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 own 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, 4, & 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 failures but not the final success, more children chose to show the familiar toy again to demonstrate their competence. In Exp. 2 (3- & 4-year-olds), we replicate this finding. Even in preschool years, children can reason about what others of their own competence and strategically decide whether to communicate information about the self or the world; these results are discussed in light of prior work on reputation management and Theory of Mind.

Keywords: cognitive development, social cognition, Theory of Mind, the self, reputation management

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, the ability to reason about others' beliefs about the self is especially important for young children as they face the challenge of learning about the world and building healthy relationships with others, while also constructing a coherent sense of who they are and what they can (or cannot) do. While abundant research on public displays of generosity (Nowak & Sigmund, 2005) suggests that humans care about their reputation, we still understand little about the cognitive capacities that underlie these behaviors, and how they support the management of various aspects of self-image beyond generosity. How do we reason about others' beliefs about us, and what are the developmental roots of this capacity? Here we investigate preschool-aged children's ability to 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, requires more than the motivation to appear competent; it also requires the inferential capacity to reason about 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) have 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 informing and teaching as a way to change others' beliefs continues to develop throughout preschool years (Rhodes, Bonawitz, Shafto, Chen, & Caglar, 2015; Sobel & Letourneau, 2016); children selectively demonstrate causal evidence that is necessary for an observer by considering her goal or competence (Gweon & Schulz, 2018). Collectively, these findings suggest that preschool-aged children have an abstract understanding of how evidence (e.g., perceptual experience) influences others' beliefs about the physical world, and actively communicate or teach others to change or revise these beliefs. Thus 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.

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 desirablity 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 decisions if they do not *care* about what others think of them. Prior work suggests that preschool-aged children are motivated to promote and protect their self-image; they cheat less and share more when others are watching (e.g., Engelmann, Herrmann, & Tomasello, 2012), and they and actively attempt to maintain others' positive evaluations of them (Zhao, Heyman, Chen, & Lee, 2017). However, it remains unclear whether children can use others' prior observations to infer what others think of the self and actively communicate to change these beliefs.

Prior literature suggests an early-emerging appreciation of the relationship between agents' behaviors and their unobservable traits or qualities. Even infants distinguish nice and mean agents based on whether they help or hinder others (Hamlin, 2013) and use patterns of successes and failures to infer whether agents (they themselves or others) are capable or not (Gweon & Schulz, 2011); older children readily infer others' competence based on whether they forego a rewarding treat given the high cost to attain it (Jara-Ettinger, Gweon, Schulz, & Tenenbaum, 2016). To the extent that children consider action outcomes and choices as indicative of the actor's underlying qualities (e.g., success on a task indicates competence), they might also be able to infer what others think the self based on others' observations of their own failures or successes. While prior work on reputation management has focused on whether reputational concerns give rise to specific behaviors that promote their self-image (e.g., sharing, cheating), we focus on children's choice between informing others about the world or about the self (both of which would reflect well on their self-image) based on others' past observations.

The current study investigates 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 main 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 Ninety-two children ($M_{Age}(SD) = 4.5(6.8)$, range: 3.3 - 5.9; 49 girls) were recruited from a university preschool and randomly assigned to the Present (N=44) or the Absent (N=48) condition. An additional 8 children were recruited but excluded due to not finishing the study (N=3), refusing to choose a toy (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 on 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 placed the two toys on the table and said that her friend "Anne" (a confederate) would watch them play. The confederate then 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 removed the other toy (henceforth Unobserved Toy). Toy type (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 succeeded 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 "...you have to push this

