Can neural activities during the traditional Piagetian AB search task explain infants' perseverative search error?

Preliminary results

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BACKGROUND

- The infant perseverative error (Piaget, 1954) is one of the most replicated findings, yet, there is no general agreement on why the error occurs and what aspect of infants' cognition error reflect.
- Looking and reaching measures have yielded mixed evidence of infants' object permanence (e.g. Baillargeon, 1987; Diamond, 1988). No theories proposed thus far can fully explain mixed results reported (e.g. Bremner & Bryant, 1977; Diamond, 1988; Harris, 1973; Munakata, 1998; Thelen et al., 2001; Topál et al., 2008).
- Neural measures may shed light on the mechanisms underlying the error, yet have not been utilised due to technological challenges of measuring neural activity during a behavioural task.

Research Question

Can neural activities explain infants' perseverative error during the traditional Piagetian AB task?

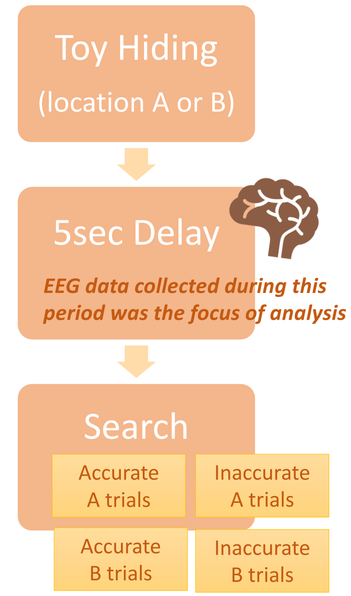
METHODS

Participants: 36 infants aged 9 months (*M*=270.1days)

Stimuli & Procedure: Infants engaged in the traditional Piagetian AB search task with an experimenter in a live situation. A box containing two hiding wells was used to conduct a task. Infants saw the experimenter hide a toy in one of the wells (A location). After the 5 second delay, the box was pushed closer to the infant to allow them to search for the toy. After 5 A trials, B trials commenced where they toy was then hidden in the other well (B location). B trials ceased when the infant stopped paying attention to the task (*M*=2.97 B trials, ranging 1-4, *SD* = .97).

Behavioural Analysis: Search accuracy [Search accuracy on the first B trial as compared to the final A trial] and **Error run** [the number of consecutive trials on which infants incorrectly searched during A and B trials] were coded from the video recordings.

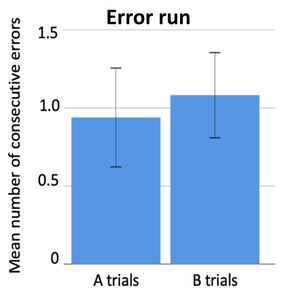
EEG Analysis: A 128-channel Geodesic Sensor Net (EGI) was used for data recording. Data during the 5-sec delay period were extracted from each trial. After removing the contaminated trials, trials were grouped into four conditions according to the infant's search performance; accurate and inaccurate A trial, and accurate and inaccurate B trial. Theta-band activities over frontal regions was the focus of the current analysis.



RESULTS

Behavioural results:

The analysis of search accuracy and error run (*p* =.24, .15 respectively) found no significant difference across trials in terms of infants' search performance. Compared with a prior study (Dunn & Bremner, 2019) infants in the current study were less likely to commit the error, and they made more errors during A trials and fewer errors during B trials.

