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Trust Matters: Measuring and Identifying a Role for Epistemic and Interpersonal Trust in Preschoolers' Learning from Teachers

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ABSTRACT

Research Findings: Although work across developmental and educational psychology reveals that trust impacts children's acceptance of claims and that teacher-student relationships impact learning outcomes, little work has integrated these literatures to better understand how students' trust in their teacher facilitates learning. In the present work, we conceptualize and measure two distinct types of trust – epistemic trust and interpersonal trust – in order to better understand trust and learning in the classroom. Study 1 (N = 63 3- and 4-year-olds) manipulated the behavior of an adult teacher in order to test for predicted differences in children's epistemic and interpersonal trust in the teacher. Study 2 (N = 43 3- to 5-year-olds) extended these findings beyond the laboratory by examining children's trust in their lead classroom teacher at a university-based preschool. We found evidence for distinguishing between epistemic and interpersonal trust but did not discover associations between trust and learning. Taken together, these studies offer new insights for exploring children's trust in applied contexts. *Practice or Policy*: Our approach highlights the importance of measuring distinct dimensions of trust from the students' perspective and has implications for educational practices related to trust-building.

Introduction

Much of what children learn, including historical facts, scientific concepts, language, and social norms, is acquired from other people. A growing literature in developmental psychology has shown that by the preschool years, child learners appreciate that sources differ in their accuracy, knowledgeability, expertise, benevolence and intent, as seen in their decisions to selectively learn from sources who have a history of positive epistemic and prosocial characteristics (Harris et al., 2018). This work provides evidence that preschool-aged children monitor adults' epistemic and social qualities and adjust whom they learn from according to a variety of considerations. Children's selectivity in their social learning decisions is taken to be an expression of *epistemic trust*, trust that is guided by evidence about an agent and their ability to transmit accurate information (D.M. Sobel & Kushnir, 2013). Although this body of work has important practical implications, very little work has examined how epistemic trust functions in more naturalistic learning situations.

One increasingly important source of information for children are teachers, who serve as a new knowledge source as early as the preschool years. Despite having related interests, work on selective trust in testimony has been conducted largely independent from work investigating similar constructs in educational psychology. Educational psychologists have shown that trust, in a more general sense, as well as teacher-student relationships, are important predictors of academic and socio-emotional outcomes. For example, research in educational psychology has revealed that for older youth, general

assessments of trust relate to academic achievement (Goddard et al., 2009), school adjustment (Betts & Rotenberg, 2008), teacher-student relationship quality (McCormick et al., 2013), and acceptance of criticism and praise for school work (Yeager et al., 2014). Student-teacher relationship quality has also been shown to relate to positive academic and social outcomes (Hughes & Kwok, 2007; Pianta, 1992). These two lines of research suggest two things. First, that young children selectively learn from adults whom they trust and second, that older youth's academic and socio-emotional outcomes are impacted by extensions of trust and teacher-student relationship quality. Taken together, these literatures converge on the importance of trust, and point to the possibility that trust might play an important role in facilitating academic achievement and learning. Bridging these two literatures has the potential to strengthen our understanding of how teacher behavior impacts student trust, and how that trust impacts learning (K. H. Corriveau & Winters, 2019).

Conceptual and Methodological Limitations of the Developmental and Educational Psychology Approaches

Although both lines of research point to the importance of trust, limitations in scope and measurement hinder our understanding of the role that trust plays in children's learning from teachers. The psychological literature is built on a body of experimental work that utilizes the now classic selective trust paradigm to assess children's epistemic trust in others, which assesses children's preferences to ask and endorse novel information provided by different informational sources (M.A. Koenig & Harris, 2005). In this literature, abundant work has identified a role for epistemic trust in preschool-aged children's learning decisions (Koenig et al., 2004), their information-seeking (Begus & Southgate, 2012), their predictions of other's learning (Jeong & Frye, 2018), inductive generalization (Butler & Tomasello, 2016), their vigilance toward text (Eyden et al., 2013) and their source memory (K. Corriveau & Harris, 2009). However, less empirical attention has been given to identifying how epistemic trust impacts learning outcomes (Yu et al., 2018), even though this work offers compelling evidence that children's learning is impacted by their trust in others. For instance, the bulk of the empirical work investigating children's epistemic trust has focused on children's word learning in "one-shot" exchanges (Harris et al., 2018), leaving unanswered questions about trust and learning in a child's daily testimonial exchanges. Furthermore, few studies have documented children's selective epistemic trust in non-experimental settings, where child learning is naturally situated (e.g., in the classroom).

Two studies to our knowledge have explored epistemic trust in educational contexts. In one study, preschool-aged children were given a standard selective trust task where the informants pitted against each other were a familiar versus an unfamiliar teacher (K.H. Corriveau et al., 2009). Children displayed higher levels of epistemic trust in the familiar teacher, but this trust was moderated by information about their teacher's accuracy (K.H. Corriveau et al., 2009). Another study examined how informant accuracy impacted fourth and fifth graders' decimal learning (Durkin & Shafto, 2016). Children were shown correct and incorrect examples of decimal placement from two sources and depending on condition, one source was always associated with the correct decimal placement examples (the *consistent* condition) or was variably associated with the correct and incorrect examples (the *inconsistent* condition) (Durkin & Shafto, 2016). Children's epistemic trust in the informant was significantly higher in the *consistent* condition, and for fourth graders, this was also associated with greater learning gains (Durkin & Shafto, 2016). These studies suggest that preschool and early elementary aged students attend to cues of familiarity and accuracy when determining whom to trust for information involving teachers (K.H. Corriveau et al., 2009) and that epistemic trust is related to learning academic content (Durkin & Shafto, 2016). But, in both of these studies, informant characteristics were overtly manipulated, leaving unclear whether children naturally assess epistemic trustworthiness in people in ecologically valid contexts. Thus, one of our goals was to assess children's appraisals of their teacher's trustworthiness as they naturally occur in the classroom. Furthermore, while the Durkin and Shafto (2016) study suggests a link between epistemic trust and learning

academic content, this has yet to be explored more generally with familiar teachers, nor has trust been explored as a predictor of learning above and beyond other factors associated with academic achievement at this age, such as executive functioning and working memory skills (Morgan et al., 2019).

Although conducted with older youth, research in educational psychology offers evidence that assessing trust from the student's perspective is informative, and a recently published report corroborates this. Researchers found that 9- to 12-year-old Chinese students' perspectives of their relationship with their teacher (e.g., "*The relationship between my teacher and I is close and warm*") played an indirect role in the association between student interpersonal trust (assessed with the Generalized Trust Belief Scale developed by Rotenberg et al., 2005) and social adjustment (Dong et al., 2021). Notably, there was no association between teacher's perspectives of the teacher-student relationship and student interpersonal trust and social adjustment (Dong et al., 2021). This study provides evidence that how students feel about their relationships with teachers matters and plays a role in their own trusting attitudes and social behaviors. In other work, middle schoolers' acceptance of criticism and praise for schoolwork from their teachers was supported by higher levels of student-reported trust in the school (Yeager et al., 2014), again revealing that student appraisals are important to consider when measuring trust and teacher-student relationship quality. But, these studies investigated middle school and high school students' trust and perceptions of the relationship, and defined trust in terms of general views about the trustworthiness of others (Dong et al., 2021) or of the school and community (Yeager et al., 2014). For example, the surveys used to measure student trust were not tailored to a specific individual (e.g., "*I am treated fairly by teachers and other adults at my school*," Yeager et al., 2014), leaving unanswered important questions about any given student's trust in their specific teachers, and in the specific characteristics of teachers that cultivate trust and positive relationships. Thus, to our knowledge, both the psychological and educational literatures have scant information about students' evaluations of the trustworthiness of their specific classroom teachers, nor how these evaluations relate to learning.

Taken together, the selective trust in testimony literature shows us that we can measure children's evaluations of trustworthiness from the child's perspective and offers evidence that epistemic trust is flexibly and selectively extended by children as young as 3-years of age. But, this literature neglects the role played by children's relationships with people in their lives, and also neglects children's epistemic trust in real-world contexts. Equally important, the educational literature tells us that relationships play a pivotal role in teacher-student relationship quality. But, the educational literature largely neglects children's own trust judgments, which are highly selective and flexible, and neglects children's trust in specific teachers. Here, we examine how children's trust judgments are made in more naturalistic learning environments, toward their teachers.

