Look, I can do it! Young children forego opportunities to teach others to demonstrate their own competence

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Abstract
We not only care about what others think of the world, but also about what others think of us. The ability to understand what others think of one’s competence is especially important for young children, as they are beginning to learn about themselves and form new relationships with others. Here we ask whether young children can use others’ observations of their failures and successes to infer others’ beliefs about the self’s competence, and would even forego an opportunity to teach new information in order to demonstrate their competence. In Exp. 1 (3-5 year-olds), when a confederate had observed the child initially fail but eventually succeed at operating a toy, children chose to teach her a new toy; however, when the confederate had observed the initial failure but not the final success, more children chose to show the familiar toy again to demonstrate their competence. Preliminary findings from Exp. 2 show the same pattern with 3-4 year-olds. These results suggest that even young children can reason about what others think of their own competence and strategically decide whether to communicate information about “me” or “the world.”

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Introduction
We cannot directly access the minds of other people, yet we are deeply curious about them. Among the unobservable contents of others minds, there is one suite of beliefs that we care extraordinarily about: others’ beliefs about us.

Others’ beliefs about who we are – especially our traits and qualities such as how nice, competent, or generous we are – have vast implications for our everyday lives. They inform our decisions about how to learn, improve, and change ourselves for the better. These beliefs also help us interpret others’ behaviors towards us and influence the ways we interact with them. Thus, our capacity to reason about others’ beliefs about the self is critical for effective learning as well as building healthy relationships with others. This is especially important for young children as they face the challenge of acquiring new skills and forming new social relationships, while also constructing a coherent sense of who they are and what they can (or cannot) do. How do we reason about others’ beliefs about us, and what are the developmental roots of this capacity? Here we investigate whether preschool-aged children infer others’ beliefs about their own competence and selectively communicate information to revise these beliefs.

Imagine you are trying to operate a new machine as your friend is watching you repeatedly fail. After a while you finally figure out the trick and successfully make it work, but your friend has already gone home! Even though you now know that you can operate the machine, you might reasonably infer that she still thinks that you cannot; she was not there to observe your final success. Therefore, the next time you see her, you might proudly show her that you can activate the machine such that she would revise her beliefs about your competence. This intuition, while seemingly simple, is a product of our ability to infer others’ beliefs about the self from their prior observations and understand how new information about the self could revise these beliefs.

A large body of work in Theory of Mind (ToM) has revealed young children’s sophisticated abilities to reason about others’ minds and how they develop in early childhood (Wellman, Cross, & Watson, 2001). The vast majority of ToM tasks has focused on children’s understanding of a particular class of beliefs: Beliefs about physical states of the world such as locations, contents, or identities of objects (Wimmer & Perner, 1983; Astington & Gopnik, 1988). During the preschool years, children show rapid improvement in tasks that probe their understanding of others’ beliefs about the world (Wellman et al., 2001), starting to show signs of success around or even before age 3 in some cases (Setoh, Scott, & Baillargeon, 2016; Baker, Leslie, Gallistel, & Hood, 2016). Recent work suggests that children also understand how agents might update their beliefs given their prior beliefs, observed data, and how the data were sampled (Magid, Yan, Siegel, Tenenbaum, & Schulz, 2017).

Children not only understand others’ beliefs about the world, but also actively communicate information to change or revise these beliefs. Even 12-month-olds point out novel information (e.g., locations of objects) when others are ignorant (Liszkowski, Carpenter, & Tomasello, 2008), and children’s understanding of teaching as a way to change others’ beliefs continue to develop throughout preschool years (Rhodes, Bonawitz, Shafto, Chen, & Caglar, 2015; Sobel & Letourneau, 2016). Recent work suggests that children provide different kinds of causal demonstrations depending on the observer’s goal or competence, selectively providing costly demonstrations only when it is necessary for the observer (Gweon & Schulz, in press). Collectively, these studies suggest that preschool-aged children have an abstract understanding of how evidence (e.g., perceptual experience) influences others’ beliefs about the physical world, and even actively communicate or teach others to change or revise these beliefs. Given prior work on ToM and communicative abilities in early childhood, it is possible that even preschool-aged children have the requisite inferential and communicative capacities to infer what others think of themselves (e.g., one’s own competence) and communicate information to revise others’ beliefs about the self.

Prior literature provides some indirect support for our hypothesis, suggesting that young children readily appreciate the
relationship between agents’ behaviors and their underlying traits or dispositions. For instance, even infants distinguish nice and mean agents based on whether they help or hinder others (Hamlin, 2013), and infer whether they themselves are capable or incapable from patterns of past successes and failures (Gweon & Schulz, 2011). Furthermore, older children readily draw sophisticated inferences about others’ competence from their choices (Jara-Ettinger, Gweon, Schulz, & Tenenbaum, 2016). Given these results, preschool-aged children might be able to infer what someone thinks of their own competence based on her observations of their failures or successes.

