Treating Another’s Actions as One’s Own: Children’s Memory of and Learning From Joint Activity

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Children often overestimate their contribution to collaborative activities. Across 2 studies, the authors investigated whether this memory bias supports internalization of the actions of others in the context of joint exchanges. After taking turns with (high collaborative condition; Studies 1 and 2) or working independently of (low collaborative condition; Study 2) an adult experimenter to create a series of novel toys, children’s agent memory and reconstruction ability were assessed. Children in the high collaborative condition but not the low collaborative condition systematically overclaimed the actions of their social partner, more frequently reporting having completed steps performed by the experimenter than vice versa. This “I did it” bias was related to learning performance: high collaborative children outperformed low collaborative children both during an immediate reconstruction task and 4 months later, and the strength of the bias predicted children’s independent toy-building accuracy. It is argued that the “I did it” bias may emerge as part of a general process of learning from others and is supported by a common framework for representing self-actions and other actions.

Keywords: memory development, memory for actions, mirror system, source monitoring

According to sociocultural approaches to development, learning happens via collaboration (Rogoff, 1990; Vygotsky, 1978). Taking part in joint exchanges in which social partners work toward a shared goal (vs. working alone) enhances children’s planning skills (Radziszewska & Rogoff, 1988, 1991), block-sorting abilities (Fawcett & Garton, 2005), categorization performance (Freund, 1990), problem-solving skills (Glachan & Light, 1982; Tudge & Winteroff, 1993), and construction abilities (Azmitia, 1988). Collaborative exchanges provide opportunities for experienced social partners to guide, structure, and scaffold children’s participation in activities (e.g., Azmitia, 1988; Gauvain & Rogoff, 1989; Rogoff, 1990; Wood, Bruner, & Ross, 1976), expose children to new problem-solving strategies (Manion & Alexander, 1997) and different perspectives (e.g., Kruger, 1993; Piaget, 1926), facilitate children’s ability to assess their own learning state (Norman, 1978), and potentially increase task enjoyment and engagement (Perlmutter, Behrend, Kuo, & Muller, 1989). Any one or combination of these task features may ultimately lead to learning from collaboration.

An intriguing question, however, concerns the processes, operations, and mechanisms that underlie learning via collaboration. Collaborative exchanges are thought to enhance individual learning by providing opportunities for internalization (Tomasello, Kruger, & Ratner, 1993), a process by which interpersonal material is imported into the intrapersonal domain (e.g., Vygotsky, 1978). Specifically, internalization entails not only the transmission of knowledge, values, standards, and abilities from one individual to another but the transformation and integration of another person’s actions, strategies, or knowledge into one’s own existing knowledge systems and behavioral routines (e.g., Lawrence & Valsiner, 1993). How does internalization happen?

Cognitive Operations Underlying Internalization: A Self-Recoding Process

According to Foley, Ratner, and colleagues (Foley, Passalacqua, & Ratner, 1993; Foley & Ratner, 1998a; Foley, Ratner, & House, 2002; Ratner, Foley, & Gimpert, 2002), internalization requires the “recoding of another individual’s actions in a way that integrates the role of the self as an agent and observer” (Ratner et al., 2002, p. 45). During joint activities, collaborators work toward a shared goal, requiring each partner to anticipate and plan the other’s actions so that actions can be properly coordinated. In these contexts, children may anticipate, imagine, or plan the actions of their social partner but do so from the perspective of the self. When children are subsequently asked to recall the agent of individual actions in a joint activity, they may use these anticipations to guide source recall, often claiming to have completed actions that were in fact enacted by their social partner. Thus, children’s memory errors are an index of their transformation of the actions of their
social partner as their own, a process that supports learning via internalization of joint activities.

Evidence for such a self-recoding process in preschool and early school age children comes from a series of seminal studies by Foley, Ratner, and colleagues (e.g., Foley et al., 1993; Foley & Ratner, 1998a). After taking part in a joint activity in which the child and an experimenter pursue a shared goal, children frequently overestimate their contribution to the activity (Foley et al., 1993; Foley & Ratner, 1998a; Foley et al., 2002; Ratner et al., 2002). In one experiment (Foley et al., 1993), 4-year-old children worked with an adult experimenter to reproduce a collage model and subsequently took part in a surprise memory task in which they were asked to recall which piece each child demonstrated a systematic bias in their recall, more frequently reporting that they had placed a puzzle piece that was actually placed by the experimenter than vice versa. Subsequent work revealed that this bias is enhanced when children are asked to imagine how they would place the experimenter’s piece during the experimenter’s turn and attenuated when children are asked to imagine how the experimenter would place his or her piece when it was the experimenter’s turn (Foley & Ratner, 1998a).

Importantly, children’s tendency to overclaim the actions of others as their own does not result from a general response bias or a broad egocentric tendency. The “I did it” bias disappears in noncollaborative contexts in which the child and experimenter plan or enact their actions independently (Foley, Johnson, & Raye, 1983; Foley et al., 1993; Ratner et al., 2002). Nor are children’s errors due to a failure to encode the actions of their social partner. In one study (Foley & Ratner, 1998a, Experiment 2), after cocreating a collage with an experimenter, children were presented with pieces from the collage along with distractor pieces. Children were equally good at recognizing the pieces that belonged to the original collage irrespective of whether those pieces were originally placed by the child or the experimenter. Taken together, these findings are consistent with the claim that agency misattributions reflect a self-recoding process underlying internalization.

Neural Systems Supporting Internalization

Recent research with both nonhuman and human primates provides evidence for overlapping neural circuits for performed and perceived actions. First documented in the ventral premotor cortex of macaque monkeys, and later in the inferior parietal lobe, mirror neurons fire both when a monkey executes certain actions and when the monkey watches an experimenter perform similar actions (Rizzolatti, Fadiga, & Fogassi, 1996; Rizzolatti, Fogassi, & Gallese, 2001). An accumulating body of evidence suggests that a similar observation/execution matching system, or mirror system, exists in adults. Premotor and the posterior parietal cortices are activated during both action perception and production (e.g., Buccino et al., 2004; Chao & Martin, 2000; Grafton, Arbib, Fadiga, & Rizzolatti, 1996; Grèzes & Decety 2001; Hamzei et al., 2003). Recent work suggests that the mirror system is evident in children (Fecteau et al., 2004) and perhaps even infants (Bertenthal & Longo, in press; Falk-Ytter, Gredenback & von Hofsten, 2006; Hauf & Prinz, 2005; Longo & Bertenthal, 2006; Sommerville, Woodward, & Needham, 2005).

The mirror system enables a covert, automatic motor simulation during action observation, which in turn has been hypothesized to underlie action recognition and understanding, action anticipation, intention reading, and empathy (Blakemore & Decety, 2001; Gallese & Goldman, 1998; Gallese, Keysers, & Rizzolatti, 2004; Jeannerod, 2001; Rizzolatti & Craighero, 2004; Sommerville & Decety, 2006; Wilson & Knoblich, 2005). Importantly, the mirror system activates when participants are asked to observe others’ actions in order to reproduce them (e.g., Iacoboni, 2005; Iacoboni et al., 1999; Jackson, Meltzoff, & Decety, 2006; Leslie, Johnson-Frey, & Grafton, 2003; Meltzoff & Decety, 2003; Nishitani & Hari, 2000, 2002). Additional research has revealed that the mirror system is also recruited during the learning of new skills via imitation (Buccino et al., 2004).