Conceptualizing Trust

Trust is a term that is difficult to define, despite widespread acknowledgment that trust plays an important role in psychological and societal functioning. Our own conceptualization of trust draws on the experimental work conducted with preschool-aged children, which, as we have reviewed, is responsive to considerations about an adult's epistemic and interpersonal or social qualities (Harris et al., 2018; D. M. Sobel & Finiasz, 2020; Tong et al., 2020). Thus, our work seeks to measure children's specific rather than general beliefs about an adult's trustworthiness. Extensive research has revealed that epistemic considerations play an important role in children's learning (Harris et al., 2018 for review), which offers ample reason to evaluate children's epistemic appraisals of an adult's trustworthiness. But, interpersonal and relational characteristics of people that derive from children's interactions with others also feature in children's learning (M. A. Koenig & McMyler, 2019), especially in the classroom (Ansari et al., 2020; Pianta et al., 2012). Indeed, children sometimes privilege certain social characteristics over epistemic ones in their testimonial learning decisions, including preferences for agents who share their racial group (Chen et al., 2013), gender (Boseovski et al., 2016), and accent (K. H. Corriveau et al., 2013). Preschoolers have also been shown

to track agents' social or interpersonal trustworthiness by monitoring helping behavior, sharing, and ability to keep commitments (Kidd et al., 2013; Michaelson & Munakata, 2016; Pesch & Koenig, 2018). Psychologists have begun to consider how social and interpersonal goals function in children's epistemic trust (Koenig et al., 2021; Kondrad & Jaswal, 2016; Tong et al., 2020). While this work suggests that distinct forms of trust play a role in children's behaviors toward others, no one to our knowledge has leveraged this work to separately measure the interpersonal and epistemic characteristics of teachers that feature in children's trust. Thus, an unexplored possibility in this literature is to characterize trust as a multifaceted construct, one that involves distinct appraisals of others, and which might differentially impact a variety of decisions including whom to learn from or engage with.

In fact, cross-disciplinary work on trust suggests that it is a multifaceted construct and highlights the utility in creating tools to measure distinct varieties of trust. For example, philosophers studying trust distinguish practical trust (trusting someone to do a certain thing, or to refrain from doing some act) from epistemic trust (trusting a source for true, reliable information) (Faulkner, 2011; Goldberg, 2008). Within the field of organizational business management, it has been argued that cognitive trust, founded on evidence of reliability, dependability, and competence, should be distinguished from affective trust, founded on emotional bonds and reciprocated care (Johnson & Grayson, 2005; Lewis & Weigert, 1985; McAllister, 1995). In support of this, empirical work with adults has found that cognitive and affective trust are distinct constructs which vary over time (with affective trust becoming increasingly important) and are uniquely impacted by different interactions and considerations of others (Webber, 2008). In line with this, other work has found that cognitive features of trust are less important when an emotional bond or "liking" between two individuals is developed (Nicholson et al., 2001).

This interdisciplinary body of work offers convincing evidence that trust is a multidimensional construct that can be measured across two unique dimensions and suggests that a range of behavioral outcomes are uniquely impacted by different levels of epistemic and interpersonal trust. By taking seriously the possibility that distinct forms of trust exist, researchers can better document and understand how distinct varieties of trust function in children's learning – opening avenues for exploring individual differences in learning decisions and the impact of relationships on children's learning.

The Current Research

Given the interdisciplinary support for distinguishing between epistemic and interpersonal trust and the importance of interpersonal or relational components of interactions in belief and knowledge acquisition, one goal of this work was to measure these distinct trust appraisals from the child's perspective in a natural context. Thus, our investigation aimed to answer the following research questions. First, is there variability in children's epistemic and interpersonal trust evaluations of adult teachers? Second, does either form of trust predict children's learning and memory above and beyond other predictors of learning, including age and working memory? We examined variation in preschool-aged children's epistemic and interpersonal trust and how trust related to learning in two studies. In Study 1, we experimentally manipulated and controlled behaviors expected to naturally occur in classroom settings in order to test for predicted differences in epistemic and interpersonal trust as a function of condition. Two learning situations were developed, with the goal of manipulating epistemic and interpersonal cues that were expected to impact children's evaluations of how trustworthy they viewed the adult. To achieve this, all children interacted with a live adult "teacher" who taught the child information either with strong interpersonal behaviors and weak epistemic ones, or with strong epistemic behaviors and weak interpersonal ones. In Study 2, we examined variation in epistemic and interpersonal trust in four preschool classrooms by assessing children's epistemic and interpersonal trust in their classroom lead teacher.

In both studies, we measured children's assessments of their teacher's epistemic and interpersonal trustworthiness using newly developed epistemic and interpersonal trust questionnaires. We modified questionnaires that were found in the adult and developmental literatures, which assess epistemic trust judgments with questions about another person's knowledge (Lutz & Keil, 2002) and interpersonal trust judgments with questions about another person's benevolence and familiarity (Rowles & Mills, 2018). Specifically, we developed two 10-item questionnaires in which children were asked to answer questions assessing their characterizations of how epistemically trustworthy (e.g., *"This person knows a lot about new animals"*) and how interpersonally trustworthy (e.g., "*This person keeps their promises"*) they viewed a specific adult teacher. We expected these assessments to be an initial step toward measuring children's epistemic and interpersonal evaluations in the classroom given extensive research showing that two kinds of characteristics of others play into children's judgments of trustworthiness – epistemic characteristics and interpersonal or social characteristics.

In both studies, we also included standard assessments of children's selective trust and prosocial behavior in order to test for predicted differences in epistemic and interpersonal decisions with widely used measures. Specifically, we measured children's epistemic learning decisions with a task developed by Jaswal (2004). In this task, children are shown a series of images of hybrid objects and animals that have features reflecting 75% of one animal (object) and 25% of another animal (object) or equally reflect features of the two animals (objects). After indicating what they think the animal (object) is, the adult teacher provides counter-testimony and children are given the option to revise their initial claim. We expected that children would display higher levels of deference, an epistemic trust decision, in teachers who displayed strong epistemic behaviors. In addition, we measured children's prosocial behavior with a resource allocation task developed by Moore (2009) in which children are provided various opportunities to allocate stickers to their teacher. Preschoolers have been shown to allocate stickers more often to friends and caregivers compared to strangers (Moore, 2009). Given research showing that children's resource allocations are sensitive to an adults' social characteristics and behaviors (Olson & Spelke, 2008; Pesch & Koenig, 2018), we expected that children would share more with teachers who displayed strong interpersonal behaviors.

Finally, we also measured children's working memory, one component of executive function, using a word span task. Experimental work with preschoolers has found that individual differences in executive function can impact how children evaluate claims. For example, while four-year-old children demonstrated skepticism toward teachers with a brief history of inconsistent statements, this was best predicted by executive function and working memory (Doebel et al., 2016). Moreover, a growing body of work suggests that EF skills are important indicators of academic achievement (Brock et al., 2009). Working memory, in particular, has been found to be an important predictor of learning in kindergarten (Fitzpatrick & Pagani, 2012). Thus, to ensure that children were not simply better able to remember information due to their EF abilities, working memory was measured and included as a covariate in our analysis of the relation between trust and learning.

Study 1

Method

Ethics Statement

This study was approved by the Institutional Review Board. A parent or guardian provided written consent and children provided verbal assent to participate. These data were collected between July 2019 and March 2020.

Participants

Sixty-three children (35 girls), including 29 3-year-olds (M = 44.5, SD = 2.91, Range = 36.30– 47.90 months, 17 girls) and 34 4-year-olds (M = 51.38, SD = 2.88, Range = 48.30– 59.80 months, 18 girls) participated in this study. An additional 4 children were excluded due to failure to complete the

study (n = 2) or experimenter error (n = 2). The current sample size had 60% power to detect a medium effect size and 95% power to detect a large effect size. Participants were recruited from a university-maintained database. Participating children were primarily White (84%). Parent-reported income was primarily middle to upper class, with 70% reporting an annual income greater than $100,000 per year.

Procedure

Half of the children were randomly assigned to the High Interpersonal, Low Epistemic Condition ($n =$ 31, 14 3-year-olds and 17 4-year-olds, 18 girls) and half were assigned to the High Epistemic, Low Interpersonal Condition ($n = 32$, 15 3-year-olds and 17 4-year-olds, 17 girls). All participants interacted with an adult "teacher," and in order to place the interaction within a context of learning, the adult taught the child the same new information across conditions: facts about a novel animal and how to use a new object.

In the High Interpersonal, Low Epistemic condition, the teacher taught the child information with strong interpersonal behaviors, which included making statements about learning together ("I'm so excited to learn about this new animal with you"), providing encouragement ("You're doing a great job today!"), and sitting with the child at a small classroom table. About the facts and demonstrations, the teacher displayed weak epistemic behaviors by professing ignorance ("I don't know anything about this animal. I've never seen it before").

In the High Epistemic, Low Interpersonal condition, the teacher taught the child information with weak interpersonal behaviors, which included making statements about the setting ("You're in the learning room and today is Monday"), the importance of learning ("You're going to learn about a new animal today"), and standing across from the child who sat at a small classroom table. She displayed strong epistemic behaviors by exuding confidence in the material by making assertions about what she knew ("I know everything about this animal. I've seen it before").

Children's memory for the information they learned was assessed both immediately after the teaching phase and again approximately 15 minutes later (after the word span task). Children's interpersonal and epistemic trust in the adult teacher was examined by asking them to respond to 10 yes/no questions related to knowledge (e.g., "Some people know a lot about new animals, does she know a lot about new animals?") and 10 yes/no questions concerning prosocial behavior (e.g., "Some people help others when they need help, does she help others?"). Children's decisions to learn new information from the teacher and to share stickers with the teacher were assessed. Finally, children's working memory, a measure of executive function (EF), was assessed using a word span task.

