The Thesis committee for Jennifer Marie Clegg

Certifies that this is the approved version of the following thesis:

The Art of Convention:

Cognitive Foundations of Cultural Learning

APPROVED BY

SUPERVISING COMMITTEE:

Supervisor: ______________________________
Cristine H. Legare

____
Art Markman

____
Jacqueline Woolley

The Art of Convention:

Cognitive Foundations of Cultural Learning

by

Jennifer Marie Clegg, B.A.

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Jennifer Marie Clegg, M.A.

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Supervisor: Cristine H. Legare

While much research has explored the role of imitation in children's learning of instrumental skills (Call et al., 2005; Carpenter et al., 2002; Gleissner et al., 2000; Lyons et al., 2007; Whiten et al., 2009), very little is known about the link between imitation and the acquisition of cultural conventional behavior. New research suggests that children rely on a variety of social and contextual cues when determining when to imitate with high or low fidelity and that these cues may reflect children's interpretation of a task as either instrumental or conventional (Herrmann et al., 2013). Previous work examining children's imitation has primarily used either unfamiliar, causally opaque object manipulation tasks (Herrmann et al., 2013) or complex instrumental tasks that make use of materials used in novel ways (Lyons et al., 2007; Williamson & Meltzoff, 2011), but research has yet to explore children's imitation when presented with a causally accessible and familiar instrumental task. Drawing from an oft-observed classroom craft, the present study examined children's reasoning about a necklace-making task when they were presented with either a conventional or an instrumental framing for the task and the cognitive consequences of this reasoning.

Table of Contents

List of Tables

List of Figures

The Art of Convention:

Cognitive Foundations of Cultural Learning

Adi, a young girl in Chiapas, Mexico, watches her mother make tortillas and then practices in the main room of the family home with a piece of plastic, mimicking the way her mother moved the tortilla around on her knee (Gaskins and Paradise, 2010). Marcos, a five-year-old Quechan boy, practices starting a fire the way he has seen his parents and siblings do it, using two stones to spark a flame (Bolin, 2006). Scenes like these are ubiquitous in early childrearing settings around the world (Lancy, Bock, & Gaskins, 2010; Lancy, 2008), and according to the archeological record have been across historical time (Crown, 2010). As cultural novices, children observe the adult behaviors they are privy to and use what they learn from their observations of adult practices to shape their behavior (Lancy, 2008; Rogoff, 2003). In each of the examples provided above, children are engaging in imitation to learn an instrumental skill and copying the actions of adults and older peers as they attempt to become active participants in their respective cultures.

Imitation facilitates high fidelity transmission of information and is an efficient tool for cultural learning (Boyd & Richerson, 2005; Harris, 2012; Tennie, Call & Tomasello, 2009; Tomasello, Carpenter, Call, Behne & Moll, 2005; Whiten, McGuigan, Marshall-Pescini & Hopper, 2009). Despite the fact that children have access to a plethora of opportunities to learn through imitation, children are not indiscriminate imitators. Instead I propose that children are selective about when they imitate and to what degree. In order to be effective and efficient learners, children must be able to discriminate between when they need to learn "the way things are done, [as opposed to] what gets done" (Nielsen, 2010, p. 735). There has been a call within comparative and developmental psychology to determine the specific conditions that lead children to engage in high fidelity imitation and those in which they choose to introduce variation (Nielsen & Tomaselli, 2010; Over & Carpenter, 2012; Whiten, et. al, 2009). Nonetheless, little is known about why children imitate some actions with higher fidelity than others or how children navigate the different functions of imitation when approaching new opportunities for learning.

Legare and colleagues (Legare, et al., under review) argue that children discriminate between cultural conventions and instrumental skill learning through the differential activation of what they term the *ritual stance* and the *instrumental stance*. The activation of each stance results in engagement in a distinct behavioral profile. The ritual stance is based on the inference that rituals (i.e., conventional, causally opaque procedures) are not grounded in observable physical-causal rationales. Thus, attempts to understand the physical-causal reasoning behind the behaviors is not of interest; instead, the behaviors themselves and the way they are executed become the focal point of learning and subsequent imitation. As a result, children engage in high fidelity imitation and display low levels of innovation, introducing little variability into their own replication of the behavior.

In contrast, the instrumental stance is based on the inference that a behavior has a clearly intended outcome or end-goal. Even if the physical-causal structure behind this outcome is not readily apparent, children are poised to quickly process connections between actions and their outcomes. Because of this, children will seek to replicate the end goal, engaging in innovation when possible and eliminating causally irrelevant actions. If the inference is made that the physical-causal structure of an action sequence is potentially knowable, they will act upon this assumption to engage in efficient replication of the end goal rather than an exact replication of the process.

The distinction between the ritual and instrumental stances is not based on the assumption that acts or behaviors are strictly or inherently conventional or instrumental, but instead assumes that the learner makes inferences about a behavior (which could contain both conventional and instrumental elements) based on the social and contextual cues present. For example, a child observing the preparation of bread in their home could be witnessing a process simply meant for the production of a food item for their household or a ritualistic undertaking meant to celebrate a coming holiday (e.g., a Bulgarian tradition of preparing a special bread for Easter). In this situation, the child must determine whether they should work toward the efficient preparation of bread, eliminating elements that may not be necessary in achieving the final end goal, or whether they should attempt an exact replication of the process. In order to determine which stance to take, the child might attend to a variety of cues, and recent work provides evidence that these cues include start/end state differences, the language used to describe the process (Legare, et al., under review; Watson-Jones, Legare, Whitehouse, & Clegg, under review), as well as consensus and synchrony among actors (Herrmann, Legare, Harris, & Whitehouse, under review).

The present study sought to further explore children's use of social cues, specifically language cues, when approaching a novel demonstration of a task. Rather than using the cues in combination with various start- and end-state or actor conditions as examined in previous research investigating the ritual and instrumental stances, this study provided children with a familiar cultural craft (necklace-making) and used language to prompt a ritual versus an instrumental interpretation of the task.

Previous work examining the activation of the ritual and instrumental stances has focused primarily on the imitation of unfamiliar, causally opaque object manipulation tasks. These action sequences are intended to approximate the arbitrary nature of most cultural rituals in which objects are used for functions that might not reflect their direct causal properties. In order to better understand the cognitive mechanisms surrounding the instrumental and ritual stances and their applicability to day-to-day learning, the present study examined the application of the stances to an ecologically valid and causally accessible task. An additional objective of this study was to explore the cognitive processes underlying the activation of the ritual and instrumental stance and subsequent differences in imitative fidelity.

Table 1. Summary of research objectives

Research Objectives
1. Can the ritual and instrumental stances be differentially activated using linguistic cues in an ecologically valid task?
2. What are the cognitive processes underlying the different behavioral profiles characteristic of the ritual and instrumental stances?

Imitation and instrumental tasks: Beyond physical-causal learning

An interest in differences in social learning between humans and great apes has generated a large literature examining how children use imitation to gain an understanding of the physical world. Human children have the unique ability to learn social and instrumental skills through the use of high fidelity imitation, an ability that allows for the faithful transmission of information and a resultant cultural continuity across generations not found in other species. Chimpanzees, in contrast, have been shown to eliminate causally irrelevant actions in situations where the intention of an actor is believed to be transparent and the causal structures behind a behavior are apparent, resulting in high morbidity levels of causally irrelevant actions (Call & Tomasello, 2008; Call, Carpenter, & Tomasello, 2005; Nagell, Olguin, & Tomasello, 1993; Tomasello, Savage-Rumbaugh, & Kruger, 1993; Whiten, Custance, Gomez, Teixidor, & Bard, 1996).

Thus, this fundamental distinction in social learning between humans and apes has resulted in interest about the various cognitive mechanisms surrounding imitation. In addition, as an artifact of this link to research in comparative psychology, many of the experimental paradigms exploring imitation in young children have made use of tasks that are meant to assess understanding of physical-causal relationships. Several studies have attempted to examine children's tendency to engage in overimitation through the use of transparent puzzle boxes, a direct result of work with primates (puzzle boxes are believed to approximate the processes of dissecting a complex fruit, Nielsen & Tomaselli, 2010; Call & Tomasello, 2008). In a typical puzzle box task, an adult model instructs a child on how to retrieve a desirable toy or sticker while including causally irrelevant actions, such as tapping the container or moving a lever that is not connected to the functional aspects of the puzzle box. Researchers argue that children should be able to identify the causally irrelevant actions in the demonstration as unnecessary in order to achieve the goal due to the design of the stimuli that either makes use of transparent elements or a combination of materials believed to be familiar to children,. Children are then given the opportunity to engage with the puzzle box themselves, and more times than not, children replicate the causally irrelevant actions demonstrated by the adult (Lyons, Damrosch, Lin, Macris, & Keil, 2011; Lyons, Young, & Keil, 2007).

To the extent that tasks used in previous research have a clear end goal and manipulate physical causal relationships, they can be considered instrumental tasks. Contrary to what would be predicted by the premise of the instrumental stance, however, children are copying irrelevant actions with high levels of fidelity instead of efficiently solving the task by recreating only the necessary actions. One possibility is that instead of adopting the instrumental stance while learning about the manipulation of the puzzle boxes, children are adopting the ritual stance, thus attending more to the process than to the end goal. Although some have argued that children's tendency to maintain the causally irrelevant features is a matter of automatically assigning causal value to all steps demonstrated (Lyons, Damrosch, Lin, Macris, & Keil, 2011), others have argued that it may simply be an artifact of their interpretation of the task as a behavior they should imitate with high fidelity due to the information and contextual cues presented to them (Kenward, Karlsson, & Persson, 2011; Over & Carpenter, 2012). What cues are children relying on in these tasks to determine that they should imitate rather than innovate?

Several components of the puzzle box tasks could have led children to interpret their presentation as an opportunity for conventional rather than instrumental learning: the causal opacity and complex nature of the task (Southgate, Chevallier & Csibra, 2009; Williamson & Meltzoff, 2011); the occurrence of pedagogical social cues, such as the presence of an adult model (Gergely & Csibra, 2006); the adult's purposeful execution of the task (Carpenter, Akhtar, & Tomasello, 1998; Csibra & Gergely, 2009); and children's affiliative drives or desire to maintain group membership (Over & Carpenter, 2009; Watson-Jones, et al., under review). All of these features of the paradigm have been demonstrated to increase imitative fidelity among children.