Recruitment of one’s own action plans during action observation may be particularly prevalent in the context of joint activities. When participants take part in a joint activity in which each person is required to perform a single response, individuals spontaneously treat their partner’s actions as their own (Sebanz, Knoblich, & Prinz, 2003) and engage inhibitory mechanisms to avoid acting during their partner’s turn (Sebanz, Knoblich, Prinz, & Wascher, 2006). Consistent with this research, Decety and colleagues have demonstrated greater activation of right inferior parietal cortex, an area implicated in attributing actions to others (Decety & Grézes, 2006), during tasks that required competition between individuals versus tasks that required cooperation (Decety, Jackson, Sommerville, Chaminade, & Meltzoff, 2004). Overclaiming of others’ actions and action effects during collaboration may arise due to the degree of mirror system activation in these contexts. Knoblich and colleagues (Knoblich & Sebanz, 2006; Repp & Knoblich, 2004) have suggested that observation of actions and action products that yield high levels of motor resonance are experienced as self-produced (Knoblich & Sebanz, 2006; Repp & Knoblich, 2004). Taken together, these findings provide converging evidence that motor resonance during action observation in collaborative contexts may lead to the experience of agency and may also support learning from others.

The “I Did It” Bias and Learning

In a recent study Ratner et al. (2002) examined the relation between collaborative contexts, learning from others, and the “I did it” bias. Five-year-old children were presented with a categorization task in which the child and an adult experimenter alternated placing furniture pieces into a dollhouse. Ratner et al. (2002) speculated that the experience of collaboratively planning individual actions with an adult experimenter would lead children to recode those actions as their own and, thus, promote learning. In the collaboration condition, children jointly planned the placement of furniture items with the experimenter and took turns placing them into the house. In the no collaboration condition, children received the dollhouse with half of the pieces already placed and moved in the remaining pieces in response to the experimenter’s directions. To ensure that the level of the child’s involvement in the task, the presence of turning, and whether or not planning occurred did not account for differences across the collaboration and no collaboration conditions, children were also tested in two additional no collaboration conditions. In the child names condition, the experimenter planned, selected, and placed all of the furniture items, asking the child to label each item prior to placement (equating for child involvement). In the child plans condi-
tion, the child and experimenter alternately planned, selected, and placed their pieces independently (equating for the presence of planning and the presence of turn taking).

Children’s recall of who placed each piece was then assessed in a surprise memory task, and children were given the opportunity to recategorize the furniture items on their own. The results from the memory task replicated those of previous studies: Children in the collaboration condition committed significantly more “I did it” than “you did it” errors in their agent recall. In contrast, in no collaboration condition, children’s “I did it” and “you did it” errors were equivalent. Ratner et al. (2002) also demonstrated two ways in which children’s memory bias was linked to learning. First, children in the collaboration condition outperformed children in the no collaboration condition on one measure of learning performance: the extent to which they replaced furniture items in an organized fashion (placing all of the items belonging in one room before proceeding to the next). Second, the “I did it” bias was positively correlated with children’s planning language (statements reflecting impending intentions), which in turn was positively related to organization scores on the recategorization task and the number of rooms in which the child correctly replaced at least four furniture items.

These findings seem to suggest that self-recoding is enhanced via collaborative planning, leading to learning. However, it is possible that uncontrolled-for task factors may have contributed to or accounted for Ratner et al.’s (2002) findings. First, the overall amount of planning and time devoted to each furniture item was not explicitly controlled between the collaboration and no collaboration conditions. Thus, it is possible that overall exposure to planning or familiarity with furniture items was greater in the collaboration than in the no collaboration condition, accounting for superior performance. Second, Ratner et al. provided evidence for an impact of collaboration on only one aspect of learning: how organized children’s responses were. Children’s ability to correctly replace items, however, did not differ significantly across collaboration and no collaboration conditions. Thus, differences on the organizational score may have been due to differences in stylistic approaches rather than overall learning accuracy per se. Furthermore, it is not clear whether the order in which the furniture items were entered into the house during the original placement task was matched across conditions, raising the possibility that children in the collaboration condition may have outperformed no collaboration children along this dimension because they were exposed to a more systematic ordering of furniture pieces during training.

The Present Study

The goals of the present study were fourfold. First, we sought to assess the presence of the “I did it” bias across different response measures using a range of collaborative activities. Previous work has only investigated children’s agent misattributions in response to direct questions (“Did I do it, or did you do it?”; e.g., Foley et al., 1993; Foley & Ratner, 1998a; Foley et al., 2002; Ratner et al., 2002). In Study 1, we assessed whether these errors were also present in a free recall task, to further ensure that children’s responses were not tied to any demand characteristics of the questioning method. In addition, in an advance over previous work that has examined the “I did it” bias in the context of collage making (e.g., Foley et al., 1993; Foley & Ratner, 1998a), a “Where’s Waldo?” task (e.g., Foley et al., 2002), and a furniture placement task (Ratner et al., 2002), we sought to establish whether this bias was present in a range of novel goal-directed toy-building activities.

Our second goal was to assess whether collaborative planning of individual actions is necessary for self-recoding to occur. According to the mirror system hypothesis, observing or anticipating another’s actions leads to a covert, automatic simulation of the observer’s own action plans. Thus, active engagement in the formation of action plans should not be necessary for self-recoding and learning. Instead, merely witnessing the experimenter’s plans or having visual access to upcoming plans in the context of collaborative exchanges should suffice.

Our third goal was to further assess the relation between collaboration, children’s “I did it” bias, and learning performance. To do so, we focused on learning accuracy (the extent to which children could reproduce an activity on their own) and tested children in closely matched conditions that differed along one critical dimension: the extent to which the child and experimenter acted toward a shared goal.

Finally, we sought to assess whether a direct link might exist between children’s “I did it” bias and learning. The mirror system hypothesis posits that action simulation exists at a primarily implicit level and need not be mediated by explicit cognition (e.g., planning language). Thus, we hypothesized that the “I did it” bias would be directly related to children’s learning from collaborative exchanges.

Across two studies, we investigated children’s agent recall and their ability to reconstruct a series of novel toys after taking part in a construction task in which they worked in collaboration with (Studies 1 and 2) or primarily independently of (Study 2) an adult experimenter. We predicted that children’s agent recall would be affected by the collaborative nature of the activity: When working in collaboration with an adult, children should overclaim the actions of their social partner as their own, but they should not do so when working independently of their social partner. Furthermore, we predicted that high collaborative conditions would produce greater learning accuracy of the construction activities than low collaborative conditions and that children’s tendency to overclaim their partner’s actions should be related to how readily they learned the toy-building sequences.

STUDY 1

Study 1 explored the robustness of children’s “I did it” bias in the context of joint activity. A variety of researchers have suggested that a central element of collaboration involves individuals working toward a common goal (e.g., Hartup, 1998; Howe, McWilliam, & Cross, 2005; Leman & Oldham 2005). Children worked with an experimenter using a set of pictures, each of which depicted a single step of a toy-building sequence, to create a series of novel toys. The child and experimenter took turns completing steps of the sequence, working toward the shared goal of toy construction. After the construction task, children received two surprise memory tasks (a free recall task and an agent memory task), followed by an independent reconstruction task.

In Study 1, we investigated children’s agent memory for a range of novel, goal-directed toy-building activities for two reasons. First, researchers have argued that collaborative exchanges are
particularly beneficial for children’s learning of construction tasks (Morrison & Kuhn, 1983). Second, previous studies have documented evidence of enhanced learning from collaboration in construction tasks (Azmitia, 1988). A replication of the “I did it” bias across these activities would provide evidence that children’s tendency to recode others’ actions generalizes to a variety of contexts and assessment methods.

