradigm, called “diffusion chains,” initially is arranged so that one individual (B) observes another individual (A) perform a target act. Then, going beyond this first dyad, B becomes the model for a third individual (C), who in turn is the model for a fourth individual (D) and so on. Such a method offers new ecological validity insofar as it relates readily to real-life situations in which information spreads through a community, family, or friendship group and may lead to the establishment of a tradition.

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