Not seeing it: What young children don't understand about attention

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Abstract

Do children understand that people vary in how attentive they are and recognize that people prefer attentive social partners? Across six experiments, we showed participants one agent engaging attentively with a child puppet and another who was distracted throughout the interaction. Across four experiments, four and five-year-olds (total N= 132; overall mean: 4.85; range: 4.0-5.9 years) failed to distinguish the agents. Six and seven-year-olds (total N=131; overall mean: 7.01; range: 6.0-7.9 years) succeeded given repeated interactions but not robustly: fewer than half the children consistently chose the attentive agent. By contrast, adults succeeded given a single demonstration. Children's difficulty was not due to task demands; four and five-year-olds readily distinguished agents who did and did not satisfy the puppet's desires. Thus, although children understand attention as a discrete mental state very early in development, and react negatively when adults are not responsive, children may be relatively insensitive to cues to attention as a continuous mental state.

Keywords: Social attention; social cognition; development

Introduction

One of the classic studies in developmental psychology is the "still face" paradigm (Weinberg & Tronick, 1996): an adult interacts with a baby – and then simply assumes a neutral expression and stops responding to the infants' bids for attention. Babies as young as two months begin showing signs of distress almost immediately. Attentive, responsive parenting predicts children's health and developmental outcomes around the world (Eshel, Daelmans, Mello, & Martines, 2006). In addition to the effect of stable patterns of caregiver responsiveness and attunement, children are also sensitive to moment-to-moment attentiveness. Recent studies of adult media and cell phone use suggest that young children respond to distracted caregivers with everything from increased physiological stress responses (Porter et al., 2024) to reduced learning and question-asking (Herbst, Cruz, Bower, Hirsh-Pasek, & Golinkoff, 2022; Reed, Hirsh-Pasek, & Golinkoff, 2017) to increased acting out and "attention-seeking" behavior (McDaniel & Radesky, 2018; Kildare & Middlemiss, 2017; Kirkorian, Pempek, Murphy, Schmidt, & Anderson, 2009; Radesky et al., 2015).

A separate line of work suggests that children are sensitive to others' visual attention. Infants begin engaging in joint attention with caregivers between nine and ten months (Scaife & Bruner, 1975; Carpenter, Nagell, Tomasello, Butterworth, & Moore, 1998; Moore, Dunham, & Dunham, 2014; Tomasello, 2014). By 12 months, infants track changes in others attention and recognize when someone is paying attention to a novel object (Tomasello & Haberl, 2003; Woodward, 2003) and connect seeing with knowing in the second year of life (Poulin-Dubois & Chow, 2009; Poulin-Dubois, Sodian, Metz, Tilden, & Schoeppner, 2007). Toddlers selectively point to communicate the location of a target their parent did not see (O'Neill, 1996; O'Neill & Topolovec, 2001) and preschoolers are more informative when their conversational partner lacks visual access to a scene (Matthews, Lieven, Theakston, & Tomasello, 2006). Preschoolers can also compare agents who did and did not see something and infer their knowledge accordingly (Perner & Ogden, 1988; Pillow, 1989; Povinelli & DeBlois, 1992; Pratt & Bryant, 1990; Ruffman, 1996; Wimmer, Hogrefe, & Perner, 1988; Woolley & Wellman, 1993).

Work on children's sensitivity to adult attentiveness (as defined by sensitive, prompt, contingent responding) and work on children's sensitivity to attention (as defined by tracking agent's gaze) are connected in that attentive social partners may be expected to engage in mutual gaze, and joint attention more consistently than distracted partners. However, although children respond to both others' attentiveness and what they are attending to, we only know that children *understand* the latter. As reviewed above, it is clear that by four and five, children not only track others' visual attention, they use this to draw a wide range of inferences from deciding who knows what, to whom to ask for help, to what someone will do next. By contrast, although it is clear that children's stress levels, learning, and emotion regulation vary depending on whether they have attentive or distracted caregivers, none of these responses require that children understand attentiveness per se: distinguishing attentive and distracted agents, or recognizing that attentive people make better social partners. One reason to suspect that children might understand what others are attending to but fail to understand attentiveness is that attentiveness is a continuous mental state: People can be more or less attentive and people's attention can fluctuate depending on both internal (e.g., level of interest, energy, competing demands) and external factors (e.g., (environmental distractors). As measured by psychophysicists, the same is true of visual attention (Esterman, Noonan, Rosenberg, & DeGutis, 2013). However, as studied in developmental research, children's understanding of what others are attending to is almost always treated as a discrete state: whether someone sees something or not.

