

Instrumental and Conventional Interpretations of Behavior Are Associated With Distinct Outcomes in Early Childhood

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Four tasks ($N = 191$, 3- to 6-year-olds) examined the effect of instrumental versus conventional language cues on children's imitative fidelity of a necklace-making activity, their memory and transmission of the activity, and their perceptions of functional fixedness. Children in the conventional condition imitated with higher fidelity, transmitted more of the modeled behavior, and showed higher levels of functional fixedness than children in the instrumental condition. There were no differences in children's memory of the activity between conditions demonstrating that memory alone does not explain differences in imitative fidelity. The data demonstrate that children's interpretation of behavior as instrumental or conventional has wide-ranging implications for what children imitate, what they transmit to others, and how they reason about objects' functions.

Imitation facilitates efficient early social learning (Gergely, Bekkering, & Király, 2002; Tennie, Call, & Tomasello, 2009; Tomasello, Carpenter, Call, Behne, & Moll, 2005; Whiten, McGuigan, Marshall-Pescini, & Hopper, 2009). Despite potentially unlimited opportunities to learn through imitation, children are not indiscriminate imitators (Nielsen, 2006). New research on the development of flexible imitation indicates that children are highly selective about when to imitate and to what degree, discriminating between when they need to reproduce an outcome or imitate a process (Herrmann, Legare, Harris, & Whitehouse, 2013; Legare, Wen, Herrmann, & Whitehouse, 2015).

Children use imitation flexibly to acquire both instrumental skills (Call, Carpenter, & Tomasello, 2005; Call & Tomasello, 2008; Nagell, Olguin, & Tomasello, 1993; Tomasello, Savage-Rumbaugh, & Kruger, 1993; Whiten, Custance, Gomez, Teixidor, & Bard, 1996) and the cultural conventions or rituals of their social groups (Kenward, Karlsson, & Persson, 2010; Keupp, Behne, & Rakoczy, 2013; Nielsen, Cucchiaro, & Mohamedally, 2012; Over & Carpenter, 2012). We propose that children's flexible use of imitation is guided by interpreting

behavior as an *instrumental* versus a *ritual* act. Children interpret a behavior as an instrumental act if the physical-causal basis of an action is potentially knowable, even if it is currently unknown (as would be the case for novice learners). In contrast, children interpret a behavior as a ritual act if it cannot be understood from the perspective of physical causality and instead is based on social conventionality (Legare et al., 2015). We define ritual as socially stipulated, causally opaque, conventional behavior (Legare & Souza, 2012, 2014) and propose that ritual is a socially motivated subset of conventional behavior with affiliative functions (Legare & Watson-Jones, 2015).

Instrumental and ritual behaviors are not distinguished exclusively by the presence of causal opacity (i.e., a physical-causal rationale for the action is unavailable) but rather the interpretation of causal opacity. The behaviors that children observe are often not easily distinguishable as instrumental or conventional based on the action alone (Humphrey & Laidlaw, 1994; Staal, 1990; Whitehouse, 2004). Because of this, children must rely on social cues and contextual information in order to interpret the goal of a behavior (Legare et al., 2015). For example, a child observing the preparation of bread could interpret the purpose of the behavior instrumentally (e.g., to produce a food item) or conventionally (e.g., to commemorate a special event or make an offering). In this situation, the child must determine

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whether she should work to execute the most efficient preparation of bread, eliminating elements that are not necessary for achieving the end goal (e.g., putting a decorative pattern on the top of the bread), or whether she should engage in high-fidelity imitation of the process. In both situations, the child must attend to social information to infer an instrumental or conventional goal for the behavior. We propose that behaviors are often interpreted as primarily instrumental versus conventional as a matter of degree rather than of kind (Legare & Nielsen, 2015; Legare et al., 2015). Children infer the goal of a behavior to be primarily instrumental or conventional based on the social and contextual cues presented. This allows for children to use imitation flexibly and to reevaluate their interpretation of the goal of a behavior based on the social information presented in subsequent exposures to the behavior.

Imitating instrumental behaviors allows for innovation and variability, whereas imitating conventional behaviors requires close attention to and reproduction of the way other group members perform the actions (Herrmann et al., 2013). When imitating instrumental behavior, the focal point of imitation is the end goal (Legare et al., 2015). In contrast, when imitating conventional behavior, the focal point of imitation is the process (Carpenter, Call, & Tomasello, 2005; Schachner & Carey, 2013) and the normative execution of the behavior (Haun, Rekers, & Tomasello, 2012; Kallgren, Reno, & Cialdini, 2000; Over & Carpenter, 2013; Rakoczy, Warneken, & Tomasello, 2008). Thus, children engage in higher fidelity imitation when imitating conventional behavior than when imitating instrumental behavior.

Social motivations, such as learning normative behaviors (Kenward, 2012; Kenward et al., 2010), affiliation with social groups (Over & Carpenter, 2012), and shared experience (Tomasello et al., 2005; Wen, Herrmann, & Legare, 2015), may drive high-fidelity imitation (Uzgiris, 1981). Moreover, fear of ostracism has also been found to lead to higher levels of imitative fidelity, further supporting social motivations as a basis for high-fidelity imitation (Over & Carpenter, 2009; Watson-Jones, Legare, Whitehouse, & Clegg, 2014; Watson-Jones, Whitehouse, & Legare, 2015).

Present Study

Our objective was to examine the behavioral outcomes associated with interpreting a behavior instrumentally or conventionally. In four tasks, we investigated the effect of instrumental versus

conventional language cues on children's imitative fidelity of a necklace-making activity, their memory and transmission of the activity to others, and their reasoning about the functions of the stimuli used in the activity.

