



# Navigating pedagogy: Children's developing capacities for learning from pedagogical interactions



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## ABSTRACT

Young children can use cues that an adult is pedagogically providing information for their benefit to evaluate its importance and generalizability. But to use pedagogical actions to guide learning, children must learn to navigate ongoing pedagogical interactions, identifying which specific actions within an overarching context are in fact meant as pedagogical. In two experiments ( $N = 120$ ) we illustrate that 3-year-olds struggle with this ability, failing to distinguish pedagogical from merely intentional actions unless the endpoints of a pedagogical interaction were clearly demarked. These results shed light on the development of this powerful learning mechanism for facilitating inductive inference.

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## 1. Introduction

The ability to learn from others is an essential learning mechanism to foster cognitive development. Social learning is what enables complex cultural knowledge to be faithfully learned and transmitted from generation to generation (Gergely & Csibra, 2005, 2006; Tomasello, 1999). A large proportion of social learning undoubtedly takes place via language, but children also learn a lot from observing the actions of others. Others' actions, and in particular the underlying intentions that guide them, are potentially rich sources of information about the world. Recognizing that someone is intentionally reaching for a particular object, for example, licenses inferences about a person's visual access, desires, preferences, and possibly even beliefs (Luo & Baillargeon, 2007; Onishi & Baillargeon, 2005; Woodward, 1998). And inferring the underlying goals of an action, even an incomplete or unsuccessful one, allows for rapid and accurate imitation of novel actions (Meltzoff, 1995).

Moreover, recognizing that the goal behind an action is not merely instrumental (for the actor's own benefit) but rather pedagogical (that is, done communicatively for the child's benefit) may allow for further inferences about the intended meaning of that communicative act and why an adult is choosing to communicate this information in this particular context (Gergely & Jacob, 2012; Sperber & Wilson, 1986). Specifically, if children recognize that a communicative act is being done pedagogically, for their benefit, they may reason that the information being communicated is likely important and generalizable beyond the particular individual or situation (Csibra & Gergely, 2009). Thus children may be able to use their reading of the intentions behind others' actions to infer enduring, general knowledge about the world from episodic bits of information, the classic inductive problem (Gelman, 2003; Gelman & Wellman, 1991; Goodman, 1965; Keil, 1989; Markman, 1989).

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Preverbal infants appear to recognize ostensive cues that can signal pedagogical intent—most canonically seeing another person make direct eye contact with them and establish joint attention on an object (Csibra, 2010). Moreover, they take information accompanied by ostensive cues such as direct eye contact as more stable, kind relevant, and generalizable than identical information produced intentionally, but with no direct eye contact, joint attention, or other cues to ostension (Egyed, Király, & Gergely, 2013; Gergely, Egyed, & Király, 2007; Futó, Téglás, Csibra, & Gergely, 2010; Yoon, Johnson, and Csibra, 2008). Moreover, by 4 years of age children appear to use this sensitivity to pedagogical intent to guide more calibrated inductive inferences about to what extent novel information is generic, taking information conveyed pedagogically as both more generalizable to a novel kind (Butler & Markman, 2012), and more conceptually central to what it means to be a member of that kind (Butler & Markman, 2014).

However, this research with preschoolers also revealed a potential developmental difference in how children use pedagogical cues to guide their inductive inferences (Butler & Markman, 2012). In that study 4-year-olds made stronger inductive generalizations about a novel object property specifically when it was demonstrated for their benefit, compared both to seeing it produced accidentally and even compared to seeing identical evidence produced in an intentional, but non-pedagogical manner. In contrast, 3-year-olds made equivalently strong inferences on the basis of both the pedagogical demonstration and the intentional, but non-pedagogical, action. This result poses a puzzle, as even preverbal infants show clear effects of pedagogical cues on their encoding and, at least in one study, on their generalization of novel information (Egyed et al., 2013; Gergely et al., 2007; Futó et al., 2010; Yoon et al., 2008). What, then, is preventing 3-year-olds from making use of those cues in guiding their inductive inferences? To answer this question, it is helpful to take a step back and discuss more broadly how this inferential process might play out in actual learning episodes preschoolers might encounter, and how that might map onto the methodology used in prior research.