Teacher Behavior. An adult research assistant taught each participant about a novel animal and demonstrated how to use a new object. The way the information was delivered differed as a function of condition. The interactions in each condition were scripted to ensure that participants received the same type of interaction in each condition and were designed to reflect behaviors and statements that are expected to naturally occur in classrooms. Although the teacher scripts were matched with respect to the number and type of statements made to ensure similar lengths of interaction duration, the average interaction duration differed across conditions (High Interpersonal, Low Epistemic: M = 2.96 minutes, SD = 1.01; High Epistemic, Low Interpersonal: $M = 2.41$ minutes, $SD = 0.46$; $t(36) = 2.57$, $p = .01$). Despite this, preliminary analyses found no effect of interaction duration on any of the dependent measures. The full script for each condition can be found in Appendix.

Teaching Modules. Each child participant was taught a set of facts about a novel animal and how to use a new object. The order of presentation of these was counterbalanced across participants and conditions. The animal instruction and object demonstration did not differ across conditions. This was done to ensure that memory for the information was not attributable to differences in the type of animal or type of object used in the demonstration. For novel animal instruction, the teacher produced a laminated image of a novel animal and told the child a series of facts about the animal. The animal

Table 1. Animal facts and object demonstration actions taught in Study 1.

Novel Animal Facts	Object Demonstration Actions
1. This is a kinkajou	1. Touch RED peg to nose
2. Kinkajous live in the rainforest	2. Place RED peg in bottom right hole
3. Kinkajous like to eat nectar	3. Rub left arm with YELLOW peg
4. Kinkajous are nocturnal, which means they sleep during the day	4. Place YELLOW peg in bottom left hole
5. Kinkajous are pollinators, which means they help plants grow	5. Place GREEN peg on top of head
6. Kinkajous can turn their feet around to walk backwards	6. Place GREEN peg in center hole
7. Kinkajous are sometimes called honey bears	

was selected based on its unique name and appearance. No child indicated prior knowledge of or familiarity with this animal. The facts contained no perceptually available features of the animal to reduce children's ability to independently confirm the truth of the facts or to more easily recall the information at test. For object demonstration, the teacher produced a peg toy apparatus and three different colored pegs. The teacher demonstrated how to place the pegs on the apparatus. Specific facts and actions are shown in Table 1.

Learning & Memory. Following the teaching phase, the adult teacher left the room and a neutral experimenter entered. The learning assessment phase of the study began with the short-term memory recall assessment. The long-term memory recall assessment was administered approximately 15 minutes later after participants completed the trust evaluation assessment, selective trust, resource allocation, and working memory tasks. The short- and long-term assessments were identical. They were matched to the order in which the information was presented. Scores were calculated for each memory assessment (short term, long term) as well as for each task (animal instruction, object demonstration).

Novel Animal Instruction Assessment. E produced the laminated picture of the animal and told the child, "Remember this animal? I'm going to ask you some questions about it." E then asked a series of open-ended questions (consistent across conditions) and recorded the child's responses. Questions included: 1. *What is this animal called?*; 2. *Where does it live?*; 3. *What does it like to eat?*; 4. *This animal is nocturnal. What does nocturnal mean?*; 5. *This animal is a pollinator. What does pollinate mean?*; 6. *What does this animal do with its feet?*; 7. *What is it sometimes called?*

Object Demonstration Assessment. E produced the peg apparatus and the different colored pegs and placed them in front of the child. E stated, "Remember this? Can you show me how to use it?" E recorded the child's actions.

Trust Evaluations. The trust evaluation assessment was administered after the short-term memory assessment. E produced a picture of the adult teacher the child had interacted with and stated, "Remember her? I'm going to ask you some questions about her." E asked the child to respond to the epistemic and interpersonal trust questions. The questions were given in alternating order (e.g., epistemic question, interpersonal question). Whether the epistemic or interpersonal question was asked first was counterbalanced across participants. Sample questions are included in Table 2 below. The full set of questions can be found in the supplementary material.

Selective Trust and Resource Allocation. Immediately after the trust assessment, E administered the selective trust and resource allocation tasks. These tasks were always administered in the same order (described in detail below). In both tasks, an image of the adult "teacher" whom they had learned from during the teaching phase was referred to throughout to ensure children knew who the target adult was.

Table 2. Sample trust evaluation questions.

Epistemic Trust:
1. Some people know a lot about new animals and some people do not. Does your teacher know a lot about new animals?
2. Some people know a lot about food at the grocery store and some people do not. Does your teacher know a lot about food at the grocery store?
3. Some people know a lot about why plants need sunlight to grow, and some people do not. Does your teacher know a lot about why plants need sunlight to grow?
4. Some people know a lot about why apples are sweet, and some people do not. Does your teacher know a lot about why apples are sweet?

Interpersonal Trust:
1. Some people keep every promise they make, and some people do not. Does your teacher keep their promises?
2. Some people follow through with what they say they will do, like giving out stickers, and some people do not. Does your teacher follow through with what she/he says they will do?
3. Some people are really good at listening to others, and some people are not. Does your teacher listen to others?
4. Some people help others when they need help, and some people do not. Does your teacher help others?

Selective Trust (Adapted From *JASWAL, 2004*). Children were shown an image of a hybrid object or animal, designed to look like one of two things (e.g., a ball or a button; a dog or a cat), and asked what they thought it was. The animal or object in each picture had features that reflected 75% of one animal/object and 25% of another animal/object, or equally reflected features of two different animals/objects. Children were then told that their teacher thought it the opposite of what they said, for example: "You [child] think it's a ball and your teacher says it's a button. Which one is it, a ball or a button?" For each trial, children received a score of 1 if they changed their initial response to match the adult's or a score of 0 if they continued to endorse their claim. The first two trials (50/50 hybrid) were administered after the first set of resource allocation trials, and the second two trials (75/25 hybrid) were administered after the second set of resource allocation trials.

Resource Allocation (Adapted From *MOORE, 2009*). Children were shown an image of the adult teacher and presented with two types of allocation decisions: prosocial and sharing. On Prosocial Trials (3 trials) children were told, "You can have one sticker for yourself now or one for your teacher and one for you later. What would you like to do?" On Sharing Trials (3 trials), children were told, "You can have two stickers for yourself now or one for your teacher and one for you later. What would you like to do?"

Executive Function. Forward and backward working memory was assessed using a word span task. In this task, children were asked to repeat a series of words back to the experimenter (forward or backward). The span increases with each success until the child makes three consecutive failures. Each child received two scores – one for forward span and a second for backward span – that indicated the highest level passed (i.e., the largest sequence of words successfully repeated forward/backward).

Results

Epistemic and Interpersonal Trust

The internal consistency of the epistemic and interpersonal trust assessments was examined using Cronbach's alpha. Both assessments had high internal consistency, with alphas over the recommended value of 0.70 (Epistemic Trust: Cronbach's alpha = 0.86; Interpersonal Trust: Cronbach's alpha = 0.87). Thus, a composite score was calculated for each trust type by averaging across the 10-items. Average trust scores by condition and age are reported in Table 3.

We examined whether our experimental manipulation impacted children's trust. A 2 (Condition) X 2 (Age) multivariate analysis of variance (MANOVA) was conducted with Epistemic Trust and Interpersonal Trust as dependent variables. There were no significant main effects of Condition (Pillai's Trace = 0.080, $F(2,58) = 2.549$, $p = .086$) or Age (Pillai's Trace = 0.081, $F(2,58) = 2.583$, $p = .084$), and the interaction between Condition and Age was not significant (Pillai's Trace = 0.019, $F(2,58) = 0.582$, $p = .561$) on the combined dependent variables.

Table 3. Mean *(SD)* epistemic and interpersonal trust score by condition.

	High Epistemic, Low Interpersonal		High Interpersonal, Low Epistemic	
	3-year-olds	4-year-olds	3-year-olds	4-year-olds
Epistemic Trust	0.93 *(0.13)*	0.90 *(0.17)*	0.86 *(0.26)*	0.74 *(0.31)*
Interpersonal Trust	0.88 *(0.21)*	0.91 *(0.13)*	0.85 *(0.28)*	0.82 *(0.27)*

Investigation of the univariate main effects revealed a significant difference in Epistemic Trust between the two conditions ($F(1,59) = 4.475$, $p = .038$) but not Interpersonal Trust ($F(1,59) = 0.999$, $p = .321$). There were no age-related differences in children's trust (Epistemic Trust: $F(1,59) = 2.091$, $p = .153$, Interpersonal Trust: $F(1,59) = 0.015$, $p = .902$). In line with our predictions, children's epistemic trust in the adult teacher who displayed weak epistemic behaviors was lower compared to their epistemic trust in the teacher who displayed strong epistemic behaviors. This suggests that young children make inferences about the epistemic quality of adults they interact with based on statements that the adult makes. Contrary to our predictions, interpersonal trust did not differ between the two conditions. Children displayed high levels of interpersonal trust in teachers who displayed either weak or strong interpersonal behaviors. These results should be interpreted with caution, as the epistemic and interpersonal trust scores were relatively high and approaching 1.00 in both conditions for each age group, indicative of a yes-bias in children's responses.

