

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.¹⁻⁴
- 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 scarce.
- 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 ($M = .67$, $SD = .13$) aged 24-50 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Marshall et al.³ used 10 – 50 Hz bandpass filter to study sensory gating in 10 socially outgoing children, 12 socially withdrawn children, and 10 “unselected” children aged 7-13 years old.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.
- Kisley 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 affect 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.

Purpose

- To determine the best bandpass filter setting for processing the P50 ERP data in adults and children.
- To investigate how the bandpass filter settings affect the within-group variance of P50 ERP T/C ratios.

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 of 24 dB/octave :
 - .23 – 75 Hz band pass
 - 10 – 75 Hz band pass
 - 10 – 200 Hz band pass
- EOG artifact rejection (+/- 100 μ V)
- 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 μ V between the P50 peak and its preceding negative trough

Results

Sensory Gating in Adults

P50 T/C Ratio

- A repeated measure ANOVA with Bandpass Filter (3) as the factor revealed:
 - Bandpass Filter $F_{(2,34)} = 5.10$, $p = .012$
 - Post hoc comparison using within-subject contrast revealed only the 10 – 75Hz is different from 10 – 200Hz $F_{(1,17)} = 16.11$, $p = .001$

P50 Peak-to-Peak Amplitude

- A repeated measure ANOVA with Bandpass Filter (3) x Click (2) as the factors revealed:
 - Bandpass Filter $F_{(2,34)} = 19.99$, $p < .0001$
 - Click $F_{(1,17)} = 49.12$, $p < .0001$
 - Bandpass Filter x Click $F_{(2,34)} = 23.79$, $p < .0001$

	T/C Ratio	Amplitude Conditioning Click	Amplitude Test Click
Adult			
.23 – 75 Hz	.37 (.26)	4.33 (2.70)	1.74 (1.69)
10 – 75 Hz	.39 (.17)	5.92 (2.68)	2.29 (1.42)
10 – 200 Hz	.46 (.16)	6.28 (2.63)	2.74 (1.41)
Children			
.23 – 75 Hz	.59 (.51)	5.29 (3.11)	2.93 (2.93)
10 – 75 Hz	.62 (.43)	4.59 (2.62)	2.32 (1.38)
10 – 200 Hz	.58 (.31)	5.04 (2.44)	2.67 (1.37)

Table 1. Mean T/C Ratio and Peak-to-Peak Amplitude (in μ V) for both adults and children. Standard deviations are shown in parentheses.

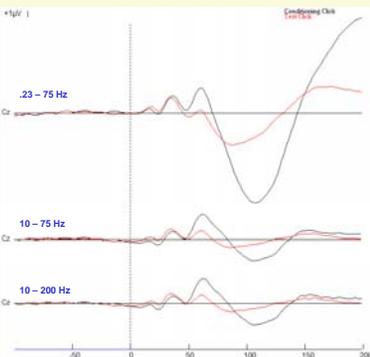


Figure 1. – Grand averaged ERPs in adults for each setting of the bandpass filter.

Sensory Gating in Children

P50 T/C Ratio

- A repeated measure ANOVA with Bandpass Filter (3) as the factor revealed:
 - Bandpass Filter $F_{(2,48)} = .21$, $p = .81$

P50 Peak-to-Peak Amplitude

- A repeated measure ANOVA with Bandpass Filter (3) x Click (2) as the factors revealed:
 - Bandpass Filter $F_{(2,48)} = 1.55$, $p = .22$
 - Click $F_{(1,24)} = 25.37$, $p < .0001$
 - Bandpass Filter x Click $F_{(2,34)} = .045$, $p = .96$

Investigating Covariates of Sensory Gating in Children

P50 T/C Ratio

- A repeated measure ANCOVA with Bandpass Filter (3) as the factor and both Age and Numbers of Trials as the Covariates revealed:
 - Bandpass Filter $F_{(2,44)} = 1.924$, $p = .158$
 - Bandpass Filter x Numbers of Trials $F_{(2,44)} = 5.015$, $p = .011$

P50 Peak-to-Peak Amplitude

- A repeated measure ANOVA with Bandpass Filter (3) x Click (2) as the factors and both Age and Numbers of Trials as the Covariates revealed:
 - Bandpass Filter $F_{(2,44)} = 4.131$, $p = .023$
 - Click x Age $F_{(1,22)} = 7.419$, $p = .012$

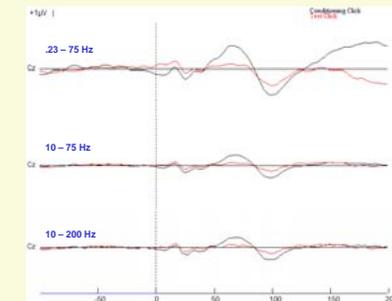


Figure 2. – Grand averaged ERPs in children for each setting of the bandpass filter.

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 for studying 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

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