Auditory Evoked Potentials Discriminate between Adults, and Children with and without Sensory Processing Disorders

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Purpose
To investigate whether the organization of the auditory evoked potentials (AEPs) obtained from presentation of stimuli differing in intensity and frequency can assist in classifying adults, and children with and without sensory processing disorder (SPD) while controlling for the maturation effect (i.e., age) and the number of the trials in the AEP.

Introduction
The AEPs have been increasingly studied in developmental research in children and young adults.1,2 The AEPs have exhibited age-related physiological changes, which may reflect the development of complex neural network processes, such as higher stimulus-specificity, automatic information processing, and maturation of adaptive and attention-related processes.3 Among the AEP components, age-related decreases in the amplitude and latency of the N1 and P2 have been shown across 5 to 20 years.2 Amplitude changes in the N1/P2 have been shown in response to different stimulus intensities.4 Studies have also shown that children with autism do not exhibit increased amplitudes of the N1-P2 in response to increased stimulus intensity compared to typically developing children.4,5

An age-related increase in the amplitude of the N2 has been found from ages 4 to 10 and thereafter an age-related decrease to reach adult level by age 17.2 Age-related changes of the P3 have been found. Children produced large P3s to the target stimuli with a posterior maximum and start to show the break between blocks.

Electrophysiological Recordings
BioSemi EEG ActiveTwo system
32 scalp sites, 2 bipolar eye monitors
Recorded at A/D Rate = 1024 Hz
Bandwidth = 268 Hz, Gain: 1000
Offline filter: 23 – 30 Hz band pass
EOG artifact rejection (+/- 100 μV)
Fz, Cz and Pz sites were used for statistical analyses

AEP Component Analyses
N1: 70 – 140 ms (Adult); 80 – 170 ms (Child)
P2: 130 – 240 ms (Adult); 130 – 270 ms (Child)
N2: 200 – 350 ms (Adult); 200 – 375 ms (Child)
P3: 250 – 400 ms (Adult); 250 – 450 ms (Child)

Method
Participants
18 Adults (9 males) aged 20-55 years (M = 33.28, SD = 11.25)
25 typically developing children (13 males) aged 5 – 10 years (M = 8.33, SD = 1.88)
28 children with SPD (22 males) aged 5 -12 years (M = 7.70, SD = 1.96)

Procedures
Participants were seated quietly in a relaxed position with eyes opened and listening to auditory stimuli while staring at a fixed object
Sensory Registration ERP paradigm
100 presentations of each of 4 auditory stimuli
1 kHz at intensity = 50 dB SPL
1 kHz at intensity = 70 dB SPL
3 kHz at intensity = 53 dB SPL
3 kHz at intensity = 73 dB SPL
Each stimulus duration = 50 ms with 10 ms ramps
Time between presentation of stimuli = 2 s
Presented in random order with 10 stimuli per block with a break between blocks

Results
Comparison Between Groups via ANCOVA
Peak-to-Peak Amplitude from N1 to P2
Group x Intensity
Site x Intensity
Site x Age
F(4,120) = 6.03, p = .004
F(4,120) = 7.43, p < .0001
F(4,120) = 4.09, p = .019

Peak-to-Peak Amplitude from N2 to P3
Group x Site
Group x Intensity
Site x Intensity
F(4,120) = 8.17, p = .049
F(4,120) = 3.20, p = .028
F(4,120) = 3.61, p = .036
F(4,120) = 3.93, p = .025

Discriminant Function Analysis - Full Model

<table>
<thead>
<tr>
<th>Group</th>
<th>Correct Classification</th>
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<tbody>
<tr>
<td>Adult</td>
<td>100%</td>
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<tr>
<td>Typical</td>
<td>78.3%</td>
</tr>
<tr>
<td>SPD</td>
<td>81.5%</td>
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Discriminant Function Analysis - Stepwise

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<td>SPD</td>
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</tr>
</tbody>
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Conclusions
The organization of the AEPs successfully discriminated between adults, typical children and SPD children with 95.2% accuracy.

The AEPs may serve as a clinical tool to identify children with sensory processing disorders.

References

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