Novel agents engage automatic reorienting of covert spatial attention in preschool-aged children and adults

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Background

"**Gaze-cueing** " is the rapid and automatic reorienting of spatial attention in the direction of another's line of sight. This response is private - occurring without any visible changes in the observer's eye, head, or body orientation (Friesen & Kingstone, 1998; Posner, 1980). The rapid, covert, and automatic nature of gaze cueing distinguish it from the slower, overt, and less automatic reorienting of visual attention known as "**gaze-following**".

In early infancy, gaze cueing is heavily influenced by the low-level, perceptual features of stimuli (e.g., motion: Farroni et al., 2000) and the initial acquisition and maintenance of cued responses may be underlain by "overlearning" the perceptually represented features of directional, biological signals (Vecera & Rizzo, 2006). However, by adulthood, abstract attributions about a cueing character's visual experiences or mental capacities influence this response (Wiese et al., 2012). There are no studies assessing when in development young children's cued responses achieve adult-like sophistication.

Young children's and adult's deliberate, social behaviors are influenced by abstract representations of agents – e.g., "gaze" following and mentalistic descriptions of perceptually unfamiliar characters (Beier & Carey, 2014; Johnson, Slaughter, & Carey, 1998). However, given the rapid, automatic nature of cueing, it is unknown whether such abstract representations of agency also inform this reflexive social response.

Aims & Design

This study seeks to assess whether a novel agent, identified via a contingent, communicative interaction will recruit a covert "gaze"-cued reorienting response in **4 – 6-year-old children** and **adults**.

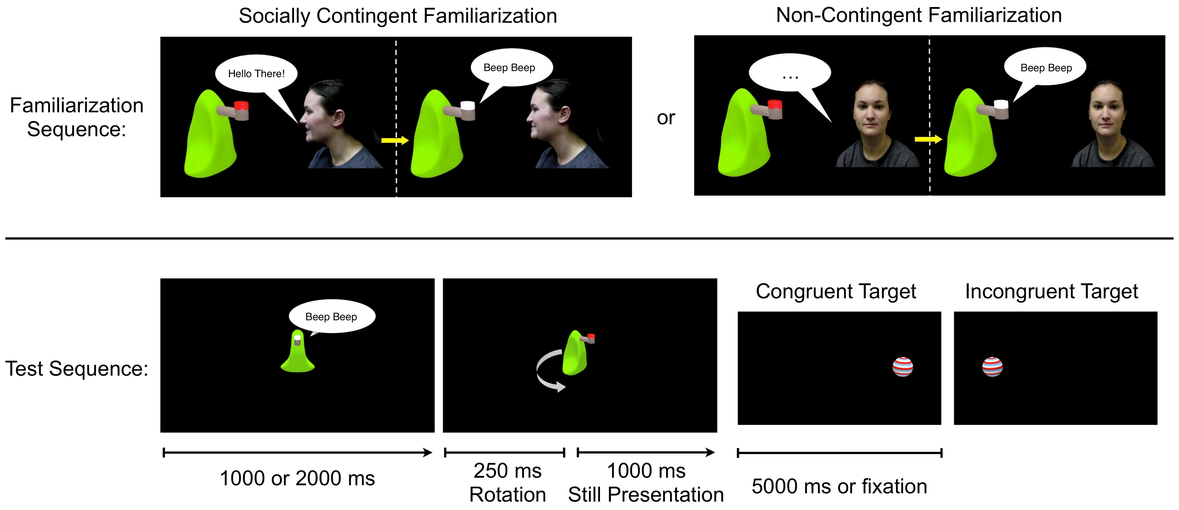
Between-subjects manipulation

- Socially Contingent or Non-Contingent Control familiarization movies. (60s introduction movie at start; 20s re-familiarization every 8 trials)

Gaze-cueing test trials:

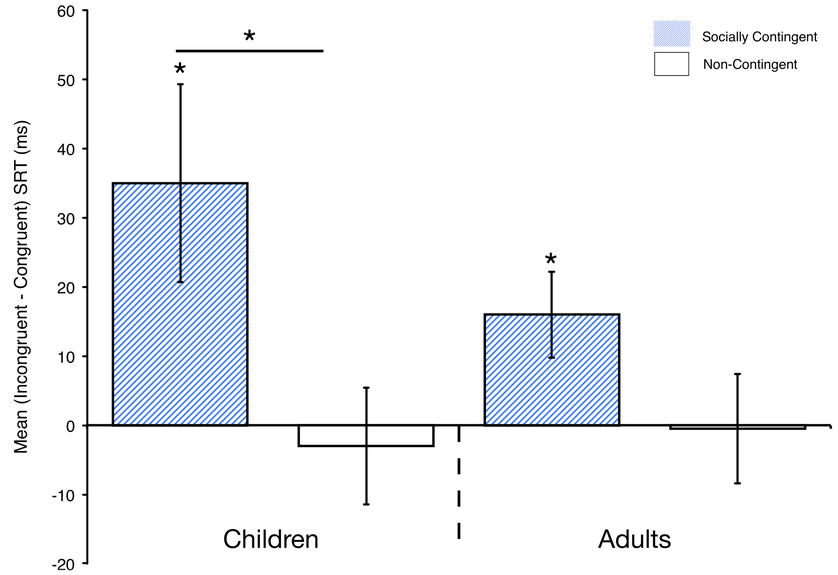
- A Tobii TX-300 eye-tracker measured participants' *saccadic reaction times* (SRTs) to fixate peripherally appearing target objects.
- On each test trial, target object appearance was either Congruent or Incongruent with the direction of the entity's rotation.
- Shorter SRTs on Congruent trials indicate that the entity's turn cued participants' covert spatial attention.

Methods



Results

	Condition	# of subjects	Mean SRT Congruent Trials (*SD*)	Mean SRT Incongruent Trials (*SD*)	ind. samples *t*	two-tailed *p*	Mean # Congruent Trials (*SD*)	Mean # Incongruent Trials (*SD*)
Children	Socially Contingent	26 (11 female)	**426 (*118*) ms**	**460 (*143*) ms**	**2.45**	**0.02**	13.12 (*5.45*)	12.81 (*5.24*)
	Non-Contingent	27 (15 female)	**380 (*110*) ms**	**377 (*111*) ms**	0.34	0.74	12.63 (*6.25*)	12.96 (*5.75*)
Adults	Socially Contingent	28 (21 female)	**289 (*47*) ms**	**305 (*51*) ms**	**2.56**	**0.02**	22.82 (*4.35*)	22.50 (*5.27*)
	Non-Contingent	31 (23 female)	**321 (*71*) ms**	**321 (*58*) ms**	0.06	0.90	22.19 (*4.34*)	21.71 (*4.05*)



Children
Congruency x Condition
$F(1, 51) = 3.82$, $p = .03$

Adults
Congruency x Condition
$F(1, 57) = 2.58$, $p = .11$

* = p < .05
error bars are +/- 1 SE

Trial Coding Check

To ensure that participants' orienting responses were covert, research assistants coded videos of each trial with overlaid gaze plots. For included trials:

1. The participant's gaze did not leave the centrally positioned entity until the target appeared.
2. The participant's saccade from central entity to peripheral target was direct and uninterrupted.

Discussion

By 4 years of age and continuing through adulthood, **abstract attributions of intentional agency engage automatic reorienting of covert spatial attention**.

These behaviors cannot be explained by perceptual reflexes or histories of associative learning:

- The low-level motion of the entity did not drive these responses. Participants did not respond similarly during identical test trials in the Non-Contingent condition, when they did not view the entity as an agent.
- The non-predictive nature of the task ensured that participants' cued responses were not based upon learning during the study that the entity's turns were directionally meaningful.
- The novelty of the entity prevented participants from drawing upon extensive prior experiences with other cues (c.f., cueing to grasping hands: Daum & Gredebäck, 2011; arrows: Jakobsen et al., 2013).

Young children's most automatic social responses are informed by rich conceptual considerations about the agents that they encounter, and are not limited to overlearned responses to specific, perceptually defined stimuli.

This finding suggests that conceptually informed cueing may occur in even younger children. We are pursuing this possibility, using various ways of establishing the agency of a novel entity and manipulating the perceptual experiences we attribute to it.

References

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