To examine children's flexible imitation, we developed an experimental paradigm that can be interpreted both instrumentally and conventionally. Most of the previous experimental paradigms examining imitation in young children have used instrumental tasks (e.g., puzzle boxes) that have clear end goals (i.e., the retrieval of a prize) and highlight children's understanding of physical-causal relations. In a typical puzzle box task, an adult model demonstrates how to retrieve a prize using both causally relevant (e.g., lifting a door to retrieve the prize) and causally irrelevant (e.g., tapping the container or moving a lever that is not connected to the functional components of the puzzle box) actions. The adult model then gives children the opportunity to engage with the puzzle box themselves. In these studies, children have tended to "overimitate" by producing both the causally relevant and causally irrelevant actions (Horner & Whiten, 2005; Lyons, Young, & Keil, 2007; McGuigan, Whiten, Flynn, & Horner, 2007; Nielsen, Mushin, Tomaselli, & Whiten, 2014; Nielsen & Tomaselli, 2010; Whiten et al., 2009). One potential explanation for children's overimitation in puzzle box tasks is that they interpret the goal of the behavior as conventional rather than instrumental based on the social information presented and lack of information about an explicit end goal.

Several components of the puzzle box tasks may lead children to interpret their goal as conventional rather than instrumental: the causal opacity and complex nature of the task (Kapitány & Nielsen, 2015; Southgate, Chevallier, & Csibra, 2009; Williamson & Meltzoff, 2011; Williamson, Meltzoff, & Markman, 2008); the presence of pedagogical social cues, such as having an adult model execute the sequence (Gergely & Csibra, 2006; Király, Csibra, & Gergely, 2013); and the adult model's intentional execution of the task (Carpenter, Akhtar, & Tomasello, 1998; Csibra & Gergely, 2009). All of these features of the standard puzzle box paradigm have been shown to increase imitative fidelity among children. In the absence of explicit information about an end goal, these features may have led children to interpret the purpose of the puzzle box tasks as conventional, resulting in them attending more to the process demonstrated than to the end goal of retrieving a prize (Kenward et al., 2010; Keupp et al., 2013; Over & Carpenter, 2012).

This study also builds upon previous research examining the impact of interpreting behavior instrumentally or conventionally on children's imitation of object manipulation tasks that were intended to approximate the arbitrary nature of rituals. In these tasks, objects were used for functions that might not reflect their direct causal properties, eliminating their link to physical-causal rationales (Herrmann et al., 2013; Legare et al., 2015; Watson-Jones et al., 2014). For the present study, we selected an activity that children are familiar with—necklace making—to control for the novelty and complexity of the activity. We incorporated both instrumental elements (i.e., bead stringing) and conventional elements (i.e., bead shape and color choice, novel gestures with the materials) to examine imitative fidelity. In this sense, children were exposed to a behavior that drew on familiar motor activities presented in a novel sequence with novel actions. Using a familiar activity (e.g., necklace making) allows us to more directly attribute children's imitative fidelity to the manipulation of social information rather than to the nature of the task itself. The children could either interpret the goal of the task as instrumental—making a necklace—or as conventional—engaging in a social activity with beads and string.

Causal opacity (i.e., action sequences with identical start and end states or observable nonfunctional components), consensus (i.e., multiple actors performing the same actions), and synchrony (i.e., multiple actors performing the same actions at the same time) are all cues to the conventionality of a behavior (Herrmann et al., 2013; Kapitány & Nielsen, 2015; Legare et al., 2015; Watson-Jones et al., 2014). These cues, however, often require children to imitate different types of action sequences between and within conditions. For the current study, we investigated the impact of language cues rather than other cues to conventionality so that we could examine children's interpretation of an identical action sequence across conditions. Language cues are also interesting because they can direct children's attention to the goal of a behavior prior to the behavior, rather than causing children to make post hoc assessments about the purpose of a behavior after it is completed.

In the first task, we examined the impact of instrumental versus conventional language cues on children's imitative fidelity. We predicted that children would engage in higher fidelity imitation of the demonstrated necklace-making sequence when it was preceded by a conventional language cue (i.e., "Everyone always does it this way") than an instrumental one (i.e., "I'm going to make a necklace"). Previous research by Legare and colleagues has

demonstrated that convention-oriented language (i.e., language that references group norms—*we* and *everyone*—or consistency of performance over time—*always*) is associated with conventional interpretations of behavior and outcome-oriented language (i.e., language that references an instrumental end goal) is associated with instrumental interpretations (Herrmann et al., 2013; Legare et al., 2015).

To examine whether the conventional language cue is interpreted merely as explicit direction to imitate rather than a cue to the conventionality of the behavior, we also included an imperative language condition with explicit instruction to copy the model (i.e., "I want you to do what I am going to do"). We predicted that when children use social information such as language cues to interpret the goal of a behavior as conventional, they are not interpreting these cues as instructions to imitate. Rather, we predicted that interpreting behavior as conventional is linked to a differential interpretation of the goals of the demonstrated actions, such that children will imitate with relatively higher fidelity than children who interpret the purpose of a task as instrumental, but with lower fidelity than children who have been explicitly instructed to copy.

To assess developmental changes in early childhood, we examined imitation in 3- to 6-year-olds. We predicted that older children would engage in higher levels of imitative fidelity than younger children across conditions based on the findings from the previous research (Herrmann et al., 2013; Lyons et al., 2007; McGuigan et al., 2007; Nielsen & Tomaselli, 2010; Watson-Jones et al., 2014).

In the second task, we examined whether there are differences in children's memory of the necklace-making sequence based on whether they are presented with instrumental or conventional language cues. To date, little is known about how to explain the differences in children's imitative fidelity of instrumental versus conventional behavior. Even if the interpretation of the primary goal of a task as instrumental or conventional results in different behavioral outcomes, in either situation, children are engaging in a cognitively demanding task. They are not only attending to multiple actions (e.g., gestures, object manipulation), but also determining which of these they should imitate. We included an immediate recall measure to examine whether differences in children's imitative fidelity across conditions can be attributed to memory differences rather than to the inferences children make about the goal of the behavior.

We predicted that children would not show a difference in their ability to recall the materials

used in the necklace-making sequence across conditions, which would indicate that differences in imitation between conditions are not due to differences in memory alone. We also predicted that imitative fidelity should be positively correlated with working memory across conditions (Subiaul & Schidler, 2014) and expected age-related improvements in both imitative fidelity and memory. For this reason, we included memory as a covariate in our analyses of imitative fidelity to examine the impact of the language cues on imitative fidelity beyond any differences that might be due to memory.

