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Causal learning from joint action: Collaboration helps first graders but hinders kindergartners



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ABSTRACT

This study investigated whether early school-aged children's causal learning from collaborative joint action differs from their learning from their own individual action or observation. Children in a joint condition performed causal interventions with an adult on two causal systems. Children in an independent condition took turns and observed an adult perform the same interventions on one system and performed the same interventions themselves on the other system. Joint action improved first graders' ($n = 60$) causal inference compared with individual action and observation. However, joint action impaired kindergartners' ($n = 60$) inference relative to individual action and observation. These findings demonstrate that joint action, as a component of collaborative activity, can help or hinder inductive causal learning depending on features of the learner. Children's abilities to learn from collaborative joint action undergo a developmental shift during the early school years.

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Introduction

Children learn by acting on their environments to solve problems and generate evidence. However, in many learning circumstances one simply cannot do everything oneself. As a social species, much of

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what we accomplish and learn occurs with and through social others. The current research compared children's causal learning from collaborative joint action with learning from individual action and observation. In collaborative joint action, individuals coordinate their actions toward fulfillment of shared goals (Sebanz, Bekkering, & Knoblich, 2006). Learning from joint action, thus, involves learning from the outcomes of both one's own actions and those of a partner. Collaboration is usually thought of as benefitting learning, but there are ways in which it may be challenging as well. For example, collaboration imposes the extra processing demands of representing a social partner's actions (e.g., Gerson, Bekkering, & Hunnius, 2016). Is children's causal learning from evidence generated via joint action different from learning from evidence generated via one's own or another's action?

The idea that children learn from collaborative experiences is widespread across disciplinary and theoretical perspectives (Hmelo-Silver, Chinn, Chan, & O'Donnell, 2013). Working with partners toward shared goals can benefit children's planning (Radziszewska & Rogoff, 1988), executive functioning (Qu, 2011), mathematical and scientific problem solving (Schwarz, Neuman, & Biezuner, 2000; Teasley, 1995), categorization (Fawcett & Garton, 2005), toy construction (Sommerville & Hammond, 2007), and conceptual change (Howe, 2009). Many distinct processes and mechanisms may underlie the potential learning advantage of working with a partner. Although theorists from different traditions emphasize different potential mechanisms of collaborative learning, within the field of cognitive development collaborative learning is frequently viewed in terms of coordinating shared action and thinking (Dillenbourg, Baker, Blaye, & O'Malley, 1995). For example, sociocultural theorists emphasize collaborative interactions with experienced partners as opportunities for guided exposure to more advanced cultural practices and tools (Gauvain, 2001; Rogoff, 1998; Vygotsky, 1978). Constructivist theorists emphasize cognitive conflict and talk among peers as opportunities for the co-construction of novel cognitive and behavioral forms (Ames & Murray, 1982; Howe, 2009; Piaget, 1926). In both cases, partners in pursuit of shared goals coordinate their own perspectives and actions toward shared thinking, and the effort and outcomes of coordination serve as the impetus for cognitive growth (Tomasello, Kruger, & Ratner, 1993).

Within the contexts of scientific and causal reasoning, it is not surprising that engaging with collaborators' different perspectives and strategies may promote learning. Prior research suggests that peer collaborators might generate more informative evidence, evaluate evidence more thoroughly, entertain different hypotheses, and/or justify hypotheses more fully (Azmitia & Montgomery, 1993; Howe, 2009; Okada & Simon, 1997; Shtulman & Young, 2017; Teasley, 1995; Young, Alibali, & Kalish, 2012). These mechanisms suggest that collaboration can expose learners to different evidence—both the evidence itself and talk about evidence—than they would encounter alone. However, if evidence quality is the mechanism producing learning gains, then other components of collaboration might not be critical (e.g., Teasley, 1995). Does collaboration have an effect over and above the quality of evidence that learners encounter? Would acting jointly with a partner still affect children's learning in the absence of variations in evidence, talk, and scaffolding? The current research compared learning during joint action with learning during individual action and observation, holding constant the evidence encountered in each context.

By 4 or 5 years of age, children can form and maintain representations that facilitate collaborative joint action. Preschool-aged children can spontaneously coordinate complementary roles and support each other toward shared problem-solving goals (Hamann, Warneken, & Tomasello, 2012; Warneken, Steinwender, Hamann, & Tomasello, 2014), simultaneously represent their own and a partner's roles in relation to joint task goals (Fletcher, Warneken, & Tomasello, 2012; Rakoczy, Gräfenhain, Clüver, Schulze Dalhoff, & Sternkopf, 2014), and incorporate a partner's role into their own action plans (Meyer, van der Wel, & Hunnius, 2016; Milward, Kita, & Apperly, 2014; Saby, Bouquet, & Marshall, 2014). Furthermore, learning from a collaborator's actions is thought to be a consequence of joint action (Tomasello, Carpenter, Call, Behne, & Moll, 2005). For example, 5-year-olds perform a novel role more efficiently if they have previously performed a complementary role in a collaboration than if they have not (Fletcher et al., 2012). Thus, joint action may benefit learning and performance even in the absence of variation in evidence and learning-relevant talk. That is, joint action may lead children to attend to or interpret evidence in distinctive ways.

Although joint action can facilitate learning, in many circumstances children are also quite skilled at learning from both their own individual actions (e.g., McCormack, Bramley, Frosch, Patrick, &

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