How you learned matters: The process by which others’ learn informs young children’s decisions about whom to ask for help

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Abstract

Prior work suggests that young children consider others’ knowledge and expertise to decide from whom to learn. Do children also consider how others came to know what they know? Here we investigate young children’s sensitivity to the process by which people have learned. In Experiment 1, 3- to 6-year-olds preferentially sought help from an active learner, who had figured out how to solve a problem by herself, over learners who had learned through passive observation or direct instruction. Yet, this preference emerged only when the problem children needed to solve was related to the one the learners had solved, when they thought the active learner’s competence would be relevant. These findings suggest children infer competence from the process of active learning, and consider this competence to be constrained to a particular task rather than generalized as a global positive trait. The results of Experiment 2 hint at a developmental difference in the cues used by children to infer competence: By age 6, but not at age 3, children prefer the active learner even when she is not alone while learning, suggesting an appreciation for the process of active learning that goes beyond superficial cues.

Keywords: help-seeking; selective trust; active learning; knowledge acquisition; problem-solving

Introduction

Children are selective social learners. Even very young children have mental models of what constitutes a knowledgeable informant and strategically choose from whom to learn (Shafto, Eaves, Navarro, & Perfors, 2012). For instance, children as young as 3 preferentially learn from those who are knowledgeable rather than ignorant, and their ability to identify trustworthy informants continues to develop across the preschool years (e.g., Birch, Vauthier, & Bloom, 2008; Corriveau, Fusaro, & Harris, 2009; Einav & Robinson, 2011; Koenig & Harris, 2005; Sabbagh & Baldwin, 2001; Sobel & Kushnir, 2013).

Much of the research on children’s selective social learning has focused on children’s ability to identify good teachers. Collectively, this literature suggests that children are sensitive to the quality of information different teachers provide and use it to identify who is more knowledgeable and helpful. However, learning involves more than receiving useful information from others; it also involves acquiring the abilities to actively explore and gather information yourself. By identifying good learners and learning from them, children not only can learn about the world from others, but also how to effectively learn about the world. Indeed, a good learner offers a model of how to perform goal-directed actions that generate useful evidence or how to ask questions that elicit informative answers from others (Frazier, Gelman, Kaciroti, Russell, & Lumeng, 2011; Markant & Gureckis, 2014; Mills, Legare, Bills, & Mejias, 2010; Schulz & Bonawitz, 2007).

Similar to how knowledgeable teachers can be identified by the quality of information they provide, competent learners could be identified by the quality of their explorative actions or questions or by their ability to make novel discoveries on their own. Prior work suggests that already preschoolers are sensitive to the effectiveness of learners’ inquiring strategies before being able to implement efficient strategies on their own. For instance, children as young as 4 years are already able to identify which agents ask the most informative questions, despite not being able to generate such questions on their own (Ruggeri, Sim, & Xu, 2017). In this sense, identifying competent learners might be useful not only to identify who can best help us learn new things, but also to serve as a stepping stone to develop successful inquiry strategies.

How do young children recognize good, competent learners? In this paper we investigate the extent to which young children (3- to 6-year-olds) infer competence based on the nature of others’ learning. In particular, do children prefer to learn and seek help from active problem-solvers, and does this preference depend on the kind of problem children themselves have to solve? In other words, is the learner’s competence, inferred from her learning process, global or constrained to the range of tasks on which this process was observed? We designed a study implementing an experimental paradigm similar to that used in prior work on selective trust. We presented children with multiple agents and asked them to choose whom they wanted to ask for help. But rather than contrasting informants who differed in knowledge, we presented children with learners who eventually acquired the same knowledge (i.e., how to activate a novel toy), but differed in how they had acquired this knowledge. Our critical question was from whom children would seek help when given a novel problem that varied in its similarity to the one the learners had figured out.

Experiment 1

In Experiment 1, children observed three learners: the Active learner figured out how to activate a causal toy on her own; the Instructed learner learned from another person through direct instruction; the Passive learner learned by watching an active learner figure the toy out. Children were then given a causal toy to figure out, and the opportunity to seek help from one of the three learners. To examine whether children’s choice was influenced by the similarity between the problem on which children needed help and the problem the learners had previously solved, children were presented with three different toys: (1) the Original toy, identical to the one the learn-
ers’ had figured out; (2) a Similar toy, which looked similar but was visually more complex; (3) a Different toy, visually and functionally dissimilar from the original one. Following prior work on children’s selective trust and help-seeking, as well as that on children’s question selection, we investigated children aged 3 to 6 years.