I propose that the complex and causally opaque nature of the behaviors used in previous research on overimitation (Lyons, Young, & Keil, 2007; Williamson & Meltzoff, 2011) led to the activation of the ritual stance for these otherwise instrumental tasks. When exposed to a novel stimulus, such as a puzzle box, children have no way of distinguishing what is and is not necessary due to a level of relative inexperience with similar stimuli[1] (Southgate, Chevallier & Csibra, 2009; Williamson & Meltzoff, 2011). A common misconception in this series of studies is that physical transparency indicates causal transparency. Children's tendency to engage in high fidelity imitation in these tasks suggests that even if the parts of a stimulus are physically transparent, the causal structures of the sequence executed might not be cognitively transparent. This lack of causal transparency and the novelty of the object leaves children to perceive the task as difficult and causally opaque, thus increasing their likelihood of engaging in high fidelity imitation. When children (and adults) are unsure of the causal structure of an event, they are more likely to imitate with high fidelity because they cannot parse what is and is not necessary (Legare, et al., under review). In addition, work by Williamson et al. (2008)

[1] Lyons et al. (2007) presented two-step training tasks using common household objects such as jar that children were told to retrieve a small toy from. These two-step training tasks were far removed from the challenge posed by the transparent puzzle box.

suggests that when children perceive a task as difficult, they are more likely to imitate the exact means used by an adult demonstrator. Despite the instrumental nature of tasks previously employed to examine overimitation in children, the ritual stance seems to have been activated due to children's perceptions of the stimulus as unfamiliar and causally opaque and therefore difficult to manipulate.

In sum, in spite of the intentions of the researchers, the materials presented in the puzzle box series are more similar to the intentionally opaque action sequences previously used in the investigation of the ritual and instrumental stances than actual instrumental tasks (Legare et al., under review; Watson-Jones, et al., under review). To address this, the present study sought to use materials that preschool-aged children would have experience with and could understand from a physical-causal perspective - a necklace-making sequence. Unlike a novel puzzle box stimulus, children in a U.S. context have experience with bead-stringing and necklace-making activities and understand what is instrumentally necessary to make a necklace (i.e., stringing a bead) as well as the kinds of behaviors that could be considered conventional (i.e., bead shape and color choice, novel gestures). Thus, high fidelity imitation in the context of the presentation of the necklace-making sequence should be the result of an interpretation of the event as an opportunity for conventional learning for reasons other than an inability to understand the physical-causal components of the novel action sequence.

Instead of activating the ritual stance through a lack of causal transparency, the present study examined the impact of social cues, specifically language cues, on children's interpretation of events as opportunities for either conventional or instrumental learning. I anticipated that if children rely on given verbal cues to indicate the presence of a clear and familiar end-goal before the presentation of a sequence (i.e., “I am going to make a necklace.”), information about the end goal will take precedence and children will process the event from the perspective of the instrumental stance. If children are not cued about the presence of an end goal, and instead provided conventional explanations for the sequence (i.e., “Everyone always does it this way.”) children will approach the event from the perspective of the ritual stance, overriding their knowledge of what is and is not necessary to make a necklace.

Cognitive Underpinnings of Imitative Fidelity

To date little is known about the cognitive processes underlying the distinct behavioral profiles that characterize the ritual and instrumental stances. Are children engaging in more high fidelity imitation when the ritual stance is activated because they remember the components of the sequence with a higher degree of accuracy than children taking an instrumental stance? Do children in the ritual stance innovate or deviate less from the demonstrated actions because the demonstrated function of the objects becomes a rigidly assigned function? In addition to exploring the extent to which the ritual and instrumental stances can be differentially activated for a familiar craft-making task, the present study examined the cognitive underpinnings of imitative fidelity to determine whether the demonstrated differences in performance between the stances are a matter of interpretation or memory.

Memory. Previous research has demonstrated that when approaching behavior from the ritual stance, children become more adept at accurately identifying differences in performance on similar tasks (Legare et al., under review). From the perspective of cultural transmission, this would mean that children are equipped to not only observe and learn a new behavior but to assign it conventional meaning. Thus, the observed behavior becomes the prototype for that particular kind of behavior. Other behaviors meant to approximate the same task are viewed as either conforming to or deviating from this prototype. When children then attempt to recreate this behavior, their subsequent imitative fidelity should reflect their memory of this prototype.

Children who have watched the same behavior from the perspective of the instrumental stance, however, should not demonstrate the same behavioral or cognitive profile as the children for whom the ritual stance has been activated. Instead of forming a prototype of the behavioral pattern and working to detect deviations in performance, they should observe new behaviors from the perspective of determining the most effective means of achieving the desired end goal. While attempting to recreate the behavior, these children shift focus to the end goal and the execution becomes an exploration of the different components of the sequence, informed by the child's observation.

Whereas the activation of each stance results in different behavioral outcomes, children in both stances are engaging in tasks of great cognitive effort – not only attending to the multiple components of behaviors (e.g., gestures, object manipulation, verbal utterances), but also determining which aspects they should attempt to recreate. In both instances, children must process and encode multiple components of a behavior while taking into consideration the number of performances they have seen in addition to the social and contextual cues discussed previously. Thus, if children are attending to the desired behaviors with similar levels of cognitive engagement – what is leading to the difference in the behavioral profiles between the stances? Is the manifested behavior a result of differential processing and memory or is it simply a matter of interpretation of what components of the behavior need to be reproduced?

Past work has argued that overimitation is not a matter of a difference in memory, but a matter of interpretation and processing (Nielsen & Tomaselli, 2010). When children who had previously eliminated some elements of a novel object-action sequence were asked to reproduce what an experimenter demonstrated, they were consistently able to faithfully recreate the behavior (Williamson & Markman, 2006). Moreover, prior experience with stimuli does not seem to lead to a decrease in imitation when novel actions with the same stimuli are demonstrated. Children who have knowledge of how the stimuli work still recreate the new behaviors faithfully (Nielsen & Tomaselli, 2010), but presumably this is not a result of a lapse in memory of how to successfully manipulate the stimuli (i.e., how to extract a prize from a puzzle box). Instead, children seem to approach the stimuli with a re-interpretation of what their interactions should be comprised of, incorporating the new actions instead of efficiently executing the end goal.

Research on transmission chains also provides insight into children's cognitive encoding when learning a new behavior. Working on the assumption that when demonstrating a behavior for a peer, children will engage only in those aspects of the behavior they deem important, it seems that children are assigning different levels of value to the actions they have seen demonstrated. Flynn (2008) found that even though the first child in a transmission chain paradigm could be trained to reproduce both causally relevant and causally irrelevant actions, children in later positions in the chain eliminated the causally irrelevant actions in their subsequent demonstration for the next child. Thus, children have the capacity to remember and execute both conventional (causally irrelevant) and instrumental (causally relevant) elements of a novel action sequence, but in the absence of other social and conventional cues will assign value to the particular components of the action sequence and in turn recreate these valued elements.

Children are indeed capable of transmitting conventional knowledge and work to reinforce norms in contexts where they deem high fidelity imitation as the desired means of learning and the reproduction of a specific behavior (Kenward, 2012). It follows that their interpretation of a behavior's purpose, and subsequently the activation of the ritual or instrumental stances, will result not in a difference in memory, but in interpretation of which aspects of a behavior should be reproduced. Rather than only assessing children's ability to recall a novel sequence, a more nuanced assessment of their processing of the sequence can be ascertained through presenting a situation in which they become the demonstrator or teacher. Thus, through the implementation of multiple memory measures, the present study attempted to gain insight not only what children are remembering, but what aspects of the sequence they are assigning value to based on the social cues they are provided with.

The present study sought to examine the role of memory in children's imitation in both ritual and instrumental conditions, using both a direct measure of memory and an indirect evaluation of memory through a simulated peer transmission task. Children were asked to directly recall components of the action sequence, particularly the specific objects used, as an objective measure of attention to and memory of the sequence (see *Immediate recall task*) and were also asked to model the behavior demonstrated by the experimenter for a puppet, meant to approximate a peer (Kenward, 2012; Rakoczy, Warneken, & Tomasello, 2008; see *Teaching task*). Together, these measures were intended to provide further insight into whether or not memory differences for the sequence exist and if children interpret different components of the action sequence as important depending on the activation of the ritual or instrumental stances. I predicted that children would not show differences in memory across stances, but when asked to reproduce the sequence for purposes of information transmission, children in the ritual condition would reproduce more of the causally irrelevant and conventional components in their demonstration.

Functional fixedness. A crucial component of the ritual stance is not only an increase in imitative fidelity, but also a decrease in innovative actions using the materials presented (Legare, et al., under review). It has been found that children are less likely to engage in innovation or use the objects in a novel manner once the ritual stance is activated seemingly assigning the demonstrated functions to objects used in the action sequence and not deviating from these assignments (Legare, et al., under review; Watson-Jones, et al., under review). For example, in previous work, children are presented with a series of object manipulation actions and then see an object used to open a box. When the ritual stance is activated, children are less likely to use object other than the demonstrated object to open the box (Legare, et al., under review). Whereas other objects certainly have the affordance of being able to be used to open the box (and are used by children interpreting the process from the instrumental stance), there appears to be a reduction in children's flexibility of object use so that, to borrow from German & Defeyter (2000), the object appears to become "functionally fixed."

Functional fixedness, or the interpretation of an object's function as that for which it was originally designed or the capacity demonstrated (German & Defeyter, 2000), may be part of the reason children in the ritual stance are less likely to engage in innovation or divert from the demonstrated components of a novel behavior. Indeed, when children approach the world, they are presented with a variety of objects that have been designed for a specific purpose (German & Barrett, 2005; Tomasello, 1999) and serve as more or less ritualized objects. Paper towel holders, apple slicers, beverage frothers – any American kitchen will reveal a variety of these objects designed and typically used for a specific purpose (which is often inherent in their all-too-creative names). How is it that the other affordances of these objects are overlooked? The answer may be functional fixedness as a result of learning about these objects in a conventional way or from the perspective of the ritual stance.

This concept may be best understood in the context of an actual ritualized object, for example, the Catholic rosary. A rosary can be worn as a decorative element (i.e., a necklace), but it is meant to serve as a prayer guide, and therefore its use as a necklace is rare and often not condoned. How is it that the rosary comes to occupy this very specific niche? One possible explanation could be that the rosary becomes functionally fixed as a result of being initially processed from the perspective of the ritual stance (i.e., the contextual and social cues surrounding the way it is presented leave children to interpret its use as conventional).