Selective Trust and Resource Allocation

Selective Trust

To explore differences in children's decisions to defer to the adult's label, we conducted a mixed-effects logistic regression using the glmer function of the lme4 package in R Statistical Software (R Core Team, 2014). Deference decision (0: did not defer, 1: deferred) was entered as the outcome. Condition (High Interpersonal, Low Epistemic vs. High Epistemic, Low Interpersonal), age-group (3 year olds vs. 4 year olds), hybrid type (50/50 vs. 75/25), the two-way interaction between condition and hybrid type, the two-way interaction between age and hybrid type, and the three-way interaction between condition, age and hybrid type were entered as predictors. Participant intercept was allowed to vary. The model including the interactions was significant, $\varkappa^2(4) = 12.998$, $p = .011$. Therefore, the model with interaction terms included is reported here. The model revealed a significant effect of condition ($\beta = -5.766$, SE = 2.012, z = -2.865, $p = .004$), a significant effect of hybrid type ($\beta = -1.929$, SE = 0.974, z = -1.979, $p = .047$), and a significant interaction between condition and hybrid type ($\beta = 4.182$, SE = 1.596, z = 2.620, $p = .008$). To explore the interaction between condition and hybrid type, a mixed-effects logistic regression model on children's deference decisions was conducted separately for each condition with hybrid type entered as the predictor. Participant intercept was allowed to vary in both models. Whereas children were more likely to defer on 50/50 hybrid trials compared to 75/25 hybrid trials in the High Interpersonal, Low Epistemic condition ($\beta = -1.889$, SE = 0.693, z = -2.724, $p = .006$), they did not differentiate between the two types of trials in the High Epistemic, Low Interpersonal condition ($\beta = 0.496$, SE = 0.582, z = 0.851, $p = .394$), see Figure 1. This suggests that children were more likely to defer to the highly interpersonal adult, despite her displays of ignorance, when it involved identifying ambiguous images.

Resource Allocation

To explore differences in children's decisions to allocate stickers to the adult, we conducted a mixed-effects logistic regression using the glmer function of the lme4 package in R Statistical Software (R Core Team, 2014). Allocation decision (0: did not allocate stickers, 1: allocated stickers) was entered as the outcome. Condition (High Interpersonal, Low Epistemic vs. High Epistemic, Low Interpersonal), age-group (3-year-olds vs. 4-year-olds), allocation type (prosocial vs. sharing), the two-way interaction between condition and allocation type, the two-way interaction between age and allocation type, and the
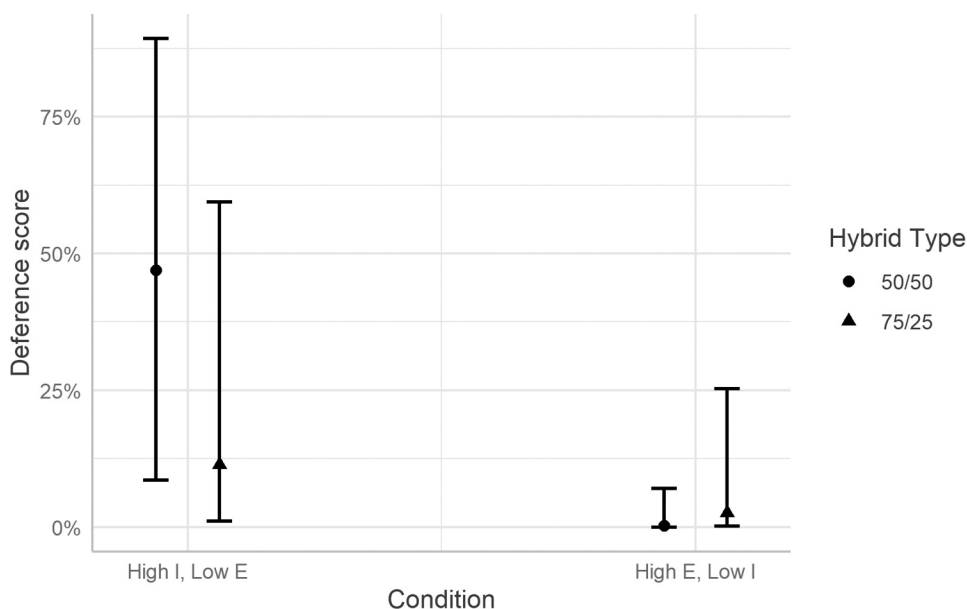
Figure 1. Predicted values of deference score by condition and hybrid type.

three-way interaction between condition, age and allocation type were entered as predictors. Participant intercept was allowed to vary. There were no significant differences between the full model including interactions and the model without interactions, $x^2(4) = 4.933$, $p = .294$. Therefore, the reduced model is reported here. The model revealed a significant effect of condition ($\beta = 1.477$, SE = 0.585, z = 2.525, $p = .011$), a nonsignificant effect of age ($\beta = 0.197$, SE = 0.576, z = 0.343, $p = .731$) and a nonsignificant effect of allocation type ($\beta = -0.436$, SE = 0.264, z = -1.647, $p = .099$). Children in the High Epistemic, Low Interpersonal condition ($M = 0.56$, $SD = 0.36$) allocated more resources to the adult teacher compared to children in the High Interpersonal, Low Epistemic condition ($M = 0.37$, $SD = 0.33$).

Working Memory

Each child received two scores: one for their forward word span and the second for their backward word span. The scores indicate the child's highest level passed on each assessment type, which ranged from 1 to 5. A linear mixed effects model was conducted with score as the outcome and age (months), condition, and span type (forward vs. backward) entered as predictors. Participant intercept was allowed to vary given repeated responses on span type. There was a significant main effect of age ($\beta = 0.072$, SE = 0.017, $p < .001$), suggesting that children had higher span lengths with age. There was also a significant main effect of span type ($\beta = 2.098$, SE = 0.118, $p < .001$), with higher forward span ($M = 3.66$, $SD = 0.87$) than backward span ($M = 1.56$, $SD = 0.76$). These findings are consistent with the literature on working memory with preschoolers.

Learning and Memory

Novel Animal Facts

Children responded to 7 questions assessing their recall of the novel animal facts taught to them. A score was calculated for each recall assessment by summing the number of correct responses divided by 7. A linear mixed effects model was conducted with score as the dependent variable. Condition, age

(year), assessment type (short term vs. long term) and their interactions were entered as predictors. Participant intercept was allowed to vary. There was a significant main effect of Age, with 3-year-olds ($M = 0.19$, $SD = 0.20$) recalling less facts than 4-year-olds ($M = 0.40$, $SD = 0.21$), ($\beta = 0.201$, SE = 0.050, $p < .001$). In addition, there was a significant main effect of assessment type, with more facts recalled on the short-term assessment ($M = 0.32$, $SD = 0.23$) than the long-term assessment ($M = 0.28$, $SD = 0.23$), ($\beta = -0.028$, SE = 0.009, $p < .01$).

Object Demonstration

Children were given the object and asked to show E how to use it. There were 6 demonstrated actions by the adult teacher. A score was calculated for each recall assessment by summing the number of correct actions copied divided by 6. A linear mixed effects model was conducted with score as the dependent variable. Condition, age (year), assessment type (short term vs. long term) and their interactions were entered as predictors. Participant intercept was allowed to vary. There was a significant main effect of assessment type, with more correct actions copied on the short-term assessment ($M = 0.26$, $SD = 0.28$) than the long-term assessment ($M = 0.20$, $SD = 0.26$), ($\beta = 0.144$, SE = 0.066, $p < .05$).

Predictors of Learning

One of the aims of this study was to examine whether relationships exist between children's trust in an agent and their learning from that agent. Four hierarchical linear regression models were conducted for each memory assessment (short term, long term) and each topic (animal facts, object demonstration). Score was entered as the outcome variable with condition, age (year), working memory score (forward, backward), epistemic trust, and interpersonal trust entered as predictors in three steps. In the first step, condition and age were entered to examine effects of age controlling for condition. In the second step, working memory scores were entered to examine how these impacted memory recall scores controlling for condition and age. In the third step, epistemic and interpersonal trust were entered to examine whether these predictors explained additional variance in memory recall scores controlling for condition, age, and working memory. The results are shown in Table 4 and described below.

Novel Animal Facts: Short-Term Recall

The results are shown in Table 4. At Step 1, age accounted for significant unique variance in recall score ($\beta = 0.020$, $t(58) = 3.239$, $p = .001$). The overall Step 1 model was significant ($F(2,58) = 6.177$, $p = .003$) and accounted for 14% of the variance in recall score. Step 2 examined the contribution of working memory by including forward and backward word span scores. After controlling for condition and age, working memory marginally improved the model ($\Delta R^2 = 0.06$, $F(2) = 2.927$, $p = .06$, $R^2 = 0.20$). Specifically, backward working memory score was a significant predictor of recall score above and beyond condition and age ($\beta = 0.081$, $t(56) = 2.043$, $p = .04$). Step 3 examined the contribution of trust by including epistemic and interpersonal trust scores. Trust did not explain additional variance in recall score ($F(2) = 0.056$, $p = .945$).