Methods

Participants We recruited 120 3-, 4-, 5-, and 6-year-olds (n = 30 per age group; M(SD) = 60(14) months; 53% female) from local museums in Berlin, Germany. An additional 5 children were excluded from analysis because they refused to seek help (n = 4) or due to experimental error (n = 1).

Materials The Original toy was a blue cardboard box with a single row of 4 buttons (2 red, 2 black) alternating in color, and a green push-switch. When activated, this toy played music. The Similar toy looked similar to the Original toy and had similar causal affordances; the only difference is that it had two rows of the same 4 buttons. When activated, this toy also played music. The Different toy looked different from the Original toy and had additional causal affordances: It was made of a white round box with a wicker texture with 4 black buttons, another row of 4 different colored flip-switches, and a green push-switch. When activated, an LED strip that was wrapped around the toy lit up. See Figure 1 for a visual schematic of the toys. The toys were not actually functional, but surreptitiously activated by a remote control hidden from the child’s view.

Three videos were used to introduce the different learners. The actors were three Caucasian women with brown hair, each wore a different colored t-shirt (blue, yellow, or red) and was referred to by that color (e.g., “My friend Blue”). Each actress always wore the same colored t-shirt, but the learner each actress performed (Active, Instructed, or Passive) was counterbalanced across children.

Procedure Children were introduced to the experimenter’s friends, who had learned earlier that day how to activate a fun novel toy. Children were presented with videos of the three different learners (Active, Instructed, Passive) in a pseudo-randomized order, on a tablet. All videos involved the Original toy and consisted of 4 phases: Introduction, Exploration, First Activation, Second Activation (see Figure 2).

The Introduction phase was identical across videos. The learner sat at a table behind a black screen and lifted the Original toy from behind the screen. She rotated it forward such that children could see the top of the toy with the buttons and switch, while saying “Look at this cool toy. I wonder how it works.” The learner then placed the toy back behind the screen. In subsequent phases, the toy remained behind the screen out of children’s view: Children could see whether someone was actively performing actions on the toy, but not what those actions were.

The Exploration and First Activation phases differed by learner. The Active learner apparently pushed buttons on the toy behind the screen. She explored the toy for 5 seconds, said “Hmm” to herself (2 seconds), and then explored for another 5 seconds (Exploration). Then music played from behind the screen, suggesting that the toy was activated, and the learner said: “Aha! So, that is how this toy works!”, indicating that she had discovered how to activate the toy (First Activation).

For the Instructed learner, the Exploration phase was the same as in the Active learner video (5 + 2 + 5 seconds). In the First Activation phase, however, a second actor wearing a grey t-shirt (henceforth the teacher) entered, made eye-contact with the learner, and apparently pushed a particular combination of buttons on the toy. The music played, indicating that the teacher had activated the toy. The Instructed learner said, “Aha! So that is how this toy works!”.

In the Passive learner video, the Exploration phase started with the entrance of a second actress (black t-shirt, henceforth the model learner). The model learner apparently pushed buttons on the toy behind the screen. She explored the toy for 5 seconds, said “Hmm” to herself (2 seconds), and then explored for another 5 seconds. The Passive learner simply watched her, and never interacted with the toy. In the First Activation phase, the music played from behind the screen, suggesting that the toy was activated, and the Passive learner said, “Aha! So that is how this toy works!”.

In the Second Activation phase, which was identical for all learners, learners successfully activated the toy by themselves. This phase made clear that all learners knew how to activate the toy, regardless of how they learned the solution (see Figure 2).