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In the experiments to follow, we examine whether children distinguish between attentive and distracted agents. We capitalize on the early understanding of attention as gaze and compare one agent who engages in mutual and joint attention with a puppet and another agent who repeatedly breaks attention with the puppet to look at her phone or a magazine. To ensure that the experimental contrast between attentive and distracted agents is readily observable, we first test adults (Exp 1). We then run a series of experiments (Exp 2-5) adding cues, or simplifying task demands, to try to support children's success. To foreshadow, four and five-year-olds failed to distinguish attentive and distracted agents in all experiments, and six and seven-year-olds succeeded, but their ability to make the distinction was surprisingly weak. In Experiment 6, we run a closely matched control experiment (comparing agents who do or do not respond to what the puppet wants) to ensure that children's limitations are due to their understanding of attentiveness and not performance limitations.

Experiment 1

Methods

Participants 34 adults were recruited via Prolific and paid $15/hour prorated for completing the study. Adults were fluent English speakers from the United States, and gave informed consent. One participant was excluded for failing an attention check question ("click the giraffe"; n=1). N = 33 adult participants were included in the analysis.

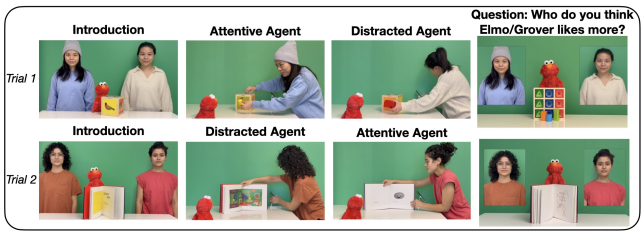

Figure 1: Example Design for Experiment 1.

Materials and Procedures Each participant received two test trials (see Figure1 as an example). In each trial, participants watched a video of two adult agents interacting with a puppet. The two agents in each trial were introduced as twin sisters and played by the same person with different clothing and hairstyles. We controlled the duration of interaction, affect, facial expression, and speed of conversation across the attentive and distracted agents so they differed only in that the attentive agent maintained eye contact or engaged in joint attention with the puppets throughout, whereas the distracted agent kept shifting their attention away from the puppet to their phone. In the first trial, the two agents took turns demonstrating a toy to the puppet. Participants were asked which agent they thought the puppet liked playing with more. In the second trial, two different agents each read a storybook to the puppet and participants were asked which agent they thought the puppet liked reading with more. After the second trial, participants were asked which agent looked at their phone more. The order in which the attentive and distracted agents were introduced was counterbalanced.

Results and Discussion We conducted a one-tailed binomial test to determine whether the proportion of participants who chose the attentive agent in both trials was greater than chance (25%). Adults preferred the attentive agent: 24 out of 33 (73%) selected the attentive agent in both trials (one-tailed binomial: 95% bootstrapped CI=[0.58,0.88], $p < .001$)(Figure2a). Additionally, 78.8% of participants correctly answered the manipulation check question about which agent looked at their phone more. Among those who passed the manipulation check, 81% chose the more attentive agent in both trials.

Experiment 2

Experiment 1 shows that adults have no difficulty distinguishing attentive and distracted agents and infer that others will prefer the attentive one. What about young children?

Methods

Participants Children were recruited through and tested on the asynchronous online testing platform Children Helping Science (Scott & Schulz, 2017). The data were collected in two consecutive stages. First, forty-eight 4-5-year-olds participated in the study. Fifteen child participants were excluded from the analysis for failing more than one warm-up trial (n=6), technical difficulties (n=1), failure to complete the study (n=2), or failing to point or unclear pointing in any test trials (n=6). N = 33 child participants (M = 4.8, range = 4.0-5.8 years) were included in the analysis. Second, thirty-nine 6-7-year-olds participated in the study. Six child participants were excluded for technical difficulties (n=2) or failure to complete the study (n=4). N = 33 child participants (M = 6.9, range = 6.0-7.9 years) were included in the analysis.

