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RESEARCH ARTICLE

The role of goals and outcomes in young children's memory for actions

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Abstract

Four- to six-year-old children participated in three experiments designed to investigate action features that may contribute to the self-enactment effect and help clarify contradictory findings in the literature. Although activity is important in young children's learning and development, preschoolers' memory for self-actions is often found to be no better than memory for another person's actions. In the few studies in which the self-enactment effect has been found for this age group, the actions included as test materials differ markedly from those in the studies in which no differences occur. Specifically, the actions in studies finding the effect are goal-directed and enable outcomes whereas the actions in studies that don't find the effect have no instrumental goals, other than to perform the action, and often do not enable outcomes external to the action carried out. In Experiment 1 source memory and in Experiment 2 free recall were better for children's own actions than those of the experimenter when children participated in actions that produced outcomes in a game-like context. Findings from these two studies suggested that action outcomes were particularly important in these self-enactment effects which were then verified in Experiment 3. Our results support the role of self-directed actions for learning in early childhood classrooms, but highlight the contribution of goal-based activities that lead to instrumental and enabling outcomes in that learning.

Keywords Preschool · Self-enactment · Goals · Outcomes · Source monitoring · Recall

Introduction

Activity is central to children's lives and important to many approaches to understanding cognitive development (e.g., Nelson 1986; Piaget 1970; Vygotsky 1962; Gauvain and Perez 2015). As a result, memory for activity has been explored within a wide variety of domains, such as action concepts, autobiographical memory, event memory, eyewitness testimony, motor-skill enhancement, and source monitoring (e.g., Foley 2014). Nevertheless, there is contradictory evidence as to whether a child's own actions are remembered better than another person's actions. The purpose of this paper is to explore action features that might contribute to understanding when and why the self-enactment effect, defined here as better memory for self than other actions, occurs for preschool children. This understanding is important not only for theoretical reasons but also for application to educational contexts. A cornerstone of early childhood education practice is that self-generated activity in the classroom is essential for child learning (e.g., Ballantyne and Packer 2009; Cameron 2012). Identifying when this may or may not be true would be useful to early childhood educators.

To begin to explore the factors that might contribute to the self-enactment effect, we searched for peer-reviewed published studies in which children aged eight or under were tested for their memory of their own and another person's actions. We were able to identify only 14 experiments from 10 papers appearing between 1972 and 2018 that satisfied these criteria. In five of the experiments, at least under some conditions, a self-enactment effect was found (Baker-Ward et al. 1990, Experiments 1 and 2; Bauer et al. 1995, Experiment 3; Sommerville and Hammond 2007, Experiments 1

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and 2), even for children as young as 15 months (Bauer et al 1995). In nine experiments, it was not (Badinlou et al. 2017; Badinlou et al. 2018; Foley and Johnson 1985, Experiments 1 and 2; Johnson et al. 1979, Experiments 1 and 2; Ratner and Hill 1991; Waterman et al. 2017, Experiment 2A; Wolff and Levin 1972). A striking difference between the two sets of studies involved the actions children either performed or watched. When a self-enactment effect was found, actions were carried out as part of an instrumental goal-directed sequence with outcomes that were enabled by individual actions, across the series of actions, or both. Thus, these actions either individually or in a sequence (or both) brought about some consequence and made "something" happen. In the experiments in which no self-enactment was found, the actions were disconnected from one another and had a goal only in the performance of the action itself. Consequently, any outcome that occurred was nested within the action and nothing else resulted from carrying it out. For example, in an action like "open the pen-case" a participant could either open or pretend to open the case, but nothing would result from doing so other than the performance of this action. The opening of the pen-case would lead to a goal-related outcome only if the pen inside or the open case were then used in the service of some other result. Action results seem even further diminished when there is no interaction with an object (Hornstein and Mulligan 2001), either because of the nature of the action (e.g., "point to the circle") or because the enactment involves imaginary elements that preclude an actual outcome from occurring. In all of these cases, children are prevented from making "something" happen either within individual actions or across actions in a sequence.

Studies incorporating outcome-limited actions and finding no self-enactment effect often include a condition involving only verbal presentation of the action description. Questions of primary interest seem to involve memory comparisons between verbal and enacted encoding of the action descriptions rather than comparisons between self and other actions (e.g., Seiler and Engelkamp 2003). Experimental comparisons between action and word presentation of information necessarily invoke conceptual frameworks used to explain processing features relevant to understanding memory for words (e.g., Engelkamp and Dehn 2000; Waterman et al. 2017), in particular the contrast between item-specific and relational information (Hunt and Einstein 1981), rather than a focus on characteristics of the actions. This approach potentially shifts attention away from the most important aspects of actions (Ratner and Foley 1994) and may lead to the use of relatively impoverished actions as experimental materials (Foley and Ratner 2001). Specifically, from the perspective of activity-grounded approaches to cognition (e.g., Barsalou 2016; von Cranach et al. 1982; Wilson 2002), persons are goal-directed and perform actions within the context of larger activities in an attempt to bring about outcomes that satisfy some purpose. Central to this perspective is the goal-directed nature of action and the binding effects of goals on action features (Moeller and Frings 2019). When actions are not organized by goals, they mimic the surface features of their performance, but do not necessarily reflect their goal-directed meanings and become only action symbols.

An example of potential differences derived from the two approaches involves explanations provided by Engelkamp and colleagues for cross-study inconsistencies in memory for subject-performed and experimenter-performed tasks (SPT and EPT, respectively). SPTs are thought to be remembered better than EPTs because of item-specific information (Engelkamp and Zimmer 1997). Action performance forces an individual to focus on action-relevant information such as how to enact a specific action (e.g., "twist a cap" or "lift and ring a bell") and to focus less on contextual information such as temporal ordering or relations among actions. In contrast, EPTs do not require attentional restriction and so both item- and context-specific information may be encoded. When both SPTs and EPTs are presented in a within-subject design, memory for SPTs tends to be better than for EPTs; however, when memory for the two action types is tested in a between-subject design, the effect disappears, except when lists are long (Golly-Haring and Engelkamp 2003). The explanation for this difference is that the contrast in the within-subject design between self and other heightens attention to item-specific actor information boosting memory for self-actions whereas in a between-subject design, when only one actor is present, attention shifts to item-order, a relational or context-focused feature, enhancing memory for EPTs and eliminating the self-enactment effect.

