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Do infants track multiple altercentric perspectives in an active behavioral task?

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Abstract

Studies suggested that infants may track others' perspectives (Baillargeon et al., 2010; but see Dörrenberg, et al., 2018), showing altercentric effects (Kovács et al., 2010; Manea et al., 2023). However, it remains unknown whether infants can track multiple perspectives distinctively, a hallmark of real-world social interactions, and how this relates to their developing self-concept. We presented a search task to 15-to-18-month-olds (N=96), involving two agents with different perspectives (true/false-beliefs). We varied which agent prompted infants' search, and asked whether search is modulated by the prompter's perspective. Infants' displayed interference from the other's perspective when the false-belief agent made the prompt in the false-belief, but not the true-belief trials, and not when the true-belief agent made the prompts. Furthermore, such altercentric influences were unrelated to self-awareness, as measured by the Mirror Self-Recognition task. Thus, infants may sustain multiple other perspectives besides their own and rely on them differentially.

Keywords: Theory of Mind, false belief understanding, object representation; altercentricism, infancy

Introduction

Humans can successfully navigate the social environment through reasoning about others' actions and their underlying mental states such as beliefs and desires. Cognitive capacities enabling humans to represent others' distinct perspectives may be present from early infancy (Baillargeon et al., 2010; Scott & Baillargeon, 2017). However, it has been argued that understanding what others think and perceive is cognitively effortful (Epley et al., 2004; Keysar et al., 2003; Nickerson, 1999). According to a long-standing view, children are initially egocentric and gradually acquire the ability to consider others' perspectives (Piaget & Inhelder, 1956; Piaget, 1926). Children's difficulty to take others' perspectives has been seen as a signature of egocentricism (Perner, 1991; Wellman et al., 2001). Egocentric influences continue to shape decisions even in adulthood (Samson et al., 2010).

In contrast, other studies have suggested that humans can readily take others' perspectives even when the situation or the task does not require perspective taking (i.e., altercentric influences: Kovács et al., 2010; Samson et al., 2010; see also Kampis & Southgate, 2020, for a review). Altercentricism could be defined as strong or unexpected influences of others' attention and perspective on humans' behavior when events are co-witnessed (Samson et al., 2010). For instance, adults' judgements (e.g., accuracy rate and reaction times) about a target object could be influenced by others' perspectives on the target object (Elekes et al., 2017; Fogd et al., 2025; Samson et al., 2010; Kovács et al., 2010).

Recent research revealed that infants seem to track others' perspectives (specifically, their false beliefs) and display altercentric influences, as suggested by behavioral data (looking time: Kovács et al., 2010; Manea et al., 2023; preferential looking: Grosse Wiesmann et al., 2025; active-behaviors: Kampis and Kovács, 2021; Kovács & Celik, in review; pupillary response: Yeung et al., 2022, Tebbe et al., 2025) and neural measures (Kampis et al., 2015; Southgate & Vernetti, 2014; Tebbe et al., 2025), but see replication failures with anticipatory looking (e.g., Dörrenberg et al., 2018; Kampis et al., 2021) and interactive measures (e.g., Grosse Wiesmann et al., 2017; Wenzel et al, 2020). Studies revealed that neural systems involved in representing the world from infants' own perspective are also recruited to encode others' representations – specifically, others' beliefs about an object's whereabouts (Kampis et al., 2015; Southgate & Vernetti, 2014).

Infants' active behavior seems to be influenced by others' perspectives even when the task does not require perspective taking. For instance, infants searched longer when the agent believed that an object was still present in the box, compared to when she believed it to be absent – even though the infants themselves had seen the object being removed (Kampis & Kovács, 2021). Additionally, in a recent study, Celik and Kovács (2024; in review) found that infants spontaneously point to an empty location where the agent thinks the object is. The same study also showed that infants' searching behavior was influenced by the agent's belief: they searched for the object more in the empty location, where the agent falsely believed the object to be. An altercentric influence was also observed in infants' decision latency when searching for the object. Specifically, infants took longer to decide where to search when the agent held a false belief about the object's location, even though the agent's perspective was irrelevant for finding the toy.