Task factors, such as the timing of children’s contribution to the activity, promote anticipation and have been demonstrated to enhance children’s “I did it” bias (Foley et al., 2002). We sought to investigate another factor that might promote anticipation in the context of joint activity and, hence, lead to recoding errors. Previous research indicates that children demonstrate more accurate memory of goal-directed sequences with causally related steps than of goal-directed sequences with causally unrelated steps. Causally related sequences are recalled at earlier ages than are noncausally related sequences (Wennen & Bauer, 1999), nonverbal reminders enhance memory of causally related sequences but not of nonrelated sequences (Bauer, Hertsgaard, & Wewerka, 1995), and memory for causally related sequences is superior to memory for nonrelated sequences (Bauer, 1992; Bauer & Fivush, 1992; Bauer & Travis, 1995). In our toy-building sequences, we included some sequences in which there was a clear causal link from one step to the next (enabling sequences) and other sequences in which the order of the steps was causally unconstrained (arbitrary sequences). We predicted that children’s “I did it” bias would be stronger for enabling than for arbitrary sequences. This effect may arise because enabling sequences more readily allow children to anticipate upcoming steps and/or because enabling relations cause steps to be chunked together in memory, necessitating attribution of the steps to a single source.

Finally, we sought to investigate the relation between the “I did it” bias and children’s ability to reconstruct the sequences on their own. Because we expected the “I did it” bias to be more prevalent for enabling sequences, we also expected better learning of these sequences than of the arbitrary sequences. We further predicted a relation between the “I did it” bias and learning at an individual level: We expected that children with a stronger “I did it” bias would show better reconstruction performance than children with a weaker or no “I did it” bias. We tested a group of children in the experimental condition and another group of children in a baseline condition to ensure that children’s reconstruction performance reflected learning from the construction task as opposed to an ability to use the affordances of the stimuli to create the toys.

Method

Participants

Twenty-four children took part in Study 1 (mean age = 4 years, 2 months; range = 3 years, 6 months to 4 years, 7 months). Six boys and two girls participated in the baseline condition (mean age = 4 years, 3 months). Nine boys and 7 girls participated in the experimental condition (mean age = 4 years, 1 month). One other participant was excluded from data analysis due to a procedural error. Children were recruited via a database maintained by a medium-sized university in the midwestern United States. Sixteen of the children were White (non-Hispanic), 6 children were Black, 1 was Hispanic, and one parent declined to identify his or her child’s race/ethnicity. The majority of parents reported having at least an undergraduate college education (67% of women and 75% of men). Information regarding average household income was not collected.

Design and Materials

Children in the experimental condition took part in (a) a construction task, (b) a free recall task, (c) an agent memory task, and (d) a reconstruction task. These tasks were administered in a fixed order, with a 10-min break (during which the primary experimenter read a story to the child) between the construction task and the rest of the tasks. Children in the baseline condition participated only in the reconstruction task. Children were randomly assigned to the experimental condition (n = 16) or the baseline condition (n = 8).

For the construction task, children took turns with the experimenter creating a series of novel toys using a set of pictures (a bunny, a gong, a party hat, a ramp, a house, and clay spaghetti [see the Appendix]). The construction of these toys occurred in a fixed order. A warm-up sequence (flowerpot) served to familiarize the child with the nature of the task and was not used in the reconstruction task. To construct each toy, the experimenter and child had to use a set of component parts to complete six steps, each of which corresponded to a construction picture. Some of these toy sequences were adapted and expanded from previous action sequences used by Bauer and colleagues (e.g., Bauer, Hertsgaard, Dropik, & Daly, 1998; Bauer, Van Abbema, & de Haan, 1999). For half of the sequences (enabling sequences: gong, ramp, clay spaghetti), the order of the steps was causally constrained. For the other half of the sequences, the order of the steps was arbitrarily determined (arbitrary sequences: bunny, party hat, house). Figure 1 depicts the steps and pictures of an arbitrary sequence (party hat) and an enabling sequence (gong).

Procedure

All aspects of the procedure were videotaped. During testing, the child and the primary experimenter sat across from one another at a rectangular table measuring 90 cm × 120 cm in a small room. The primary experimenter constructed the novel toys with the child, read the story to the child, and administered the free recall and agent memory tasks. A second experimenter brought the toy materials to the primary experimenter and child and removed the materials once the goal of each sequence was completed.

Construction Task

Warm-up phase. The warm-up phase was conducted to ensure that the child understood the nature of the game (e.g., that he or she was taking turns to create toys with the experimenter) and was capable of using the pictures to create the construction steps. As necessary, the primary experimenter provided encouragement to the child and restated the rules of the game.

The warm-up phase consisted of the primary experimenter and child cocreating one novel toy. To begin, the primary experimenter explained to the child that she and the child were going use a set of pictures to construct toys in a turn-taking fashion. The secondary experimenter then brought out the materials for a four-step
flowerpot sequence. Each construction component for these materials was placed in a set location on the table in a cardboard box on the primary experimenter’s right-hand side. The box was presented on the table such that the envelope containing the step pictures was facing the primary experimenter and obscured from the child’s view. The primary experimenter began the sequence by saying “I’m going to start this one” and removing the picture of the first step of the sequence from the envelope. The experimenter then showed the picture to the child and said, “I need to make it look like this,” and directed the child’s attention to the picture. Subsequently, the experimenter removed the first object (the flowerpot) from the box and placed it on the tabletop. After placing the object, the experimenter said, “See, just like in the picture,” and redirected the child’s attention to the picture.

For the second step, the experimenter removed the next picture from the box and said to the child, “Now it’s your turn to make it look just like this picture,” and directed the child’s attention to the picture. After the child removed the relevant object from the box (a flower), the experimenter redirected the child’s attention to the picture and said, “See, just like in the picture.” Subsequently, the experimenter and child continued to take turns performing each step of the sequence using the pictures (i.e., the experimenter performed Steps 1 and 3, the child performed Steps 2 and 4). Once the goal step was completed, the secondary experimenter removed the stimulus materials from the table, and the construction phase began.

Construction phase. During the construction phase, the primary experimenter and child used a set of prespecified pictures to create a series of six novel toys. For each sequence, the child and experimenter took turns completing each step to goal completion. The format and instructions of the task were similar to those of the warm-up phase. Because children would later be asked who completed each step of the sequences, the primary experimenter was careful not to touch or interact with any part of the apparatus when it was not her turn. In addition, the primary experimenter closely monitored the child so that he or she did not intervene during the experimenter’s turn. In a small subset of cases (2% of all steps), the child had difficulty physically performing a step of the sequence, in which case the secondary experimenter offered physical intervention.

The sequences were constructed in a fixed order across all children (bunny, gong, party hat, ramp, house, spaghetti). The person (i.e., child vs. primary experimenter) responsible for constructing the first

Figure 1. Steps of sample arbitrary and enabling sequences.
step of the first construction sequence was counterbalanced across children: Half of the children constructed the first step of the bunny sequence. Within children, the child and experimenter alternated starting each sequence (e.g., if the primary experimenter performed the first step of the sequence for the bunny, the child performed the first step of the sequence for the gong).

Memory Tasks
Following a short (approximately 10-min) break, during which the primary experimenter read the child a story, the child completed two memory tasks.

Free recall. During the free recall task, the primary experimenter presented the child with a 9-in. × 7-in. image of the final step of each toy sequence and asked, “Remember when we made this? What happened?” and the child was given the opportunity to spontaneously recall what happened during the construction phase for each toy.

Agent memory task. For the agent memory task, children were shown a photograph of each of the steps for a single toy construction and asked (while the experimenter pointed to the piece in question), “Who put this piece on? Did I do that or did you do that?” For each toy, the steps were depicted on a single page in the order in which they were completed. The experimenter then pointed to these pictures in a random order (e.g., Step 3, Step 5, Step 1, Step 6, Step 2, and Step 4) and asked children who had performed the step.