Materials and Procedures The experiment began with four warm-up trials to familiarize children with pointing at the screen. In each trial, Elmo appeared in the center, with two familiar objects (e.g., a flower, bananas) on either side. Participants were asked to point to the named object. Participants who failed to point correctly or whose pointing responses were unclear on more than one trial were excluded. The rest of the experiment was identical to Experiment 1.

Results and Discussion Children were recruited and tested in two age bins so we report the results for younger (four- and five-year-old) and older (six- and seven-year-old) children separately. Four- and five-year-olds chose between the attentive and distracted agents at chance, with only 10 out of 33 children (30.3%) choosing the attentive agent in both trials (one-tailed binomial test: 95% bootstrapped CI = [0.15, 0.46], $p < .3$). Six- and seven-year-olds also failed to show a preference (10/33 children preferred the attentive agent in both trials (30.3%); one-tailed binomial: 95% bootstrapped

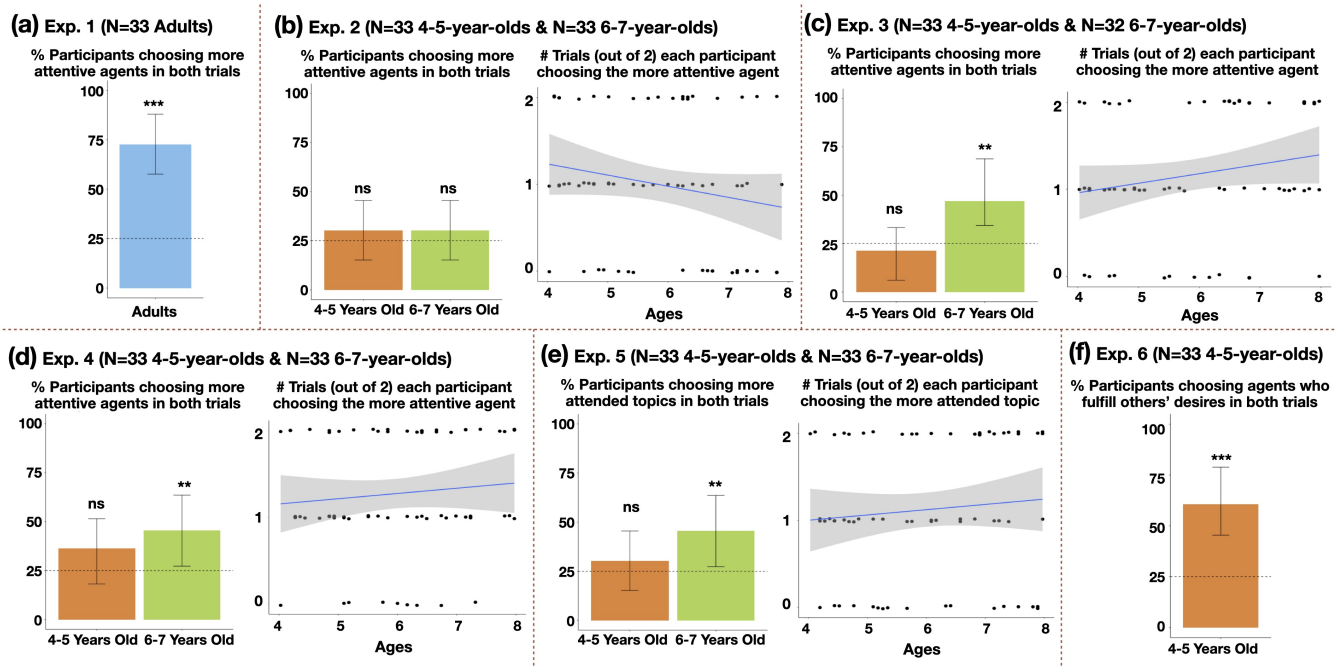

Figure 2: Results for each experiment.

CI=[0.15,0.46], $p < .3$). Collapsing across groups, there was no effect of age on children's performance (Figure2b). The mixed-effect logistic regression predicting the choices of attentive or distracted agents from age (in months), with random intercepts for subjects, did not explain significant additional variance (likelihood ratio test $\chi^2(1) = 2.72, p < .1$) compared to the intercept-only model.

Only the older children were asked the manipulation check question. Among those who responded, only 40% answered correctly and 48% responded that both agents spent the same amount of time looking at their phones. The remaining children either said they did not know or chose the opposite agent. Of the six and seven-year-olds who passed the manipulation check, only 50% chose the more attentive agent in both trials.