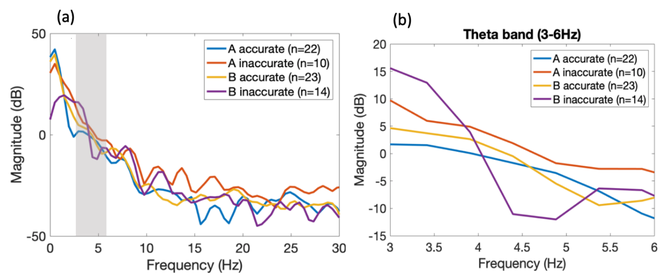


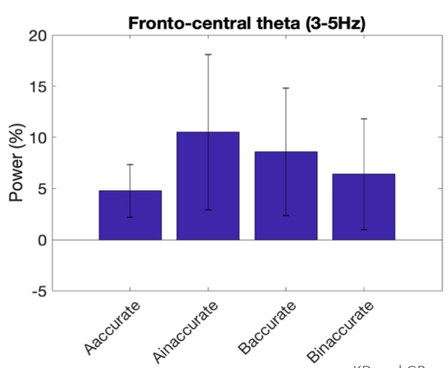
Search accuracy

	Final A trial	
First B trial	accurate	inaccurate
accurate	10	5
inaccurate	11	1

EEG results:

Power spectrum suggested neural activities in theta-band over frontal regions may be reduced prior to inaccurate B trials compared to B accurate or A inaccurate trials. Due to the absence of infants who contributed data to all the four conditions, three pair of conditions were conducted (A accurate-A inaccurate [N=3], B accurate - B inaccurate trials [N=10], and A accurate - B accurate [N=15]). None of them found a significant difference across conditions (*p*= .109, .646, .124 respectively).





DISCUSSION and FUTURE DIRECTIONS

- **Setup issues affecting behavioural results**: Some infants might have been unable to see inside the wells, which could make it difficult for them to understand the goal of the task. This likely affected the level of infants' task engagement and increased random reaching versus active searching.
- **Individual differences in EEG data**: A large standard deviation in the EEG data may mask the effect of neural activities that could predict infant's search.
- Nevertheless, **this pilot study showed that it is feasible to measure neural response and to explore online cognitive process underlying infants' perseverative error while they actively engage in the traditional AB search task**. This means that it is now possible to understand cognitive processes as illuminated by EEG that underly behavioural tasks. This can be done in such a way where it does not interfere with behavioural tasks such as the traditional A not B task.

Authors Contributions and Acknowledgements

KD and GB conceptualized and designed the study. SL and MA ran the data acquisition sessions with SK helping with recruitment. SK performed the analysis and made the original draft of the poster including the visualizations. SK, 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, as well as European Commission Marie Skłodowska-Curie Actions for funding SK's PhD project.

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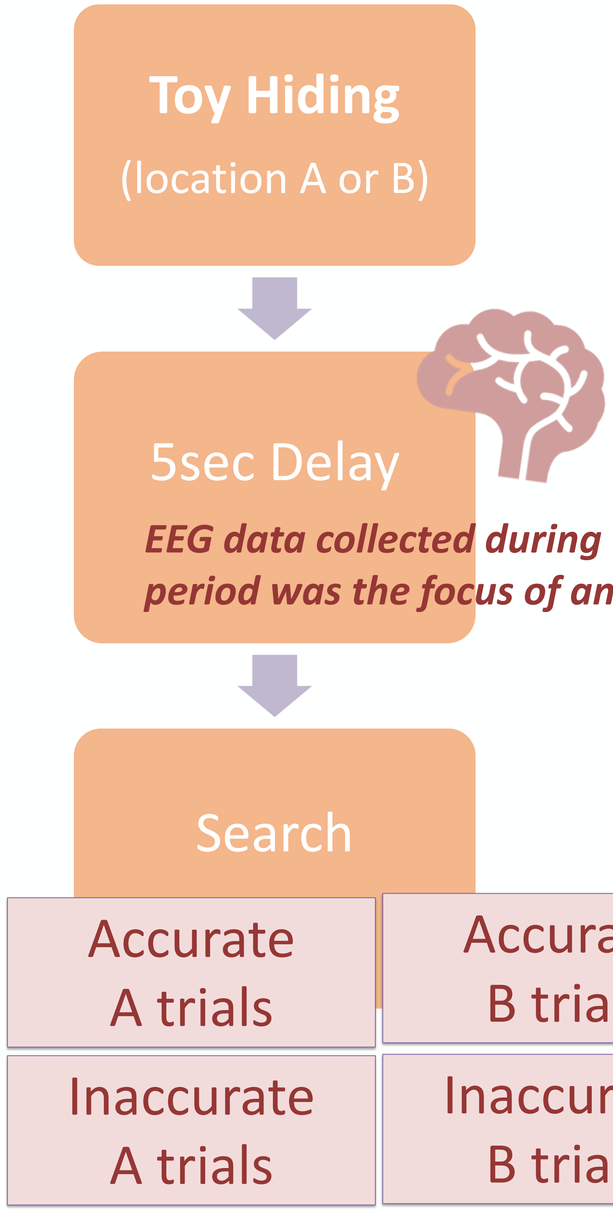