Reconstruction Task
Finally, during the reconstruction task, we re-presented the child with the stimulus box for each toy (e.g., the box with the component parts of the sequence completely deconstructed) and said to the child, “Can you make this one just like we did before?” The stimulus box for each sequence was presented in the same order as in the construction phase. Children were given the subsequent stimulus box once the goal step was completed or the child indicated that he or she was finished.

The purpose of the baseline condition (in which children performed only the reconstruction task) was to ensure that children could not spontaneously create the final products (the toys) using the materials given simply by responding to affordances of the stimuli. If children were given the deconstructed toys and spontaneously created the toys on their own in the absence of training or explicit instruction, these findings would suggest that the toy-building task was not a good task for assessing learning. Because children had never seen the stimuli, the stimuli were presented in a manner similar to how they were presented in the experimental condition, but we said to children, “Can you make something from this?”

The criterion for moving on to the next stimulus box was identical to that of the experimental condition.

Coding
Free recall. For the free recall task, we coded the number of steps reported and the pronoun used to recount the step (“I,” “you,” “we,” or no pronoun).

Agent memory task. For the agent memory task, we recorded whether the child said, (a) “I did it,” (b) “you did it,” or (c) “I don’t know.”

Reconstruction task. Because we were interested in how faithfully children reproduced the sequences from training, we coded each of a child’s actions on the objects. Steps were coded as either correct construction steps (actions on objects that resulted in the correct placement of an object) or other steps. Other steps included incorrect steps (misperformed construction steps; e.g., putting the nose in the party hat sequence depicted in Figure 1 in the wrong orientation), additional steps (construction attempts that were not part of the training sequence; e.g., putting the nose in the party hat sequence beside the water bottle), repeated steps (a repetition of a construction step; e.g., removing the nose from the party hat and replacing it), and ambiguous actions (actions on objects that were not correct construction steps but did not clearly conform to the criteria of incorrect, repeated, or additional steps).

Reliability. Children’s responses were clear and unambiguous for the memory tasks. Therefore, reliability coding was only performed for the reconstruction task. A secondary coder coded 25% of children in the experimental condition (n = 4) and the baseline condition (n = 2). The primary and secondary coder agreed on the classification of 94% of steps for the experimental condition and 98% of steps for the baseline condition. Disagreements were resolved by a third coder.

Results

Free Recall

Memory Tasks

To explore children’s recollection of their own and other’s acts as a function of who started the sequence during the initial construction and sequence type, we first entered the number of steps that children spontaneously reported in the free recall task into an analysis of variance (ANOVA) with the agent who started the initial construction as the between-subjects variable (child vs. experimenter) and sequence type (arbitrary vs. enabling) as the within-subject variable. This analysis revealed no significant main effects or interactions (ps > .30). Thus, in subsequent analyses, we collapsed across these variables. On average, children spontaneously recalled 22.8 construction steps (out of a potential 36; SE = 2.13).

We next examined children’s pronoun use in the context of free recall. When children recalled a step of the construction sequence, they could (a) use the correct pronoun (e.g., say “I put on the nose” for a step that the child had completed during training), (b) commit a pronoun reversal (e.g., say “You put on the nose” for a step that the child completed during training), (c) use the pronoun “we” (e.g., say “We put on the nose”), or (d) fail to use a pronoun (e.g., say “Put on the nose”). As Table 1 indicates, children were more likely to correctly use a pronoun for self- versus experimenter-performed actions (42% vs. 32%) and more likely to reverse pronouns for experimenter-
performed steps than for self-performed steps (13% vs. 4%). This association between the agent who performed the step during the construction task and children’s pronoun usage (correct vs. reversal) was confirmed by a Fisher’s exact test, $\chi^2(1, N = 166) = 10.2, p < .001$. Children were 290% more likely to commit a pronoun reversal when the experimenter performed the step during training than when the step was self-performed (odds ratio = 3.9).

Agent Memory Task

To evaluate children’s performance, we summed the number of “I did it” errors and the number of “you did it” errors across the three enabling sequences and the three arbitrary sequences. Preliminary analyses revealed no main effect of who started the construction phase (child or primary experimenter) and no interactions with other variables ($p > .30$). Therefore, subsequent analyses collapsed across this factor.

We next entered children’s “I did it” and “you did it” errors into an ANOVA with sequence type (arbitrary vs. enabling) as the within-subject variable. This analyses revealed a main effect of type, $F(1, 15) = 16.0, p < .001$; $\eta^2_g = .26$, and no other significant effects or interactions. Children committed significantly more “I did it” ($M = 5.13, SE = 0.98$) than “you did it” errors ($M = 1.20, SE = 0.37$; see Figure 2). Nonparametric statistics confirmed these findings: 15 of 16 children committed more “I did it” than “you did it” errors ($p < .0005$).

Because we had hypothesized that the extent of children’s “I did it” bias might vary as a function of sequence type, we performed planned comparisons between the arbitrary and enabling sequences. These analyses revealed that the “I did it” bias was present for both arbitrary (“I did it” errors: $M = 2.25, SE = 0.51$; “you did it” errors: $M = 0.44, SE = 0.16, t(15) = 4.0, p < .001$), and enabling (“I did it” errors: $M = 2.88, SE = 0.57$; “you did it” errors: $M = 0.75, SE = 0.34), t(15) = 3.5, p < .003$. sequences.

Reconstruction Task

We calculated children’s reconstruction scores by dividing the number of correct steps by the possible number of construction steps (six per sequence) plus any additional, repeated, or ambiguous steps that the child performed. Reconstruction scores were summed across arbitrary and enabling sequences. This measure controls for the possibility of more active children scoring higher on the reconstruction task simply because they produced more actions, thereby increasing the likelihood of reproducing a correct target action. Table 2 presents children’s reconstruction scores as a function of condition.

To ensure that children’s ability to reproduce steps from the construction task actually reflected memory for the sequences, as opposed to affordances of the particular items used in the study, we compared the proportion of correct steps children produced during the reconstruction task as a function of experimental condition. Children in the experimental condition ($M = .78, SE = .03$) significantly outperformed children in the control condition ($M = .09, SE = .02, t(22) = 16.32, p < .0001; \eta^2_g = .89$).

Preliminary analyses revealed no main effects or interactions regarding the agent who started the sequence (child vs. experimenter) on children’s reconstruction performance ($p > .30$), therefore subsequent analyses collapsed across this variable. We next entered children’s reconstruction scores into an ANOVA with sequence type (arbitrary vs. enabling) as the within-subject variable. This analysis revealed no effect of sequence type ($p > .20$) on children’s reconstructions. Planned comparisons revealed that children’s reconstruction performance for enabling sequences ($M = .75, SE = .03$) did not differ significantly from their reconstruction performance for arbitrary sequences ($M = .78, SE = .03$).

Relation Between Agent Memory Performance and Reconstruction Task Performance

To determine whether children’s “I did it” bias was related to their ability to reconstruct the toys from memory, we looked at the relationship between children’s agent memory and reconstruction performance. For children in the experimental condition, we calculated an “I did it” bias score by subtracting the number of “I did it” errors from the number of “you did it” errors and dividing this number by the total number of agent memory errors committed.

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1 One child from the low collaborative condition was not included in the agent memory analyses because she demonstrated errorless performance on the agent memory task until the last five questions were asked. At that point, she answered “I did it” for the final five questions before the experimenter could ask the agent memory question.

