THE SOCIAL TRANSMISSION OF INFORMATION ABOUT MENTAL STATES: IMPLICATIONS FOR CHILDREN'S VISUOSPATIAL AND SOCIOEMOTIONAL LEARNING

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THE SOCIAL TRANSMISSION OF INFORMATION ABOUT MENTAL STATES: IMPLICATIONS FOR CHILDREN'S VISUOSPATIAL AND SOCIOEMOTIONAL LEARNING

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Across five studies, this dissertation explores the thesis that children are sensitive to information about others' mental states and that this sensitivity scaffolds their learning in both the physical (Chapter 1) and social (Chapters 2 and 3) domain. Chapter 1 explores the interplay between the physical and mental world during visuospatial learning. Although a 180° perspective presents the greatest visual disparity between teacher and learner, it may promote social perspective taking through face-to-face interaction and thus improve learning. Children (4-6 years) and young adults (18-27 years) observed a model open a puzzle box from a first-person (0°) or third-person (90° or 180°) perspective. Both children and adults who learned face-to-face at 180° were fastest to open the box and most likely to discover a novel solution, consistent with goal emulation. Chapter 2 explores children's utilization of a different type of mental state — verbally shared emotions (i.e., emotion talk) — when making social affiliative decisions and their sensitivity to valence and context. Five to 8-year-olds listened to two children describe their day and then indicated their social preferences. Children preferred a child who shared a happy experience over a neutral child and a neutral child over a child who shared a sad experience. However, when the sad experience was presented within the context of the COVID-19 pandemic, children's preference for the neutral child disappeared. Chapter 3 further explores emotion talk in childhood by examining children's developing beliefs about emotion talk. Five to 8-year-olds viewed stories in which characters did or did not engage in emotion talk. Then children guessed which story characters usually affiliated and answered questions about gender and emotion talk. Although girls' social inferences based on emotion talk stayed constant with age, boys became less likely to associate emotion talk and friendship with age. Additionally, children who believed boys "never" talk about feelings were less likely to infer that boys who talked about feelings were friends, demonstrating a link between gender beliefs and inferences. Together these findings offer new insights into how early in development children use others' invisible mental states to learn about the physical and social world.

BIOGRAPHICAL SKETCH

Ashley Ransom was born and raised in Arkansas. She graduated with her bachelor's degree in psychology from Hendrix College and then completed a master's degree in experimental psychology at the University of Arkansas. After finishing her master's degree, she spent time traveling and pursuing other interests. Eventually, she returned to academia and accepted a job as a lab manager at the University of Chicago. From Chicago, she moved on to the Ph.D. program in developmental psychology at Cornell University. In both her personal and professional life, Ashley values curiosity and exploration, which has led her to study a diverse range of topics including early word learning, linguistic essentialism, spatial development, imitation, and emotions.

Dedicated to everyone who is told, “you can’t”

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INTRODUCTION

Humans share information with one another, and this proclivity has played a crucial role in our success as a species (Boyd et al., 2011). The ability to learn from one another allows us to accumulate knowledge over time so that each generation does not need to rediscover the knowledge acquired by previous generations. Instead, knowledge is disseminated across generations via imitation. Children acquire culturally relevant information such as tool use (e.g., eating with a fork), social norms (e.g., shaking hands upon meeting), and educational skills (e.g., writing) from more experienced members of their society. In this way, imitation is both evolutionarily adaptive and a vehicle for cultural transmission. However, the information that we share with one another is varied. In addition to sharing information about the physical world, we also share information about our internal, mental world. For example, we might communicate our religious beliefs or food preferences to others. Thus, the social transmission of information can be broadly divided into two domains — information about the physical world and information about one's mental world. Here I focus on how information about invisible mental states impacts children's visuospatial and socioemotional learning. By looking beyond the visible physical world, we can better understand the complex ways in which humans share and acquire knowledge.

Imitation: Sharing Information About the Physical World

Although socially transmitted information can be broadly categorized as physical or mental, these two domains often interact. In fact, understanding mental states may actually facilitate the transmission of information about the physical world. Classic imitation research has focused on the physical side of imitation (i.e., learning to complete a visuospatial task), but imitation consists of two components: a model's (observable) actions and a model's (invisible) goal (Want & Harris, 2002). These two components of imitation correspond to two types of perspective taking — visual perspective taking and social perspective taking. Visual perspective taking helps us see *what* someone is doing in the physical world. Social perspective taking helps us know *why* they are doing it based on their invisible mental state. Both are essential for imitation. Even young children are sensitive to this interplay between the physical environment and mental states. After watching a model turn on a light with her head, the majority of 14-month-olds will imitate this unusual behavior when the model's hands are free but not when her hands are constrained, demonstrating that they are sensitive to the model's intentions (Gergely et al., 2002). Because imitation relies on more than simply seeing what another person is doing, we may be able to improve imitation by scaffolding social perspective taking. Two potential mechanisms for improving social perspective taking are providing pedagogical cues and fostering social affiliation.

Early in life, children learn that certain social behaviors (e.g., eye contact) signal important information and begin to attend to pedagogical cues such as child-directed speech, gesture, and eye gaze (Csibra & Gergely, 2009). These cues play a prominent role in learning and increase imitation in children. For example, eye gaze and verbal cuing increase imitation in infants (Brugger et al., 2007; Nielsen, 2006) and preschool children (Butler & Markman, 2012). Research on educational technology shows that infants have difficulty learning from non-social sources. Children learn more from live social interactions than from television, books, or apps, a finding referred to as the "transfer deficit" (Barr, 2013). For example, 12 to 25-month-olds watched a Baby Einstein video at home for six weeks that aimed to teach the children 30 words. At the end of the six weeks, children who watched the video did not know the words better than children in a control group who never watched the video (Richert et al., 2010). The transfer deficit is not caused by a complete inability to transfer information from a video to the real world. Two-year-olds will imitate a video model as much as a live model when the model provides pedagogical cues (Nielsen et al., 2008). Thus, the transfer deficit is not due to an inability to learn from a 2-dimensional source. Rather, it may be difficult for children to learn from sources that lack social support.

In addition to pedagogical cues, however, a social model offers the chance to connect with another person. Humans are social creatures, and belonging to a group was crucial for our evolutionary survival (Hare, 2017). Therefore, it is reasonable that humans would be socially motivated to imitate. In support of this hypothesis, both social ostracism (Over & Carpenter, 2009) and group membership increase imitation. Fourteen-month-olds (Buttelmann et al., 2013) and 4 and 5-year-olds (Kinzler et al., 2011) prefer to imitate native language speakers over foreign language speakers. Children's preference for in-group models even outweighs their preference for prosocial individuals. Surprisingly, children prefer to imitate an antisocial in-group member over a prosocial out-group member (Wilks et al., 2018). Imitation is intrinsically rewarding; humans enjoy imitating and being imitated. Children will reward someone who imitates them (Thelen et al., 1977), and preschoolers regulate their behavior to make it more likely that an experimenter will imitate them (Fouts et al., 1976).

Overimitation provides additional evidence that imitation can be socially motivated. Overimitation is the tendency to imitate actions that are unnecessary for achieving a goal. Because these behaviors are irrelevant to the goal, imitating these behaviors may be a way to signal affiliation with someone. Overimitation in children is not due to a lack of understanding causal relationships. Four-year-olds will imitate unnecessary actions when they know the actions are causally irrelevant (Yu & Kushnir, 2014) and when they have discovered a more efficient way to achieve the goal (Nielsen et al., 2012). Instead, children knowingly imitate unnecessary actions. While imitation clearly serves a learning function, we should not underestimate the social motivation to imitate.

Emotion Talk: Sharing Information About One's Mental World

Beyond sharing information about the physical environment, however, humans also share information about mental states. We routinely talk about our desires, beliefs, and emotions, and sharing information with others activates reward centers in the brain (Tamir et al., 2015). While imitation helps us acquire new behaviors and skills, talk about mental states helps us acquire epistemological knowledge and form social bonds. Emotions are internal experiences that can be divided according to two dimensions: valence (positive versus negative) and arousal (high versus low) (Russell & Barrett, 1999). Traditionally, emotion research has focused on the non-verbal communication of emotions (i.e., facial expressions), but humans also express emotions verbally and volitionally, a process known as "the social sharing of emotion" (Rimé et al., 2020) or, as I refer to it here, "emotion talk". Compared to the immense body of work on non-verbal emotional displays, emotion talk has been scientifically neglected. Unlike non-verbal emotional expressions that may reflect involuntary and automatic reactions to stimuli (Kret et al., 2020; Darwin, 1872), emotion talk is the deliberate sharing of an internal experience. Additionally, while non-verbal emotions largely communicate information about the present, emotion talk is more flexible. Through emotion talk, emotional events from the past are revisited, which allows us to experience emotions as more than distinct, temporary events (e.g., Ekman, 1992). In a sense, emotion talk makes emotional time travel possible. When we talk about past emotions, we can relive the feelings we experienced.

Emotions are a fundamental part of the human experience, and this is reflected in the frequency of emotion talk. Talking about emotions is common in everyday life. When asked to think of an emotional experience, the majority of adults (> 85%) reported sharing the experience at least once, and most shared the experience multiple times with different people (Rimé et al., 1991). Additionally, stronger emotions elicit more sharing (Rimé et al., 2020). While epistemic states are shared with anyone, emotions are more private mental states that are most often shared with a close friend, spouse/partner, or family member (Rimé et al., 1991). Individuals engage in emotion talk for a variety of reasons, but the most frequently reported motives are venting, seeking advice, seeking empathy/comfort, and warning the listener (Nils & Rimé, 2012). Additionally, talking about our emotions helps us regulate our emotions (Brans et al., 2013), and plays a key role in the formation and maintenance of social relationships (Laurenceau et al., 1998).

Humans share both positive and negative emotional events with one another (Rimé, 2009), but sharing positive emotions generally leads to more favorable outcomes. On Facebook, people gain more satisfaction from sharing positive emotions than negative emotions (Bazarova et al., 2015). Adults like strangers who share positive information more than those who share negative information (Gilbert & Horenstein, 1975), and view positive emotion sharers as more competent (Miller et al., 1992). Sharing positive emotions often produces positive feelings in the sharer (capitalization), while sharing negative emotions often produces negative feelings in the sharer (emotional reactivation) (Rimé et al., 2020; Choi & Toma, 2014).

Nonetheless, sharing negative emotions results in better outcomes than suppressing negative emotions (Cameron & Overall, 2018), and sharing negative emotions is associated with positive friendships in adolescence (Rose, 2002). Sharing negative emotions can also increase interpersonal liking by creating a sense of vulnerability, a finding known as the “beautiful mess effect” (Bruk et al., 2018). Additionally, the listener’s response shapes the outcome of sharing negative emotions (Levy-Gigi & Shmay-Tsoory, 2017; Batenburg & Das, 2014; Nils & Rimé, 2012). When a listener helps the sharer reframe a negative emotional experience, this reduces the sharer’s negative affect (Nils & Rimé, 2012). In contrast, a purely empathetic response, without cognitive reframing, generally does not reduce negative affect in the sharer (Batenburg & Das, 2014). The listener’s response also shapes the outcome of sharing positive emotions. When the listener responds positively to the event, then this enhances the sharer’s positive affect (Hovasapian & Levine, 2018).

Though it might seem that emotion talk would be more important for the sharer than the listener, emotion talk is an interpersonal process that affects both the listener and the sharer. In fact, listeners report more liking for sharers than vice versa, but reciprocal sharing leads to the greatest levels of liking in social dyads (Sprecher et al., 2013). For both positive and negative emotional events, social bonding is the most commonly reported motive for listening to emotion talk (Delelis & Christophe, 2016). According to the “belongingness hypothesis”, a desire to belong is the primary reason that humans listen to emotional talk (Hackenbracht & Gasper, 2013). In support of this hypothesis, social exclusion in adults increases the desire to listen to emotional self-disclosure but not non-emotional self-disclosure (Hackenbracht & Gasper, 2013).

Research on the social sharing of emotion has focused almost exclusively on adults and adolescents, but studies on language development offer some insights into early emotion talk. Before children can engage in emotion talk, they must acquire the appropriate linguistic skills to express their emotions verbally. Infants begin to use basic emotion words to refer to both their own and others’ affective states as early as 18 months (Bretherton et al., 1986), and production of emotion words continues to increase throughout childhood (Grosse et al., 2021). In comparison, children's use of belief-words (e.g., "think") emerges slowly during the third year of life (Bartsch & Wellman, 1995), suggesting that emotion talk may be more important for human social communication than talk about other mental states. Furthermore, some findings suggest that children's ability to talk about emotions is associated with positive outcomes. Preschoolers who use more emotion words during peer interactions are more popular with their peers (Fabes et al., 2001), and 4 to 9-year-olds' emotion vocabulary is positively associated with emotion regulation skills (Streubel et al., 2020). Unlike the non-verbal expression of emotion, children must learn to represent their mental states with language before they can engage in emotion talk with others.

Overview of Dissertation Chapters

In three manuscripts, I examine the thesis that children are sensitive to invisible mental states and that this sensitivity scaffolds children's learning in both the physical and social domain. The first manuscript (Chapter 1) examines the transmission of visuospatial information through imitation in both children and adults, while the last two manuscripts (Chapters 2 and 3) examine the transmission of socioemotional information through emotion talk in children. Chapter 1 focuses on the interplay between the physical and mental world during the social transmission of information. In a study with adults and children, it investigates how visual versus social perspective taking regulates imitation and goal emulation during social learning. Chapter 2 presents some of the first studies to systematically examine the social utility of emotion talk in childhood. Specifically, these studies look at children's use of emotion talk in the context of making social affiliative choices. Taking inspiration from research on metacognition, Chapter 3 explores children's meta-emotional development and the role of emotion talk in making social inferences about others. Additionally, Chapter 3 looks at children's developing beliefs about gender and emotion talk. Although each chapter focuses on a distinct facet of social communication in young children, together they provide important insights into how children acquire, think about, and use information about others' mental states during visuospatial and socioemotional learning.

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CHAPTER 1: FACE-TO-FACE LEARNING ENHANCES THE SOCIAL TRANSMISSION OF INFORMATION

Ransom, A., LaGrant, B., Spiteri, A., Kushnir, T., Anderson, A. K., & De Rosa, E. (2022). Face-to-face learning enhances the social transmission of information. *PLOS One, 17.* doi: 10.1371/journal.pone.0264250

Abstract

Learning from others provides the foundation for culture and the advancement of knowledge. Learning a new visuospatial skill from others represents a specific challenge — overcoming differences in perspective so that we understand what someone is doing and why they are doing it. The "what" of visuospatial learning is thought to be easiest from a shared 0° first-person perspective and most difficult from a 180° third-person perspective. However, the visual disparity at 180° promotes face-to-face interaction, which may enhance learning by scaffolding social perspective taking, the "why" of visuospatial learning. We tested these potentially conflicting hypotheses in child and young adult learners. Thirty-six children (4 - 6 years) and 57 young adults (18 - 27 years) observed a live model open a puzzle box from a first-person (0°) or third-person (90° or 180°) perspective. The puzzle box had multiple solutions, only one of which was modelled, which allowed for the assessment of imitation and goal emulation. Participants had three attempts to open the puzzle box from the model's perspective. While first-person (0°) observation increased imitation relative to a 180° third-person perspective, the 180° observers opened the puzzle box most readily (i.e., fastest). Although both age groups were excellent imitators and able to take the model's perspective, adults were more faithful imitators, and children were more likely to innovate a new solution. A shared visual perspective increased imitation, but a shared mental perspective promoted goal achievement and the social

transmission of innovation.

"Perfection of means and confusion of goals — in my opinion — seem to characterize our age" Einstein (1973) pg 337, Ideas and Opinions

Introduction

Learning from others is the foundation of culture and cumulative knowledge (Boyd et al., 2011) but also represents a physical conundrum. Visuospatial learning requires us to “see” the world as another does, which necessitates a deviation from an egocentric perspective. In some of the earliest work on social learning, Thorndike (1898) noted that learning involves the transformation of a model’s actions (allocentric) to fit the observer’s (egocentric) perspective, which utilizes visual perspective taking (VPT). Yet, observation is insufficient for learning. Social learning also requires an understanding of a model’s intentions and goals, which utilizes social perspective taking (SPT). Early in life, humans are discerning learners who utilize SPT to increase the efficiency of social learning (Gergely et al., 2002; Carpenter et al., 1998). VPT allows an observer to see *what* a model is doing. SPT allows the observer to know *why* the model is doing it. In this way, VPT and SPT work in tandem to support learning. Beyond literally seeing the world through another’s eyes, successful learning requires that we understand another’s mental perspective. Here we examined the potential interplay between visual and social perspective taking when learning to solve a complex visuospatial problem with multiple solutions, and further, how they integrate and exploit initial observational learning into self-guided exploration (Geana et al., 2016).