Novel Animal Facts: Long-Term Recall

At Step 1, age accounted for significant unique variance in recall score ($\beta = 0.018$, $t(58) = 2.873$, $p = .005$). The overall Step 1 model was significant ($F(2,58) = 4.623$, $p = .013$) and accounted for 11% of the variance in recall score. Step 2 examined the contribution of working memory by including forward and backward word span scores. After controlling for condition and age, working memory significantly improved the model ($\Delta R^2 = 0.06$, $F(2) = 3.139$, $p = .051$, $R^2 = 0.17$). Specifically, backward working memory score was a significant predictor of recall score above and beyond condition and age ($\beta = 0.087$, $t(56) = 2.169$, $p = .034$). Step 3 examined the contribution of trust by including epistemic and interpersonal trust scores. Trust did not explain additional variance in recall score ($F(2) = 0.298$, $p = .743$).

Table 4. Hierarchical regression analysis predicting learning and memory.

	Step 1		Step 2		Step 3	
Predictor	Estimates	p	Estimates	p-value	Estimates	p
Short term animal fact score						
Intercept	−0.644	.045*	−0.493	0.118	−0.486	.160
Condition (High I, Low E)	−0.067	.236	−0.088	0.115	−0.091	.128
Age (months)	0.020	.001**	0.013	0.070	0.013	.076
Forward Word Span			0.029	0.408	0.033	.384
Backward Word Span			0.081	0.045*	0.083	.047*
Epistemic Trust					0.037	.852
Interpersonal Trust					−0.068	.749
Observations	61		61		61	
R^2/R^2 adjusted	0.176/0.147		0.256/0.203		0.258/0.175	
Long term animal fact score						
Intercept	−0.590	.068	−0.430	0.174	−0.371	.282
Condition (High I, Low E)	−0.047	.399	−0.069	0.218	−0.056	.350
Age (months)	0.0185	.005**	0.010	0.137	0.009	.181
Forward Word Span			0.026	0.457	0.023	.547
Backward Word Span			0.087	0.034*	0.083	.045*
Epistemic Trust					−0.151	.449
Interpersonal Trust					0.141	.507
Observations	61		61		61	
R^2/R^2 adjusted	0.137/0.108		0.226/0.171		0.235/0.150	
Short term object demonstration score						
Intercept	0.338	.517	0.092	0.864	0.357	.560
Condition (High I, Low E)	0.097	.240	0.086	0.300	0.123	.190
Age (months)	−0.002	.816	0.002	0.830	−0.001	.933
Forward Word Span			0.047	0.359	0.054	.342
Backward Word Span			−0.116	0.103	−0.113	.118
Epistemic Trust					−0.239	.463
Interpersonal Trust					0.079	.826
Observations	51		51		51	
R^2/R^2 adjusted	0.029/-0.012		0.088/0.009		0.107/-0.015	
Long term object demonstration score						
Intercept	−1.068	.021*	−1.205	0.011*	−1.036	.051*
Condition (High I, Low E)	0.099	.165	0.080	0.263	0.103	.202
Age (months)	0.025	.008**	0.025	0.017*	0.023	.037*
Forward Word Span			0.069	0.117	0.082	.097
Backward Word Span			−0.070	0.239	−0.067	.270
Epistemic Trust					−0.098	.726
Interpersonal Trust					−0.063	.837
Observations	49		49		49	
R^2/R^2 adjusted	0.185/0.149		0.239/0.170		0.253/0.146	

*$p<.05$, **$p<.01$, ***$p<.001$

Object Demonstration: Short-Term Recall

At Step 1, neither condition nor age accounted for significant unique variance in recall score. The overall Step 1 model was not significant ($F(2,48) = 0.713$, $p = .495$) and accounted for 0% of the variance in the overall demonstration recall score. Step 2 examined the contribution of working memory by including forward and backward word span scores. Working memory did not explain variance in recall score ($F(2) = 1.468$, $p = .241$). Step 3 examined the contribution of trust by including epistemic and interpersonal trust scores. Trust did not explain additional variance in recall score ($F(2) = 0.454$, $p = .638$).

Object Demonstration: Long-Term Recall

At Step 1, age accounted for significant unique variance in recall score ($\beta = 0.025$, $t(46) = 2.732$, $p = .008$). The overall Step 1 model was significant ($F(2,46) = 5.207$, $p = .009$) and accounted for 15% of the variance in recall score. Step 2 examined the contribution of working memory by including forward

and backward word span scores. Working memory did not explain variance in recall score ($F(2) =$ 1.538, $p = .226$). Step 3 examined the contribution of trust by including epistemic and interpersonal trust scores. Trust did not explain additional variance in recall score ($F(2) = 0.378$, $p = .687$).

Discussion

In Study 1, we examined how differences in an adult teacher's behavior during a short teaching session impacts children's epistemic and interpersonal trust, and whether trust is related to learning. Our experimental manipulation was expected to produce differences in children's epistemic and interpersonal trust assessments. We predicted that children would display higher levels of epistemic trust in the adult teacher in the High Epistemic, Low Interpersonal condition compared to those in the High Interpersonal, Low Epistemic condition. In line with this prediction, we found that children reported higher levels of epistemic trust in the adult in the High Epistemic, Low Interpersonal condition. We also expected that children would display higher levels of interpersonal trust in the adult teacher in the High Interpersonal, Low Epistemic condition compared to those in the High Epistemic, Low Interpersonal condition. Against this prediction, we found similar and consistently high levels of interpersonal trust in the adult teacher regardless of condition. One possibility for this is that our manipulation might have failed to create meaningful differences in interpersonal characteristics of teachers. Indeed, the cultivation of interpersonal trust might require more time and experience and in the current study we sought to make the interactions equal in duration across the two conditions. Alternatively, it may be that children find others to be interpersonally trustworthy in the absence of an overt interpersonal offense (e.g., broken promises, unfair treatment, failed commitments) (Pesch & Koenig, 2018). More work will be needed to better understand the specific behaviors or statements that impact different children's evaluations of teachers' interpersonal trustworthiness.

In addition to our novel assessment of children's epistemic and interpersonal trust in the adult teacher, established assessments of selective trust and resource allocation were administered. We examined selective trust by asking children to decide whether to update their initial judgment about the label of an animal or object using a series of hybrid pictures (Jaswal, 2004). Previous work using this task has found that preschoolers are less likely to defer to adults simply described as a teacher or a mother on 75/25 hybrid images (Ronfard et al., 2017), but are more likely to revise their judgments when the counterclaim is made by their own mother versus a stranger on both 50/50 and 75/25 hybrid images (K.H. Corriveau et al., 2009). We found that preschoolers were more likely to defer to the adult's claims on 50/50 hybrid images compared to 75/25 hybrid images in the High Interpersonal, Low Epistemic condition. That is, when the hybrid image was perceptually ambiguous, children updated their label to match the adult's more often in the High Interpersonal, Low Epistemic condition compared to those in the High Epistemic, Low Interpersonal condition. Thus, despite having weak epistemic behaviors during the teaching session, children were more willing to accept the adult's claims. Although preliminary, this suggests that children's willingness to accept claims made by other adults might be particularly responsive to the adult's attempts to establish interpersonal connections with the learner.

A different pattern emerged on our measure of resource allocation. In this task, children were given the option to share stickers with the adult teacher or to keep the stickers (Moore, 2009). We found that children were more likely to allocate stickers to the adult in the High Epistemic, Low Interpersonal condition compared to those in the High Interpersonal, Low Epistemic condition. One reason for this might be that children were sensitive to the adult's calibration – a trait which has been found to be important to children at this age (Suárez, 2019). Specifically, the adult teacher in the High Epistemic, Low Interpersonal condition clearly indicated having knowledge about the information and then provided it. Although the adult in the High Interpersonal, Low Epistemic condition was more engaged with the child, the adult indicated a lack of knowledge about the facts or object but then proceeded to

provide that information. This discontinuity might be reflected in children's decisions to allocate more resources to the more calibrated adult compared to the inconsistent adult. Taken together, the current work offers initial evidence that differences in adult behavior impact how children respond to decisions to revise claims and allocate resources. More work is needed to better understand children's reasoning behind these decisions, including specific aspects of the interactions driving their behaviors.

Lastly, we assessed children's learning using a memory recall assessment and examined whether trust was associated with this learning outcome. Children were asked to recall the facts that were taught to them and how to use the object immediately after the teaching session and again approximately 15 minutes later. We found that children recalled more facts and demonstrated more correct actions on the short-term assessment compared to the long-term assessment, and that 4-year-olds tended to recall more than 3-year-olds. Differences in memory recall were not attributable to condition. We examined how trust related to memory recall using hierarchical linear regression modeling. Backward word span was the only significant predictor to emerge on all models, including memory for the novel animal facts and how to use the object. Epistemic and interpersonal trust were not associated with learning in any of the models.