This may be a useful characterization of many SPT and EPT findings; however, when more than one actor is present, as in a within-subject design, the presence of another person creates the opportunity for the target actor to interpret what he or she is doing as connected or coordinated with the other person, potentially in the service of a mutual goal or intended outcome, rather than just watching the other person. A person-based, activity theory approach (Leont'ev 1978; Lewin 1951; Foley and Ratner 2001; Sereda 2011) would start with the assumption that participating individuals attempt to view their actions as goal-directed and will search for contextual cues (such as task instructions, objects, action types, or action outcomes) to support this interpretation. These cues would bind actions together in some way, either as a set of turns between actors, sets of actions within the sequence, across an entire sequence of actions, or between the actor and the outcome produced (e.g., Hala et al. 2013). In turn, these features then would be expected to enhance memory for the actions involved. This information, however, would be considered relational under the Engelkamp model and should eliminate the self-enactment effect and not enhance it, as appears to occur in the child studies. Perhaps there are developmental differences that account for the contrast, but researchers have argued that younger children are less not more likely to show the effect than older children (e.g., Badinlou et al. 2017; Saltz and Dixon 1982), and Baker-Ward et al. (1990) argues that it is children's understanding of the actions they are asked to remember, rather than their developmental status, that is important in whether children at various ages show the self-enactment effect or not. Indeed, it is possible that apparent developmental patterns have occurred precisely because goal-related cues are not associated with the test actions in many of these studies. Finally, even if item-specific, rather than goal-based relational, information is important in understanding children's self-enactment effect, a person-based perspective (Ratner et al. 2000) may be useful in characterizing what this action information might be. In a series of three experiments, we use the person-based approach to help identify action features of goal-directed activities that may be relevant to the self-enactment effect for preschool children. Tasks were varied across the three experiments to test the effect of specific action features on memory for the actions. In Experiment 1, we focused on individual action type; in Experiment 2, on action sequences; and in Experiment 3, on action outcomes.

Experiment 1

In the first experiment, children performed and watched familiar actions carried out with a teddy bear in the context of a collaborative game. Collaborative activities typically involve a mutual goal and the production of a series of outcomes within the action sequence that either lead to accomplishing a final result (e.g., I win!) or express the intended goal of the overall activity through their implementation (i.e., I'm playing a game with Teddy!). The child and the experimenter carried out the actions alternating turns with one another across the course of the game-based sequence. The timing of actors' actions, including turn-taking, provides a basis for children to interpret action sequences as collaborative (Foley et al. 2002), which in turn can positively influence memory (Ratner et al. 2002; Sommerville and Hammond 2007). The information provided by these action cues was expected to support memory for self-action and so we expected to find the self-enactment effect.

Over the course of this game, the two actors carried out two different types of actions, Elaborated or Non-Elaborated. Elaborated items included descriptions of symbolic action elements that would require some kind of extension or elaboration that would not actually be performed. For example, in "play patty-cake with Teddy," "wipe away Teddy's tears," or "rock Teddy to sleep" Teddy could not reciprocate in the game "patty-cake," produce tears, or go to sleep. These elements, if represented, would require additional symbol use (e.g., images, words). Non-elaborated actions involved similar movements as the elaborated actions (e.g., "clap Teddy's hands," "stand Teddy up," or "roll Teddy over"), but the descriptions accompanying them did not refer to any action features that would require representation of something more than performance of the action and its outcome. Note that both types of actions were goal-directed because they were embedded within a game and they both had outcomes, as a result of the entire sequence of actions (i.e., a game) and the individual actions comprising the game. The primary difference between them involved their descriptions and the symbolic elements entailed by these descriptions. According to the item-specific hypothesis, elaboration of individual items should enhance item-specific information and improve self-enactment memory. If so, then the self-enactment effect should be larger or occur only for the elaborated items. In contrast, the person-based perspective would predict that the self-enactment effect would emerge for both types of actions because they both enabled outcomes within and across the action sequence to accomplish a larger goal (i.e., playing a game).

Varying representational requirements across the two action types during encoding also allowed us to consider working memory in this context (Waterman et al. 2017). It might be harder for children to perform the elaborated than non-elaborated actions (Wolff and Levin 1972; Ratner and Hill 1991) because of increased complexity (Hornstein and Mulligan 2001) due to the symbolic representations required during enactment. If so, item-specific information might be reduced because working memory demands would be increased (Badinlou et al. 2018). Consequently, memory for the non-elaborated actions might be better than the elaborated and the self-enactment effect might only occur for the non-elaborated actions.

Finally, we tested action memory using source monitoring (SM) for three reasons. First, SM emphasizes the role of the distinctiveness of the items in making memory-related decisions, potentially highlighting item-specific information, providing a stronger test of the competing hypotheses (e.g., Foley 2014; Johnson et al. 1993; Lindsay 2008). Second, SM paradigms are used typically to evaluate accuracy within the context of a recognition memory task, thereby potentially reducing memory demands for these preschool children. Indeed, some aspects of SM show no or small developmental effects (e.g., Foley 2014; Foley and Johnson 1985). Third, using an SM paradigm allowed us to test for what has come to be called the "I did it" bias or appropriation error, which can be used as an index of collaborative contexts in which there is a shared goal (Foley et al. 1993). If children demonstrate this bias for both types of actions, greater support would be provided that children paid attention to the actions as a sequence and interpreted both types as collaborative and goal-directed.

Methods

Participants

Fifteen girls and 14 boys drawn from Head Start programs in a large US Midwestern metropolitan area participated in this study. Their ages ranged from 4.10 to 5.03 years with a mean of 4.27 years.

Materials

Two groups of 12 actions for a total of 24 were created to be performed by either the child (Self) or the experimenter (Other). One group, Elaborated Actions, involved symbolic embellishments of the actions that reflected themes of play or comfort. The other, Non-Elaborated Actions, did not. Both types of actions involved the performance of similar actions, were designed to be goal-directed, and enabled an outcome, either as the result of individual actions or the entire sequence (i.e., playing a game). Elaborated actions were: (1) hug Teddy, (2) hold Teddy's hand, (3) whisper in Teddy's ear, (4) play patty-cake with Teddy, (5) rock Teddy to sleep, (6) cuddle Teddy, (7) wipe Teddy's tears, (8) smile at Teddy, (9) wave bye-bye to Teddy, (10) give Teddy a kiss, (11) rub Teddy's sore tummy, and (12) tickle Teddy's chin. Non-elaborated actions were: (1) feel Teddy's hat, (2) clap Teddy's hands, (3) put Teddy upside down, (4) bend Teddy's leg, (5) stand Teddy up, (6) bounce Teddy, (7) fly Teddy in a circle, (8) touch Teddy's nose, (9) roll Teddy over, (10) raise Teddy's arm, (11) point to Teddy, and (12) make Teddy hop.

Actions within each group were organized into four sets of three actions each. These action sets were counterbalanced across participants so that the actions within each set were performed equally often as Self or Other actions. Thus, each child experienced 12 actions, three of each of four types: Elaborated Self, Elaborated Other, Non-Elaborated Self, and Non-Elaborated Other.