German and colleagues have found that functional fixedness is a common part of adult cognition cross-culturally (German & Barrett, 2005), but children younger than six years-old appear to be immune to functional fixedness and are quite flexible in their reasoning about object use (Defeyter & German, 2003; German & Defeyter, 2000). Functional fixedness has been typically assessed through a problem-solving task in which an individual must suspend their understanding of an object's function when that function is being primed, in order to use the object in a different way. For example, children must use a box that is holding materials as a stool in order to reach a desired object. In order to do so, children must suspend their understanding of a box as an item that holds things, in order to use it for a novel purpose, to reach something. German and colleagues refer to the box whose function has been primed as *preutilized* – in essence, it is being presented in a way in which its main function is already in play. Children who demonstrate functional fixedness are not only less likely to solve the task when an object is preutilized, but when they do solve the task, they take much longer than peers for whom the primary function of the object has not been primed (Defeyter & German, 2003; German & Defeyter, 2000).

If functional fixedness contributes to the ritual stance as predicted, it follows that when children are presented with objects in a ritualistic manner, they will be less likely to use these objects in a novel way. Moreover, given that children younger than 6 years-old are susceptible to the social and contextual cues surrounding the ritual stance (Herrmann, et al., in preparation; Legare, et al., under review; Watson-Jones, et al., under review), it is possible that functional fixedness can be activated in children previously thought to be immune to functional fixedness as a result of the ritual stance. The proposed study seeks to explore the extent to which functional fixedness is a potential mechanism difference in imitative fidelity between the ritual and instrumental stances by presenting children with a problem-solving task in which they must overcome the primed function of objects previously presented in either a conventional or instrumental manner. I predict that children in the ritual condition will be less likely to solve the task and when they do so will take longer to solve the task than children in the instrumental condition. Moreover, given the saliency of the ritual and instrumental stances to young children, I anticipate that children under the age of six will demonstrate higher levels of functional fixedness in the ritual condition, reducing young children's immunity to functional fixedness.

Methods

Participants

Sixty 3-4-year-olds (37 females; *M* age = 3.97, age range 2,11 – 4,11) and sixty-five 5-6-year-olds (38 females; *M* age = 5.80, age range 5,0 – 6,11) were recruited from preschools and a children's museum in an urban university town in the American southwest. Children were primarily Euro-American and from middle class families. Data from 17 additional participants were dropped due to experimenter error, equipment malfunction, or participant refusal to participate in all components of the study. Twenty-eight 5-6-year-olds (11 females, *M* age = 5.89, age range 5,0 - 6,11) were recruited from the same setting for a baseline measure after participating in an unrelated study.

Procedure

All children in the study were randomly assigned to one of two conditions in a between-subjects design. In the *instrumental condition,* children were given either an instrumental explanation of a task (e.g. "I am going to make a necklace.") and in the *ritual condition* children were given conventional explanation (e.g. "Everyone always does it this way."). During the course of the study, children participated in five tasks: a memory game (warm up) task, an imitation task, an immediate recall task, a teaching task, and a functional fixedness task. First, children were presented with a memory game using pictures of fruit and vegetables to build rapport with the researcher (*warm-up game*). The researcher then presented a novel action sequence that resulted in the construction of a necklace. After demonstration of the action sequence, children engaged in an imitation task (*imitation task*). Children then participated in an *immediate recall* *task* about the action sequence presented by the researcher. A *teaching task* in which the children taught a puppet how to complete the demonstrated task will followed the questions and recall task. At the end of the study, 4, 5, and 6-year old children were presented with a *functional fixedness* problem-solving task. Pilot data showed that the functional fixedness problem-solving task was too difficult for 3 year-old children so they completed the study after the teaching task.

Children in the baseline measure were asked if they would like to play an additional game after the completion of an unrelated study examining children's explanation-seeking behaviors. Children who completed the baseline measure did not participate in any other component of the study.

Warm-up game

At the beginning of the testing period, children were presented with a set of three different target pictures – an apple, a green pepper, and a lemon (Figure 1a). The researcher told the children that they would be picking these pictures out from other sets of pictures and once the children had demonstrated an understanding of the task at hand, the researcher showed the children three additional sets of pictures (1 – broccoli, apple, potato, 2 – pepper, tomato, lime, 3 – celery, strawberry, lemon) and asked them "Have I shown you any of these pictures before?" (For images used, see Figure 1b-1d) This task was used for both rapport building and establishing an attentive mindset in the children.

Imitation task

After building rapport with the researcher through the picture memory game, the research placed a set of necklace-making materials on the table in front of them and children were given one of two prompts:

1. *Instrumental condition* – *"*Now we are going to do something new. I am going to make a necklace. Let's watch what I am doing. I am going to make a necklace".

   OR

2. *Ritual condition*– *"*Now we are going to do something new. 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".

Following the verbal prompt the researcher demonstrated a sequence resulting in the construction of a necklace (for an outline of the action sequence, see Table 2; for an outline with pictures, see Figure 2 in the appendix). Children in both conditions viewed the same action sequence.

After the task demonstration, children were provided with an unstructured opportunity to engage with the objects used in the necklace construction sequence. The researcher gave the children a duplicate set of the same items used by the researcher, positioned and oriented the same way as at the beginning of the action sequence (Figure 3). While the researcher moved the tray of objects toward the child she said, "Here you go. Now it's your turn!" Children's engagement with the objects were video-recorded and coded for imitative fidelity and construction variability. If help is sought from the researcher, the child was given a neutral answer such as "Do your best!" or "What do you think you should do?” At the end of engagement or after 90 seconds, the objects were moved out of the child’s reach but remain in view.

Table 2. Necklace construction sequence

Action	Description
1. Choose string	Pick up red string with each end in one hand
2. Novel string actions	Stretch out the string and then bring the ends together (repeat once)
3. String placement	Place straight string above the top of the tray holding the stimuli
4. Purple bead	Pick up purple bead with right hand
5. First forehead touch	Touch purple bead to forehead with right hand while left hand picks up right end of the string
6. String purple bead	Right hand brings purple bead down to the end of the string in left hand, string bead and move to the middle of the string
7. Yellow bead	Pick up yellow bead with right hand
8. Second forehead touch	Touch yellow bead to forehead with right hand while left hand picks up right end of the string
9. String yellow bead	Right hand brings yellow bead down to the end of the string in left hand, strings bead and moves to middle of string
10. Green bead	Pick up green bead with right hand
11. Third forehead touch	Touch green bead to forehead with right hand while left hand picks up right end of the string
12. String green bead	Right hand brings green bead down to the end of the string in left hand, moves bead on to the middle of the string
13. Hold up	Pick up one end of string with each hand, hold necklace up and declare, “Look what I did!”

Baseline measure. A baseline measure examining children’s interaction with the imitation task stimuli was run in order to examine children’s spontaneous tendencies to explore the stimuli and to ensure that the imitation task is leading children to engage in behaviors that are not typical. A research assistant presented each child in the baseline condition with the stimuli set-up as they would be in the imitation task and asked, "Would you like to play with these?" Children's engagement with the objects was video-recorded. At the end of engagement, or after 90 seconds, the objects were removed from the child's reach.

Coding: Imitation task.

Imitative fidelity score. A research assistant who is blind to the condition to which each child has been allocated coded children's interactions with the imitation task stimuli. Following the analysis structure of Over & Carpenter (2009), Legare, et al. (under review) and Watson, et al. (under review), each child were each given a summary score between 0 and 5 that was indicative of the number of target behaviors of the modeled necklace construction sequence they replicated (the table below illustrates scoring procedures)[2]. Data from 25% of the sample was independently coded to assess inter-rater 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 the imitative fidelity score and coders demonstrated 100% agreement with the Kappa for this coding falling within very good agreement (.81 and above) levels (Landis & Koch, 1977). Each of the actions

[2] Originally the summary score consisted of an additional component – using only one side of the string to string beads as demonstrated – for a total of six components. This sixth component was eliminated due to baseline measurements (see baseline measure) that found that over 50% of children naturally only used one side of the string to string beads. Given that this was a common behavior, it is not anticipated that including this behavior in an imitation score would capture behavior above and beyond what would naturally occur if children were engaging with the stimuli without a demonstrated action sequence.

included in Table 3 was also analyzed using non-parametric tests to examine frequency of engagement across conditions and age groups.

Baseline measure. A research assistant familiar with the imitative fidelity score coding schema coded children's interactions with the stimuli. Each child's interactions were coded for the occurrence of six different behaviors – the components of the imitative fidelity score (see Table 3) and one additional component that was originally considered as part of the imitative fidelity score – only using one side of the string to string beads. Children were given a 1 if they engaged in the behavior and a 0 if they did not and frequencies were recorded for each target behavior.

Table 3. Imitative fidelity score components

Component of action sequence	Description of model's (R) behavior	Operational criteria for a correct response
1. Stretch string	R brings the ends of the string together and then opens it twice	The child brings the ends of the string together and opens it at least once.
2. Place string	R lays the string out on the table above the tray	The child lays the string out on the table either in front of or behind the tray.
3. Three bead to forehead touches	R touches the purple, yellow, & green beads to forehead before placing them on the string	The child touches three beads s to their forehead before placing them on the string
4. Final necklace – circle, square, circle	R's necklace consists of three beads in order– a circular bead, a square bead, and a circular bead	The child's necklace consists of a circular bead, a block bead, and a circular bead in order
5. Three beads	R's necklace consists of only three beads	The child's necklace consists of only three beads

Innovation score. A research assistant who was blind to the condition to which each child has been allocated coded children's interactions with the imitation task stimuli. Children were given a summary score between 0 and 6 that was indicative of the amount of variability in their construction of their necklace (i.e. behaviors that differ from those the researcher modeled; see Table 4). Data from 25% of the sample was independently coded to assess inter-rater 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 the imitative fidelity score and coders demonstrated 100% agreement with the Kappa for this coding falling within very good agreement (.81 and above) levels (Landis & Koch, 1977).

Table 4. Innovation score components

Behavior	Description
1. String choice	The child selects the green string to build the necklace.
2. First bead	The child does **not** select a circle bead first.
3. Second bead	The child does **not** select a block bead second.
4. Third bead	The child does **not** select a circle bead third.
5. Final necklace	The child constructs a necklace that does not consist of a circular bead, a block bead, and a circular bead.
6. Three beads	The child's necklace consists of less/more than three beads.

Immediate Recall Task

Immediately following the imitation task questions, the researcher 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 (Figure 4):

1. Both strings present on the stimuli tray during the necklace construction task.
2. 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 string 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 bead did I use first? Second? Third?” The researcher repeated the children’s responses for confirmation and clarity. Children’s responses were evaluated for accuracy.

Immediate Recall Task Coding. Children’s responses were scored for correctness, with each correct response being given a point. Children could earn a score between 0 and 7. Scores will be 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); order of beads - purple first (1 pt), yellow second (1 pt), green third (1 pt). A 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.

