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Children's Imitation of the Majority in a Goal-Directed Task: Examining Number of Demonstrators and Demonstration Modality

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By

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Under the Direction of Rebecca Williamson

ABSTRACT

Children's imitation is not random, but depends on the context of the demonstration and imitation opportunity. For example, children are more likely to copy acts modeled by multiple people versus a single individual. In this study, I investigate the mechanisms underlying this phenomenon by manipulating the number of demonstrators and mode of presentation for a goal-directed task. Children saw either one or two adults demonstrate unnecessary target acts while opening boxes to retrieve toys, and demonstrations were presented either live or on video. Children imitated the target acts at equal rates across conditions. This may reflect children's heightened attention to reproducing the salient goal (i.e., opening the box to retrieve a toy) as opposed to copying the acts used to achieve the goal. Future studies should manipulate children's prior experiences, goal salience, and the majority influence to determine the relative importance of each of these factors in guiding social learning.

INDEX WORDS: Imitation, Cognitive development, Social cognition, Observational learning, Preschool-aged children

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1 INTRODUCTION

As children grow up, they are faced with the task of acquiring countless skills and behaviors in order to become capable members of society. Some of a child's learning occurs through direct instruction, either in a formal setting (i.e., from a teacher in a classroom) or in everyday life (i.e., from a parent at home), and from independent trial and error and explorative play (Steinberg, Belsky, Meyer, 1991). Still, each of these learning strategies involves a fair amount of conscious effort on the part of the child, and cannot wholly account for the rapid achievement of skills. Scientists have additionally explained some of children's development as a product of observational learning (Berk, 1996). Instead of seeking out explicit learning opportunities, children may encode and reproduce adults' everyday actions. Indeed, even within the early days of infancy, infants will reproduce facial gestures (Meltzoff & Moore, 1983) and by one year of age they will spontaneously copy object-centered actions (Want & Harris, 2002).

The process of imitation has been extensively studied, including comparison of humans and chimpanzees (e.g., Horner & Whiten, 2005; Tennie, Greve, Getscher, & Call, 2008) and is experiencing a renewed interest in the literature. Specifically, researchers have a particular interest in *when* and *what* children imitate. How do children know what is important to copy and retain for future use, and how do they know what to ignore? The goal of the present study is to examine how the context of the imitation opportunity (specifically, the number of demonstrators a child sees and their mode of presentation), in combination with task features, affect imitation.

1.1 Faithful Imitation and Complex Culture

Children's earliest imitation tends to involve copying primarily the physical outcomes of others' behaviors (Zmyj, Daum, & Aschersleben, 2009). During the second year of life, children also begin to reproduce the specific acts a model uses to complete those goals (Nielsen, 2006;

Tomasello, Carpenter, Call, Behne, & Moll, 2005). For example, after seeing an adult use a rake-like tool retrieve a toy, children are likely to reproduce the exact means they saw (i.e., using an edge or raking) to achieve the outcome of retrieving the toy (Nagell, Olguin, & Tomasello, 1993). Through early elementary school and even in adulthood, individuals imitate entire action sequences, even when some actions are clearly and visibly unnecessary (e.g., McGuigan, Whiten, Flynn, & Horner, 2007; Nielsen & Blank, 2011; Nielsen & Tomaselli, 2009).

Faithful imitation is present even in remote human populations. Nielsen and Tomaselli (2010) found that Kalahari Bushman children imitated causally irrelevant actions at similar rates to a typical Australian sample. The Kalahari are a group who do not engage in direct pedagogy with children, and these results are taken to suggest that high imitative fidelity is not the result of Western pedagogical emphasis. This suggests that the tendency to copy another's exact means is a ubiquitous human trait.

In contrast, nonhuman primates rarely copy the exact means an adult uses to produce outcomes (e.g., Call, Carpenter, & Tomasello, 2005; Tennie, Greve, Getscher, & Call, 2010). Comparative research has found that our closest evolutionary relatives, chimpanzees, ignore faithful copying and instead use an emulative approach when sufficient causal knowledge is made available (Horner & Whiten, 2003). This was found in direct contrast to the performance of 3- and 4-year-old children, who more often adopted an imitative approach, regardless of the availability of causal information. Similarly, even children as old as ten are found to copy the means to an outcome exactly, even when it is not the most efficient strategy (DiYanni, Nini, & Rheel, 2011). With this in mind, researchers have investigated faithful imitation to better understand human learning and how it differs from that of other primate species.

Some researchers have posited that imitating not only the outcomes of others' behaviors, but also the exact means used, serves an important function for the development of complex culture. In particular, faithful imitation may allow for cultural "ratcheting" by allowing an individual to take in everything that another person does and then make modifications to it (Tomasello, 1999). This optimized method can then be passed on to others and modified further, allowing for a methodological advancement along generations. Accordingly, faithful copying and cultural ratcheting are two processes that appear to be unique to humans (Dean, Kendal, Schapiro, Thierry, & Laland, 2012).

1.2 Factors Guiding Imitation

Although the ability to copy acts in precise detail may be useful, it is not always an efficient strategy. Blindly copying everything observed would lead children's behaviors to become a jumble of mistakes and miscues. Instead, children also make use of a variety of contextual cues and strategies to guide their imitation. For example, children pay attention to intentionality when deciding what behaviors to imitate. When actions appear accidental, children are less likely to copy modeled behaviors (Carpenter, Akhtar & Tomasello, 1998). Children also take into account situational constraints and the goal at hand. For example, when an adult modeled turning on a light by pressing it with their forehead, children were only more likely to imitate these exact means of turning on the light when the adult's hands were not occupied (Gergely, Bekkering, & Kiraly, 2002).

