Altercentric Bias in Preverbal Infants' Memory

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Abstract

Human infants would seem to face a daunting challenge in selecting what they should attend, encode and remember. We investigated whether early in life, infants might use others' attention as an exploitable source of information filtering, by prioritizing the encoding of events that are co-witnessed with someone else over events witnessed alone. In a series of studies (n=255), we show that infants who can otherwise remember an object's location, misremembered the object where another agent had seen it, even if infants themselves had subsequently seen the object move somewhere else. With further exploratory analyses, we also found that infants' attention to the agent rather than the object seems to drive their memory for the object's location. This series points to an initial encoding bias that likely facilitates information selection but which can, under some circumstances, lead to predictable memory errors.

Young children are commonly held to be egocentric and unable to consider others' differing perspectives (Piaget, 1926). A popular interpretation of the development of the understanding of other minds involves children becoming able to manage conflicting perspectives and implicates the maturation of executive functions (Devine & Hughes, 2014). However, nonverbal tasks with preverbal infants suggest that they can generate expectations about others' actions even when perspectives diverge (Choi et al., 2022; Luo, 2011; Luo & Johnson, 2009; Onishi & Baillargeon, 2005; Southgate & Vernetti, 2014). Arguably the biggest challenge this newer data presents is how to account for the apparent absence of egocentric influence when infants have notoriously poor executive functions (Holmboe et al., 2018). Different accounts have attempted to address this challenge in different ways, but common to most is the assumption that it is the nonverbal nature of the task that allows infants to take others' perspectives, or appear as if they can (Baillargeon et al., 2010; Butterfill & Apperly, 2013; Doherty, 2011; Heyes, 2014; Ruffman, 2014).

Recently, a novel account proposed that it is not the nature of the task, but the nature of infant cognition that may circumvent the need to manage conflicting perspectives (Southgate, 2020). Informed by work suggesting that we experience interference from others' perspectives, this account proposes that infant cognition has an altercentric bias which prioritizes the encoding of information derived from tracking another's perspective over the encoding of events witnessed in the absence of other agents. The term altercentric describes how our own perception and resulting cognitive processing can be altered by the presence of others (Kampis & Southgate, 2020). A number of studies have measured behavior in situations where participants must respond based on their own perspective, but another agent with a conflicting perspective is present. Participants are slower to respond to confirmation of their own perspective when the other's perspective differs (Furlanetto et al., 2016; Samson et al., 2010; Santiesteban et al., 2014), and faster to detect the presence of a ball in a scene when another agent should believe the ball to be there, even if the participant themselves should not (El Kaddouri et al., 2020; Kovács et al., 2010; Phillips et al., 2015). Both studies suggest interference from a spontaneous

encoding of the other's perspective. Altercentric interference is also documented in infants, in similar paradigms (Kampis & Kovács, 2022; Kovács et al., 2010).

The altercentric bias account proposes that young infants can track others' perspectives without the need to manage conflict when perspectives diverge because the two perspectives do not exert a competing influence on infants' memory. Drawing on a large body of work suggesting that self-representation emerges around 18 months (Amsterdam, 1972; Anderson, 1984; Bulgarelli et al., 2019), it is proposed that a key feature of early development that fosters an altercentric bias is the initial absence of self-representation. Prior to the emergence of self-representation, young children experience less conflict when self and other perspectives diverge (Yeung et al., 2022), and, it is proposed that the absence of a distinct self-representation is associated with a relatively weaker memory for events that the infant sees alone than events that are cued by others' attention. In the context of the classic task of competing perspectives, the false belief task, in which the infant sees an agent observing an object in one location followed by the object moving to a second location in the agent's absence, the altercentric hypothesis proposes that the first event will be encoded and remembered better than the second (Southgate, 2020).

Thus, an altercentric bias arises in young infants as a result of both the tendency for spontaneous encoding of others' attention and the initial absence of self-representation. This prioritization of what is encoded in the other's presence creates not merely an altercentric interference in which the other's perspective is encoded as well as the participant's own, but an altercentric bias in which the other's perspective is encoded instead of the participant's own. Thus, the difference, in terms of altercentric influence, between infant and adult cognition is not simply one of degree. It is proposed that this bias will serve to constrain infants' attention to those things deemed worth attending to by those around them, and infants thus use the attentional cues of others — the other's perspective — to prioritize what is worth attending to, and learning about.

