If I told you everyone picked that (inefficient) tool, would you? Children attend to normative language when imitating and transmitting tool use

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Abstract

This study explored how conventional versus instrumental language influenced children's imitation and transmission of inefficient tool use. Rather than examining children's imitation of unnecessary actions that do not impede goal-completion, we examined children's conformity with a modeled behavior that may result in sacrificing goal completion. Children ($N = 96$ 4- to 6-year-olds) were presented with either a conventional or instrumental description of a model's actions before watching the model choose an inefficient tool. Children who heard conventional language imitated and transmitted the model's inefficient tool choice at significantly higher rates than when they heard instrumental language. The results have implications for the extent to which children will conform with what "we" are "supposed" to do.

key words: imitation, conventionality, normativity, language, tool use

If I told you everyone picked that (inefficient) tool, would you? Children attend to normative language when imitating and transmitting tool use.

Imitation has widely been studied as a mechanism for early social learning (Carpenter, Akhtar, & Tomasello, 1998; Gergely, Bekkering, & Kiraly, 2002; Meltzoff, 1995; Whiten, McGuigan, Marshall-Pescini, & Hopper, 2009). A great deal of attention has been paid to over-imitation, or the copying of a model's unnecessary actions (see Lyons, Young, & Keil, 2007; Nielsen & Tomaselli, 2010), and to the imitation of a model's inefficient actions (see DiYanni & Kelemen, 2008; DiYanni, Nini, Rheel, & Livelli, 2012; Kiraly, Csibra, & Gergely, 2013). The willingness of children to copy inefficient or unnecessary actions is influenced by both epistemic and social factors. For example, children are more willing to copy questionable actions from models who appear to be knowledgeable (Buchsbaum, Gopnik, Griffiths, & Shafto, 2011) and who act intentionally (DiYanni & Kelemen, 2008; Gardiner, Grief, & Bjorklund, 2011). They are also more willing to copy such actions if the model is present (DiYanni, Nini, & Rheel, 2011; Nielsen & Blank, 2011).

In addition to attending to person-specific cues, children are sensitive to the context in which information is presented. They are more accepting of questionable information that is presented by multiple informants rather than a single informant (Corriveau & Harris, 2010; Haun & Tomasello, 2011; McGuigan & Robertson, 2015). Deference to a consensus is particularly notable among children whose cultures emphasize collectivistic ideals such as conformity—e.g., those of Asian descent (Corriveau & Harris, 2010; Corriveau, Kim, Song, & Harris, 2013; Corriveau, DiYanni, Clegg, Min, Chin, & Nasrini, 2017; DiYanni, Corriveau, Kurkul, Nasrini, & Nini, 2015). Taken together, these findings support the idea that children's high-fidelity imitation

is a fundamentally social behavior rather than a heuristic for approaching causal learning (see Over & Carpenter, 2012).

In the current study, we extend research on children's selective imitation by examining the impact of an additional social factor—normativity—on children's decision about whether to imitate inefficient actions in the context of tool use. Past work suggests that children's perception of particular behaviors as normative may be a key component in their decision to imitate those behaviors. Kenward, Karlsson, and Persson (2011) asserted that over-imitation is better explained by children following what they believe to be prescriptive norms than interpreting all demonstrated actions as causally necessary. This claim is bolstered by evidence that over-imitating preschoolers will go so far as to protest when a third party omits an unnecessary action to enforce what they perceive as a norm (Kenward, 2012; Schmidt, Butler, Heinz, & Tomasello, 2016). If children, by default, tend to view models' actions as normative, then language highlighting the actions as normative or *conventional* should increase their imitation.

Within the context of social learning, the use of *conventional* language to describe a behavior (e.g., "Everyone always does it this way") should lead children to attend to and recreate a model's precise actions. Evidence from multiple studies examining children's imitation of object-based action sequences has found that children imitate a modeled behavior with high fidelity after a model has described the task using conventional language (e.g., Clegg & Legare, 2016a; 2016b; Hermann, Legare, Harris, & Whitehouse, 2013; Legare, Wen, Hermann, & Whitehouse, 2015). By contrast, when a model highlights the goal of an action by using *instrumental* language (e.g., "I am going to..."), children imitate with lower levels of fidelity. The general interpretation of this finding is that the difference in children's imitation is based on children's interpretation of the importance of the actions in the task. Conventional language

draws children's attention to the importance of the demonstrated process, potentially because this language highlights that these behaviors are normative and builds on children's desire to affiliate with others (Nielsen & Blank, 2011; Over & Carpenter, 2009; 2012). By contrast, instrumental language draws children's attention to the ideal end-state, without focusing on the means used to reach it. Instrumental language should encourage children to attend to the physical-causal relationships between actions, and to assess the most efficient means of achieving the goal (Legare & Nielsen, 2015).