In addition, children are more likely to imitate adults' exact behaviors as opposed to those of their peers, even when the younger demonstrator explicitly states their competency (Wood, Kendal, & Flynn, 2012). This bias of attributing expertise to older individuals may represent one way that children avoid adopting inefficient or erroneous behaviors of their

inexperienced peers. It is also possible that this adults-as-experts bias is a culturally embedded learning strategy that is hard to extinguish, even with explicit task prompts. Although children often copy faithfully, attention to these types of cues may guide children to adopt a rational strategy where appropriate.

Another efficient learning strategy may be to copy what multiple individuals do. It makes intuitive sense that children can circumvent adopting an individual's idiosyncrasies by paying attention to and reproducing the common behaviors of the many people they see. Recent research has found that this is indeed the case; children are more likely to adopt the response of a majority as opposed to that of an individual.

1.3 Majority-biased Transmission

To date, there have been two studies that have demonstrated that children are more likely to adopt the behaviors of a majority than those of an individual. The first of these studies, by Haun, Rekers, and Tomasello (2012), dubbed this phenomenon "majority-biased transmission". In their study, children watched either one or three adults drop a ball down a colored tube. There were three different tubes to choose from, and the total number of demonstrations was equal across conditions. When later given the opportunity to drop a ball down one of the tubes, children were more likely to drop it down the same color tube as had been selected by the majority, and not the response demonstrated by an individual multiple times. Chimpanzees' responses also showed a pattern of majority-biased transmission, which suggests that this response strategy is shared with our closest biological relatives.

Results from another recent study have provided evidence of increased imitation in response to multiple individuals (Herrmann, Legare, Harris, & Whitehouse, 2013). In their study, children watched video displays of either one or two adults demonstrating an action sequence of

pushing and tapping on differently colored pegs using a mallet. The task was designed to replicate performing a ritual, and as such it had no obvious physical goal, other than changing the position of the pegs. Children's imitation was scored by allocating one point for reproduction of each part of the demonstration, with a maximum score of six points. They found that children had significantly higher imitation scores after viewing two successive demonstrators, in comparison to viewing one demonstrator model the action sequence twice.

1.4 Explanations for Majority-biased Transmission

There are several possible explanations for why children and chimpanzees choose to copy what the majority of individuals do. Authors of the original findings of majority-biased transmission posit that it is an efficient means for learning because the response of the majority is likely to be "safer, more reliable, and more productive" (Haun, et al., 2012, p. 727). To put it another way, the majority behavior represents an "expert" response that is potentially useful or efficient. It makes sense that children would want to copy what most people do.

However, it is important to note that the task used in the original paper (dropping a ball down a tube) is fairly simple, and does not produce an obvious physical reward or goal. Therefore, it remains to be seen whether majority-biased transmission extends to more functional or goal-directed acts. If children view the majority as a useful expert, then we would expect children to imitate the majority behaviors in goal-directed tasks, where 'doing it right' is important.

The more recent study of majority-biased transmission also uses a non-goal-directed task, although this is because these authors approach majority-biased transmission from a different perspective. Instead of focusing on the majority response as one that is 'safer' and 'more reliable', Herrmann and colleagues (2013) suggested that copying the majority is how children

learn social conventions and rituals. These are sequences of behaviors that often have no obvious physical goal, and accordingly, their task includes an action sequence that produces no outcome on the stimuli.

An unaddressed explanation for majority-biased transmission is that it is socially motivated. Many researchers have explained faithful imitation as a mechanism by which social affiliation is achieved. Notably proposed by Uzgiris (1981), imitation is not only an efficient way to learn about the world, but can also be a way we establish affiliation and "likeness" with other people. This idea remains very prevalent today, with many authors explaining the robustness of faithful imitation as the result of an engrained social process that facilitates interactions between people. In support of this proposal, recent studies show that manipulating the social context of a task can affect children's imitation. For example, children are more likely to copy irrelevant acts leading to an outcome when the person who demonstrated the acts is present to watch (Nielsen & Blank, 2011). This suggests that imitation is employed to achieve a perceived social benefit. Another study varied the social responsiveness of demonstrators using both pre-recorded videos and Skype, revealing higher imitation performance with the socially interactive model (Nielsen, Simcock, & Jenkins, 2008).

Given that social context determines children's faithful imitation, it is possible that majority-biased transmission could be explained as a socially motivated process. Using multiple demonstrators presents a heightened social pressure, or enhanced opportunity to affiliate via imitation, which could increase children's copying.

1.5 Current Study

The goal for the current study is to address the role of two explanations for majority-biased transmission. First, in the current study I address the role of expertise by using explicitly

goal-directed acts. Specifically, in this task, children interact with different types of boxes containing toys. Before viewing demonstrations, children are given the opportunity to manipulate the boxes and open them, which highlights the goal of the task – opening the boxes to retrieve the toys. Allowing children to have a successful experience with the boxes prior to demonstrations not only underscores the goal of retrieving the toy, but should prevent ceiling levels of imitation across conditions.