2 For effects that reach the level of statistical significance, we report generalized eta squared as a measure of effect size. Recently, scholars have argued that traditional effect size measures (e.g., Cohen’s $d$) and measures of association (e.g., partial eta squared) can be influenced by the design used to assess the effect, making it difficult to compare findings across studies. Generalized eta squared removes potential confounding between the effect size measure and the study design (Bakeman, 2005; Olejnik & Algina, 2003). Bakeman suggested following Cohen’s (1988) guidelines for eta squared to interpret generalized eta squared (where .02 represents a small effect, .13 represents a medium effect, and .26 represents a large effect).

3 In Studies 1 and 2, children’s raw reconstruction scores as well as transformed values ($Y_i = 2\arcsin \sqrt{P_i}$) were analyzed. Analyses performed on transformed scores yielded an identical pattern of results to those performed on raw scores. For the purpose of brevity and clarity, we report only the results of analyses on the raw scores.
This measure controls for the overall number of errors that a child commits. A Spearman rank order correlation revealed a significant relation between the extent of children’s “I did it” bias and their reconstruction performance ($r = .51$, $n = 16$, $p < .02$ [one-tailed]): Children with a stronger “I did it” bias performed better than those with a weaker “I did it” bias on the reconstruction task.

Discussion

The results from Study 1 both replicate and extend the work of Foley, Ratner, and colleagues (Foley et al., 1993; Foley & Ratner, 1998a; Foley et al., 2002; Ratner et al., 2002). We replicated the finding that in the context of a novel joint activity, preschool age children are more likely to overclaim the actions of an adult experimenter as self-performed than vice versa. Our findings suggest that the “I did it” bias is evident across a range of different types of collaborative activities and a range of assessment methods. Our findings also add to this literature by demonstrating a direct relation between children’s “I did it” bias and their ability to reconstruct a series of novel toys: Children with a stronger “I did it” bias and their ability to reconstruct a series of novel toys: Children with a stronger “I did it” bias outperformed children with a weaker or no “I did it” bias. Importantly, in an advance over previous studies (e.g., Ratner et al., 2002), we found that the extent to which children overclaim the actions of others as their own predicted their ability to correctly reproduce the toys on their own, a central aspect of learning performance.

Although we hypothesized that the type of sequence (arbitrary vs. enabling) would impact the strength of children’s “I did it” bias, this prediction was not borne out. However, it is possible that differences between enabling and arbitrary sequences may only emerge under circumstances in which recalling the agent is more challenging than it was in the current study. We explored this possibility in Study 2.

STUDY 2

In Study 2, we sought to identify the extent to which collaborating with another individual influenced children’s agent recall and subsequent ability to reproduce the toy-building steps on their own. Because we were interested in not only the short-term benefits of collaboration on children’s learning but also whether these benefits would be maintained over time, we assessed children’s learning of the toy-building sequences directly after the agent memory task and roughly 4 months later.

We sought to refine and improve the methodology of Study 1 in several ways. First, we omitted the free recall portion of the experiment. We did this because children were often reluctant to provide details of what happened in their free recall and had to be prompted several times. In addition, the inclusion of this task may have influenced children’s subsequent performance on the agent memory task and artificially supported reconstruction performance by giving children the opportunity to view a picture of the completed toy and to rehearse or reminisce what had happened during the construction task.

The second change that we made to the procedure in Study 2 was to modify the format of the agent memory task. In Study 1, children were shown the pictures for each step of a single toy-building sequence together and asked who performed each step in a random order. Because we felt that this presentation format may have boosted children’s performance on the agent memory task and the reconstruction task, in Study 2 we intermixed the pictures from each step of each sequence in a completely random fashion and then administered the task.

To assess how collaboration affected children’s agent recall and subsequent reproduction of the toy building activities, we had children participate in either the high collaborative condition or the low collaborative condition. The high collaborative condition was identical to the experimental condition of Study 1 with the exception of the aforementioned changes. The low collaborative condition differed from the high collaborative condition in that children took turns with the experimenter building individual toys (such that the child created half the toys during training, and the experimenter created the other half) rather than completing each step within a toy-building sequence. Thus, the high and low collaborative conditions were matched in terms of the child’s involvement in the task, the overall level and amount of planning that the child engaged in, the extent to which the child had access to the experimenter’s plans, the presence of turn taking, and children’s attention to the task.

We elected to label these conditions high versus low collaborative rather than collaborative versus noncollaborative because the low collaborative condition still required some degree of collaboration between the child and adult: The adult removed pictures from the box and asked the child to perform the step just like in the picture during the child’s turn. Thus, the adult was still guiding the child’s initial toy-building construction, but the extent of the adult’s participation was less than it was in the high collaborative condition. These conditions differed, however, along two key dimensions: the type of turn taking and the extent to which the experimenter and child worked together toward a shared goal. Both of these factors have previously been demonstrated to affect children’s tendency to claim others’ actions as their own (Foley et al., 2002; Ratner et al., 2002). Working toward a shared goal necessitates coordinating one’s actions with a partner’s. This process may enhance anticipation of upcoming steps leading children to ultimately treat their partner’s actions as their own.

We made two predictions regarding children’s performance. With respect to agent memory performance, we hypothesized that the “I did it” bias would either be unique to the high collaborative condition or enhanced in that condition relative to the low collaborative condition. We further hypothesized that children in the high collaborative condition would outperform children in the low collaborative condition on the reconstruction task. Such findings would provide support for the hypothesis that children’s tendency to treat the actions of others as their own in the context of joint
activity may reflect internalization of the actions of others, which in turn supports learning.

Method

Participants

Forty-two children took part in Study 2 (mean age = 4 years, 2 months; range = 3 years, 6 months to 4 years, 7 months). Children were randomly assigned to one of two experimental conditions. Eleven boys and 10 girls participated in the high collaborative condition (mean age = 4 years, 2 months). Eleven boys and 10 girls participated in the low collaborative condition (mean age = 4 years, 2 months). Seven additional participants were excluded across both conditions due to procedural errors (n = 2), equipment failures (n = 1), and failure to comply with task instructions during the construction phase of the study (n = 4). The recruitment procedures were identical to those of Study 1. Twenty-nine children were White/non-Hispanic, 6 were Black, 4 were Hispanic, and 1 was Asian/Pacific Islander. Two parents declined to identify the race/ethnicity of their child. The majority of parents reported having at least an undergraduate college education (79% of women and 69% of men). Information regarding average household income was not collected.

Subsets of children in the high collaborative condition (n = 14) and the low collaborative condition (n = 13) returned to the lab for a second visit approximately 4 months after their first visit (mean time elapsed for both conditions = 3 months, 25 days; range = 3 months, 15 days to 4 months, 18 days). Across both conditions, children’s average age on their second visit was 4 years, 6 months (range = 3 years, 10 months to 4 years, 10 months).

Design and Materials

Across both conditions, children took part in a construction task, an agent memory task, and a reconstruction task. Although the high collaborative children completed the construction phase in an identical fashion to that of Study 1, the low collaborative children took turns creating toys with an experimenter rather than taking turns completing each step within the making of a toy. As in Study 1, there was a 10-min break between the construction task and the other tasks.

Procedure

Construction Task

Warm-up Task. For the high collaborative condition, the warm-up phase was identical to that of Study 1. For the low collaborative condition, children first watched while the experimenter completed each step of the sequence. For example, the primary experimenter pulled a picture out of the box, showed it to the child, and said, “I need to make it look like this,” then completed the step and redirected the child’s attention to the picture and said, “See, just like in the picture.” On the second step, the experimenter pulled the next picture from the box, showed it to the child and said, “It’s my turn again, I need to make it look like this,” and so forth to goal completion. Subsequently, the sequence was readministered so that the child completed each of the steps. For instance, the child was shown the picture and told “Now it’s your turn, you need to make it look like this.” Once the step was complete, the experimenter redirected the child’s attention to the picture and said, “See, just like in the picture.” Then she pulled the next picture from the envelope and said, “It’s your turn again, you need to make it look just like this,” and so forth to goal completion.