The manipulation check was asked at the end of the second trial so children's failure to answer correctly may have reflected children's failure to remember which agent was more distracted rather than their failure to distinguish the agents. However, given the brief delay between the test trial and the manipulation check, it is more likely that children struggled to distinguish the attentive and inattentive agents, and even to the degree that they did, both older and younger children failed to use attentiveness as a basis for preference judgments.

Experiment 3

In Experiment 2, children saw only a single interaction per trial—either a toy demonstration or a story reading—each lasting less than one minute. It is possible that the brief exposure was not enough for them to notice or evaluate the differences in the agents' attentiveness. Furthermore, transient differences in agent's attention might not warrant choosing between them; children might need more evidence that the difference in attentiveness was a stable distinction between agents. To address this, in Experiment 3, we presented children with multiple interactions per trial, giving children more evidence and time to detect attentional differences.

Methods

Participants Children were tested asynchronously on Children Helping Science. The data were again collected in two consecutive stages. First, forty-one 4-5-year-olds completed the study. Eight participants were excluded for technical difficulties (n=2) or looking away from the screen for more than 8 consecutive seconds (n=6). N = 33 child participants (M = 4.8, range = 4.0-5.9 years) were included in the analysis. Second, forty-two 6-7-year-olds completed the study. Ten participants were excluded for technical difficulties (n=3), looking away from the screen for more than 8 consecutive seconds (n=6), or duplication (n=1). N = 32 child participants (M = 7.1, range = 6.1-7.9 years) were included in the analysis.

Materials and Procedures The experiment was similar to Experiment 2 except that one agent participated in three unique interactions and then the second agent was introduced. The three interactions were demonstrating a toy, reading a story, and having a conversation; the specific toy, part of the story, and topic of conversation differed but were matched for total time. During the interactions, one agent paid undivided attention to the puppet; the other looked back and forth at her phone. Then, participants were asked to choose the person that the puppet liked more. The second trial was identical

to the first, except that participants saw two different agents demonstrate another toy, read another story, and talk with another puppet. Again, one agent paid full attention to the puppet, while the other frequently looked at her phone and participants were asked to choose the agent they thought the puppet liked more. After their choice in the second trial, participants were asked which agent looked at their phone more.

Results and Discussion Four- and five-year-olds showed no preference (7/33 chose the attentive agents (21.2%); one-tailed binomial: 95% bootstrapped CI=[0.06,0.33], $p < .8$) but this time, six- and seven-year-olds preferred the attentive agents (15/32 (46.9%); one-tailed binomial: 95% bootstrapped CI=[0.34,0.69], $p < .01$) although combining both age groups, there was no significant effect of age on children's choices (Figure2c). A mixed-effects logistic regression predicting agent choice based on age did not explain significantly more variance than the intercept-only model (likelihood ratio test $\chi^2(1) = 2.68, p = .1$).

On the manipulation check question, only 23% of four- and five-year-olds answered correctly, and 40% believed both agents spent the same amount of time on their phones. The remaining children either said they did not know or chose the opposite agent. Among those who answered the manipulation check correctly, only 43% consistently chose the more attentive agents. Six- and seven-year-olds performed slightly better, with 46.9% answering correctly and 34% believing both agents looked at their phones equally. Of those who passed the check, 67% consistently chose the more attentive agent.

The results suggest that six- and seven-year-olds begin to distinguish the relative attentiveness of agents and use it as a basis for preference judgments. However, their preference for the more attentive agent was relatively weak, with fewer than half of the six- and seven-year-olds selecting the attentive agents in both trials. Results from the manipulation check indicate that both younger and older children also struggled to notice or remember which agent was more attentive.

Experiment 4

Experiments 2 and 3 suggest that children struggle to distinguish attentive and distracted agents or treat attentiveness as a basis for other's preferences. In Experiment 4, we tested whether children might be more successful if we explicitly introduced the adults as a caregiving role, where children might be especially likely to notice and value attentive agents.