Children's attention to conventional language is not limited to learning novel behaviors. Research focusing on naturalistic parent-child conversations about artifacts also highlights differences in the ways in which families employ instrumental and conventional language. When parents talk about an object's functions, they typically do so with conventional language (Callanan, Siegel, & Luce, 2007). Children's attention to how an artifact is described may be especially important when observing the use of an artifact in a normative way that may not seem to suit its design (Siegel & Callanan, 2007). In the current study, we contrast the influence of *instrumental* versus *conventional* language on children's imitation of the use of a particular tool to achieve an instrumental goal.

We focus, for the first time, on the impact of linguistic cues on children's imitation of *inefficient* tool use. Previous work examining the influence of these cues has focused on children's over-imitation of *unnecessary* actions within tasks with non-consequential end-goals. For example, previous studies have examined whether children would imitate a demonstrated behavior such as touching a bead to their forehead before stringing it to make a necklace (e.g., Clegg & Legare, 2016a; 2016b). In this example, not touching a bead to their forehead would not prevent children from achieving the goal, rendering the action *unnecessary*, but not *inefficient*.

Even in studies of over-imitation that feature a puzzle box—a common apparatus used to examine over-imitation (e.g., Lyons et al., 2007)—performing the unnecessary actions does not hinder children’s ability to ultimately achieve the goal.

In the current study, the model’s selection of an inefficient tool makes the completion of the task substantially more difficult. The question is whether the drive to follow a stated convention is so strong that children are willing to exert considerably more effort to achieve the desired end-state—or perhaps risk not achieving the end-state at all—in order to follow the normative behavior. We examined within-subjects whether children would be more willing to imitate the model’s inefficient action if she indicated that the action was *conventional* versus if she introduced the task by highlighting the goal with *instrumental* language. Examining children’s responses to the cues within-subjects, rather than between-subjects as has been the norm in previous examinations of children’s responses to language cues, allowed us to explore the relative impact of the cues on children’s imitation.

We predicted that children would be more likely to imitate the model and select the inefficient tool after they had heard *conventional* language used to describe the task. We also included a third condition in which the model’s cue included a combination of *instrumental* and *conventional* language. This cue featured both a reference to a norm (*conventional*) and to the goal of the task (*instrumental*); e.g., “We always do X like this.” This cue was included to see whether children attended more to information about the normative or instrumental nature of a task when deciding whether or not to imitate. Here, we predicted two possibilities: (1) Children could prioritize information about the conventional nature of the task, thus imitating tool selection at similar rates to those in the *Conventional* condition. (2) Children could instead focus

more on the instrumental outcome of the task and privilege a tool that would help them to expediently achieve that outcome.

Another goal of the current study was to examine whether children would not only *imitate* the model's inefficient actions with higher fidelity if she used *conventional* language, but also faithfully transmit that inefficient solution to a third party. Previous research has found that children will reliably transmit culturally-relevant information (Flynn & Whiten, 2008; Whiten & Flynn, 2010). They will also demonstrate unnecessary actions to third parties, and will do so more frequently if the actions were modeled to them originally after a conventional language cue (Clegg & Legare, 2016b). We predicted that, in the current study, conventional language would similarly influence children to direct a third party to use the inefficient tool.

We examined these questions with 4- to 6-year-olds, given previous research indicating that children in this age range attend to conventional versus instrumental language cues to guide their imitation (Clegg & Legare, 2016b; Legare et al., 2015). Moreover, by age 4, children can reliably ascertain which tool may be more functional for a task, even when presented with a model choosing otherwise (DiYanni & Kelemen, 2008). Thus, we can be confident that children's choice to imitate or transmit the choice of inefficient tool would be due to their interpretation of the tool as normative rather than as more causally effective.

Finally, we were interested in factors that might contribute to children's attention to *instrumental* versus *conventional* cues. We therefore included a measure of young children's social desirability (Ford & Rubin, 1970) and parental views of authoritarianism (Feldman & Stenner, 1997). These measures were not predictive of children's overall imitation or transmission of the inefficient tool use, so they are not included here. Further information about these measures and associated findings can be found in *Supporting Information, Appendix A*.

