Evaluating Bandpass Filter Settings for Measuring the P50 in Adults and Children

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Introduction

- Sensory gating has been extensively studied in diverse populations focusing primarily on the measurement of the P50 ERP component.1
- While studies have used a variety of different bandpass filtering settings to process the P50 ERP data when examining gating performance, empirical evidence for the best setting is sparse.
- For example, Olincy et al.1 used 10 – 300Hz bandpass filter to examine P50 T/C ratios in 16 healthy adults (T/C ratio: m = 16, SD = 12), 16 adults with ADHD (m = 31, SD = 35), and 16 adults with schizophrenia (m = 87, SD = 13) aged 24-60 years old. They found that ADHD adults were different from schizophrenia adults, but not healthy adults.
- Kemner et al.2 used 0.1 – 200Hz bandpass filter to examine P50 T/C ratios in 11 typical children (T/C ratio: m = .47, SD = .50) and 12 children with autism (m = .28, SD = .36) aged 7-13 years old. These results revealed no significant difference between the two groups.
- Marshall et al.3 used 10 – 50 Hz bandpass filter to study sensory gating in 10 socially outgoing children, 12 socially withdrawn children, and 10 ‘unselected’ children aged 7-13 years old. They found that the mean P50 T/C ratio was .90 across whole sample with a SD of .53.
- Kleyse et al.4 used 10 – 75 Hz bandpass filter to study sensory gating in 22 healthy adults aged 18-35 years old. They found a mean P50 T/C ratio of .40 with a SD of .25.
- Since Type II error could be detrimental to finding differences in P50 T/C ratios between groups in sensory gating studies, it is important to examine whether several bandpass filter settings may differentially effect measurement error. Thus, the present study aims to determine which bandpass filter setting has the lowest within-group variance in adults and children when processing the P50 ERP data.

Method

- Participants
  - 18 healthy 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)

- Procedures
  - Participants were seated quietly in a relaxed position with eyes opened and listening to auditory clicks while watching a silent animated movie.

- Auditory threshold testing
  - Sensory Gating ERP paradigm
    - Click intensity = ~85 dB SPL
    - Click duration = 3 ms
    - Paired-clicks at 500 ms SOA
    - 10 s between pairs
    - 120 pairs of clicks

Electrophysiological Recordings

- BioSemi EEG ActiveTwo system
- 32 scalp sites, 2 bipolar eye monitors
- Recorded at A/D Rate = 1024 Hz
- Bandwidth = 268 Hz
- Offline bandpass filter settings with roll off of 24 dB/octave: .23 – 75 Hz band pass .10 – 75 Hz band pass .10 – 200 Hz band pass
- EOG artifact rejection (+/- 100 μV)
- Cz site was used for statistical analyses

ERP Component Analyses

- P30: 25 – 40 ms
- P50: 40 – 70 ms (Adult); 40 – 80 ms (Child)
- Negativity preceding P50: the most negative trough between P30 peak and P50 peak
- Peak-to-peak amplitude of P50: the difference in µV between the P50 peak and its preceding negative trough

Results

Sensory Gating in Adults

<table>
<thead>
<tr>
<th>P50 T/C Ratio</th>
<th>Amplitude Conditioning Click</th>
<th>Amplitude Test Click</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23 – 75 Hz</td>
<td>1.74 (2.49)</td>
<td>1.74 (2.49)</td>
</tr>
<tr>
<td>10 – 75 Hz</td>
<td>2.29 (1.49)</td>
<td>2.29 (1.49)</td>
</tr>
<tr>
<td>10 – 200 Hz</td>
<td>2.74 (1.41)</td>
<td>2.74 (1.41)</td>
</tr>
</tbody>
</table>

- Post hoc comparison using within-subject contrast revealed only the 10 – 75Hz is different from 10 – 200Hz
- Paired-clicks at 500 ms SOA

P50 Peak-to-Peak Amplitude

<table>
<thead>
<tr>
<th>Click (2) as the factors revealed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bandpass Filter</td>
</tr>
<tr>
<td>F(2, 34) = 5.10, p = .012</td>
</tr>
<tr>
<td>Click</td>
</tr>
<tr>
<td>F(1, 17) = 49.12, p &lt; .0001</td>
</tr>
<tr>
<td>Bandpass Filter x Click</td>
</tr>
<tr>
<td>F(2, 34) = 23.79, p &lt; .0001</td>
</tr>
</tbody>
</table>

Investigating Covariates of Sensory Gating in Children

Sensory Gating in Children

- A repeated measure ANOVA with Bandpass Filter (3) as the factor revealed:
  - Bandpass Filter F(2, 44) = 21, p = .012
  - Click F(1, 24) = 25.37, p < .0001
  - Bandpass Filter x Click F(2, 44) = .045, p = .67

P50 Peak-to-Peak Amplitude

- A repeated measure ANOVA with Bandpass Filter (3) x Click (2) as the factors revealed:
  - Bandpass Filter F(2, 44) = 1.55, p = .27
  - Click F(1, 24) = 25.37, p < .0001
  - Bandpass Filter x Click F(2, 44) = .045, p = .67

Conclusions

- The results suggest that, given the bandpass filters evaluated, 10 – 75 Hz may be the best setting to use for adult only studies.
- A bandpass filter setting of 10 – 200 Hz may be the best setting to use for children aged 5-10 years old because it produces the smallest mean and standard deviations of P50 T/C ratios.
- For studies with both children and adults groups the best filter setting would be 10 – 200 Hz because it produces the smallest standard deviation values for the P50 T/C ratios in both groups.

References


Acknowledgements: Funded in part by Wallace Research Foundation to PLD & WJG, from NICHD to PLD & WJG, and by Helen F. Michigan Graduate Fellowship to WPC.

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