These actions were also presented during the SM phase of the experiment in addition to six New actions, three Elaborated and three Non-Elaborated, that had not been performed previously. The New actions were also organized into two different sets by group, Elaborated and Non-Elaborated, and counterbalanced across participants so that half of the children were presented an action set within each group type and half were presented the actions from the other set. New actions varied across children in this way so that not all children were presented with the same actions. New Elaborated actions were: (1) play peek-a-boo with Teddy, (2) dance with Teddy, (3) tuck Teddy into bed, (4) sing to Teddy, (5) pat Teddy's cheek, and (6) help Teddy drink his milk. New Non-Elaborated actions were: (1) lift Teddy high, (2) spin Teddy, (3) wiggle Teddy's toes, (4) pull Teddy's sweater, (5) squeeze Teddy's knees, and (6) make Teddy run.

Procedure

The game was begun with the child and experimenter seated next to a table and facing one another. Children were told "we're going to play with this bear named Teddy" as the experimenter pointed to the bear. Teddy was taken from a bag and then held against the chest of the experimenter so that the bear faced the child. The experimenter went on to explain that "sometimes I'll tell you to do things with Teddy and sometimes I'm going to do things too." Teddy was placed next to the experimenter and then a series of practice trials was begun.

A sheet of paper with a large circle in the middle of the page was presented to the child. The experimenter then said, "I want you to trace the circle with your finger. Then you would trace the circle." If the child did not initiate the action, the experimenter then said "go ahead." When the child completed the action, the experimenter then said, "Good!" The experimenter then went on to say, "But other times I'll say I'm going to trace the circle with my finger. Then I would trace the circle and you would watch." The experimenter demonstrated the action by tracing the circle with her finger. The experimenter then presented a square and said, "I'm going to trace the square with my finger," which she subsequently traced. Next she presented the child with a triangle and said, "I want you to trace the triangle with your finger." When the child completed the action, she praised the child by saying, "Good!" Before beginning the experimental procedure, the experimenter presented a toy frog and asked the child to pick up the frog. After the child completed the action, she put a toy drum on the table and said, "I'm going to turn over the drum." Once she performed this action she said, "We're ready to play our game."

The name of each of the 12 actions to be carried out during the presentation phase (i.e., three Self Elaborated, three Other Elaborated, three Self Non-Elaborated, and three Other Non-elaborated) was written on an index card. The index cards were shuffled and the experimenter read the name of the action to be performed and who should carry it out. After all of the actions were completed, the child and the experimenter talked about home, play, or preschool for about 3 min. Then a surprise SM task was initiated. After adding cards with the name of each of the six New actions to the deck of performed actions, the deck was shuffled and children were told that they were going to play another game. This time the experimenter said the name of an action and then asked, "Did you do it, did I do it, or is it new?" The experimenter said the name of the first action from the card and if the child did not respond she repeated the three response options. The experimenter recorded the child's response on a data sheet. When all of the 18 actions were presented and responded to (the 12 "old" actions that had been performed and the 6 new actions that had not), the child was thanked for playing the game.

Results

Source monitoring

The number of actions that children correctly identified as an action they did or the experimenter performed was entered into a 2 (Actor: Self, Other) × 2 (Action Type: Elaborated, Non-Elaborated) × 2 (Gender: Boys, Girls) ANOVA. The first two factors were within-subject. The highest possible score for each of the four action types was three. There were significant main effects of Actor, $F(1, 27) = 6.73$, $p < 0.02$, partial $\eta^2 = 0.20$ and Action Type, $F(1, 27) = 12.39$, $p < 0.01$, partial $\eta^2 = 0.31$. The number of correct Self actions was higher ($M = 2.47$, SD = 0.61) than Other actions ($M = 2.05$, SD = 0.81). More Elaborated ($M = 2.48$, SD = 0.59) than Non-Elaborated ($M = 2.03$, SD = 0.73) actions were also more often correct.

Recognition memory

To ensure that source monitoring patterns did not emerge because of poor encoding of the other person's actions or a tendency to respond "I did it" for most items, we determined whether Self and Other actions could be identified as having occurred equally often. The numbers of Self-Elaborated and Non-Elaborated actions that children attributed either themselves or the other person were summed separately to create two Self-Action scores. Similarly, the numbers of Other-Elaborated and Non-Elaborated actions that children attributed either to the other person or to themselves were summed separately to create two Other-Action scores. These measures were entered into a 2 (Actor: Self, Other) × 2 (Action Type: Elaborated, Non-Elaborated) ANOVA. Both factors were within-subject and the maximum score was 3 for each of the four action types. There were no significant effects. Self-Elaborated ($M = 2.76$, SD = 0.58), Self-Non-Elaborated ($M = 2.59$, SD = 0.68), Other-Elaborated ($M = 2.69$, SD = 0.71), and Other-Non-Elaborated ($M = 2.62$, SD = 0.62) actions were all recognized equally well.

Performed action errors

Children could commit one of the two types of errors on trials involving actions that were actually performed by either the child or the experimenter. They could say that an action that had actually been performed by either themselves or the experimenter had been performed by the other person, or they could incorrectly say that the performed action had not been carried out and was new. Note that in the Self condition the person attribution error would involve saying "You did it" and in the Other condition the person attribution error would involve saying "I did it." When incorrectly identifying a performed action as "new," the form of the response would not differ in the two conditions. Three children who made no errors were excluded from this analysis, resulting in an n of 26 with 13 girls and 13 boys. Errors were entered into a 2 (Actor: Self, Other) × 2 (Error Type: Person Attribution, New) × 2 (Action Type: Elaborated, Non-Elaborated) × 2 (Gender: Boys, Girls) ANOVA. All factors were within-subject except gender. Overall, error rates were low, less than one per each of the four action types ($M = 0.41$, SD = 0.26); however, effects were observed. Main effects occurred for Actor, $F(1, 24) = 5.55$, $p < 0.03$, partial $\eta^2 = 0.19$; Action Type, $F(1, 24) = 12.22$, $p < 0.01$, partial $\eta^2 = 0.34$; and an interaction between Actor and Error Type, $F(1, 24) = 6.75$, $p < 0.01$, partial $\eta^2 = 0.22$. The effects for Actor and Action Type mirrored the findings for correct items: Fewer errors occurred for Self ($M = 0.31$, SD = 0.32) than Other actions ($M = 0.53$, SD = 0.39) and for Elaborated ($M = 0.29$, SD = 0.30) than Non-Elaborated actions ($M = 0.55$, SD = 0.59). The interaction occurred because errors did not differ by Actor for incorrectly saying that the item was "new" (Self: $M = 0.39$, SD = 0.53; Other: $M = 0.39$, SD = 0.59); however, there was a bias to say "I did it" ($M = 0.67$, SD = 0.62) more often than "You did it" ($M = 0.23$, SD = 0.38). This attribution error did not depend on Action Type.