Method

Participants

Ninety-six children (50 females) ages 4 to 6 years ($M = 58.7$ months) recruited from day care centers and elementary schools on the East Coast of the United States participated.

Although SES was not directly measured, the schools serve primarily middle- and upper-middle class families. Of the children, approximately 2/3 were Caucasian, 16% did not specify race, and the rest were an equal mixture of African American, Asian American, Hispanic, Indian, and mixed race. We used a within-subject design, so that each child participated in one task after hearing an *Instrumental* cue and one task after hearing a *Conventional* cue (order counterbalanced).

Materials

Children each completed two tasks: a cookie-crushing task and a water-moving task (see Corriveau et al., 2017 for research using the same tasks). In each task, children were introduced to both a Non-Affordant tool (NA), or a tool that was causally-ineffective for the task, and a Functionally Affordant (FA) tool, or a tool that was causally-effective. Figure 1 displays the sets of tools used in each task. For the cookie-crushing task, the NA tool was composed of a metal handle with several fuzzy pom-poms affixed. The FA tool consisted of a long solid handle with a circular wooden base attached. The cookie was a chocolate sandwich cookie. For the water-moving task, the NA tool was a flimsy rubber square, and the FA tool was a rubber tool in the shape of a cup. Two plastic bowls (one of which was empty and one of which was about 1/3 full with water) were also used.

Insert Figure 1 about here

Two female models, matched for age and attractiveness and each wearing different solid-colored shirts, were filmed individually completing each of the tasks by selecting the NA tool over the FA tool. Prior to selecting the NA tool, the model said one of three cues: a *Conventional* cue (“We always do it this way.”), a *Conventional* cue with *goal-naming* (e.g., “We always crush cookies/move water like this.”); or an *Instrumental* cue (e.g., “I am going to crush a cookie/move water.”).

Each participant viewed two videos (one for each task): one in which one of the models performed one task (e.g., crushing cookies) using the *Instrumental* cue, and one in which the other model performed the other task (e.g., moving water) using either the *Conventional* cue or the *Conventional* cue with *goal-naming*. The children all viewed an *Instrumental* cue in one video; half of the children viewed a *Conventional* cue in the other video, and the other half viewed a *Conventional* with *goal-naming* cue in the other video. The order in which the tasks were presented, the model who performed the task, and whether the *Instrumental* cue was presented with the cookie-crushing or water-moving tasks were counterbalanced among participants.

Procedure

Baseline exploration period. The experimenter introduced each tool set individually, counterbalancing which was shown first. To introduce each set, the experimenter stated that she had brought some tools from her school, and asked the children if they had ever seen the tools, or if they knew the tools’ functions. A cookie on a plate and the two bowls (one empty and one 1/3 full of water) were also present on the table within reach of the child. The goal of the baseline period was to ensure that no children spontaneously used any of the tools to crush the cookie or move the water or suggested that they were for this purpose. No children did so.

Imitation trial. Children watched a video of a model crushing a cookie or moving water (counterbalanced) with a NA tool while using *Instrumental* language or *Conventional* language (either with or without naming the goal). Immediately following each video, children were invited to perform the task themselves and were asked, “Which tool would you need to crush the cookie/move the water?” The first tool the child used was recorded as their tool of choice.

Memory check. For each task, after selecting a tool for themselves in the imitation trial, each child was asked to indicate which tool the model in the video had used. Seven children failed the memory check in one task (2 water-moving task, 4 cookie-crushing task, 1 not asked in cookie-crushing task), but no children failed both. Analyses were conducted both with and without the data for children that failed the memory check, and results were not substantively different. Results reported below include the data for the children that failed the memory check. Results for data without these children are included in *Supporting Information, Appendix B*.

Teaching trial. Immediately following the memory check question, children were introduced to a puppet named Sam. The experimenter introduced the task by saying, “Sam wants to crush a cookie/move water but doesn’t know how to do that. Can you teach Sam how to crush a cookie/move water?” The first tool children instructed Sam to use was recorded as their tool choice.

Results

Children’s likelihood of selecting the NA tool first in the imitation and teaching trials was analyzed using a series of mixed-effects binary logistic regressions with a random effect of participant to account for multiple observations per child. In preliminary analyses, we examined the influence of gender, child age (in months), and task type (cookie versus water) on children’s likelihood of selecting the Non-Affordant tool overall in either the imitation or teaching tasks.