The effects of pedagogical cues on infants' learning (Egyed et al., 2013; Gergely et al., 2007; Futó et al., 2010; Yoon et al., 2008) may well be driven by a relatively automatic, cue-driven process. But preschoolers appear to be assessing whether others' actions are being carried out with pedagogical intent, and using that assessment to guide inferences about the importance and generalizability of demonstrated information (Butler & Markman, 2012, 2014). This more complex process presents an inductive challenge. Actions do not occur in isolation, but rather occur amidst ongoing, dynamic interactions. And adult-child interactions may often at some level be implicitly pedagogical, in that the child likely assumes that the adult knows more than they do, potentially leading the child to expect to be taught. But even within a pedagogical interaction, adults may perform any number of actions that are not intended to carry meaningful information. To use their sensitivity to pedagogical intent to accurately assess the importance of novel information, children need not only to recognize cues to pedagogical intent, they need to be able to navigate pedagogical interactions, sorting out which actions in an overarching context are in fact meant as "teaching moments," and which are done merely intentionally, not directed with pedagogical intent toward the child. If children struggle to do this, potentially misinterpreting various intentional actions as acts of teaching this would attenuate the power of learning from pedagogical demonstration.

As an illustrative example, imagine that a young child is watching her father prepare eggs for breakfast. As the child watches, her father takes out a whisk and labels it for her. He then goes about various tasks involved in making eggs—cracking the eggs, chopping some herbs, adding salt and pepper. At one point the phone rings, and the father engages in a short conversation. Afterwards, he absent-mindedly uses a fork (instead of the whisk) to beat the eggs, and later as the eggs are cooking he uses the whisk to brush herbs from the cutting board into the pan.

In this dynamic, flowing context, identifying which actions are meant as pedagogical demonstrations poses a challenge. The child needs to assess, for example, whether her father was showing her that whisks are for brushing things off cutting-boards—or whether he was merely grabbing what was convenient to accomplish this goal. Thus using pedagogical intent to guide inductive inferences requires children to navigate the ongoing situation, actively tracking the adult's intentions over the course of the dynamic interaction, and selectively using only those actions that are clearly meant as pedagogical demonstrations as the basis for their inferences. Given this, we might expect a developmental trajectory in which very young children are capable of broadly recognizing pedagogical contexts, but must learn how to navigate dynamic interactions in order to pinpoint which actions are truly meant for them.

Indeed, we know from the literature on "overimitation" that children have a tendency to assume that any novel action that they see in the context of being shown how to carry out a novel task ought to be imitated (Horner & Whiten, 2005). This phenomenon appears early in development, and appears to increase with age (McGuigan & Whiten, 2009; McGuigan, Whiten, Flynn, & Horner, 2007). There are differing proposals for what psychological mechanisms underlie overimitation. One argument is that children view each intentional action as causally necessary (Lyons, Damrosch, Lin, Macris, & Keil, 2011; Lyons, Young, & Keil, 2007). The other is that children over-imitate for social reasons, such as the drive to affiliate with others (Over & Carpenter, 2012) because they interpret the actions as part of a culturally-relevant ritualistic or normative action (Herrmann, Legare, Harris, & Whitehouse, 2013; Kenward, 2012; Kenward, Karlsson, & Persson, 2011; Keupp, Behne, & Rakoczy, 2013; Nielsen, Moore, & Mohamedally, 2012; Nielsen, Kapitany, & Elkins, 2015). Relatedly, children imitate more faithfully when they do not know the goal or underlying causal structure of an action (Williamson & Markman, 2006; Williamson & Meltzoff, 2011; Williamson, Meltzoff, & Markman, 2008), which could potentially be consistent with either proposal.

Most importantly for our purposes, the extent to which children overimitate depends on various social factors, including whether or not the demonstration is carried out live and with clear pedagogical cues and whether or not the demonstrator had previously engaged with the child (Marsh, Ropar, & Hamilton, 2014; Nielsen, 2006; Nielsen et al., 2012, 2015). This

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