After their initial experience with the boxes, children view either one or two adults demonstrate opening the boxes while employing a causally irrelevant act (e.g., turning a switch attached to the side of the box). Research has found that children imitate irrelevant acts even when they recognize that the acts are unnecessary to achieving a goal (Lyons, Young, & Keil, 2007). Thus, we expect children to imitate in this task, despite their knowledge that the acts are unnecessary. If majority-biased transmission occurs in goal-directed tasks, then children should copy the irrelevant act more often after viewing two demonstrators, rather than one.

A second question addressed in the current study regards the extent to which majority-biased transmission is a socially motivated phenomenon. Previous research has manipulated the social context of an imitation task using live and video models (e.g., Nielsen, Simcock, & Jenkins, 2008); in the current task, children see either live or videotaped demonstrations. If majority-biased transmission is motivated by social affiliation via imitation, then it should only occur in the live demonstration condition. However, it is possible that majority-biased transmission is robust regardless of the affiliative opportunity, in which case it may also occur in response to video demonstrations.

It is important to note that a large amount of research has found that children imitate less following video demonstrations, in comparison to live ones. This is said to reflect a “video

deficit effect" by which children learn substantially less from 2-D video displays in comparison to 3-D, interactive live ones. (Anderson & Pempek, 2005; Barr, 2010). However, there are several examples of imitation following video demonstrations in recent research literature (e.g DiYanni, et al. 2011; McGuigan, et al., 2007; Wood, et al., 2012 Zmyj, et al., 2010). It has also been shown that children are capable of learning from video by two years of age (Brito, et al., 2012). It is still unclear whether majority-biased transmission can be induced following video demonstrations. If social motivation plays only a limited role in majority-biased transmission, it is possible that there will be equal levels of imitation in both the live and video conditions.

2 METHOD

2.1 Participants

Forty three-year-olds (*M* = 37.1 months, *SD* = 2.7; 17 males) were recruited from the Learning and Development Lab Subjects Database for this study. This database includes families living in and around the city of Atlanta. In our sample, 55% of families self-identified as White, 27.5% as Black/African-American, and 15% as mixed race (one family did not report ethnicity). In addition, 80% of families self-identified as Non-Hispanic/Latino and 15% as Hispanic/Latino (two families did not specify).

2.2 Materials

Four types of boxes were used, and there were two boxes of each type. Each box contained a unique, age-appropriate toy that fit easily within the box. Each box could be easily opened with a simple manipulation (e.g., pulling a drawer out, lifting the top). There was also an attachment on each box (e.g., a plastic or metal piece, a carrying handle) that was manipulated during the adult demonstration (the target act). The manipulated attachments were superficial and did not affect how the boxes opened. The boxes and the target acts associated with each are detailed in Table 1.

In the video condition, children viewed demonstrations on a portable DVD player (11.5 cm x 20 cm).

Table 1

Description of Materials

Box type	Target Act	Photo
Black Drawer	Turn side wheel switch to make a clicking noise	
Blue Knob Box	Squeeze metal piece with thumb and forefinger	
Heart box	Swipe white plastic piece with forefinger	
Suitcase	Flip blue carrying handle up and down	

2.3 Design

Participants were randomly assigned to one of two modality conditions (live or video) and all participants saw either one or two demonstrators; this created an experiment with a 2x2 mixed factors design. In the video condition, children viewed demonstrations by either one or two adult models in video format. In the live condition, live adult demonstrators replaced the videos. In both conditions, the demonstrators were unfamiliar to the child.

The presentation order of boxes and order of demonstrators was counterbalanced across participants. Specifically, the first two demonstrations of each session always contained the same number of models (one or two), and it switched for the second two demonstrations.

2.4 Procedure

There were four components of the task. The task was identical for each pair of boxes, which produced four trials for comparison and analyses. The only differences between the live and video conditions existed in part (3) of the task, which is the demonstration (see Figure 1). The task for each set of boxes proceeded as follows:

(1) *Introduction to boxes and toys*. An adult experimenter sat across from the child at a small table inside a laboratory testing room. The experimenter brought up the pair of boxes from behind the table. The boxes were open and the toys were clearly visible. The experimenter introduced each of the toys to the child. After the child had a chance to play with each of the two toys, the toys were placed back inside the boxes and the experimenter closed the boxes. This part of the procedure ensured that the children knew what is inside the boxes, and that the boxes were identical. After the boxes were closed with the toys inside, the experimenter took both boxes below the table and out of the child's sight.

(2) *Successful experience with first box*. The experimenter brought up one of the boxes, presented it to the child, and said something like, “Why don’t you try to open it?” The child was then allowed to interact with the box. Children almost always opened the boxes easily without further direct instruction. After the child opened the box, the experimenter removed it from view by placing it back under the table.

(3) *Demonstration*. In the video condition, the experimenter brought up a DVD player and placed it on the table. The experimenter directed the child’s attention by saying something like “Let’s see what they do in the video”. The video demonstrators were male and female.

In the live condition, the two adult demonstrators stayed in the room throughout the task, in addition to the experimenter who directed the task. The demonstrators did not interact with the child aside from providing the demonstrations, which were identical to those presented in the video. A male and female were not always available to demonstrate; in some cases, two females demonstrated.

The target acts were modeled on both boxes in each set. In the single demonstrator condition, the adult demonstrated the target act twice (once on each box). In the two demonstrator condition, each demonstrator modeled the target act once. This controlled for the total number of demonstrations per condition. The boxes and toys used in the video were the same ones used in the test room.