These analyses indicated that there were no significant effects of child age ($p = .271$) or task ($p = .773$), so in subsequent analyses we collapsed across age and task. There was a significant effect of gender on children's likelihood of selecting the NA tool, such that girls were more likely than boys overall to select the NA tool ($OR = 3.78, p = .045$). Given that trials were presented within-participants, so that all participants completed one set of imitation and teaching trials after hearing an *Instrumental* cue and one set after hearing one of the *Conventional* cues, we are confident that any effects reported below are not artifacts of gender imbalance across conditions. In subsequent analyses, however, we maintained gender as a predictor to control for its effects.

Insert Table 1 about here

Next, we examined the impacts of cue (*Instrumental*, *Conventional*, *Conventional* with *goal-naming*) and task (imitation versus teaching), controlling for child gender, on children's likelihood of selecting the NA tool. We dummy coded cue, such that in one analysis we compared both *Conventional* cues to the *Instrumental* cue and in another we compared the *Instrumental* and *Conventional* cue to the *Conventional* with *goal-naming* cue. Summaries of these analyses are in Table 1. There was not a significant effect of task ($OR = 1.58, p = .154$). There was a significant effect of cue, such that children were more likely to select the NA tool after they heard the *Conventional* cue ($OR = 3.81, p = .005$) or the *Conventional* cue with *goal-naming* ($OR = 4.27, p = .001$) than when they heard the *Instrumental* cue. There was no significant difference in likelihood of selecting the NA tool between children who heard the *Conventional* cue and those who heard the *Conventional* cue with *goal-naming* ($OR = 1.12, p = .851$), so in subsequent analyses we collapsed across the two conventional cues. As depicted in

Figure 2, a greater proportion of children selected the NA tool first in both the imitation and teaching tasks after hearing one of the *Conventional* cues.

Insert Figure 2 about here

In planned comparisons, we compared children's likelihood of selecting the NA tool in the imitation and teaching tasks separately.

Imitation task. Children's likelihood of selecting the NA tool first during the imitation task was assessed using a mixed-effects binary logistic regression with a random effect of participant since each child experienced one imitation task with a *Conventional* cue and one task with an *Instrumental* cue, controlling for child gender. Children were more likely to imitate using the NA tool after hearing a *Conventional* cue ($M = 0.72$, $SE = 0.05$) than after hearing an *Instrumental* cue ($M = 0.59$, $SE = 0.05$; $OR = 2.50$, $p = .028$; for a full summary of model coefficients, see Table 2).

Teaching task. Children's likelihood of selecting the NA tool first during the teaching task was assessed using a mixed-effects binary logistic regression with a random effect of participant since each child participated in two teaching tasks, controlling for child gender. Children were more likely to teach using the NA tool after hearing a *Conventional* cue ($M = 0.69$, $SE = 0.05$) than after hearing an *Instrumental* cue ($M = 0.52$, $SE = 0.05$; $OR = 4.77$, $p = .003$; for a full summary of model coefficients, see Table 2).

Insert Table 2 about here

Discussion

The use of conventional language led to higher rates of both imitation and teaching with an inefficient tool, in line with the findings of previous research (Clegg & Legare, 2016a; 2016b; Hermann et al., 2013; Kenward, 2012; Legare, et al., 2015). It extends these findings to suggest that children are willing to imitate and to transmit the use of a non-affordant tool—even when goal completion may be sacrificed—when they believe it is in line with conventional norms. In addition, this study found that even when children were presented with a conventional cue which explicitly stated the goal of the task (e.g., “We always crush cookies like this”), they attended more to the normativity indicated by the description than to the instrumental goal it named. The use of a within-subjects design allowed us to confirm that descriptions that included conventional language impacted children’s imitation and transmission of inefficient tool use above and beyond individual differences in children’s baseline imitation rate.

There is strong motivation for children to follow conventions (e.g., Haun & Tomasello, 2011; Haun, Rekers, & Tomasello, 2012). Parents attend to conventional language, and instruct their children to pay closer attention and to copy more precisely when conventional language is used (Clegg & Legare, 2017). Children and adolescents associate conformity with intelligence and better behavior (Wen, Clegg, & Legare, 2017). It is therefore not surprising that the conventional cue was so powerful in this study, even when conforming with the convention could have hindered goal completion. As previous research suggests, the use of the conventional cue triggers attention to the model’s precise means, and the need for group affiliation leads to the copying and transmission of those means (Legare et al., 2015; Nielsen & Blank, 2011; Over & Carpenter, 2009; 2012). The results have strong implications for the extent to which children will attempt to conform with what “we” are “supposed” to do.