These results are consistent with work showing a strong relationship between executive function and academic outcomes (Diamond, 2012; McClelland et al., 2007). In particular, our learning measure required children to retain a set of facts and actions in memory and to respond to questions assessing their ability to recall and reproduce the actions at test. Thus, it is unsurprising that working memory capacity was related to performance on these assessments. There are several reasons why we found nonsignificant relations between trust and learning. With respect to our learning measure, we opted for a set of open-ended test questions which might have particularly taxed memory-related skills in ways that were impervious to considerations of trust. Other metrics to assess learning will be important to understanding how trust relates to different components of the learning process. For example, trust might not be directly implicated in a memory-recall assessment but could be indirectly related at other points of the learning process, such as attention to and engagement with the teacher or the materials during the teaching phase. It is also important to consider our measures of trust. Indeed, it is possible that our assessments of epistemic and interpersonal trust failed to capture the underlying constructs that they were designed to assess. Although both assessments had high internal consistency, more work is needed to establish psychometric support. Furthermore, the use of yes-no response items on our trust assessment yielded a yes-bias, which produced less variation in epistemic and interpersonal trust scores. We thus modified the trust assessments in Study 2 to a 3-point Likert Scale. Finally, it is possible that the interaction the child had with the adult was not enough to allow for a meaningful level of trust to develop. Although our goal was to create natural interactions, scripts were used to ensure children had consistent information about the adult teacher within each condition, and to ensure children had the opportunity to learn the same information across the two conditions. This might have created interactions that felt artificial to children. Further, the interactions averaged to 3-minutes, which may not have been enough time for children to develop trust in the adult. Study 2 responds to many of these limitations by examining children's epistemic and interpersonal trust in their preschool lead teacher and relations between trust and learning in an applied classroom context.

Study 2

Method

Ethics Statement

This study was approved by the Institutional Review Board. These data were collected between November 2019 and March 2020.

Participants

The sample included 43 children (25 girls and 18 boys) and 4 lead teachers recruited from four multi-age preschool classrooms at a university-based preschool. This sample size was determined based on the number of eligible children enrolled in the preschool where this research was conducted. Eligible children included those in our age range (3- to 5-years-old), whose primary language was English, and whose parents consented to their participation in this research study. Participating children were predominantly White, though other ethnic groups were represented in this sample. Teachers were all White and female. All teachers agreed to participate. A letter detailing the procedure and a short description of the study was sent home with families of children enrolled in the multi-age classes. Parents were given one week to opt their child out of the study.

Children were approached by a graduate research assistant during regular school hours and asked if they would like to participate. Approximately 10 children from each classroom participated at Time 1 (Range: 9– 10) and 8 children from each classroom participated at Time 2 (Range: 6– 10). A total of 40 children agreed to participate at Time 1 (Fall 2019) and 32 agreed to participate at Time 2 (Spring 2020). The data from 5 children at Time 1 were removed due to missing data (e.g., failure to complete assessments). Of the 32 children tested at Time 2, 3 had not been tested at Time 1 and 11 declined to participate again. The average number of days between the target group lesson and the individual testing session was approximately 20 days (Range: 3– 33 days) at Time 1 and approximately 6 days (Range: 4– 21 days) at Time 2. Despite this difference, average cued recall scores (collapsed across age and classroom) were nearly identical at both times points (55% and 56%, respectively).

Procedure

At each time point, participating lead teachers were videotaped leading a large group lesson on a topic of their choice. Teachers were given no direct instructions regarding how to lead the lesson and were informed that the material covered should be something new to the children. Memory recall questions were developed to assess children's learning. After the large group lesson, children were individually pulled from class for approximately 20 minutes and assessed by a graduate research assistant. At both time points, children were asked to respond to memory recall questions about the lesson. After the memory assessment, all children were asked to make epistemic and interpersonal trust judgments, selective learning decisions, and resource allocation decisions about their lead teacher. Finally, all children completed a word span task assessing forward and backward working memory.

Teaching and Memory Assessments. All children were asked a set of follow-up memory questions about the content taught during the lesson. Open-ended memory recall questions were written about the information taught in each target lesson. The recall questions were coded and scored 1 if the child answered correctly or 0 if the child answered incorrectly. Tables 5–6 detail the topic and memory questions for each classroom at both time points.

Trust Evaluations. The trust evaluation assessment was administered after the memory assessment. The questions were identical to those used in Study 1. A 3-point Likert Scale was used instead of yes/no questions. The scale was a laminated image of three cups ranging from empty, half full, to full. Children were told that they would be using the cups to tell the experimenter how much someone knows about different things [*Epistemic Trust Assessment*] or how often someone does different things [*Interpersonal Trust Assessment*]. Children were first introduced to the scale by completing three familiarization trials. In each, a stuffed animal was produced (e.g., a bear) and children were provided information about the animal's knowledge or prosocial behavior (e.g., "*bear knows everything/some things/nothing*" or "*bear always helps/sometimes helps/never helps*"). Children indicated which cup reflected the animal's epistemic or interpersonal status. Incorrect responses were corrected and explained. After familiarizing children to the scale, E produced

Table 5. Topic and cued recall questions for time 1 memory assessments.

Topic: Patterns
1. What is one really important thing about patterns? [Answer: Repeats]
2. When does a pattern end? [Answer: Never]
3. Do patterns have to be made with colors? [Answer: No]
4. What other things can we use to make patterns? [Answer: Shapes, music]
5. See this? Can you make a pattern with it? [Answer: Star, Square, Star, Square]
Topic: Germs
1. What does invisible mean? [Answer: You can't see it]
2. Are germs invisible? Why? [Answer: Yes. Because you can't see them]
3. What does fever mean? [Answer: When your body is too hot]
4. How do you get rid of germs? [Answer: Wash your hands]
5. What do we need to do when we wash our hands to keep germs away? [Answer: Soap, water, rinse off, dry them]
Topic: Winter clothing
1. What do you wear in the winter when you want to go outside? [Answer: Boots, Jacket, Scarf, Hat, Mittens, and Boots]
2. Your jacket covers this part (motion) of your body. What is this part of your body that your jacket covers called? [Answer: Torso]
3. What part of your body do each of these clothes cover? Hat: [Answer: Head]; Scarf: [Answer: Neck]; Pants: [Answer: Legs]
4. What is different about gloves and mittens? [Answer: fingers open vs fingers closed]
5. In what order should you put your winter clothes on? [Answer: Snow pants, boots, jacket, hat, mittens]
Topic: Hibernation and Migration
1. Some animals migrate in the winter. What does migrate mean? [Answer: Go south for the winter]
2. Which one of these animals migrates in the winter? (picture of goose/bear) [Answer: Goose]
3. Some animals hibernate in the winter. What does hibernate mean? [Answer: Sleep all winter]
4. Which one of these animals hibernates in the winter? (picture of goose/bear) [Answer: Bear]
5. When you see birds flying in a V shape in the sky, what does this mean they are doing? [Answer: Migrating]

Table 6. Topic and cued recall questions for each time 2 memory assessments.

Topic: Symmetry
1. What does symmetrical mean? [Answer: same on both sides]
2. Is this picture symmetrical or not symmetrical? Snowflake (Answer: Symmetrical); Dog (Answer: Not Symmetrical); Building (Answer: Symmetrical); Bug (Answer: Not Symmetrical)
3. What is the name of the line that is drawn down the middle? [Answer: Line of Symmetry]
4. How can we make this picture symmetrical? [Answer: Draw other half of a heart]
Topic: Hibernation
1. What does hibernation mean? [Answer: sleep in the winter]
2. Do all animals hibernate during the winter? [Answer: No]
3. What is a den? [A: Cave where animals sleep]
4. Do all large animals sleep in dens? [Answer: No]
5. Does this animal hibernate or stay awake during the winter? Answers: Snake (Hibernate), Bear (Hibernate), Deer (Awake), Wolf (Awake), Turtle (Hibernate), Snail (Awake)
6. When animals hibernate, how long do they sleep for? [Answer: The entire winter/All winter]
Topic: Properties of water
1. What is this [picture] called? [Answer: Ice cube tray]
2. What do you use it for? [Answer: to make ice]
3. How do you make ice with this? [Answer: fill it with ice and place in the freezer]
4. Why do you put it in the freezer? [Answer: so that it freezes]
5. What does the word freezing mean? [Answer: water turning to ice]
Topic: Pottery
1. What shape does a pinch pot start out as? [Answer: Ball/Circle]
2. What is another word that means ball/circle? [Answer: Sphere]
3. How many steps are there to make a pinch pot? [Answer: 3]
4. What is the first thing you do to make a pinch pot? [Answer: Roll into a ball]
5. What is the second step to make a pinch pot? [Answer: Poke a hole]
6. What is the third step to make a pinch pot? [Answer: Pinch all around]

a picture of the child's lead classroom teacher and stated, "Do you know who this is?" All children correctly identified the image as their teacher. Children were then told that they would be using the cups to show E how much their teacher knows about different things [*Epistemic*] or how often their teacher does different things [*Interpersonal*]. The order of presentation (epistemic vs. interpersonal) was counterbalanced across participants.

Selective Trust and Resource Allocation. Immediately after the trust assessment, the selective trust and resource allocation tasks were administered. They were identical to the assessments used in Study 1.

Working Memory. Forward and backward working memory was assessed using a word span task as in Study 1.

Results

Epistemic and Interpersonal Trust

At each time point, a score was calculated for each trust type by averaging across the 10-questions. Scores ranged from 0 to 2. A linear mixed effects regression was conducted in R Studio (2014) using the lme4 package (Bates, Maechker, Bolker & Walker, 2015). Trust score was entered as the dependent variable. We added fixed effects of trust type and time as well as the interaction between trust type and time. A random intercept with participants nested within classrooms was included. Significance was calculated using the lmerTest package, which applies Satterthwaite's method to generate *p*-values. There was a significant main effect of trust type ($F(1,91) = 11.878$, $p < .001$), confirming that interpersonal trust scores ($M = 1.44$, $SD = 0.38$) were significantly higher than epistemic trust scores ($M = 1.29$, $SD = 0.42$). Time was not significant ($F(1,100) = 0.0003$, $p = .986$) and the interaction between trust type and time was not significant ($F(1,91) = 1.704$, $p = .194$). The predicted values are shown in Figure 2.