New items

The number of new items correctly identified was entered into a 2 (Action Type: Elaborated, Non-Elaborated) × 2 (Gender: Girls, Boys) ANOVA. The highest possible number of items correct for each Action Type was three. Only a main effect of gender was observed, $F(1, 27) = 11.74$, $p < 0.01$, partial $\eta^2 = 0.30$. Girls ($M = 2.23$, SD = 0.90) outperformed boys ($M = 0.93$, SD = 1.14). The number of elaborated actions identified as new ($M = 1.55$, SD = 1.30) was equivalent to the number of Non-Elaborated actions ($M = 1.66$, SD = 1.26).

New item errors

Incorrect responses to new items could involve either claiming "I did it" or "You did it." The number of new item errors was entered into a 2 (Error Type: I did it, You did it) × 2 (Action Type: Elaborated, Non-Elaborated) × 2 (Gender: Girls, Boys) ANOVA. The highest possible number of errors for each action type was three. Only children who made an error on new items were included in this analysis, resulting in an n of 22 with 10 girls and 12 boys. No effects were observed. The mean number of errors was 0.92 (SD = 0.52).

Discussion

The key findings from this experiment are that the self-enactment effect was observed and that the effect was equivalent for both action types. Source memory for the Elaborated actions was greater than for the Non-elaborated actions but the self-enactment effect occurred in both, even though the recognition memory results showed that children encoded both Self and Other actions equally well. Finding the self-enactment effect is consistent with the results of other child studies described in the Introduction that have used goal-related, outcome-enabled actions as test items. Although self- and other-actions were interleaved in a within-subject design, potentially providing item-specific information, we still should have observed a difference in the self-enactment effect between the Elaborated and Non-elaborated actions. These findings, then, are more consistent with a person-based approach to action memory and suggest that the contribution of item-specific information may best apply when decontextualized actions are included as experimental materials. Better memory for the Elaborated actions also suggests that children's performance of both types of actions was well within their working memory capacity. Perhaps because these actions were play-like and would be familiar, working memory demands were reduced and better recall of the actions resulted (Jaroslawska et al. 2016). We did not assess working memory, however, so its potential role is unclear.

The suggestion that the entire set of actions may have been interpreted as a collaborative, goal-based sequence is bolstered by the presence of the appropriation error for both action types. The appropriation error (more "I did it" than "You did it" errors) has been found to be an index of collaborative or goal-related sequences, occurring when two people's actions are coordinated to accomplish a common outcome and absent when they are not (e.g., Foley et al. 2002). The description of the sequence as a game, turn-taking between the two actors, enabling of action outcomes, and the involvement of the toy bear within each action may have served as cues that the actors or their actions were bound together by their goals and outcomes. Note that the effect of the presence of the bear throughout the action sequence would lead to different predictions from the person-based and item-specific perspectives. The person-based perspective would predict that the bear would increase the likelihood of a self-enactment effect because it could cue the presence of a collaborative, goal-based sequence whereas an item-specific explanation would predict the opposite. The bear's involvement in every action would reduce action discriminability and as a result a self-enactment effect would be less likely to occur.

Experiment 2

Although we found evidence that the self-enactment effect was equivalent for the two action types in the first experiment, the actions in each differed. There was no obvious difference between their action features, but it is possible that some characteristics of the elaborated actions reduced the strength of the self-enactment effect. Stronger evidence for the role of goal-directed sequences in the self-enactment effect would be provided if the actions themselves were identical within different sequence types. In addition, accuracy for source monitoring (82%) and recognition memory (89%) was quite high and may have masked effects of item-specific information despite our deliberate choice of SM to test discriminability of action source. Moreover, memory for source can be independent of memory for the action itself (e.g., Foley and Johnson 1985; Johnson et al. 1993) so different results may have occurred if children's free and cued recall of the actions had served as the memory measures. Free and cued recall are often used as memory measures in SPT/EPT studies with older children as described in the Introduction, so interpretation of results in relation to other findings might be more easily drawn.

In Experiment 2, we examined the self-enactment effect again under two instructional conditions. Each involved the same action test materials. In both, the actions were goal-directed and enabled outcomes for each individual action performed. In addition, the actions involved turn-taking and a character common to the actions, just as in Experiment 1. But one set of actions also created a causal sequence (Sequence-Outcome) with an additional overarching goal and the other did not (Action-Outcome) (Schult et al. 2014). The difference was created by the story children heard and the props presented to accompany each story which either led to actions enabling outcomes across the entire sequence (Sequence-Outcome) or only for the individual actions within the sequence (Action-Outcome). Children were also required to free recall the actions with and without cues.

Under Sequence-Outcome instructions, children were told that a prince or princess lived in a magical kingdom and was attempting to get home to the castle from school. But along the way there were many things he or she had to do in order to arrive at the castle so the child and the experimenter were going to help the prince or princess reach the destination. This story was intended to strengthen children's interpretation of the actions as enabling an outcome across the sequence of actions in that the performance of each would enable the one following it in order to accomplish the overall goal (e.g., Bauer 2007). The cues supporting this story included dolls and models of a castle and a school. Each action was carried out with props that were placed within individual boxes. The boxes were arranged in rows and the school was placed at what was designated the "beginning" of the journey and the castle, at the "end." Under Action-Outcome instructions, children were told that they were going to help a toy squirrel carry out the actions which were arranged in the boxes as a single row. No model of a castle or school was present, and no narrative was provided to support a sequence-outcome interpretation of the actions. Instead, the outcomes that occurred were enabled by the individual actions (e.g., unlock the gate, drive through the mountains). Therefore, in the two conditions the actions and the individual outcomes they produced were exactly the same but only in the Sequence-Outcome condition was there an intended result to be accomplished and bound together by the sequence as a whole.

Because the action sequences were similar to those in Experiment 1 in that there was a game-like context, enabled outcomes, a common action focus (prince/princess, squirrel), and turn taking, we expected the self-enactment effect to occur only or be greater in the Sequence-Outcome condition, if the source monitoring results generalized to free or cued recall. Finding the self-enactment effect in both conditions might imply that children interpreted both sequences as making "something" happen, either across the sequence or in response to individual actions. Finding no self-enactment effect in either condition would suggest that children interpreted both sets of actions as ones that led to no outcomes. Finally, no overall recall differences between conditions might occur because the actions in each were exactly the same.

Methods

Participants

Forty preschool children, 24 boys and 16 girls, from a university early childhood center participated in this study. Children ranged in age 4.0–6.9 years with a mean age of 5.2 years. Information concerning age was not available for two children because parents did not provide it.