When learning a new visuospatial skill, such as how to tie a knot or play an instrument, an observer embodies the model’s external experience of the world. This visual perspective taking consists of two levels that develop sequentially and provide complementary information

(Flavell et al., 1981; Flavell et al., 1978; Masangkay et al., 1974). Level 1 is the ability to discern whether another person can see an object and is fully developed by 2-years (Moll & Tomasello, 2006; Flavell et al., 1978). Level 2 is the ability to discern how an object appears to another person (e.g., object orientation) and develops during the preschool years (Flavell et al., 1981; Masangkay et al., 1974). Here we examined young adult and child learners to consider how Level 2 VPT impacts the social transmission of visuospatial knowledge across development.

In our daily lives, we routinely interact with others from multiple viewpoints, and these changes in viewpoint alter the difficulty of VPT. VPT utilizes mental rotation, which increases in difficulty as angle of rotation increases (Shepard & Metzler, 1971). Accordingly, visuospatial learning should be most difficult from observational viewpoints that necessitate mental rotation. Even more than a first-person versus third-person distinction, the magnitude of disparity between model and observer is crucial during learning. Prior studies found that imitation of specific actions is faster when seen from a 0° viewpoint compared to a 180° viewpoint (Fiorella et al., 2017; Watanabe et al., 2013; Jackson et al., 2006). Thus, observational viewpoint becomes a critical structural constraint on learning, particularly when the objective is fidelity in copying specific actions. Examining a shared first-person perspective (0° viewpoint) versus third-person perspectives differing in angular disparity (90° and 180° viewpoints) affords an examination of the role of mental rotation in observational learning.

Beyond a model's external experience of the world, learning also requires the observer to understand a model's internal experience of the world. Understanding a model's intentions (Tomasello, 1996) and goals (Gergely et al., 2002) promotes social learning. Rather than imitating all actions, SPT helps the learner discern a model's inner state and thus supports learning of goals. Even young children use SPT to imitate intentional but not accidental actions

(Carpenter et al., 1998). While VPT is more difficult from a 180° relative to a 90° viewpoint, and most difficult relative to a 0° viewpoint, a 180° viewpoint allows for face-to-face interaction, which may scaffold SPT. Face-to-face interaction improves communication (Argyle et al., 1968; Sumby & Pollack, 1954), encourages social affiliation (Argyle et al., 1968), and heightens visibility of the mouth and eyes, which facilitate the comprehension of mental states (Lee & Anderson, 2017; Back et al., 2009). In a learning context, face-to-face interaction may bolster attention to social cues that support learning such as eye contact, eye gaze, and smiling (Butler & Markman, 2012; Brugger et al., 2007; Nielsen, 2006). If SPT plays an important role in the social transmission of complex visuospatial knowledge, there may be a nonlinear relationship between model-observer viewpoint disparity and learning. Viewpoint disparity that enhances SPT (i.e., a 180° viewpoint) may actually facilitate the social transfer of knowledge.

Past studies on observational viewpoint and visuospatial learning relied on asocial models (e.g., Watanabe, et al., 2013; Jackson, et al., 2006). In these studies, participants watched a video of a model and then imitated the model's motor actions (e.g., simple hand movements). Only the model's hands were visible, and the model never interacted with participants. Although the research we present here was informed by this literature, we moved away from these paradigms by examining visuospatial learning from a live, highly visible model. Furthermore, more than strict imitation, we examined the social transmission of real world "know-how" towards solving a complex visuospatial problem, a puzzle box. Beyond mimicking a model's actions, we were interested in how viewpoint influences achievement of a goal (solving the puzzle box). We hypothesized that the social affordances of face-to-face learning may be powerful enough to reverse the difficulties of visual perspective taking so that visuospatial learning becomes easiest at a 180° viewpoint, promoting goal accomplishment. As such, the difficulties of third-person learning will be mitigated by face-to-face observation, with a 180° viewpoint resulting in greater puzzle opening ability than a 90° observational viewpoint, and potentially rivaling a 0° first-person viewpoint.

We examined how face-to-face learning affects the social transmission of visuospatial information between an observer and a model. Based on studies of observational learning in non-human primates and young children (e.g., Whiten, 2017), we employed a puzzle box. Puzzle boxes are complex visuospatial tasks that, although artificial, are ecologically relevant as they capture individual differences in the social transmission of learning (Rawlings, Flynn, & Kendal, 2021). We utilized a type of puzzle box known as an artificial fruit box because they are analogous to a fruit that one must learn to open. Artificial fruit boxes have been used to study social learning in humans and non-human primates (Flynn & Whiten, 2008; Whiten, Custance, Gomez, Teixidor, & Bard, 1996). They have multiple solutions, but all involve a sequence of hierarchical actions. As such, the puzzle box affords joint examination of imitation of the model's actions and exploration of new solutions discovered by the observer from their own experience.

We examined children's and adults' tendency towards strict imitation versus innovation, i.e., solving the puzzle box using a repertoire of the model's actions in a new order. A potent individual difference is age, which reflects both the amount of formal education as well as experience with visual and social perspective taking. We examined 4 to 6-years-olds; children of this age have just begun formal education and have developed Level 2 VPT (Flavell et al., 1981; Masangkay et al., 1974), which is a prerequisite for performance on our social learning task. Additionally, children of this age have developed theory of mind, which supports SPT (Baron-Cohen, Leslie, & Frith, 1985). The young adults in our study were expected to be better at mental rotation (Kail, 1985; Childs & Polich, 1979), had more years of formal education, and presumably had more advanced skills that support social learning than the children. As such, this afforded an examination and potential generalization of our results across both expert and novice learners.

Observers watched a live model open a puzzle box from a 0° , 90°, or 180° viewpoint before attempting to open the box from the model's perspective at 0°. The model performed both necessary and causally unnecessary actions when opening the puzzle box. Using the model's sequence of actions to open the puzzle box was an index of imitation. We added unnecessary actions as an additional measure of imitation fidelity. There is evidence from prior studies that both children and adults will overimitate, or "blindly" copy, actions that are causally irrelevant to task success (see Hoehl et al., 2019 for a review). Coding of these unnecessary "flourishes" that were causally unrelated to the solution was taken as a measure of overimitation. To index puzzle solving efficiency independent of success in opening the box, which would likely be at ceiling level for adults, we measured how long it took to open the puzzle box. To examine the maintenance of observational learning and its evolution over time, we measured participants' puzzle box solutions across three trials following initial observation of the model. Finally, as a novel measure of implicit perspective taking, we allowed participants to choose where to sit after the model demonstration. If participants in the 90° and 180° conditions took an egocentric rather than allocentric perspective, then they should choose their original seat over the model's seat. This behavior would indicate a preference for emulation rather than imitation of the precise actions of the model.

Method

Participants

Ninety-three participants (young adults, n = 57; children, n = 36) were tested over the course of an academic semester. An additional eight participants were excluded because of experimenter error or study incompletion. The adult participants were university students (18 to 27 years; $M = 19.91_{years}$, SD = 1.61) who received course credit for participation. The child participants were 4 to 6-year-olds ($M = 4.75_{years}$, SD = 0.81) who participated at a science museum or preschool. Children received a small prize (stickers or toy) for their participation.

Adult participants provided written consent. Child participants gave oral assent, and a parent/guardian provided written consent. The study protocol was approved by the university institutional review board and met recognized ethical guidelines.

Materials

Prior to the study, adults completed the Autism-Spectrum Quotient Test (AQ-Adult), which quantifies level of autistic traits in adults (Baron-Cohen et al., 2001). This was an exploratory covariate assessing potential individual differences in SPT. Difficulty with SPT is well-documented among individuals with Autism Spectrum Disorder (ASD) (Kimhi, 2014; Baron-Cohen et al., 1997), and deficit in imitation is a quintessential feature of ASD (Bottema-Beutel et al., 2019). Parents completed the Autism-Spectrum Quotient Test: Children's Version (AQ-Child; Auyeung et al., 2008), which quantifies level of autistic traits in children. The AQ-Child items are identical to the AQ-Adult items.

Apparatus

The social learning task utilized a colorful puzzle box (similar to Horner & Whiten, 2005). The puzzle box hierarchy contained four layers with each subsequent layer accessed by opening the previous layer. Layer 1 was opened by removing three bolts. Layer 2 was opened by removing three panels. Layer 3 was opened by moving three sliders. Layer 4 was opened by using the bolts to turn three screws. The layers could be opened in a horizontal sequence — a row-wise strategy — or in a vertical sequence — a column-wise strategy (Figure 1).

Procedure

Participants were tested individually in a quiet room.

Observation phase

Participants were randomly assigned to watch a model open the puzzle box from a 0° viewpoint (n = 32; 20 adults, 12 children), a 90° viewpoint (n = 31; 19 adults, 12 children), or a 180° viewpoint (n = 30; 18 adults, 12 children) (Figure 2). We utilized four models during the course of the study. All were in their early twenties; two models were men and two were women. The puzzle box was placed on a table, and the model sat facing the front of the puzzle box. Participants in the 0° condition sat next to the model. Participants in the 90° condition sat perpendicular to the model. Participants in the 180° condition sat across from the model. The model's actions were clearly visible from every viewpoint. The research sessions were video recorded from three angles corresponding to these three viewpoints (behind the participant, perpendicular to the participant, across from the participant) for later behavioral coding.

Participants were told to watch carefully because they would open the puzzle box later. The model opened the puzzle box by performing 12 necessary actions — each of the four layers was opened by performing three actions (Figure 1). The model opened the first three layers using only their hands, while the fourth layer required a switch to tool use (using bolts to turn screws). In addition to these 12 necessary actions, the model performed 14 causally unnecessary actions when opening the puzzle box (e.g., tapping a bolt against the box) so that we could measure overimitation (Table 1). The model opened the puzzle box with a row-wise strategy and moving from left to right. Adults watched the model demonstration once, and children watched the model demonstration twice.

Pre-test seat choice

Once the model completed the demonstration, participants left the room while an experimenter prepared for the test trials. When participants re-entered, they were allowed to choose their seat upon returning to the test table. They could choose to sit facing the front of the puzzle box (0° viewpoint), the side of the puzzle box (90° viewpoint), or the back of the puzzle box (180° viewpoint). This served as a measure of viewpoint preference. If the participant did not choose the 0° viewpoint, then the puzzle box was turned so that it was facing the participant for the test trials. All participants were tested opening the puzzle box from the 0° viewpoint (i.e., the model's perspective).

Test phase

Participants received three opportunities to open the puzzle box, which comprised three test trials. If a participant was unable to open the puzzle box, then an experimenter reset the puzzle box and initiated the next trial.

Results

Behavioral coding

From the video recordings, an experimenter, blind to condition, coded participants' seat choice before beginning the test trials and the specific actions performed when opening the puzzle box on each trial. We used this coding to calculate four dependent variables — the number of layers opened as an index of accuracy, puzzle box solution type as an index of imitation of the model's solution, time to opening the puzzle box as an index of learning, and the proportion of unnecessary actions performed as an index of overimitation. If a participant opened the puzzle box the way the model demonstrated (row-wise and left-to-right), then this was coded as the model's solution. If a participant opened the puzzle box using a different method, then this was coded as a novel solution. We measured how long participants took to open the puzzle box in two ways. First, we measured time spent on each trial, which was defined as the number of seconds from touching the first piece of Layer 1 to the last piece of Layer 4. Second, as a more granular measure of intra-puzzle progress, we measured how long participants took to open each puzzle box layer, which was defined as the number of seconds from touching the first piece of the layer to the last piece of the layer. A second experimenter coded 20% of participants. Interrater reliability was high with intraclass correlations greater than .85 for each of the variables (layers opened, puzzle box solution, time by trial, time by layer, unnecessary actions).

Individual differences in SPT

We calculated a percentage score for the AQ because some participants and parents did not answer all of the AQ items. Higher scores were used to index lower levels of SPT. Adult scores ranged from 20.67 to 57.33 with an average of 40.73 (*SD* = 8.72). Child scores ranged from 14.29 to 62 with an average of 37.16 (*SD* = 10.24). None of the participants had a score of clinical significance (a score of 64+).

A one-way ANOVA revealed no significant difference in AQ scores across viewpoint conditions, $p = .48$. As such, there was sufficient randomization of perspective taking traits across between-subject factors. Further, AQ scores did not account for a significant portion of variation in performance, all p's > .05. Thus, it was not explored as a factor of interest but was controlled for in all analyses.

Analysis plan

We examined various facets of performance on the puzzle box task including 1) proportion of layers opened (success), 2) proportion of layers opened using the model's solution (imitation), 3) proportion of model's unnecessary actions performed (overimitation), 4) time to open the puzzle box on each trial, 5) time to open each puzzle box layer. For each dependent variable, we conducted the same mixed model ANCOVA with trial (Trial 1, Trial 2, Trial 3) as a within-subjects variable, viewpoint (0° condition, 90° condition, 180° condition) during initial observation as a between-subjects variable, age group (adults, children) as a between-subjects variable, and SPT individual differences as a covariate. We tested for interactions between trial, viewpoint, age group, and SPT, and significant interactions were included in the model. We further examined time to open the puzzle box and unnecessary actions with a mixed model ANCOVA that included puzzle box layer (Layer 1, Layer 2, Layer 3, Layer 4) in place of trial. We included unnecessary actions as a covariate on the time analyses since performing these additional actions contributed to how quickly the box was opened.

Ten trials out of a total of 279 trials were excluded from the analysis because the experimenter did not reset the puzzle box completely (n = 2) or the participant chose to skip the trial (n = 8).

To examine viewpoint preference for opening the puzzle box, after initial observation of the model, we also examined whether participants chose the model's seat, observer's seat (their original seat), or novel seat before beginning the test trials. We did not include the 0° condition in this analysis because the model's seat and observer's seat were in the same orientation.

Power analysis

We conducted a post hoc power analysis using the “simr” package in R, which calculates observed power through Monte Carlo simulations. We calculated observed power for the main effect of viewpoint on time to open the puzzle box because this index of learning was the focus of our study. The observed power for time to open the puzzle box across trials was 80.90% with an alpha level of .05.

Puzzle box success

Adults and children were successful at solving the puzzle box. As a measure of accuracy, we examined the number of puzzle box layers that participants successfully opened. There was a main effect of age group, $F(1, 88.44) = 7.91$, $p = .006$, $\eta_p^2 = .08$ (Figure 3a). Adults ($M = 3.99$ out of 4 layers, $SD = 0.15$) successfully opened more puzzle box layers than children ($M = 3.76$ out of 4 layers, $SD = 0.58$), 95% CI[0.07, 0.39]. There was no main effect of trial, $p = .93$, or viewpoint condition, $p = .44$. Adults were at near perfect performance on all trials, while child performance was best on the final trial.

Puzzle box solution

As a measure of imitation, we examined the proportion of layers on which participants used the model’s solution when opening the puzzle box. There was a main effect of trial, $F(2, 175.64) = 7.37$, $p < .001$, $\eta_p^2 = .08$. Imitation of the model was greatest on the first attempt after observation and decreased with practice solving the puzzle box. Participants used the model’s solution more often on Trial 1 ($M = .80$, $SD = .28$) than on Trial 2 ($M = .72$, $SD = .34$), 95% CI[.02, .13], $p = .007$, or Trial 3 ($M = .70$, $SD = .35$), 95% CI[.05, .17], $p < .001$. There was no significant difference between Trial 2 and Trial 3, $p = .29$.

There was a main effect of viewpoint, $F(2, 87.83) = 4.04$, $p = .02$, $\eta_p^2 = .09$ (Figure 4). Replicating prior results, imitation of actions was greatest when the participant shared the model's perspective. The first-person 0° condition ($M = .81$, $SD = .28$) used the model's solution more often than the 180° condition ($M = .64$, $SD = .33$), 95% CI[.05, .30], $p = .007$. The 90° condition ($M = .77$, SD = .34) used the model's solution marginally more often than the 180° condition, 95% CI[.005, .24], $p = .06$. There was no significant difference between the 0° condition and the 90° condition, $p = .39$. More than a first-person versus third-person perspective, increased observer-model viewpoint disparity resulted in decreased imitation.

There was a main effect of age group, $F(1, 89.05) = 31.40$, $p < .001$, $\eta_p^2 = .26$. Adults ($M = .85$, $SD = .28$) were much more likely to imitate the model's solution than children ($M = .56$, $SD = .31$), 95% CI[.19, .40], $p < .001$. Compared to adults, children were more likely to use a novel solution when solving the puzzle. When the observer shared the model's vantage point during learning, this resulted in the greatest imitation of the model's solution, while face-to-face learning resulted in the least imitation. Practice opening the puzzle box resulted in decreased imitation of the model's solution.