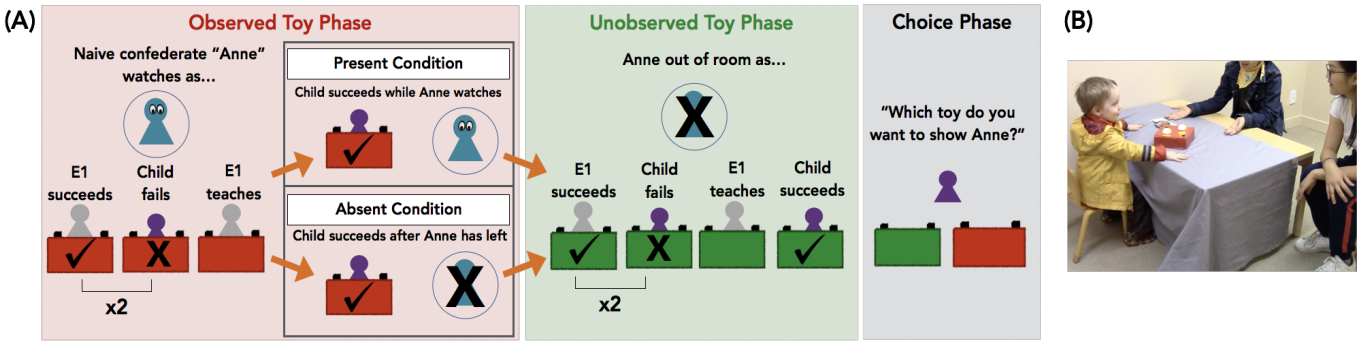

Figure 1: (A) Procedures for Experiments 1 and 2. (B) Child demonstrating toy to confederate (on rightmost side of image).

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 confederate left the room during this phase. In the Present Condition, the confederate stayed in the room and observed the child's final success. In the Absent Condition, the confederate left immediately after the experimenter's instruction and did not observe this final success.

In the *Unobserved Toy Phase*, the confederate 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 twice more, ensuring that children learned how to operate both toys and were 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. To assess their explicit memory of the confederate's observation, children were then asked whether they were playing with the Observed Toy or Unobserved Toy while Anne was watching. Finally, the confederate came back into the room and children demonstrated the toy that they had chosen.

Results and Discussion

In both conditions, the confederate had not seen the Unobserved Toy; by choosing this toy, children could provide new information by showing how it works. Critically, however, while 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: 63% (Absent) vs. 27% (Present), $p < .001$; Fisher's Exact Test). Children in the Present Condition showed a strong preference to show the Unobserved Toy (73%, $p = .004$, Binomial Test), but children in the Absent Condition did not show a clear preference for either toy ($p = .111$, Binomial Test), suggesting that they were split between teaching new information and demonstrating their competence. Logistic regression with age as a continuous predictor revealed no effect of age (`Toy choice ~ Age in Months`; Absent: B = -.272, z = -.593, p = .553; Present: B = .506, z = 1.00, p = .316).

Notably, the same pattern of results was present not only in children who passed the memory check question (% choice for Observed Toy: 55% (Absent, N=38) vs. 28% (Present, N=32), $p = .030$, Fisher's Exact Test) but also those who failed (90% (Absent, N=10) vs. 25% (Present, N=12). As the task involved tracking two toys and the presence or the absence of a confederate, this question was initially designed to identify children who were confused by these events. However, the results suggest that giving an inaccurate response to this question does not necessarily indicate being confused or failing to track what others observed. Given that 24% of participants failed the memory check, we include all children in the main analyses while separately reporting results from just those who passed the memory check.

These results provide initial support for the hypothesis that preschool-aged children can reason about others' beliefs about their own competence and strategically decide whether to provide novel information about the world or demonstrate their success. All children failed twice and succeeded once on both toys, and their experience with the toys as well as the confederate's knowledge of the toys 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 made different decisions across conditions. Their preference for the Unobserved Toy in the Present Condition suggests that children are motivated to show a toy that is novel to the confederate; however, when she was absent during the final success, children were more likely to override this desire to choose the Observed Toy to demonstrate their success, even though she already knew how it worked.

Experiment 2

As an initial investigation, participants in Exp. 1 were recruited from a relatively broad age range. In Exp. 2, we recruited 3- and 4-year-olds to replicate the results in younger children and explore potential developmental change.

Methods

Participants A total of 131 children (M_{Age}(SD) = 4.1(0.5), range: 3.2 - 4.9) were recruited from a university preschool and randomly assigned to the Present (N=64) or Absent (N=67) condition. Power analysis using data from Exp. 1 suggested N=66 (33 per condition) achieves 80% power; we thus conducted exploratory analyses within each age bin. An additional 19 children were recruited but excluded for technical errors (N=5) or not completing the task (N=14).