Teaching task

After the completion of the immediate recall task, the children were introduced to a bear hand puppet named Alex. The children were told that Alex would like to learn what the researcher did. The researcher then asked the children if they could help Alex learn what the researcher did and presented a tray containing the stimuli used in the imitation task. At this point, in order to capture natural peer teaching behaviors, the researcher sat Alex next to the tray and made Alex look from the children to the tray and back to the child. If the children did not begin to engage with Alex after a period of 20 seconds, the experimenter prompt the children by repeating, “Alex would like to learn what I did. Can you help Alex learn what I did?”

The researcher used Alex to carry out any actions indicated by the children. If the children chose to engage in the action sequence themselves as a means of demonstrative teaching, the researcher positioned Alex 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 imitative fidelity (whether or not they made the same necklace as the model originally demonstrated).

Teaching task coding. Children’s reconstruction (either through guided instruction to the puppet or demonstrative teaching) of the necklace was coded for imitative rigidity and assigned an imitation score from 0 to 5 based on the rubric presented for the *imitative fidelity score.*

Functional fixedness task

At the conclusion of the study session, children were presented with a problem-solving task similar to that used by German and Defeyter (2000). The researcher showed them a wooden box consisting of three walls and a floor (Figure 5). On the back wall of the house, there was a shelf. In front of the box there was a collection of objects. Children were then introduced to Bobo the bear, a small bear toy, and informed that this box is Bobo the bear's house. A tiger toy was then placed on the back shelf and the children were told:

> "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 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. Can you help him reach his toy using any of these things?"

The objects on the table will be a wooden box with a lid, two wooden blocks, a pencil, a toy car, a ball, a flat magnet, a coin and either the assembled necklace from the imitation task (*preutilization condition,* Figure 6a) or the string and beads the final necklace in the imitation task placed next to each other (*non-preutilization condition,* Figure 6b). Half of the children in each group (ritual and instrumental) will be assigned randomly to one of the two functional fixedness conditions (preutilization and non-preutilization). Assignment to functional fixedness category will be balanced across more strict age groups, with each age being examined separately (i.e., 4, 5, & 6 year-olds were each their own age group)[3].

The wooden blocks and box can be stacked to make a structure that when combined with Bobo's height will not be tall enough to allow the bear to reach the shelf. In order for Bobo to reach the shelf, the children needed to use all three of the beads from the imitation task in addition to the box and the blocks (Figure 7).

If children sought advice, they were given neutral responses, such as "What do you think you should do?" or "Do your best!" If children offered an incorrect solution to

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[3] Three year-olds in the pilot phases of the study showed consistent difficulty in understanding the prompt, indicating that the task used to assess functional fixedness was beyond three year-olds cognitive capacities. For this reason, three year-olds completed the study after the teaching task.

the problem (i.e. Bobo could not actually reach the toy, the researcher showed them that Bobo could not reach the toy and encouraged them to seek another solution by asking, “Is there *anything* else Bobo could use to get to 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 object use in addition to the amount of time it took for them to solve the task. If functional fixedness is an underlying cognitive component of the ritual stance than children in the ritual preutilization condition were anticipated to show the lowest rates of solving the problem, lower than children in the instrumental preutilization condition. Children in the ritual-preutilization condition were also anticipated to take the longest to solve the problem, followed by children in the instrumental preutilization condition. Children in both the ritual non-preutilization and instrumental non-preutilization conditions were expected to show equal rates of solving the problem and solve the problem the fastest.

Children’s inability to solve the task could represent their hesitancy or inability to assign a new purpose to the beads other than that that was demonstrated (although it could also represent a general misunderstanding of the task at hand). By presenting the children with the necklace from the action sequence in its final form, the functional fixedness problem forces the children to reconsider their understanding of the object moving from a whole units to functional parts. Comparing children in both the instrumental and ritual conditions allows for an assessment of whether or not the ritual condition amplifies children's encoding of objects as functionally fixed with the instrumental-preutilization condition serving as a control.

Functional fixedness coding. Children were scored on whether or not they use the beads and the string as separate entities from the necklace in their solution to the problem and the amount of time that elapses before they solve the problem. If children took longer than 180 seconds to solve the task, they were coded as not solving the task.

Results

Baseline. Frequencies (reported as percentage of children engaging in target action) for each target action are reported in Table 5. No children demonstrated the novel actions assessed by the imitative fidelity score (stretch string, place string, & bead to forehead touches). Children rarely made necklaces using a circle bead, square bead, circle bead pattern and less than one-third of baseline children used only three beads on there necklace. The only target action that occurred with notable frequency was only using one side of the string to place beads on the string. Due to the high frequency of this behavior in the baseline assessment, it was removed from the imitative fidelity score.

Table 5. Frequency of target actions in baseline measure

Target Action	Operational criteria for a correct response	Frequency
Stretch string	The child brings the ends of the string together and opens it at least once.	0%
Place string	The child lays the string out on the table either in front of or behind the tray.	0%
Bead to forehead touches	The child touches a bead to their forehead before placing it on the string	0%
Final necklace – circle, square, circle	The child's necklace consists of a circular bead, a block bead, and a circular bead in order	11%
Three beads	The child's necklace consists of only three beads	29.6%
Same side	The child only uses one side of the string to string the beads.	52.9%

Imitative fidelity. As anticipated, children engaged in higher levels of imitative behavior in the ritual condition than in the instrumental condition. Contrary to predictions, however, there was not an effect of age and children showed similar imitative patterns in each age group. A 2x2 ANOVA with imitative fidelity summary score as the dependent measure and condition (2: ritual and instrumental) and age group

(2: 3-4 year-olds and 5-6 year-olds) as between subjects factors revealed a main effect of condition, $F(1, 115) = 15.13$, $p < .001$ but no main effect of age $F(1, 115) = 2.99$, $p = .09$. There was not a significant interaction between condition and age $F(1, 115) = 1.33$, $p = .25$. Children in the ritual condition had higher imitative fidelity scores ($M = 2.23$, $SD = 1.33$) than children in the instrumental condition ($M = 1.34$, $SD = 1.21$; Figure 8). For a summary of Pearson Chi-Square scores of individual components of the imitative fidelity score, see Table 6.

Table 6. Pearson Chi-Square Coefficients for elements of Imitative Fidelity Score

Target Action	X^2	p
Stretch string	X^2 (1, N = 119) = 15.23	$p < .0001$
Place string	X^2 (1, N = 119) = 1.89	$p = .17$
Three bead to forehead touches	X^2 (1, N = 119) = 6.47	$p < .05$
Final necklace – circle, square, circle	X^2 (1, N = 119) = 3.89	$p < .05$
Three beads	X^2 (1, N = 119) = 1.89	$p = .17$

Innovation score. Contrary to predictions, children did not engage in different levels of innovation across conditions. A 2x2 ANOVA with innovation summary score as the dependent measure and condition (2: ritual and instrumental) and age group (2: 3-4 year-olds and 5-6 year-olds) as between subjects factors did not indicate a main effect of condition, $F(1, 99) = 0.94$, $p = .33$ or a main effect of age $F(1, 99) = 0.19$, $p = .66$. There was not a significant interaction between condition and age $F(1, 99) = 0.93$, $p = .34$. There was not a significant difference in innovation scores between children in the ritual condition ($M = 3.32$, $SD = 1.77$) and children in the instrumental condition ($M = 2.98$, $SD = 1.86$; Figure 9).

Immediate recall. As predicted, children in the ritual and instrumental conditions demonstrated similar immediate recall abilities. A 2x2 ANOVA with immediate recall score as the dependent measure and condition (2: ritual and instrumental) and age group (2: 3-4 year-olds and 5-6 year-olds) as between subjects factors did not indicate a main effect of condition, $F(1, 99) = 2.92$, $p = .09$ or a main effect of age $F(1, 99) = 2.52$, $p = .12$. There was not a significant interaction between condition and age $F(1, 99) = 0.04$, $p = .85$. There was not a significant difference in immediate recall scores between children in the ritual condition ($M = 3.32$, $SD = 1.77$) and children in the instrumental condition ($M = 2.98$, $SD = 1.86$; Figure 10).

Teaching task imitative fidelity. As anticipated, children engaged in higher levels of imitative fidelity in the ritual condition than in the instrumental condition when demonstrating the task for a puppet. Moreover, older children showed higher levels of imitative fidelity than younger children. A 2x2 ANOVA with teaching task imitative fidelity summary score as the dependent measure and condition (2: ritual and instrumental) and age group (2: 3-4 year-olds and 5-6 year-olds) as between subjects factors revealed a main effect of condition, $F(1, 86) = 6.52$, $p < .05$ and a main effect of age, $F(1, 86) = 6.82$, $p < 0.05$. There was not a significant interaction between condition and age, $F(1, 86) = 0.40$, $p = .53$. Five and six year-old children had higher imitative fidelity scores ($M = 2.09$, $SD = 1.29$) than three and four year-old children ($M = 1.33$, $SD = 1.43$). Children in the ritual condition had higher imitative fidelity scores ($M = 2.09$, $SD = 1.52$) than children ($M = 1.36$, $SD = 1.2$) in the instrumental condition (Figure 11).

Functional fixedness. As evidenced in Table 7, children in the ritual-preutilization condition showed the smallest proportion of solving the task using the beads from the necklace across all age groups. Older children were better at solving the task overall X^2 (2, N = 97) = 11.62, $p < 0.01$. Subsequent analyses revealed that 4 year-olds solved the tasks at significantly lower rates than 5 year-olds (Fisher's exact test, $p < .01$) and 6 year-olds (Fisher's exact test, $p < .01$) but no significant differences between 5 year-olds and 6 year-olds (Fisher's exact test, $p = .78$; Figure 12). Because there were no differences between 5- and 6-year-olds' performances, they were collapsed for purposes of analyses.

Four year-olds did not demonstrate significant differences in the proportion of children solving the task across conditions (two-tailed Fisher's exact test, p = .12). Planned non-parametric comparisons demonstrated that four year-olds did not show a significant difference in performance between the ritual preutilization and the instrumental preutilization conditions (the target comparison of the measure; one-tailed Fisher's exact test, $p = .45$) or between the ritual non-preutilization and the instrumental non-preutilization conditions (two-tailed Fisher's exact test, $p = 1.0$). Five and six year-olds collapsed demonstrated significant differences in the proportion of children solving the task across conditions (two-tailed Fisher's exact test, $p < .05$). The difference between the propotion of the children solving the task in the ritual preutilization condition and in the instrumental preutilization condition reached marginal significance (one-tailed Fisher's exact test, $p = .07$) for five and six year-olds. As anticipated, there was no difference in the proportion of children in each non-preutilization condition solving the task (two-tailed Fisher's exact test, $p = .38$).