In addition, other studies have found empirical support for an early emerging and *strong altercentric* bias based on various measures (looking time: Manea et al., 2023; preferential looking: Grosse Wiesmann et al., 2025; pupillary responses: Yeung et al., 2022; Tebbe et al., 2024; neural responses: Kampis et al., 2025; Yeung et al., 2024). Manea and colleagues (2023), for instance, showed that 8-month-old infants may misremember an object's location when an agent had observed the object only in its initial location but not its

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transfer to a new location. This effect was reflected in longer looking times to outcomes in which the object's initial location was revealed to be empty compared to outcomes in which the current location was empty. Such findings align with a recent proposal according to which a strong altercentric bias is present in young infants and that before they develop self-awareness, they may endorse others' perspective overriding their reality representations, a bias that will disappear with infants' development of the self-awareness (Southgate, 2020). Infants' ability to recognize themselves in a mirror – commonly assessed using the Mirror Self-Recognition (MSR) task – has been taken as a hallmark of emerging self-awareness and typically emerges between 18 and 24 months of age (Amsterdam, 1972; see also Kampis et al., 2022). In this strong altercentric framework, it was argued that after passing the MSR task, infants may start to represent the world from their own perspective and thus the altercentric bias should not be observed. Alternatively, one may argue that infants from early on may show altercentric modulations independently of their self-awareness development, and they may be able to represent an other's (or even multiple others') perspectives, but these will not override their own representations, but be rather sustained in parallel.

In the current study, we targeted two questions. On the one hand, we asked whether infants with a more developed self-awareness are influenced differently by the presence of a conflicting perspective compared to infants with less developed self-awareness. To test this, we presented a search task to 15- to 18-month-olds that included a false-belief (FB) and a true-belief (TB) scenario and an MSR task to measure their self-awareness. In the search task, we measured how successful infants are in finding a toy when another person has a conflicting belief (FB trial) or a congruent belief (TB trial). If infants who have little developed self-awareness are strongly influenced by the presence of a conflicting perspective in the FB trial, to the extent that they endorse that instead of their own reality representation, they should look first for the toy where the other person believes it to be and thus find it below chance level in the FB trial (but perform above chance in the TB trial). Furthermore, infants with a more developed self-awareness should show no or less altercentric bias. However, if the altercentric influence is not strong but rather moderate (Kampis & Kovács, 2021; Scott & Baillargeon, 2017), and it is independent of self-awareness development, we expect performance to be modulated by the other's false belief in both groups, compared to when the agent has a TB, but we do not expect a below chance level performance in the FB condition.

Second, we aimed to investigate whether infants can flexibly represent and switch between different perspectives of multiple agents, as this was suggested to be crucial hallmark of theory of mind in earlier research (Helming et al., 2014; Westra & Carruthers, 2017). Specifically, it was proposed that even in the standard false belief task, in case the person with the false belief would ask the critical question, this would result in a more active representation of her perspective and an increased relevance of the FB, and possibly in an improved explicit false belief performance in young children. In a similar vein, if infants can track the perspectives of multiple others in the current search task, their search could be biased by the belief of the agent who has the false belief but only when this person prompts them to search for the object and her belief becomes relevant, but less so when the TB person (i.e., a common-ground Experimenter) prompts them to search, who always holds a true belief (and thus in this interaction, the FB of the other agent may be less relevant). To this end, we also varied which agent asked infants to search, resulting in two conditions: Agent-Asks and Experimenter-Asks, each with two trial types: False Belief and True Belief.