Materials The same toys as in Exp. 1 were used, but the red toy's causal effect (music) was replaced with lights to make the two toys equally desirable [1].

Procedure The procedures were identical to Exp. 1.

Results and Discussion

Our critical question was whether children's toy choice differed across conditions. As predicted, children in the Absent Condition were more likely to choose the Observed Toy than children in the Present Condition (% choice for Observed Toy: 54% (Absent) vs. 30% (Present), $p = .008$, Fisher's Exact Test). In the Present Condition, only 30% of children chose the Observed Toy ($p = .002$, Binomial Test), suggesting that they were motivated to show 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: 54%, $p = .625$, Binomial Test).

Other aspects of the results also mirrored Exp.1. First, excluding the 32 children who failed the memory check did not change the results (N=99, % choice for Observed Toy: 53% (Absent) vs. 29% (Present), $p = .024$)[2]. Second, logistic regression with age as a continuous predictor did not reveal an effect of age (Absent: B = -.648, z = -1.146, p = .252; Present: B = .587, z = .960, p = .337). However, exploratory analyses

[1] Although the toys were fully counterbalanced in Exp.1, post-hoc analyses revealed a global preference for the green light-up toy over the red music toy (63%, p = .016, Binomial Test); matching the causal effect of the two toys eliminated this preference in Exp.2 (43% chose the green toy, $p = .111$, Binomial Test).

[2] The pattern of results were similar among children who failed the memory check; 56% (Absent, N=16) vs. 31% (Present, N=16).

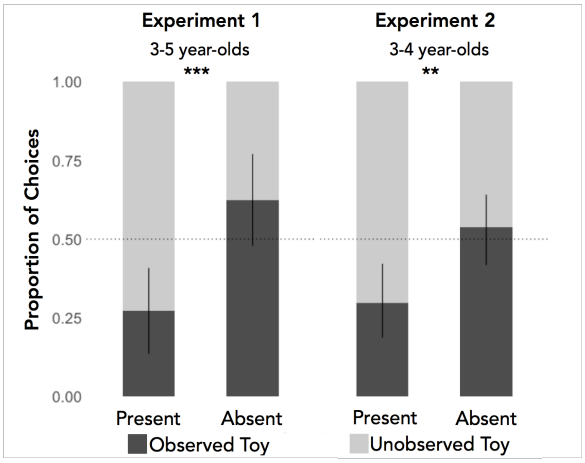

Figure 2: Results for Exp. 1 and 2 (*** $p < .001$, ** $p < .01$). Error bars are 95 percent confidence intervals.

in each age group suggested that the difference in children's toy choice across conditions is clear in 4 year-olds (% choice for Observed Toy: 60% (Absent) vs. 24% (Present), p = .003, Fisher's Exact Test) but not in 3 year-olds (47% (Absent) vs. 37% (Present), p = .451).

In sum, our findings from Exp. 2 replicate the results in Exp. 1 in a younger age group; as young as four years of age, children strategically decide whether to communicate information about a novel toy or demonstrate their own success on a familiar toy depending on others' observations of their own successes and failures. Even though age did not predict children's choices, separate analyses in 3- and 4-year-olds suggested a potential developmental change.

General Discussion

Across two experiments, we find 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 they cannot activate it. Exp.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. Exp.2 replicated these findings in a younger age group.

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 observed and thought about their ability to active the Observed toy. These results suggest an early-emerging ability to reason about what others *think* about one's own competence, given others' prior observations of one's failures and successes, and selectively choose whether to communicate information about the world (e.g., how a toy works) or the self (e.g., what "I" can do).

One might wonder why children would ever choose to show the Observed Toy; by showing the novel toy, children could provide information about how it works as well as their ability to activate it. Note however that although the confederate had little 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 reason to show her the Unobserved Toy in both conditions, children selectively overrode this desire depending on the confederate's observation of their final success.