Construction phase. As in Study 1, the child and experimenter sat across from one another at a rectangular table. The primary experimenter was responsible for creating the toys with the child, and the secondary experimenter was responsible for bringing and removing the test material. For the high collaborative condition, the construction phase was identical to that of Study 1. For the low collaborative condition, the construction phase was completed in a manner similar to the warm-up phase with the exception that only one person (the child or the primary experimenter) constructed each of the toys while the other looked on. The person who started the first construction sequence was counterbalanced across children, and the person who started each sequence during the construction phase alternated within child. Thus, half of the children in the high collaborative condition started the bunny, party hat, and house sequences, whereas half started the gong, ramp, and clay spaghetti sequences. Similarly, half of the children in the low collaborative condition constructed the bunny, party hat, and house sequences, whereas half constructed the gong, ramp, and clay spaghetti sequences. For example, a child in the low collaborative condition might create the bunny, followed by the experimenter creating the gong, followed by the child creating the party hat, followed by the experimenter creating the ramp, and so forth.

For both the high and low collaborative conditions, for each sequence step, the experimenter pulled the picture from the box, either asked the child to complete the step or completed it herself, and then redirected the child’s attention to the picture. Across both conditions, care was taken to ensure that the child attended to the picture both before and after the completion of each step, whether he or she had completed the step or the experimenter completed the step. As in Study 1, care was taken to ensure that both the experimenter and child acted on the stimuli only during their respective turns.

Agent Memory Task

Following a short (approximately 10-min) break, during which the primary experimenter read the child a story, children took part in a surprise agent memory task. This task was similar to that of Study 1 with the following exception. Instead of showing children the step pictures in order and asking them about each step within a sequence in a random fashion, we randomly intermixed the 36 pictures and asked children who had performed each of the steps. Children in both the high and low collaborative conditions were queried about all 36 steps. As in Study 1, each child was asked for each step, “Remember when we put this piece on? Did I do that or did you do that?”

Reconstruction Task

As in Study 1, children were given the stimulus boxes for each of the toy sequences one at a time in a fixed order and asked to “make this one just like we did before.” Children across both conditions were asked to recreate all six toys. Children received the reconstruction task directly after the agent memory task. A
subset of children also completed the reconstruction task during their second visit, roughly 4 months later.

**Coding and Reliability**

The coding of children’s agent memory performance and reconstruction task performance was identical to that of Study 1. Because children’s responses were clear and unambiguous for the memory tasks, reliability coding was only performed for the reconstruction task. A secondary coder coded roughly one third of children in the high collaborative condition (n = 7) and the low collaborative condition (n = 7) for their first visit. The primary and secondary coder agreed on the classification of 93% of steps for the high collaborative condition and 94% of steps for the low collaborative condition. A secondary coder also coded roughly one third of children in the high collaborative condition (n = 5) and the low collaborative condition (n = 5) during their second visit. The primary and secondary coder agreed on the classification of 91% of steps for the high collaborative condition and 89% of steps for the low collaborative condition. All disagreements were resolved by a third coder.

**Results**

**Agent Memory Task**

To explore whether the nature and frequency of children’s agent memory errors were affected by the degree of collaboration with the experimenter, we entered children’s memory errors into an ANOVA with error type (“I did it” vs. “you did it” errors) and sequence type (enabling vs. arbitrary) as the within-subject variables and condition (high collaborative vs. low collaborative condition) as the between-subjects variable. This analysis revealed only a main effect of error type, $F(1, 40) = 21.9, p < .0001$, and no other main effects or interactions ($ps < .30$). The coding of children’s agent memory performance and reconstruction performance was identical to that of Study 1. Because children’s responses were clear and unambiguous for the memory tasks, reliability coding was only performed for the reconstruction task. A secondary coder coded roughly one third of children in the high collaborative condition (n = 7) and the low collaborative condition (n = 7) for their first visit. The primary and secondary coder agreed on the classification of 93% of steps for the high collaborative condition and 94% of steps for the low collaborative condition. A secondary coder also coded roughly one third of children in the high collaborative condition (n = 5) and the low collaborative condition (n = 5) during their second visit. The primary and secondary coder agreed on the classification of 91% of steps for the high collaborative condition and 89% of steps for the low collaborative condition. All disagreements were resolved by a third coder.

**Reconstruction Task**

Table 2 presents children’s reconstruction scores as a function of condition.

**Visit 1**

Preliminary analyses revealed no main effects or interactions regarding the agent who started the sequence (child vs. experimenter) on children’s reconstruction performance ($ps > .30$); therefore, subsequent analyses collapsed across this variable. To determine whether children’s reconstruction performance was influenced by the degree of collaboration with the experimenter, we entered children’s reconstruction scores into an ANOVA with sequence type (enabling vs. arbitrary) as the within-subject variable and condition (high collaborative vs. low collaborative) as the between-subjects variable. This analysis revealed a main effect of condition, $F(1, 40) = 4.7, p < .04$, indicating that children in the high collaborative condition ($M = 0.78, SE = 0.02$) outperformed children in the low collaborative condition ($M = 0.70, SE = 0.03$), and no other significant effects ($ps > .20$).

**Visit 2**

Preliminary analyses revealed that who started the training task (experimenter vs. child) exerted no influence on children’s reconstruction performance ($p > .80$). We next entered children’s reconstruction scores from their second visit into an ANOVA with sequence type (enabling vs. arbitrary) as the within-subject variable and condition (high collaborative vs. low collaborative) as the

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4 From one perspective, it may not be fair to compare agent memory errors across the high and low collaborative conditions, because it is possible that once a child in the low collaborative condition remembers who performed a particular activity, that child will remember that the agent performed all the steps of the activity. Such an account predicts that agent memory errors that arise in the low collaborative condition arise from a few children attributing an entire sequence to the wrong agent. Our data, however, indicate that this was not the case. First, the difference in the number of children committing agent memory errors did not differ across conditions: 15 of 21 children in the low collaborative condition committed at least one agent memory error versus 18 of 21 in the high collaborative condition, $x^2(1, N = 42) = 1.3, p > .26$. To further investigate this claim, we undertook a type/token analysis by dividing the number of types (number of sequences on which agent memory errors were committed) by tokens (overall agent memory errors) for children who committed agent memory errors. The proportion was in fact higher for children in the low collaborative condition (.88) than for children in the high collaborative condition (.72), indicating that children’s errors in the low collaborative condition did not derive from a large number of errors on a few sequences. We thank an anonymous reviewer for bringing this concern to our attention.
between-subjects variable. This analysis revealed a main effect of condition, $F(1, 25) = 4.3, p < .05$, $\eta^2_p = .11$; a main effect of sequence type, $F(1, 25) = 4.9, p < .04$, $\eta^2_p = .06$; and no other significant effects ($ps > .05$). Children in the high collaborative condition ($M = 0.50, SE = 0.03$) outperformed children in the low collaborative condition ($M = 0.41, SE = 0.03$) and children more accurately reproduced arbitrary ($M = 0.49, SE = 0.03$) than enabling ($M = 0.42, SE = 0.03$) sequences.

Subsequent analyses revealed that children in the two conditions did not differ in time elapsed since the first visit or average age at the second visit ($ps > .20$). These analyses suggest that differences in children’s reconstruction performance arose as a result of differences in the nature of the construction task.

