

# An EEG Examination of Early Visual Processing in Cochlear Implant Using Children



## INTRODUCTION

- Auditory deprivation at early ages is believed to influence primary sensory processing and some higher-level cognitive domains, such as attention and learning.<sup>1</sup>
- A possible explanation is cross-modality plasticity (CMP), which is the reallocation of neural resources of deprived sensory systems by intact sensory systems
- We aim to identify evidence of CMP by comparing the visual evoked potentials (VEP) of **Cochlear Implant (CI)** using children and age matched **typically developing (TD)** children.

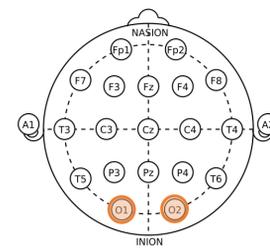


Figure 3.a) 19-electrode map with O1 and O2 sites highlighted.

## RESULTS

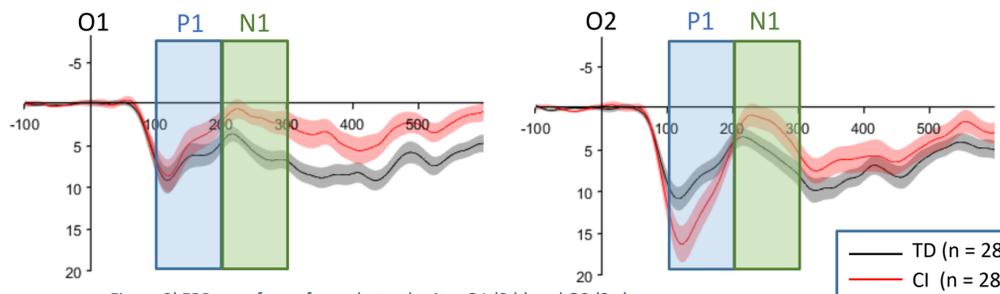


Figure 3) ERP waveforms from electrode sites O1 (3.b) and O2 (3.c).

- Both groups exhibited visual evoked potentials (VEP) at both occipital electrode sites in response to visual stimuli onset
- First positive peak (**P1**) between 100-200 msec
- First negative peak (**N1**) between 200-300 msec

## CONCLUSION

- The **larger right occipital P1 amplitude** could be a reflection of **enhanced visual processing in CI using children.**
- The **greater N1 amplitude in CI using children** could reflect increased **engagement to/or orientation of visual attention.**<sup>4</sup>
- These changes may reflect intra-modal or cross-modal reorganization.

## SUBJECTS

### CI using Subjects:

- n = 28 (20 males, 8 females)
- Mean age = 74 months
- Age Range: 46-128 months
- Implanted < 31 months

### TD Controls

- n = 28 (12 males, 16 females)
- Mean age = 77 months
- Age Range: 31-122 months



Figure 1.a) A subject participating in the paradigm



Figure 1.b) CI user participating in a pilot version of the paradigm

## MATERIALS & METHODS

- This study uses a novel passive electroencephalogram (EEG) paradigm that rapidly and reliably collects the neural activity along visual and auditory pathways of the participants.<sup>2</sup>
- **Visual stimuli:** center cartoon with two peripheral flickering checkerboard rings.
- EEG recorded with a BioSemi Active Two System.
- 19 cap electrodes, 2 mastoid references

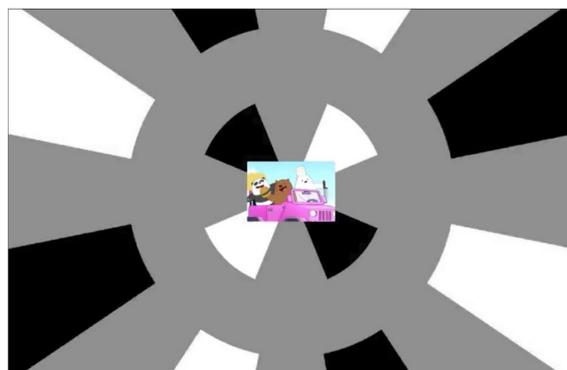


Figure 2) Example of the paradigm's visual stimuli, with a central cartoon and two radial checkerboard rings in the peripheral.