A remaining question is to what degree identification with the model matters when children are thinking about conventionality. Our results indicated that rates of imitation were slightly higher among females, which is consistent with some studies that have found sex differences in rates of over-imitation (Gruber, Deschenaux, Frick, & Clément, 2019) although other studies have found an opposite effect, with males imitating more (Frick, Clément, & Gruber, 2017). Given that the models in our study were female, it is important for future research to consider the impact of models' social group membership (e.g., gender, nationality) on both the imitation of inefficient actions as well as the imitation of actions which are presented as conventional versus instrumental.

An additional consideration is the extent to which children who imitate a model's use of an inefficient tool truly encode it as normative. The results here suggest that children in the *Conventional* conditions were more likely to teach a third party to use an inefficient tool. How would they respond in a pressure-based situation? For instance, if children were required to crush multiple cookies within a time limit, which tool would they choose? As Ronfard, Was, and Harris (2016) suggest, if children are asked to demonstrate the *fastest* way to perform a task, their subsequent actions would clarify how they are interpreting what they have observed. Lyons and colleagues (2007) found that children persisted in over-imitating unnecessary actions despite an experimenter's request that they needed to achieve the task quickly. If a result such as this held true in a situation akin to the one presented here—if, for example, children persisted in using the inefficient tool to crush multiple cookies as quickly as possible—it would be a stronger indication that they had truly encoded the inefficient tool as normative. Future research should incorporate circumstances such as these to assess the degree to which children are willing to stick with an inefficient tool, and truly establish it as being *for* the task at hand.

Taken together, the results from our study indicate that even in instances where children have intuitions about how best to complete a task, the language to which young children are exposed impacts the way in which they interpret the behavior of others. This, in turn, has consequences for their own behavior as well as what they choose to faithfully transmit to others.

Submitted for review

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Table 1.

Mixed effects binomial logistic regression analyses for effects of trial and cue on children's likelihood of selecting the non-affordant tool, controlling for gender.

Dummy-coded comparison	Predictor	β	$SE \beta$	p	Odds Ratio (OR)	95% CI OR
Conventional and Conventional with goal versus Instrumental	Intercept	-0.37	0.57	.518	0.69	[0.23, 2.12]
	Gender (Female)	1.51	0.76	.048*	4.53	[1.01, 20.23]
	Trial (Imitation)	0.46	0.32	.154	1.58	[0.84, 2.97]
	Cue: Conventional vs. Instrumental	1.34	0.48	.005**	3.81	[1.50, 9.66]
	Conventional with goal vs. Instrumental	1.45	0.45	.001**	4.27	[1.75, 10.42]
Conventional with goal and Instrumental versus Conventional	Intercept	0.97	0.64	.132	2.63	[0.74, 9.29]
	Gender (Female)	1.51	0.76	.048*	4.53	[1.01, 20.23]
	Trial (Imitation)	0.46	0.32	.154	1.58	[0.84, 2.97]
	Cue: Conventional with goal vs. Conventional	0.12	0.61	.851	1.12	[0.34, 3.76]
	Instrumental vs. Conventional	-0.51	0.48	.005**	0.26	[0.10, 0.67]

* $p < .05$, ** $p < .01$

Table 2.

Binomial logistic regression analyses for effects of cue on children's likelihood of selecting the non-affordant tool by trial, controlling for gender.

Task	Predictor	β	$SE \beta$	p	Odds Ratio (OR)	95% CI OR
Imitation	Intercept	0.14	0.45	.747	1.15	[0.48, 2.76]
	Gender (Female)	1.01	0.60	.093	2.74	[0.85, 8.86]
	Cue (Conventional)	0.92	0.42	.028*	2.50	[1.10, 5.69]
Teaching	Intercept	-0.68	0.61	.269	0.51	[0.15, 1.68]
	Gender (Female)	1.92	0.93	.039*	6.83	[1.10, 42.47]
	Cue (Conventional)	1.56	0.53	.003**	4.77	[1.69, 13.46]

* $p < .05$, ** $p < .01$

Figure 1. Tool sets used in the cookie crushing (left) and water moving (right) tasks. Non-affordant (NA) tools are on the right in each picture.

Submitted for review

Figure 2. Proportion of children who chose the inefficient non-affordant (NA) tool in the imitation and teaching trials in the Conventional versus Instrumental conditions. Conventional condition is collapsed across both Conventional cues. Error bars represent 1 Standard Error of the Mean.