Neural Differential Processing of Gaze Cueing from a Congruent and Incongruent Informant

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BACKGROUND

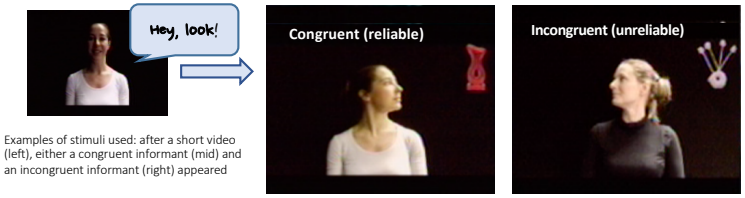
- Young children preferentially learn from reliable others over unreliable others. Prior empirical studies have demonstrated how children can respond differently to individuals with a different level of reliability (Harris, Koenig, Corriveau, & Jaswal, 2018; Mills, 2013).
- A recent study showed that infants as young as 8 months of age only followed the gaze of a person who consistently gave them accurate gaze cues to an object location, but not the gaze of a person who did not always give them accurate cues (Tummeltshammer et al., 2014).
- No direct investigations have been conducted to clarify the cognitive processes underlying how infants discriminate reliable others from unreliable others.

QUESTION

How do 9-month-old infants process information from reliable and unreliable informants?

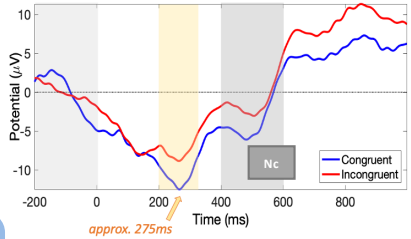
METHODS

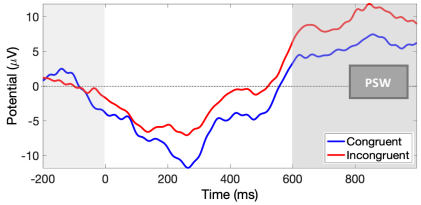
Participants: 22 infants aged 9months (*M*=271days)
Stimuli & Procedure: Infants watched static images showing a congruent (reliable) or incongruent (unreliable) informant, presented after a 2s video where the informant said "Hey look!" with her eyes directed to the infant. A congruent informant looked at the object 100% of the time, whilst an incongruent informant looked at the object 25% of the time and looked away from it 75% of the time. Presentations ceased when infants were no longer able to attend to the stimuli. On average, infants watched 82 images in total (both conditions).
EEG: A 128-channel Geodesic Sensor Net (EGI) was used for data recording, and data pre-processing and analysis was conducted according to a standard ERP analysis procedure. Participants who contributed more than 5 artefact-free trials consisted of the final sample.



Examples of stimuli used: after a short video (left), either a congruent informant (mid) and an incongruent informant (right) appeared

RESULTS





Figures: Grand-average waveforms on the congruent (blue) and incongruent (red) trials over frontocentral electrode sites [right] and over frontotemporal sites. The x = 0 marks the stimuli onset, and the lighter grey shading indicates the baseline (-200ms to 0) and the darker shading the time-window of focus for the Nc [right] and the PSW [left]. The yellow shading in the right figure represents the time window within which the early negative deflection was observed.

- The negative component (Nc) was enhanced for the congruent informant ($t(22)$=-2.25, p=.035)
- The positive slow wave (PSW) was greater in amplitude for the incongruent informant ($t(22)$=-2.53, p=.020)
- A negative deflection at early latency differentiated the congruent informant from the incongruent informant ($t(22)$=-2.86, p=.009).

DISCUSSION

- Three key neural components were identified as indexing underlying selective social learning based on informant reliability.

1. **Negative Component (Nc)** [**attention allocation** (Reynolds & Richards, 2005)]: Larger amplitude for the congruent informant than the incongruent informant.
2. **Positive Slow Wave (PSW)** [**memory updating** (de Haan & Nelson, 1999)]: Greater mean amplitude for the incongruent informant than the congruent informant.
3. **Early-latency negative deflection**: Differential responses to the congruent and incongruent informants. It is difficult to label or discuss its function only from this study.

- Taken together, the current study demonstrates that **infants process information differently according to the informant's reliability.** When the informant is reliable and consistently gives a correct cue, infants pay enhanced attention and are able to better encode the provided information. When the informant gives information with mixed accuracy, infants' attentional allocation decreases and the information is only partially encoded.
- These neural correlates are likely to predict infants' cognitive processing mechanisms that can be modulated by informant reliability.

References

de Haan, M., & Nelson, C. A. (1999). Brain activity differentiates face and object processing in 6-month-old infants. *Developmental Psychology, 35*(4), 1113–1121.

Harris, P. L., Koenig, M. A., Corriveau, K. H., & Jaswal, V. K. (2018). Cognitive foundations of learning from testimony. *Annual Review of Psychology*. 69. 251-273.

Mills, C. M. (2013). Knowing when to doubt: developing a critical stance when learning from others. *Developmental Psychology*. 49(3). 404-418.

Reynolds, G. D., & Richards, J. E. (2005). Familiarization, attention, and recognition memory in infancy: An event-related potential and cortical source localization study. *Developmental Psychology*. 41 (4). 598-615.

Tummeltshammer, K. S., Wu, R., Sobel, D. M., & Kirkham, N. Z. (2014). Infants track the reliability of potential informants. *Psychological Science*. 25(9). 1730-1738.

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KD and GB conceptualized and designed the study. SL and MA ran the data acquisition sessions with SF helping with recruitment. SF performed the analysis and made the original draft of the poster including the visualizations. SF, VR, GB, KD were involved in editing. MATLAB program required for data acquisition was provided by Barrie Usherwood at Lancaster University. Special thanks to all the participating parents and children.