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Social perception: How do 6-month-old infants look at pointing gestures?

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ABSTRACT

The study explored 6-month-old infants' ability to follow a pointing gesture in a dynamic social context. The infants were presented with a video of a model pointing to one of two toys. The pointing gesture was performed either normally (with arm and hand pointing at the same direction), with a stick, or the model's arm and hand pointing in different directions (at different toys). The results indicate that infants at this age reliably followed pointing performed normally.

To follow the direction of pointing gestures is a critical ability that infants acquire during the first year of life. At the same time, there is not complete agreement in the field on when infants start to follow a pointing gesture. According to results of several earlier studies it happens at the end of the first year (Blake, O'Rourke, & Borzellino, 1994; Butterworth, 2003; Franco, 2005; Morissette, Ricard, & Decarie, 1995). This view is supported by Daum, Ulber, and Gredebäck (2013) study results. The authors, using a spatial cueing paradigm, showed static images of a pointing hand, in combination with acoustic stimuli (human voice, mechanical sound or no sound). The study's results demonstrated that 12-month-old infants but not 10-month-olds attended to the pointed target and the strongest effect was observed in the human voice condition. At the same time, results of two other recent studies demonstrate that even younger infants are able to react to pointing gestures. Using the same spatial cueing paradigm, Rohlfing, Longo, and Bertenthal (2012) presented static and dynamic pointing hand gestures to 4.5- and 6.5-month-old infants. Both age groups were able to orient their attention in the direction of a pointed target but only when the posture of the pointing hand and its motion were directed to the pointed target. Bertenthal, Boyer, and Harding (2014), modified the spatial cueing paradigm so that the pointing cue and the pointed target were visible simultaneously. They compared how 4- and 6-month-old infants react on pointing gestures produced by: a pointing hand, a foil with the shape of pointing hand and by an arrow. That was done in order to compare if infants at these ages are differentially sensitive to social and non-social spatial cues. The results showed that both 4- and 6-month-old infants generally preferred to attend to the pointing hand in comparison to the quasi-social (foil) and non-social (arrow) stimuli. At the same time, 6-month-olds shifted their attention significantly more toward the pointed target compared with 4-month-olds during the congruent pointing hand gesture but not during the foil condition. Moreover, 6-month-old infants oriented their attention in the direction of the target when the stimulus-target asynchrony was 100 ms but not after 500 ms.

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Based on these results, the authors concluded that though infants at both ages were more interested in the pointing hand, the 6-month-olds oriented specifically after seeing the pointing hand and not after seeing the foil as 4-month-olds did. According to the authors, this response of 6-month-olds was no longer a reflexive reaction but a developing ability to co-orient their attention in the direction of a presented social cue. However, the authors note that this ability is still restricted compared to conscious understanding of the pointing gesture. The limitations of this ability in more natural situations outside the spatial cueing paradigm are still unknown. Placing the gesture in a more naturalistic context, with a person in the frame, would add more ecologic validity to the finding. In other words, Bertenthal et al. (2014) study demonstrated that, in a spatial cueing paradigm 6-month-old infants follow pointing gestures (but not foils). The question is how infants will follow pointing gestures if they are presented in more natural context.

In this study we presented 6-month-old infants with a video, where a model performed pointing to one of two toys. The video presentation helped us to include motion information from gesture dynamics. We were also able to carefully control the presented stimuli, while still preserving the social context in which pointing gestures naturally occur. The pointing was always combined with the model's utterance directed to the child. According to the study by Daum et al. (2013) adding of such social context increases children's attention to the stimuli.

Pointing, like other referential social cues such as following other person's gaze direction, is a brief social sign that is normally performed and followed quickly, already by the first saccade (for more details see Theuring, Gredebäck, & Hauf, 2007). Thus, the direction of the infants' first saccade from the model's pointing hand to any of the targets can provide us with information about infants' ability to follow referentially the direction of pointing. Other measures that can been used to investigate how referential cues affect later gaze behavior is first fixation duration, looking times at congruent vs. incongruent objects and reaction times.