Method

The pre-registration of this study can be found at https://osf.io/p2xkw/overview?view_only=118d54a03c6c4f7494b37db5211c48ef

Participants

Ninety-six infants between 15 and 18 months of age participated from German-speaking households (mean age = 16.4; range = 15.0 – 19.1; 44 female) in the study, randomly assigned to one of the two conditions, and divided into two subgroups based on their MSR task performance (Experimenter-asks: N = 24 mirror recognizers and 24 mirror non-recognizers; Agent-asks: N = 24 mirror recognizers and 24 mirror non-recognizers). All participants (N = 96) were presented with the MSR task (Amsterdam, 1972; see also Kampis et al., 2022). Participants were recruited from the developmental centre's database of parents who agreed to participate in the study in a metropolitan city of Austria. Eighteen additional infants were tested but excluded from the analyses due to fussiness/crying in the search task (N = 10) or in the MSR task (N = 7), and experimenter error (N = 1) in the search task. To test whether the altercentric bias is related to the development of self-awareness, we aimed to have two subgroups in the two conditions: mirror recognizers and mirror non-recognizers. To find a significant ($\alpha = 0.05$) medium to large within-subjects effect ($d = .60$) with medium power ($1 - \beta = 0.8$), 25 total participants are required in each of the four subgroups (i.e., Experimenter-asks mirror recognizers; Experimenter-asks mirror non-recognizers; Agent-asks mirror recognizers; Agent-asks mirror non-recognizers). To have an equal number of participants in each of the counterbalancing orders, we aimed to collect 24 participants in total. This sample size is also comparable to other studies (e.g., Buttelmann et al., 2009).

Materials and Design

In the warm-up trials of the search task, a blue owl-shaped jumping toy with a clockwork mechanism was used. In each of the four test trials, a similar size (4*4*5 cm) but different jumping toy was used in a fixed order (green clown, brown deer, orange clown, and white unicorn). For the hiding places,

two identical blue plastic cups (8*8*10 cm) were used, placed upside down (so that one could not see whether they covered an object or not), arranged at about 30 cm away from each other on a table (120*60*80 cm), and approximately 70 cm away from the infant. The cups were placed on a white cardboard (50*10 cm).

Infants were presented with either of the Experimenter-asks or Agent-asks conditions of the search task and with the MSR task. Each condition of the search task included two FB and two TB trials, and infants received the FB and TB trials in a within-subjects design, 4 test trials in total. The order of the FB and TB conditions was counterbalanced across infants (FB;TB;FB;TB or TB;FB;TB;FB). The initial hiding location of the object (the left or right cup) in the belief formation phase was counterbalanced across infants (L;R;L;R or R;L;R;L). The seating side of the agent (A) and the experimenter (E) was also counterbalanced across infants (Left/Right).

Warm-up trials

Throughout the procedure, E and A made eye contact with the participants when they talked to them. E first placed two identical cups side by side on a table with their opening downwards, so that one could not see inside them. She/he then showed that the cups were empty to both A and the infant and said, “Look! They are empty.” All communication took place in German. Then A took the jumping toy (i.e., a blue owl) out of her/his toy bag and gave it to E. E said, “Look! I put it here!” and hid the jumping toy visibly under one of the two identical cups while both A and the infant were watching. After the hiding, A said, “There it is! I would like to play with it!” Then A retrieved the toy from under the cup and rotated the clockwork mechanism on the jumping toy, which then independently moved for roughly 10 seconds. While the toy was moving, both E and A looked at it with a lot of interest and expressed liking and enthusiasm (e.g., smiling, vocalizing, clapping hands). The same event was repeated with hiding the toy in the remaining cup. (See Figure 1).

Test trials

Hiding phase In both Experimenter-asks and Agent-asks conditions, A took one of the jumping toys (e.g., the green clown) and gave it to E. Then E placed the toy under one of the two cups (e.g., the right end) while both A and the infant could see where the toy was hidden. Then A said “Aha, OK.”, leaned forward, and touched the top part of the upside-down pointed cup without looking under it. A announced, “Oh, I need to go out, but I will be back in a bit.” Then she/he tapped on the bottom of the cup, added, “Then we can continue.”, and left the room.

