Infant Neural Responses to Timing-Deviations in High and Low Tones

Ciara Ritchie, Daniel J. Cameron & Laurel J. Trainor

Dept. Psychology, Neuroscience and Behaviour, McMaster University, Canada

INTRODUCTION

- Adults have superior timing for low vs. high pitches, in both behaviour (tapping) and brain responses (mismatch response, or MMR)[1]
- We do not know whether this timing bias for low pitch develops in early life or is present in infancy
- Here, we assess mismatch responses in 7-month-olds using electroencephalography (EEG)

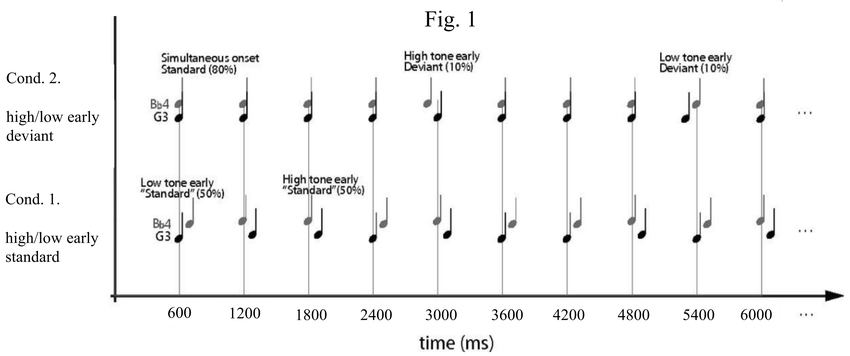
RESEARCH QUESTIONS

- **Do 7-month-olds' mismatch responses (MMRs) reveal a superior timing bias for low vs. high pitches, as found in adults?**

METHODS

- 12 infants (7 males, 5 females, mean age = 7.5m, range =7.1m-8.0m), data collection ongoing (toward n = 30)
- Recorded with 124-channel HydroCel GSN nets at a sampling rate of 1,000 Hz using a CZ reference.
- Two synthesized piano tones of 196.0 Hz (G3) and 466.2 Hz (B-flat4) were presented at 600ms (adapted from [1])
- Tones were presented simultaneously (standard), or with either the high or low tone 50ms early (deviant).
- **Condition 1:** only deviant trials (50% high tone early, 50% low tone early) (**high/low early standard**)
  Condition 2: simultaneous standards (80%) and deviants (10% high tone early, 10% low tone early) (**high/low early deviant**). Fig.1

Fig. 1

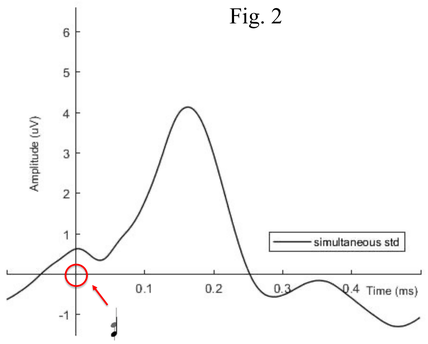


PREPROCESSING AND ANALYSIS

- Used fieldtrip toolbox in MATLAB [2]
- Butterworth highpass and lowpass filters (0.5 and 20Hz), processed through the Artifact Blocking algorithm. [3]
- Bad channels were rejected by visual inspection and interpolated from neighbouring channels.
- Data segmented -100ms to 500ms
- Expected and unexpected low tone and high tone deviants were averaged separately for each participant.
- Averaged channels were baselined using the average amplitude -100ms – 0ms
- The difference between expected and unexpected make up the respective high and low tone Mismatch Responses (MMR).

PRELIMINARY RESULTS

Fig. 2



- Fig.2 Averaged response to simultaneous standards, presented at 0 ms
- Fig.3 Averaged response to high early standards (predictable deviants) and high early deviants (unpredictable deviants)
- Fig.4 Averaged response to low early standards (predictable deviants) and low early deviants (unpredictable deviants)
- Larger responses are demonstrated for unexpected high and low deviants, compared to their corresponding expected deviant tone.