Here we test the main prediction of the altercentric hypothesis, that infants will misremember an object at a location where it was co-witnessed with another agent, rather than at a location where the infant subsequently sees the same object alone (Southgate, 2020). Such a situation is analogous to a change-of-location false belief event, but rather than testing where the infant expects the agent to search, we test where infants remember the object to be. In a series of looking-time studies, 8-month-old infants saw a ball transported first behind one occluder, and then behind a second occluder. We preregistered a sequential testing strategy to first obtain evidence that infants remember the ball's at its last location when no agent is present (Study 1a) and then contrast this with the critical experimental condition in which the first hiding event is co-witnessed with an agent (condition '*First'*, Study 1b). Infants' memory for the location of the object was tested by measuring looking time after revealing the object's absence at either the first or the second location. These conditions were preregistered (#33255 | AsPredicted). Study 2 reports additional exploratory conditions.

Study 1a: Non-social object memory

Participants

We chose the sample sizes for all of the conditions reported here based on the simulations of Oakes (2017) for infant looking-time studies, adjusted upward given the uncertainty associated with the new paradigm. 64 infants aged 8 months were randomly assigned to either the *Hand* or *Conveyor* condition (Mean age: 236 days, SD 11, 38 girls). A further 50 infants were excluded because of fussiness (n = 14), inattentiveness during the object transfer on any test trial (n=24), experimenter error (n = 9), looking for entire duration of test trial on first pair (n = 2) and parental interference (n = 1). For the Hand condition, all 32 infants contributed both pairs; for the Conveyor condition, 30 infants contributed both pairs and 2 infants contributed 1 pair (in both cases the first pair). See SOM for description of exclusion criteria. The study was approved by the Research Ethics Committee (blinded for review) and parents provided informed consent prior to participation.

Procedure

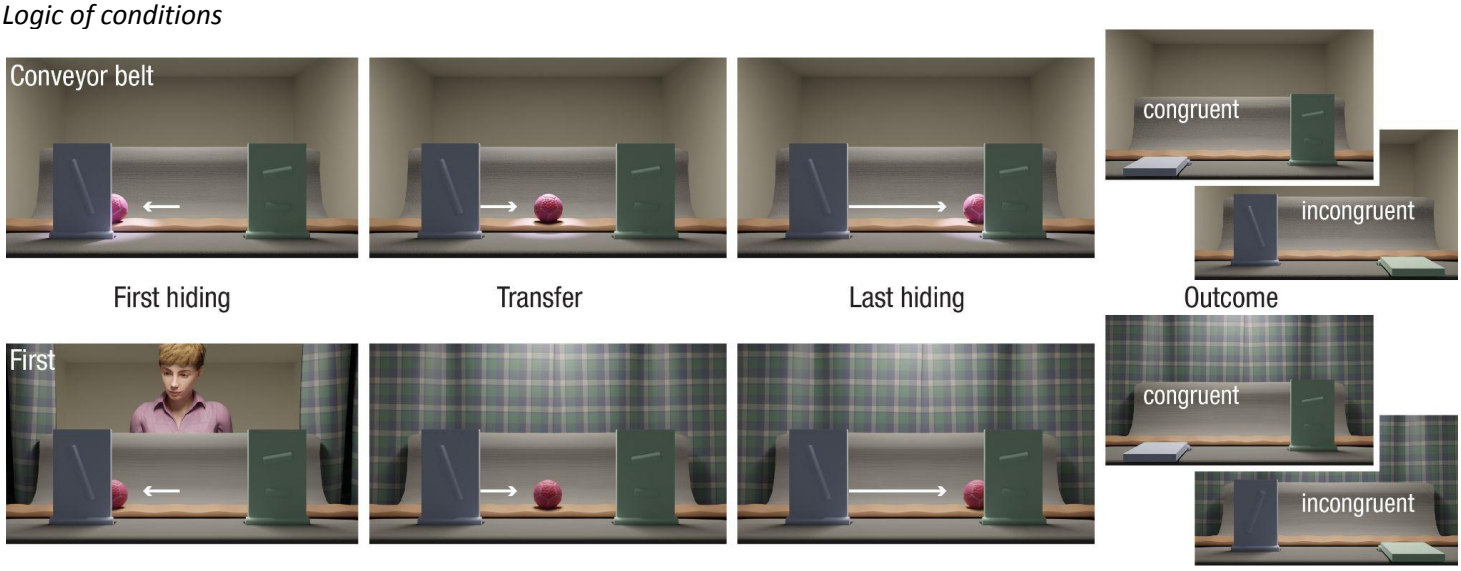
As the critical condition (*First*, Study 1b) was intended as a contrast between a first co-witnessed displacement and a second witnessed-alone displacement, we aimed to minimize other agency cues. Thus, two conditions were included in which either a hand or a conveyor belt transported the object behind each occluder (Figure 1, top). We preregistered our plan that assuming infants correctly remember the object's last location under both conditions, the conveyor belt would be used to transport the object in Study 1b. In 4 familiarization trials, a ball was transported behind one of two occluders. At the end of each familiarization trial, infants saw one of the occluders lowered to reveal either the ball, or the other, empty, location. Next, on 4 test trials, the hand or the conveyor belt (Figure 1, top) moved the ball behind one of the occluders (first displacement) and then moved it behind the other occluder (second displacement). Each test trial ended with one of the occluders lowered to reveal the absence of the ball either at the location congruent (videos: Conveyor, hand) or incongruent (Conveyor; hand) with reality. The last frame of the video was paused until the trial ended and both infants' first look duration and total looking-time was coded. For further details, counterbalancing and coding, see SOM.