Methods

Participants The data were collected on Children Helping Science in two consecutive stages. First, forty-eight 4-5-year-olds completed the study, with fifteen excluded due to warm-up trial failures (n=3), technical issues (n=4), parental interference (n=3), or unclear pointing in any test trials (n=4), leaving N = 33 participants (M = 4.96, range = 4.0-5.8 years) in the analysis. Second, fifty 6-7-year-olds completed the study, with seventeen excluded for warm-up trial failures (n=4), technical difficulties (n=4), parental interference (n=2), or unclear pointing (n=7). N = 33 child participants (M = 6.94, range = 6.0-7.9 years) were included in the analysis.

Materials and Procedures The design was identical to Experiment 3, with one modification: the test question now asked participants to choose who they thought should be the puppet's babysitter.

Results and Discussion Four and five-year-olds were again equally likely to choose the attentive and distracted agents (12/33 (36.4%); one-tailed binomial: 95% bootstrapped CI=[0.18,0.52], $p = .1$). Six and seven-year-olds preferred the attentive agents (15/33 (45.5%); one-tailed binomial: 95% bootstrapped CI=[0.27,0.64], $p < .01$). However, there was again no significant effect of age on children's choices (Figure2d), and a mixed-effects logistic regression including age as a predictor did not explain additional variance (likelihood ratio test $\chi^2(1) = 0.69, p = .41$) compared to the intercept-only model.

We asked the manipulation check question only of the older children: 46.9% responded correctly and 34.4% believed both agents looked at their phones equally. The remaining children either said they did not know or chose the opposite agent. Among those who passed, only 48% consistently chose the more attentive agent.

The results mirrored those of Experiment 3, showing that by ages six and seven, children are sensitive to variations in attentiveness between agents and use this information to guide their preferences and decisions. However, this preference remained weak, with fewer than half consistently choosing the attentive agents and fewer than half correctly identifying the more distracted agent in the manipulation check.

Experiment 5

Young children are thought to be highly sensitive to adults' attention, so why did they seem oblivious to the cues to attentiveness in our study? One possible reason is that we used a minimal contrast to differentiate the agents. Although the agents differed in the extent to which they made eye contact with the puppets and engaged in joint attention (versus looking at their phones), they were otherwise matched in all respects. Although we know that young children are sensitive to eye gaze as a cue to what agents can see (and infer that seeing leads to knowing), our experimental manipulation arguably created an unrealistic portrayal of distraction, as real-life inattentiveness often involves not only reduced coordination of gaze but also less responsive interactions, reduced affect, and longer latency to respond. Though the minimal manipulation was useful in isolating attention and joint attention from other factors, the subtle behavioral differences may have had a correspondingly limited impact on children.

Additionally, the current study design required children to track attentiveness differences between agents. Although presenting the agents as identical twins eliminated nuisance factors that might have affected children's preferences, this manipulation might have made it harder for children to distin-

guish and remember who was who, adding a cognitive load that could have affected their sensitivity to attentiveness cues. In Experiment 5, we addressed these issues by using only a single agent and incorporating additional cues to agent distraction including reduced affect and longer response delays.

Methods

Participants Children were tested asynchronously on Children Helping Science. N=33 four- and five-year-olds (M = 4.85, range = 4.03-5.84 years) and N=33 six- and seven-year-olds (M = 7.10, range = 6.08-7.97 years) were included in the analysis. Seven four- and five-year-olds were excluded for looking away from the screen for longer than 8 consecutive seconds (n=5) and technical difficulties (n=2). Ten six- and seven-year-olds were excluded for looking away from the screen for longer than 8 consecutive seconds (n=7), parental interference (n=1), technical difficulties (n=1), and being outside the age range (n=1).

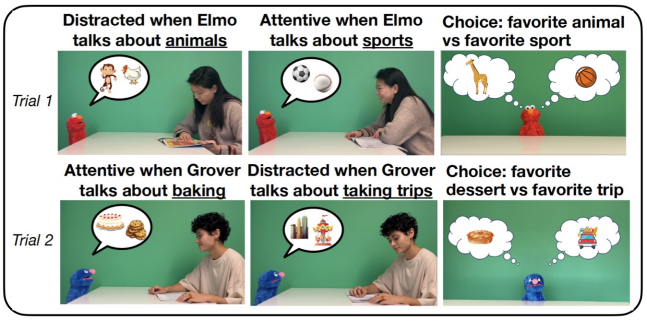

Figure 3: Example Design for Experiment 5.