As a group, children in the Absent Condition were split between showing the Observed Toy and Unobserved Toy. While children might be genuinely torn between providing information about the world and providing information about the self, children may vary in how much they care about what others think of them; thus this split could reflect individual differences in how they weight their goal to teach vs. appear competent. However, it is also possible that children did not consider the confederate's beliefs about their competence and simply wanted to show a success on either toy. One way to address this concern is to examine children's choices when the confederate knows how both toys work but does not observe the child's final success on the Observed Toy; without a reason to "teach" either toy, children might show a stronger tendency to demonstrate their success on the Observed Toy.

Exp.2 provided a robust replication of results from Exp.1. However, we did not find a clear pattern when 3-year-olds were analyzed separately. While this might suggest a potentially interesting developmental difference, we remain cautious about interpreting the absence of a condition difference in this age group, especially because age as a continuous predictor did not predict children's choices in either condition. Given that the power analysis was based on older children, these exploratory analyses might also be underpowered. However, there are also reasons to expect differences between age groups. First, younger children may have more difficulty tracking the confederate's observations and understanding how those observations relate to the confederate's beliefs about their competence; thus our results might reflect children's developing Theory of Mind abilities between ages 3 to 5. Second, this task requires children to learn the causal mechanisms of two different toys while tracking the confederate's observations to decide what to communicate; the complexity of the task may have masked younger children's ability to infer others' beliefs about the self. Given that even 3-year-olds are motivated to appear "smart" to others (Zhao et al., 2017), it is possible that a task with reduced demands can reveal their ability to reason about others' beliefs about the self and demonstrate their competence accordingly.

So far we have described the confederate's representation of the child's competence as a *belief*. However, 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, many children were unable to verbalize the reasons behind their choices, and when they did, almost none referred to the confederate's observations or her mental states[3]. Relatedly, even children who failed the memory check showed the predicted pattern of choices, suggesting that children's toy choices are not necessarily supported by their ability to explicitly recall past events; it is also possible that these responses were influenced by the main question which immediately preceded this memory check and also involved a choice between the two toys. Regardless of the exact nature of the representations that support children's decisions, our results do suggest that preschool-aged children understand how one's observations of their own actions and outcomes can influence her knowledge or belief about them.

These results are consistent with recent work on reputation management in early childhood (e.g., Engelmann et al., 2012; Zhao et al., 2017). Whereas these studies primarily focus on changes in the frequency of children's moral or prosocial behaviors for the promotion or maintenance of a reputation, our study asked whether children naturally track others' beliefs given her previous observations and strategically communicate information when she might be wrong about their competence. Further, our experiments harnessed children's *motivation* to communicate their competence to others to reveal underlying inferential capacities; how children communicate about the self, however, likely depends on their cultural context, norms, and values. Future work should investigate how different reputational concerns or cultural contexts might inform how we track and represent others' beliefs, as well as what we decide to communicate about the self.

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). Children in the Absent Condition might have been motivated to change the confederate's belief to be more 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

[3]Across Exp.1-2, in the Present Condition, 24 of 77 (31%) children who chose the Unobserved Toy referred to the confederate's prior observations (or lack of them) of the toys. Somewhat strikingly, in the Absent Condition, only 1 of 66 children who chose the Observed Toy mentioned her lack of observation of their success ("because she can't know that I'm doing it").

other times, we may care primarily about accuracy (e.g., during long-term relationships or pedagogical interactions) and openly disclose our weaknesses. One interesting question is how different social contexts might guide the nature of the information we provide about ourselves.

Inferences about one's competence involve more than tabulating past successes and failures 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) collectively influence these evaluations. Given an early-emerging understanding of task difficulty (Gweon, Asaba, & Bennett-Pierre, 2017) and sensitivity to the 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 how these different factors influence children's reasoning about others' beliefs about the self.

The ability to communicate information about the self is fundamental to building strong, healthy relationships with others. We often face competing motivations to *display* ourselves in the best light or *disclose* our shortcomings, and sensitivity to others' beliefs about the self is critical for balancing these motivations and making appropriate communicative decisions depending on the context. 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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