Results

A Bayesian linear regression model of all the variables of interest across all conditions was preregistered and is reported in the online materials (SOM). We present the frequentist statistics in the main text for ease of interpretation. Readers interested in the estimation of effects and the uncertainty around them can, for all of the results in this series, consult Figure 3.

Figure 1

Logic of conditions



Note. Top: In the non-social Conveyor condition the ball in the centre of the scene is first transported behind one occluder (first hiding), and then transferred behind the second (last hiding). In the Hand condition, a hand transports the ball. Bottom: In the social First condition, an agent witnesses the first hiding event, and then the curtains in front of her close and infants witness the second hiding alone. In the Both condition, the curtains only close after the last hiding event. At outcome either the first or the second occluder is lowered, always revealing the absence of the ball.

First look duration. (Figure 2): An ANOVA with condition (*Hand* vs. *Conveyor*) as a between-subjects factor and Outcome (Congruent vs. Incongruent) as a within-subjects factor revealed a significant main effect of outcome [$F(1, 62) = 6.21$, $p = 0.015$, $\eta^2 = 0.033$) but no effect of condition [$F(1, 63) = 0.101$, $p = 0.751$, $\eta^2 = 0.001$) and no interaction between outcome and condition [$F(1, 62) = 8.867\times10^{-5}$, $p = 0.99$). A paired-samples t-test comparing the two outcomes show that infants looked longer to the Incongruent (*Hand*: 7.19s, *SD* = 3.07s; *Conveyor*: 6.99s, *SD* = 3.43s) than Congruent (Hand: 6.25s, SD = 3.08s; Conveyor: 5.87s, SD = 2.70s) outcomes [$t(63) = 2.512$, $p = 0.007$, $d = 0.314$), suggesting that they had a stronger expectation that the ball should be in its actual, reality congruent, location than its first, reality incongruent, location.