After having watched all three videos, the experimenter brought out the three toys, one at a time (toy order counterbalanced). For each toy, the experimenter explicitly stated its relation to the toy the learners had figured out in the videos. For the Original toy, she said, “This is the same toy as the one in the videos. Yellow, Red, and Blue have seen it before”; Similar toy: “This toy is similar to the one in the videos, but it looks more complicated. Yellow, Red, and Blue have never seen it before”; Different toy: “This toy is completely different than the one in the videos. Yellow, Red, and Blue have never seen it before.” Children were given 10 seconds to explore the toy, but were unable to activate it. Then the experimenter presented photos of the three learners on the tablet.

Figure 1: Schematic of toys: The Original and Similar Toys were the same shape and color, and both played music when activated. The Different Toy had a different shape, color, and texture; when activated, it lit up.
and said, “Hmm, it’s hard, isn’t it? Maybe we should ask for help. Whom do you want to ask for help?” Children responded by tapping a photo on the tablet. The same procedure was repeated for the two remaining toys. At the end, the experimenter showed children how to activate the Different toy and gave them the opportunity to activate it. Children’s responses were recorded on the tablet.

**Results and Discussion**

By the end of the videos, all three learners knew how to activate the Original toy. Thus, in the Original toy trial, we predicted children would have no preference for any of the learners. However, only the Active learner video provided clear evidence that the learner was capable of discovering the correct solution by herself. If children were sensitive to the process of learning and used it to guide their decisions about whom to seek help, they should prefer the Active learner over the other learners, but only when they think her competence is likely to be helpful for solving the new problem. Thus, we predicted that children would show a preference for the Active learner in the Similar toy trial, because this toy appears to be of the same type as the Original toy. If children think the Active learner’s competence generalizes to all sorts of toys, then they might also prefer to seek her help in the Different toy trial. However, if they have inferred a competence specific to a certain kind of toy (e.g., blue toys, or music toys), children might again show no preference.

We fit a MCMC generalized linear mixed model predicting learner choice (Active, Instructed, Passive) with fixed effects of toy trial (categorical, 3-levels: Original, Similar, Different) and age (continuous) with a random effect of intercept for subject. This model revealed a main effect of toy trial: Children were more likely to ask the Active learner for help on the Similar toy compared to the Original ($p = .0056$), but were no more likely to select the Active learner on the Different toy compared to the Original ($p = .887$). Fitting this model again, dummy coding the Similar toy as the baseline variable, revealed that children were also more likely to select the Active learner on the Similar toy compared to the Different ($p = .0008$). This model also showed a marginal main effect of age ($p = .099$), providing suggestive evidence that children’s preference for the Active learner increases with age.

We further analyzed children’s choices by collapsing across age and conducting a series of chi-square goodness of fit tests comparing learner choice on each toy trial against chance (33%). As can be observed in Figure 3, children had no preference for which learner to ask for help when presented with the Original toy ($\chi^2(2) = 2.45$, $p = .294$) or the Different toy ($\chi^2(2) = 2.15$, $p = .341$). When presented with the Similar toy, however, children selected the Active learner more often than the other two ($\chi^2(2) = 18.6$, $p < .001$).

These results suggest that children consider the process of learning (i.e., active learning versus instruction or passive observation) as a relevant cue for deciding from whom to seek help. Note that all learners knew how and were able to activate the Original toy. Indeed, when faced with a problem identical to the one the learners had previously solved (the Original toy), children showed no preference for any learner. However, when faced with a novel problem, children’s choice of learner showed a clear pattern: They preferred to seek help from the Active learner on a related novel problem (the Similar toy), but not on a more distant novel problem (the Different toy).

Notably, children had no evidence that the Instructed or Passive learners would have failed to solve the problem. In

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1 This model was run using the MCMCglmm package, version 2.25.
fact, both the Instructed and the Passive learners were interrupted before or during their exploration, and it is possible that, if left to their own devices, they too would have figured out the toy by themselves. Yet, children still preferred to seek help from the active learner; the only one for whom they had positive evidence that she could figure out the toy via her own exploration.

The selectivity observed in children’s preference for the Active learner suggests that they did not just form a positive association with her. Rather, children seemed to infer from the Active learner’s successful exploration of the toy some kind of competence or knowledge that is helpful for particular tasks but not for others.