Switch phase In the false belief trials of both Experimenter-asks and Agent-asks conditions, while A was absent, E said to the infant, “Oh, look!”, while touching the top part of the upside down cup that contained the toy (i.e., initially baited cup) and alternated gaze between the door and the infant. E then took the toy out of the cup where it was hidden, said, “Look! I’m putting it here.” and put it under the cup at the opposite end (i.e., the currently baited cup from now on). Before putting down the cup on the toy, she/he alternated gaze between the door and the infant, lifted the toy, drew the infant’s attention to it, and placed the cup on it. Then A came back to the room (A spent about 15 seconds outside).

The true belief trials of both Experimenter-asks and Agent-asks conditions followed the same procedure as the false belief trials, except for the following changes. A witnessed the change of the location before going out of the room. E did not alternate gaze between the door and the infant while changing the location of the toy. Instead, before E took the toy out of the initially baited cup, she/he looked at A and said, “Look, “[Name of A]”. She/he then took the toy out of its location, said, “Look, “[Name of A], I’m putting it here.” and put the toy under the cup at the opposite end (i.e., the currently baited cup). Before putting down the cup on the toy, she/he showed the toy to both A and the infant again and placed the cup back on it. Then A said, “Aha, OK.” to demonstrate that she/he witnessed the location-change of the toy, and then she/he left as before. The change of location took about the same time as in the FB condition, and to have the two conditions of equal length, A spent less time outside the room before coming back (about 2-3 seconds), and no event happened while she/he was absent.

Search phase In the Agent-asks condition, A immediately sat down on her/his chair after coming back to the room and greeting infants and E. After sitting at the table, A pushed the tray with the cups closer to the infant by holding it from the two sides, and said, “Let's find the toy, can you give the toy to me?". If the infant did not respond, A repeated the question. If the infant reached for or pointed to one of the cups within 30 seconds after A said, “Let’s find the toy.”, the trial ended. If the infant did not respond within the pre-determined 30-second response period, the trial was coded as ‘No response’ in both FB and TB trials. However, the trials continued in a belief-congruent manner (aligned with A’s beliefs). In the TB trials, A found the toy in its current location, and the trial ended. In the FB trials, if the infant did not respond to the repeated question, A reached for and checked the initial location of the toy. She/he then said, "Huh? How is this possible? It is empty!" and subsequently found the toy in its current location.

The search-phase of the Experimenter-asks condition was the same as in the search-phase of the Agent-asks condition, except that E pushed the tray with the cups closer to the infant by holding it from the two sides and asked about the object’s whereabouts (See Figure 1).

MSR Task

We followed the standard procedure as in Kampis et al. (2022) that included 4 phases: 1) the first mirror exposure phase 2) the mark application phase 3) the second mirror exposure phase 4) the question phase. The main dependent variable was whether infants touched the mark on their face in the phase 3 or phase 4. Infants passed the MSR task (i.e.,

mirror recognizers) if they touched the mark on their face in the phase 3 (i.e., showing mark-directed behavior) or phase 4 (i.e., showing mark-directed behavior, using first-person pronouns, or using their own name) and were coded as mirror-recognizers; if not, coded as mirror non-recognizers.