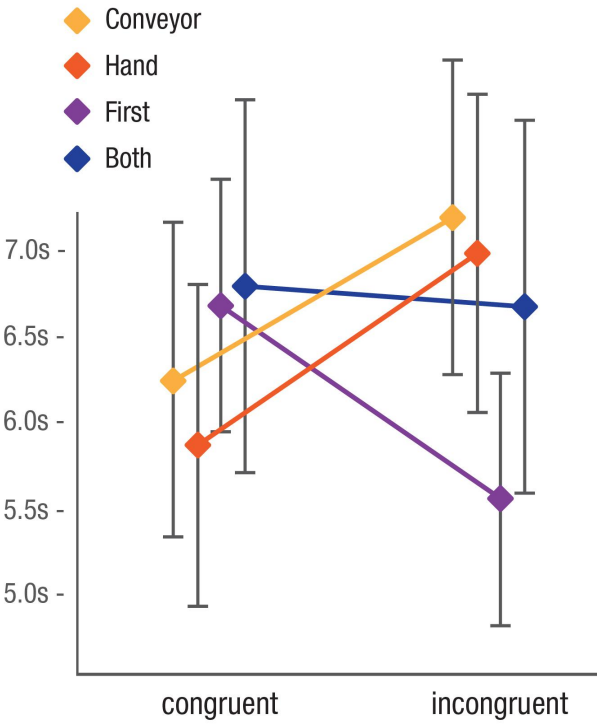
Total looking time. An ANOVA with condition (*Hand* vs. *Conveyor*) as a between subjects factor and Outcome (Congruent vs. Incongruent) as a within-subjects factor revealed no main effect of outcome [$F(1, 62) = 2.33$, $p = 0.132$, $\eta^2 = 0.011$), no effect of condition [$F(1, 62) = 0.045$, $p = 0.832$, $\eta^2 =$

2.218×10^{-4}) and no interaction between condition and outcome [$F(1, 63) = 0.004$, $p = 0.953$, $\eta^2 = 3.868\times10^{-5}$).

These results confirm that, with first look as the dependent measure, infants looked longer to the incongruent than congruent outcome, and that this was not modulated by whether infants saw the hand or conveyor belt transporting the object (see Figure 3 on page 11 with the posterior distribution of of effects).

Figure 2

looking times in seconds



Note. Looking times (seconds) for first look measure with 95% CIs for the 4 preregistered conditions.

Based on these results, subsequent conditions used the conveyor belt to minimize agency cues and we limited our reported analyses to first look duration. Total look for all conditions is reported in the supplementary materials.

Study 1b: Testing for an altercentric bias

This study probed the main hypothesis that the presence of an agent during the first hiding event will reverse infants' memory for the ball's location. The '*First*' condition is the critical test of the altercentric hypothesis because it predicts the opposite pattern of looking from that of the non-social conditions reported above. The condition names (*First, Both*) refer to which events were co-witnessed with the other agent.

Participants

64 infants aged 8 months were randomly assigned to either the *First* or *Both* conditions (Mean age: 247 days; SD = 10; 24 girls). A further 12 infants were excluded because of fussiness (n = 2), inattentiveness during the object transfer (n = 6), experimenter error (n = 3), or looking for the entire duration of the test trial on the first test trial pair (n = 1). Of the 64 infants, 54 contributed both trial pairs. For the *First* condition, 29 infants contributed both pairs and 3 infants contributed only the first pair; for the Both condition, 25 infants contributed both pairs and 7 infants contributed only the first pair (see SOM for details).

Procedure

The structure and timing of both familiarization and test trials were identical to Study 1a. Infants saw the conveyor belt transporting the object (Figure 1, bottom). Familiarization events now included an agent in the background that visually tracked the ball as it was transported by the conveyor belt behind one of the occluders.

First **condition**. The agent is revealed prior to the first displacement, looks down to the ball, and tracks it as it is transported by the conveyor belt behind the first occluder. The curtains then close to hide the agent, after which the ball emerges from behind the first occluder and is transported behind the second occluder.

***Both* condition**. The agent is revealed prior to the first displacement, looks down to the ball, and tracks it as it is transported by the conveyor belt behind the first occluder. The agent then looks directly ahead and, as the ball emerges from behind the first occluder, refocuses attention on the ball and watches as it is transported behind the second occluder, at which point the curtains close to hide the agent. At the end of each trial, an occluder is lowered to reveal the ball's absence.

