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Limitations to the cultural ratchet effect in young children



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ABSTRACT

Although many animal species show at least some evidence of cultural transmission, broadly defined, only humans show clear evidence of cumulative culture. In the current study, we investigated whether young children show the “ratchet effect,” an important component of cumulative culture—the ability to accumulate efficient modifications across generations. We tested 16 diffusion chains—altogether consisting of 80 children—to see how they solved an instrumental task (i.e., carrying something from one location to another). We found that when the chain was seeded with an inefficient way of solving the task, 4-year-olds were able to innovate and transmit these innovations so as to reach a more efficient solution. However, when it started out with relatively efficient solutions already (i.e., the ones that children in a control condition discovered for themselves), there were no further techniques invented and/or transmitted beyond that. Thus, young children showed the ratchet effect to a limited extent, accumulating efficient modifications but not going beyond the inventive level of the individual.

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Introduction

Human culture, unlike that of other animal species, accumulates modifications over time (Dean, Vale, Laland, Flynn, & Kendal, 2014; Tennie, Call, & Tomasello, 2009; Tomasello, 1999). Humans socially learn from others, and once one individual makes an improvement in technique, then others may adopt the improved method so that later generations may eventually have only the improved version as an object of their social learning. This process has been dubbed the “ratchet effect” because it typically leads to continual improvements over historical time (Tomasello, Kruger, & Ratner, 1993).

Recently, researchers have begun to study various types of cultural accumulation in the laboratory with both adults (e.g., Bangertner, 2000; Caldwell & Millen, 2008, 2009; Kirby, Cornish, & Smith, 2008; Mesoudi & Whiten, 2004) and children (e.g., Flynn, 2008; Flynn & Whiten, 2008; Hopper, Flynn, Wood, & Whiten, 2010; Horner, Whiten, Flynn, & de Waal, 2006). The basic technique is to create “generations” of learners in a diffusion chain (B learns from A, then C learns from B, then D learns from C, etc.). Using such a method, Caldwell and Millen have shown that improvements in simple construction tasks can accumulate across generations of adult learners. Flynn and Whiten (2008) found that 3- and 5-year-old children can transmit observed techniques across generations as well and that the fidelity of transmission increases with age (see Flynn, 2008, for similar results with 2- and 3-year-olds, and see Horner et al., 2006, for a comparison of children with chimpanzees). In contrast, McGuigan and Graham (2009) found that 3-year-olds copied irrelevant actions in diffusion chains more robustly than 5-year olds. Flynn (2008) also found a loss of irrelevant actions across diffusion chains in 2- and 3-year olds and argued that such a loss of irrelevant actions can be interpreted as some form of cultural evolution because the action sequence becomes more streamlined and efficient when irrelevant actions are eliminated (a “subtractive” version of the ratchet effect). But none of these studies has asked whether children would also show what we call the “additive ratchet effect,” that is, inventing and accumulating improvements across generations in a manner similar to adults. This is what we did in the current study.

We tested children in diffusion chains in an experimental condition and a baseline condition. In the experimental condition, an adult experimenter started each diffusion chain with a demonstration (presented pedagogically).¹ The experimenter demonstrated techniques that were not the most efficient given the materials available in order to leave room for improvement. We compared children’s performance in the experimental condition with that in the baseline condition where no previous demonstration was given (the adult simply explained the goal of the task to children). Each diffusion chain consisted of 5 children who were tested in succession (i.e., only one child at a time observed either the experimenter or the preceding child). We used a task that was novel for the children—transporting dry rice from one location to another.

Method

Participants

A sample of 80 4-year-old children ($M = 4$ years 5 months [4;5], range = 4;3–4;8, 40 boys and 40 girls) participated in the study. All were tested with a diffusion chain method in eight chains of 5 boys each ($n = 40$) and eight chains of 5 girls each ($n = 40$). We separated boys and girls because previous publications showed gender effects in copying in diffusion chains (Flynn & Whiten, 2008). Data from an additional 5 children were excluded from the final analysis because of Generation 1’s (see “Experimental condition” section below) reluctance to perform demonstrations. Children were recruited and tested in their kindergartens, which were located in a mid-sized city in Germany. Their parents had given written permission for them to participate in child development studies.

¹ A pilot study, the results of which are available from the first author, revealed few effects of whether the demonstration was presented pedagogically or not, but order effects that were present in the analyses limited what we could conclude from it. Still, in it we replicated the finding of Flynn (2008) and McGuigan and Graham (2009) that irrelevant actions can be eliminated by chains of children.

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