Experiment 2

Although results from Experiment 1 were consistent with our hypothesis, they leave open an alternative possibility: Children could have attributed competence to the Active learner simply because she was alone while learning, not because she actively discovered the solution by herself. Being alone makes it clear that the learner did not receive help; it also suggests that no one else thought the learner needed help, because no one stepped in as they did for the Instructed and Passive learners. Thus it is possible children thought the Active learner was more competent due to the absence of other people in the video, rather than by virtue of the process of learning itself.

We address this possibility in Experiment 2, introducing a small change to the active learner video, where now another person comes in and offers help to the learner. Because we did not observe any differences in children’s preference for the Passive versus the Instructed learner in Experiment 1, in Experiment 2 we just compared the Active learner to the Instructed learner whose intention to explore and actions on the toy are more closely matched to those of the Active learner.

Although we did not find a clear age trend in Experiment 1, we recruited specifically from the youngest and the oldest age groups (3-year-olds and 6-year-olds) to explore whether a developmental difference would emerge in the cues (i.e., learning independently vs. being alone while learning) children use to infer competency.

Methods

Participants  We recruited 30 3-year-olds (M(SD) = 42(3) months; 43% female) and 30 6-year-olds (M(SD) = 78(4) months; 50% female) from local museums in Berlin, Germany. An additional four children were excluded from analysis because they refused to seek help (n = 1) or due to distractions at the museum (n = 3).

Materials  All materials were identical to those used in Experiment 1, except that the Passive learner video was not used and the Active learner video was replaced with a Modified Active learner video.

Procedure  The procedure was identical to Experiment 1 except that children only saw two learner videos, the Modified Active learner and the Instructed learner videos (order counterbalanced). The Modified Active learner video was similar to the Active learner video used in Experiment 1, but a second actress (henceforth the teacher) entered at the end of the Exploration phase and looked at the learner, as if to offer help. The Active learner shook her head, suggesting that she refused the help, and acted on the toy, successfully activating it as the teacher watched. Thus, both the (modified) Active learner and the Instructed learner explored the toy for the same amount of time, and were both offered help by the teacher. The only difference was who eventually activated the toy successfully for the first time: the Active learner in the Modified Active learner video, and the teacher in the Instructed learner video.

Results and Discussion

We fit a binomial generalized linear mixed model predicting learner selected (Active vs. Instructed) with fixed effects of toy (categorical, 3-levels: Original, Similar, and Different) and age-group (categorical, 2-levels: 3- and 6-year-olds) with a random effect of intercept for subject. This model revealed no main effect of toy (largest \( \beta = 0.4026, SE = 0.368, z = 1.095, p = .273 \)) or age-group \( (\beta = -0.180, SE = 0.301, z = -0.600, p = .548) \).

Yet, as can be observed in Figure 4, 3-year-olds appear to not have a preference for either learner across toys, while 6-year-olds seem to prefer the Active learner on the Similar toy. A series of binomial tests looking at the learner children selected within each toy trial and age group confirmed this trend (two-tailed binomial tests, all \( ps > .1 \), except 6-year-olds on

\[^2\] This model was run using the \texttt{lme4} package, version 1.1-15.
Similar toy: $p = .0987$).

We also found a marginal effect of age in Experiment 1, suggesting that children’s preference for the Active learner increases from 3 to 6. Together, these age trends suggest that 3- and 6-year-olds may be relying on different cues when assessing the Active learner’s competency: Older children may be inferring competence from the process of successful active learning itself, while younger children may be using more superficial cues, such as being alone. We are currently running Experiment 2 with a larger sample size and the full age range from 3 to 6 to see if the hint of developmental change we observed here holds.

**General Discussion**

Children are selective in whom they decide to learn and get help from. Building on past research exploring how children evaluate informants based on their knowledge, we show that young children are also sensitive to the process by which people come to know what they know. Indeed, children differentiate a learner who solved a problem through independent, active exploration from a learner who was taught by or watched someone else solve the same problem. In particular, they preferred to seek help from the Active learner on a related, seemingly more complex problem. However, when faced with a problem that was identical to or different from the problem for which all learners knew the solution, children showed no preference in whom they asked for help.