Results

We tested for an interaction between the two non-social and two social conditions. As our first analysis did not detect a difference between Hand and Conveyor conditions, we collapsed the data and included these as a single condition (non-social)[1]. We ran a mixed ANOVA on the first-look durations with condition (Conveyor, First, Both) as between-subjects factors and outcome (Congruent vs. Incongruent relative to real location), as within-subjects factors. This analysis revealed the predicted interaction between Condition and Outcome [$F(3, 124) = 5.224$, $p = 0.007$, $\eta^2 = 0.024$], but no main effect of either Condition [$F(2, 125) = 0.495$, $p = 0.611$, $\eta^2 = 0.005$), nor Outcome [$F(1, 126) = 0.004$, $p = 0.949$, $\eta^2 = 0$). To investigate the interaction, we ran paired-sample t-tests on the two new conditions separately. For the critical First condition, as predicted, infants looked longer at the Congruent than Incongruent outcome [$t(31) = -2.427$, $p = 0.011$, $d = -0.429$, Incongruent: 5.54s (SD = 2.86s), Congruent: 6.67s (SD = 3.15s)]. However, for the Both condition, infants looked equally at both outcomes [$t(31) = 0.182$, $p = 0.428$, $d = 0.032$, Incongruent: 6.67s (SD = 3.17s), Congruent: 6.80s (SD = 3.77s).

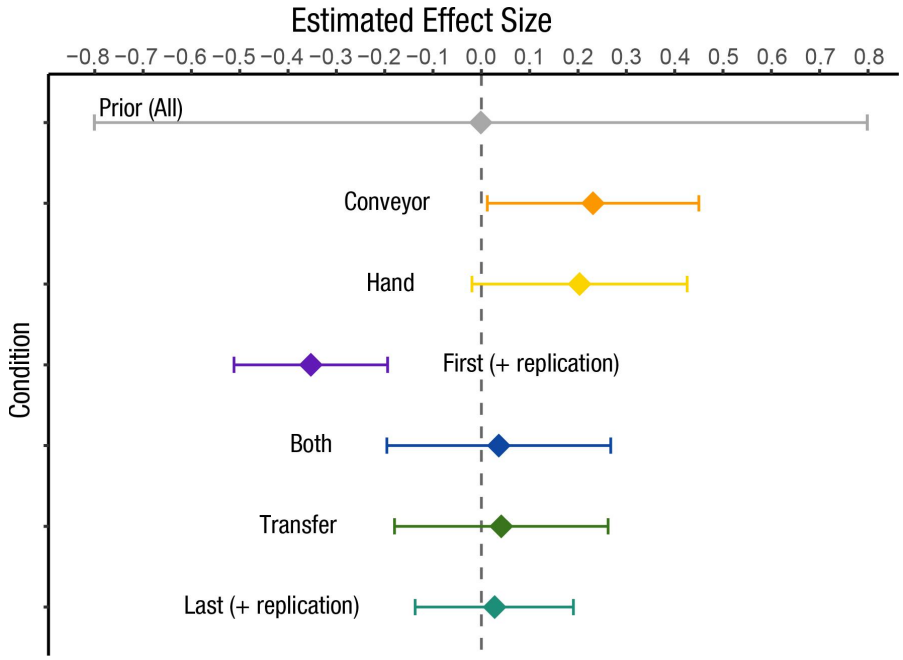
Thus, infants looked significantly longer to the Incongruent outcome on the non-social conditions, but significantly longer to the Congruent outcome on the First condition, indicating that co-witnessing the first hiding with another agent reversed their expectation about the location of the ball (Figure 2 & 3). This pattern reveals the predicted memory error when the perspective of the infant and the agent diverge. The finding from the Both condition did not conform to our prediction that infants would look longer to the Incongruent outcome, as they did in the non-social conditions.

[1] For the Bayesian analysis these two conditions were separate.

A plausible explanation for why infants in the Both condition do not seem to remember the object's last location could be that co-witnessing the object at both locations led them to encode the object at both locations. The possibility of memory traces in multiple locations has previously been proposed as explanations for infants' apparent memory failures on classic tasks of object permanence (Harris, 1989; Munakata, 2001). If so, we reasoned that a situation in which the agent and the infant only co-witnessed the final location, should generate in infants a clearer expectation of the object in its last location. We explore this possibility in Study 2a.