(4) *Imitation opportunity.* After viewing each demonstration including the target actions, the child was presented with the second box (i.e., the box he/she had not already opened). The experimenter said something like, “Why don’t you try to open this one?” The child

was allowed to interact with each box until he/she has successfully opened it or he/she lost interest in the task.

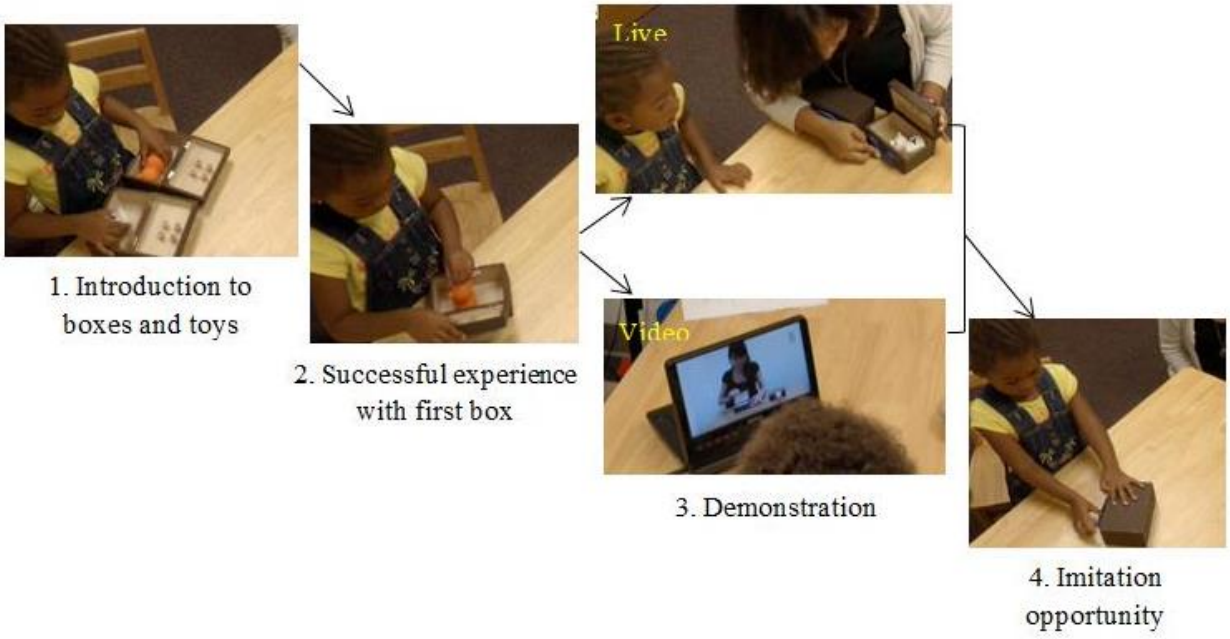

*Figure 1***.** Photographic description of task progression.

3 RESULTS

3.1 Scoring

Children's imitation performance was scored with a yes/no (1/0) judgment in regards to their production of the target act (one per object). Children's performance of the target act was scored on both the first and second boxes. Performance on the first box of each set provides a baseline measure of how often children spontaneously execute the target act, whereas performance on the second box represents a standard measure of imitation. The first dependent measure is children's imitation score (sum of target act completions during imitation opportunity; range 0 to 4, or 0 to 2 for each set of demonstrators). Difference scores were calculated by subtracting the total number of target acts completed on the first boxes (children's baseline rate of producing the target acts) from imitation scores (range -4 to 4). Difference scores can be compared to zero to assess children's learning of the target act from pre-demonstration to post-demonstration.

To address the possibility that children paid more attention when viewing one modality versus the other, a randomly selected 27.5% of subjects (n = 11) were coded on how long they spent looking at the demonstrations. Research assistants who were blind to the research hypothesis scored from video the times at which children looked to and from the live and video demonstrations, to the video frame. There are 30 video frames per second.

To assess reliability, imitation scores were recoded for a randomly selected 30% of subjects (n = 12), ICC(1,9) = .89.

3.2 Preliminary Analyses

A preliminary analysis using a 2(participant gender) x 4(counterbalancing order) x 4(object) repeated measures ANOVA revealed no significant interactions of these variables.

There were no effects of gender or counterbalancing order; therefore, we collapsed across these groups for analyses.

The percent of the total demonstration time spent looking at the displays did not differ between subjects in the live (M = 98.6%, SD = 2.25) and video conditions (M = 96.5%, SD = 3.27), $t(9) = 1.26$, $p = .239$. Percent of time spent looking also did not differ between viewing one demonstrator (M = 96.1%, SD = 4.97) or two demonstrators (M = 99.1%, SD = 2.14), $t(10) = 1.87$, $p = .09$.

3.3 Main Analyses

3.3.1 Imitation Scores

A 2 x 2 repeated measures ANOVA was used to investigate the effects of number of demonstrators and demonstration modality on imitation scores (see Figure 2). There was neither a main effect of number of demonstrators, $F(1,38) = 0$, or demonstration modality, $F(1,38) = .087$, $p = .77$, on imitation scores. Additionally, there was no interaction of number of demonstrators and demonstration modality on imitation scores, $F(1,38) = 1.03$, $p = .32$.

