

# Developmental Trends in Sensory Gating Measured in Young Children

Patricia L. Davies<sup>1</sup>, William J. Gavin<sup>2</sup>, Michael A. Kisley<sup>3</sup>

<sup>1</sup>Colorado State University, <sup>2</sup>University of Colorado, Boulder, <sup>3</sup>University of Colorado, Colorado Springs



## Summary

Sensory gating can be measured by using a paired-click event-related potential (ERP) paradigm. Sensory gating has been found to be impaired in adults with schizophrenia (e.g., Nagamoto, et al., 1989; Olincy, et al., 2000). A growing interest in measuring sensory gating in children has necessitated finding a valid method for collecting these data in young children (e.g., Myles-Worsley, et al., 1996). We recorded ERPs from 22 children, ages 4 to 11 years, in two conditions; 1) sitting quietly while listening to paired clicks (auditory only), and 2) watching a silent movie while listening to paired clicks (auditory + movie).

We examined sensory gating by evaluating changes in the P50 and N100 components using a ratio of the amplitude of the test click (T) to the amplitude of the conditioning click (C). While 73% of the children displayed sensory gating in at least one condition (T/C ratio < .80), there was not a significant correlation between the 2 conditions measure at Cz (for P50  $r = -.02$ ; for N100  $r = .06$ ). Differences between the mean T/C ratios of the two conditions for the P50 and N100 for were not significant because of large within group variances. These results are similar to previous studies showing that sensory gating is not consistently observed in children using traditional ratio measures (e.g., Freedman, et al., 1987). A developmental trend was found in the auditory only condition where N100 suppression significantly correlated with age ( $r = .67, p = .001$ ).

## Introduction

Only a few studies have investigated the P50 paradigm in typical children and one study included children with autism. Freedman, et al. (1987) examined the gating of the auditory evoked potentials in 163 subjects ranging in age from 18 months to 55 years old. They reported age-related changes in the latency of the P50 component and concluded that the conditioning-testing ratio did not reach adult levels until the end of adolescence. Myles-Worsley, et al. (1996) included 127 participants ages 10 to 39 years. They reported the mean P50 T/C ratio to be .74 with .02 standard error and contrary to the first study there was not a significant difference in the P50 ratio between children and adults. Kemner, et al. (2002) included a group of 12 children with autism and a group of 11 children without autism, age range of 7 to 13 years. The average T/C ratio for the control group was .53 and the average T/C ratio for the autistic group was .72, but due to great variability there was no difference between the groups.

## Purpose

- To assess the sensory gating of young children, ages 4 to 11 years.
- To determine if children will exhibit sensory gating to the same extent when they watch a silent movie (auditory + movie) as compared to staring at a fixation point (auditory only).
- To establish if there is a developmental trend in sensory gating.

## Method

### Participants:

- 22 children aged 4 to 11 years (12 females and 10 males).

### Procedure:

- Stimulus was paired clicks with ISI = 500 ms
- Each click duration = 3 ms
- Each click intensity = ~50 dB SPL
- Time between presentation of pairs = 10 s
- 120 pairs presented in each of two conditions
- Auditory Only condition: Participant sat quietly while listening to clicks, with breaks after every 40 pairs.
- Auditory + Movie condition: Participant sat quietly while listening to auditory clicks and watching a silent movie with no breaks.
- Conditions were counterbalanced
- Participants were seated in a reclined position with eyes open

### Electrophysiological Measurements:

- 6 scalp sites, 1 bipolar eye monitor
- Recorded at 1000 samples/s, .23 to 200 Hz
- Offline filter 10 to 200 Hz band pass for scoring P50
- Offline filter .23 to 30 Hz band pass for scoring N100
- EOG artifact rejection (+/- 100  $\mu$ V)

## Results

The amplitude of the test click (auditory only  $M = 2.05$ ; auditory + movie  $M = 1.9$ ) was significantly less than the amplitude of the conditioning click (auditory only  $M = 2.85$ ; auditory + movie  $M = 2.65$ ) in both conditions ( $t = 2.84, p = .01$ ;  $t = 2.83, p = .01$ ). The sensory gating suppression ratios (T/C ratios) for each participant are reported in Table 1.