Allocentric vs egocentric reference frame in imitation

As a more detailed analysis, we further explored participants' solutions by examining the use of egocentric third-person (mirror reversed at 180°) or allocentric first-person motor actions (as observed at 0°), indexed by the direction in which they opened the puzzle box. The model demonstrated opening the puzzle box moving from left-to-right, which would appear mirror reversed, as right-to-left, for participants in the 180° condition. If these participants took the model's visual perspective, then they should reverse their observed actions, opening the box from left-to-right. If, instead, they took an egocentric perspective, then they should open it from right-to-left.

Observers opened the majority of layers using allocentric model-based coordinates, moving from left-to-right (*M* = 73% of layers, *SD* = 29%). There was a main effect of viewpoint, $F(2, 87.87) = 3.53$, $p = .03$, $\eta_p^2 = .07$. Participants in the 180° condition (*M* = .14, *SD* = .22) opened a higher proportion of layers from an egocentric right-to-left fashion than those in the 0° condition (*M* = .03, *SD* = .12), *p* = 01, 95% CI[.03, .19]. There was no significant difference between the 90° condition (*M* = .08, *SD* = .22) and the 180° condition, *p* = 23, or the 0° condition, *p* = .15.

There was a main effect of age group, $F(1, 88.91) = 13.91$, $p < .001$, $\eta_p^2 = .14$. Children (*M* = .17, *SD* = .27) opened a higher proportion of layers from right-to-left than did adults (*M* = .03, *SD* = .12), 95% CI[.06, .20]. There was no main effect of trial, *p* = .75.

On the majority of trials, observers transformed their third-person viewpoint into allocentric coordinates, preferring to use the model's precise actions. Nonetheless, children and face-to-face learners were more likely to use other coordinates when solving the puzzle box compared to other participants.

Unnecessary actions

As a measure of overimitation, we examined the proportion of unnecessary model actions that participants performed on each trial and on each puzzle box layer.

By trial. There was a significant effect of trial, $F(2, 174.80) = 9.00$, $p < .001$, $\eta_p^2 = .09$. Participants performed more unnecessary actions on their first attempt at opening the puzzle box, on Trial 1 (*M* = .46, *SD* = .25), than on Trial 2 (*M* = .40, *SD* = .23), 95% CI[.02, .09], *p* = .005, or Trial 3 (*M* = .38, *SD* = .25), 95% CI[.04, .11], *p* < .001. There was no difference between unnecessary actions on Trial 2 and Trial 3, $p = .17$. There was no main effect of viewpoint, $p = .67$, or age group, $p = .31$.

By puzzle box layer. There was a significant effect of layer, $F(3, 268.55) = 13.23$, $p < .001$, $\eta_p^2 = .13$. Participants performed fewer unnecessary actions as they progressed through the layers of the puzzle box. There was no main effect of age group, $p = .28$, but there was an interaction between layer and age group, $F(3, 268.55) = 3.00$, $p = .03$, $\eta_p^2 = .03$. Adults ($M = .58$, $SD = .35$) performed more unnecessary actions on the first layer than children ($M = .43$, $SD = .35$), 95% CI[.008, .29], $p = .04$. There was no main effect of viewpoint, $p = .68$.

There were high levels of imitation of the model's actions even when those actions had no functional utility. Overimitation was greatest on the first attempt and first layer of the box, consistent with a primacy effect. However, this was not influenced by viewpoint.

Time to puzzle solution

Success in opening the puzzle box was near perfect in adults. To assess learning efficiency, we examined how quickly participants were able to open the puzzle box on each trial and each puzzle box layer. Five participants were excluded from trial analysis because they never completed Layer 4 and so failed to open the box.

By trial. There was a main effect of trial, $F(2, 164.96) = 23.35$, $p < .001$, $\eta_p^2 = .22$. Consistent with learning, time to open the puzzle box decreased linearly with repeated practice. Participants were faster on Trial 3 ($M = 49.62_{\text{seconds}}$, $SD = 26.54$) than on Trial 1 ($M = 67.25_{\text{seconds}}$, $SD = 23.09$), 95% CI[12.69, 23.20], p < .001, or Trial 2 ($M = 56.37_{\text{seconds}}$, $SD = 25.73$), 95% CI[1.62, 12.00], $p = .01$. Participants were faster on Trial 2 than on Trial 1, 95% CI[5.96, 16.30], $p < .001$.

There was a main effect of viewpoint, $F(2, 81.87) = 4.74$, $p = .01$, $\eta_p^2 = .10$ (Figure 5). There was a curvilinear relation between viewpoint and time to open the puzzle box. The 180° condition ($M = 51.80_{\text{seconds}}$, $SD = 19.93$) was significantly faster than the 90° condition ($M = 64.68_{\text{seconds}}$, $SD = 31.27$), 95% CI[4.86, 23.23], $p = .003$. The 0° condition ($M = 57.28_{\text{seconds}}$, $SD = 24.85$) was marginally faster than the 90° condition, 95% CI[0.13, 17.95], $p = .05$. There was no significant difference between the 0° condition and 180° condition, $p = .26$.

There was a main effect of age group $F(1, 83.94) = 28.73$, $p < .001$, $\eta_p^2 = .25$ (Figure 3b). Overall, adults ($M = 50.63_{\text{seconds}}$, $SD = 23.04$) were faster than children ($M = 72.41_{\text{seconds}}$, $SD = 25.94$), 95% CI[13.40, 29.20] at opening the puzzle box.

By puzzle box layer. There was a main effect of puzzle box layer, $F(3, 263.81) = 154.29$, $p < .001$, $\eta_p^2 = .64$. Time on each layer increased as participants progressed through the puzzle box, with the final layer representing the greatest challenge.

As expected from the trial analysis, there was a main effect of viewpoint, $F(2, 86.99) = 3.59$, $p = .03$, $\eta_p^2 = .08$. Collapsing across layers, the 180° condition ($M = 9.73_{\text{seconds}}$, $SD = 8.24$) was significantly faster than the 90° condition ($M = 15.89_{\text{seconds}}$, $SD = 19.27$), 95% CI[1.58, 10.62], $p = .009$. There was no significant difference between the 0° condition ($M = 12.68_{\text{seconds}}$, $SD = 13.20$) and the 90° condition, $p = .17$, or the 180° condition, $p = .18$.

There was a significant interaction between layer and viewpoint, $F(6, 263.83) = 3.48$, $p = .002$, $\eta_p^2 = .07$ (Figure 6). The effect of viewpoint was most pronounced for the later layers of the puzzle box (Figure 6). Again, we found a curvilinear relationship between observational viewpoint and time. On Layer 3, the 180° condition ($M = 5.69_{\text{seconds}}$, $SD = 6.63$) was marginally faster than the 90° condition ($M = 11.83_{\text{seconds}}$, $SD = 18.14$), 95% CI[0.08, 11.25], $p = .05$. On the most challenging layer, Layer 4, the 180° condition ($M = 21.21_{\text{seconds}}$, $SD = 6.69$) was significantly faster than both the 90° condition (M = 34.67$_{\text{seconds}}$, SD = 17.62), 95% CI[7.61, 18.94], p < .001, and the 0° condition (M = 27.03$_{\text{seconds}}$, SD = 12.41), 95% CI[0.48, 11.61], p = .03. On Layer 4, the 0° condition was faster than the 90° condition, 95% CI[1.67, 12.79], p = .01.

As with the trial analysis, there was a main effect of age group, F(1, 87.51) = 11.38, with adults (M = 10.37$_{\text{seconds}}$, SD = 11.84) opening each layer more quickly than children (M = 16.77$_{\text{seconds}}$, SD = 17.34), 95% CI[2.66, 10.30], p = .001, η_p^2 = .12.

Adults were faster than children in opening the puzzle box, but both became more proficient with practice. The effect of viewpoint was curvilinear and thus inconsistent with a mental rotation account. A 180° observational viewpoint resulted in the fastest puzzle box solving. Face-to-face observation promoted efficient puzzle solving, even when accounting for the number of unnecessary actions performed. More than first versus third-person observer-model reference frames, there was a special role for face-to-face learning that overcame disparity in visual perspectives to enhance puzzle solving. Further, the benefit of face-to-face learning was most prominent on the most challenging layer of the puzzle box.

Seat choice

There was evidence of a systematic seat choice preference. Overall, participants were more likely to choose the model's seat (n = 36) than their observer's seat (n = 21), X^2(1, 61) = 6.45, p = .01, or the novel seat (n = 4), X^2(1, 61) = 35.75, p < .001, and were more likely to choose the observer's seat than the novel seat, X^2(1, 61) = 12.88, p < .001.

To examine the other factors of interest, we conducted a binomial logistic regression that included viewpoint, age group, and AQ score in the model. As so few chose the novel seat (n = 4), we excluded these participants to simplify analysis to observer (egocentric) and model (allocentric) seat choice. There was a significant interaction between viewpoint and age group,

$F(1, 61) = 4.03$, $p = .04$ (Figure 7). For adults in the third-person viewing conditions, both the 90° condition, $X^2(1, 19) = 6.74$, $p = .009$, and 180° condition, $X^2(1, 18) = 9.00$, $p = .003$, chose the model's seat (i.e., changed seats to the model's perspective) more often than their observation seat. In contrast, for children in the third-person viewing conditions, the 180° condition chose the observation seat more often than the model's seat, $X^2(1, 11) = 6.55$, $p = .01$, while children in the 90° condition were equally likely to choose the observation and the model's seat, $p = .35$. Adults preferred to solve the puzzle box from an allocentric perspective, and thus a vantage point facilitating imitation of the model's specific actions. Children preferred an egocentric perspective, suggesting their implicit viewpoint preference was not to embody the model and imitate the model's specific actions.

Discussion

Although visual (VPT) and social (SPT) perspective taking work in tandem to support social learning, each suggests a different relationship between the observation of knowledge and its social transmission. Visuospatial learning requires seeing the world from another's perspective, which utilizes VPT. VPT depends upon mental rotation, so visuospatial learning should be most difficult from a 180° viewpoint, when learning face-to-face. Here we show that face-to-face learning can supersede the challenge of differences in visual perspective and the requirement for mental rotation. While a shared first-person visual perspective increased imitation (the learning of specific functional actions), replicating prior findings on action imitation (e.g., Fiorella, 2017), face-to-face learning enhanced goal emulation. Face-to-face learning also increased the likelihood of discovering a novel solution and, critically, resulted in more efficient/faster puzzle solving. The effect of the 180° observational viewpoint translated into improved complex visuospatial puzzle solving that persisted across trials.

Observational viewpoint had a large impact on imitation and learning to solve the puzzle box, but in opposite ways. Participants who engaged in face-to-face learning solved the puzzle box faster than those who sat next to or perpendicular to the model. Instead of a linear relationship between viewpoint and time, time to open the puzzle box increased between a 0° and 90° viewpoint but decreased between a 90° and 180° viewpoint. This was especially true on the most challenging final layer of the puzzle box, which required tool use. More than sharing a visual perspective, it appears that sharing a mental perspective supports the social transmission of knowledge.

In particular, face-to-face learning enhanced goal emulation over imitation. These related forms of social learning differ in how an outcome is achieved. Imitation achieves a model's goal utilizing a model's strategy, whereas goal emulation achieves the goal without utilizing the model's strategy (Carpenter & Call, 2009; Tomasello, 1996). The 180° condition was the most likely to discover a novel solution to the puzzle box and relied the least on the model's solution. These participants also engaged in more motor mirroring. The 180° condition opened the puzzle box from right-to-left more often than participants in the 0° condition, suggesting an egocentric rather than allocentric perspective. This less faithful imitation was rewarded. In deviating from the model, participants achieved their goal of opening the puzzle box more quickly.

Overall, adults were more faithful imitators than children, exhibiting less goal-oriented behavior. Adults adopted the model's solution more often than children and overimitated on the first layer more than children. In a sense, adults were more restricted learners than children. Adults focused on recreating the model's actions rather than the end result. While this can be an effective way to develop expertise in an area, persistent imitation may hinder self-sufficiency and originality. This supports past findings that adults overimitate more than children, resulting in less efficient learning (McGuigan et al., 2011). Additionally, children are more flexible learners than adults and engage in more exploration during learning (Gopnik et al., 2015).

We saw this same imitative behavior in adults' seat choice. Overwhelmingly, adults chose the model's seat when choosing where to sit. In contrast, children in the 180° condition chose the original seat from which they learned, further demonstrating a focus on goal achievement rather than model affiliation. This behavior was not due to egocentricity. If children were acting egocentrically, then all children should have returned to their original seat. Instead, children in the 90° condition were equally likely to choose the model's seat as the observer's seat. Perhaps strict imitation becomes ingrained through years of learning experience. Highly structured classroom activities cause declines in creativity (Berretta & Privette, 1990), and classroom activities that encourage exploration promote creativity (Howard-Jones et al., 2002; Dansky & Silverman, 1973). As the number of years in formal educational settings increases, adults may become less divergent thinkers, depending less on self-generated learning and innovation.

There are a few limitations to our results and the conclusions we can draw from them. First, one possible explanation for these findings is that participants who were less imitative (i.e., the 180° condition, children versus adults) simply forgot the model's actions or did not learn from observing the model. However, the 180° condition, which was the least imitative condition, was also the fastest condition. This suggests that non-imitation was not indicative of poor learning. Furthermore, if there was reduced learning/increased forgetting, then it was restricted to a diminished primacy effect (first trial, first layer of puzzle box). Participants' memory for the unnecessary actions stabilized with practice; their performance of the model's unnecessary actions did not significantly decrease between the last two trials. Additionally, adults and children performed the same number of unnecessary actions on the last three layers of the puzzle box, suggesting equivalent memory for these actions. Second, although a 180° observational viewpoint improved learning to solve the puzzle box in both adults and children, our results are not clear on whether the strength of this effect may change with age. It is interesting to note that face-to face learning caused adults to look more like child learners — less imitative and more exploratory. Future work is needed to systematically determine whether face-to-face learning is equally beneficial across development.

Lastly, we did not find an interaction between our control measure of SPT (normative autistic traits) and observational viewpoint. One explanation is that there was limited variability in our sample; the highest score among participants was below the cutoff for clinical levels of autistic traits. A second possibility is that higher autistic trait participants were better at mental rotation (Hamilton et al., 2009) and had enhanced spatial skills (Muth et al., 2014), so they were not affected by the increased demand for mental rotation at the 180° viewpoint. If high autistic traits are simultaneously related to better VPT and worse SPT, then this could lead to a null result. While we did not find them here, there is evidence of individual differences in personality that do modify observational learning (Rawlings et al., 2021).

Remarkably, the simple act of sitting across from someone can help overcome limitations in shared visual perspective. As suggested earlier, face-to-face learning may improve SPT through social affordances that enhance mind reading. Eye gaze, in particular, is a powerful pedagogical cue. Eye gaze promotes learning (Butler & Markman, 2012; Brugger et al., 2007; Nielsen, 2006), and children learn early on that social behaviors such as eye contact signal important information and carefully attend to these behaviors (Csibra & Gergely, 2009). This may be why adults prefer to sit where a conversational partner is most visible (Sommer, 1967; Steinzor, 1950). More than spatial proximity, face-to-face interaction may provide the foundation for social perspective taking, overcoming the structural constraint of different visuospatial perspectives.

In sum, we found that face-to-face learning overrode the inherent difficulty of taking another's visual perspective. A 180° observational viewpoint enhanced goal emulation over action imitation and increased innovation during learning. The importance of observational viewpoint during learning has been undervalued. These insights can motivative research that considers the role of both visual and mental perspective during learning to enhance the balance between imitation and innovation.

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Appendix

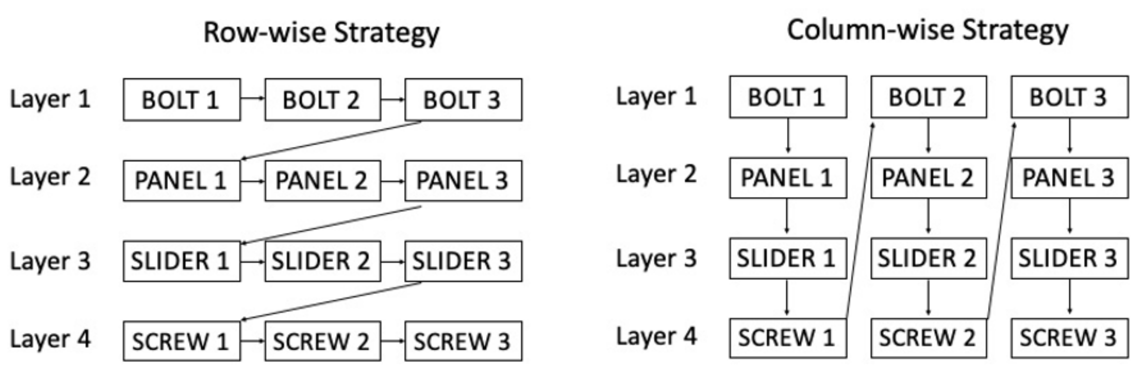
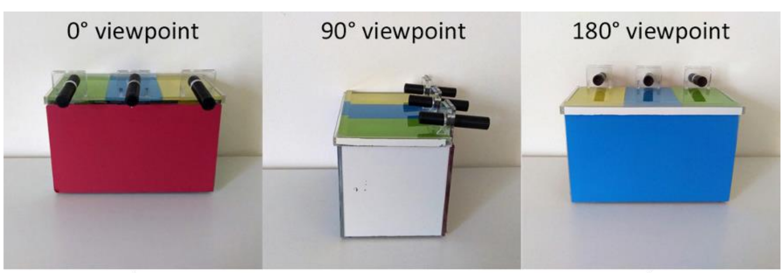


Figure 1. *Two strategies for opening the puzzle box.* The puzzle box consisted of four layers and could be opened using a row-wise (horizontal) or column-wise (vertical) strategy.