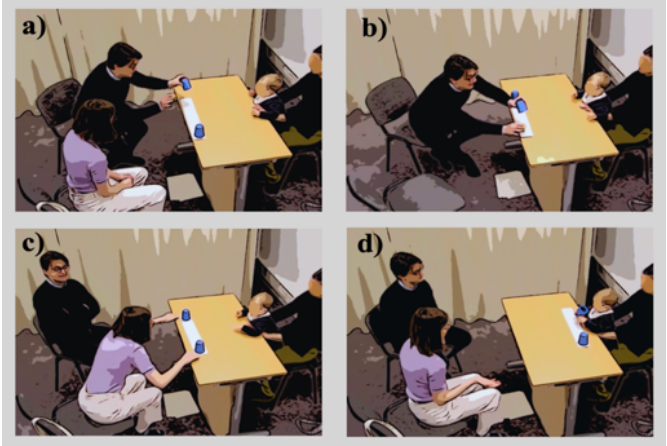


Figure 1: Schematic depiction of the experimental design in the search task. a) Hiding phase: The E hid the toy into the cup at either the right or left end while both A and the infant saw where the toy had been hidden. b) Switch phase: E changed the location of the object either it is unbeknown to A (false belief condition; depicted here) or not (true belief condition; not depicted here). c) and d) Search phase: A re-entered the room, sat at the table, and either E (the Experimenter-asks condition; not depicted here) or A (the Agent-asks condition; depicted here) pushed the tray with the cups closer to the infant by holding it from the two sides, and asked, "Let's find the toy, can you give the toy to me?"

Coding and analysis

The main dependent variable was the average proportion of trials with searching for the object in the currently baited cup. Infants' searching was coded based on their first reaching (i.e., touching, opening) or pointing to one of the cups after the agent's first or the second question: "Can you give the toy to me?" across the false and true belief trials. The infants were assigned "1" in each FB and TB trial if they first touched the currently baited cup or first pointed to the currently baited location (if there was no touching response) within the pre-determined response time; if they first touched the initially baited cup or first pointed to the initially baited location, they were assigned "0" for the given trial. Cohen's kappa was κ = .91. We also measured the latency to choose one of the two cups (pre-registered; The inter-rater agreement: r = .98, p < .001), infants' looks at the unchosen cup (exploratory; κ = .86), and the infants' looks at the bystander (the agent that was not asking them to search; exploratory; κ = .83), based on the infants' head turns (or eye movements, when visible) within the pre-determined response period (i.e., the time from the end of the agent's first statement revealing her/his intention for finding the toy, "Let's find the toy." to the participant's first touch for the one of the cups: max. 30 seconds). We performed the additional analyses (on latency and looks) to investigate a potential conflict effect in the FB trials stemming from sustaining two different and equally salient representations (e.g., a longer latency in the FB than in the TB trials to decide; Celik & Kovács, in review).

All analyses were conducted in Rstudio (Version 2023.06.01). We have preregistered ANOVAs and Wilcoxon sign-rank tests to compare infants' performances across the conditions. However, considering that the mixed-models could account for both participant- and item-level variability, here, we report mixed-models instead of aggregated ANOVA analyses. For each main model, we first assessed the potential effects of the child's gender, experimenter-gender, counterbalancing-order, age in months (log-transformed) and included them in the main model in case of a significant contribution to the model. To investigate the effect of individual predictors, we conducted likelihood ratio tests (using the *drop1*-command of the R package lme4).

The data for this study can be found at https://osf.io/h6wd9/

Results

Choice of the current location

A full GLMM containing the predictors: the gender of the participants, the gender of the experimenter, counterbalancing order, age in months (log-transformed), and the random intercept as the participant ID did not differ significantly from a null model containing only the random intercept, $\chi 2(4) = 3.30$, $p = .509$. Additionally, the models including the MSR task as factor did not improve the null model, suggesting that infants' search performance was not modulated by passing or not passing the MSR task and therefore for simplicity, the MSR task was dropped from the final model.

The final model (Search ~ Belief*Who-asks + (1 | ID)) revealed a significant two-way interaction, $\chi 2(1) = 7.59$, $p = .006$. Subsequently, we analyzed the effect of Belief (FB/TB) in each of the Experimenter-asks and Agent-asks conditions. These analyses revealed a main effect of Belief in the Agent-asks condition, $\chi 2(1) = 13.14$, $p < .001$, but not in the Experimenter-asks condition, $\chi 2(1) = 0.08$, $p = .787$.