To learn more about our auditory and concurrent auditory + visual findings of this project, check out Corina et al. 2022.<sup>3</sup>

## P1

(100-200 msec)

### VEP P1 Peak Amplitude

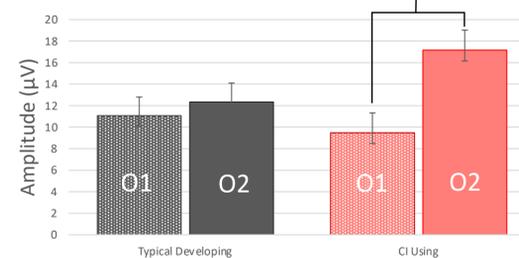


Figure 4.a)

- CI users exhibit an **asymmetrical right hemisphere effect**
- TD children presented **more symmetrical peak amplitudes**
- No latency differences were observed in the P1 component across conditions, groups, or electrode sites.

## RESULTS

## N1

(200-300 msec)

### VEP N1 Amplitude

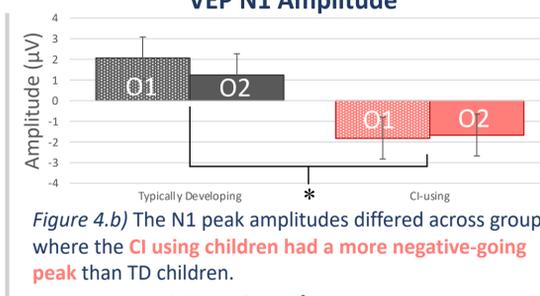


Figure 4.b) The N1 peak amplitudes differed across groups where the **CI using children had a more negative-going peak** than TD children.

### VEP N1 Peak Latency

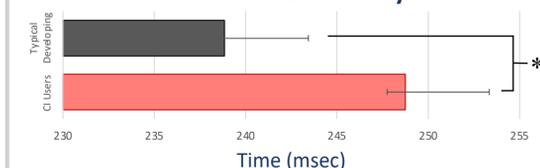


Figure 4.c) **CI using children showed later N1 peak latencies** than TD controls at averaged occipital electrode sites.

## Current Source Density (CSD) Plots

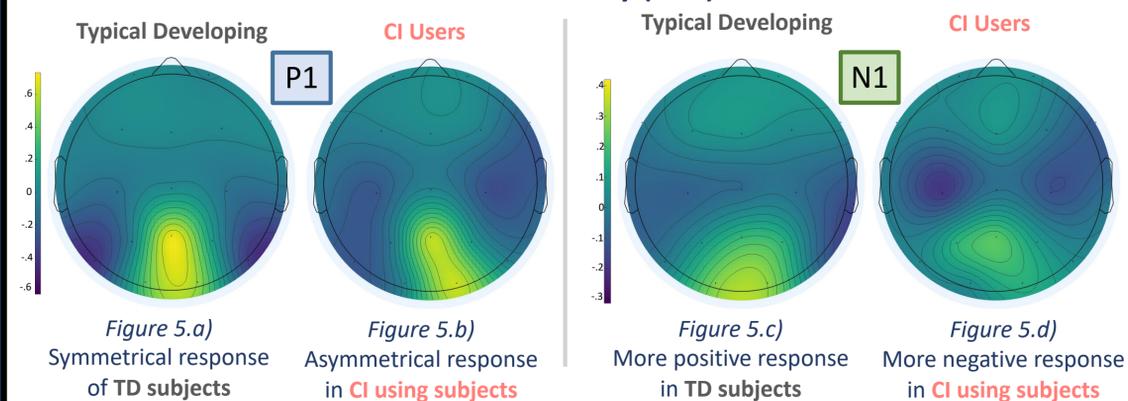


Figure 5.a) Symmetrical response of TD subjects

Figure 5.b) Asymmetrical response in CI using subjects

Figure 5.c) More positive response in TD subjects

Figure 5.d) More negative response in CI using subjects

## FUTURE DIRECTIONS

- Evaluate if observed adaptations are due to intra-modal or cross-modal plasticity
- Examine the influence of concurrent auditory and visual stimuli on VEP morphology
- Evaluate the visual response of the flickering stimuli in the frequency domain

## REFERENCES

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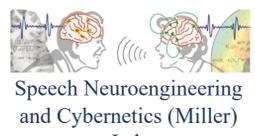
## ACKNOWLEDGEMENTS

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