Figure 3

Estimated effect of trial outcome in each condition.



Note. Diamonds represent means, error bars represent the 89% credible interval around the mean. Gray: prior distribution (equal, a priori, for all conditions); colored: posterior distributions by condition. Identical replications merged with original conditions.

Study 2a: Exploratory conditions

Participants

64 infants aged 8 months were randomly assigned to either the Transfer or Last conditions (Mean age: 248 days; SD = 8; 28 girls). A further 25 infants were excluded because of inattentiveness during the object transfer (n = 20), experimenter error (n = 4), looking for the entire duration of test trial on first pair (n = 1). The condition names (Transfer, Last) refer to which events were co-witnessed with the other agent.

Procedure

The timing of the ball's transition in each condition is the same as in previous conditions and familiarization trials are the same as for the conditions in Study 1b. In the *Transfer* condition, 28 infants contributed both pairs, and 4 infants contributed only the first pair. For the *Last* condition, 26 infants contributed both pairs, and 6 infants contributed only the first pair.

Transfer condition: In test-trials, infants observed the agent appear after the ball is occluded behind the first location and before the ball emerges to begin its transition to the second location. However, the agent only looks down towards the ball and tracks its movement from the midpoint in its transition from first to second hiding locations.

Last condition: In test-trials, the agent was revealed as the ball paused briefly during its transition from the first to the second hiding location. The agent tracks the ball as it is moved behind the second occluder. In both conditions, the curtains close to hide the agent and an occluder is lowered to reveal the ball's absence.

Results

Paired samples *t*-tests revealed no difference between incongruent and congruent outcomes on either the *Transfer* [$t(31) = 0.306$, $p = 0.381$, $d = 0.054$. Incongruent: 7.05s (*SD* = 4.14s); Congruent: 6.62s

(*SD* = 3.11s)] or *Last* conditions [*t*(31) = 0.023, *p* = 0.491, *d* = 0.004. Incongruent: 7.04s (*SD* = 4.20s), Congruent: 7.02s (*SD* = 4.02s)]. The posterior distributions are in Figure 2. Thus, these additional conditions confirmed the null-result in the *Both* condition, yielding further evidence that the presence of an agent who, together with the infant, observes the ball at its final location, does not lead infants to have an expectation that the ball should be present at this final location. This was puzzling because a) in the absence of an agent (*non-social* conditions), infants evidence an expectation that a ball they see disappear behind a second location should be present at that second location and b) in the presence of an agent who sees the ball only at the first location (*First*), infants generate a clear expectation that the ball will be present at the first location.

Study 2b: Replications

Participants

63 8-month-old infants were randomly assigned to a direct replication of either the *First* or the *Last* conditions (Mean age: 247 days, SD 6; 30 girls). In the *Last Replication* condition a further 21 infants were excluded because of inattentiveness during the object transfer (*n* = 6), experimenter error (*n* = 16; mistakenly tested with an error in the counterbalancing, see online supplementary material), looking for entire duration of test trials on first pair (*n* = 1). For the *First Replication* condition, 26 infants contributed both trial pairs and 6 infants contributed only the first pair. For the *Last Replication* condition, 26 infants contributed both pairs, and 5 infants contributed only the first pair.

Procedure

These conditions were a direct replication of the *First* and *Last* conditions.

We replicated the original findings from Study 1b (see SI). From these additional conditions (Figure 3; for procedure. see Study 2b and in SOM) we derive additional confidence in our main predicted results: the reversal of infants' expectation when there is a conflict of perspectives. This additional data in both the *First and Last* replication conditions provided a further motivation to

understand the unexpected lack of memory across three variations and one direct replication of the condition in which the agent co-witnesses the last location. To shed light on this finding, we conducted the exploratory analyses reported below.