To check whether infants' performance in the FB and TB trials of the Experimenter-asks and Agent-asks conditions was above chance level, we checked whether the bootstrapped (with 1000 boots) confidence intervals (95% CI) included chance level. In the FB trials of the Agent-asks condition, the Cis included chance level [0.40-0.61], but not in the TB trials [0.67-0.85]. However, in the Experimenter-asks condition, the CIs did not include the chance level in the TB [0.52-0.73] or the FB [0.56-0.75] trials (see Figure 2A). The results revealed an altercentric influence such that infants had difficulty in finding the toy only when the question was asked by the agent (but not the experimenter) while having a false (but not a true) belief about the object's location.

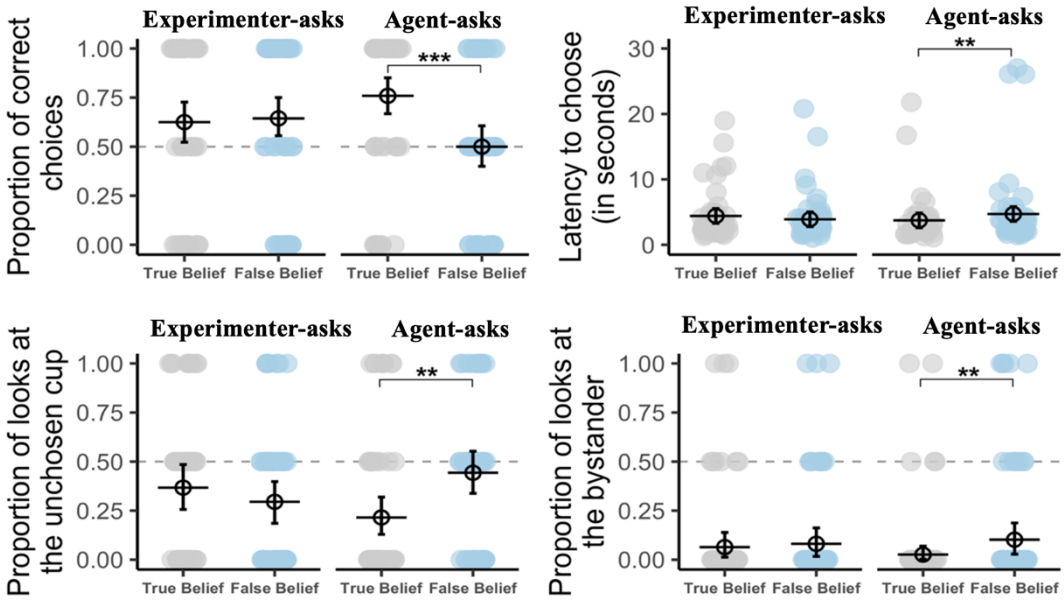


Figure 2: **A)** Proportion of search for the object in the current location, **B)** Latency to choose. **C)** Proportion of looks at the unchosen cup. **D)** Proportion of looks at the bystander. Transparent dots represent the proportions of search for the object in the current location per participant, based on the trials in which any choice was made. Circled dots represent the aggregated proportions in FB and TB trials of per condition. Horizontal line indicates predicted probabilities. Vertical lines indicate the 95% CIs, calculated with 1000 boots, $^{**}p < .01$.

Latency to choose

A full LMM containing the predictors: gender of the participants, counterbalancing order, age in months (log-transformed), and the random intercept as the participant ID differed significantly from a null model containing only the random intercept, $\chi2(6) = 16.32$, $p = .012$. The final model (Latency ~ Belief*Who-asks + (1 | ID) + Experimenter-Gender) revealed a significant two-way interaction, $\chi2(1) = 4.76$, $p = .029$. Subsequently, we analyzed the effect of Belief in each of the Experimenter-asks and Agent-asks conditions. These analyses revealed a significant effect of Belief in the Agent-asks condition, $\chi2(1) = 8.40$, $p = .004$, but not a significant effect of the Experimenter-asks condition, $\chi2(1) = 0.20$, $p = .657$ (see Figure 2B). Thus, upholding two conflicting representations in the FB trials of the Agent-asks condition was reflected in longer duration to make a choice between the currently vs. initially baited locations.