Selective Trust

To explore differences in children's decisions to defer to their teacher's claims on the set of hybrid classification trials, we conducted a logistic mixed effects regression using the glmer function of the lme4 package. Deference decision (0: did not defer, 1: deferred) was entered as the outcome. Age (3-, 4-, 5-year-old), hybrid type (50/50 vs. 75/25), time (Fall vs. Spring), and their interactions were entered
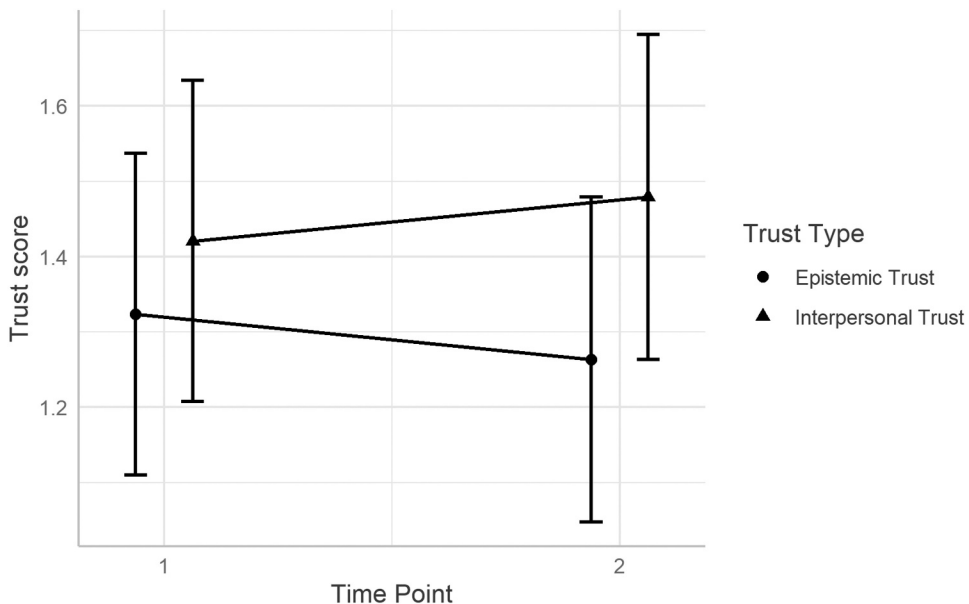

Figure 2. Predicted values of trust score by time point and trust type.

as predictors. A random intercept with participants nested within classrooms was included. There were no significant differences between the full model including interactions and the model without interactions, $x^2(7) = 7.403$, $p = .388$. Therefore, the reduced model is reported here. The model revealed a significant effect of hybrid type (β = −0.963, SE = 0.307, z = −3.135, $p = .001$). There were no other significant predictors. Children were more likely to defer to their teacher's label on 50/50 hybrid trials ($M = 0.48$, $SD = 0.50$) compared to 75/25 hybrid trials ($M = 0.32$, $SD = 0.46$).

Resource Allocation

To explore differences in children's decisions to allocate stickers to their teacher, we conducted a logistic mixed effects regression using the glmer function of the lme4 package in R. Allocation decision (0: did not allocate stickers, 1: allocated stickers) was entered as the outcome. Age (3-, 4-, 5-year-old), allocation type (prosocial vs. sharing), time (Fall vs. Spring), and their interactions were entered as predictors. A random intercept with participants nested within classrooms was included. There were no significant differences between the full model including interactions and the model without interactions, $x^2(7) = 8.682$, $p = .27$. Therefore, the reduced model is reported here. The model revealed a significant effect of allocation type (β = −0.682, SE = 0.266, z = −2.566, $p = .01$). Children were more likely to allocate resources to their teacher on prosocial trials ($M = 0.35$, $SD = 0.47$) compared to sharing trials ($M = 0.25$, $SD = 0.43$). There were no significant effects of age (year) or time ($ps > 0.09$).

Working Memory

Each child received two scores: one for their forward word span and the second for their backward word span. The scores indicate the child's highest level passed on each assessment type, which ranged from 1 to 5. A linear mixed effects regression was conducted with score as the outcome and age (year), condition, and span type (forward vs. backward) entered as predictors. A random intercept with participants nested within classrooms was included. Significance was calculated using the lmerTest package. There was a significant main effect of age ($F(1,91) = 11.878$, $p < .001$), confirming that span length increased with age. There was also a significant effect of span type ($F(1,100) = 0.0003$, $p = .986$), with higher forward span ($M = 3.66$, $SD = 0.87$) than backward span ($M = 1.56$, $SD = 0.76$). These findings are consistent with the literature on working memory with preschoolers.

Table 7. Results of linear mixed effects regression predicting learning and memory.

Predictor	ƃ	SE	t	p
Intercept	0.054	0.223	0.242	.810
Time (2)	−0.055	0.074	−0.744	.460
Age (Year)	0.115	0.059	1.946	.056
Forward Word Span	0.007	0.049	0.148	.883
Backward Word Span	0.091	0.053	1.730	.088
Epistemic Trust	−0.023	0.111	−0.206	.837
Interpersonal Trust	0.085	0.127	0.672	.504
Random Effects				
σ²	0.08			
τ00 Child/Classroom	0.00			
τ00 Classroom	0.01			
N Child	39			
N Classroom	4			
Observations	67			
Marginal R²	0.194			

Predictors of Learning

A recall score was calculated for each participant by summing the number of correct responses on the memory assessment and dividing by the number of questions asked. There were 5 questions per class at Time 1, and the number of questions ranged from 4 to 6 at Time 2. A linear mixed effects regression model was conducted to explore associations between recall score and dependent measures of interest. Recall score was entered as the outcome and age (year), time (1 vs 2), forward word span, backward word span, epistemic trust and interpersonal trust entered as predictors. A random intercept with participants nested within classrooms was included. The results are shown in Table 7. Age was a marginally significant predictor of recall score (β = 0.11, SE = 0.059, p = .056), indicating that children tended to recall more with age. There were no other significant predictors.

Discussion

In Study 2, we examined children's epistemic and interpersonal trust in their preschool-classroom lead teacher and explored how these distinct forms of trust relate to learning. We measured epistemic and interpersonal trust using the same two 10-item assessments from Study 1, modified to a 3-point Likert Scale to allow for more variation in responses. As in Study 1, we also examined children's decisions to defer to their teachers' labels on a set of hybrid classification questions and to share stickers. Learning was assessed using a memory recall assessment with open-ended questions tailored to a large group lesson taught by the child's lead classroom teacher. Working memory was examined using a word span task.

We corroborated many of our findings from Study 1. First, we found variation in children's extensions of epistemic trust and interpersonal trust. Specifically, children's epistemic trust was significantly lower compared to their interpersonal trust. This suggests that preschool-aged children might pay particular attention to the epistemic qualities of the adults they engage with and learn from. More work is needed to determine what specific components of a classroom environment or teacher behavior support or undermine children's epistemic trust. For example, observational tools could be used to document the types of epistemic behaviors or statements that teachers make in classrooms and examine how they relate to children's epistemic trust. Second, we found that children were more likely to revise their claims on a selective trust task on 50/50 hybrid trials compared to 75/25 hybrid trials. In Study 1, we suggested that this offered tentative evidence that interpersonal trust might be important to children's learning. The fact that children reported high levels of interpersonal trust in Study 2 offers further support for this claim. Third, we found that children were more likely to allocate resources to their lead teacher on prosocial trials compared to sharing trials. This aligns with previous research suggesting that children are more willing to allocate resources with familiar agents compared to strangers (Moore, 2009).

Finally, we found that neither form of trust was related to learning. There are different possibilities for this finding. Learning was contingent upon child attentiveness and ability to later recall the material taught during a large group lesson, which might have been easier for older children to accomplish. In future work, differences in learning should be explored by evaluating children's recall of material taught in both large and small group lessons. In addition, although teachers were asked to teach on a topic unfamiliar to the children, it is possible that some children were more familiar with the material than others. To address this limitation in future work, lessons and questions should be developed that are identical across a set of classrooms that parents and teachers have indicated are unfamiliar to students. Finally, it is possible that variation in teaching style might be attributable to children's learning. For example, some lessons were taught by reading a book aloud to the children, while other lessons involved teachers providing information with pictures or material objects. The lessons included varied levels of interactive exercises and differed in length depending on these exercises. Differences in teaching style and classroom dynamics are all likely related to children's learning, and it will take a larger sample and more work, including more careful coding of variation in

teacher behavior such as time spent in interaction with individual children, time spent reading books versus providing information with other materials, and time spent asking and answering questions, to fully examine the impact such differences have on trust and learning.