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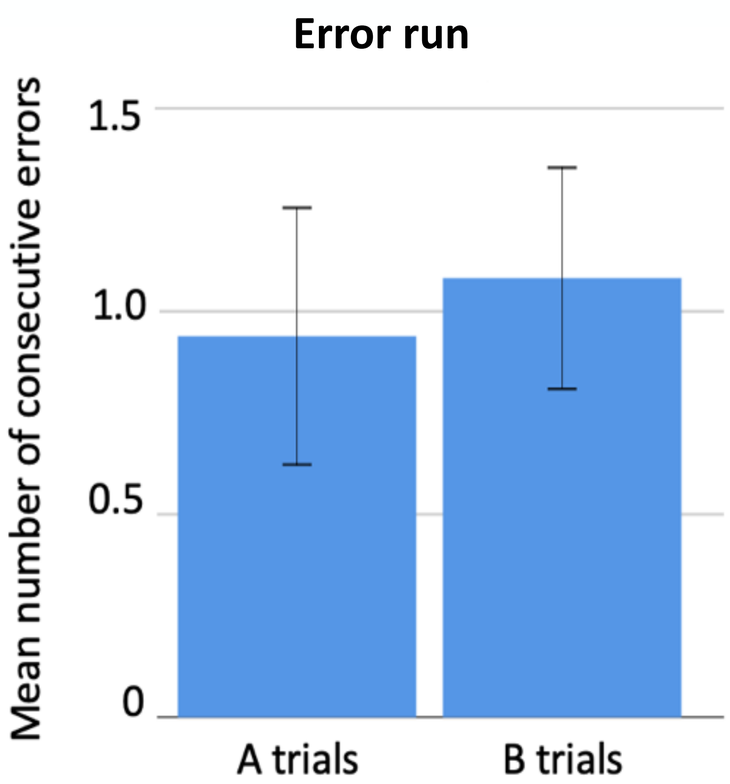