Yet, reasoning about others’ beliefs about one’s own competence might be more challenging than reasoning about others’ beliefs about the physical world. First, although beliefs about observable physical states can be easily evaluated as “true” or “false” by their correspondence to reality (Russell, 1906), beliefs about qualities of the self often lack clear ground truths. In the absence of a verifiable correspondence between belief states and reality, children might have difficulty representing what others think of them. Second, qualities of the self are often associated with a valence, making some qualities more desirable than others (e.g., being competent is more desirable than being incompetent). Indeed, children tend to hold positive beliefs about their own competence (Schneider, 1998) and even assert that they have performed well when they have not (Hembacher & Ghetti, 2014). Thus, the desirability of certain qualities and children’s positivity bias in self-evaluation might interfere with their ability to rationally reason about what others think of them.

Importantly, even if children can reason about others’ beliefs about the self, this ability might not manifest in their communicative behaviors if they do not care about what others think of them. Prior work suggests that preschool-aged children do care about their reputation and behave differently in the presence of others; they cheat less and share more when others are watching (e.g., Engelmann, Herrmann, & Tomasello, 2012 and actively attempt to maintain others’ positive evaluations of them (Zhao, Heyman, Chen, & Lee, 2017). Critically, although this literature suggests that children are motivated to promote and protect their self-image, it remains unclear whether their behaviors reflect a global desire to look good or a more nuanced understanding of what others believe about them.

In our current study, we ask whether young children can reason about others’ beliefs about the self and rationally decide whether to communicate information about the self’s competence. More specifically, we ask whether children strategically forego an opportunity to provide new information about the world to a naïve agent (i.e., demonstrate how to activate a novel toy) in order to show off their own competence (e.g., demonstrate their success on a familiar toy) only when the agent wrongly thinks the child is incompetent. Given 3-year-olds’ difficulty with standard ToM tasks (Wellman et al., 2001) and the complexity of verbally describing others’ beliefs about one’s own competence, we designed a behavioral task that can tap into this capacity with minimal verbal demands. While our critical measure concerns what information children choose to communicate, this decision critically relies on their ability to spontaneously track and reason about others’ beliefs about the self, and an understanding of how their demonstration would revise others’ beliefs about the self.

Experiment 1

Methods

Participants Seventy 3-5 year-olds (39 girls, $M_{Age}(SD) = 4.7(0.7)$, Range = 3.4-5.9) were recruited from a university preschool and were randomly assigned to one of two conditions: Present or Absent. Twenty-two children (12 in Present, 10 in Absent) were tested but excluded from the final sample due to failure on the memory check question.1 An additional 8 children were tested but excluded due to not completing the study (N=3), refusing to make a choice in the Choice Phase (N=2), or technical errors (N=3).

Materials We constructed two novel causal toys, a red music toy and a green light-up toy. Each toy was approximately 7” x 7” x 3” and had a distinct mechanism that activated its causal effect. The red toy had two buttons, both of which had to be pressed simultaneously to play a musical tune. The green toy had two levers, both of which had to be pulled simultaneously to activate the lights. In reality, the experimenter controlled the activation of the toys with a remote switch on the floor (hidden from the child’s view) to manipulate the child’s success and failure with the toys. Children were also shown a 3” x 5” photo of the confederate.

Procedure Participants were tested in a quiet room inside of the preschool. The experimenter first showed subjects the two toys and said that her friend “Anne” (a confederate), would watch them play sometimes. Then, the confederate entered the room and sat next to the experimenter (facing the child) and said, “Wow, these toys are really cool! I’ve never seen these toys before, I don’t know anything about them!” The experimenter said that they were first going to play with one of the toys (henceforth Observed Toy) and moved the other toy (henceforth Unobserved Toy). Toy color (red/green) was counterbalanced.