Exploratory analyses

The amount of time infants spend looking at the ball during its transition from one hiding place to the other may influence infants' memory of the ball's location. We therefore coded and analyzed infants' visual attention to the ball to exclude the possibility that infants' expectation that the ball is still in the first location in the crucial *First* condition is because the agent's disappearance from the scene distracted them from the ball's second displacement. We compared how much of the ball's second transfer infants witnessed in the *First* condition compared to the identical movement in the non-social *Conveyor* condition (for both conditions: no agent was present during this phase, see Table 1 below). This analysis revealed that infants spent most of the 4 second transition period watching the ball in both conditions (82%, *SD* 7.3% vs. 81.5%, *SD* 8%) with no difference between the conditions (see SOM), indicating that the agent's disappearance did not change infants' visual attention to the subsequent transition. Differences in visual attention after the agent's disappearance in the *First* condition could therefore not explain infants' lack of memory of the ball's second transfer. Furthermore, it is at the first location that infants remembered the ball, although they spent less time watching the ball during its first (61.6%, *SD* 20.9%) than second hiding (81.5%, SD 08.0%).

Table 1.
Percentage of looking at the ball during the two hiding events. In some conditions, the agent in the background competes for the infants' interest.

	condition			
	Conveyor	*First*	*Both*	*Transfer*
	First hiding (3 seconds)			
agent present?	NO	**YES**	**YES**	NO

percentage looking time	95.3% (*SD* 07.9%)	61.6% (*SD* 20.9%)	63.3% (*SD* 22.8%)	92.8% (*SD* 07.2%)
	Second hiding ('Transfer', 4 seconds)			
agent present?	NO	NO	**YES**	**YES**
percentage looking time	82.0% (*SD* 07.3%)	81.5% (*SD* 08.0%)	67.0% (*SD* 18.0%)	59.5% (*SD* 22.3%)

This observation suggests that it may be infants' attention to the agent, rather than the ball, that predicts where they remember the ball to be. Following from this, we reasoned that infants' visual attention to the ball versus the agent during the second transfer in the conditions where this transfer was witnessed by the agent could inform our finding that infants did not seem to remember the ball's location in these conditions. To address this, we categorized infants as those who looked predominantly at the ball (ball-lookers) vs. those who distributed their attention between the ball and the agent (agent-lookers) during the transfers (see SOM for details). Merging data across the two conditions in which the agent was present for the entirety of the second displacement (*Both* and *Last*), an ANOVA with Group (ball vs. agent lookers) as a between-subjects factor and Outcome (Incongruent, Congruent) as a within-subjects factor indicated a significant interaction [$F(2, 62) = 9.8$, $p = 0.003$, $\eta^2 = 0.034$]. Follow-up *t*-tests indicated that infants who looked less at the ball looked longer at the Incongruent than the Congruent outcome [$t(33) = 2.560$, $p = 0.015$, $d = 0.446$] in line with the original prediction. Infants who looked predominantly at the ball, in contrast, tended to show a reverse pattern of looking at outcome [$t(31) = -1.905$, $p = .066$, $d = -0.342$].

Taken together, the additional analyses of infants' visual attention in the First as well as across conditions where the second hiding is co-witnessed suggest that infants' increased attention to the agent, and not the ball, in co-witnessed hidings may enhance their memory of the ball in this location. It is the infants who looked at the ball more when both locations were co-witnessed, who failed to remember the ball's final location.

General Discussion

The altercentric bias hypothesis proposes that infants' memory for events that are the targets of others' attention, is privileged. The main prediction of this hypothesis is that, if there is a conflict between what the self and other have experienced, infant memory will prioritize representations derived from tracking the targets of the other's attention. In an object displacement event like that used in the current study, this prioritization of co-witnessed events will lead infants to misremember the location of the object. We first obtained evidence that, with our stimuli, 8-month-old infants remembered the location of an object at its final location. Next, we asked whether we could reverse infants' expectation by including an agent who co-witnesses the hiding of the object at its first location. In a preregistered condition and replication, we indeed found that infants had a stronger expectation that the ball should be in the first location than the second, even though in both conditions they attended equally to the second displacement. This data suggests that, if there is a conflict in perspectives, infants remember better what they co-witness with another agent than what they subsequently witness alone, as predicted by the hypothesis (Southgate, 2020).