Why did children prefer the Active learner only when the task they had to solve was similar to the one that the learner was able to solve on her own? It is possible that children attributed a competence for problem-solving to the learner, and understood that it would likely apply to a near-transfer problem (the Similar toy). Interestingly, children did not generalize this expectation to a far(ther)-transfer problem, where the task was possibly unrelated to the one that the Active learner was able to solve (the Different toy). In this sense, children’s preference for the Active learner suggests that they did not just form a positive or “warm glow” association with her (a “halo effect” (e.g., Cain, Heyman, & Walker, 1997)). Rather, children seemed to infer from the Active learner’s successful exploration of the toy some kind of competence or knowledge that is constrained to a particular class of problems.

Defining the boundaries of a class of problems and deciding when competence in one task is likely to transfer to another is challenging. In our experiments, the similarity between the toys was visually evident, but we would not necessarily expect children to preferentially seek help from the Active learner in domains where they struggle to assess the similarity between problems. In a sense, children were actually quite conservative in their willingness to extend the Active learner’s competence. The ability to solve one mechanical toy might very well reflect a knack for solving mechanical toys in general. In another sense, this conservatism seems justified given that children have only seen the Active learner figure out one toy. Children’s selective help-seeking is also consistent with their behavior in studies on selective trust of informants: Children not only prefer certain informants over others but also within a single informant only expect her knowledge to extend within the domain she demonstrated expertise and not across domains (Koenig & Jaswal, 2011; Kushnir, Vredenburgh, & Schneider, 2013).

Our findings begin to shed light on what components of the active learning process children are using to assess the learner’s competency. All learners knew how to activate the Original toy, so their preference for the Active learner likely comes from the process by which she arrived at this knowledge state and not from her declarative knowledge of how to make the toy play music. Furthermore, children’s preference for the Active learner cannot purely be attributed to her experience directly interacting with the toy, since the Instructed learner also had such direct experience. Nor is it solely dependent on observing a pattern of actions that eventually led to successfully activating the toy, since the Passive learner observed the model learner’s successful exploration. We can thus be more confident that this preference is due to the actual process of effective active learning (i.e., the ability to generate interventions that eventually led to successful activation), and not other factors shared with learning from others.

Our results also suggest that the ability to infer competence from the effectiveness of a learner’s exploration is developing across the preschool years. Younger children may be using more superficial cues that are correlated with active learning (such as being alone) but not active learning itself. Experiment 2 is the first step in exploring this possibility and our ongoing research will provide insight on how the bases of children’s judgments might be changing.

Moving forward, we also plan to further interrogate the inferences children are drawing about the Active learner. We interpret children’s preference for the Active learner’s help as reflecting an attribution of competence but what the exact nature of this competence might be remains unclear. Children consider this competence to be bounded but do they think the Active learner just knows more about this particular class of toys or do they really think she knows more about how to solve them? Manipulating the process by which the Active learner explores the toy and seeing how this affects children’s help-seeking would begin to answer these questions. For example, would children prefer an active learner who deliberately figured out the toy to an active learner who stumbled upon the correct activation sequence?

Similarly, our experiments only investigate whom children select to learn from but it remains an open question what exactly they want to learn. If children could see the actual actions different learners took on the toy, would they choose to imitate certain learners over others? We know that toddlers exert different amounts of effort to achieve a goal depending on how much effort an adult exerts (Leonard, Lee, & Schulz, 2017), and preschoolers imitate intentional agents more faithfully than agents who act accidentally (Buchsbaum, Gopnik, Griffiths, & Shafto, 2011). It thus seems plausible that
children would also selectively imitate the actions of certain learners depending on the competence inferred from their learning process.

This is early, but promising, work suggesting that similar to how children have models of good teachers they also have models of good learners. The current investigation focused on one quality of good learners: the ability to effectively query their environment. But competent learners also effectively query other people. Children can identify people who ask good questions, would they also prefer to seek their help? It is also possible that children’s understanding of what makes a good learner is mediated by the learning they see modeled and encouraged within their community and culture (Legare & Harris, 2016).

Here, we find that children are sensitive to the benefits of active learning and selectively use it as a cue to identify helpers with abilities relevant for the task at hand. Even if two people have the same knowledge content, children can differentiate between them based on the learning process by which they have acquired this knowledge and consider some processes to reflect more skill than others. Evidently, already quite early in childhood we understand that how you know, not just what you know, matters.

References