Although the mean time taken to solve the problem was the highest in the ritual preutilization condition for five and six year-olds[4] (see Table 7) as anticipated, when five and six year-olds' solution times were analyzed together there was not a significant difference in solution times across conditions (*F* (3,44) = 1.04, *p* = 0.39; Figure 13).

[4] Only one 4 year-old solved the task in the ritual preutilization condition, therefore this time is not regarded as a comprehensive representation of solution time.

Table 7. Percentage of children solving problem and mean solution time (in seconds) at each age according to condition

	Condition							
	Instrumental				Ritual			
	Non-preutilization (beads next to string)		Preutilization (necklace)		Non-preutilization (beads next to string)		Preutilization (necklace)	
Age Group	Percent Solving	Time Solved	Percent Solving	Time Solved	Percent Solving	Time Solved	Percent Solving	Time Solved
4 year-olds	62.5	53.2	25	82.5	50	78.5	12.5	33
5 year-olds	88.9	60.5	62.5	66.6	81.8	46.6	37.5	94
6 year-olds	100	42.7	85.7	63.6	75	64.2	50	67.8
5&6 year-olds	92.3	55.6	75	64.8	78.9	51.8	43.8	79

Discussion

The findings from this study shed light both on children's use of imitation as a tool for learning in their daily activities and on some of the cognitive mechanisms potentially underlying the distinct behavior profiles children manifest in the ritual and instrumental stances.

As predicted, after being cued with a either a conventional, social language prime (ritual condition) or a goal-oriented language prime (instrumental condition) and then exposed to a novel, but causally accessible task, children in the ritual condition engaged in higher levels of imitative fidelity than children in the instrumental condition. Thus, language cues referencing group norms may activate the ritual stance and lead children to interpret the task as an opportunity for learning through high fidelity imitation. Alternatively, language cues referencing a clear end goal may activate the instrumental stance and lead children to seek out efficient means for executing the given goal, rather than engaging in high levels of imitative fidelity.

Additionally, as predicted, both groups of children showed similar immediate recall abilities when asked about the materials used to make the necklace and the order of the sequence, but children in the ritual condition engaged in higher levels of imitative fidelity when asked to help a puppet (approximating a peer) learn the sequence, indicating that the different behavioral profiles manifested by the groups may not be a matter of memory but rather a matter of interpretation. Moreover, as children age, they appear to transmit behaviors with higher levels of imitative fidelity. This difference in imitative fidelity across ages could represent children's developing cognitive reasoning abilities through ontogeny. An additional component of the difference between the stances may be the ritual stance's activation of functional fixedness for the objects presented. as children in the ritual condition were less likely to solve a task that required disassembling a necklace similar to that constructed in the study.

Imitation and ecologically valid tasks

The types of behaviors children imitated with high fidelity differed between the conditions further suggesting that children were aware of the different causal components of the task and relied on social contexts to determine when to use this knowledge. Children in the ritual condition were more likely to recreate the behaviors that were causally irrelevant to the construction of the necklace such as stretching the string and touching the beads to their foreheads. Children in the ritual condition were also more likely to recreate a more nuanced version of the necklace – one with the clear circle bead, square bead, circle bead pattern demonstrated – which from a causal perspective in the construction of a necklace could be deemed irrelevant. Children in the instrumental condition were more likely to eliminate these elements from their construction of the necklace, perhaps because they understood that stretching the string and placing the beads to their foreheads were not directly causally related to the actual act of making a necklace as they had been instructed. Interestingly, children in both conditions were equally likely to make necklaces with only three beads. This indicates that perhaps children in the instrumental condition are sensitive to the outcome of an action sequence, but not to the level of detail demonstrated by the children in the ritual condition who would also used three beads, but in the configuration demonstrated by the model.

These differences in behavior are more striking when considering that the only difference in manipulation between the two conditions was whether the children were given a social, conventional language cue or a goal-oriented, instrumental language cue. Children saw the same action sequence with the same stimuli from 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 or different amounts of pedagogical cuing. The different behavioral profiles manifested by children in each condition (i.e., higher levels of imitative fidelity, lower levels of behavioral variability for children in the ritual condition and lower levels of imitative fidelity, higher levels of behavioral variability for children in the instrumental condition) based on this social cue manipulation further support the distinction between the ritual and instrumental stances in children's learning.

Indeed, it should be noted that children imitated with some fidelity regardless of condition indicating that the ritual and instrumental stances should not be regarded as a binary but rather as two lenses for approaching different opportunities for learning that can and do overlap. Given that children in both conditions were placed in front of a live model that was actively demonstrating a new behavior for them while attending to them as individuals, in other words, engaging children with high levels of pedagogical cuing (Gergely & Csibra, 2006) there is no surprise that children incorporated some of the modeled actions into their own behaviors regardless of condition. Further research is needed to investigate children's learning outside of this very specific laboratory model of exploring children's behavior.

The action sequence presented in the study approximated the types of materials and tasks that children in the United States interact with in their typical environments. Because of this, the task addressed limitations of previous research on overimitation and high fidelity imitation by presenting children with an action sequence that was causally accessible due to familiarity. Unlike previous studies with puzzle boxes believed to be causally transparent due to actual transparent elements (Lyons, Damrosch, Lin, Macris, & Keil, 2011; Lyons, Young, & Keil, 2007) or tasks with intentionally novel materials such as Velcro hair curlers (Callaghan et al., 2011), the present study relied on materials that children could not only find, but also typically interact with in their homes or preschool classrooms. The present study demonstrates that previously documented cases of overimitation where the causal structures are apparent to adults may not be due to children's automatic causal encoding of novel behaviors, but rather the activation of the ritual stance caused by the novelty and complexity of the stimuli.

Future research will build upon this drive to engage children in ecologically valid learning situations and will examine children's imitation outside of the experimenter/child set-up common to previous imitation research. Rogoff and colleagues have suggested differences in learning in third-party observation where children are placed on the periphery of a demonstration (Correa-Chávez & Rogoff, 2009; López, Correa-Chávez, Rogoff, & Gutiérrez, 2010; Rogoff, 2003; Silva, Correa-Chávez, & Rogoff, 2010), which would help to answer how much of children's imitation is due to a desire to replicate a behavior for the model and how much is due to their drive to learn a new behavior. Providing children with a familiar model, such as a parent or teacher, might also provide further insight into how children use imitation as a tool for learning in their daily experiences. Given the concurrence 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, 2006; 2011; Gauvain, 2001; Lancy, Bock, & Gaskins, 2009; Rogoff, 1990, 1998, 2003; Tudge, Putnam, & Valsiner, 1996; Valsiner & Van der Veer, 1988; Wertsch & Tulviste, 1992), examining child-parent interaction in regard to imitation is a natural and necessary step in gaining a full understanding of children's use of imitation. In addition to these more quasi-experimental studies, there is also much to be gained from examining children's behavior in more naturalistic environments such as preschools, homes, and playgrounds. Observational research can provide insight to the types of social and contextual cues that children rely on to determine when to engage in high fidelity imitation as a tool for social learning.

The cognitive underpinnings of the ritual and instrumental stances

Previous research on children's high fidelity imitation has focused primarily on the act of imitating rather than the potential cognitive mechanisms behind said imitation. The present study attempted to explore the different cognitive processes underlying high fidelity imitation. While examining the cognitive underpinnings of the ritual and instrumental stances, the predominant goal was to determine whether the demonstrated differences in behavioral profiles between the stances are a matter of interpretation or memory.

Memory. The findings from this study support a difference in interpretation over a difference in memory as one of the factors underlying the divergence in imitative fidelity between the stances. When prompted with an immediate recall task, children in both conditions showed similar levels of recall, but when asked to recreate the sequence for a peer, children in the ritual condition demonstrated higher levels of imitative fidelity than children in the instrumental condition. Thus, even though children's accessible memory of the sequence is arguably similar, it appears that children are placing different values on the components of the action sequences in the ritual and instrumental stances.

Previous research has suggested that that overimitation is not a matter of a difference in memory, but a matter of interpretation (Nielsen & Tomaselli, 2010). When prompted to recreate a modeled action sequence just as a researcher has done, children are capable of faithfully reproducing the action sequence even when they have eliminated components in previous interactions with the stimuli presented (Williamson & Markman, 2006). Thus, the differences in imitative fidelity observed between the stances should be a consequence of interpretation rather than memory. Research examining the ritual and instrumental stances, however, has found that children in the ritual stance become more adept at accurately identifying actors' differences in performance on similar tasks (i.e. tasks with the same stimuli, perceivable end-goal; Legare et al., under review). If children are recalling the components of the novel action sequences with similar levels of accuracy across conditions, why does this divergence in difference detection exist?

Similar immediate recall abilities across conditions support the possibility that children are attending to the sequence with similar levels of attention and memory. Both sets of children are engaging in tasks of significant cognitive effort to determine which behaviors are relevant to each of their specific goals (either the recreation of the demonstrated sequence or efficient end goal execution) but demonstrate a difference in interpretation of what components of the behavior need to be attended to and reproduced.

When children initially observe a new behavior, if social and contextual cues lead to the activation of the ritual stance, then the observed behavior becomes the prototype for that particular kind of behavior. When processing other behaviors meant to approximate the same task, children compare them to this prototype and can identify similarities and differences between their executions. In their own behaviors, children in the ritual stance should also work to recreate this prototype to the best of their ability.

In the instrumental stance, rather than forming a prototype of the behavioral pattern, children are shifting focus to the most efficient execution end goal. In this instance, children are attending to the full sequence in order to determine what actions are and what actions are not necessary to execute the end goal rather than to encode the sequence in and of itself. When attending to subsequent behaviors that approximate the observed behavior, children process the different components as more or less effective rather than as deviations from a prototypical sequence. In their own behaviors children will work to execute the end goal in the most efficient way available to them, incorporating information from each demonstration.