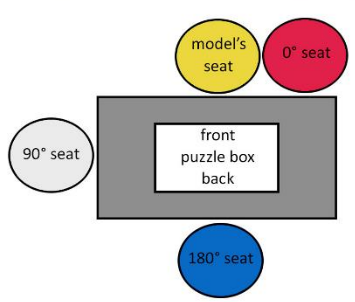


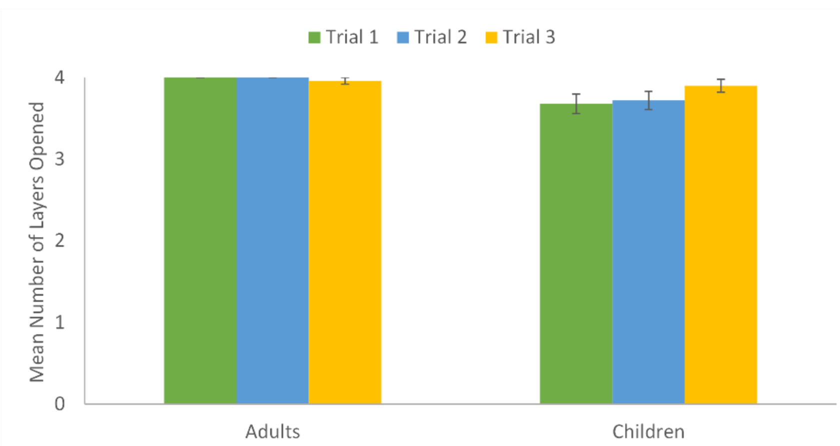
Figure 2a (top). *The appearance of the puzzle box in each viewpoint condition.* The puzzle box was opaque so that the inner machinery was invisible. The front of the puzzle box was red, and the back was blue, which allowed participants to differentiate the sides.

Figure 2b (bottom). *The testing room set-up.* Participants in the 0° condition sat facing the puzzle box. Participants in the 90° condition sat facing the side of the puzzle box. Participants in the 180° condition sat facing the back of the puzzle box.

Table 1. *The 14 unnecessary actions performed by the model during the learning phase.*

Layer 1	**Layer 2**
Stand Bolt 1 next to puzzle box	Place Panel 1 on table, facing self
Push Bolt 2 away from self	Place Panel 2 on top of Panel 1, facing left
Stand Bolt 2 next to puzzle box	Place Panel 3 on top of Panel 2, facing self
Stand Bolt 3 next to puzzle box	
Layer 3	**Layer 4**
Move Slider 1 down, up, down	Tap Bolt 1 on puzzle box three times
Move Slider 2 up, down, up	Return Bolt 1 to holder

Move Slider 3 down, up, down	Return Bolt 2 to holder Return Bolt 3 to holder



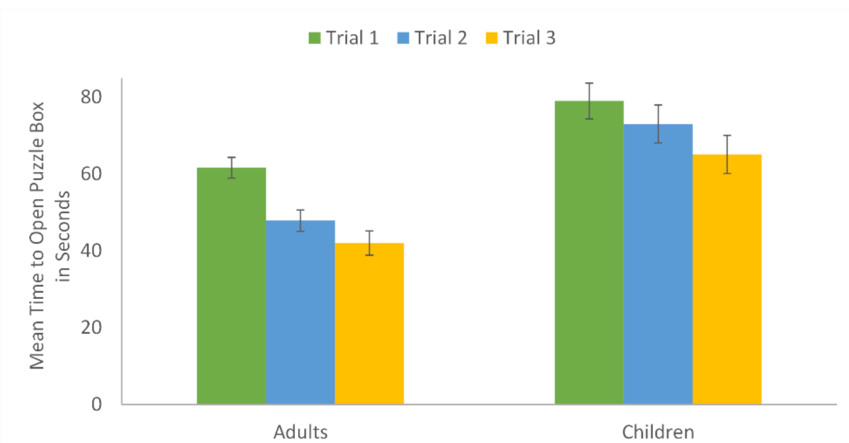


Figure 3a (top). *Puzzle box success by trial and age group.* Adults opened significantly more puzzle box layers than children.

Figure 3b (bottom). *Puzzle box time to open puzzle box by age group.* Adults were significantly faster at opening the puzzle box than children.

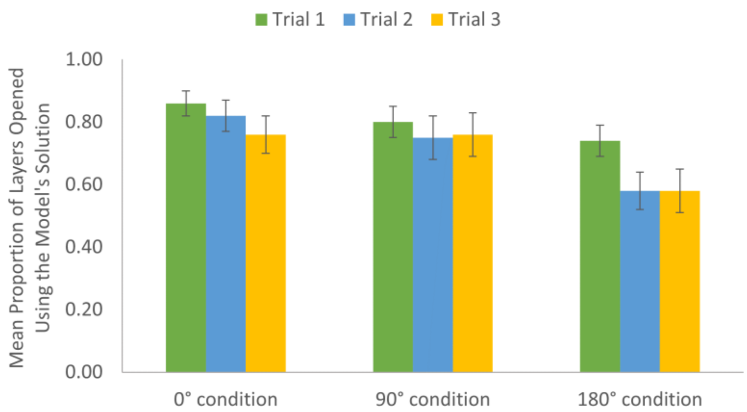


Figure 4. *Use of the model's solution by trial and viewpoint condition.* Participants used the model's solution significantly more on the first trial than on the second or third trials. The 180° condition used the model's solution significantly less than the 0° condition and marginally less than the 90° condition.

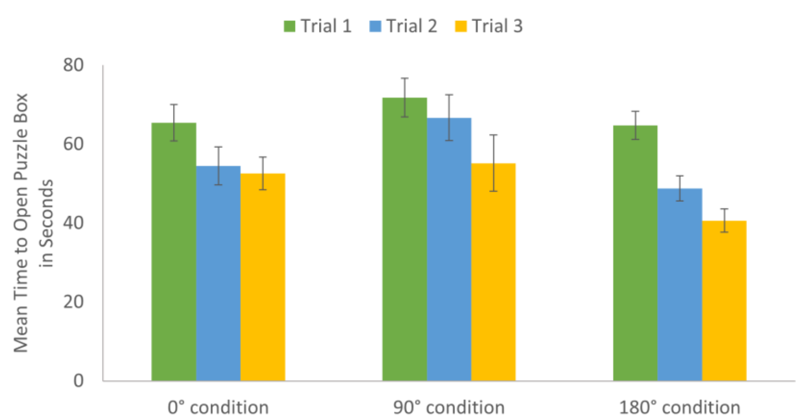


Figure 5. *Mean time to open puzzle box by trial and viewpoint condition.* Participants were significantly faster on the last trial than on the first or second trials and were significantly faster on the second trial than on the first trial. The 180° condition was significantly faster than the 90° condition, and the 0° condition was marginally faster than the 90° condition.

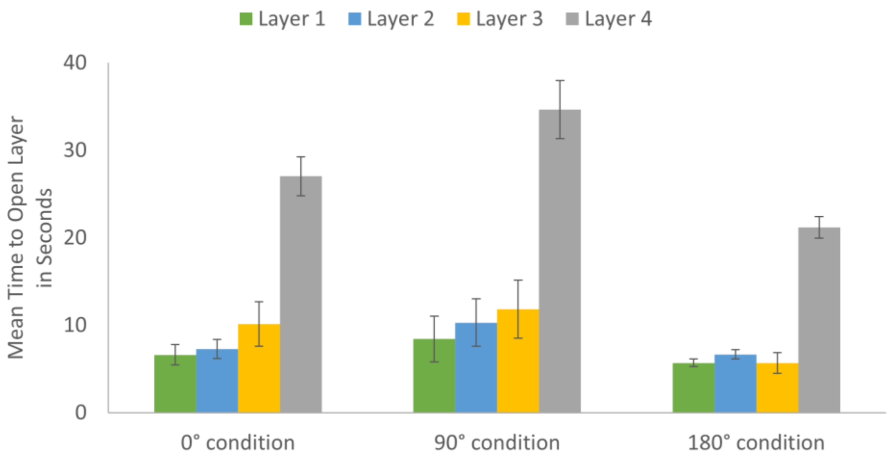


Figure 6. *Mean time by puzzle box layer and viewpoint condition.* On Layer 3, the 180° condition was marginally faster than the 90° condition. On Layer 4, the 180° condition was significantly faster than the 0° and 90° conditions, and the 0° condition was significantly faster than the 90° condition.

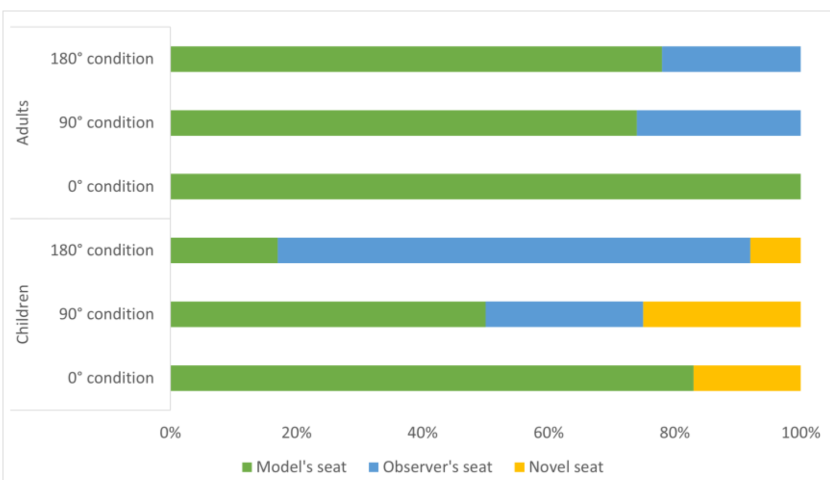


Figure 7. *Percentage of participants choosing each seat by viewpoint condition.* Adults in the 90° and 180° conditions chose the model's seat significantly more often than the observer's seat. Children in the 180° condition chose their observer's seat significantly more often than the model's seat.

CHAPTER 2: EMOTION TALK: DISCLOSED EMOTIONS SHAPE CHILDREN'S SOCIAL CHOICES

Abstract

Emotional self-disclosure fosters adult relationships, but the function of emotion talk early in life is less understood. In three studies, 5 to 8-year-olds heard two children describe past emotional events and then answered questions to assess their social preference. Children in Study 1 (N = 36) preferred a child who described a happy experience over one who described a neutral experience, while children in Study 2 (N = 36) preferred a neutral child over one who described a sad experience. In Study 3, children experiencing social distancing during the COVID-19 pandemic (N = 49) were equally willing to affiliate with a sad child experiencing social isolation and a neutral child. Thus, sharing negative feelings was not always detrimental to social affiliation, suggesting an early and sophisticated social utility of verbal emotional disclosure.

Introduction

If a co-worker makes you cry, then you have communicated your affect to one person. Yet, this single emotional event can have a much wider social reach. The event can be shared volitionally and verbally with multiple people for social support. For over a century, researchers have debated the form and function of non-verbal emotional displays (e.g., Lee & Anderson, 2017; Lee et al., 2014; Darwin, 1872), but humans may talk about their emotions more frequently than show them (Rimé et al., 2020; Rimé et al., 1991). This emotion talk has social benefits. In adults, talking about emotions increases social connectedness, reduces loneliness, and ultimately strengthens interpersonal relationships (Nils & Rimé, 2012; Laurenceau et al., 1998). Similarly, listening to emotional disclosure signals a desire to affiliate (Delelis & Christophe, 2016; Hackenbracht & Gasper, 2013). However, the social function of emotion talk early in life is unclear. We know that children harness non-verbal emotional expressions to understand their physical (Walle et al., 2017) and psychological world (Wu et al., 2020). Aligning with the social communicative function of emotions (Buck, 1984), here we asked whether verbal emotional disclosure plays an important role in how children navigate their social world. The present studies examined how emotion talk shapes children's affiliative choices, one of the crucial decisions that children make when building their social lives.

Two sets of findings demonstrate that children comprehend and utilize emotional information early in life. First, young children use emotional cues to regulate physical behaviors, a process known as social referencing (Walk, 1966). Twelve-month-olds are unlikely to cross a visual cliff when their mother displays negative emotions such as fear or anger, but a mother's display of happiness increases infants' crossing of the visual cliff (Sorce et al., 1985). Similarly, infants use emotional cues when deciding whether to approach a novel stimulus (Kim & Kwak, 2011; Hornik et al., 1987) or imitate a novel action (Patzwald et al., 2018). Second, children use emotional displays to infer mental states such as goals (Skerry & Spelke, 2014), preferences (Repacholi & Gopnik, 1998), and beliefs (Asaba et al., 2020; Wu et al., 2018). For example, 5- and 6-year-olds infer that someone expressing anger is aware of a wrongdoing (Wu et al., 2018), and 18-month-olds use expressions of disgust to infer others' food preferences (Repacholi & Gopnik, 1998). Together, these findings highlight that children readily attend to emotional information to make sense of both the physical world and others' minds.

While pre-verbal children must rely on non-verbal emotional displays, older children's use of verbally expressed emotion is not well understood. Non-verbal expressions have been abundantly studied but are limited in that they often reflect nonvolitional affective states in the moment, which can result in reflexive mimicry (e.g., Chick et al., 2020). In contrast, we examined children's utilization of verbally shared emotional information. That is, emotion talk, the volitional sharing of past emotional experiences. While previous work has focused on children's sensitivity to information reflecting current emotional states (e.g., Sorce et al., 1985), in real life, emotional information is often shared outside of an emotional event via emotion talk (Rimé et al., 1991). This distinction requires children to differentiate between a person's past and current emotional state, and thus provides a strong test of children's sophisticated understanding of emotions. Specifically, we asked whether children are sensitive to verbally disclosed emotional information when making social affiliative decisions and, if so, which aspects of emotions exhibit influence? Addressing this question would demonstrate that children consider the social function of emotions, using emotional information to inform social decisions.

To address this question, we first need to identify which characteristics of disclosed emotions may influence children's social choices. While few studies have examined this question with children, findings with adults and adolescents suggest that the valence of disclosed emotions may influence social decisions. However, past evidence on how positive versus negative emotional disclosure influences affiliative intentions is mixed. On the one hand, adults prefer strangers who share positively valenced information over those who share negatively valenced information (Miller et al., 1992; Gilbert & Horenstein, 1975). Sharing positive emotional experiences increases trust (Reis et al., 2010) and fosters close interpersonal relationships (Gable et al., 2004). On the other hand, studies have shown that communicating negative feelings to others can also strengthen social bonds (e.g., Calmes & Roberts, 2008; Rose, 2002). Adolescents who discuss negative feelings with their friends tend to have high-quality friendships (Rose, 2002).

It is an open question whether and how children use the valence of disclosed emotions to guide their social choices. Children may simply act according to the mere presence of positive or negative information, resulting in relative approach/avoidance behavior. Alternatively, if emotional disclosure represents a unique mode of communication that is deeper than face value, then children should be guided by more than simple valence. We hypothesize that, in addition to considering valence, children can flexibly appeal to contextual features to inform their affiliative choices. One prominent contextual feature facilitating social affiliation in children is perceived similarity (e.g., Liberman & Shaw, 2019; Dunham et al., 2008). We propose that sharing a similar experience might interact with the valance of disclosed emotions to impact children's affiliative choices.

In three studies, 5 to 8-year-old children were introduced to two child characters. One character disclosed neutral information, and the other disclosed either positive (Study 1) or negative emotional information (Studies 2 and 3). In Study 3, children were introduced to a child character experiencing social isolation. Across the world, the COVID-19 pandemic disrupted children's social lives and emotional well-being. The social distancing measures instituted in response to the pandemic created a common experience of social isolation among children and their peers, which may alter children's interpretations of disclosed negative emotions. This offered a unique opportunity to address our research questions within a naturalistic environment to illustrate how the shared context of social distancing may influence children's affiliative choices in response to emotional disclosure.