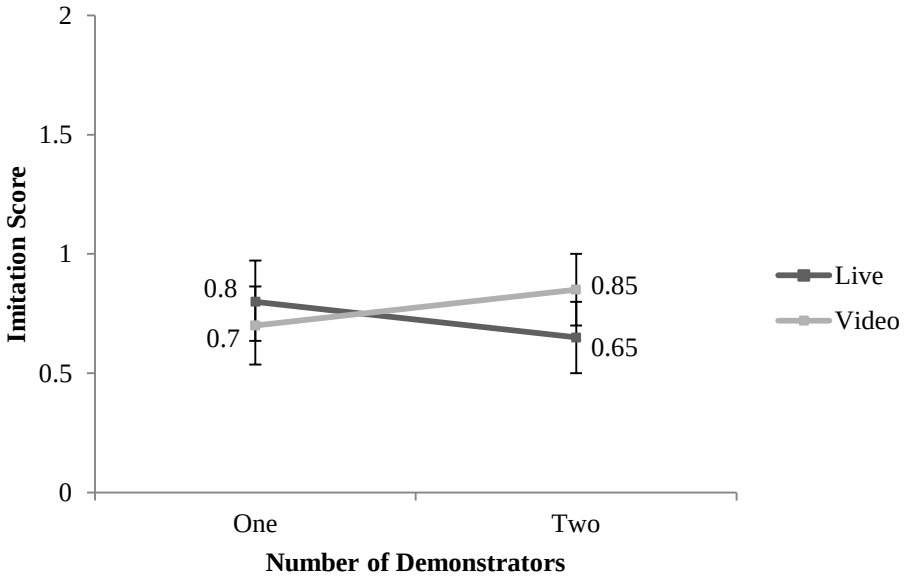

Figure 2. Mean imitation scores (+/- SEM) by number of demonstrators and demonstration modality.

It is possible that children's behavior changed across trials. To account for this possibility, we separately analyzed imitation scores in the first two and second two trials with two 2 x 2 between-subjects ANOVAs. In these analyses, number of demonstrators was a between-subjects variable. In the first two trials, there was neither a main effect of number of demonstrators, $F(1, 36) = .112$, $p = .74$, or demonstration modality, $F(1,36) = .062$, $p = .74$, on imitation scores. There was also no interaction of these variables, $F(1,36) = .020$, $p = .89$ (see Figure 3). Although the pattern of imitation scores in the later trials is somewhat different (see Figure 4), again, there were no significant main effects of demonstrators ($F(1,36) = .124$, $p = .73$) or modality ($F(1,36) = .077$, $p = .78$) and no significant interaction ($F(1,36) = 1.35$, $p = .25$).

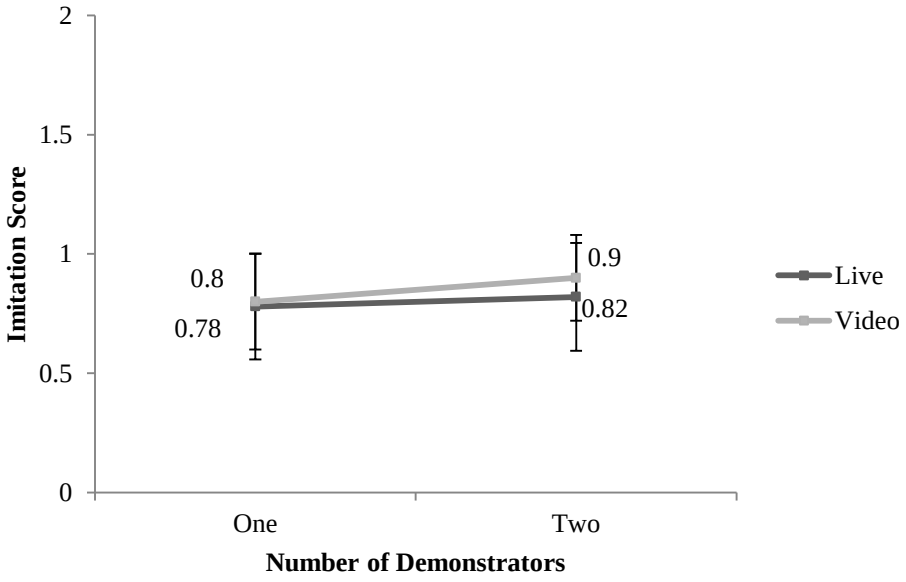

Figure 3. Mean imitation scores (+/- SEM) in the first two trials by number of demonstrators and demonstration modality.