Materials and Procedures Each participant received two trials (see Figure3 for an example). In the first trial, Elmo talked about two topics: animals and sports, interleaving the conversation so they discussed the topics in an ABAB order: the adult gave full attention to the puppet during one topic (e.g., sports) but was distracted, flipping through a magazine, during the other topic (animals). Distracted agents also showed longer delays in verbal and physical responses (e.g., nodding) and displayed reduced affect. The order of topics was fixed but which topic received attention or distraction was counterbalanced across participants. After the adult briefly left and returned, children were asked to choose which topic Elmo should discuss next: animals or sports. The second trial followed the same structure but featured a different puppet, a new adult, and two new topics (baking and taking a trip). As a final manipulation check, participants were asked which topic the agent paid more attention to in the second trial.

Results and Discussion Four and five-year-olds chose at chance between the topic (10/33 children chose the more attended topic in both trials (30.3%); one-tail binomial test against 25% chance: 95% bootstrapped CI=[0.15,0.46],$p = .3$), but six- and seven-year-olds selected the attended-to topic (15/33 children (45.5%); one-tail binomial test against 25%: 95% bootstrapped CI=[0.27,0.64],$p < .01$). Collapsing across groups, age had no significant effect on children's performance, and a mixed-effects logistic regression including age as a predictor did not explain additional variance compared to the intercept-only model (likelihood ratio test $\chi^2(1) = 0.32, p = .57$) (Figure2e).

The manipulation check question was a forced choice between the topics: 57.6% of four- and five-year-olds answered correctly. Among those who answered correctly, only 26.3% (5/19) consistently chose the more attentive agent; of the six and seven-year-olds, 66.7% answered the manipulation check question correctly. Of those who passed the manipulation check, 54.5% chose the more attentive agent in both trials.

Again, these results suggest that by the age of six and seven, children are beginning to track agents' attentiveness and are sensitive to the co-variation between the agents' attentiveness and the topics of conversation. The older children tended to choose the topics that engaged the adults' attention more effectively. However, even given redundant cues to attentiveness (eye gaze, latency to respond, and affect) children's success remained relatively fragile.

Experiment 6

The results of Experiments 2-5 surprised us. Given children's early sensitivity to visual attention, and children's reactions to adult inattentiveness, we expected that children would have no difficulty distinguishing the attentive and distracted agents and inferring a preference for the attentive agent. One possibility is that children struggled to draw inferences about social interactions in this online, asynchronous task. To test this, we used the same design but a contrast we believed even the younger children should understand: adults who did and did not satisfy the puppets' desires.

Methods

Participants Thirty-seven 4-5-year-olds were recruited and tested asynchronously on the Children Helping Science. Four participants were excluded from the analysis for incompletion (n=2), or technical difficulties (n=2). N = 33 participants (M = 4.9, range = 4.0-5.9 years) were included in the analysis

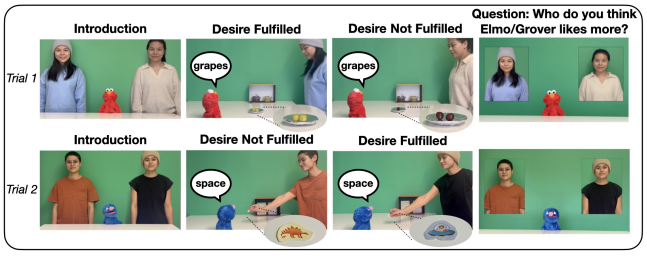

Figure 4: Example Design for Experiment 6

Materials and Procedures Each participant completed two trials (see Figure4 for an example). In each trial, chil-

dren watched two agents, presented again as identical twins with different clothing and hairstyles, interacting with a puppet. In the first trial, both agents offered Elmo a choice between grapes and cherries, asking which he preferred. Elmo always chose grapes, but only one agent gave him what he wanted. All other aspects of the interaction, including duration, affect, and conversation content, were matched between the agents. Then, participants were asked which agent Elmo liked more. The second trial followed the same structure with a different puppet Grover, two new agents, and two sticker options (space and dinosaur stickers). Grover always chose space stickers, but again, only one agent fulfilled his preference. Participants were then asked which agent Grover liked more. As a manipulation check, participants identified which agent in the last trial gave Grover the sticker he wanted. Critically, these videos were matched in total length, length of the interactions between the agents and the puppet, and surface visual features to the stimuli used in Experiments 1 and 2.