Children’s different levels of imitative fidelity in their demonstrations of the action sequence for a puppet approximating a peer across conditions provides further support for differences in interpretation of novel behavioral sequences as an explanation for the divergent behavioral profiles seen in the ritual and instrumental stances. When asked to help a bear puppet learn what the experimenter had done children in the ritual condition recreated the sequence with higher fidelity than children in the instrumental condition. This indicates that children in the ritual condition demonstrated the causally irrelevant or conventional aspects of the sequence, such as string stretching and bead to forehead touches more than children in the instrumental condition. In contrast, children in the instrumental condition labored to make a necklace without much regard to the sequence previously demonstrated by the experimenter. Research on children's transmission of novel behaviors from peer to peer (transmission chains) suggests that when demonstrating a behavior for a peer, children tend to replicate those aspects of the behavior that they deem important (Flynn, 2008). Thus, it seems that children are assigning different levels of value to the actions they see demonstrated based on the activation of the instrumental or ritual stance and in turn recreating those actions when asked to demonstrate the behavior for a peer.

The different components of the action sequence children demonstrated when recreating the action sequence for a puppet approximating a peer further supports the two cognitive profiles proposed of the ritual and instrumental stances. Children in the ritual stance appear to be creating a prototype of the novel behavior, encoding the components of the sequence with attention to all components, even those that could be deemed causally irrelevant. Thus, children in this condition were more likely to demonstrate behaviors such as bead to forehead touches and stretching the string rather than just making a necklace.

In contrast, children in the ritual stance appear to focus on efficient end-goal execution through the creation an evaluative catalogue of behaviors rather than a behavioral prototype. Rather than recreating the causally irrelevant components of bead to forehead touching or string stretching, children in the instrumental condition were more likely to simply make a necklace. Moreover, children's reconstruction of the necklace for the puppet was their second interaction with the necklace-making materials. Ostensibly in their first interaction with the necklace-making materials (in the imitation task), the children in the instrumental condition would have had an opportunity to assess what was and was not causally efficacious in the creation of the necklace. Therefore, in their second interaction, demonstrating the behavior for the puppet, they were better poised to engage in only the behaviors necessary to make a necklace (stringing the beads).

Given that children were only assessed on two dimensions of memory and attention, however, there is insufficient evidence to demonstrate definitively that interpretation rather than memory is driving the behavioral differences between the stances. In the immediate recall condition, children were not asked to about the novel gestures or various action components of the sequence. While it might be difficult to assess this knowledge via a direct recall measure, future studies could examine potential differences in memory by explicitly asking children to exactly reproduce what the model had done. Moreover, future research is needed to assess children's recall of the novel behavior over time to examine how the stances might affect long-term memory encoding of the action sequence. In addition, eye-tracking studies might provide a more nuanced picture of what children are attending to during the demonstration of a novel behavior and if children in different conditions display different attention patterns.

Furthermore, whereas a puppet is a controlled and efficient approximate peer from an experimental perspective, there is much to be gained from examining imitation as it occurs in peer group settings. More research is needed to explore how children use imitation as a tool for learning from each other and how observing a novel behavior in the presence of peers might impact children's imitative behaviors. Some such research could be a variation on the transmission chain research used previously with preschoolers and chimpanzees (Flynn, 2012; Horner, Whiten, Flynn, & DeWaal, 2006) to see if different types of social and contextual cuing could be used to encourage the maintenance of causally irrelevant components over the course of a new behavior's transmission.

Functional fixedness. Findings from the present study support functional fixedness as a potential cognitive factor underlying children's high levels of imitative fidelity in the ritual stance, at least for 5 and 6 year-old children. As anticipated, older children in the ritual stance showed higher levels of functional fixedness as manifested by marginally lower rates of solving the problem presented in the ritual preutilization condition than in the instrumental preutilization condition. While some children in both preutilization conditions demonstrated difficulty with solving the problem, as anticipated, a greater proportion of children in the instrumental preutilization condition were able to solve the problem. This difference indicates the possibility that children in the ritual condition had formed a less flexible representation of the necklace making materials when their previous function – the end result of a novel action sequence – was activated.

Children in both the ritual non-preutilization and instrumental non-preutilization conditions more or less consistently solved the problem with little difficulty, as would be predicted from the perspective of functional fixedness – as functional fixedness tends to only be enacted when the known function of an object is being activated. Moreover, five year-olds demonstrated behavioral patterns very similar to six year-olds indicating that functional fixedness may have been activated in children younger than six, an age group thought to be immune to functional fixedness (German & Defeyter, 2000).

These findings suggest that when the ritual stance is activated, children may form a more strict representation of the use of any objects acted upon in the action sequence while children for whom the instrumental stance is activated may not show the same cognitive inflexibility. This potential state of cognitive flexibility or cognitive inflexibility suggests that children may be imitating with greater fidelity in the ritual condition due to a fixed representation of the objects and a resultant desire to only use the objects in the way they had been presented. Alternatively, children in the instrumental stance are not limited by the same inflexibility and may feel more comfortable exploring the multiple functions of the objects in order to assess the most causally efficacious way of executing the given end goal.

Given that four year-old children did not demonstrate similar patterns of functional fixedness (possibly due to the overall difficulty of the task) and the inaccessibility of the task to three year-olds, it is difficult to extend this generalization beyond the older children. Three and four year-olds, however, are susceptible to the same social and contextual cues as five and six year-olds in regards to the activation of the ritual and instrumental stances and therefore it follows that they too might demonstrate functional fixedness if presented with a task that is better suited for their problem-solving abilities.[5] Future research is needed to examine if functional fixedness is a potential underlying cognitive component of the ritual stance across ages or if it develops through ontogeny.

Imitation and cultural learning

Young children are proficient causal learners (Gopnik, et al., 2004, Gopnik, Sobel, Schulz, & Glymour, 2001) so their documented tendency to engage in high fidelity imitation in causal-learning situations can and should be attributed to social and contextual factors rather than an overzealous penchant for inefficient mimicry. The findings from the present study suggest that children are relying on social and contextual cues when determining whether to imitate with high fidelity or to eliminate unnecessary elements from an action sequence.

Children have access to an assortment of opportunities to learn through imitation in their daily lives. Although imitation efficiently facilitates the faithful transmission of information and skills, the findings of this study suggest that children are selective about when they employ imitation, specifically high fidelity imitation, as a tool for social learning. Rather than engaging in indiscriminate imitation, children use social and contextual cues to determine when they need to attend to process rather than product in order to become competent cultural members.

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[5] It should be noted that in German & Defeyter's (2000) study, their youngest age group was five year-olds, thus the functional task on which this measure was based had not been previously executed with children younger than five years-old.

Appendix:

Figure 1. Warm-up game pictures

1a: Target pictures

1b: First set of pictures

Figure 1. Warm-up game pictures (cont.)