In the third task, we examined differences in children's transmission of the necklace-making sequence to a simulated peer based on whether they were presented with instrumental or conventional language cues. If conditional differences in imitative fidelity are driven by interpretation of the goal of a behavior, rather than memory of the behavior, we anticipated that we should also see differences in which behaviors children choose to transmit to others.

Transmission chain studies with children (in which a child is taught a behavior and then asked to teach the behavior to a subsequent series of children) provide insight into the relative contributions of children's memory versus task interpretation when imitating a behavior. Flynn (2008) found that the first child in a transmission chain paradigm could be trained by an adult experimenter through demonstrations and subsequent encouragement to reproduce a series of both causally relevant and causally irrelevant actions in a puzzle box task when teaching another child. Children in later positions in the chain (i.e., those after the first child), however, eliminated the causally irrelevant actions in their demonstrations for subsequent children (Flynn, 2008). This finding is noteworthy in light of research suggesting that children are in fact quite capable of transmitting conventional knowledge and work to reinforce norms in contexts where they deem high-fidelity imitation as the appropriate means of engaging in a novel behavior (Kenward, 2012). Indeed, there is some evidence that when children interpret the purpose of a task as conventional, they transmit causally irrelevant actions (Flynn & Whiten, 2008; Nielsen, Kapitány, & Elkins, 2014), and inefficient methods for achieving instrumental outcomes (Tennie, Walter, Gampe, Carpenter, & Tomasello, 2014) persist. Thus, it is possible that based on their interpretation of the task as conventional or instrumental, children will differentially evaluate which aspects of a behavior they

should model for their peers. We predicted that children in the conventional condition would transmit the necklace-making sequence with higher fidelity than children in the instrumental condition.

In the fourth task, we examined the relation between children's interpretation of a behavior as instrumental or conventional and their capacity to reason flexibly about an object's function. Functional fixedness is the inability to override knowledge of an object's intended function in order to use it in novel ways (Duncker, 1945). In previous research on functional fixedness, when an experimenter presents an object in a way that is consistent with its proper function, the object is considered *preutilized* (e.g., a box that is full of objects). Children who demonstrate functional fixedness are less likely to use a preutilized object in a novel way than a *nonpreutilized* object (i.e., no function primed; Defeyter & German, 2003; German & Defeyter, 2000).

We propose that interpreting a behavior conventionally increases functional fixedness, limiting children's ability to use the objects in novel ways. The interpretation of the functions of objects used in social conventions is often highly restricted and inflexible. For example, although a birthday candle could potentially serve as a light source, it is rarely used in this way. Instead, it is typically put on top of a birthday cake and lit only to be immediately blown out at the end of the birthday song.

To examine the effect of interpreting a behavior conventionally on functional fixedness, we presented 5- and 6-year-old children with a problem-solving task in which they engaged with objects used in the necklace-making sequence. We chose this age group based on the previous research demonstrating that functional fixedness emerges in 6-year-olds (German & Defeyter, 2000). Children were either presented with the completed necklace from the modeled activity (*preutilized*) or the beads and the string used in the completed necklace side by side (*nonpreutilized*). We were interested in the combined effect of the language cues with the preutilization of the materials. We predicted that there would be greater functional fixedness in the conventional/preutilized condition relative to the other conditions (two nonpreutilized conditions [which served as our controls] and the instrumental/preutilized condition). Moreover, given the saliency of instrumental and conventional learning to young children, we predicted that 5-year-olds, who have previously demonstrated an immunity to functional fixedness (Defeyter & German, 2003; German & Defeyter, 2000), would display similar behavioral patterns to 6-year-olds and thus would also

demonstrate higher levels of functional fixedness when interpreting a task as conventional.

In sum, in four tasks we examined the behavioral outcomes associated with interpreting a behavior instrumentally or conventionally. We used a familiar task to assess the impact of language cues on children's imitative fidelity. We also examined children's memory and transmission of the behavior and their ability to flexibly reason about objects' functions based on their interpretation of the task as instrumental or conventional, providing novel insight into the behavioral outcomes associated with interpreting a behavior instrumentally or conventionally.

Method

Participants

Three- to 6-year-olds ($M_{\text{age}} = 5.23$, age range = 2,11–6,11) were recruited from preschools, a participant database, and a children's museum in an urban university town in the American Southwest. Data collection occurred between April 2012 and June 2013 with additional data collection between January 2014 and December 2014. Children were primarily from Euro-American, middle-class, English-speaking families, which is representative of demographics of the community where the study was conducted. Participants from all age groups participated in three tasks: an imitation task, an immediate recall task, and a peer transmission task (191 participants total, 101 females). Data from 19 additional participants were dropped due to children electing to stop the study (11), and parental interference (8).

After completing the first three tasks, 5- and 6-year-olds (fifty-three 5-year-olds and fifty-six 6-year-olds) also participated in a functional fixedness task (3- and 4-year-olds did not participate in the functional fixedness task). Data from one additional child who participated in the functional fixedness task were dropped due to experimenter error.

An additional twenty 5- and 6-year-old children participated in a baseline condition to assess children's spontaneous behaviors with the stimuli. We also collected data for an imperative condition with an additional thirty-five 5- and 6-year-old children who only participated in the imitation task.

Procedure

Testing was conducted in a quiet room in each of the recruitment locations. During the experiment

the child sat across a table from the experimenter. All children in the study participated in an imitation task and were randomly assigned to one of two conditions (instrumental and conventional conditions) in a between-subjects design. During this task, children watched an experimenter demonstrate a necklace-making sequence and were then given an opportunity to interact with the stimuli.

After the completion of the imitation task, the experimenter asked children to recall the specific objects used in the necklace-making sequence as a measure of memory (immediate recall task) and then asked them to model the behavior demonstrated for a puppet, meant to approximate a peer (Kenward, 2012; Rakoczy et al., 2008; peer transmission task). The order of the immediate recall and peer transmission tasks were counterbalanced.

At the end of the study, 5- and 6-year-old children participated in a problem-solving task to assess whether or not they would engage in functional fixedness when presented with the objects from the necklace-making sequence.

For an overview of the tasks included in this study and our associated predictions, see Table 1.