Materials

Sixteen simple actions were created for use within the experiment. Each action was described by a verb and either an object or a prepositional phrase. These actions included (1) turn the wheel, (2) unlock the gate, (3) knock down the blocks, (4) go down the slide, (5) put down the bridge, (6) fly over the trees, (7) roll down the hill, (8) drive through the mountains, (9) climb the ladder, (10) swing over the hole, (11) hop through the beads, (12) open the door, (13) crawl under the net, (14) walk on the rope, (15) chop through the wall, and (16) pull out the plug. Actions were counterbalanced so that each action appeared equally often as a Self (child) and Other (experimenter) action. During the experimental task, children experienced only half of the actions (eight) and the actions experienced were counterbalanced so that each of the 16 appeared equally often across all children.

The props that defined the actions and made it possible to perform them were constructed to be self-contained within a separate box for each action. Each box was 11″ long, 6 and 3/8″ wide, and 3½″ deep. A square opening measuring 2½″ high and 3½″ wide was cut out of each end of the box so that the materials inside could be easily accessed by the child or experimenter to perform the action. Props inside the box were constructed either of papier mache, cardboard, or plastic. For "drive through the mountains," for example, models of two mountains were created from papier mache and then painted brown with white "snow caps" added on top. For "open the door," a wall made of plastic blocks was built to extend across the width of the box with a central door that opened and closed. These props were complemented by any additional objects needed to complete the action (e.g., a plastic car for "drive through the mountains," a bathtub plug for "pull out the plug," a ladder for "climb the ladder").

For Sequence-Outcome trials, the boxes were arranged in five rows with one box in rows 1 and 5 and two boxes in the other three. Spaces were left between the boxes so that the child could access each box to perform the action. Two additional boxes, one decorated to represent a school and the other, a castle, appeared at either end of the maze connecting the eight action boxes. The box representing the school was at the beginning of the maze near the first action box and the box representing the castle sat near the eighth action box. Children were given a doll, either male or female selected to match their gender, to manipulate as they wished during the Sequence-Outcome trials. For Action-Outcome trials, the boxes were lined up in a row and no school or castle was presented to them. Instead of a doll introduced as the prince or princess, children were given a toy squirrel. Half of the children participated in the Sequence-Outcome condition and the other half, in the Action-Outcome condition.

Procedure

The name of each of the 16 actions was printed on a separate index card. These cards were used to determine the order in which the action boxes were set up in both the conditions. Before the experimental session began, the experimenter selected the eight cards representing the actions the child would be presented and separated them into two piles of four cards each. One pile was for Self (child) actions and the second, for Other (experimenter) actions. Each pile of cards was shuffled separately. The experimenter selected the top card from the "Other" pile as the first action to be performed, the second card from the "Self" pile, and then alternated card selection between the two piles until all the cards had been ordered. The presentation order to be used during the session was recorded on the data sheet and the action boxes were set up accordingly.

After the experimenter escorted the child from his or her classroom to a nearby room, the session began. In both conditions, the experimenter told the child, "I have some things for us to do. We're going to use these boxes. Each one of them has something inside that's fun to do."

For children in the Sequence-Outcome condition, the experimenter continued by saying, "In the game we're going to play this prince (princess) lives in a magical land where there are all sorts of fun things to do. He (she) lives in that castle over there, and he (she) goes to school over here. Every day after school, he (she) gets to go through all these things on his (her) way home. Every day he (she) has to go through these crazy things on his (her) way to the castle. He (she) has to get through one before she can do the next one, and he (she) has to get through that one before the next one—all along the magical path to the castle. You and I are going to take turns helping her so that neither one of us gets too tired. I'll help him (her) do the first thing, then you help him (her) do the second thing, and you and I will take turns like that until the prince (princess) gets all the way to the castle. When we're all done, I'm going to ask you to tell me the story of how the prince (princess) got to the castle. So you'll have to watch the prince (princess) carefully so you can remember everything he (she) did to get to the castle. Because when we're done I'm going to ask you to tell me the story of how the prince (princess) got to the castle." During the actions, children were reminded that they were helping the prince or princess get to the castle.

After the general introduction to the game and the boxes, children in the Action-Outcome condition were told, "You're going to do some and I'm going to do some. I'll do the first one and you do the next one. Then when we're all done, I'm going to ask you to tell me the story of the squirrel. You'll have to watch the squirrel carefully so you can remember everything he did. Because when we're done I'm going to ask you tell me the story of the squirrel."

When all the actions were completed, recall was begun. The experimenter told the child, "now I want to play another game.' For children in the Sequence-Outcome condition, the experimenter said, "I want you to tell me the story of how the prince (princess) got to the castle. I want you to tell me all the things the prince (princess) did to get to the castle." If children did not respond after a short pause, the experimenter said "Can you remember anything about the story of the prince (princess)?" During recall when the child paused, the experimenter asked, "Anything else?" When children appeared to have recalled all that they could, the experimenter said, "That's very good but maybe I can help you remember some more of the things the prince (princess) did. I'll start and you finish it. We made the prince (princess) (verb phrase) the…." For children in the Action-Outcome condition, after introducing the recall procedure the experimenter said, "I want you to tell me the story of the squirrel. I want you tell me all the things the squirrel did." If the child did not respond right away, the experimenter prompted the child with "Can you remember anything about the story of the squirrel?" The rest of the recall procedure was the same as in the other condition with the experimenter substituting "squirrel" for prince or princess.

Measures

The number of items reported before the verb phrase cues was the measure for Free Recall. The number of new (unique) actions reported after the cue were added to Free Recall for the Total Recall measure. Free Recall measured all the items children could generate on their own without retrieval support. Total Recall measured all the items children could generate both on their own and with cues, providing a better measure of what children had encoded.

An ordering score for free recall was also calculated (e.g., Ratner et al. 2002). If children were more likely to represent the actions as a sequence they might be more likely to recall the actions in the order in which they occurred. The number of pairs of actions that were recalled in order divided by the number of pairs possible to recall (i.e., $n-1$) served as the order score. If an action recalled within each pair occurred before the other in the presentation sequence, it was counted as an ordered pair. For example, if the first action recalled actually occurred in the sequence before the second action recalled, one ordered pair was counted. Similarly, if the second item recalled actually occurred before the third item recalled an ordered pair would be counted. Seven children had to be eliminated from this analysis either because no actions or only one action could be recalled ($n=4$), resulting in no ordered pairs, or because order information was inadvertently not recorded ($n=3$). There were 16 children in the Sequence-Enabled condition and 17 in the Action-Enabled condition for this analysis.

Results

Preliminary findings indicated that gender was not a significant factor in any recall analysis and was, therefore, excluded as a factor. All analyses are based on an n of 40.