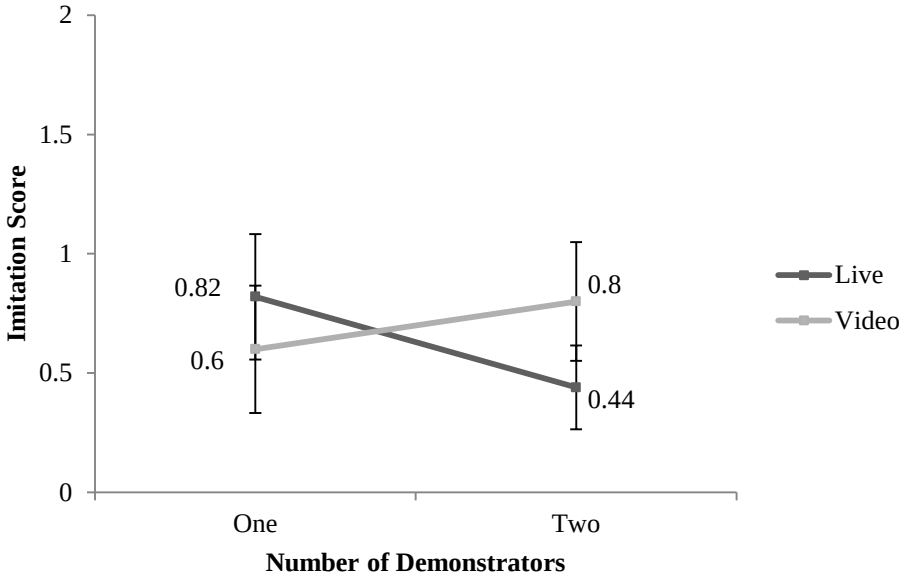

Figure 4. Mean imitation scores (+/- SEM) in the second two trials by number of demonstrators and demonstration modality.

3.3.2 Difference Scores

To assess whether seeing the demonstration affected children's production of the target acts, we examined difference scores in both the live and video conditions using one-sample t-tests. Difference scores from children in the live condition (M = 1.00; SD = 0.97) were significantly greater than zero, $t(19) = 4.60$, $p < .001$, indicating imitation. The same was true for children in the video condition (M = 0.85; SD = 1.14), $t(19) = 3.34$, $p = .003$.

We also ran the same 2 x 2 ANOVAs as we did in the previous section, except we replaced imitation scores with difference scores as the dependent variable. The pattern of the results was similar to what was found with imitation scores. There were no significant main effects of number of demonstrators, $F(1,38) = 1.41$, $p = .24$; demonstration modality, $F(1,38) = .201$, $p = .66$; or interaction between these variables, $F(1,38) = .156$, $p = .70$.

3.3.3 Children with Unsuccessful First Experience

Some children (n = 15) were unable to get the first box open on some of the trials. We re-ran the main analyses with these unsuccessful trials removed to account for the possibility that a prior unsuccessful experience could affect imitation. There were no significant differences in these analyses compared to the original results.

4 DISCUSSION

Children showed evidence of imitating the target acts. Difference scores in both the live and video conditions were significantly greater than zero. This finding is encouraging because it shows that children did learn from both live and video of displays of one and two demonstrators. However, the current results show no effect of either of the experimental manipulations. For one, imitation was not affected by the number of demonstrators (one or two) viewed. Thus, I did not find evidence of majority-biased transmission. Second, children in the live condition did not imitate more than those in the video condition. This suggests a limited role of social motivation driving imitation on this task.

There are several possible explanations for why the experimental manipulations did not produce significant differences in the current study. It is important to note that the current task is similar in many ways to previous tasks that have elicited the expected effects. For one, past studies have found increased imitation after children viewed video displays of two demonstrators in comparison to one demonstrator acting twice (Herrmann, et al., 2013). The age range tested here (three years) also fits within the range of ages where majority-biased transmission has been previously found (two to four years). Previous work has manipulated the social context of imitation by using live versus video displays, with results of increased imitation in response to live models in the room (Nielsen & Blank, 2011; Nielsen, Simcock, & Jenkins, 2008). Lastly, this type of imitation task has produced variable levels of imitation across experimental manipulations in prior studies (Williamson, Meltzoff, & Markman, 2008).

With these points in mind, in the next sections I evaluate explanations for majority-biased transmission, present hypotheses of why null results were obtained, and outline potential future studies that could clarify these issues.

4.1 The Majority as an Expert Response

The goal of this study was to evaluate different possible underlying causes of majority-biased transmission. The original authors documenting this effect proposed that it is a mechanism by which individuals learn "safer, more reliable, and more productive" behaviors (Haun, et al., 2012, p. 727). Taken a step further, individuals may view the majority response as an expert response. There is sufficient evidence showing that perceptions of expertise, in general, guide children's faithful imitation (e.g., Wood, et al., 2012). However, in the present goal-directed task, children showed no evidence of imitating the majority at higher rates than in response to an individual. These null results support the possibility that children do not view the majority response as an expert response. This strong interpretation of these findings would suggest that the effect of majority-biased transmission found in past studies is due to other factors, such as the social situation within the tasks.

Before drawing this strong conclusion, however, an alternate explanation must be considered: children may view the majority response as an expert response but do not make use of this expertise in the current imitation paradigm.

4.1.1 The Effect of Prior Experience on Imitating the Majority

One feature of the current task that may have influenced children's imitation of the majority response is that participants were allowed to complete the overall goal of the task (i.e., opening the box to retrieve a toy) prior to viewing the demonstrations. This part of the procedure was included because it allowed measurement of children's initial rates of target act production and also to ensure the goal was salient to them. However, these initial experiences also provided children an efficient response for the task. This may have overridden children's consideration of other contextual factors in imitation (e.g., number of demonstrators or demonstration modality),

which could explain why there were no differences. A logical next step in this line of research is to remove the initial successful experience and investigate whether majority-biased transmission can occur with the same materials and design.

Data collection for this project has already begun. So far, I have tested both three- and four-year-olds using the same method, but have removed the initial successful experience of opening the boxes. Although data collection is still in progress, there is trend toward majority-biased transmission, with greater imitation scores after viewing two demonstrators compared to one demonstrator. Taken together, these findings seem to suggest that children value their own experiences more highly than a model's example when executing functional acts on objects, even when they see multiple models.