Imitation Task

After building rapport through a picture memory game, the experimenter told children they would be completing a new activity and placed a set of necklace-making materials (a metal tray with one row of three circular beads—purple, orange, and green [left to right]—in front of a row of three cube beads—red, yellow, and blue [left to right] in front of two folded strings—red and green) on the table. The experimenter then told the children one of two language cues while smiling, with both hands flat on either side of the tray. In the instrumental condition, children heard an outcome-oriented language cue (e.g., "I am going to make a necklace. Let's watch what I am doing. I am going to make a necklace"). In the conventional condition children heard a convention-oriented language cue (e.g., "I always do it this way. Everyone always does it this way. Let's watch what I am doing. Everyone always does it this way").

Previous research has demonstrated that language cues that are outcome oriented or that refer to the process of a sequence prime instrumental interpretations of tasks (Herrmann et al., 2013). Convention-oriented cues that reference group norms (e.g., *we*) and continuity of performance (e.g., *always*), including "This is how we do it" (Legare et al., 2015; Tennie et al., 2014) and "She

Table 1
Overview of Tasks, Ages Participating in Each Task, Conditions, and Predictions

Task	Ages	Conditions	Predictions
1. a. Imitation task	3- to 6-year-olds	Instrumental & conventional	Imitative fidelity higher for children in conventional condition. Increase in imitative fidelity with age.
b. Imitation task	5- and 6-year-olds	Conventional & imperative	Imitative fidelity higher for children in imperative condition.
2. Immediate recall task ^a	3- to 6-year-olds	Instrumental & conventional	Similar levels of recall between conditions. Increase in recall with age.
3. Peer transmission task ^a	3- to 6-year-olds	Instrumental & conventional	Higher fidelity transmission in conventional condition. Increase in transmission fidelity with age.
4. Functional fixedness task	5- & 6-year-olds	Instrumental/preutilized, Instrumental/nonpreutilized, conventional/preutilized, & conventional/nonpreutilized	Lowest rates of solving for children in the conventional/preutilized condition. No differences in solving rates between 5- and 6-year-olds.

^aCounterbalanced in order.

always does it this way" (Herrmann et al., 2013), have been found to cue conventional interpretations of tasks.

The experimenter began the sequence by looking down and picking up the red string. She held one end of the red string in each hand, stretched the string into a straight line, and then brought the ends back together in front of her. The experimenter repeated this action once more before stretching the string into a straight line and placing it in front of the tray (the side closest to the child) and removing both of her hands. The experimenter then picked up the purple circular bead and touched it to her forehead before stringing it on the right side of the string and moving the bead to the middle of the string. The experimenter repeated this sequence for the yellow square bead and the green circular bead. After the experimenter placed the green bead on the string, she picked one end of the string up in each hand, held the necklace up, and while smiling said, "Look what I did!" For an illustration of the action sequence, see Figure 1. After finishing the sequence, the experimenter placed the necklace back on the tray and removed the tray from the child's view. Children in both conditions viewed the same sequence.

After the necklace-making demonstration, children were provided with an unstructured opportunity to engage with a duplicate set of the beads and string used by the experimenter, positioned in the same (left to right) orientation. While the experimenter moved the tray of objects toward the child she said, "Here you go. Now it's your turn!" Children's engagement with the objects was video-recorded and coded for imitative fidelity. The experimenter remained across from the children while they interacted with the stimuli. The experimenter displayed positive facial affect during the children's interaction with the stimuli. If children sought help from the experimenter, the experimenter gave a neutral answer such as "Do your best!" or "What do you think you should do?" At the end of engagement or after 90 s, the objects were moved out of the child's reach and hidden from view.

Baseline Condition

To assess children's spontaneous behaviors with the necklace-making materials and to ensure the validity of the imitative fidelity score, 20 children were presented with the full set of beads and

Target behavior	Description of experimenter's (E) behavior	Operational criteria for coding
1. Stretch string	E brings the ends of the string together and then opens it twice.	Child (C) brings the ends of the string together and opens it at least once.
2. Place string	E lays the string out on the table above the tray.	C lays the string out on the table and removes both hands.
3. Three bead to forehead touches	E touches the purple, yellow, & green beads to forehead before placing them on the string.	C touches three beads to forehead before placing them on the string.
4. Circle, square, circle	E's necklace consists of three beads in order— a circular bead, a square bead, and a circular bead.	C's necklace consists of a circular bead, a square bead, and a circular bead in order.
5. Three beads	E's necklace consists of only three beads.	C's necklace consists of only three beads.

Figure 1. Necklace-making sequence and target behaviors included in imitative fidelity score.

strings used in the necklace-making task without any instruction or demonstration after completing an unrelated study. At the end of engagement, or after 2 min, the beads and string were moved out of the child's reach and that concluded their involvement in the study. None of the target behaviors coded to assess imitative fidelity were generated frequently (only 11% of children spontaneously generated the circle, square, circle pattern; only 30% of children made necklaces with three beads; and none of the children engaged in the string stretching, string placement, and bead to forehead touches).

Imitative Fidelity Score

Each child was given a summary score between 0 and 5 that was indicative of the number of target behaviors of the modeled necklace-making sequence they replicated (the table in Figure 1 illustrates scoring procedures). A research assistant blind to the condition of the participant and the hypotheses of the study coded the imitative fidelity. Data from 30% of the sample (60 children) were independently coded to assess interrater reliability. The second coder was blind to the hypotheses of the study and the condition to which each child

was assigned. Reliability was calculated for each target behavior of the imitative fidelity score and coders demonstrated 100% agreement for all target behaviors. Each of the target behaviors included in the table in Figure 1 were also analyzed using non-parametric tests to examine frequency of engagement across conditions.

Imperative Condition

We also included a comparison condition in which, prior to the imitation task, 35 additional 5- to 6-year-old children were told, "I want you to do what I am going to do. Let's watch what I am doing. I want you to do what I am going to do." We included this condition to examine whether imitative fidelity is higher when children receive directions to imitate than when they hear a conventional language cue. The children then watched an experimenter perform the same necklace-making sequence as the children in the conventional and instrumental conditions. After the task demonstration, children were provided with an unstructured opportunity to engage with a duplicate set of the beads and string used by the experimenter. At the end of engagement or after 90 s, the objects were moved out of the child's reach and this concluded the child's participation in the study. Children's engagement with the objects was coded for imitative fidelity using the criteria for the imitative fidelity score. A research assistant blind to the condition of the participant and the hypotheses of the study coded the imitative fidelity. We predicted that children's imitative fidelity in the imperative condition would exceed that of children in the conventional condition, given that they were being explicitly instructed to imitate the behavior.