In the Observed Toy Phase, the confederate (Anne) watched as the child and the experimenter played with the Observed Toy. First, the experimenter successfully activated the toy by pressing both buttons simultaneously (red toy) or pushing both levers (green toy), and the confederate acknowledged the success by saying: “Cool! I really like this music! (red toy)” or “Cool! I really like these lights! (green toy).” Then, the child attempted but failed to activate the toy, and the confederate acknowledged the failure with a neutral “Hm”. This procedure was repeated such that the experimenter suc-

1 Due to the high exclusion rate on the memory question, we also present results including these participants.
ceed twice and the child failed twice. The experimenter then instructed the child how to activate the toy by saying “On this toy, you have to push this button and this button at the exact same time (red toy)” or “On this toy, you have to push this lever and this lever at the exact same time” (green toy). Then the child was given a third chance and successfully activated the toy. The critical manipulation between conditions was when the experimenter instructed the child how to activate the toy, and placed the Unobserved Toy on the table. The sequence of experimenter’s successes and the child’s failures was identical to the Observed Toy Phase. After the child failed twice, the experimenter instructed the child how to activate the toy, and the child succeeded on the third attempt. The experimenter then placed both toys on the table and asked children to activate each toy again, ensuring that children learned how to operate both toys and was confident about their success.

In the Unobserved Toy Phase, the experimenter was absent throughout. The experimenter put away the Observed Toy and placed the Unobserved Toy on the table. The sequence of experimenter’s successes and the child’s failures was identical to the Observed Toy Phase. After the child failed twice, the experimenter instructed the child how to activate the toy, and the child succeeded on the third attempt. The experimenter then placed both toys on the table and asked children to activate each toy again, ensuring that children learned how to operate both toys and was confident about their success.

In the Choice Phase, the experimenter placed the two toys equidistant from the child and placed a photo of the confederate in front of the child. She asked, “Now you can show Anne one of these toys. Which toy do you want to show her?” Children responded by touching or pointing to one of the toys.

In the Memory Check Phase, children were asked whether the confederate was watching when they were playing with the Observed Toy or Unobserved Toy; subjects responded by touching or pointing to one of the two toys. Only children who passed this question were included in the analyses below. Finally, the confederate came back into the room and children demonstrated her the toy that they had chosen.

**Results and Discussion**

In both conditions, the confederate had not seen the Observed Toy. Thus, by choosing this toy, children could provide new information by showing how it works. Critically, however, although the confederate in the Present Condition had observed the child’s initial failures and the final success on the Observed Toy, the confederate in the Absent Condition had only observed the failures (but not the final success); she would wrongly believe that the child cannot activate this toy. Thus we predicted that children in the Absent Condition would be more likely than children in the Present Condition to forego the opportunity to show her the Unobserved Toy and demonstrate their success on the Observed Toy instead. Because the desire to show the Unobserved Toy was present in both conditions, our main prediction was a difference in children’s toy choice across conditions, likely driven by a clear preference for the Unobserved Toy in the Present Condition.

As predicted, children were more likely to show the Observed Toy to the confederate in the Absent Condition than in the Present Condition (% choice for Observed Toy: 55% (Absent) vs. 28% (Present), p = .029; Fisher’s Exact Test). In the Present Condition, only 28% of children chose to demonstrate the Observed Toy (p = .020, Binomial Test), showing a strong preference for the Unobserved Toy instead. In the Absent Condition, children’s choice for the Observed Toy did not differ from chance (p = .627, Binomial Test), suggesting that children were split between teaching new information and demonstrating their competence.

We then explored whether children’s age predicted their choices by running a logistic regression in each condition. We found a significant effect of age in the Present Condition (B = -1.52, z = -2.04, p = 0.041) but no effect of age in the Absent Condition (B = 0.49, z = 0.97, p = 0.334).

Finally, given the high exclusion rate, we ran a post-hoc exploratory analysis including children who failed the memory check question. This did not change the results: Children in the Absent Condition chose the Observed Toy more often than children in the Present Condition (63% vs. 27%, p < .001; Fisher’s Exact). As in the main analyses, children in the Present condition preferred the Unobserved Toy (p = .004; Binomial Test), but those in the Absent condition did not show a clear preference (p = .111; Binomial Test).

In sum, the results were consistent with our hypothesis that preschool-aged children are sensitive to what someone thinks about their own competence, and strategically decided when to demonstrate their success rather than information about a novel toy. Note that children’s own failures and successes...
with the toys, as well as the confederate’s knowledge of how the toys work, were identical across conditions; the only difference was whether the confederate was present or absent during the child’s final success on the Observed Toy. Nevertheless, children’s choices of toys differed across conditions. When the confederate was present during the final success, children showed a clear preference for the Unobserved Toy, suggesting a desire to demonstrate a toy that was novel to the confederate. However, when she was absent during the final success, children were more likely to override this desire and choose the Observed Toy instead to demonstrate their success, even though she had seen this toy before.

