Individual Differences in Sensory Gating in Children

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Summary

Electroencephalographic measures consistently show that adults with sensory processing deficits (e.g., schizophrenia) have reduced abilities to gate out repetitive information. However, studies contrasting children with and without disabilities are inconclusive due to large within-group variances. Characterizing individual differences may lead to better understanding of sensory gating in children. We examined sensory gating in 22 children ages 5 to 10 years (15 typical and 7 with sensory processing disorders; SPD) using the P50 and N100 T/C ratios. Parents completed the Sensory Profile, a behavioral measure of their child's sensory processing abilities. The P50 T/C ratios of typical children (M = .57) revealed significantly greater gating compared to children with SPD (M = .99), $t(20) = 1.93$, $p = .034$. There were no group differences in N100 gating. A developmental trend was found as age significantly correlated with T/C ratios of the P50 (r = -.59, p = .004) and the N100 (r = -.50, p = .017). A discriminant analysis revealed that scores from 2 of the 13 subscales on the Sensory Profile, Auditory Filtering and Sensory Processing related to Endurance/ Tone, were significant in correctly classifying the children with 91% accuracy (Lambda = .46, p = .001). Regression analysis reveal that age accounted for 35% of the variance of the P50 ratios when entered first, and the scores of the 2 behavioral subscales accounted for 6%, r^2 = .41, F(3,18) = 4.15, p = .021. For the N100 ratios, age accounted for 25% of the variance and the behavior subscales 18%, r^2 = .44, F(3,18) = 4.63, p = .014.

Introduction

Studies of sensory gating in children with and without disabilities have been shown large within group variances. Freedman, et al. (1987) included 108 typical children aged 1-19 years. They reported that the P50 T/C ratio in typical children ranged from 0 to 1.0. Kemner, et al. (2002) examined 12 children with autism and 11 children without autism aged 7-13 years. The mean P50 T/C ratio for typical children was .47 (S.D = .50) and for children with autism was .28 (S.D. = .36). Marshall, et al. (2004) included a group of 10 outgoing children, a group of 12 socially withdrawn children, and an "unselected" group of 10 children, all within the ages of 7-13 years old. The mean P50 suppression score across whole sample was .10 (S.D. = .53); i.e., a T/C ratio of .90. Characterizing the sources of the individual differences in sensory gating in young children may lead to better early detection and treatment of children with sensory processing disorders.

Purpose

Explore the contribution of following variables that may account for individual differences in sensory gating.

- Diagnosis of sensory processing disorders
- Age
- Behavioral indicators of sensory processing abilities in daily life

Method

Participants

22 children aged 5 to 10 years

- 15 typical children (6 females and 9 males)
- 7 children with sensory processing disorders (all males)

Procedure

- Initial auditory threshold testing
- Paired-clicks paradigm with SOA = 500 ms
- Time between presentation of pairs = 10 s
- Each click duration = 3 ms
- Each click intensity = ~ 85 dB SPL
- 120 pairs of clicks were presented
- Participants were seated quietly in a reclined position with eyes opened while listening to auditory clicks and watching a silent movie
- The parents filled out the Sensory Profile

Electrophysiological Measurements

- BioSemi EEG ActiveTwo system
- 32 scalp sites, 2 bipolar eye monitor
- Recorded at A-D Rate: 1024 Hz, Bandwidth of 268 Hz, Gain: 1000
- 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 µV)
- Cz was used for statistical analyses

Behavior Measurement – Sensory Profile

Example for items of Auditory Filtering

- Is distracted or has trouble functioning if there is a lot of noise around
- Can't work with background noise
- Has difficulty paying attention