Immediate Recall Task

During the immediate recall task, the experimenter told the children, "I forgot what I did! Can you help me remember what I did?" Children were then presented with two sets of stimuli sequentially—both strings present on the stimuli tray during the necklace construction task and the beads present on the stimuli tray during the necklace construction task in the same positions. The order of presentation was counterbalanced, with the researcher presenting half of the children with the strings first and half of the children with the beads first. While the researcher presented each child with the strings she asked, "Do you remember which of these I used?" For the beads, the researcher first

asked which beads were used, "Which of these did I use?" and then asked about the order in which the beads were used, "Which one did I use first? Second? Third?" If children only named one bead for the first question, the experimenter did not ask the bead order questions. If children indicated that they did not know or remember for any of the questions, the experimenter proceeded to the next question. The experimenter repeated the children's responses for confirmation and clarity. Children's responses were evaluated for accuracy. Our recall task was based on the children's memory of the stimuli and did not include questions about the actions (i.e., stretch string, place string, bead to forehead touches) demonstrated by the experimenter to prevent influencing what actions they felt compelled to include in subsequent tasks.

Immediate Recall Task Coding

Children's responses were scored for correctness, with each correct response being given 1 point. Children could earn a score between 0 and 11. Scores were assigned based on the children's answers to the following questions: string color used (1 pt); beads used—purple (1 pt), yellow (1 pt), green (1 pt), two circular beads and one square bead named only (1 pt); order of beads—purple first (1 pt), circular bead first (1 pt), yellow second (1 pt), square bead second (1 pt), green third (1 pt), circular bead third (1 pt). One point was eliminated from each child's score if they named more than three beads as having been used in order to account for those children who would receive points due to naming all beads. The immediate recall task was coded by a research assistant blind to the condition of the participant and to the hypotheses of the study.

Peer Transmission Task

During the peer transmission task, the experimenter sat next to the children and introduced them to a hand puppet. The experimenter then told the children, "Alex would like to learn how to do what I did. Can you help Alex learn how to do what I did?" and presented them with a tray containing the stimuli used in the imitation task. In order to capture natural peer teaching behaviors, the experimenter moved the puppet next to the tray and made the puppet look from the children to the tray and back to the child. If the children did not begin to engage with the puppet after a period of 20 s, the experimenter prompted the children by

repeating, "Alex would like to learn how to do what I did. Can you help Alex learn how to do what I did?"

The experimenter used the puppet to carry out any actions indicated by the children. If the children engaged in the action sequence themselves, the experimenter positioned the puppet so that he appeared to be watching the action sequence and would move his head and arms in ways that indicated he was attentive. Children's behaviors were video-recorded and coded for similarity to the modeled necklace-making sequence.

Peer Transmission Task Coding

Children's reconstruction (either through guided instruction to the puppet or their own interactions with the materials) of the necklace was coded for similarity to the modeled necklace-making sequence and assigned a transmission score from 0 to 5 based on the rubric presented for the imitative fidelity score. The peer transmission task was coded by a research assistant blind to the condition of the participant and the hypotheses of the study. Data from 30% of the sample (60 children) were independently coded to assess interrater reliability. The second coder was blind to the hypotheses of the study and the condition to which each child was assigned. Reliability was calculated for each target behavior of the transmission score and coders demonstrated 100% agreement for all target behaviors.

Functional Fixedness Task

After completing the imitation, immediate recall, and peer transmission tasks, 5- and 6-year-old children were presented with a problem-solving task similar to that used by German and Defeyter (2000). The researcher showed them a wooden box (35 cm wide \times 25 cm deep \times 50 cm high) consisting of three walls and a floor. There was a shelf (18 cm long and 30 cm from the floor) on the back wall with a small plastic toy tiger on top and there was a small stuffed bear (11 cm tall) on the floor. The experimenter pointed to the bear and told the children,

This is Bobo the bear. Bobo's favorite toy lion is up on this shelf. Bobo wants to get his toy lion from the shelf, but he can't reach it because he is too short and he cannot jump to reach the toy because he has short legs. Bobo has all of these things in his room [pointing to a collection of

objects in front of the box]. Can you help him reach his toy using any of these things?

In front of the box there was a collection of objects, including a flower-shaped wooden box with a lid (5 cm tall \times 8 cm wide), two wooden blocks (7.5 cm tall \times 5 cm wide), a pencil, a toy car, a flat square magnet, a penny, and either the assembled necklace from the imitation task (a duplicate of the final necklace the experimenter made in the necklace-making demonstration; preutilized) or the string and beads from the final necklace in the imitation task placed next to each other with the beads on their side and in order as if they were on the string and the string folded behind the beads (nonpreutilized; Figure 2). Half of the children in each language cue condition (conventional and instrumental) were randomly assigned to one of the two functional fixedness conditions (preutilized and nonpreutilized) so that there were four possible conditions overall—instrumental/nonpreutilized, instrumental/preutilized, conventional/nonpreutilized, and conventional/preutilized.

The wooden blocks and box could be stacked to make a structure that when combined with the bear's height was not tall enough to allow the bear to reach the shelf. In order for the bear to reach the shelf, the children needed to use at least two of the beads (either both circular beads [2.5 cm tall each] or a square bead [3.5 cm tall] and a circular bead) from the imitation task in addition to the box and the blocks (Figure 2).