For this initial experiment, we recruited children from a relatively broad age range and identified a weak effect of age only in the Present Condition. In order to examine whether the effect is present even in the youngest group, and verify the influence of age, in Experiment 2 we ran a replication with separate groups of 3- and 4-year-old children. Although toy type (red, green) was fully counterbalanced, post-hoc analysis identified a general preference for the green light-up toy over the red music toy in both conditions (Present: 60%; Absent: 71%), suggesting children liked the light-up effect more than the music effect. Although this does not influence the interpretation of our results, in Exp. 2 we used two toys that had the same causal effects.

**Experiment 2**

**Methods**

**Participants** We determined our sample size prior to data collection by running a power analysis with data from Exp. 1. To achieve 70% power (Odds Ratio = 3.14), the required sample size is N=96 (N=48 in each condition). We planned to collect independent groups of 3- and 4-year-olds. Because data collection is ongoing, here we report preliminary findings collapsed across the two age groups.

Eighty-three 3-4 year-olds (47 girls, \(M_{\text{Age}}(SD) = 4.1(0.5)\), Range = 3.2-4.9) were recruited from a university preschool and were randomly assigned to the Present or Absent Conditions. Additionally, 27 children (12 in Present, 15 in Absent) were tested but excluded due to failure on the memory question. An additional 19 children were excluded for not completing all phases of the task (N=14) or technical errors (N=5).

**Materials** The same toys as in Exp. 1 were used, except that the red toy’s causal effect (music) was replaced with lights.

**Procedure** The procedures were identical to Exp. 1.

**Results and Discussion**

Our critical question was whether children’s toy choice differed across conditions. The results mirrored those from Exp. 1: children in the Absent Condition were more likely to choose the Observed Toy than children in the Present Condition (% choice for Observed Toy: 61% (Absent) vs. 26% (Present), \(p = 0.002\), Fisher’s Exact Test). In the Present Condition, only 26% children chose the Observed Toy (\(p = 0.003\), Binomial Test), suggesting that they were motivated to present the toy that was new to the confederate. In the Absent Condition, however, children did not show a clear preference for either toy (Observed Toy: 61%, \(p = .211\)).

We then asked whether there is an effect of age by running the same logistic regression as in Experiment 1. While there was a small effect of age in the Present Condition in Exp. 1, in Exp. 2 we did not find an effect of age either condition (Absent: \(B = 0.24, z = 0.40, p = 0.69\); Present: \(B = 0.24, z = 0.46, p = 0.64\)). Finally, given the high exclusion rate for children who failed the memory check question, we ran the analyses including these children. The results again replicated the findings in Exp. 1: Children in the Absent Condition chose the Observed Toy more often than those in the Present Condition (55% vs. 30%, \(p = 0.007\), Fisher’s Exact Test). Children in the Present condition strongly preferred to show the Unobserved Toy, with only 30% selecting the Observed Toy (\(p = 0.004\), Binomial Test), and 55% children in the Absent Condition chose the Observed Toy (\(p = .50\)).

Our preliminary findings from Exp. 2 replicate the pattern in Exp. 1: Children’s decisions about what to show the confederate critically depended on whether they had previously observed them only fail (Absent Condition) or eventually succeed (Present Condition) on the Observed Toy. These data provide initial evidence that even 3- and 4-year-old children selectively communicate novel information or demonstrate their success depending on what the confederate thinks about their own competence. Furthermore, as the data collection is still ongoing, we remain cautious about interpreting results from individual age groups.

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2 Although data collection is ongoing, these effects were present in each age group: 4-year-olds (N=48; % choice for Observed Toy: 59% vs. 26%, \(p = 0.036\), Fisher’s Exact); 3-year-old group (N=38; 63% vs. 26%, \(p = 0.049\), Fisher’s Exact Test).
General Discussion

Our results across two experiments suggest that preschool-aged children readily demonstrate a toy that an adult had not observed before, but selectively override this desire to demonstrate their competence about a familiar toy when the adult thinks that the child cannot activate it. Experiment 1 (3-5 year-olds) shows that when a confederate observed children succeed on a toy (Present Condition), children highly preferred to provide information about a new toy to her; however, when the confederate only observed them fail (Absent Condition), children were more likely to show their competence on the already familiar toy. Preliminary results from Experiment 2 replicate these findings with 3- and 4-year-olds.

Note that the experimenter never asked the child to monitor what the confederate believed about the toys or the child's abilities. Nevertheless, children chose to show different toys depending on what the confederate presumably thought about their ability to active the familiar toy. These results reveal an early-emerging ability to reason about what another individual thinks about one's own competence based on the individual's prior observations of their own failures and successes, and selectively choose whether to communicate information about the world (e.g., how a toy works), or information about the self (e.g., what "I" can do).