Fig. 3

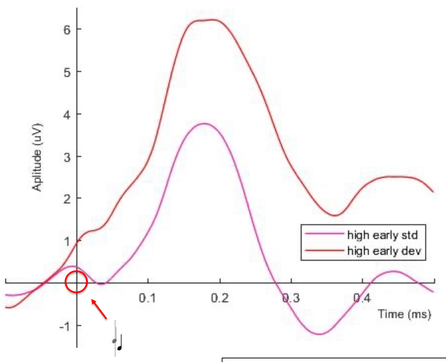
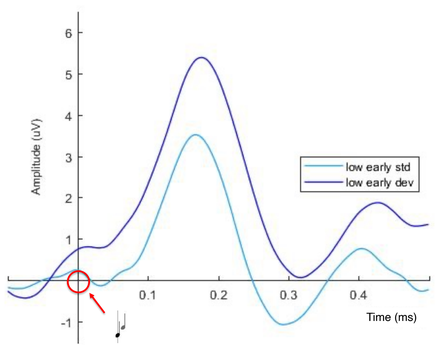


Fig. 4



PRELIMINARY RESULTS

Fig. 5

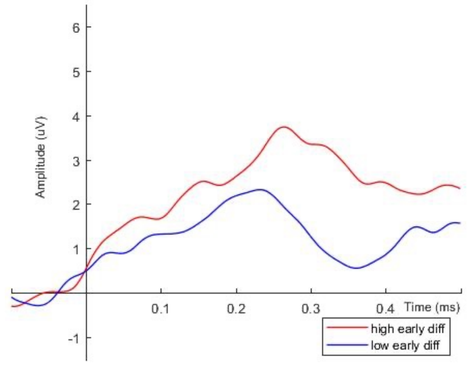


Fig. 6

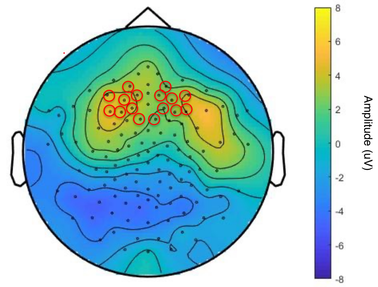
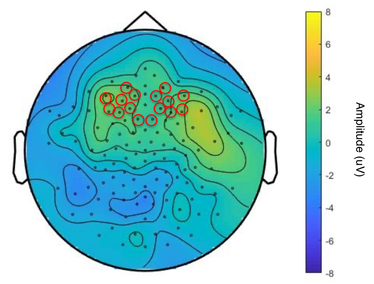


Fig. 7



- Fig 5. Difference waves (MMR) for early standards vs early deviants (high vs low).
- Preliminary results suggest **the MMR for high pitch deviants has a greater peak amplitude** and **MMR for low pitch deviants has a faster peak**
- Fig 6.,7. Topographic maps representing MMR amplitude for the high-early (L) and low-early (R) deviant-standard difference waves. Red circles represent channels used for Fig 2-5

DISCUSSION

- Preliminary (n = 12) results suggest differing infant MMR for high and low pitch timing deviants: high-pitch deviants elicited a greater amplitude MMR and low-pitch deviants elicited a faster-peak MMR.
- If this result is ultimately reliable, it would differ from results found in adults: low tones elicited a stronger MMR, together suggesting that the superior timing bias for low pitch may develop over childhood.
- Previous work found a high-pitch bias in infant MMRs for pitch-based deviants. Together with our current data, this could suggest a general high-pitch bias in infancy [4], consistent with infant-directed speech using higher pitch than adult-directed speech [5].
- Knowledge about how infants process frequencies may provide insight into early language acquisition, attention, parent-infant interactions, and how the human brain processes music and timing throughout development.

References

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5 Trainor, L. J., Austin, C. M., & Desjardins, R. N. (2000). *Psychological Science*, **11**, 1-8.

Acknowledgements

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