Nevertheless, we found an apparent absence of memory for the object's location when the agent witnessed both object displacements. Across three conditions (*Both*, *Transfer*, and *Last*), infants did not evidence a greater expectation that the object should be revealed at its last, actual, location. An exploratory analysis of infants' visual attention to the ball vs. agent during the transfer of the ball from the first to the second location indicated that infants who distributed attention between the agent and

the ball remembered the ball's last location, as expected. Infants who attended predominantly to the moving ball, in contrast, tended to misremember the ball at its first location. While exploratory, this is consistent with the core of the altercentric hypothesis: tracking the agent's attention seems to be what drives infants' expectations. This data is also consistent with previous work showing that it is infants' attention to the agent, not the object, that appears to determine what they remember about that object (Kovács et al., 2017).

The data from these conditions is also consistent with a recent review of infant non-verbal Theory of Mind studies which suggested that while there was evidence that infants expect actions consistent with the agent holding a false belief (similar to our *First* condition), there was little evidence that infants generate correct expectations from true-belief events (similar to *Both*) (Rubio-Fernández, 2019). In our study, although we observed variance in attention to the agent and ball on conditions where an agent was present during the first object displacement (*First* and *Both*), more infants were categorized as ball lookers on the second hiding (33/64) than the first (22/64) in those same conditions. This could suggest that babies were better able to divide their attention between the agent and ball earlier in the trial. It is possible that at 8 months, dividing attention between the agent and ball is more effortful the longer the trial goes on. Thus, when the agent is present throughout the entire trial (*Both*), infants may be less able to exploit the agent's attention as a cue to the object's location during the second displacement.

While we used looking time to index object location memory, our data cannot tell us what infants expected to see at the location revealing the object's absence. Different scholars have hypothesized that in similar tasks of object permanence, infants may have memory traces at both locations, and which could both contribute to their expectations of object existence (Harris, 1989; Munakata, 2001). Much research on memory for object identity suggests that infants younger than 12 months are less sensitive to a change in object identity than to a change in object location (Kibbe & Leslie, 2011; Newcombe et al., 1999), especially if, as in the current study, they know the object to be

graspable (Mareschal & Johnson, 2003). A recent study shows that, when tracking a moving object, even adults have only a coarse approximation of the object's form (Li et al., 2022). Thus, it is plausible that what infants represent at the co-witnessed location — or what they generate from tracking the other's attention — is a representation of something relevant at this location, but not necessarily a detailed representation of the object (*a pink ball*). The fact that it was the group of agent-lookers and not ball-lookers that seemed to have the stronger expectation of the ball in its actual location, is consistent with a representation of 'something' rather than a specific object.

This study provides the first support for the presence of an altercentric bias in infants' object encoding (Southgate, 2020). This support was found in the preregistered *First* condition and a subsequent replication. This indicates that indeed, an event that is co-witnessed with another agent is better remembered than an event that infants subsequently witness alone. We do not know of any other theory that would predict this result. In addition, our exploratory analyses reveal that an altercentric bias is more likely when infants pay more attention to the co-witnessing agent.

Originally, the altercentric bias hypothesis was conceived to explain how young infants could apparently accurately predict where another agent holding a false-belief about an object's location would search, even when the other's representation of the object's location should conflict with the infant's own. Our data presents a plausible answer to that puzzle. Specifically, it suggests that infants may be able to accurately predict where an agent with a false-belief will search because infants have a stronger representation of the object at the location where the other has seen it, than they have at the location where they themselves have last seen the object. For infants, this becomes the first-person representation that also drives how they expect others to behave. If correct, this implies that infants may not be thinking about where the other thinks the ball to be, but are using their — albeit wrong — representation of the object's location to predict where anyone will search. This suggests something unique about infant cognition: that far from being egocentric, infants may filter the world through the eyes of more experienced and knowledgeable others. Such a bias could serve to constrain infants'

attention to events that their adult caregivers have already deemed worthy of attention and in this way, is proposed to serve an important learning function.

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