Free recall

The number of actions children reported during free recall was entered into a 2 (Actor: Self, Other) × 2 (Outcome:

Sequence, Action) ANOVA. The first factor was within-subject and the second, between-subject. The highest possible score was 4 for each of the four action types. Only the main effect of Actor was significant, $F(1, 38) = 4.57$, $p < 0.04$, partial $\eta^2 = 0.11$. The number of Self actions recalled was higher ($M = 1.80$, SD = 0.94) than Other actions ($M = 1.40$, SD = 1.10); however, recall of Sequence-Outcome ($M = 1.70$, SD = 0.98) and Action-Outcome ($M = 1.50$, SD = 0.61) actions did not differ, $F(1, 38) = 0.60$, $p > 0.40$.

Total recall

The total number of actions children reported during free and cued recall was entered into a 2 (Actor: Self, Other) × 2 (Outcome: Sequence, Action) ANOVA. The highest possible score was 4 for each of the four action types. No significant effects emerged. Self ($M = 3.10$, SD = 0.90) actions were reported more often than Other ($M = 2.82$, SD = 0.76) actions, similar to free recall; however, the difference was not significant, $F(1, 38) = 1.64$, $p > 0.20$. Sequence-Outcome ($M = 3.05$, SD = 0.76) and Action-Outcome ($M = 2.88$, SD = 0.58) recall also did not differ, $F(1, 38) = 0.67$, $p > 0.40$.

Order scores

The mean proportion of ordered pairs free recalled in the Sequence-Outcome ($M = 0.59$, SD = 0.38) and Action-Outcome ($M = 0.58$, SD = 0.37) conditions was the same, $t(31) = 0.09$, $p > 0.90$.

Discussion

These results replicate and extend the findings of Experiment 1. Within the context of game-like sequences with outcomes, these young children free recalled the actions they produced better than those of the experimenter, demonstrating the self-enactment effect once again with a different measure. With cues, however, both actors' actions were remembered equally well, also demonstrating that actions of both actors were encoded but that the child's own actions were easier to retrieve in the absence of contextual support. This result too mirrors the findings in Experiment 1 involving source monitoring and recognition memory. Nevertheless, we did not find a difference in the self-enactment effect between outcome conditions. Free and Total action recall was the same whether the actions were organized to produce an outcome as a result of the sequence as a whole or whether the outcomes produced only resulted from the individual actions themselves.

Because children recalled their own actions better than those of the experimenter in both conditions, children may have interpreted both sets of actions as enabling outcomes, making "something" happen, either across the sequence or for individual actions. The equivalent order scores and recall of the Sequence- and Action-Outcome actions suggests that children responded to both sets of actions similarly. The basis for that similarly, however, is unclear. They may have interpreted the actions in both conditions as enabling outcomes across the sequence because they were told they were playing a game, took turns within the game, were asked to tell a story, and they played with a common figure across the actions traversing space and moving the figure from action box to box. In contrast, they might have focused on the outcomes of the individual actions within the sequence and may have been insensitive to the two different structures we were attempting to create. In either case, however, the results suggest that children interpreted the actions as instrumental, producing outcomes derived from and bound to their goals in bringing them about.

Experiment 3

If children interpreted the actions in Experiments 1 and 2 as instrumental, making "something" happen, there are at least two types of cues that could support this interpretation, sequence and individual action outcomes. Insight into the role of these cues in the self-enactment effect might be provided if self-enactment recall were reduced or eliminated when one or both of these cues were removed. We hypothesized that sequence outcomes were supported by the presence of a common character, a story, and the description of the actions as a game. These cues were eliminated in this experiment and we expected that if sequence outcome cues were primary in influencing the self-enactment effect that self-actions would be recalled the same as another person's actions regardless of action type because these cues would not be available.

Alternatively, children could have focused not on the overall outcome of the sequence but instead on the outcomes of individual actions they produced, representing these actions as bringing about a particular action's result. If so, then removing individual action-outcome cues should eliminate the self-enactment effect when self-generated action outcomes do not occur. To test this hypothesis, two types of actions were included in this experiment: those that enabled individual action outcomes as in Experiments 1 and 2 and those that did not, as is more typical in SPT/EPT studies. The actions performed and the objects involved were exactly the same whether an outcome occurred or not but in one version the action made something else happen (outcome present) and in the other, it did not (outcome absent). For example, one action involved turning a crank on a box. When an outcome was produced, the crank turn released a doll that popped out of the box. Without an outcome, nothing occurred. When the crank was turned the box lid remained closed and no doll appeared. If self-produced outcomes influence the self-enactment effect, as the person-based perspective would predict, then children should only remember their own actions better than the adult's when the actions they perform lead to some result external to the action producing it. The person-based perspective would predict that self-actions that produce no outcome independent of the action should be remembered no better than the other person's actions, with or without outcomes.

If self and other memory are the same in the presence of an outcome, regardless of the actor who produces it, then the salience of the outcome rather than the instrumental relation between the actor and the outcome he or she produces would seem important in the self-enactment effect. The characteristics of outcomes are important in young children's memory (Ratner et al. 2001) so outcomes themselves might be effective memory cues regardless of who produces them. It is also possible that actions without outcomes might be better remembered than those with outcomes because actions typically lead to some result. Thus, actions with no outcomes might be surprising, increase attention to them, and improve memory (e.g., Stahl and Feigenson 2017; Ratner et al. 2019). The item-specific hypothesis would predict either finding because in both cases distinctiveness of the action would be enhanced.

Methods

Participants

Sixteen children, 6 boys and 10 girls, participated in this study. Children were between 4.1 and 5.6 years with a mean age of 5.0 years. Participants were enrolled in a university early childhood center.

Materials

Twelve actions in two different versions, one resulting in an outcome and the other not were developed for use in this experiment. The 12 actions were: (1) drop the marble, (2) cut the balloon, (3) trace the duck, (4) pull the strings, (5) turn over the can, (6) mix up the sand, (7) blow on the wand, (8) spin the wheel, (9) shake out the powder, (10) turn the handle, (11) shake the barrel, and (12) dunk the paper. The materials for both versions of the actions looked the same, but for the Outcome-Absent actions the materials were altered in some way so that the action produced no result. For example, in both versions of "pull the strings" a puppet was placed in a box and strings were attached to it through the top of the box. In the Outcome-Present version, when either the child or adult "pulled the strings" at the top of the box the puppet moved. In the Outcome-Absent version of the action the puppet strings were attached to the sides of the box and pulling the strings on the top had no effect on the puppet's movement. In the Outcome-Present version of "turn over the can" a toy, which resembled a can, made an animal noise when turned over. For the Outcome-Absent version of the action, the sound was disabled and so nothing was heard when the can was manipulated. As a final example, the two versions of "blow on the wand" involved a small bubble wand and a bottle of liquid. In one version, the liquid contained soap and in the other, the liquid was water, colored to match the soap. Bubbles were produced in the outcome-present version with soap but nothing occurred with water in the absent-outcome action.