**Relation Between Agent Memory Performance and Reconstruction Task Performance**

To determine whether children’s “I did it” bias was related to their ability to reconstruct the toys from memory, we looked at the relationship between agent memory and reconstruction performance. As in Study 1, we calculated an “I did it” bias score for children in the high collaborative condition by subtracting the number of “I did it” errors from the number of “you did it” errors and dividing this number by the total number of agent memory errors committed. Three children committed no agent memory errors and were, therefore, excluded from the analysis. A Spearman rank order correlation revealed a marginally significant relation between the extent of children’s “I did it” bias and their reconstruction performance ($\rho = .38, n = 18, p < .07$ [one-tailed]): Children with a stronger “I did it” bias performed better than those with a weaker “I did it” bias on the reconstruction task. When the data from the high collaborative condition of Study 2 were pooled with the data from the experimental condition of Study 1, a significant relation between children’s “I did it” bias and their reconstruction performance emerged ($\rho = .39, n = 34, p < .01$ [one-tailed]).

**Discussion**

In Study 2, we replicated the finding that children overclaim the actions of others as self-performed in high collaborative conditions. Changing the way in which we administered the agent memory task had no impact on children’s error bias.

Children tested in the low collaborative condition showed fewer agent memory errors and no “I did it” bias in their agent recollections. The low collaborative condition shared many task features with the high collaborative condition: The toys that were created, the setting, the pace of the task, and the instructions to complete the task were identical across conditions. The only difference between conditions was the level at which the turn taking occurred and whether the experimenter and child worked toward a shared goal. In the high collaborative condition, the child and experimenter took turns completing each step of the toy-building sequence to create a novel toy. In the low collaborative condition, the child and experimenter took turns building toys.

We assessed learning of the activity across the two conditions to examine the influence of condition on children’s ability to reconstruct the sequences. We found that children in the high collaborative condition were better at reconstructing the toys than were their peers in the low collaborative condition. Moreover, we found that differences in children’s performance as a function of the collaborative nature of the task extended roughly 4 months beyond the initial testing date.

Our findings indicated that there was no effect of who started the training sequence. For children in the low collaborative condition, these findings indicate that children’s reconstruction performance was equivalent whether they originally created the toy or the experimenter originally created the toy. These findings raise the possibility that children in the low collaborative condition might just be less engaged in the task than children in the high collaborative condition. Indeed, some authors have suggested that one of the prime ways that collaboration leads to learning is by enhancing task engagement and enjoyment (e.g., Perlmutter et al., 1989). However, we think differences in attention or engagement across the two conditions are unlikely explanations for our findings, given that children in the low collaborative condition performed better on the agent memory task than did children in the high collaborative condition (e.g., they committed fewer agent errors overall), and given the relation between the extent of the “I did it” bias and learning. Rather, we suggest that because collaboration involves coordination of one’s actions with those of another person, collaborative contexts may lead to not only greater anticipation of another person’s upcoming actions but also of one’s own. This anticipation may lead to greater consolidation of children’s own earlier construction actions.

Although the type of sequence (arbitrary vs. enabling) exerted no influence on children’s agent memory performance or immediate reconstruction performance, differences across these two sequence types emerged in the second visit. Specifically, children performed better on arbitrary sequences than they did on enabling sequences. Bauer and colleagues (e.g., Bauer, 1992; Bauer & Fivush, 1992; Bauer & Travis, 1993) have reported that children typically demonstrate enhanced memory for enabling versus arbitrary sequences. On the basis of these results, it is somewhat surprising that children demonstrated better learning and retention of arbitrary sequences during their second visit. However, research by Bauer and colleagues also indicates that whereas children demonstrate superior memory for the ordering of enabling versus arbitrary sequences, children’s memory for individual target actions within arbitrary and enabling sequences is often equivalent (e.g., Wenner & Bauer, 1999). Furthermore, the majority of studies on children’s memory for enabling versus arbitrary sequences has focused on younger children, and these studies suggest that differences in memory for arbitrary versus enabling sequences diminish during the 3rd year of life (Bauer et al., 1998; Wenner & Bauer, 1999).

In our study, superior memory for arbitrary sequences during the second visit may have emerged because the performance of steps late in the sequence did not require successful performance of steps early in the sequence. To illustrate, in the party hat sequence (see the Appendix and Figure 1), children did not need to have placed decorations on the hat in the correct location or the correct order prior to completing the final step of the sequence (placing the hat on Tweety). In contrast, in the gong sequence (see the Appendix and Figure 1), to complete the final step of the sequence (hitting the gong), children had to first insert the supporting bars, hang the crossbar, and then hang the gong. Thus, an inability to reproduce early steps in enabling sequences may have precluded
children from producing later steps, thus limiting their reconstruction performance.

GENERAL DISCUSSION

Across two studies, and consistent with previous work (Foley et al., 1993; Foley & Ratner, 1998; Ratner et al., 2002), we demonstrated that 4-year-old children show a robust and reliable tendency to overclaim another’s actions as their own in the context of joint activities. Our results demonstrate that working toward a collaborative goal not only enhances children’s tendency to adopt others’ actions as their own but also facilitates learning. We demonstrated that the extent of children’s “I did it” bias is related to learning accuracy and that high collaborative conditions (in which the “I did it” bias is prevalent) are associated with greater learning than low collaborative conditions (in which the “I did it” bias is diminished). These findings extend previous work (e.g., Ratner, 2002) by suggesting that the effects of collaboration are not limited to children’s organizational approach and cannot be explained by differences in task factors that are not central to collaboration (e.g., the amount of overall planning present in the training task). In addition, our findings provide evidence that the link between children’s agent memory errors and learning need not be mediated by high-order variables such as planning language.

Importantly, our findings suggest that the impact of collaboration on children’s learning of novel activities is not transient. Collaborative exchanges facilitate school age children’s performance on memory tasks (Manion & Alexander, 1997) and planning tasks (Gauvain & Rogoff, 1989). Five- and 6-year-old children have shown enhanced performance on a balance-beam task after working with a more competent partner (Tudge & Winterhoff, 1993), and 3- and 5-year-olds who worked with their mothers on a furniture placement were more successful on a later independent recategorization task than were children who worked alone but received corrective feedback (Freund, 1990). Studies have assessed and documented enhanced learning immediately after collaboration (Gauvain & Rogoff, 1989; Manion & Alexander, 1997), several days following collaboration (Azmitia, 1988; Freund, 1990; Tudge & Winterhoff, 1993), 1 week later (Fawcett & Garton, 2005; Garton & Pratt, 2001), and 2 weeks later (Perlmuter et al., 1989). Our findings suggest that the effects of collaboration on children’s learning persist for at least 4 months after the joint activity. Research on children’s learning has also documented that the effects of collaboration generalize to novel activities (e.g., Azmitia, 1988; Garton & Pratt, 2001; Fawcett & Garton, 2005). Future work should address whether the benefits that we have documented in children’s learning extend to novel toy-building activities.

The “I Did It” Bias and Children’s Source Monitoring

Foley, Ratner, and colleagues interpreted children’s errors in agent recall as source-monitoring failures (Foley et al., 2002). The source-monitoring framework (e.g., Johnson, Hastoudi, & Lindsay, 1993) suggests that individuals use various memory features or characteristics—such as semantic knowledge, contextual information, perceptual details, and emotional information—to guide source recall. Specifically, Foley and colleagues focused on the role of cognitive operations—processes activated during the encoding of an event that are subsequently stored in memory and used to guide agent discriminations (Ratner, Foley, & Gimpert, 2000). These cognitive operations can take many forms; however, Foley and colleagues argued that prospective processes (e.g., anticipating action outcomes, imagining oneself performing a given action and planning actions), in particular, play a prominent role in children’s agent attributions (Foley et al., 2002; Ratner et al., 2000).