General Discussion

This work offers an initial step in translating empirical work on children's selective epistemic trust to more applied contexts, specifically in early childhood classrooms. Our findings build on work from developmental psychology, which has revealed that children selectively learn from agents based on a variety of epistemic and social characteristics, and from educational psychology, which finds that teacher-student relationships and trust impact academic achievement in school. Our translational approach, grounded in conceptual and empirical work across philosophy, economics, and psychology, led us to assess two types of trust – epistemic and interpersonal trust. By assessing these distinct types of trust, we were positioned to measure and understand the distinct role that trust plays in children's learning from adult teachers in applied learning situations.

Epistemic and Interpersonal Trust

The two studies reported here offer initial evidence for distinguishing and independently measuring epistemic and interpersonal trust. Specifically, in both quasi-experimental and quasi-longitudinal designs, we found that preschoolers' epistemic trust was more variable than their interpersonal trust. In Study 1, children displayed higher levels of epistemic trust in an adult who substantiated claims with references to knowledge compared to an adult who claimed to know little about the information that was taught. Likewise, in Study 2, children drawn from four different preschool-classrooms displayed lower levels of epistemic trust in their preschool-classroom lead teacher compared to interpersonal trust. In both studies, children reported having high levels of interpersonal trust in their teacher. This offers initial support for differentiating between these two types of trust – as it appears that they are independently variable. Further, this finding suggests that preschoolers may be aware of and attending to indicators of knowledge and expertise in adults around them, including their teachers, and work will need to continue to explore what behaviors support epistemic trust so that teachers are aware and can cultivate that with their students. Although it is difficult to determine what caused differences in epistemic trust, the script used in Study 1 suggests that certain differences might be attributed to statements about ignorance (e.g., "I don't know about that," "I've never seen it before") or lack of calibration (e.g., claiming ignorance, but then providing information). Indeed, in educational contexts, it is not uncommon for teachers working with young children to make claims about ignorance (even feigned ignorance) to stimulate learning. For example, a student who asks a teacher how something works or how to complete a new task might receive the reply, "I don't know, what do you think?" While such replies are typically intended to stimulate the child's own exploration in the learning process, it could be that these claims also reflect back on the epistemic status or quality of the teacher. More work is needed to better understand the impact of teacher behavior on children's epistemic and interpersonal trust, and whether this has implications on various decisions and outcomes for children.

Taken together, these results align with the existing body of research which has revealed preschoolers' proficiency at identifying epistemically trustworthy sources in testimonial learning decisions (Harris et al., 2018). Moreover, the sensitivity of our epistemic trust assessment to an adult's epistemic statements and behaviors is encouraging, as it corroborates the findings in the extant selective trust literature which has relied on the standard selective trust paradigm (M.A. Koenig & Harris, 2005). Our approach offers new directions for assessing epistemic and interpersonal trust in more applied contexts, like classrooms, without restricting researchers to an experimental manipulation of an agent's characteristics. In order to better understand how trust uniquely relates to children's learning in other contexts, we believe it worthwhile to independently measure trust and learning. This work provides a framework for future research investigating trust and learning. Moving forward, it

will be critical to obtain more psychometric support in our assessments of epistemic and interpersonal trust. With this, future work will be positioned to utilize these assessments in conjunction with other quantitative and qualitative measures to better understand features of interactions that support trust, and various outcomes that trust impacts in child development.

Trust and Learning

In both studies, we found that neither epistemic nor interpersonal trust were related to learning. The best predictors of learning were backward word span and age. Learning was assessed by asking children to respond to a set of open-ended recall questions (e.g., "Where does this animal live?," "When does a pattern end?"). Open-ended questions were used to allow for consistency across the two studies, and to allow for more variation in recall scores. However, the use of open-ended questions could have made it difficult for the younger children to respond accurately, leading to better recall with age and working memory capacity. Other metrics for assessing learning have been used in studies showing relationships between trust and academic achievement, including scores on standardized assessments (e.g., Woodcock-Johnson Test of Cognitive Abilities, Woodcock, 1977) or cognitive mechanisms that support learning, like task persistence, attention, and motivation (Coolahan et al., 2000; Fantuzzo et al., 2004). Thus, it is possible that epistemic and/or interpersonal trust are related to different measures of learning, beyond recall of content, that were not used in the work presented here. Another possibility is that trust plays a larger role in learning later in development. To this end, it will be important for future work to explore whether there is variation in children's epistemic and interpersonal trust in the elementary school years and how trust impacts learning at different ages. Additional metrics assessing learning will also be useful to determine whether trust impacts learning in general (e.g., a grade in a class) or learning of specific material (e.g., a classroom assignment).

Executive function, and specifically, working memory have been found to relate to learning in kindergarten (Fitzpatrick & Pagani, 2012), and in the current study, it was a significant predictor of learning in both studies. Indeed, this finding is supported by work showing that for preschoolers and kindergartners, EF is an important skill that can aid in children's learning because it allows them to self-regulate, inhibit disruptive behavior and focus on tasks at hand (Diamond, 2012). Nonetheless, although EF clearly plays an important role in children's abilities to learn in classroom settings, teacher quality also has powerful effects on the classroom environment. The current work suggests that teacher-behavior can impact children's trust as early as the preschool years. This finding, combined with recent theoretical accounts of EF suggesting that EF skills are utilized to serve different goals, depending on the context (Doebel,2020), highlights the unexplored possibility of a relation between trust, EF, and learning. Specifically, it is possible that varied levels of trust might impact children's use of their EF skills in the classroom, resulting in differences in academic achievement. In future work, this could be explored by examining whether trust mediates the relationship between EF and academic achievement or engagement.

Limitations

There are various limitations to the current investigation. Although we offer a new framework and tools for measuring epistemic and interpersonal trust, the validity of these assessments as measures of epistemic and interpersonal trust relies on further investigation. Specifically, a larger sample will be needed to conduct appropriate analyses (e.g., exploratory factor analysis) to determine whether these two dimensions of trust are in fact distinguishable. Relatedly, our sample in both studies included predominantly White preschoolers from highly resourced homes. This limits our ability to generalize these findings and requires that we ensure that our assessments of epistemic and interpersonal trust are culturally sensitive and appropriate for students from a range of racial, ethnic, and socioeconomic backgrounds. Careful attention to the types of questions included in these survey-instruments,

including feedback from parents, teachers, and students about the characteristics of others that play a role in their extensions of trust, will be crucial next steps to ensure that our assessments of student trust are culturally appropriate.

Conclusion

Together, these studies offer new directions for exploring children's trust and the impact that it has on learning. Grounded in abundant experimental work showing that preschoolers' epistemic and inter-personal trust can be moved based on agent characteristics, the studies carried out here sought to extend these ideas to an applied setting. The novel epistemic and interpersonal trust assessments used in these two studies offer one approach for measuring trust in classroom settings by asking children to evaluate how knowledgeable and how helpful an adult is across various scenarios and domains. In the current work, epistemic and interpersonal trust were differentiated, and epistemic trust was more flexibly extended. While these were not related to learning as measured in these studies, future work should explore associations between trust and learning by examining different age groups and by using different learning measures. Additionally, future work is needed to understand how different agents are evaluated (e.g., parents, strangers), to better substantiate the psychometric properties of the trust assessments with a larger, culturally, and economically diverse sample, and to explore more carefully the types of behaviors that are important to foster epistemic and interpersonal trust.

Disclosure Statement

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Appendix

Scripts for Study 1 teaching phase

<u>Condition 1: High Interpersonal, Low Epistemic</u>

Animal Facts

Sit next to child at table

Hi [child's name]
My name is [your name].
How are you today?
Welcome to the learning room!
I'm so excited to learn new things with you today!
Right now, we're going to learn about a new animal.
I've never seen the animal that we're going to learn about.
I don't know anything about it.
We're going to look at a picture of this animal.
Are you ready?!

Bring out picture and state facts
Thank you for listening!

Object Demonstration

You're doing a great job [child's name]!
I'm so excited to show you the next thing that we're going to learn about.
We're going to learn how to use a new toy.
I've never seen the toy that we're going to learn how to use.
I don't know how to use it.
Here it is!
Hmm, I think this is how you use it.

Actions
1. Touch RED object to nose
2. Place RED object in hole on bottom right
3. Rub left arm with YELLOW object
4. Place YELLOW object in hole on bottom left
5. Place GREEN on top of head
6. Place GREEN in center

Thank you for watching!
You did such a good job today [child's name]!
Now, I'm going to get someone else who's going to ask you some questions.

<u>Condition 2: High Epistemic, Low Interpersonal</u>

Animal Facts

***Stand** in front of child across table*

Hi.
My name is [RA name].
Today is [day of the week].
You are in the learning room.
You're going to learn new things today.
Right now, you're going to learn about a new animal.
I have seen the animal that you're going to learn about.
I know everything about it.
I'm going to show you a picture of this animal.

Do you understand?

Bring out picture and state facts
Those are the facts.

<div align="center">Object Demonstration</div>

Good.
Now you're going to learn the next thing.
I'm going to show you how to use a new toy.
I've seen the toy that you are going to use before.
I know everything about how to use it.
Here it is.
This is how you use it.

Actions
1. Touch RED object to nose
2. Place RED object in hole on bottom right
3. Rub left arm with YELLOW object
4. Place YELLOW object in hole on bottom left
5. Place GREEN on top of head
6. Place GREEN in center

That's how you use it.
Good.
Now, I'm going to get someone who is going to ask you some questions.