Results and Discussion Four- and five-year-olds succeded on the task, consistently preferring in both trials the agent who gave the puppet what they wanted (20/33 (60.6%); one-tail binomial test against 25%: 95% bootstrapped CI=[0.46,0.79],$p < .001$). 87.8% of participants correctly answered the manipulation check question. This strong performance suggests that children's difficulty in the previous tasks was not due to general task demands or superficial aspects of the study design. Instead, children's earlier struggles may reflect a specific challenge in representing others' attentiveness.

General Discussion

Across six experiments, we show that while adults easily distinguish between attentive and inattentive agents and recognize that others prefer attentive agents, six- and seven-year-olds succeed only marginally, and four- and five-year-olds fail to make this distinction at all, even when presented with repeated interactions and multiple cues to differential attentiveness including direction of gaze, latency to respond, and degree of positive affect. Although even much younger children react negatively to distracted adults and track agents' visual attention, the results of the current study suggest that children are surprisingly insensitive to the difference between attentive and distracted adults.

Children today are surrounded by (hopefully otherwise loving and responsive) caregivers who are frequently distracted by phones and other media. It is possible children distinguished the attentive and distracted agents but failed to infer that others would have a preference between them. However, our results suggest otherwise. Four and five-year-olds not only failed to infer the puppet's preference across studies, they also failed to track which agent looked at her phone more, and which topic the agent paid more attention to. Even at ages six and seven, many children failed these manipulation checks. These results suggest that children do not merely struggle to infer preferences from attentiveness, they struggle to represent attentiveness at all.

In these experiments, we studied children's understanding of attentiveness in a third-person context, where children were not the target of either attention or distraction. This aligns with much of the work on preschoolers' understanding of visual attention, where the children are not part of the interaction but distinguish which of two agents knows the contents of a container or the location of an object. Four and five-year-olds succeed at these tasks; however, it is possible that children are more sensitive to adult attentiveness and distraction when they experience its impact firsthand.

However, the difficulty in first-person contexts is distinguishing children's reactions to the adult's non-responsiveness from a genuine understanding of the adult's mental state. Future research might explore this further, by adapting a design comparable to the design in Experiment 4, in which an adult is attentive to some topics but not others and seeing if children actively modify their behavior to try to engage the adult's attention. If so, this might suggest that children understand the factors that modulate others' attentiveness. Even in this case however, children might unconsciously adapt their behavior without fully understanding attentiveness as a mental state. For this reason, we believe third-party judgments, in which children must distinguish attentiveness in others rather than responding to it directly, may offer a more reliable measure of their understanding.

As we noted above, visual attention in developmental research is typically operationalized as a discrete state: whether someone sees something or not. By contrast, attentiveness is a continuous mental state, varying in graded ways within and across individuals. Our finding that children struggle to understand attentiveness is consistent with earlier research on children's theory of mind, suggesting that children six and younger fail to understand thinking as an ongoing mental process. For example, when asked whether a person waiting for something to happen "has thoughts and ideas in their head", 95% of adults say yes, compared to only 5% of three-year-olds, 20% of four-year-olds, and 55% of six-year-olds (Flavell, Green, & Flavell, 1993). Similarly, when asked to "think of nothing at all" for 20 seconds, five-year-olds claimed to have succeeded in having no thoughts during the interval but adults and eight-year-olds maintained that they had thoughts anyway (Flavell, Green, & Flavell, 2000). Relatedly, recent work has made a distinction between theory of mind frameworks focused on propositional attitudes like beliefs, desires, and intentions and the kinds of computations involved in real-time communication that involve tracking ongoing processes like attention, cognitive load, and memory (Rubio-Fernandez, Berke, & Jara-Ettinger, 2024). Abundant work suggests that preschool children represent the propositional content of mental states (Imuta, Henry, Slaughter, Selcuk, & Ruffman, 2016; Wellman, Cross, & Watson, 2001; Milligan, Astington, & Dack, 2007); the results of the current study suggest that children may only represent continuous cognitive processes later in development.

Open Science

All experiments were preregistered. The sample size was determined by power analysis. All the preregistraions can be found: https://osf.io/d65qt/?view_only=e3e1bf40715c4c5d9d0be641cac0e0fd

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