Another important question is which cues infants rely on when following pointing. Woodward, 1998 and Hofes, Hauf, and Aschersleben (2005) studies found, using a habituation paradigm, that infants younger than 12 months coded the goal of grasping gestures only when they were performed by a human hand and not by a mechanical claw. Bertenthal's et al. (2014) results point into the same direction. Both 4- and 6-months-olds did not orient toward the target when an arrow pointed at it, however they did when the foil (only 4-month-olds) or the hand pointed. In this study, we presented pointing both with a human hand (normal pointing) and a stick (stick pointing) in order to further explore the influence of the social agent on pointing following. In addition, as pointing indicates a direction in space, the direction of the gesture should be a necessary cue. But will it be the direction of the pointing hand or the direction given by the arm of the pointing person that infants follow in natural situations? A third condition, angular pointing, was introduced. It was done in such a way that the model's arm and hand pointed to different directions (at different toys). In this case, if infants have no preference for one of these cues they could follow hand and arm direction equally and would not be able to follow the direction indicated by the pointing hand. That is because arm and hand directions contradict each other. Only if they followed the hand pointer's direction, would they follow the gesture correctly. In all of these conditions the human model pointed to one of two toys that were placed at the same distance from the pointing hand or stick (in the stick condition the hand was not visible).

Eighteen 6-month-old healthy full-term infants (8 boys, $M = 26.2$, SE = 0.36) participated in the experiment. Six additional infants were excluded due to fussiness or technical problems. Infants' gaze direction was measured with a Tobii 1750 (Stockholm, Sweden) gaze tracker system (accuracy = 0.5°, spatial resolution = 0.25°, sampling rate: 50 Hz).

Each stimuli movie started with the whole scene being occluded. Then a window (height 22.62 × width 20.78 visual degrees) appeared through which a part of the scene became visible. First, the left half of the screen became visible where the participant could see a female model looking at the camera, saying "Hello!" and waving to the child (Fig. 1a). After that, the window moved to the right half of the screen. Now, only the two target toys became visible through the window. At the next moment the model's arm appeared at the window (moving from the lower part of the window upwards) and pointed toward one of the toys during approx. 5 s. Simultaneously with the arm appearing in the window, the model, not visible at the moment, said: "Look", making the infant attend to the stimuli and framing the stimuli to a social context. The model was hidden during the pointing gesture. That was done in order to remove referential influence of her gaze direction during pointing gesture. According to D'Entremont, Hains, and Muir (1997) and von Hofsten, Dahlström, and Fredriksson (2005) infants rely more on the direction of the model's gaze compared to the direction that is pointed.

Three different stimuli were presented. In the first stimuli condition (normal pointing) we presented a pointing gesture. Two toys were situated at the distance 9.52° from the model's tip of the pointing finger (Fig. 1b). In the second condition (angular pointing) when the model performed pointing, her hand was bending in such a way that the arm direction was different from the hand and pointing finger's direction (Fig. 1c). In the third condition (stick pointing) the model used a stick to point and during the pointing time the model's hand holding the stick was invisible (Fig. 1d).

Each participant was demonstrated 8 repetitions of each condition (4 gestures pointing at the upper toy and 4 pointing at the lower toy). The order of the presented video clips was randomized, and attention grabbers were presented between every three video clips. In total, each participant saw 24 pointing gestures during the experimental session.

When arriving to the lab, the parents were informed about the purpose of the experiment and signed a written consent form. After that, the baby was seated in a safety car seat that was placed on the parent's lap, at an approximate distance of 60 cm from the gaze tracker. Before the infants were presented with the stimuli the eye tracker was calibrated. During the calibration procedure each participant was presented with nine calibration points. At the end of the calibration a graph appeared that reported how successful the calibration was; any unsuccessfully calibrated points were recalibrated. The duration of the calibration lasted about 1–2 min.