The experimenter remained next to the child while he or she completed the task. If children sought advice, they were given neutral responses,

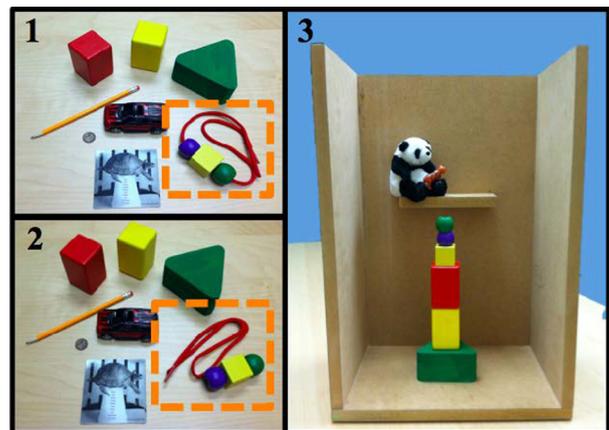


Figure 2. Functional fixedness task materials. (1) Preutilized condition—beads on string. (2) Nonpreutilized condition—beads and string separate. (3) Solution to task.

such as “What do you think you should do?” or “Do your best!” If children offered an incorrect solution to the problem (i.e., the bear could not actually reach the toy or an item was used that made the structure unstable such as the car), the researcher showed them that the bear could not reach the toy or that the structure was not stable and encouraged them to seek another solution by asking, “Is there anything else Bobo could use to get his toy?” or “Bobo has all of these things in his room!”

Children’s interactions with the problem-solving task were video-recorded and coded for whether or not they solved the task within 90 s.

By presenting the children with the necklace from the action sequence in its final form (i.e., pre-utilized), the functional fixedness problem required the child to reconsider their understanding of the object as a whole unit (e.g., a necklace) and instead to view it as its separate functional parts (e.g., beads and string). Comparing children in both the instrumental and conventional conditions allowed for an assessment of whether or not the conventional condition amplifies children’s encoding of objects as functionally fixed.

Functional Fixedness Coding

A coder blind to which language cue condition the children were in and to the hypotheses of the study scored whether or not children solved the task. In order to solve the task, children needed to stack both blocks, the box, and at least two of the beads (either both circular beads or a square bead and a circular bead). Children in the preutilization condition needed to remove the beads from the string in order to be counted as having solved the task. If children took longer than 90 s to solve the task, they were coded as not solving the task.

Results

Imitative Fidelity

A two-way analysis of covariance was conducted to examine the effects of condition (instrumental, conventional) and age (3, 4, 5, 6) on children’s imitative fidelity controlling for immediate recall score (i.e., memory of the materials used in the task). An analysis assessing the homogeneity-of-slopes assumption suggested that the relation between immediate recall (the covariate) and imitative fidelity (the dependent variable) did not differ significantly as a function of condition or age. There

was a marginally significant interaction between condition and age, $F(3, 182) = 2.58, p = .055$, partial $\eta^2 = .041$. This marginally significant interaction may indicate that children display a greater distinction in imitative fidelity between the instrumental and ritual stances as they increase in age. We offer this interpretation cautiously, however, given that the results of this analysis indicated that there was a significant main effect of condition, $F(1, 182) = 17.33, p < .001$, partial $\eta^2 = .087$, and a significant main effect of age, $F(3, 185) = 2.90, p = .04$, partial $\eta^2 = .046$ (Figure 3). As predicted, children engaged in higher levels of imitative fidelity in the conventional condition ($M_{\text{observed}} = 2.45, SD_{\text{observed}} = 1.51; M_{\text{adjusted}} = 2.40, SD_{\text{adjusted}} = 1.46$) than in the instrumental condition ($M_{\text{observed}} = 1.49, SD_{\text{observed}} = 1.17; M_{\text{adjusted}} = 1.54, SD_{\text{adjusted}} = 1.22$). Imitative fidelity also increased with age across both conditions. For a summary of Pearson chi-square coefficients of individual target behaviors of the imitative fidelity score, see Table 2. Children in the conventional condition were more likely to imitate four of the five target behaviors (stretch string, place string, three beads to forehead touches, and circle, square, circle pattern) than children in the instrumental condition.

Imperative Condition

A two-way analysis of variance (ANOVA) was conducted to examine the impact of cue (two: conventional, imperative) and age (two: 5, 6) on children’s imitative fidelity. There was not a statistically significant interaction between condition and age, $F(1, 95) = 0.59, p = .59$, so this term was removed from the analysis. Results revealed a main effect of condition, $F(1, 95) = 17.87, p = .004$, partial $\eta^2 = .087$, and but not a significant main effect of

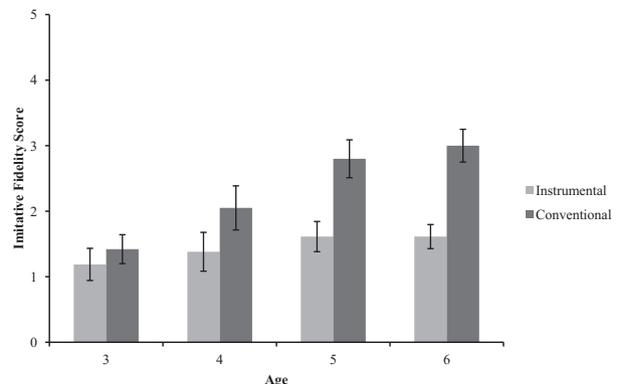


Figure 3. Observed imitative fidelity score by age and condition. Significant main effects of age and condition. Error bars represent SEM.

Table 2

Percent of Children Engaging in Target behaviors of Imitative Fidelity and Transmission Scores in the Imitation and Peer Transmission Tasks (Pearson Chi-Square Coefficients Listed for Each Target Behavior.)

Target behavior	Imitation task		Peer transmission task	
	Percent	$\chi^2(1, N = 191)$	Percent	$\chi^2(1, N = 190)$
Stretch string	Instrumental: 18 Conventional: 41	11.58***	Instrumental: 12 Conventional: 24	4.56*
Place string	Instrumental: 58 Conventional: 72	4.37*	Instrumental: 32 Conventional: 59	13.44***
Three bead to forehead touches	Instrumental: 13 Conventional: 36	13.38***	Instrumental: 4 Conventional: 19	9.42**
Circle, square, circle	Instrumental: 15 Conventional: 39	13.55***	Instrumental: 31 Conventional: 38	1.02
Three beads	Instrumental: 45 Conventional: 59	3.76	Instrumental: 66 Conventional: 59	0.13

* $p < .05$. ** $p < .01$. *** $p < .001$.

age, $F(1, 95) = 2.44$, $p = .27$. As predicted, children imitated with higher fidelity in the imperative condition ($M = 3.80$, $SD = 1.30$) than in the conventional condition ($M = 2.90$, $SD = 1.48$), $t(95) = 3.09$, $p = .003$, $d = .63$, consistent with our interpretation that children do not interpret convention-oriented language simply as a cue to follow directions.