Example for items of Sensory Processing related to Endurance/Tone

- Moves stiffly
- Poor endurance/ tires easily

Results

Examples of Averaged Waveforms – Figures 1 & 2

Figure 1 – An example of a typical child

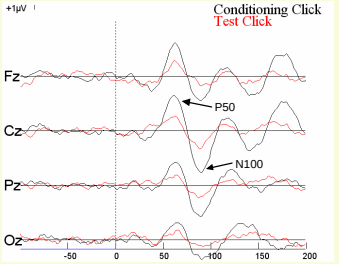
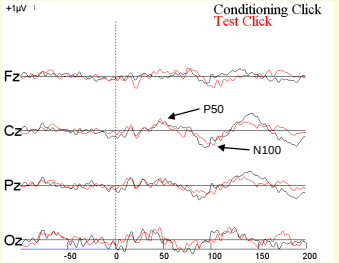


Figure 2 – An example of a child with SPD



Comparisons between Clicks

There were significant differences between the amplitude of conditioning click and that of test click on both P50 and N100 components in typical children, but not in children with SPD (see Table 1 and Table 2)

Table 1 – Amplitudes (µV) of P50 component

	Conditioning	Test	Paired-Sample *t*-Test	*p*
	Mean (S. D.)	Mean (S. D.)		
Typical Children	4.19 (2.11)	2.12 (1.07)	3.722	.001
Children with SPD	4.43 (3.02)	2.83 (1.19)	1.570	.084

Table 2 – Amplitudes (µV) of N100 component

	Conditioning	Test	Paired-Sample *t*-Test	*p*
	Mean (S. D.)	Mean (S. D.)		
Typical Children	10.29 (5.45)	6.45 (4.93)	2.350	.017
Children with SPD	11.83 (8.34)	6.89 (3.99)	1.606	.080

Comparisons in Sensory Gating

There was a significant difference between typical children and children with SPD in P50 T/C ratio, but not in N100 T/C ratio (see Table 3)

Table 3 – T/C ratios of P50 and N100

	Typical Children		Children with SPD		*t*	*p*
	Mean	(S. D.)	Mean	(S. D.)		
P50 T/C ratio	.57	(.34)	.99	(.68)	1.929	.034
N100 T/C ratio	.86	(.82)	1.34	(1.37)	1.036	.157

Developmental Trends

Both P50 and N100 T/C ratios were significantly correlated with age (P50, r (22) = -.59, p = .004; N100, r (22) = -.50, p = .017) (See Figure 3 & 4).

Figure 3 – P50 T/C ratio in all children by diagnosis

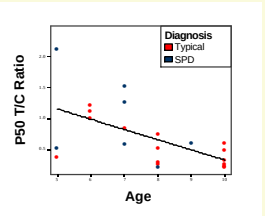
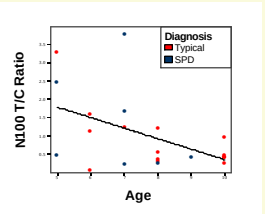


Figure 4 – N100 T/C ratio in all children by diagnosis



Behavior Indicators

A stepwise discriminant analysis revealed that scores from 2 of the 13 subscales on the Sensory Profile, Auditory Filtering and Sensory Processing related to Endurance/ Tone, were the most significant in correctly classifying the children with 91% accuracy (Lambda = .46, p = .001).

Regression analysis revealed that age accounted for 35% of the variance of the P50 T/C ratio when entered first, and the scores of the 2 behavioral subscales accounted for 6%, r^2 = .41, F(3,18) = 4.15, p = .021. For the N100 T/C ratio, age accounted for 25% of the variance and the behavior subscales 18%, r^2 = .44, F(3,18) = 4.63, p = .014.

Conclusions

- As a group, typical children in this study displayed sensory gating and showed less variance (S.D. = .34) in P50 T/C ratio then previous studies.
- As a group, children with SPD did not demonstrate sensory gating and showed more variance in P50 T/C ratio (S.D. = .68).
- There was a developmental trend in sensory gating. Age accounted for 35% of variance in P50 T/C ratio and 25% in N100 T/C ratio.
- Two behavioral items successfully classified typical children and children with SPD and predicted sensory gating performance.

References

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