Each child experienced three actions under all four conditions: Self Outcome-Present, Other Outcome-Present, Self Outcome-Absent, and Other Outcome-Absent. Actions were counterbalanced so that they appeared equally often across participants within each action type. The actions for each child were presented in a random order.

Procedure

Children were accompanied by an experimenter to a quiet room adjacent to their preschool. Children were told that they were going to do some fun things with the experimenter and that they would do some and she would do some. Children were told that they would be asked to remember all the actions after completing them. For each action, the experimenter placed the materials to be used on a small child-sized table positioned between the child and the adult. For Self Actions the experimenter said, "You do this one," and then said the name of the action with one repetition. For Other Actions the experimenter said, "I'll do this one." She performed the action while labeling it twice. Once an action was performed the materials were placed into a basket and covered with a cloth. After all 12 actions had been completed, the recall phase was begun. Children were asked to tell the experimenter all the things that the two of them just did. Once all the actions that the child was able to recall were reported, the experimenter said, "You remembered a lot of things, but maybe I can help you remember some more." The experimenter provided the verb for each action even if it had been reported during Free Recall and then asked the child to complete the action with the object. As in Experiment 2, Free Recall was the number of items reported before the action cue and Total Recall was the sum of the number of unique items reported before and after the cues. As in Experiment 2, Free Recall measured all the items children could generate on their own without retrieval support. Total Recall measured all the items children generated both on their own and with cues, providing a better measure of what children had encoded.

Results

Preliminary findings indicated that gender was not a significant factor in any recall analysis and was, therefore, excluded as a factor. All analyses are based on an *n* of 16.

Free recall

The number of actions children reported during free recall was entered into a 2 (Actor: Self, Other) × 2 (Outcome: Present, Absent) within-subject factor ANOVA. The highest possible score was 3 for each of the four action types. The interaction between Actor and Outcome was significant, $F(1, 15) = 5.00$, $p < 0.05$, partial $\eta^2 = 0.25$. The number of Self Outcome-Present actions free recalled was significantly greater ($M = 1.13$, SD = 0.72) than Other Outcome-Present actions ($M = 0.56$, SD = 0.51), $t(15) = 3.09$, $p < 0.01$, whereas the number of Self Outcome-Absent ($M = 0.69$, SD = 0.79) and Other Outcome-Absent ($M = 0.88$, SD = 0.96) actions recalled did not differ from one another, $t(15) = 0.72$, $p > 0.45$.

Total recall

The total number of actions children reported during free and cued recall was entered into a 2 (Actor: Self, Other) × 2 (Outcome: Present, Absent) within-subject factor ANOVA. The highest possible score was 3 for each of the four action types. Again, a significant interaction occurred between Actor and Outcome, $F(1, 15) = 10.91$, $p < 0.01$, partial $\eta^2 = 0.42$. The pattern was the same as that of free recall in that Self Outcome-Present actions were reported significantly more often ($M = 2.13$, SD = 0.81) than Other Outcome-Present actions ($M = 1.44$, SD = 0.63), $t(15) = 2.30$, $p < 0.05$, whereas Self Outcome-Absent ($M = 1.31$, SD = 1.08) and Other Outcome-Absent ($M = 1.62$, SD = 0.72) actions were recalled equally often, $t(15) = 1.32$, $p > 0.20$. Self Outcome-Present actions were also recalled more often than Self Outcome-Absent actions, $t(15) = 3.31$, $p < 0.01$.

Discussion

Children remembered their own actions better than those of the experimenter only when their actions produced an outcome. Action outcomes in and of themselves were not remembered better; it was the relation between the actor and the outcome that was important in the self-enactment effect. This pattern supports the predictions made from the person-based perspective and is inconsistent with the item-specific hypothesis. Moreover, this effect occurred even when actions were given as cues, in contrast to Experiment 2. This suggests that children may have been less attentive to the other person's actions, and encoded them more poorly, without the support that outcomes provided. The pattern of results also suggested that neither the presence of a game, the consistency of a common object, or turn taking are necessary for the self-enactment effect to emerge. These action features may support interpretation of a set of actions as goal-based with outcomes enabled across a sequence but self-produced outcomes appear more relevant to the effect.

General discussion

Across three experiments that included various memory measures, 4- to 6-year-old preschool children remembered their own actions better than those of the experimenter. Whether the measure involved source monitoring or free recall, children were better able to discriminate action source or report the action if they had performed it, at least when outcomes occurred in response to their actions. These self-enactment effects are consistent with findings from other studies that incorporate actions involving features that reflect instrumental goals and enable outcomes, providing support for the person-based perspective outlined earlier. The only time that the self-enactment effect did not occur was in Experiment 3 when the actions children performed produced no outcomes, consistent with the findings of other studies in which these kinds of actions typically occur. Importantly, the appearance of an outcome in and of itself, as the item-specific hypothesis would predict, was not the critical factor; it was the production of the outcome by the child that was significant. The other person's actions were remembered similarly whether an outcome was enabled or not. Thus, making "something" happen by the child actor seems critical for the self-enactment to occur. Outcomes may serve as markers, both in the realization of one's goals through an action to bring about the intended result and then later exist as a cue when remembering this realization (e.g., what I did made something happen) perhaps because goals bind actions and their outcomes together.

Perhaps the kinesthetic feedback from carrying out the action or the objects involved in producing the outcome added an item-specific cue for self-actions that produced an outcome, making them more distinct, but in Experiment 3 this feedback was exactly the same whether an outcome occurred or not because the action and objects were the same. The contribution of outcomes to the self-enactment effect, at least for preschool children, may account not only for the current results but might also explain why other researchers have sometimes not found the effect. In those studies, actions were de-contextualized, disconnected from the actor's goals, and typically involved no instrumental goals or outcomes, except those entailed by performing the action itself. In SPT/EPT studies that typically include these kinds of actions children have been found not to show the self-enactment effect. Our findings here suggest that the reason may be that these actions are not instrumental: They do not enable outcomes that extend beyond the action itself to achieve a goal independent of just performing the action. Perhaps when goals and outcomes are absent from the encoding context, item-specific information becomes more relevant to supporting memory because there are no other cues available. In turn, this information may be more difficult for younger children to make use of than older children or adults because to do so taxes working memory (Jaroslawska et al. 2016), requires strategy use (Foellinger and Trabasso 1977; Ratner and Hill 1991), or both (Badinlou et al. 2018), resulting in no better memory for self than other actions, or in some cases better recall of another person's actions. The finding that children as young as 15 months of age show a self-enactment effect (Bauer et al. 1995) suggests that task factors rather than features inherent to self-action itself influences when the effect occurs and when it doesn't. Questions related to the effect on memory of the interaction between developmental factors and goals and outcomes cannot be answered here. These will need to be addressed in future studies that include children across a broad age range, beginning with preschool, and incorporate test actions with and without instrumental goals and outcomes within and across sequences. The role of goals and outcomes may also be relevant to related areas of action research. Current debates about theories of action perception and understanding including those invoking the mirror neuron system (e.g., Ferrari and Rizzolatti 2015; Gerson and Woodward 2014) might be informed by further study of the interplay between the goal-directed nature of actions and their corresponding outcomes when accounting for self-enactment.