1c: Second set of pictures

1d: Third set of pictures

Figure 2. Necklace construction sequence

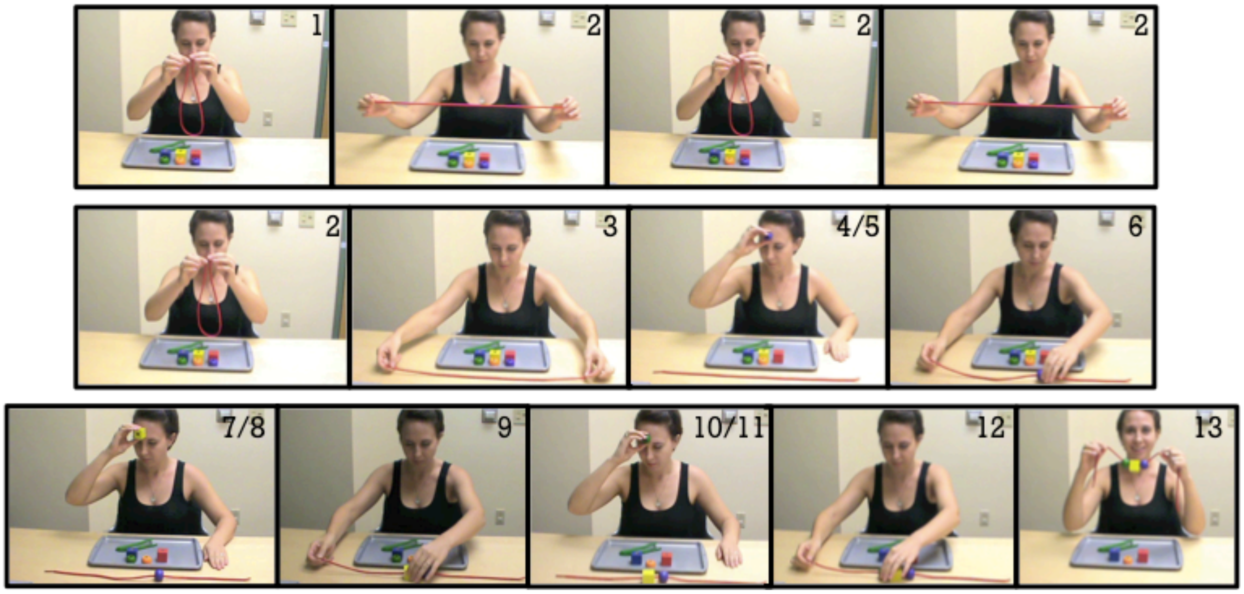


Figure 3. Full stimuli set for imitation task

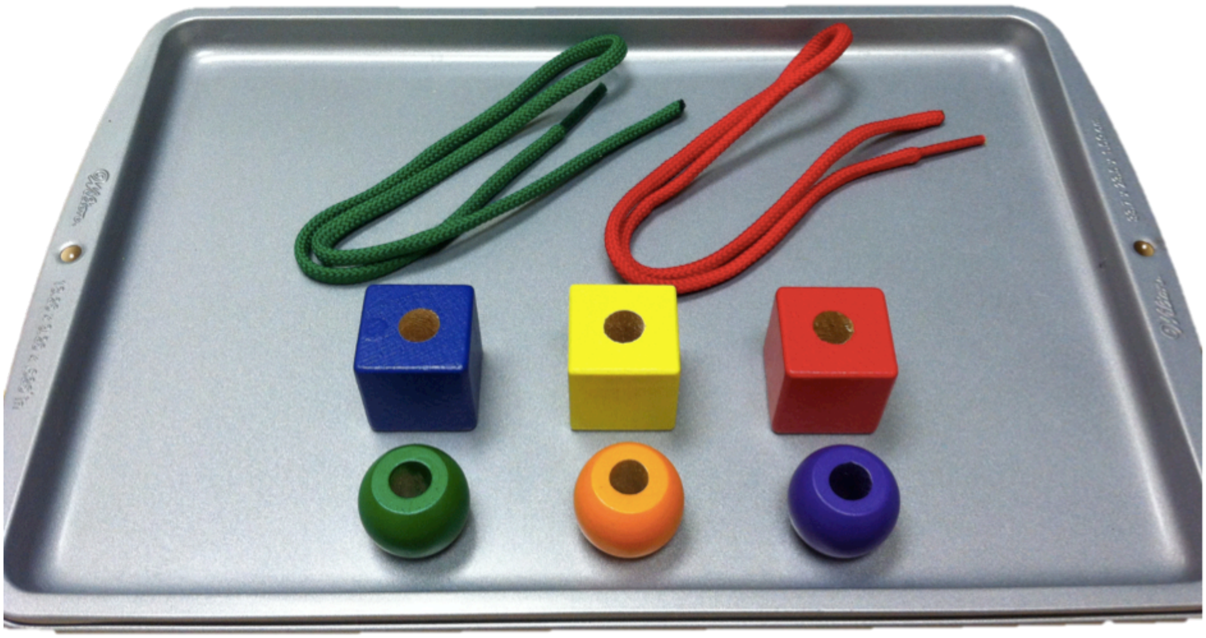


Figure 4. Full stimuli set for immediate recall task

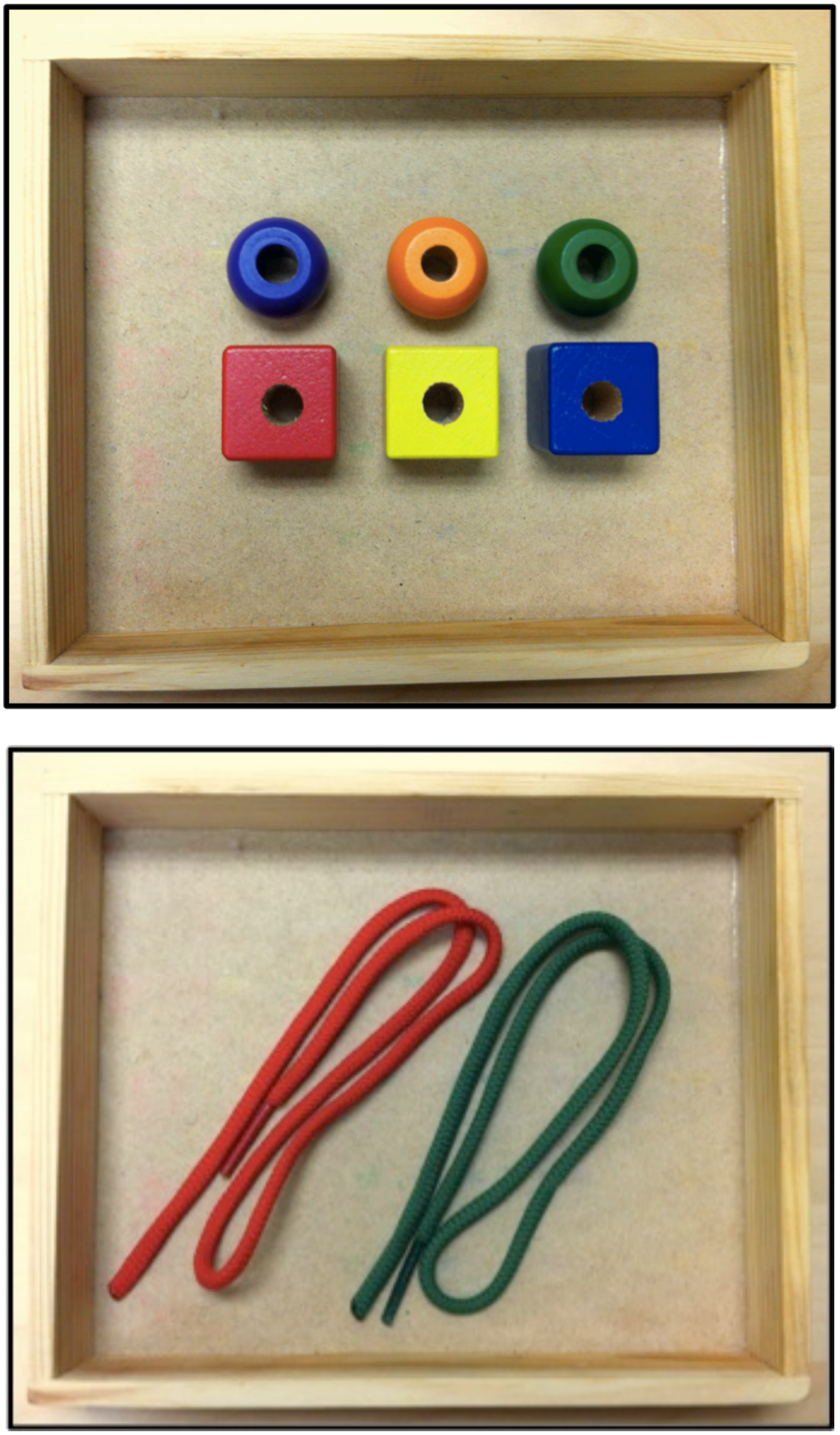
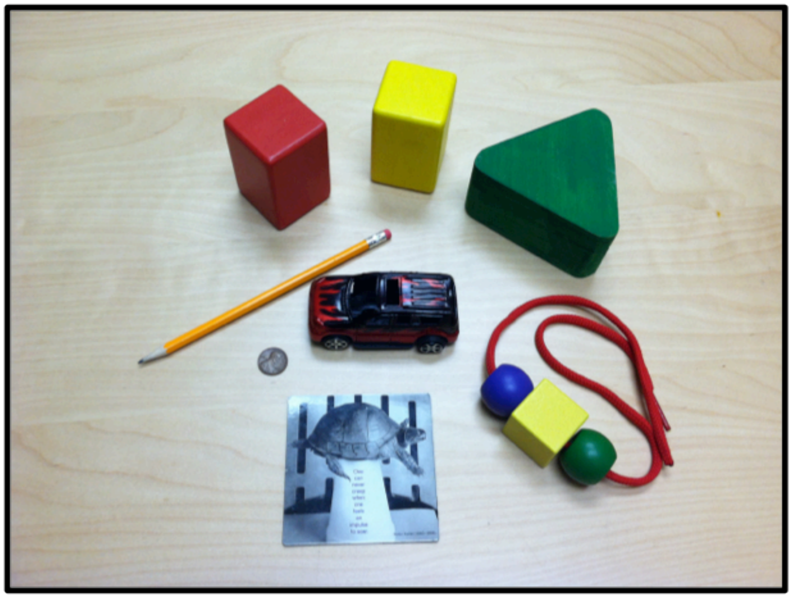


Figure 5. Functional fixedness room ("Bobo's room")

Figure 6. Object sets for functional fixedness

6a. Preutilization (beads on string)



6b. Non-preutilization (beads next to string)

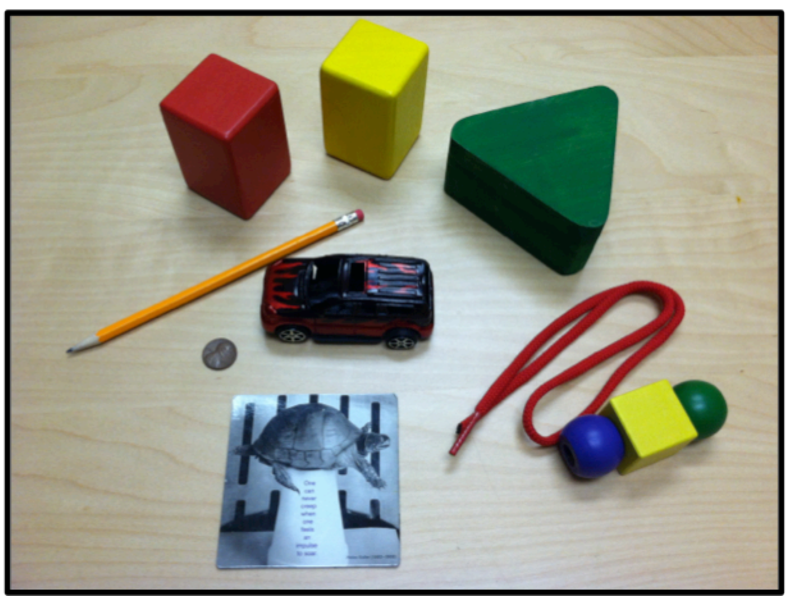


Figure 7. Functional fixedness task solution

Figure 8. Imitative fidelity score for imitation task by condition collapsed across age groups