Looks at the unchosen cup

A full GLMM containing the predictors: the gender of the participants, the gender of the experimenter, counterbalancing order, age in months (log-transformed), and the random intercept as the participant ID did differ significantly from a null model containing only the random intercept, $\chi2(6) = 17.97$, $p = .006$. The final model (Look_at_unchosen_cup ~ Belief*Who-asks + Participant-gender + Counterbalancing-order + (1 | ID)) revealed a significant two-way interaction, $\chi2(1) = 8.52$, $p = .004$. Subsequently, we analyzed the effect of Belief in each of the Experimenter-asks and Agent-asks conditions. These analyses revealed a significant effect of the Agent-asks condition, $\chi2(1) = 9.85$, $p = .002$, but not a significant effect of the Experimenter-asks condition, $\chi2(1) = 0.96$, $p = .328$, (see Figure 2C). That is, upholding two conflicting representations in the FB trials of the Agent-asks condition was reflected in their looks at the cup, which was the unchosen alternative.

Looks at the bystander

A full GLMM containing the predictors: the gender of the participants, counterbalancing order, age in months (log-transformed), and the random intercept as the participant ID differed significantly from a null model containing only the random intercept, $\chi2(6) = 14.97$, $p = .021$. The final model (Look_at_bystander ~ Belief*Who-asks + (1 | ID) + Experimenter-Gender) revealed no significant two-way interaction, $\chi2(1) = 2.48$, $p = .115$. Although the interaction did not reach significance, to align with the earlier analysis, we also looked at the effect of Belief in each of the Experimenter-asks and Agent-asks conditions, separately, while controlling for the experimenter-gender. These analyses revealed an effect of Belief in the Agent-asks condition, $\chi2(1) = 7.15$, $p = .008$, but no effect in the Experimenter-asks condition, $\chi2(1) = 0.27$, $p = .601$ (see Figure 2D).

Discussion

The first aim of the current study was to investigate whether infants' level of self-awareness, as measured by the MSR task, has an impact on how much infants are influenced by another person's different perspective in a search task, and whether infants with less developed self-awareness would show very strong altercentric biases (i.e., searching in the empty location), which would be predicted by a strong altercentric framework. Alternatively, altercentric biases could be more moderate, and possibly independent of their level of self-awareness. The findings suggest that infants'

self-awareness did not influence their search behavior, and they have displayed moderate altercentric biases. Independently of whether they have passed the MSR task, infants seemed to experience an interference from the other's conflicting belief, resulting in a moderate difficulty in finding the toy in the false-belief (FB) trials but not in the true-belief (TB) trials. Infants found the toy in only about 50 % of the cases in the FB trials but were more successful in the TB trials. This pattern suggests that altercentric perspectives affect infants' memory for object locations; however, they do not exert a *strong* influence on infants' search behavior, in the sense that it did not fully override their own object representation, which would have resulted in searching more in the empty location where the other believes the object to be. Overall, such findings support a moderate influence of others' beliefs on infants' search behavior (Kampis & Kovács, 2021; Scott & Baillargeon, 2017). One may argue that these results reflect a communicative drive to inform the agent about the empty cup, but this seems unlikely, as infants showed no behavioral cues consistent with such an interpretation (e.g., showing the empty cup to the agent).