Study 1: Method

Power analysis

A power analysis using G*Power (Faul et al., 2007) revealed that a sample of 27 participants would achieve 80% power to detect a medium effect size (Cohen's d = .50) using a one sample t-test (alpha = .05). We chose a sample size of 36 for Studies 1 and 2 to properly counterbalance all aspects of the study. We stopped data collection when a useable sample size of 36 was reached.

Participants

The final sample consisted of 36 5 to 8-year-olds (M_{age} = 7.00$_{\text{years}}$, *SD* = 1.18$_{\text{years}}$; 18 boys and 18 girls). An additional three children participated in Study 1 but were excluded from the study because they failed the memory check (see below). Thirty-two parents reported their child's race/ethnicity. For this subset, the sample was 59% White/non-Latino (*n* = 19), 19% Asian (*n* = 6), 9% multiracial (*n* = 3), 6% Latino (*n* = 2), 3% Black (*n* = 1), and 3% Native American (*n* = 1). Twenty-six parents reported income; the median household income was $100,000. Thirty-one parents reported education demographics. Of these children, 97% (*n* = 30) had a parent with a bachelor's degree.

Procedure

In all studies, parents completed an online consent form, and children provided oral assent. Participants were tested individually via Zoom video chat.

Warm-up session. The study began with a warm-up session to acclimate children to interacting over video. The experimenter asked children what they had for breakfast and to share one thing about their day. The experimenter then shared what she had for breakfast and one thing about her day.

Next, the experimenter shared her computer screen. The screen displayed the study stimuli with the experimenter and child visible to one another in a small box in the corner. The experimenter showed children a yellow circle and a green square and asked them to name the color of each to ensure that children could differentiate the colors used throughout the study.

Emotion sharing manipulation. Children saw photographs of two children that were equated for age, attractiveness, and emotional expression. The children in the photographs were slightly smiling and matched the child's gender. One photograph was surrounded by a green border and the other a yellow border.

The experimenter said, "*Here are two of my friends. I asked them to tell me what they did yesterday. Do you want to hear what they said?"* and played an audio clip of each child describing their day. One child (the neutral child) shared non-emotional information and said, *"I woke up at 8:00. I had breakfast. Then I played a game. I had a normal day."* The other child (the emotion child) said, *"I felt happy yesterday. I liked what I ate for breakfast. Then I had fun playing my favorite game. I had a good day."* The experimenter played each audio clip twice and asked children to repeat what they heard. We counterbalanced which photograph was the emotion child and the order in which we introduced the two children.

Social preference questions. Children answered three questions adapted from prior studies (e.g., Fawcett & Markson, 2010; Kinzler et al., 2009) to evaluate their social preference — *Who would you rather be friends with? Who would you rather play with? Who do you like better?* Children answered these questions by saying *"yellow box"* or *"green box"* to conceal our purpose of testing children's preferences based on emotional information. We assessed social preference by calculating the proportion of times that children chose the emotion child across the three questions.

Liking questions. We also assessed degree of liking by asking about the emotion child and neutral child separately — *How much do you like my friend in the green box/yellow box?* Children responded on a 4-point Likert scale that we scored from 0 to 3 (dislike a lot = 0, dislike a little = 1, like a little = 2, like a lot = 3).

Memory check. Lastly, the experimenter asked children if they remembered who had a normal day yesterday and who felt happy yesterday to ensure that children had understood and retained the shared information. Three children missed at least one memory question and were excluded from the final sample.

Analysis plan

We conducted the following analyses in all three studies. We first checked for age or gender effects on social preference with a mixed-effects binomial logistic regression. The model included participant and question as random intercepts, age in months and gender as well as their interaction as fixed predictors, and choice on each social preference question (emotion child, neutral child) as the dependent variable. If the interaction between age and gender was non-significant, then it was excluded from the model.

To address our main question about children's social preference, we conducted a one-sample t-test to compare the proportion of times children chose the emotion child on the three social preference questions to 0.50, which represents chance level. If children were choosing at chance, then, on average, they should have chosen the emotion child on 50% of trials.

We examined children's responses to the two liking questions with a mixed-effects linear regression model. The model included participant as a random intercept, age in months, gender, and disclosed information (emotional, neutral) as well as possible interactions as fixed predictors, and liking score (0–3) as the dependent variable. Non-significant interactions were excluded from the model.

Study 1: Results

Social preference questions

There was no effect of age, $p = .62$, nor gender, $p = .68$, on children's social preference, and there was no age by gender interaction, $p = .62$.

On average, children chose the emotion child on 65% of trials ($SD = 0.30$), which was significantly higher than chance level (50%), $t(35) = 2.99$, $p = .005$, 95% CI[0.55, 0.75] (Figure 1). This suggests that children are sensitive to emotional information when making social affiliative choices and use emotion talk to guide their choices.

Liking questions

There was a main effect of disclosed information on children's liking scores, $F(1, 35) = 6.93$, $p = .01$ (Figure 2). Children liked the child who disclosed emotions ($M = 2.58$, $SD = 0.50$) significantly more than the neutral child ($M = 2.28$, $SD = 0.57$). There was also a main effect of age, $F(1, 33) = 13.82$, $p < .001$. Younger children liked both child characters more than older children did. There was no main effect of gender, $p = .59$, nor any significant interactions, *p's* > .05.

Study 1: Discussion

In Study 1, children demonstrated a social preference for and increased liking of a child who shared a happy compared to a neutral experience. These results suggest that sharing positive emotional information is beneficial for social affiliation. However, it is possible that disclosing any emotional information would increase social affiliation. We examined this possibility in Study 2 by investigating children's social preference for a child who disclosed negative emotional information versus a neutral child.

Study 2: Method

Participants

The final sample consisted of 36 5 to 8-year-olds (M_{age} = 6.97$_{years}$, *SD* = 1.17$_{years}$; 18 boys, 17 girls, and 1 child with a non-binary gender identity). Thirty-four parents reported their child's race/ethnicity. For this subset, the sample was 62% White/non-Latino (*n* = 21), 26% Asian (*n* = 9), 6% Latino (*n* = 2), 3% Native American (*n* = 1), and 3% multiracial (*n* = 1). Twenty-five parents reported income; the median household income was $120,000. Thirty-four parents reported education demographics. Of these children, 100% had a parent with a bachelor's degree.

Procedure

Study 2 utilized the same paradigm as Study 1, except that the emotion child shared negative emotional information. The child said, *"I felt sad yesterday. I didn't like what I ate for breakfast. Then I couldn't play my favorite game. I had a bad day."* The child with a non-binary gender identity saw photographs of two boys.

Study 2: Results

Social preference questions

There was a marginal effect of age on social preference, X^2 (1, *N* = 36) = 3.42, *p* = .06, with older children choosing the sad child more than younger children. There was a main effect of gender, X^2 (2, *N* = 36) = 8.38, *p* = .02. On average, boys chose the sad child on 18% of trials (*SD* = 0.27), while girls chose the sad child on 51% of trials (*SD* = 0.37). It is possible girls were more empathetic towards the sad child than boys (e.g., Lennon & Eisenberg, 1987). However, these findings should be interpreted with caution given our small sample size. The interaction between age and gender did not reach significance, *p* = .12.

On average, children chose the emotion child on 34% of trials (*SD* = 0.36), which was significantly lower than chance level (50%), $t(35) = 2.72$, $p = .01$, 95% CI[0.22, 0.46] (Figure 1). Children now demonstrated a preference for the neutral child compared to a child who shared negative emotions. This result ruled out the possibility that children simply favor people who share emotions, regardless of the valence of the disclosed emotions.

Liking questions

There was a main effect of disclosed information on children's liking scores, $F(1, 33) = 8.46$, $p = .006$. Children liked the neutral child ($M = 2.51$, $SD = 0.51$) significantly more than the child who shared negative emotions ($M = 2.14$, $SD = 0.81$). There was no effect of age, $p = .88$, or gender, $p = .77$, but there was a significant interaction between age and disclosed information, $F(1, 33) = 6.55$, $p = .02$. Liking of the neutral child decreased with age, whereas liking of the emotion child increased with age. There were no other significant interactions, *ps* > .05.

Study 1 & Study 2 comparison

To further understand the effect of emotional valence on children's social preferences, we compared children's responses on the social preference questions in Studies 1 and 2 with a mixed-effects binomial logistic regression. The model included participant and question as random intercepts and study (Study 1, Study 2) as a predictor. There was a main effect of study, X^2 $(1, N = 72) = 14.33$, $p < .001$. Children chose the emotion child in Study 2, who disclosed negative emotional information, significantly less often than they chose the emotion child in Study 1, who disclosed positive emotional information.

We also compared children's liking scores with a mixed-effects linear regression model that included participant as a random intercept, and study and disclosed information as fixed factors. There was a significant interaction between study and disclosed information, $F(1, 69) =$

11.00, p = .001. Children in Study 1 liked the child who shared emotions more than children in Study 2, $t(138) = 3.05$, p = .003, but there was no significant difference in children's liking of the neutral child, p = .10. Together, these results demonstrated a relative positivity bias when children consider emotions in their social choices.

Study 2: Discussion

Studies 1 and 2 provide converging evidence that children (1) are sensitive to verbally disclosed emotions when making social choices and (2) prefer to affiliate with a child who shares relatively more positive emotions. In Study 3, we focused on the moderating effect of context related to social isolation during the COVID-19 pandemic. If children have a sophisticated understanding of emotions that allows them to consider contextual factors, this may alter their preference for the relatively more positive child. Thus, disclosing sad emotions may not always be detrimental to social affiliation.

Study 3: Method

Power analysis

The first two studies had sufficient power to detect children's social preference based on emotional information. In the present study, we hypothesized that contextual factors would diminish the effect found in Study 2; thus, we increased the sample size slightly to reduce the risk of a Type II error. We chose a sample size of 48 in Study 3, which was sufficient to detect a small-to-medium effect size (Cohen's d = 0.36) with 80% power in a one sample t-test (alpha = .05). By accident, one additional child participated in the study.

Participants

The final sample consisted of 49 5- to 8-year-olds ($M_{age} = 6.93_{\text{years}}$, $SD = 1.14_{\text{ years}}$; 24 boys, 24 girls, and 1 child with a non-binary gender identity). Forty-three parents reported their child's race/ethnicity. For this subset, the sample was 70% White/non-Latino (*n* = 30), 19% Asian (*n* = 8), 7% multiracial (*n* = 3), 2% Latino (*n* = 1), and 2% Black (*n* = 1). Thirty-eight parents reported income; the median household income was $125,000. Forty-five parents reported education demographics. Of these children, 89% (*n* = 40) had a parent with a bachelor's degree.

All participants in Study 3 were experiencing social isolation due to the COVID-19 pandemic. Before the study, parents completed a questionnaire that assessed children's frequency of social contact. Children were eligible for the study if parents indicated that their child saw friends "less than usual" or "not at all" in the month prior to the study.

Procedure

Study 3 utilized the same paradigm as in Studies 1 and 2 with three exceptions. First, during the warm-up session, the experimenter asked children three social contact questions to highlight their similarity to a socially isolated child–*How often do you get to see your friends in person? How often do you get to see your friends on a screen? Do you ever miss your friends?* Eighty percent of children said they missed their friends either "*a little bit*" (*n* = 11) or "*a lot*" (*n* = 28). For children who reported missing their friends, the experimenter asked, *"Why do you miss your friends?"* One child did not answer, and one child's session was not recorded. Of the remaining children, 51% (*n* = 19) referenced the COVID-19 pandemic when explaining why they missed their friends (e.g., *"we can't really play when the pandemic happens"*).

Second, the emotion child shared negative emotional information about social isolation. They said, *"I felt sad yesterday. I still can't see my friends, and I miss my friends. I had a bad day."* The child with a non-binary gender identity saw photographs of two girls.

Third, we asked children to provide explanations for their answers to the liking questions, to probe the cognitive factors driving children's affiliative behavior. One way a shared context might bolster social affiliation is by minimizing the fundamental attribution error, whereby behavior is attributed to an enduring trait of a person rather than their impermanent situation (Ross, 1977). An experimenter coded whether the child's reason was situation-focused or person-focused. One child's session was not recorded, and 16 children did not provide a reason. Of the remaining 32 children, 31% (*n* = 10) provided a situation-focused reason (e.g., "*he missed his friends"*), 31% (*n* = 10) provided a person-focused reason (e.g., *"she's gloomy"*), and 38% (*n* = 12) provided an alternate reason (e.g., *"I like his hair"*).

Study 3: Results

Social preference questions

There was no effect of age, $p = .89$, nor gender, $p = .25$, on children's social preference, and there was no age by gender interaction, $p = .46$.

On average, children chose the emotion child on 45% of trials ($SD = 0.39$), which did not differ from chance level (50%), $p = .40$ (Figure 1). Unlike in Study 2, children were equally willing to affiliate with a neutral child and a child who disclosed negative emotions.

Liking questions

There was no effect of disclosed information on children's liking scores, $p = .93$. Children liked the emotion child ($M = 2.37$, $SD = 0.67$) and the neutral child ($M = 2.38$, $SD = 0.64$) equally. However, there was a significant main effect of age, $F(1, 45.62) = 5.16$, $p = .03$. Again, younger children liked the child characters more than older children did. There were no significant interactions, *p*'s > .05.

Social contact

We examined the relationship between children's perceived social contact and their social preference with a mixed-effects binomial logistic regression. The model included participant and social preference question as random intercepts and response on each social contact question as fixed predictors. There was a main effect of in-person contact on children's social preference, X^2 (2, N = 49) = 5.94, p = .05. Children who reported seeing friends in person "all the time" (n = 7; M = 0.19, SD = 0.26) chose the emotion child significantly less than those who reported seeing friends "sometimes" (n = 34; M = 0.47, SD = 0.41), p = .03, or "never" (n = 8; M = 0.60, SD = 0.33), p = .02, suggesting that a similar experience moderates children's response to negative emotion talk. However, none of these children were actually seeing friends in person according to their parents. Thus, children's perception of their situation may be more important than the reality of their situation.

We examined the relationship between children's perceived social contact and liking scores with a mixed-effects linear regression model that included participant as a random intercept, and social contact and disclosed information as well as their interaction as fixed predictors. The interaction between disclosed information and in-person contact was not significant. However, there was a main effect of in-person contact, F(2, 42.34) = 3.81, p = .03. Children who reported seeing their friends in person "all the time" had overall higher liking scores (M = 2.79, SD = 0.43) than children who reported seeing their friends "sometimes" (M = 2.31, SD = 0.60), t(41.3) = 2.65, p = .01, or "never" (M = 2.27, SD = 0.88), t(42.5) = 2.31, p = .03.

Liking reason

We next performed similar models to examine the relationship between children's liking reason and their social choices. There was a marginal main effect of liking reason on social preference, X^2 (3, N = 48) = 6.83, p = .08. Children who focused on the situation chose the sad child significantly more often than children who provided no reason, z = 2.49, p = .01, and marginally more than children who provided a person-focused reason, z = 1.88, p = .06. There was no effect of liking reason on children's liking scores, p = .40, and there was no interaction between liking reason and disclosed information, p = .12.

Study 3: Discussion

In Studies 1 and 2, children preferred to affiliate with a child demonstrating relatively more positive affect. In contrast, in Study 3, children were equally willing to affiliate with a neutral child and a child who disclosed negative emotional information. These results demonstrate that a common context can moderate the effect of valence on children's social preference and liking. Children are not always averse to negative emotional information. Rather they consider context as well as valence when interpreting verbal emotional disclosure.

General Discussion

In three studies, we found that children use emotion talk to guide their social choices. In Study 1, when presented with a happy child and a neutral child, 5 to 8-year-olds chose to affiliate with the happy child. In Study 2, when presented with a sad child and a neutral child, children chose to affiliate with the neutral child. In Study 3, children's choice to not befriend a child communicating sad emotions was attenuated by context. When children experiencing social isolation were introduced to a sad child also experiencing social isolation, children's preference for the relatively more positive child disappeared. Thus, children consider not only the valence of emotion talk when making social decisions but also the specific context in which it is shared. Children use emotion talk to navigate the social world in a nuanced way that reflects more than simple approach/avoidance behavior — sad is not always bad.

These findings speak to children's sophisticated understanding of emotion and its social function in several respects. First, building on past work showing that children harness involuntary non-verbal expressions of emotion, we found that volitional emotion talk about one's private emotional world is utilized in early childhood and has a robust effect on how children establish social affiliations. Children readily used emotion talk to choose social affiliative partners and were attentive to multiple facets of the emotion talk (i.e., valence and context).