4.1.2 The Effect of Goals on Imitating the Majority

Another element that may affect children's use of the expertise of the majority is that this was a goal-directed task. My hypothesis was that having a goal should emphasize the importance of expertise. However, it is possible that this type of task, instead, de-emphasized the importance of the specific acts or means leading to that goal. Some research has found that children imitate with higher fidelity when there is no obvious physical goal at hand (e.g., Bekkering, Wohlschläger, & Gattis, 2000; Carpenter, Call, & Tomasello, 2005; Williamson & Markman, 2006). In contrast, when acts have a clear goal, children may be more likely to disregard the adult's exact actions in favor of producing the physical outcome. Thus, the goal in the current task may have made the manipulation of the number of demonstrators less effective for the peripheral target act.

One way to address the role of a physical goal within the design of the current task would be to remove the goal of retrieving the toy. The design of this modified task would be identical to

what was used here, with the exception that there would be no toys inside the boxes. The demonstrations would then consist of the adult(s) manipulating parts of the box, but producing no physical change in the end-state of the task. The child's attention may then shift more to production of the target act, and majority-biased transmission could be elicited.

4.2 The Role of Social Motivation in Response to a Majority

An alternative hypothesis we proposed to explain majority-biased transmission is that it is the result of social pressure, instead of a perception of expertise. Previous research has found that children's imitation is enhanced by having demonstrators present to see their acts copied (Nielsen & Blank, 2011) and when the model is socially responsive (Nielsen, Simcock, & Jenkins, 2008), but in the present study, the presence of live demonstrators did not increase imitation. Given that the current results seem to contradict prior findings, it is difficult to assess the hypothesis of whether or not majority-biased transmission is socially motivated. It remains possible that majority-biased transmission reflects some social underpinnings, but was not induced with the live and video manipulations used here. However, I can conclude that having two demonstrators present to watch the child imitate is not sufficient, in itself, to elicit majority-biased transmission.

It seems intuitive that I could better investigate the social influence of the majority by using more than two demonstrators. One important consideration in manipulating of the number of actors is to delineate majority-biased transmission versus conformist transmission. Past research has shown that adults conform to others' responses, even when they have strong reason to believe that the majority is wrong (e.g., Asch, 1956), and more recent work has revealed similar effects in four-year-olds (Haun & Tomasello, 2011). These studies have explained conformity as a result of social pressure, whereas the current findings provide at least some

evidence against the possibility that majority-biased transmission is entirely social. Future work may aim to clarify the (potentially different) mechanisms that underlie these two processes.

4.3 Conclusions

Many past studies of children's imitation have varied only a single factor, such as the salience of a physical goal, a model's expertise, or the presence of a social partner. Results from these studies have revealed a number of factors that affect children's imitation. Although the current study was designed to vary only two of these features, namely, the mode of presentation and the number of demonstrators, the null results complicated matters.

In order to explain these results in the context of previous studies, it was necessary to evaluate several factors that may have influenced imitation. Taking together the current and previous findings, one can begin to examine how multiple factors interact in children's imitation. Although future work is certainly needed, it seems from the current results that task goal and prior experience may have been most important, whereas the presence of multiple demonstrators was less influential.

Understanding the relative importance of the different factors that guide imitation will help us to explain exactly why and when children copy others' actions. This information could give us a better idea of how children learn, and could inform how we teach children using demonstrative cues. Although the current study does not conclusively answer these questions, it provides a motivation for future work investigating how various task features interact and affect imitation.

REFERENCES

Asch, S.E. (1956). Studies of independence and conformity: I. A minority of one against a unanimous majority. *Psychological Monographs*, 70(9), 1–70.

Barr, R. (2010). Transfer of learning between 2D and 3D sources during infancy: Informing theory and practice. *Developmental Review, 30*(2), 128-154.

Bekkering, H., Wohlschläger, A., & Gattis, M. (2000). Imitation of gestures in children is goal-directed. *The Quarterly Journal of Experimental Psychology, 53A*(1), 153-164.

Berk, L.E. (1996). *Infants and children: Prenatal through middle childhood.* (2nd Ed.) Needham, MA: Allyn and Bacon.

Brito, N., R. Barr, et al. (2012). Long-term transfer of learning from books and video during toddlerhood. *Journal of Experimental Child Psychology, 111*(1), 108-119.

Call, J., Carpenter, M., & Tomasello, M. (2005). Copying results and copying actions in the process of social learning: Chimpanzees (*Pan troglodytes)* and human children (*Homo sapiens). Animal Cognition, 8,* 151-163.

Carpenter, M., Akhtar, N., & Tomasello, M. (1998). Fourteen- through 18-month-old infants differentially imitate intentional and accidental actions. *Infant Behavior & Development, 21*(2), 315-330.

Cohen, D. (2001). Cultural variation: Considerations and implications. *Psychological Bulletin, 127*(4). 451-471.

Dean, L. G., Kendal, R. L., Schapiro, S. J., Thierry, B., & Laland, K. N. (2012). Identification of the social and cognitive processes underlying human cumulative culture. *Science, 335,* 1114-1117.

DiYanni, C., Nini, D., & Rheel, W. (2011). Looking good versus doing good: Which factors take precedence when children learn about new tools? *Journal of Experimental Child Psychology, 110,* 575-591.