The second aim of the current study was to explore whether infants track multiple altercentric perspectives in a search task. Pragmatic accounts propose that contextual factors could influence young children's performance in false-belief (FB) tasks (Helming et al., 2014; Oktay-Gür & Rakoczy, 2017; Westra & Carruthers, 2017). One key factor is which perspective becomes relevant (i.e., who asks the question about an object's whereabouts or where an agent with a false belief will search). In the standard verbal FB tasks used with 3 – 5-year-olds, the experimenter – who shares common ground and knowledge with the child – typically asks the question (Wellman et al., 2001). This may bias children to align their answer with the questioner's perspective, leading them to report the object's current location rather than where the agent with a false belief would search. Such a bias may contribute to young children's failures, particularly among 3- to 4-year-olds. Helming et al. (2014) proposed that when the question is asked by a person holding a false belief, children's performance may improve, and they could more accurately predict that the agent will search in the initial location.

The current study asked whether infants' performance would be modulated by who asks the question, given that the interlocutor may make her respective perspective more relevant in a given context. Thus, infants may be affected more by the agent's false belief and make more errors in searching at the empty location (false belief location) when the agent, who has the false belief, asks the infant to find the toy. In contrast, when the common-ground interlocutor asks the question, the false belief may be less salient, and infants should show an improved performance in finding the object. As predicted, the altercentric effect observed across FB and TB conditions disappeared when the experimenter (the common-ground interlocutor) asked the question. In the Experimenter-asks condition, infants performed above chance in both FB and TB trials, showing no difference in their performance to find the toy across the two trial types. In contrast, in the Agent-asks condition, an altercentric bias emerged (see also Celik & Kovács, 2024; in review): infants reached to the empty (false belief) location in about 50% of the trials but were successful in finding the toy in its current location in the TB trials, and performance was different across FB and TB trials. Such data suggests that infants encode the two different perspectives of the interlocutors and rely on those differentially in different contexts. In the FB trial of the Agent-asks condition, the FB of the agent becomes salient and competes with infants' own reality representation, and thus interferes more with the performance.

Such an account was also supported by the latency analysis. In the Agent-asks condition, infants took longer to decide in the FB than in the TB trials. This pattern has been also observed in a previous task involving a false-belief scenario (Celik & Kovács, 2024; in review). One possible explanation is that, in the FB trials, infants sustain two conflicting perspectives that may be equally salient (i.e., the agent's false belief that the object is in the initial location vs. the infant's true belief that the object is in the current location), and infants may struggle to resolve the conflict. By contrast, no such difference emerged in the Experimenter-asks condition, likely because in that case, the Agent's perspective was less salient, and thus caused less conflict, given that the question was asked by the experimenter, who shared common ground (or knowledge) with the infant regarding the object's location.

We have also explored infants' looks towards the cup they ended up not choosing. The logic behind this was that in case infants experience high conflict between two possibly equivalent representations (e.g. the FB of the agent and their own knowledge in the Agent-asks condition), they should perform more looks to the unchosen cup (the alternative), compared to a situation in which they experience no conflict (TB trials), but not when there is low conflict (Experimenter-asks condition in which the FB of the agent may be less salient). Indeed, in the FB trials of the current study, infants looked more at the unchosen cup compared to the TB trials when the question was asked by the agent. By contrast, no such differences in looks toward the unchosen cup were observed in the Experimenter-asks condition.

In a similar vein, we have also explored infants' looks to the bystander (i.e., the experimenter or the agent, the one who was not asking the question). Although the interaction was not significant for this measurement, the data pattern seems similar to the data from the looks to the unchosen cup. Infants seemed to look more to the bystander in the FB trials than the TB trials in the Agent-asks condition, but not in the Experimenter-asks condition.

The current results suggest that infants' searching behavior is subject to altercentric modulations and is influenced by others' perspectives, however they can also selectively rely on the perspectives of multiple agents. Infants searched more in the empty (FB) location only when the question was asked by an agent with a false belief. However, these altercentric influences were not modulated by self-awareness as measured by the Mirror Self-Recognition task.

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