Although individual action outcomes appear to play an important role in the self-enactment effect, outcomes enabled across an entire sequence may or may not contribute to this effect. Sequence outcomes can serve as an effective memory cue for the actions performed to accomplish them (e.g., Ratner et al. 2019), and if there are two people acting together to accomplish an overall goal the sequence outcome marks their mutual contributions (Hala et al. 2013). In Experiments 1 and 2, the context of a game, an object common to all the actions, and collaborative turn-taking may have led children to focus on the overall outcome of the actions; however, in Experiment 2 because action memory did not differ whether outcomes were embedded in the sequence or individual actions, the effect of a sequence outcome is not clear. The primary limitation in Experiment 2 is that we had no independent assessment of children's interpretation of the sequence other than the ordering scores. The success of the experimental manipulation depended on whether each action in the sequence was interpreted as enabling the outcome of the next, playing a causal role in producing the overall result. Although the castle, the school, and the story supported this interpretation these cues might not have provided enough information for children to represent the relation between the actions as enabling as we intended. Still, the results of Experiment 1 are hard to reconcile with this suggestion, unless there too the outcomes produced by children's individual actions were sufficient to support the self-enactment effect. It is also possible that results across all three experiments were influenced by the particular test actions chosen. Only three or four actions representing various action types were included across experiments to accommodate the limited memory skills of the preschool children and it is possible that particular features of these actions may have contributed to our findings. These issues will need to be addressed in future research.

The information children might draw from action sequences also raises the question of whether the interleaved actions of the child and experimenter contributed to memory for self and other actions. Engelkamp and Zimmer (2001) have suggested that the presence of both actors in a within-subject design provides additional item-specific information to support memory that separating the actors in a between-subject design does not. From a person-based perspective, however, the presence of two actors raises the possibility of a perceived relation between them in carrying out the actions. For instance, a mutual outcome does require the actors to coordinate their actions (Sebanz et al. 2006) and has been found to influence whether the sequence is viewed as collaborative or not (Foley et al. 2002), which in turn has consequences for memory and learning (Young et al. 2019).

Joint attention between the actors, however, might be expected to increase attention to the other and provide an opportunity to represent more information about them (e.g., Baker-Ward et al. 1990; Foley et al. 2010), improving memory for the other person's actions. In this situation the self-enactment effect would not occur, not because memory for self-actions is impoverished as we suggested when children participate in actions without goal-instrumental outcomes, but because memory for other-actions is enhanced. Engaging with familiar adults or peers in collaborative and goal-directed activities might in particular boost recall for the other person's actions, shifting perception of the other from someone to watch to someone to engage, and reduce or eliminate the self-enactment effect. For instance, Baker-Ward et al. found in one experiment that the self-enactment effect occurred, but in a second one it did not. In the second experiment, children interacted with peers rather than others unknown to the target child, as in the first experiment. The authors argued that the elaboration provided by information about the peer supported memory for the other's actions, and in fact, the results showed that between the first and second experiments, memory for self-actions remained the same but memory for another's actions increased.

Our findings here are consistent with these results. In Experiment 1 the appropriation error suggested that children may have interpreted the actions as a collaborative sequence, especially because the error occurred across both elaborated and non-elaborated actions. If so, memory for the other's actions would have been expected to be higher. Indeed, in collaborative contexts the appropriation error appears to index a process in which other-actions are recoded as self-actions (Foley et al. 2010). In these cases, outcomes may also serve as markers of the other person's actions and consequently be more easily retrieved. Interestingly, with additional retrieval support provided either by a recognition task or recall cues, no self-enactment did occur in the first two studies. In Experiment 1 recognition memory was the same for both self- and other-actions and in Experiment 2, when action cues were provided self- and other-actions were also recalled equally well. It was only in Experiment 3 that the action retrieval cues did not have the same effect. When no self-produced outcomes occurred, retrieval cues did not eliminate the self-enactment effect; the interaction between actor and outcome remained. These results are suggestive at best because again we did not assess how children represented the relation between the two actors; however, the findings do suggest questions for future research. This account also hints that the self-enactment effect may not be linear. That is, if actions are stripped of instrumental goal and outcome features the self-enactment effect may not occur because of poor memory for self-actions, but if the relation between actors is pre-existing, collaborative, and coordinated, especially in the presence of rich retrieval cues, the self-enactment may not occur because memory for other-actions is improved.

Finally, our findings provide suggestions for early childhood educators. Young children are understood to learn best when they are engaged in self-oriented, hands-on experiences (e.g., Saracho 2012). The results from these three experiments support this classroom practice, but highlight the contribution of goal-based activities that lead to enabled outcomes. Discrete actions disconnected from a larger activity and without outcomes that involve some result that children can produce themselves may be less likely to promote memory, and ultimately learning, from the actions involved. For project-based activities that involve multiple children and for which the activities of the other children are important to be remembered (e.g., science demonstrations) promotion of coordinated actions through mutual and collaborative goals, especially with friends, may be important to support learning. In any case, action engaged in only for the sake of the action itself is less likely to be effective as a learning tool.

In summary, the findings from three experiments demonstrate the contribution of the child's production of outcomes resulting from the actions they carry out in the self-enactment effect. More generally the results provide evidence of the usefulness of the person-based framework not only for interpretation of the findings here but also to other studies of the self-enactment effect and in other domains, such as source-monitoring (Foley et al. 1989; Foley 2014), early social cognition (e.g., Tasimi and Johnson 2015) or event memory (e.g., Bauer 2007). Drawn from this perspective, the findings also suggest that actions as experimental materials should be selected with attention to their action features and not just the characteristics of the words describing them. Even if frameworks that emphasize processing factors derived from models of memory for words, such as item-specific and relational information, prove in the end to be more encompassing, our findings here highlight the significance of self-produced outcomes in the information that supports children's memory for their own actions.

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Compliance with ethical standards

Conflict of interest The authors declare that we have no conflicts of interest and have followed all ethical research practices.

Ethical approval All procedures performed in the studies involving human participants were in accordance with the ethical standards of the Behavioral Institutional Review Board, a committee of the university's Institutional Review Board and with the 1964 Helsinki Declaration and its later amendments.

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