Gergely G., Bekkering H., & Kiraly I. (2002). Rational imitation in preverbal infants. *Nature, 415*(6873), 755.

Haun, D. B. M., Rekers, Y., & Tomasello, M. (2012). Majority-based transmission in chimpanzees and human children, but not orangutans. *Current Biology, 22,* 727-731.

Haun, D. B. M, & Tomasello, M. (2011). Conformity to peer pressure in preschool children. *Child Development, 82*(6), 1759-1767.

Herrmann, P. A., Legare, C. H., Harris, P. L., & Whitehouse, H. (2013). Stick to the script: The effect of witnessing multiple actors on children's imitation. *Cognition, 129,* 536-543.

Horner, V. & Whiten, A. (2005). Causal knowledge and imitation/emulation switching in chimpanzees (*Pan troglodytes*) and children (*Homo sapiens*). *Animal Cognition, 8,* 164-181.

Legare, C. H. & Herrmann, P. A. (2013). Commentary: Cognitive consequences and constraints in reasoning about a ritual. *Religion, Brain & Behavior, 3*(1), 63-65.

Logan, M. H. & Qirko, H. N. (1996). An evolutionary perspective on maladaptive traits and cultural conformity. *American Journal of Human Biology, 8*(5), 615-629.

Lyons, D. E., Young, A. G., & Keil, F. C. (2007). The hidden structure of overimitation. *Proceedings of the National Academy of Sciences, 104*(50), 19751-19756.

McGuigan, N., Makinson, J., & Whiten, A. (2011). From over-imitation to super-copying: Adults imitate causally irrelevant aspects of tools use with higher fidelity than young children. *British Journal of Psychology, 102,* 1-18.

McGuigan, N., Whiten, A., Flynn, E., & Horner, V. (2007). Imitation of causally opaque versus causally transparent tool use by 3-and 5-year-old children. *Cognitive Development, 22*(3), 353-364.

Meltzoff, A. N. & Moore, M. K. (1983). Newborn infants imitate adult facial gestures. *Child Development, 54*(3), 702-709.

Nagell, K., Olguin, R. S., Tomasello, M. (1993). Processes of social learning in the tool use of chimpanzees (Pan troglodytes) and human children (Homo sapiens). *Journal of Comparative Psychology, 107*(2), 174-186.

Nielsen, M. (2006). Copying actions and copying outcomes: Social learning through the second year. *Developmental Psychology, 42*(3), 555-565.

Nielsen, M. & Blank, C. (2011). Imitation in young children: When who gets copied is more important than what gets copied. *Developmental Psychology, 47*(4), 1050-1053.

Nielsen, M., Simcock, G., & Jenkins, L. (2008). The effect of social engagement on 24-month-olds' imitation from live and televised models. *Developmental Science, 11*(5), 722-731.

Nielsen, M. & Tomaselli, K. (2009). Overimitation in the Kalahari Desert and the origins of human cultural cognition. *Psychological Science, 21*(5), 729-136.

Over, H. & Carpenter, M. (2009). Priming third-party ostracism increases affiliative imitation in children. *Developmental Science, 12*(3), F1-F8.

Over, H. & Carpenter, M. (2012). Putting the social into social learning: Explaining both selectivity and fidelity in children's copying behavior. *Journal of Comparative Psychology, 126*(2), 182-192.

Shimpi, P. M., Akhtar, N., & Moore, C. (2013). Toddlers' imitative learning in interactive and observational contexts: The role of age and familiarity of the model. *Journal of Experimental Child Psychology, 116,* 309-323.

Steinberg, L., Belsky, J. & Meyer, R. B. (1991). *Infancy, childhood, & adolescence: Development in context.* New York, NY: McGraw-Hill, Inc.

Taylor, M., Cartwright, B. S., & Bowden, T. (1991). Perspective taking and theory of mind: Do children predict interpretive diversity as a function of differences in observers' knowledge? *Child Development, 62,* 1334-1351.

Tennie, C., Greve, K., Getscher, H., & Call, J. (2010). Two-year-old children copy more reliably and more often than nonhuman great apes in multiple observational learning tasks. *Primates, 51,* 337-35.

Tomasello, M. (1999). *The cultural origins of human cognition*. Cambridge, MA: Harvard University Press.

Tomasello, M., Carpenter, M., Call, J., Behne, T., & Moll, H. (2005). Understanding and sharing intentions: The origins of cultural cognition. *Behavioral and Brain Sciences, 28,* 675-735.

Uzgiris, I.C. (1981). Two functions of imitation during infancy. *International Journal of Behavioral Development, 4*(1), 1-12.

Want, S. C. & Harris, P. L. (2002). How do children ape? Applying concepts from the study of non-human primates to the developmental study of 'imitation' in children. *Developmental Science, 5*(1), 1-41.

Williamson, R. A., Meltzoff, A. N., & Markman, E. M. (2008). Prior experiences and perceived efficacy influence 3-year-olds' imitation. *Developmental Psychology, 44*(1), 275-285.

Wood, L. A., Kendal, R. L., & Flynn, E. G. (2012). Context-dependent model-based biases in cultural transmission: Children's imitation is affected by model age over model knowledge state. *Evolution and Human Behavior, 33*, 387-394.

Zmyj, N., Daum, M. M., Aschersleben, G. (2009). The development of rational imitation in 9- and 12-month-old infants. *Infancy*, *14*(1), 131-141.