Second, children did not always avoid a child sharing negative information, which suggests a deeper appreciation of the underlying thought processes or appraisals that generate sadness. The disclosed sadness in Study 2 was related to a child not getting what they desired — a "no-gain" framing. In contrast, in Study 3 the sadness was related to losing contact with friends — a "loss" framing. In addition, the disclosed sadness was non-social in Study 2 but explicitly social in Study 3. Not getting what you want and losing something that you value, particularly social connections, are different forms of sadness. As such, the underlying appraisals supporting the disclosed feelings of sadness differed in Studies 2 and 3, and children may infer and utilize such appraisals when making social calculations. This again points to a sophisticated analysis of the person, context, and even underlying appraisals during emotion talk. Beyond *what* was felt, *why* one felt it, may be critical for how children weigh shared emotions when making social judgments.

Third, situating emotion talk within a common experience altered children's social behavior. In adults, engaging in synchronous movements increases liking (Hove & Risen, 2009), trust (Launay et al., 2013), and social closeness (Tarr et al., 2015). Similarly, sharing an experience, such as watching a film together, facilitates social bonding between children and adults (Wolf & Tomasello, 2020). These studies suggest that sharing an asynchronous emotional experience may also promote social cohesion. Unlike the external experience of dancing or watching a movie, an emotional experience is internal, without a concrete reference point. Additionally, social distancing is a diffuse long-term experience rather than a single point in time. In Study 3, children were not necessarily experiencing a similar emotional state as the sad child. Thus, the results were not due to mood-congruency. Beyond valence, children considered the larger context in which the emotional talk occurred and how the context may relate to themselves.

Children show a similarity bias in many domains such as a preference for those with the same native language (Buttelmann et al., 2013), food and toy preferences (Fawcett & Markson, 2010), and religious beliefs (Heiphetz et al., 2014). Perhaps any form of similarity would mitigate the effect of negative emotion talk. In contrast, it may be that the similarity must be meaningful (Bian & Baillargeon, 2022). The majority of children in Study 3 reported missing their friends, and over half of the children referenced the COVID-19 pandemic when asked why they missed their friends. Social distancing is an experience that has a profound impact on children’s daily lives. Thus, being introduced to a child who shares this experience is a powerful real-world manipulation. A more subtle similarity, such as a shared toy preference, may not override the effect of shared emotions.

One explanation is that a similar experience may diminish the fundamental attribution error. In adults, training perspective taking skills decreases the fundamental attribution error (Hooper et al., 2015). Children in Study 3 may have been better at taking the sad child’s perspective since they were also experiencing social isolation. We saw evidence of this in children's reasons for liking the sad child in Study 3. Providing a situation-focused reason (i.e., inability to see friends) was related to increased affiliation with the sad child. Furthermore, children who reported never seeing friends chose to affiliate with the sad child more than children who reported always seeing friends. Children's perceived similarity to the sad child may have increased their willingness to befriend. A similar experience may also increase affiliation by bolstering empathy. Preschoolers show increased empathy toward an unhappy child when they have experienced the same negative event (Barnett, 1984), and empathy increases helping in older children (Sierksma et al., 2015). If children view affiliation as a means of helping, then they may become more willing to affiliate with a sad child. Children may be especially likely to view affiliation as a way to help when a negative child is experiencing limited social contact. Future work should explore these potential psychological mechanisms.

Together these studies show that emotion talk shapes children's social choices. Children are attentive to the valence of emotion talk, but they also consider more subtle factors such as the context in which the emotional information is shared. When the context is social and reflects a common experience, this changes children's response to negative emotional information, making them more willing to affiliate with someone who experienced sadness. Emotion talk builds and strengthens social bonds in early life.

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Appendix

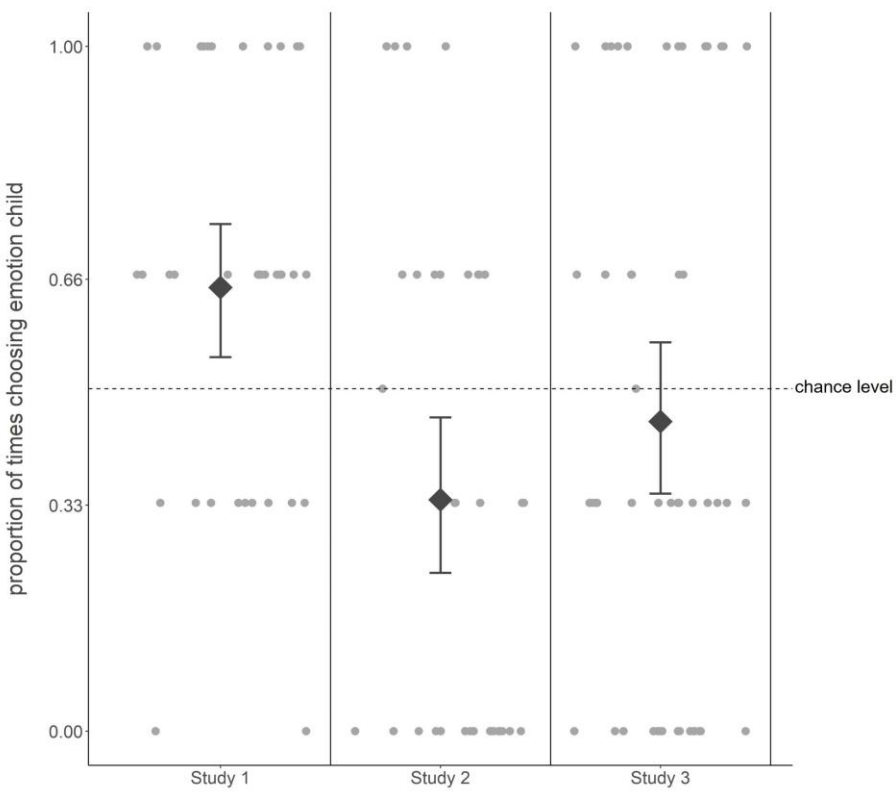

Figure 1. *Children's responses to the social preference questions in each study.* The light gray dots represent individual data points, the large diamonds indicate means, and the bars indicate 95% confidence intervals.

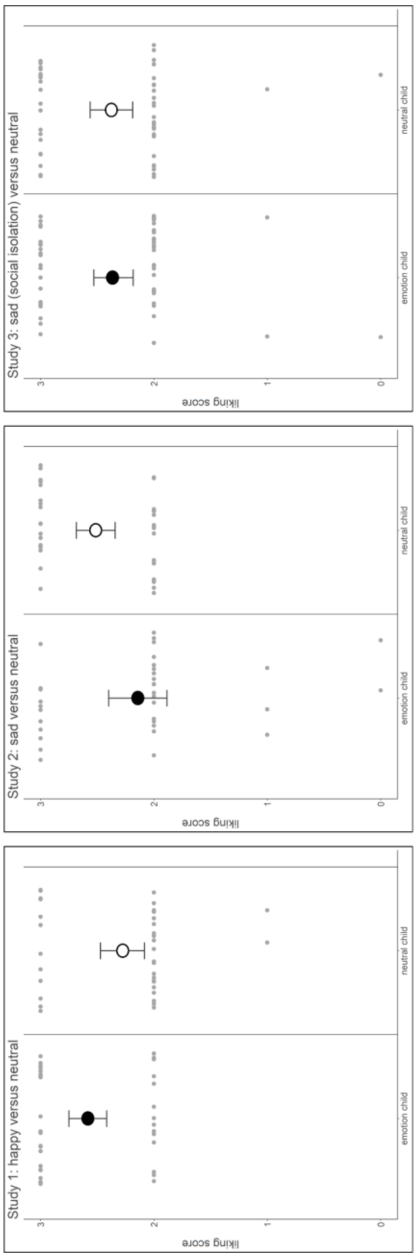

Figure 2. *Children's responses to the liking questions in each study.* The light gray dots represent individual data points, the large circles indicate means, and the bars indicate 95% confidence intervals.

CHAPTER 3: "IS IT OKAY FOR BOYS TO TALK ABOUT FEELINGS?" CHILDREN'S DEVELOPING BELIEFS ABOUT EMOTION TALK

Abstract

Humans frequently talk about their emotions, but little is known about the development of children's beliefs about emotion talk (i.e., the volitional verbal sharing of emotional states). We examined children's beliefs about emotion talk in two domains: social affiliation and gender rules. Sixty-four 5 to 8-year-olds viewed four cartoon stories of children who attend school together. The main character shared a past emotional state (positive or negative) with one character (emotion child) and similar information without an emotional state with the other character (non-emotion child). Then children answered three social affiliation questions in which they chose who the main character plays with, eats lunch with, and is friends with. Children's social inferences based on emotion talk varied as a function of participant gender and age. Boys became less likely to choose the emotion child with age, but girls' choice of the emotion child stayed constant with age. There was no effect of valence for choosing the emotion child. Overall, children did not show strong gender stereotypes about emotion talk, although children's implicit gender beliefs increased marginally with age. Children's explicit gender beliefs predicted choosing the emotion child on the social affiliation questions. Together, these findings offer new insights into children's developing meta-emotional knowledge about the social function of emotion talk and the development of gender specific beliefs about emotion talk.

Introduction

Over the course of development, children undergo important changes in metacognition, or their ability to think about thinking, including knowing what they know and how they know it (Kuhn, 2000). Similarly, children may undergo meta-emotional development in which they acquire explicit knowledge about emotions such as beliefs about what emotions represent and how they should be expressed. This is in contrast to more reflexive responses to emotional expressions that are present very early in life. Although an infant will avoid crossing a visual cliff when a mother displays negative emotions (Sorce et al., 1985), this does not mean that the infant has a well-formed conceptualization of anger. Early research on metacognition focused on memory (Flavell et al., 1970) and then later research on the topic expanded to include a variety of cognitive processes such as causal reasoning (Kuhn & Pearsall, 1998) and scientific thinking (Kuhn & Pearsall, 2000). Yet, emotions remain ignored within the metacognition framework. Just as metacognition research offered valuable insights into children's cognitive processes, examining children's burgeoning meta-emotion knowledge may offer valuable insights into how humans come to understand and use emotions.

Emotion talk is the volitional and verbal sharing of emotional information and plays a fundamental role in human social life (Rimé et al., 2020). Although most work has focused on the role of emotion talk in adult (Nils & Rimé, 2012; Laurenceau et al., 1998; Rimé et al., 1991) and adolescent (Legerski et al., 2014; Rose, 2002) relationships, recent work shows that the social utility of emotion talk is present early in life (Ransom et al.). Even 5-year-olds will attend to and utilize verbally shared emotions when making social affiliative decisions such as whom to play with (Ransom et al.). Here, we examine a different facet of emotion talk early in life — children's beliefs about emotion talk. Rather than children's interpretation and application of emotion talk, we focused on children's meta-emotional development surrounding emotion talk.

Our ability to talk about emotions may scaffold meta-emotional development. According to constructivist theories of emotion, emotion words help us identify our own and others' emotions and can shape our perception of emotions (Fugate & Barrett, 2014). In fact, simply naming emotions changes how we experience them (Nook et al., 2021). Emotional development and language development appear to be intertwined (Streubel et al., 2020; Nook et al., 2017). Children's ability to represent emotions as multidimensional (i.e., more than just valence) is mediated by verbal knowledge but not other developmental outcomes such as fluid reasoning (Nook et al., 2017). This connection between language development and emotional development might make it especially promising to examine meta-emotional development in early childhood once children have the ability to express themselves verbally and have acquired a basic emotion vocabulary (Streubel et al., 2020).

Beyond the ability to talk about emotions, children may also develop beliefs about emotion talk itself. Emotion talk is ubiquitous. Humans frequently talk about their emotions with one another (Rimé et al., 2020; Nils & Rimé, 2012), and the majority of emotional events are shared with at least one other person (Rimé et al., 1991). Starting at a young age, parents talk about emotions with children (Aznar & Tenenbaum, 2015; Racine et al., 2007) and actively elicit emotion talk from children (Brownell et al., 2013). Thus, children may acquire meta-emotion knowledge about emotion talk such as the purpose of emotion talk and the rules for engaging in emotion talk. Consistent with the social function of emotions (van Kleef, 2009; Buck, 1984), one potential belief children may acquire is that emotion talk marks social affiliation. By age 6, children expect people who share secrets to be friends (Liberman & Shaw, 2018), but much earlier, infants infer that sharing saliva is a marker of intimacy (Thomas et al., 2022). Like sharing secrets or saliva, emotion talk is the intentional sharing of something private. Unlike non-verbal emotional expressions (i.e., facial expressions), which at times reflect involuntary, automatic reactions to stimuli (Kret et al., 2020), emotion talk is deliberate. The private and deliberate nature of emotion talk may lead children to view sharing emotions as "special". That is, children may view emotion talk as distinct from other forms of epistemic communication and an indicator of intimacy or friendship.

The content of children's beliefs about emotions may be influenced by cultural and environmental factors, rather than reflect a universally shared competence. Gender is one such factor that could influence children's beliefs about emotion talk. Emotion display rules vary by gender (Sardar et al., 2009), gender stereotypes about emotions are common in Western cultures (Shields, 2002), and children rely heavily on gender when making judgements about others (Martin & Ruble, 2004). Children demonstrate gender stereotypes in multiple domains such as toy preferences (Weisgram et al., 2014) and beliefs about intelligence (Bian et al., 2017). Children also show gender stereotypes within the emotional domain. Like adults, children show a bias towards categorizing angry faces as male (Bayet et al., 2015), and children are more likely to infer that males are angry and females are sad (Parmley & Cunningham, 2008; Karbon et al., 1992). Although there is a common folk belief that young boys do not believe they should talk about emotions, past research on gender stereotypes and emotions have not examined the validity of this belief. Additionally, cultural ideals about gender are continually evolving, so it is possible that older studies on gender stereotypes and emotion no longer represent typical child development.

In the present study, we examined two facets of children's meta-emotional knowledge. First, we asked whether 5 to 8-year-olds view emotion talk as a marker of social affiliation, a question related to what beliefs they hold regarding the *purpose* of emotion talk. Children saw cartoon stories involving three children. In each story, a main character talked about emotions with one character (emotion child) and did not explicitly mention emotions with another character (non-emotion child). Then, we asked children who they thought the main character usually affiliated with (e.g., played with at recess) and was friends with. We examined whether children believe emotion talk reflects social intimacy and, if so, hypothesized they would infer more that the main character has stronger affiliation with the emotion child than the non-emotion child. Second, we asked whether children hold gender stereotypes about emotion talk, a question related to the *rules* of emotion talk. Specifically, we examined children's beliefs about the frequency and acceptability of emotion talk in boys and girls. We assessed children's gender stereotypes about emotion talk with both implicit and explicit measures. In combination these examinations provide a window into the development of beliefs about the function of emotions and their potential differences from other epistemic knowledge

Method

Power analysis

A power analysis using G*Power (Faul et al., 2007) revealed that a sample size of 47 participants would achieve .95 power to detect a medium effect (Cohen's *d* = .50; alpha = .05) with a one sample t-test. We chose a sample size of 64 participants to allow for proper counterbalancing and stopped data collection once this usable sample size was reached.

Participants

The final sample consisted of 64 5 to 8-year-olds (M_{age} = 7.04_{years}, *SD* = 1.16_{years}; 32 boys and 32 girls) who were recruited from a university lab database and online advertisements. An additional eight children participated but were excluded from the study because they failed the memory check (*n* = 4, see below), did not finish the study (*n* = 3), or struggled to understand the task (*n* = 1). Sixty-one parents reported their child's race/ethnicity. For this subset, the sample was 40% White/non-Latino (*n* = 24), 20% Asian (*n* = 12), 20% multiracial (*n* = 12), 13% Latino (*n* = 8), 5% Black (*n* = 3), and 3% Native American Indian (*n* = 2). Fifty-seven parents reported education demographics; 89% of children (*n* = 51) had a parent with a bachelor's degree. Children received a $5 gift card as compensation for participation.

Procedure

Parents completed an online consent form, and children provided oral assent. Participants were tested individually via Zoom video chat. At the beginning of the study, the experimenter shared their computer screen with the participant. The stimuli was shown on the majority of the screen, and the participant and experimenter were visible to one another in a small box in the corner of the screen.

Emotion talk stories. The experimenter said that they were going to show the participant stories of children who went to school together. The stories were presented via PowerPoint slides that showed cartoon children on a white background with the story text at the bottom of the slide. Each child in the story was surrounded by a colored box that matched the color of the shirt the child was wearing (Figure 1), and the experimenter referred to the characters by their name and box color (e.g., *"Lucy in the green box"*).