Immediate Recall

A three-way ANOVA was conducted to examine the effect of task order (two: immediate recall first, transmission task first), condition (two: instrumental, conventional), and age (four: 3, 4, 5, 6) on children's immediate recall. There was not a statistically significant main effect of task order, $F(1, 190) = 0.94$, $p = .33$, and there were no statistically significant interactions, so these terms were removed from the analyses. A follow-up two-way ANOVA was conducted to examine the effect of condition (two: instrumental, conventional) and age (four: 3, 4, 5, 6) on children's immediate recall. Analyses revealed a significant main effect of age, $F(3, 190) = 3.71$, $p = .01$, partial $\eta^2 = .056$. Immediate recall scores increased with age. There was not a statistically significant main effect of condition, $F(1, 190) = 2.24$, $p = .14$. As predicted, there was not a significant difference in immediate recall scores between children in the conventional condition ($M = 5.36$, $SD = 2.74$) and children in the instrumental condition ($M = 4.83$, $SD = 2.58$).

Peer Transmission

A three-way ANOVA was conducted to examine the effect of task order (two: immediate recall first,

transmission task first), condition (two: instrumental, conventional), and age (four: 3, 4, 5, 6) on children's peer transmission. One participant was excluded from peer transmission analyses due to video equipment malfunction. There was not a statistically significant main effect of task order, $F(1, 189) = 2.47$, $p = .12$, and there were no statistically significant interactions, so these terms were removed from the analyses. A follow-up two-way ANOVA was conducted to examine the effect of condition (two: instrumental, conventional) and age (four: 3, 4, 5, 6) on children's transmission of the target behaviors of the modeled necklace-making sequence to a simulated peer (transmission score). Results revealed a main effect of condition, $F(1, 189) = 13.42$, $p < .001$, partial $\eta^2 = .068$, and a main effect of age, $F(3, 189) = 14.57$, $p < .001$, partial $\eta^2 = .191$ (Figure 4). As anticipated, children had higher transmission scores in the conventional condition ($M = 2.07$, $SD = 1.49$) than in the instrumental condition ($M = 1.46$, $SD = 1.13$). Transmission score also increased with age. For a summary of Pearson chi-square coefficients of individual target behaviors of the imitative fidelity score, see Table 2. Children in the conventional condition were more likely to imitate three of the five target behaviors (stretch string, place string, and three beads to forehead touches) than children in the instrumental condition.

Functional Fixedness

A logistic regression analysis was conducted to examine the effects of condition (four: instrumental/nonpreutilized, instrumental/preutilized,

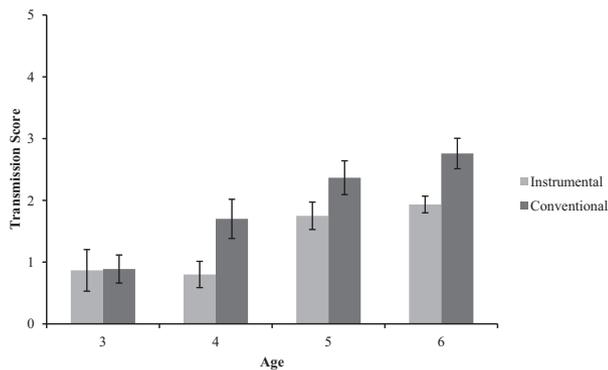


Figure 4. Transmission score by age and condition. Significant main effects of age and condition. Error bars represent SEM.

conventional/nonpreutilized, and conventional/preutilized) and age (two: 5, 6) on whether children solved the functional fixedness task. The four combinations of instrumental/conventional and preutilized/nonpreutilized were treated as individual conditions due to our predictions about the combined impact of cue and preutilization on children's performance in the functional fixedness task. There was not a significant interaction between age and condition, $\chi^2(3, N = 109) = 0.70, p = .87$, so the interaction was removed from the analysis. The results of the analysis indicate that condition did have a significant impact on children's rate of solving the task, $\chi^2(3, N = 109) = 10.97, p = .01$, but age did not, $\chi^2(1, N = 109) = 0.81, p = .37$. Since there was not a significant main effect of age, data were collapsed across age groups and a chi-square test of independence was performed to examine the relation between condition and whether or not children solved the task. The relation was significant, Pearson $\chi^2(3, N = 109) = 10.96, p = .01$, Cramer's $V = .32$. An examination of the standardized residuals suggests that children in the conventional/preutilized condition were significantly less likely to solve the task (percent *not* solving task = 73%, standardized residual = 1.87) than children in the conventional/nonpreutilized (34%, -1.03), instrumental/preutilized (52%, 0.31), and instrumental/nonpreutilized (34%, -1.03) conditions.

Discussion

As highly specialized cultural learners, children are equally well equipped to acquire the instrumental skills and the cultural conventions of their social groups. To engage in efficient social learning, children must make inferences about the goal of a

behavior to determine when to imitate, when to innovate, and to what degree (Herrmann et al., 2013; Legare et al., 2015; Watson-Jones et al., 2014). In this study, we examined whether children's instrumental versus conventional interpretation of a behavior had implications for their imitative fidelity, what they remembered about the behavior, transmitted in a peer learning task, and whether or not they displayed functional fixedness. Data from multiple tasks provide convergent evidence for distinct behavioral outcomes associated with interpreting behavior instrumentally versus conventionally.

