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Children teach methods they could not discover for themselves

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ABSTRACT

Across three studies ($N = 100$), we explored whether and, if so, under what circumstances children's self-discovered knowledge impacts their transmission of taught information. All participants were taught one of several methods for extracting rewards from a box. Half of the participants were also given an opportunity to discover their own method prior to receiving such instruction. Across studies, we varied the transparency of the taught method relative to the method children could discover on their own. When asked to teach a naive pupil about the box, children who did not explore the box always transmitted what they were taught. Children in the Exploration + Instruction condition were also likely to transmit what they had been taught, but they were especially likely to do so when the taught method was more opaque than the method they had discovered for themselves. Thus, children faithfully transmit what they have been taught, but only when that information is difficult to discover.

Introduction

The human capacity for cumulative culture is unparalleled (Boyd & Richerson, 1985; Tomasello, 2009) and attributable to a suite of species-unique sociocognitive abilities (Dean, Kendal, Schapiro, Thierry, & Laland, 2012). Teaching allows for the efficient and faithful transmission of information

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and is likely to have evolved for this purpose (Csibra & Gergely, 2009, 2011; Fogarty, Strimling, & Laland, 2011). Because teaching requires an investment of time and resources on the part of the teacher, teaching is theorized to be adaptive only in cases where the learner could not gain the information on his or her own (Fogarty et al., 2011; Thornton & Raihani, 2008). Thus, teachers are likely to differentiate between information that *must* be taught (because the learner is *unlikely* to be able to learn it on his or her own) and information that *can* be taught but does not need to be taught (because the learner is *likely* to learn it on his or her own). However, neither current theoretical models of teaching (Csibra & Gergely, 2009, 2011; Fogarty et al., 2011; Thornton & Raihani, 2008) nor prior empirical works on the development of teaching in children (e.g., Strauss & Ziv, 2012; Strauss, Ziv, & Stein, 2002; Wood, Wood, Ainsworth, & O'Malley, 1995) provide an explanation for how teachers identify information as worthy of transmission.

What teachers decide to teach a novice is likely to depend on the teachers' own learning history. More specifically, their learning history can give them a sense of what is an easily discoverable method (information that could, in principle, be taught but does not need to be taught) and what is a more opaque method (information that should be taught). When asked to teach a novice, teachers can decide to teach what they were taught, what they discovered, or a combination of what they were taught and what they discovered. If individuals have been taught a method of solving a particular problem, they will typically teach that method to a naive other because they are likely to assume that the information they have been taught is accurate and exhaustive (Bonawitz et al., 2011). However, if they have had an opportunity to discover a method for themselves before being taught, they will be more selective in transmitting the information that they were taught. Thus, if the method they are taught is just as transparent as the one they have discovered for themselves, they will be as likely to teach their own method as the taught method (or to teach both). However, if they are taught a more opaque method than the one they have discovered for themselves, they will be more likely to teach that method rather than their own method. Given that they did not discover the more opaque method themselves, they can infer that a novice would be unlikely to discover it. Such a pattern would suggest that a teacher's own learning history helps the teacher to identify what information should be taught in a way that favors the transmission of hard-to-discover information.

There is, however, a plausible alternative to this learning history heuristic, namely that teachers will teach what they were initially taught—no matter what their learning history. This strategy would faithfully preserve taught information through successive generations and require no reflection on the part of teachers about their own learning history. We know that both adults and children imitate unnecessary causally irrelevant actions (e.g., McGuigan, 2012; McGuigan, Makinson, & Whiten, 2011) and will do so even when such overimitation is costly (Flynn & Smith, 2012; Lyons, Damrosch, Lin, Macris, & Keil, 2011). Moreover, children overimitate even after they have discovered a more efficient solution themselves (Nielsen & Tomaselli, 2010) and after they have explicitly marked causally irrelevant actions as "silly" (Lyons et al., 2011). This suggests that overimitation does not result from a lack of knowledge about which actions are necessary and which actions are not; rather, it appears that overimitators view taught methods as normative (Kenward, Karlsson, & Persson, 2011). In support of this interpretation, adults are less likely to overimitate when a method is demonstrated by only a minority of experimental models (McGuigan, Gladstone, & Cook, 2012). Furthermore, children criticize others who have been shown irrelevant actions by a model (along with the child) but later omit them (Kenward, 2012; Keupp, Behne, & Rakoczy, 2013). Given the fidelity with which children reproduce what they are shown as pupils, as well as the criticism they direct at less faithful pupils, it is feasible that they adopt a similar stance in the role of teacher, namely to faithfully model whatever actions they were shown.

To determine whether children's learning history impacts their transmission of information, we conducted three studies ($N = 100$). We focused our investigation on preschool-aged children because they have less formal teaching experience than adults but do engage in teaching others (e.g., Gelman, Ware, Manczak, & Graham, 2013; Gweon, Chu, & Schulz, 2014; Strauss & Ziv, 2012; Strauss et al., 2002). In all three studies, children were randomly assigned to an Instruction Only condition or to an Exploration + Instruction condition. In each condition, they were presented with a novel puzzle box that contained rewards and were taught a method for extracting these rewards. Children in the Exploration + Instruction condition were also given an opportunity to discover their own method prior