When the participant was ready, the experimenter clicked a button, and the entire story played with pre-recorded audio. We used pre-recorded audio so that the amount of emotion conveyed by the narrator's voice was equated across participants. Participants viewed four stories. Each story featured three children — one child who shared personal information and two children who received the personal information. Each receiving child spoke to the sharing child one-on-one and asked what the sharing child did yesterday. This conversation occurred when the two children were alone on screen. One receiving child heard an emotion word (emotion child), and one receiving child did not hear an emotion word (non-emotion child). The sharing child shared emotional information with the emotion child (e.g., *"Sam said that he felt really sad* *yesterday. He lost his favorite toy."*). The sharing child shared similar information with the non-emotion child but did not use an emotion word when describing their day (e.g., *"Sam said that he went to the playground yesterday. He lost his favorite toy."*) The sharing child shared two pieces of information with both the emotion and non-emotion child. One piece of information was the same (e.g., *"lost his favorite toy"*), and one piece of information was unique (e.g., *"felt really sad"* vs. *"went to the playground"*). See Table1 for a summary of the stories. As such, the amount of shared information was equated. While both statements contained epistemic statements about that status of the world based on a prior experience, i.e., shared something good or bad, only one shared an explicit verbal declaration of an emotion.

To ensure our findings do not reflect a bias related to affective content, we manipulated the valence of the shared information and the gender of the characters in the stories. In two of the stories, the sharing child shared a positive experience with the receiving children. In two of the stories, the sharing child shared a negative experience with the receiving children. In addition, to examine the role of gender, the three children were girls in two of the stories, and the three children were boys in two of the stories. Thus, we had four distinct story trials — positive-girl, positive-boy, negative-girl, negative-boy. The order in which the story trials were presented was counterbalanced.

Memory questions. After each story, the experimenter asked participants if they remembered who the sharing child shared the non-emotional and the emotional information with. These memory questions served as a manipulation check. If children failed the memory questions for a story, then we dropped that story from the data analysis. Participants needed at least two valid story trials to be included in the final sample.

Social affiliation questions. After each story, participants answered three questions to assess participants' beliefs about the level of affiliation between the sharing child and the receiving children. The experimenter asked participants which receiving child the sharing child 1) played with at recess, 2) ate lunch with, and 3) was friends with. For example, "*Who do you think Sam usually plays with at recess? John in the red box or Charlie in the brown box?"* After each social affiliation question, the experimenter asked, "*Are you really sure or a little bit sure?"* to assess participants' confidence in their answer. We had missing data for 10 social affiliation questions because the participant skipped the question (n = 2) or chose both the non-emotion child and the emotion child (n = 8). We had missing data for 2 confidence questions because the participant skipped the question.

Implicit gender beliefs. To assess implicit beliefs about gender and emotion talk, after the story trials, the experimenter showed participants four new cartoon characters, two of whom were boys and two of whom were girls. Each cartoon character was surrounded by a colored box that matched their shirt (Figure 2). They then said, "*One of these kids talks about their feelings all the time. If you had to guess, do you think it's the one in the red box, yellow box, green box, or blue box?*" Next, the experimenter showed participants a different set of four cartoon characters. Again, two were boys and two were girls, and each was surrounded by a colored box. They then said, "*One of these kids never talks about their feelings. If you had to guess, do you think it's the one in the red box, yellow box, green box, or blue box?*" We considered this an implicit measure of gender beliefs about emotion talk since we never referenced gender. One child skipped the "never talks about their feelings" question.

Explicit gender beliefs. Lastly, the experimenter asked children a series of questions to assess their explicit beliefs about gender and emotion talk. The first questions focused on the acceptability of emotion, *"Is it okay for boys/girls to talk about their feelings?"* The experimenter asked about boys and girls separately, and after each question, the experimenter asked if it was "*really okay/not okay or a little bit okay/not okay?"*. The next questions focused on the frequency of emotion talk, *"How much do boys/girls talk about their feelings? Do you think they talk about them a lot, a little bit, or never?"* Again, the experimenter asked about boys and girls separately.

Results

Emotion sharing stories

We started with a broad analysis of the effect of emotion talk by examining the proportion of time that participants chose the emotion child on the social affiliation questions collapsed across all four stories. We compared this proportion (M = .53, SD = .19) to chance level (.50) with a one-sample t-test. This analysis was not significant, $t(63) = 1.37$, p = .19, 95% CI[.48, .58]. Overall, children were not more likely to choose the emotion child than the non-emotion child on the social affiliation questions.

We then conducted a more detailed analysis of the effect of emotion talk with a binomial logistic regression that included our experimental variables of interest. The model included response on each social affiliation question (emotion child, non-emotion child) as the dependent variable, story valence (positive, negative) as a within-subjects variable, story character gender (boy, girl) as a within-subjects variable, participant gender (boy, girl) as a between-subjects variable, and age as a covariate. Participant, social affiliation question, and trial type were included as random effects. We checked for interactions, and significant interactions were included in the final model.

There was a main effect of participant gender, X^2 (1, N = 64) = 4.85, p = .03, and age, X^2 (1, N = 64) = 5.22, p = .02. On average, girls chose the emotion child more than boys, and younger children chose the emotion child more often than older children, β = -0.19. These main effects were influenced by a significant interaction between participant gender and age, X^2 (1, N = 64) = 5.85, p = .02. Boys chose the emotion child less as they got older. In contrast, girls' choice of the emotion child stayed constant with age (Figure 3). There was no main effect of story valence, p = .68, or story character gender, p = .58.

Confidence questions. We examined children's confidence in their answers with the same binomial logistic regression model except that the dependent variable was children's responses to the confidence questions (really sure, a little bit sure). There was a main effect of story valence, X^2 (1, N = 64) = 4.12, p = .04, with children reporting more confidence on the negatively valenced stories. On average, children said they were "really sure" of their answer on 49% of the sad story questions compared to 42% of the happy story questions. There was also a main effect of age, X^2 (1, N = 64) = 5.05, p = .03. Children's confidence decreased with age, β = -0.74. There was no main effect of story character gender, p = .36, or participant gender, p = .94.

We examined the relationship between choosing the emotion child and children's confidence with a dummy-coded Pearson correlation. The correlation was not significant, p = .53, suggesting that it was not confidence that guided choosing the emotion versus the non-emotion child. The effect of emotion talk was not related to children's confidence in their responses.

Explicit gender beliefs

Emotion talk acceptability questions. We first looked at children's responses to the emotion talk acceptability questions. Overwhelmingly, children said that it was okay for both boys and girls to talk about their feelings. Only one child said it was not okay for girls to talk about their feelings, and three children said it was not okay for boys to talk about their feelings. Because so many children said it was okay for both genders to talk about feelings, we compared the number of children who said it was "really okay" for boys ($n = 50$) versus girls ($n = 53$) to talk about their feelings. A chi-square test was not significant, $p = .66$. There were no significant age or gender differences in children's responses (Table 2). Contrary to our hypothesis, children did not display strong gender beliefs about the acceptability of emotion talk.

We scored children's responses to the acceptability questions on a 4-point Likert scale and added these responses to the binomial regression model. Neither the boy-acceptability response, $p = .67$, nor the girl-acceptability response, $p = .25$, were significant predictors of choosing the emotion child. The effect of emotion talk was not related to children's beliefs about the acceptability of talking about emotions.

Emotion talk frequency questions. Next, we examined children's response to the emotion talk frequency questions. Eight children said that boys never talk about their feelings, while no one said that girls never talk about their feelings. More participants said girls talk about their feelings "a lot" ($n = 27$) than said boys talk about their feelings "a lot" ($n = 16$). This difference was marginally significant, X^2 $(1, N = 64) = 3.50$, $p = .06$. Thus, children may develop gender beliefs about the frequency of emotion talk earlier than gender beliefs about the acceptability of emotion talk. There were no significant age or gender differences in children's responses (Table 2).

We next added children's responses to the frequency emotion talk questions to the binomial regression model. We were interested in the interaction between story character gender and children's responses because this tested for a match between children's gender beliefs and their social inferences. There was a significant interaction between story character gender and response on the boy-frequency question, X^2 (2, N = 64) = 8.36, p = .02. As shown in Figure 4, for the stories featuring boy characters, children who said boys "never" talk about feelings chose the emotion child less than children who said boys talk about feelings a little bit", p = .04, or "a lot", p = .03. In contrast, for the stories featuring girl characters, children who said boys "never" talk about feelings did not differ from children who responded "a little bit", p = .22, or "a lot", p = .25. Children's beliefs about emotion talk in boys only predicted how they responded to a boy main character, not how they responded to a girl main character.

There was no significant interaction between story character gender and response on the girl-frequency question, p = .77. Children's explicit gender beliefs about boys, but not girls, predicted their social inferences based on emotion talk.

Implicit gender beliefs

We examined children's choice of a boy character versus a girl character on the two implicit gender beliefs questions. Although a greater number of children chose a girl character (n = 36) than a boy character (n = 28) when asked who always talks about feelings, a chi-square test was not significant, p = .22. A greater number of children chose a boy character (n = 34) than a girl character (n = 29) when asked who never talks about feelings, but a chi-square test was not significant, p = .48. The results were in the hypothesized direction even though they did not reach significance, suggesting that these stereotypes may be just emerging.

We further examined children's responses to the implicit gender beliefs questions with a binomial logistic regression model that included participant gender (boy, girl) as a between-subjects variable, age as a continuous covariate, and response on each implicit belief question as the dependent variable. We coded whether children's choice was gender stereotyped. Children received a score of 1 if they chose a girl character on the “always talks about their feelings” question and a 0 if they chose a boy character. Children received a score of 0 if they chose a girl character on the “never talks about their feelings” question and a 1 if they chose a boy character. There was no significant interaction between gender and age, so we did not include the interaction term in the final analysis. The model revealed no effect of participant gender, $p = .77$, but there was a marginal effect of age, X^2 (1, $N = 64$) = 3.45, $p = .06$. Older children made more stereotypical choices than younger children, $\beta = .30$.

Lastly, we examined whether children’s implicit gender beliefs predicted their responses on the social affiliation questions by adding children’s choices to the binomial logistic regression model. Neither the “always talks about their feelings” choice, $p = .99$, nor the “never talks about their feelings” choice, $p = .37$, predicted choosing the emotion child. In contrast to explicit beliefs, children’s implicit gender beliefs were not related to their inferences about social affiliation based on emotion talk.

Discussion

Although emotion talk has both interpersonal and intrapersonal benefits for adults (Rimé et al., 2020; Nils & Rimé, 2012), the social sharing of emotion in childhood has been relatively ignored. Here we examined children’s developing beliefs about emotion talk, specifically children’s social inferences about emotion talk and gender stereotypes surrounding emotion talk. Overall, at the group level, children did not make strong inferences about social affiliation based on emotion talk, but these inferences were influenced by several individual differences including age, gender, and explicit gender beliefs about emotion talk. As boys got older, they became less likely to infer that people who engaged in emotion talk were friends. In contrast, girls’ social inferences stayed constant with age. Additionally, children’s explicit gender beliefs about emotion talk predicted their social inferences; children who believed boys never engaged in emotion talk were the least likely to infer social affiliation based on emotion talk. These results suggest that children's meta-emotional beliefs about emotions and what talking about them reveals are complex and, for boys, rapidly changing. Between the ages of 5 and 8, boys start developing the belief that friends do not share feelings

One possible explanation for the age by gender interaction is that older boys are beginning to internalize stereotypes about emotion talk and responding based on how they think the main character should behave. In a series of interviews with high school boys, Oransky and Marecek (2009) found that boys viewed emotional expression as the antithesis of masculinity; the students believed that boys were not comfortable expressing emotions and would be teased if they chose to do so. By adolescence, boys engage in "policing masculinity" in which they enforce masculine norms, such as emotional stoicism, by punishing perceived rule-breakers (Reigeluth & Addis, 2021; Reigeluth & Addis, 2016). The older boys in our study may have perceived the relationship between the main character and non-emotion child as more consistent with traditional masculine relationships and so were more likely to choose the non-emotion child on the social affiliation questions than younger boys or girls.

Even girls and young boys, however, did not make robust inferences about social affiliation based on emotion talk. Overall, participants were at chance for choosing the emotion child versus the non-emotion child on the social affiliation questions. In contrast to our original hypothesis, perhaps young children view emotions as natural states that everyone experiences rather than privileged information that we share with close friends. A second possibility is that young children view sharing any valenced information as a marker of social affiliation. This study employed a strict methodological test of our hypothesis since the main character shared valenced information with both the emotion child and non-emotion child (e.g., lost their favorite toy) but only labeled their affective state with the emotion child (e.g., felt sad yesterday). A future study could explore this possibility by including a neutral child who does not hear any valenced information. If children truly do not view emotion talk as a marker of social affiliation, then they should be equally likely to infer that two people who share neutral information and two people who share valenced information are friends.

Children were more confident of their responses on the negatively valenced stories, but, surprisingly, the valence of emotion talk did not affect children's social inferences. Children were equally likely to choose the emotion child when the main character disclosed feeling happy as when the main character disclosed feeling sad. Previous work found that children are sensitive to the valence of emotion talk when making social affiliative choices and prefer someone who shares positive emotions over someone who shares neutral information (Ransom et al.). These conflicting findings suggest that children may be more attentive to valence when making judgements for themselves than when making judgements about others.

Contrary to lay beliefs, children in this study did not demonstrate gender stereotypes about emotion talk. The majority of boys and girls said it was "really okay" for both boys and girls to talk about feelings. Future work could gain a better understanding of the development of children's beliefs about gender and emotion talk by examining a larger age range. We found that children's implicit gender beliefs became marginally more stereotypical with age, suggesting that this age range (5 to 8-years) may be when gendered beliefs about emotion talk are just starting to emerge. Interventions aimed at preventing the formation of gender stereotypes about emotion talk might want to target early childhood rather than adolescence when beliefs are already formed. This might be especially beneficial for boys since they are at risk for developing harmful stereotypes about emotion talk (Oransky & Marecek, 2009).

This study sought to examine children's burgeoning meta-emotional development by examining children's beliefs about emotion talk. Just as metacognition work made great strides in understanding children's thinking about cognition, meta-emotional work can grant a more thorough understanding of children's thinking about emotions. Although a distinct construct, meta-emotional development is likely related to children's developing emotional comprehension. Pons et al. (2004) identify nine areas in which children develop emotional comprehension, including the ability to label emotions based on facial expressions, engage in emotion regulation, and understand that emotions have external causes. For example, when asked how a character in a story feels after his pet died, most 5-year-olds respond that the character feels sad (Pons et al., 2004). Although this demonstrates a basic emotional comprehension of sadness, meta-emotional research could explore more sophisticated beliefs about sadness (e.g., Is sadness ever helpful?) and if these beliefs relate to positive outcomes such as emotional intelligence or high-quality friendships. The findings reported here offer an initial step towards understanding children's developing beliefs about the function of emotion talk and provide insight into how individual differences impact meta-emotional development.

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Appendix

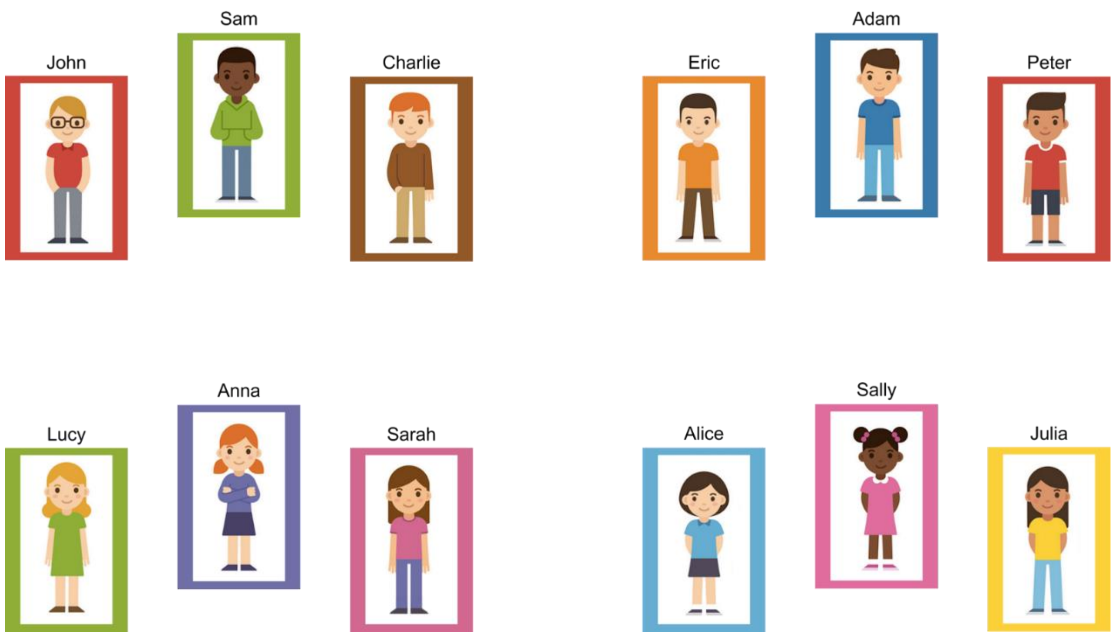

Figure 1. *Trios of cartoon characters used in the four emotion talk stories.* Children heard a different story for each trio. The story assigned to each trio was counterbalanced across participants.