Table 1 - Individual Participant T/C Ratios for Both Conditions (N = 22).

Subject Code	Age	Auditory Only Condition P50 Ratio	Auditory + Movie Condition P50 Ratio	Auditory Only Condition N100 Ratio	Auditory + Movie Condition N100 Ratio
P001	6	1.29	2.33	1.38	.63
P002	7	.37	.76	2.79	.40
P003	7	2.17	.68	.39	.44
P004	10	.67	.60	.51	.21
P006	10	1.82	1.71	.30	.34
P007	9	.33	.35	.50	.40
P008	7	4.00	.24	1.56	1.17
P009	9	2.00	.25	.28	.37
P011	10	.44	.65	1.35	2.00
P012	8	.85	.46	.66	.71
P013	10	.45	.42	.33	.20
P014	7	1.13	.43	.98	1.17
P015	10	.95	2.00	.58	1.29
P016	11	.57	.22	.24	.67
P018	8	.92	1.00	.47	.73
P019	7	.81	.84	.86	.38
P021	4	.35	.64	2.96	.47
P022	10	.17	.93	.82	.55
P023	9	.84	.87	.82	.83
P024	6	.77	.67	.79	.53
P025	8	.74	1.29	.52	1.84
P026	10	.59	.41	.87	.27
Mean	8.75	1.02	.81	.91	.71

Sixteen of the children (73%) displayed sensory gating in at least one condition for the P50. Only 6 children (27%) showed no sensory gating. The number of participants that displayed sensory gating in each condition for the P50 are shown in Table 2. Sensory gating is defined as demonstrating a T/C ratio of less than .80.

Table 2 - Crosstabulation of sensory gating in the auditory only condition versus the auditory+movie condition for the P50.

# participants	Auditory + Movie Condition		Total
	No	Yes	
Auditory Only Condition	No	6	11
	Yes	2	9
Total	8	14	22

## Comparisons between Conditions

There was not a significant correlation between the 2 conditions measured at Cz (for P50  $r = -.02$ ; for N100  $r = .06$ ). Differences between the mean T/C ratios of the two conditions for the P50 and N100 for were not significant because of large within group variances (see Table 1). The grand averages of the conditioning click and test click are shown in Figures 1 & 2 for the P50 waveforms. Note: N100 was measured at a different filter setting than shown.

Figure 1 - Grand average of waveforms in the auditory only condition at 4 electrode sites.

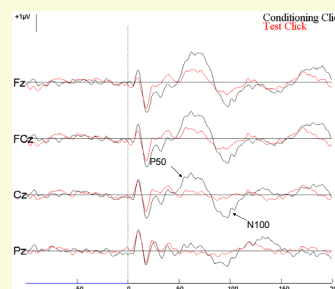
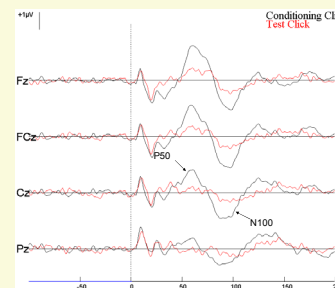


Figure 2 - Grand average of waveforms in the auditory + movie condition at 4 electrode sites.



## Developmental Trends

The N100 T/C ratio significantly correlated with age ( $r = -.67, p = .001$ ) in the auditory only condition, but not in the auditory + movie condition ( $r = .01, p = .95$ ). Latency of the N100 also correlated with age in the auditory + movie condition (for conditioning click  $r = -.52, p = .01$  and for test click  $r = -.51, p = .02$ ), but not for the auditory only condition. There were no significant developmental trends for the P50 component.

## Conclusions

- A majority of the children in this study demonstrated sensory gating (T/C ratio < .80).
- Sensory gating performance in the two conditions did not correlate.
- More children demonstrated sensory gating in the auditory + movie condition than in the auditory only condition, but the difference was not significant.
- The sensory gating of young children is very variable as shown in this study.

## References

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