These results are consistent with recent work on reputation management in early childhood. Even young children strategically choose their actions in the presence of others to protect their positive reputation or avoid negative reputation (e.g., Engelmann et al., 2012; Zhao et al., 2017). Whereas these studies primarily focus on children's behaviors to act morally or prosocially, our study focused on whether children strategically modify their behaviors depending on others' prior observations of their own successes and failures. Also, rather than asking whether children act to promote or preserve their reputation given explicit information about what others think of them (Zhao et al., 2017), we asked whether children naturally track an individual's belief based on her prior observations and try to revise it selectively when she might be wrong about their competence. Critically, children chose to do this even at the expense of an opportunity to provide new information for the individual.

While we have described the confederate's representation of the child's competence as a belief, it is unclear exactly how children are representing what the confederate thinks about them. One possibility is that children are inferring a full-fledged representation of her belief that the child can or cannot make a particular toy work, or that the child is competent at activating a particular toy. However, it is also possible that the child merely represents the confederate's knowledge, understanding that the confederate is either knowledgeable or ignorant of the child's prior success. While children's explanation could provide useful insights, most children were unable to verbalize why they chose to demonstrate the Observed Toy, and children mostly referred to the confederate's observations rather than her mental states.\(^3\)

While we did not see a clear age difference (but see Exp.1), it is also possible that younger children are representing knowledge/ignorance, while older children are inferring the content of the confederate's belief (e.g., that the child can or cannot make the toy go). Given children's transition from a knowledge-based to belief-based ToM understanding between 3 to 5 years of age (Wellman & Liu, 2004), a similar transition might take place in reasoning about what others think of the self's competence. Regardless of the exact nature of children's representations, our results do suggest that they understand a causal relationship between one's observations of their own actions and outcomes, and her knowledge or beliefs about them.

As a group, children in the Absent Condition were split between showing the Observed Toy and Unobserved Toy. This pattern could reflect the fact that children were genuinely torn between providing information about the world and providing information about the self. Alternatively, this split could reflect children's individual differences in how they weight each of these desires, as individuals may vary in how much they care about what others think of them.

Note that by showing a novel toy children could provide information about how it works as well as their ability to activate it. One might wonder why children would ever choose to show the Observed Toy. Although the confederate had no information about the child's ability to activate the Unobserved Toy, she had clear evidence that the child can or cannot activate the Observed Toy. Thus, even though there was a strong reason to show her the Unobserved Toy in both conditions, children selectively override this desire depending on the confederate's observation of their final success.

Beliefs about the self can be evaluated with respect to their accuracy (how consistent they are with reality) and desirability (how desirable the belief is). Here, we intentionally created a context in which the confederate's belief about children's competence was both accurate and desirable (Present) or inaccurate and undesirable (Absent). It is possible that children in the Absent Condition were motivated to change the confederate's belief to be either accurate, desirable, or both. An interesting question for future work is how we decide what to communicate when these dimensions are not aligned with one another: For instance, others can hold desirable but inaccurate beliefs or undesirable, yet accurate beliefs about us. Further, we may have different goals for how we want others to understand us: Sometimes, we may only care about desirability (e.g., during a first date), omitting our flaws and failures, but other times, we may care primarily about accuracy (e.g., during long-term relationships or pedagogical interactions) and openly disclose even about our weaknesses. One interesting question is how different social contexts might guide the nature of the information we provide.

\(^3\)In Experiment 1, 58% children in the Present Condition referred to the confederate's prior observations (or lack of them) of the toys (e.g., "because she did not see that one"), whereas only 18% children in the Absent Condition did so.
about ourselves.

Inferences about others’ and our own abilities are not limited to whether we have simply “failed” or “succeeded” on a task. Indeed, the amount of evidence (e.g., number of successes), nature of task (e.g., succeeding on an easy or difficult task), or the source of information (e.g., direct observation or hearsay) influences what others think of us. Given young children’s developing understanding of task difficulty (Gweon, Asaba, & Bennett-Pierre, 2017) or source of information about others’ behaviors (Haux, Engelmann, Herrmann, & Tomasello, 2017), children might also consider these factors in deciding when (or to whom) to demonstrate their competence. Future studies might explore this possibility.

Our ability to effectively provide information about the self is fundamental to building strong, healthy relationships with others; in providing information about the self, we are often motivated to not only make ourselves feel better but also to maintain a coherent representation of who we are across various individuals in our lives. Critically, these communicative decisions rely on the ability to infer others’ beliefs about the self. Our initial results suggest that even young children care about what others think of their competence, and flexibly decide what information to communicate depending on the context.

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