	Information Shared with Emotion Child	**Information Shared with Non-Emotion Child**
Positive Story 1	Sam said that he felt really happy yesterday. He watched a fun movie.	Sam said that he went to the movies yesterday. He watched a fun movie.

Positive Story 2	Sam said that he felt really happy yesterday. He got a new book.	Sam said that he went to the bookstore yesterday. He got a new book.
Negative Story 1	Sam said that he felt really sad yesterday. He lost his favorite toy.	Sam said that he went to the playground yesterday. He lost his favorite toy.
Negative Story 2	Sam said that he felt really sad yesterday. He fell and hurt himself.	Sam said that he went to the park yesterday. He fell and hurt himself.

Table 1. *Summary of the four emotion talk stories.* In each emotion talk story, the emotion child and non-emotion child asked the main character what they did yesterday, and the main character shared a unique piece of information with each child.

Figure 2. *Cartoon characters used in the implicit gender beliefs questions.* The four characters on the left were used in the "talks about their feelings all the time" question. The four characters on the right were used in the "never talks about their feelings" question.

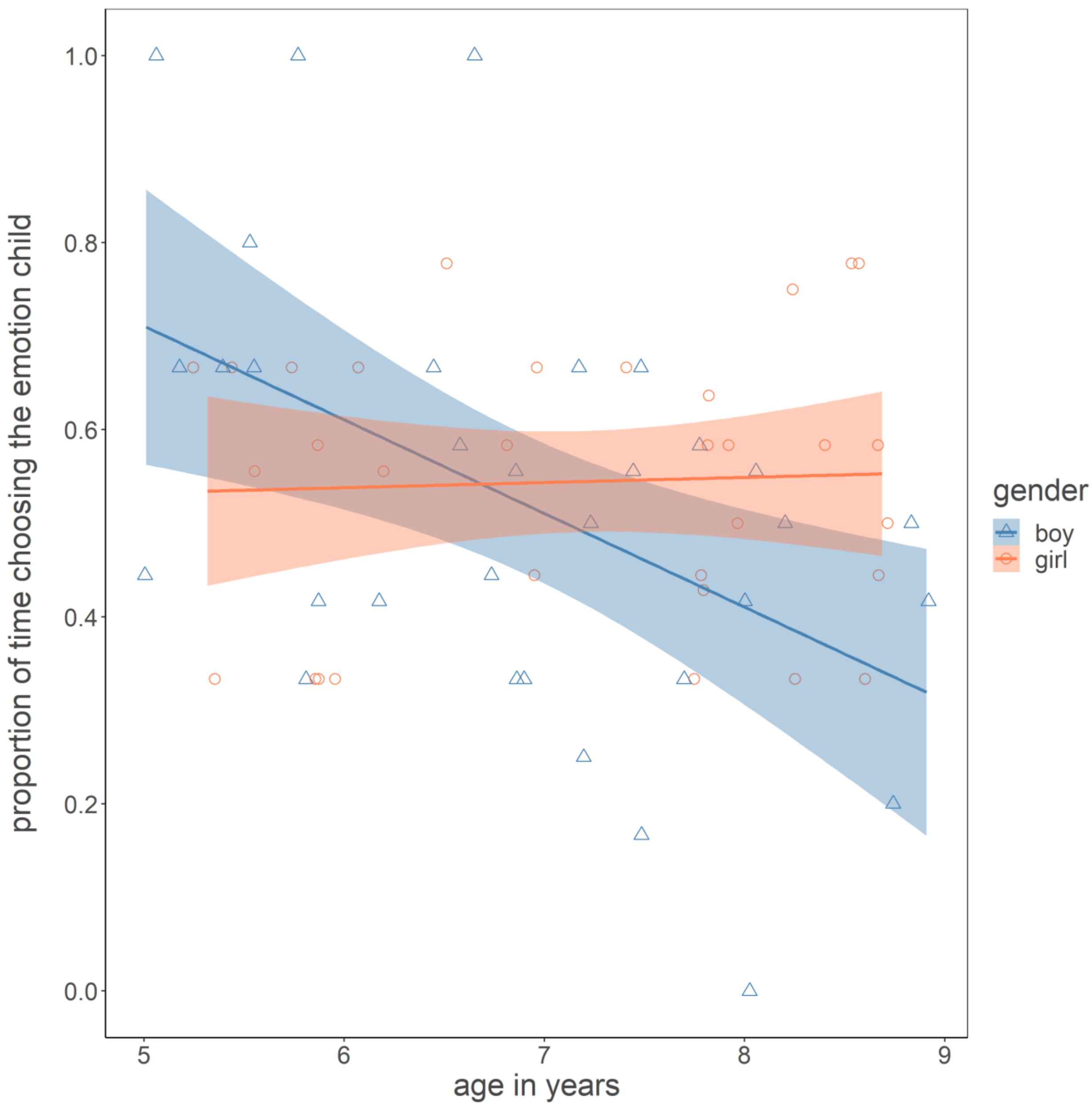

Figure 3. *Age by participant gender interaction on social affiliation questions.* Girls' social inferences based on emotion talk stayed constant with age, while boy's social inferences based on emotion talk decreased with age.

	Is it okay for boys to talk about their feelings?	Is it okay for girls to talk about their feelings?	How much do boys talk about their feelings?	How much do girls talk about their feelings?
Participant gender	$p = .48$	$p = .10$	$p = .70$	$p = .86$
Age	$p = .68$	$p = .94$	$p = .83$	$p = .62$
Gender*Age	$p = .52$	$p = .14$	$p = .70$	$p = .70$

Table 2. *Testing for gender and age differences on the explicit gender beliefs questions.* We conducted a linear regression analysis for each explicit gender beliefs question that included participant gender, age, and the interaction term in the model. There were no significant effects of gender or age nor any significant interactions, p's > .05.

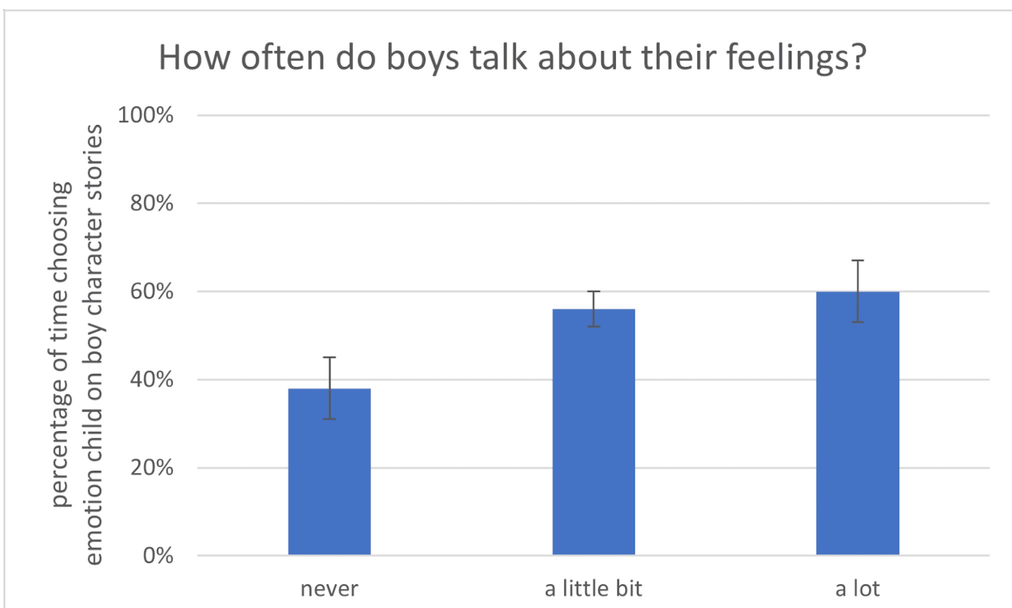

Figure 4. *Explicit gender beliefs about emotion talk frequency and choosing the emotion child.*

Children who said that boys “never” talk about feelings chose the emotion child significantly less on the boy character stories than children who said boys talk about feelings “a little bit” or “a lot”. Error bars represent standard error.

DISCUSSION

In three chapters, this dissertation presented studies that explored distinct aspects of human social communication, specifically how shared information about mental states impacts children's visuospatial and socioemotional learning. Chapter 1 examined the intersection between visual and social perspective taking in preschoolers and adults and demonstrated that an observational perspective that facilitates sharing mental states (i.e., face-to-face) can overcome inherent differences in visual perspective during learning. Incredibly, the simple act of sitting face-to-face during visuospatial learning could facilitate innovation over strict mimicry, suggesting that knowing what someone is thinking may be more important than knowing what someone can see for some types of learning. Chapters 2 and 3 turned to a different type of shared mental state — verbally shared information about emotions (i.e., emotion talk). In three studies, Chapter 2 demonstrated that 5 to 8-year-olds attend to verbally shared emotional information and use it when making social decisions for themselves. Furthermore, children are sensitive to the valence of emotion talk and, rather than a simple aversion towards negative emotions, consider the broader context in which sadness is shared. Chapter 3 demonstrated that children's inferences about social affiliation based on emotion talk vary as a function of gender and age. While girls' inferences stay constant across early childhood, boys become less likely to associate friendship and emotion talk with age. Five to eight-year-olds did not show strong gender stereotypes about the acceptability of emotion talk, but stereotypes about the frequency of emotion talk appear to be emerging and predict children's social inferences. Together, these findings demonstrate children's sensitivity to others' mental states in a variety of contexts and have important implications for children's visuospatial and socioemotional learning.

Chapter 1: Implications for Visuospatial Learning

Imitation is often considered the gold standard within social learning. Humans imitate; other animals do not. Thus, imitation is special. However, imitation and innovation work together to allow for both cultural transmission and cultural evolution. Without innovation, a society becomes stagnant. Breakthroughs in art, science, and technology require a movement beyond imitation to innovation. Although imitation is the goal in some educational settings (e.g., learning to spell), fostering innovation may be crucial in educational settings that require creativity and problem solving (e.g., working on a science fair project). The findings reported in the first chapter suggest that we may be able to improve students' innovation by manipulating observational viewpoint during learning. For both adult and child learners, an observational viewpoint that fostered social perspective taking resulted in more self-sufficiency and originality; these participants were more likely to discover a novel solution to the puzzle box rather than rely on the model's solution. They were also faster at opening the puzzle box. Thus, the boost to innovation did not come at the cost of learning. Accordingly, it may be advantageous to consider observational viewpoint and the visibility of a teacher's face when designing classroom layouts or educational videos.

Beyond manipulating the educational environment, we also may be able to foster children's innovation by encouraging an exploratory mindset. Future studies could explicitly encourage learners to innovate versus imitate. Humans are born imitators (Meltzoff & Moore, 1977), but innovation comes less naturally to us (Rawlings & Legare, 2021). By making innovation rather than imitation the goal in a learning situation, we can give students practice with this crucial skill. For example, after demonstrating how to open a puzzle box, the model could instruct learners to either open the puzzle box in the same manner or to discover a new solution. This methodology would allow for a systematic examination of the benefits of imitation versus innovation. Perhaps learners do best when first allowed to imitate and then asked to innovate. In contrast, learners who first imitate might get stuck in an imitative mindset and find it difficult to switch to innovation. If this is the case, then it would be best to start with innovation. Additionally, this might change as a function of age and the difficulty of the task, which could be investigated as well.

Chapters 2 and 3: Implications for Socioemotional Learning

While the findings from Chapter 1 have implications for traditional learning, the findings from the last two chapters have implications for children's socioemotional learning and development. Chapter 2 offers some of the first evidence that emotion talk is utilized early in life and is not restricted to adolescent and adult social relationships. This early sensitivity to emotion talk suggests that verbal emotional communication may come naturally to humans; we do not need years of practice with emotion talk before we integrate it into our social lives. By 5-years, children consider emotion talk when making social choices for themselves such as who to play with. Additionally, Chapter 2 demonstrates that children are not always averse to negative emotions. Children were equally willing to associate with a neutral child and a child who shared a sad experience when the negative emotion was presented in the context of social isolation during the COVID-19 pandemic. One explanation for this finding is that perceived similarity mitigates the effect of negative emotions because the child participants were also experiencing social isolation due to the COVID-19 pandemic. Future work could explore how other forms of similarity impact children's openness to negative emotions. For example, highlighting social similarity might be a way to encourage children to interact with someone experiencing sadness. A critical question to answer will be whether the type of similarity matters. Superficial similarities (e.g., shirt color) may be less effective than focusing children's attention on more enduring and socially meaningful similarities (e.g., gender, language group). Ultimately, the goal would be to foster empathy regardless of social group. One way to do this might be to encourage children to think about the similarities between themself and children outside of a traditional social group by highlighting universal similarities. For instance, all children have parents and enjoy playing. In this way, all children become part of a single social group.

A second explanation is that children consider the cause of an emotional event and not just the emotion itself when evaluating emotion talk. In other words, children are sensitive to appraisals as well as emotions. When the sad child was unable to play their favorite game or eat their favorite breakfast (a “no-gain” framing), children preferred a neutral child. When the sad child was unable to see their friends and missed their friends (a “loss” framing), children showed no social preference. Thus, children’s social preference changed according to the sad child’s situation. A loss framing may be especially likely to promote a more empathetic response when the loss is a social one like being unable to see friends. In contrast, a non-social loss, such as losing a favored possession, might not produce the same result. Future work could examine this systematically by introducing two children who both share a sad experience but vary the type of sadness experienced (e.g., no-gain, social loss, non-social loss). If young children are not sensitive to emotional appraisals, then they should respond the same to all types of sadness.

An open question is why children were highly sensitive to the valence of emotion talk in Chapter 2 but not in Chapter 3. One possibility is that children are more attentive to valence when they are thinking about themselves than when they are thinking about others. In Chapter 2, we asked children who they wanted to affiliate with. In contrast, in Chapter 3, we asked children who they thought a third party usually affiliated with. A second possibility is that the effect of valence differs according to different functions of emotion talk. Emotion talk has both a social-affiliative function and a cognitive function. Sharing emotions helps us bond with others (Laurenceau et al., 1998), but we also use emotions to interpret and make inferences about persons, events, and situations (van Doorn et al., 2015; van Kleef, 2009). In Chapter 2, emotion talk was serving a social-affiliative function; children were choosing a social partner. In Chapter 3, emotion talk was serving a cognitive function; children were using emotion talk to make inferences about others' relationships. Valence may be most important when we are using emotion talk to evaluate potential social partners.

The findings in Chapter 3 suggest that children's gender beliefs about emotion talk are still emerging during early childhood. Therefore, this may be the best period in which to develop interventions to prevent the development of harmful gender beliefs about emotion talk. In Chapter 3, children's explicit gender beliefs about how often boys talk about emotions predicted choosing the non-emotion child in the stories featuring boy characters. In other words, children who endorsed gender stereotypes about emotion were less likely to infer that boys who shared emotions were friends. By adolescence, boys already have damaging beliefs about emotion talk and engage in destructive "policing masculinity" behaviors (Reigeluth & Addis, 2021). It may be easier to prevent these beliefs from developing than to undo them once they are fully developed. One option is to design interventions that give boys same-gender role models who talk about their emotions. The belief that men do not or should not talk about emotions is deeply woven in Western culture (Shields, 2002). However, the first step towards reversing these beliefs might be to give boys counterexamples. Children's choice of musical instruments becomes less gender-stereotyped when they are shown counterexamples (e.g., a woman playing the trumpet) (Pickering & Repacholi, 2002). Although beliefs about emotion talk are more nuanced and complex than musical instrument choice, nonetheless, providing examples of men engaged in emotion talk may be one strategy for combatting the gender stereotypes surrounding emotion talk.

Conclusion

Humans have a powerful ability to learn from one another, which has allowed us to flourish as a species. The information we acquire from and share with others is not limited to one specific domain, but, rather, can take a variety of forms. This diversity of information makes information sharing a vehicle for both physical (e.g., tool use) and mental (e.g., religious beliefs) cultural transmission. However, the divide between physical and mental is not always strict, as shown in Chapter 1. Both adults and children displayed better visuospatial learning from an observational viewpoint that encourages reading someone's mental states, specifically their goals. Chapter 2 showed how verbally sharing another type of mental state — information about one's emotions — shapes children's social choices and liking, while Chapter 3 elucidated the individual differences (i.e., age and gender) that impact children's developing beliefs about emotion talk. Together, these findings demonstrate children's sensitivity to others' subjective mental states and how they use this information to learn about both the physical and social world.

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