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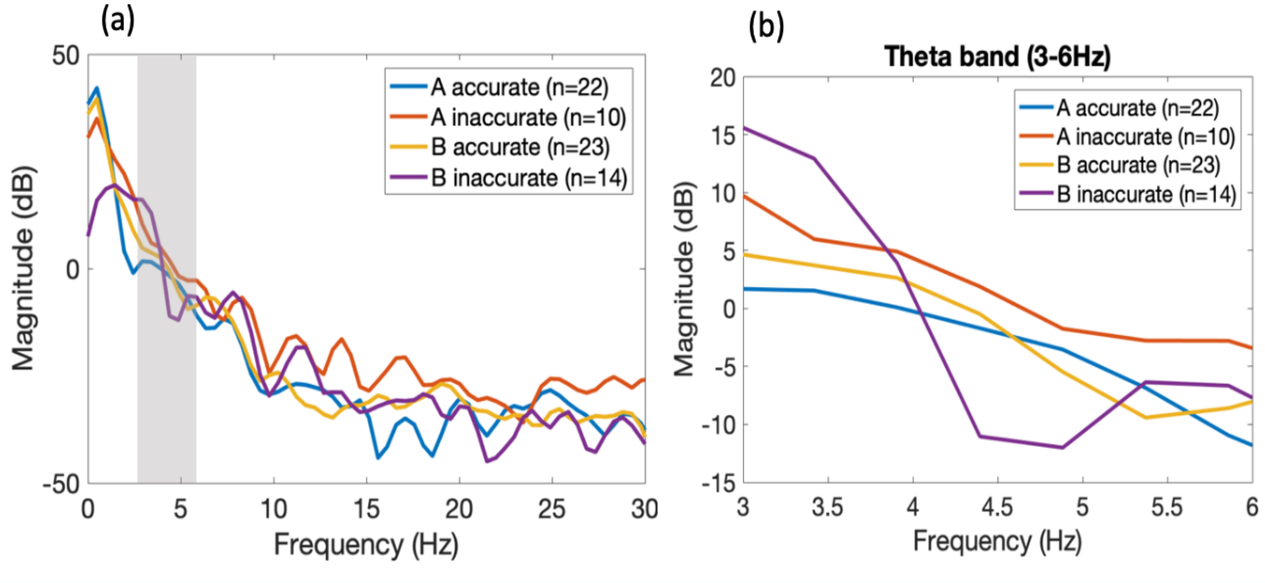

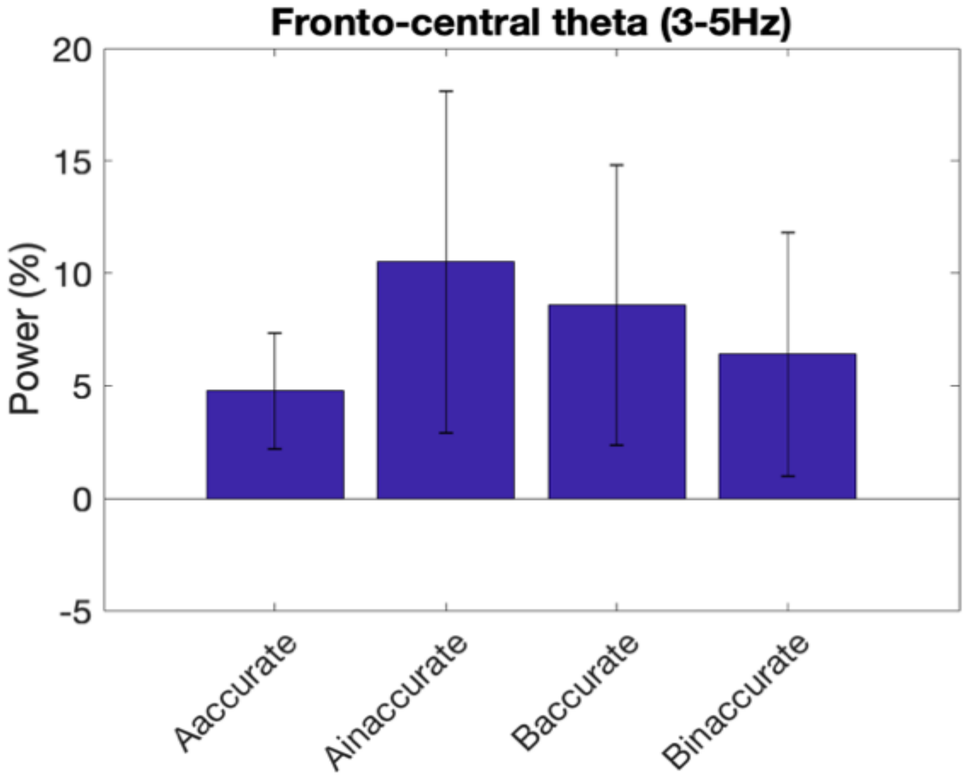

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THANK YOU!

For questions, please email to Saya Kidby on s.kidby@lancaster.ac.uk

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