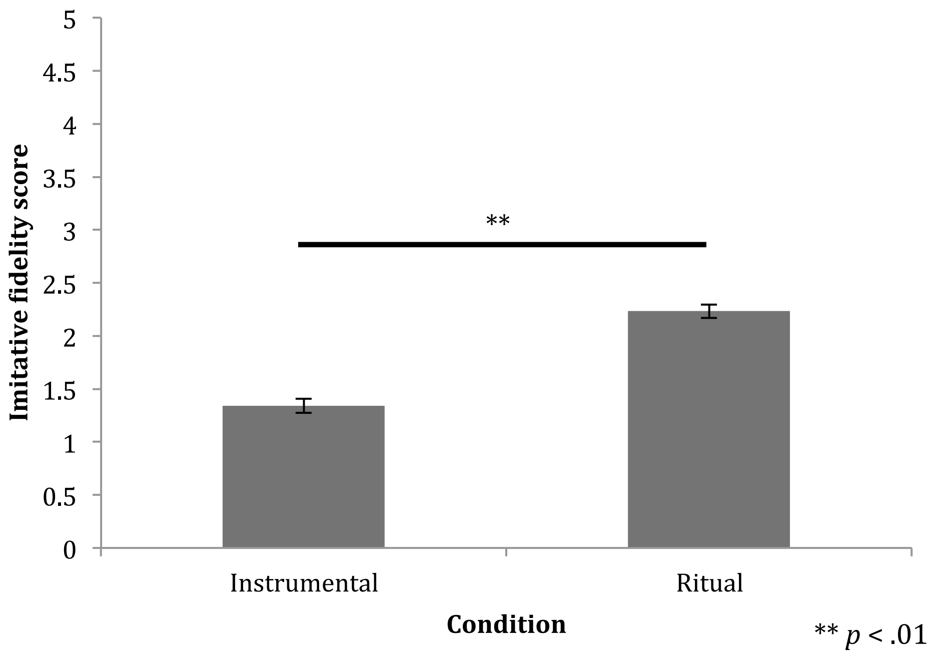


Figure 9. Innovation score by condition collapsed across age groups

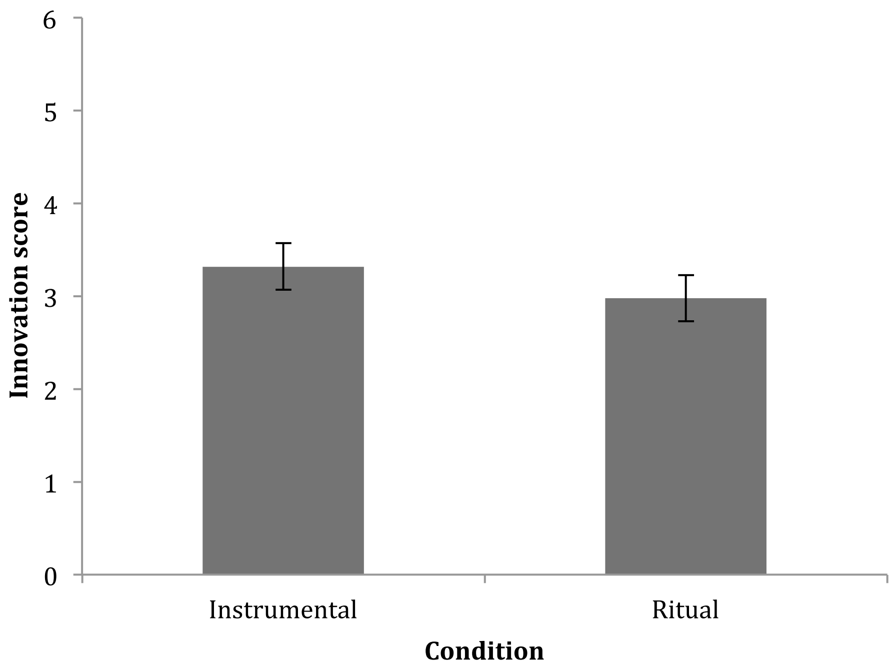


Figure 10. Immediate recall scores by condition and age group

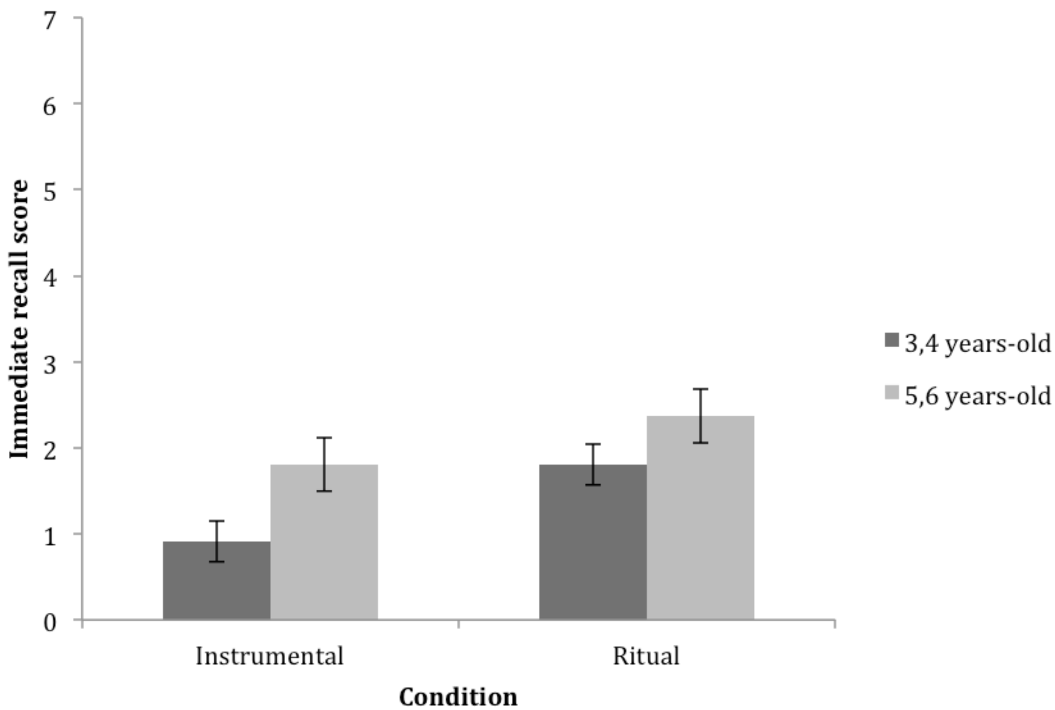
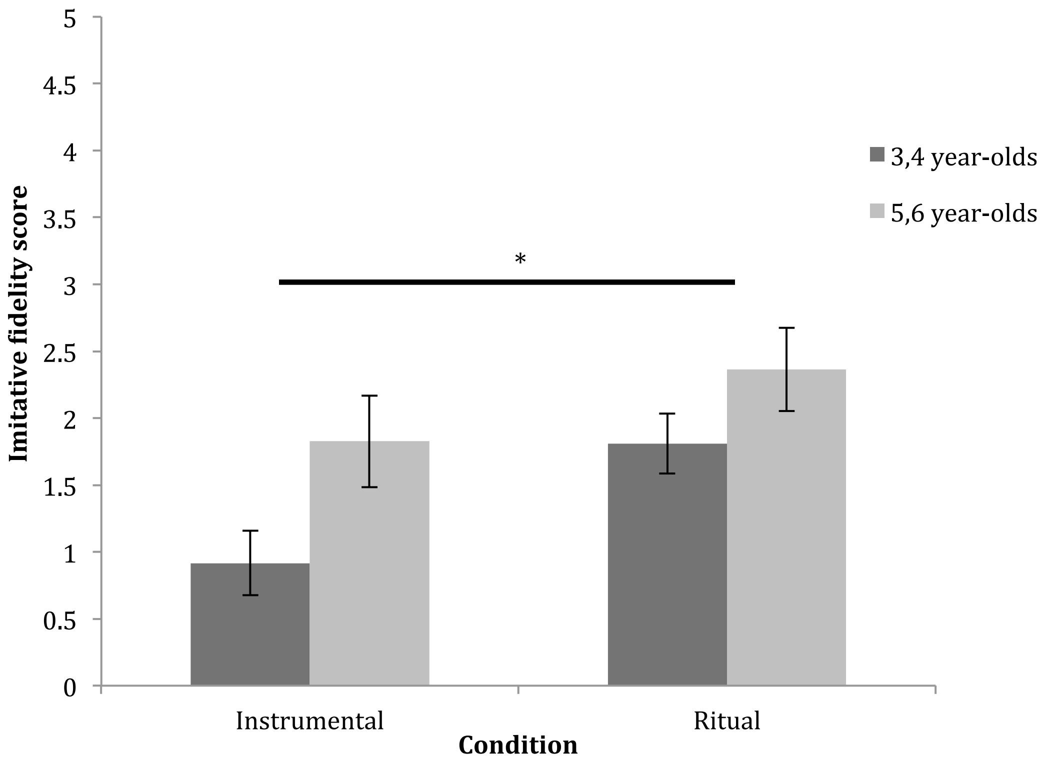


Figure 11. Imitative fidelity scores for teaching task by condition and age group



* $p < .05$

Figure 12. Proportion of children solving functional fixedness task by age group and condition

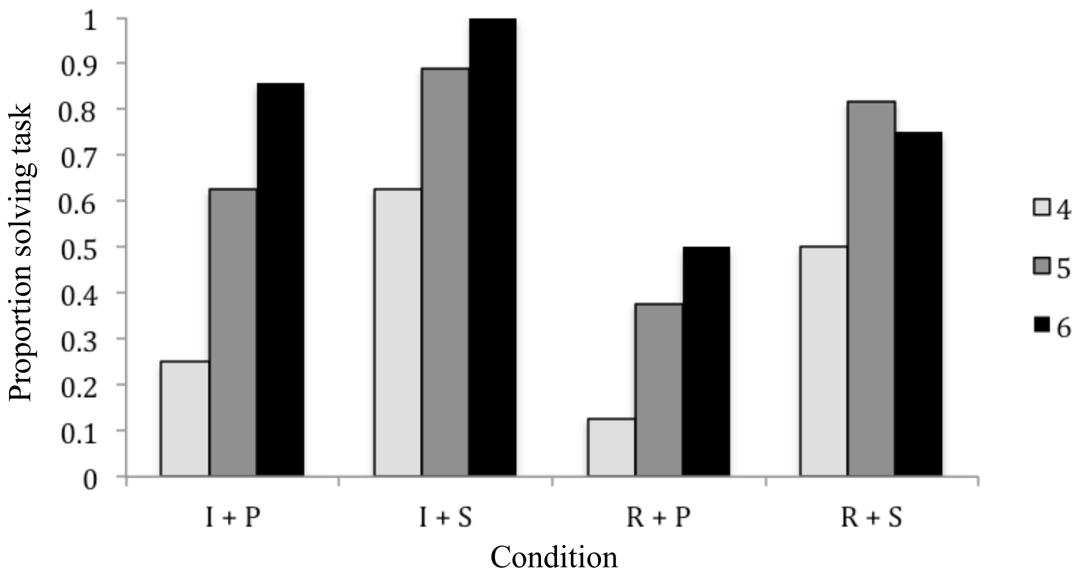
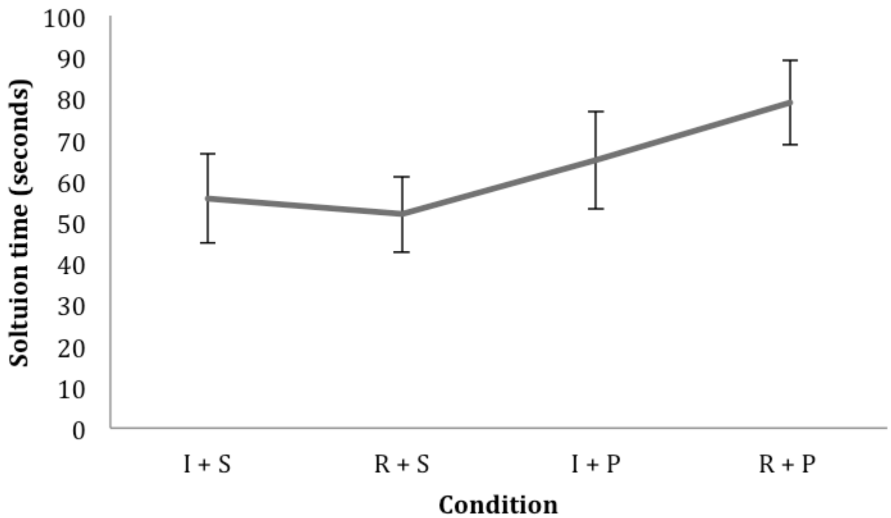


Figure 13. Mean solution time for 5 and 6 year-olds in the functional fixedness task by condition



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