A variety of task features may engage prospective processes. Our task featured pictorial previews of the upcoming action plans of one’s social partner on a step-by-step basis. However, our findings suggest that these previews are only effective in the context of shared activity goals. According to Foley and Ratner (1998a), collaborative contexts require individuals to coordinate their actions with another person, leading to anticipation of upcoming actions and action effects. In noncollaborative contexts, in which individuals act independently of one another, there is no need to anticipate others’ actions. During agent recall, children rely on the presence or absence of these anticipatory processes to make source judgments. In noncollaborative contexts, children’s recall of anticipations for their own actions facilitates agent discrimination. In collaborative exchanges, agent discrimination is impaired because both self- and other actions yield memories of anticipatory processes. The fact that children’s errors occur in a particular direction—that is, they tend to overclaim others’ actions as their own—has led Foley, Ratner, and colleagues to claim that when children do anticipate or imagine others’ actions, they do so from the perspective of the self (Foley et al., 2002; Ratner et al., 2002).

The “I Did It” Bias and Developmental Changes

The extent to which the “I did it” bias diminishes in older children is an important topic of future inquiry. Age-related changes in children’s “I did it” bias may be linked to children’s source-monitoring abilities in particular and to their reality-monitoring abilities more generally. A variety of research suggests that children’s ability to monitor source information improves throughout the preschool years (Drummey & Newcombe, 2002; Foley & Johnson, 1985; Gopnik & Graf, 1988; Lindsay et al., 1991; Sluzenski et al., 2004; Taylor, Esbensen, & Bennett, 1994; Welch-Ross, 1995) and beyond (Drummey & Newcombe, 2002; Lindsay et al., 2001; Parker, 1995; Sussman, 2001).

Information regarding developmental changes in children’s agent recall, specifically, is more limited. The present study suggests that the “I did it” bias is present and stable in 4-year-olds. Previous work has yielded mixed results regarding the presence of the bias in older children, with some studies indicating that the bias is restricted to preschool age children (Foley et al., 1993) and other studies demonstrating that the bias is present until at least in the early school years (Foley et al., 2002). In addition, even adults experience vicarious agency under certain circumstances (Brown & Halliday, 1991; Brown & Murphy, 1989; Daprati & Sirigu, 2002; Marsh & Bower, 1993; Wegner & Sparr, 2004; Wegner, Sparr, & Winerman, 2004).

We suggest a reconciliation of these findings that is in many ways commensurate with Foley and Ratner’s account (Foley & Ratner, 1998b; Foley et al., 2002; Ratner et al., 2002). Individuals anticipate the actions and action consequences of their social
partner when working toward collaborative goals. This anticipatory simulation relies on the mirror system and can be influenced not only by interpersonal goals (e.g., collaborative goals) but also by various task features (e.g., previews of upcoming action plans, observable models, the timing of action contributions), as well as personal (e.g., imitative) goals. Action simulation helps to foster action reproduction, leading to learning, and can also be used to identify self- and other actions and action effects (based on the degree of resonance; cf. Knoblich & Sebanz, 2006). Thus, situations that yield high levels of action simulation or motor resonance yield a “sense” of agency.

Developmental changes in the extent of the “I did it” bias may occur because children become more sensitive to different degrees of simulation associated with anticipating their own versus others’ actions or because children become more aware of, or reliant on, other cognitive operations (Foley & Ratner, 1998b) or memory characteristics (Parker, 1995; Slutzenski et al., 2004) in making source judgments. The “I did it” bias may attenuate because of developments in children’s ability to bind different memory characteristics into a single memorial representation (Drumme & Newcombe, 2002), as a result of the development of metacognitive strategies or metamemory beliefs (Flavell, 1985; Slutzenski et al., 2004), or because of improvements in inhibitory control (e.g., Carlson, 2005; Zelazo, Müller, Frye, & Marcovitch, 2003) that allow children to exercise these strategies. Such an account predicts that under certain circumstances (e.g., under conditions of cognitive load, when other metacognitive strategies are not available, when adults are queried about their experience of agency vs. who did what), adults too will treat others’ actions as their own.

What Actions Will Children Recode?

Another question for future research concerns the type of actions that children will treat as their own. Recent evidence indicates that the degree of motor resonance during action observation is mediated by the extent to which the observer possesses motor expertise in the observed behavior (Calvo-Merino, Glaser, Grèzes, Passingham, & Haggard, 2004; Järveläinen, Schürrmann, & Hari, 2004). Thus, children should be more likely to adopt other’s actions if these are congruent with their own level of motor expertise. In addition, individuals may use differences between their anticipations of their social partner’s actions and action outcomes and actual observed actions and action outcomes to reject their social partner’s errors and to guide subsequent agent discrimination. A recent study revealed similar event-related potential components for self-performed and observed errors (Bates, Patel, & Liddle, 2005). Thus, an important topic for future inquiry concerns the circumstances under which children will reject others’ actions as their own in the context of collaborative exchanges.

Conclusions

In closing, our findings suggest that working toward a shared goal (vs. working primarily independently) leads children to treat other’s actions as their own and fosters short-term and long-term learning. These findings are in keeping with recent work from cognitive psychology, neuroscience, and developmental science suggesting a common framework for observed and executed actions (Chao & Martin, 2000; Grafton et al., 1996; Grèzes & Decety, 2001; Hamzei et al., 2003; Hari et al., 1998; Hauf & Prinz, 2005; Longo & Bertenthal, 2006; Prinz, 1997; Sommerville et al., 2005). A variety of investigators have suggested that viewing others’ actions triggers a covert simulation of a person’s own motor plans and that this simulation guides individuals’ perception, understanding, and imitation of others’ actions (e.g., Blakemore & Decety, 2001; Blakemore & Frith, 2005; Gallesle & Goldman, 1998; Gallese et al., 2004; Iacoboni et al., 2005; Meltzoff & Decety, 2003; Rizzolatti & Craighero, 2004; Sommerville & Decety, 2006; Wilson & Knoblich, 2005). Enhanced activation of this system during collaborative exchanges may underlie experiences of agency and support the internalization of others’ actions.

Finally, our findings are in keeping with recent perspectives that stress the functional nature of memory and memory errors (Bjorklund, 1997; Schacter, 2001). The present study highlights the benefits of taking a process-oriented approach to cognition, in which cognitive processes are viewed from the vantage point of their adaptability for the learner.

References


(Appendix follows)
Appendix

Steps in Arbitrary and Enabling Sequences

Arbitrary Sequences

Sequence #1: Bunny
1. Put background onto tabletop
2. Put body onto background
3. Put head onto background
4. Put eyes onto head
5. Put nose/mouth onto head
6. Put tail onto background

Sequence #3: Party Hat
1. Put hat onto support
2. Put blue stripe onto hat
3. Put star onto hat
4. Put fake nose onto hat
5. Put pom-pom onto hat
6. Put hat onto Tweety

Sequence #5: Ghost House
1. Put house base onto tabletop
2. Put roof onto house base
3. Put window onto house base
4. Put door onto house base
5. Put chimney onto roof
6. Open door revealing ghost

Enabling Sequences

Sequence #2: Gong
1. Put base onto tabletop
2. Put round side support into base
3. Put square side support into base
4. Put top support onto side supports
5. Hang gong from top support
6. Hit gong with hammer

Sequence #4: Ramp
1. Put tall support onto base
2. Put car onto base
3. Put short support onto base
4. Put ramp onto tall/short supports
5. Put balloon on back support
6. Release car down ramp

Sequence #6: Spaghetti
1. Lift handle of press
2. Put catch bowl onto press base
3. Put clay onto press base
4. Put clay into press
5. Squeeze handle of press
6. Cut spaghetti from press

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1018 SOMMERVILLE AND HAMMOND