Our first objective was to examine the impact of instrumental (outcome-oriented) versus conventional (convention-oriented) language cues on children's imitation of a necklace-making task. By presenting children with the same action sequence across conditions, we were able to directly examine the impact of the language cues on children's imitation. Our data confirm that after being cued with either an instrumental language cue or a conventional language cue, children in the conventional condition engaged in higher levels of imitative fidelity than children in the instrumental condition. This finding is consistent with our prediction that convention-oriented language leads to a conventional interpretation of behavior and, thus, high-fidelity imitation. Alternatively, outcome-oriented language leads to an instrumental interpretation of behavior, resulting in efficient reproduction of the end goal. We also found a marginally significant interaction between age and condition, which we cautiously interpret to indicate that differences in children's imitative fidelity in response to different verbal cues may increase in age. This means that older children display a greater distinction in imitative fidelity between the instrumental and conventional conditions than younger children, which is consistent with previous work (Herrmann et al., 2013; Legare et al., 2015; Watson-Jones et al., 2014).

The difference in imitative fidelity between conditions is noteworthy when considering that the only difference between the two conditions was whether the children heard an instrumental or a conventional language cue. Children in both conditions saw the same action sequence with the same stimuli performed by a live model; thus, any differences in performance can only be attributed to the different language cues rather than differences in the complexity or causal ambiguity of the stimuli.

We also included an imperative condition to assess children's interpretations of the conventional language cue. We found that when children were explicitly instructed to attend to and imitate the

necklace-making sequence before it was demonstrated, they imitated with higher fidelity than children in the conventional condition, indicating that conventional cues produce relatively higher levels of imitative fidelity than instrumental cues, but lower imitative fidelity than when children are explicitly told to follow directions. Thus, it is unlikely that children in the conventional condition were imitating with high fidelity because they felt that they were being explicitly instructed to do so. If children were simply interpreting conventional cues as direction to conform, we would not anticipate differences in imitative fidelity between the ritual and control conditions. These data support our proposal that inferences about instrumental and conventional goals guide imitative behavior and are consistent with recent work that children interpret behavior according to an instrumental and a ritual stance (Herrmann et al., 2013; Legare et al., 2015; Watson-Jones et al., 2014).

Our second objective was to determine whether differences in imitative fidelity in the instrumental and conventional conditions are the result of differences in interpretation or in memory. The data support our claim that differences in imitative fidelity between the instrumental and conventional conditions can be attributed to inferences about the goal of a behavior rather than memory of the behavior. When given an immediate recall task, children in both conditions showed similar levels of memory of the task. Additionally, when differences in imitative fidelity between conditions were assessed controlling for children's recall scores, there was a significant effect of condition. Although the recall score did not assess children's memory of the novel actions (i.e., stretch string, place string, bead to forehead touches), it did capture whether or not there were differences in children's memory of the materials being used in the activity. Together, these findings indicate that children do not imitate with higher fidelity in the conventional condition due to better memory of the necklace-making sequence.

Convergent evidence for this interpretation can be found in the data from the peer transmission task, in which children were asked to recreate the sequence for a puppet approximating a peer. Children in the conventional condition imitated more of the target behaviors from the modeled necklace-making sequence than children in the instrumental condition. An assessment of the target behaviors of the transmission score indicates that children in the conventional condition were also more likely to demonstrate the string stretching, placing the string, and bead to forehead touches for the puppet than

children in the instrumental condition. Children in the instrumental condition, however, were just as likely as children in the conventional condition to construct a necklace with three beads and to use the circle, square, circular bead pattern in the peer transmission task. Thus, children in the conventional condition were more likely to imitate and transmit causally irrelevant actions (e.g., stretching the string, placing the string, bead to forehead touches), whereas children in the instrumental condition worked at similar rates to children in the conventional condition to exactly replicate the end goal of the modeled necklace-making sequence (e.g., using only three beads and the bead pattern demonstrated). This finding is consistent with our prediction that children are assigning different levels of relevance to the actions they see demonstrated based on instrumental versus conventional interpretations of the task.

Our final objective was to assess whether interpreting a behavior conventionally increases the likelihood that children view the objects used in the behavior as functionally fixed. As predicted, children in the conventional/preutilized condition solved the functional fixedness task at significantly lower rates than children in all three of the other conditions. This finding suggests that children in the conventional condition formed a less flexible representation of the beads and string when they were presented in a preutilized form. Thus, when children interpret a behavior as conventional, they may have a less flexible representation of the potential uses of the objects presented and imitate with higher fidelity due to a fixed representation of the objects' functions. Alternatively, children who interpret a behavior instrumentally are not limited by the same inflexibility and may feel more comfortable exploring the multifunctionality of the objects to assess the most causally efficacious way of executing the given end goal. Thus, functional fixedness may be a potential factor underlying children's high levels of imitative fidelity of conventional behavior. Five-year-olds also demonstrated behavioral patterns very similar to 6-year-olds, indicating that functional fixedness may have been activated in children younger than 6, an age group thought to be immune to functional fixedness (German & Defeyter, 2000).

Future research should examine children's imitation in ecologically valid learning situations, particularly those outside of the usual experimenter-child dyad. Providing children with a familiar model, such as a parent or teacher, may also provide insight into how children use imitation as a tool for

learning in their daily experiences. The benefits to examining children's imitation with familiar adult models are twofold: First, presenting children with a familiar model may further eliminate unintentional cues to conventionality (i.e., an unfamiliar, authoritative figure) such that a more nuanced understanding of children's imitation can be developed. Second, there is a consensus in sociocultural and evolutionary developmental psychology theory that children's development is a collaborative process between children and their caretakers (Bjorklund, Hubertz, & Reubens, 2004; Csibra & Gergely, 2009; Lancy, Bock, & Gaskins, 2009; Rogoff, 2003). Examining a child-parent interaction when a parent is attempting to teach an instrumental versus conventional behavior will shed light on the types of social cues parents use to communicate instrumental versus conventional behavioral goals.

This study provides novel insight into the distinct behavioral outcomes associated with interpreting a behavior as instrumental versus conventional in early childhood. This research contributes to a growing body of work that suggests that children engage in flexible imitation as a means of learning both instrumental skills and the rituals and cultural conventions of their social groups (Herrmann et al., 2013; Legare et al., 2015; Watson-Jones et al., 2014). Children are not indiscriminate imitators, but instead rely on social cues to interpret the goal of a behavior. Our data demonstrate that children's interpretation of the goal of a behavior as instrumental or conventional has wide-ranging implications for what children imitate, what they transmit to others, and how they reason about objects' functions.

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