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

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Introduction

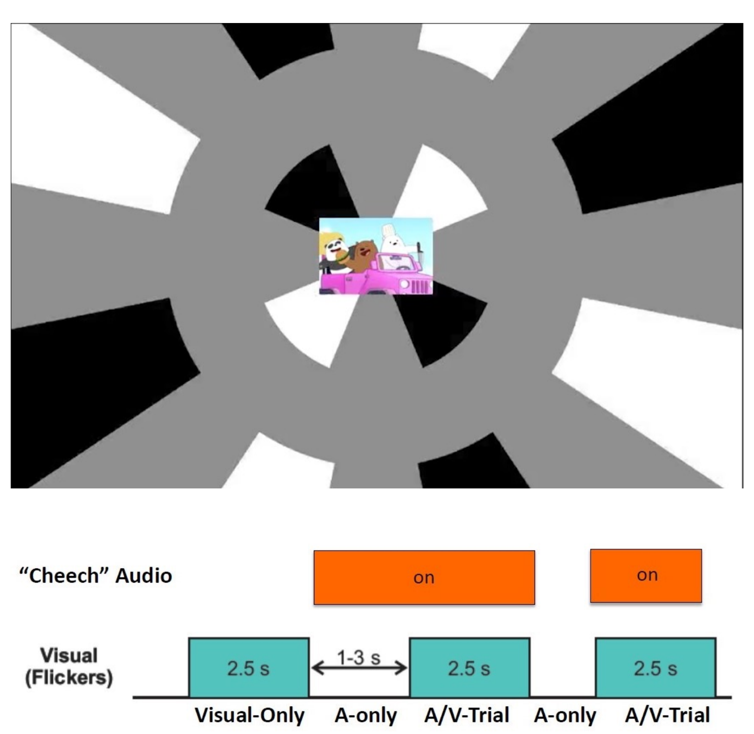
Exposure to auditory stimuli is foundational for typical development of the auditory central nervous system. We investigated the neural plasticity in response to auditory sensory deprivation in profoundly deaf children. This deprivation is believed to facilitate a cascading effect that will influence primary sensory processing and some higher-level cognitive domains, such as attention and learning.[1] An explanation of these findings is the model of cross-modality plasticity (CMP), where underutilized sensory brain regions are used to process information from the intact sensory systems. We are investigating if this same sensory reallocation is observed in children who had their hearing re-established with cochlear implants (CI) at young ages (before 31 months). We aim to evaluate the visual evoked potentials (VEP) of CI using children and age matched typically developing (TD) children. We are testing to see if there are differences in their neural activity while passively observing visual, auditory, and concurrent audiovisual stimulation. 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.[2]

Subjects

The participants of this project were two age-matched groups. One group was 28 deaf children who have received at least one CI by the age of 31 months (20 male, 8 female, mean age = 74 months, range: 46 - 128 months). Their data was compared to a control group of 28 TD children (12 male, 16 female, mean age = 77, range: 31 – 122 months).

MATERIALS & METHODS

- The paradigm was a passive task were participants fixated on a video in the center of the screen. This video was an edited children's cartoon that had all scenes of characters talking removed.
- EEG data was collected with a BioSemi Active Two System (BioSemi Inc.) at a sampling rate of 16 KHZ from 21 scalp electrode. 19 of the electrodes were in standard 10/20 location of a cap and the other 2 electrodes were applied to the left and right mastoids



RESULTS

Both groups exhibited visual evoked potentials (VEP) at occipital electrode cites in response to the onset of the flickering visual stimuli. These VEPs presented a well-defined positive peak (P1) occurring approximately at 110 msec. We also observed a negative peak (N1) from 200-300 msec.

The P1 component of the CI users presented an asymmetrical right hemisphere effect (O1: M = 9.90mV, O2: M = 17.168 mV, $p < .001$) while the TD children presented more symmetrical peak amplitudes (O1: M = 11.3224mV, O2: M = 13.224mV; $p = .257$). No latency differences were observed in the P1 component across conditions, groups, or electrode sites. The N1 peak amplitudes differed across groups ($p < .009$) where the CI using children (M = -1.262) had a more negative-going peak than TD children (M= 2.53). CI users showed a later peak latencies than TD controls for the N1 component (latencies and stats)

CONCLUSION

- The greater P1 amplitude could be due to enhanced visual processing in CI using children.
- The greater N1 amplitude could be a greater engagement or orienting of attention while observing visual stimuli.[3]

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