EEG Measures Reflect Diminished Visual Context Processing in Psychotic Disorders

Victor J Pokorny[1], Michael-Paul Schallmo[2], Cheryl Olman[2], Scott R Sponheim[1,2]
Minneapolis VAHCS[1], University of Minnesota[2]

Background

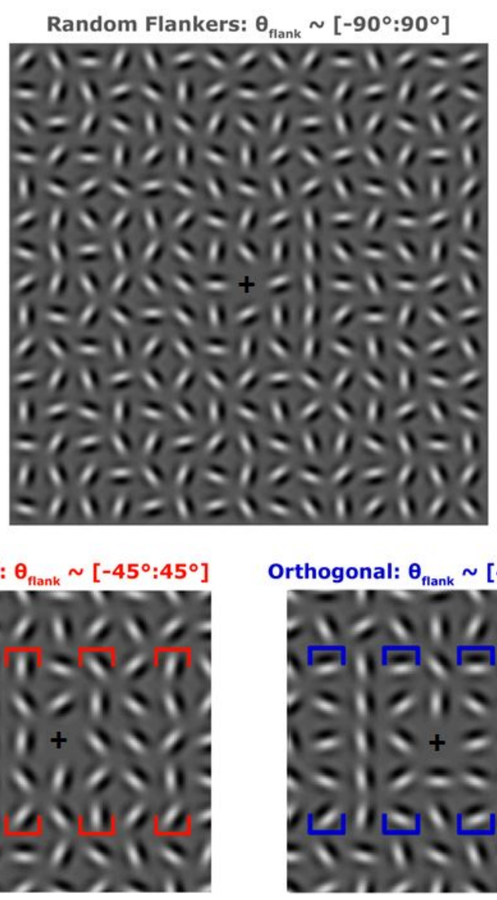
- Schizophrenia is a heterogeneous disorder often associated with abnormal sensory processing, especially in auditory and visual domains[1]
- Impaired contour detection is a well known visual deficit found in schizophrenia which involves recognition of edges and boundaries of objects[2]
- The context in which contours are viewed can impact their overall perceptual salience; sometimes referred to as surround suppression[3]
- Patients with schizophrenia (SCZ) exhibit impaired contour integration (i.e. impaired ability to perceive a spatially separated contour as a single unit) and weakened surround suppression compared to healthy controls[4]

Objectives

- *Utilize the event-related potential technique to identify neural correlates of impaired contour integration and weakened surround suppression in SCZ*
- *Assess specificity of surround suppression and contour integration impairment by exploring potential associations with first degree relatives of patients with schizophrenia, patients with bipolar disorder and healthy controls.*

Methods

- Collinear Gabor Contour Task (CGCT) was administered to patients with schizophrenia (SCZ), patients with bipolar disorder (BP), first degree relatives of patients with schizophrenia (SREL) and healthy controls (CON) as part of a family study of severe psychopathology at the Minneapolis VA Medical Center.
- Electroencephalogram data were collected during administration of the CGCT using a high density 128 electrode BioSemi ActiveTwo system referenced to linked ears.
- CGCT was designed to manipulate contour detection and surround suppression effects.
- Example of task stimuli:



Results

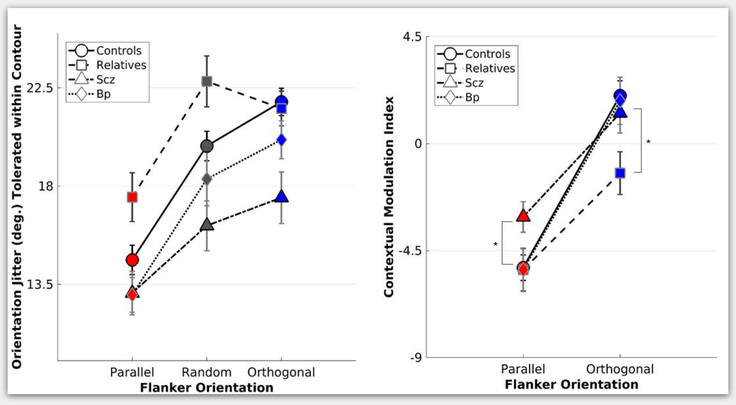
Sample Characteristics

Index	SCZ (*n*=27)	BP (*n*=23)	SREL (*n*=23)	CON (*n*=37)	Statistics
Age	43.3 (10.0)	46.1 (11.1)	45.4 (10.6)	47.1 (11.4)	$F_{(3,106)} = .656$, $p = .581$
Percent female	15%[a]	30%	57%	36%	$X^2_{(3)} = 9.824$, $p = .02$
Education	13.8 (1.9)	13.8 (1.8)	14.9 (2.5)	15.1 (1.8)	$F_{(3,106)} = 3.219$, $p = .026$
Estimated IQ (from WAIS-III)	91.3 (20.0)[b]	97.9 (14.5)	102.5 (16.1)	103.5 (14.5)	$F_{(3,104)} = 3.267$, $p = .024$
Overall Symptomatology (BPRS Total Score)	44.2 (12.0)[c]	36.3 (8.6)[d]	34.2 (8.0)	28.4 (4.1)	$F_{(3,106)} = 18.865$, $p < .001$
Schizotypal Characteristics (SPQ Total Score)	24.2 (17.3)[e]	24.4 (18.5)[e]	7.7 (10.9)	6.6 (6.3)	$F_{(3,93)} = 17.671$, $p < .001$
Abnormal Perceptual Gating (SGI Total Score)	69 (39.2)[f]	59.8 (32.4)[f]	44.3 (34.8)	34 (22.6)	$F_{(3,90)} = 6.26$, $p = .001$

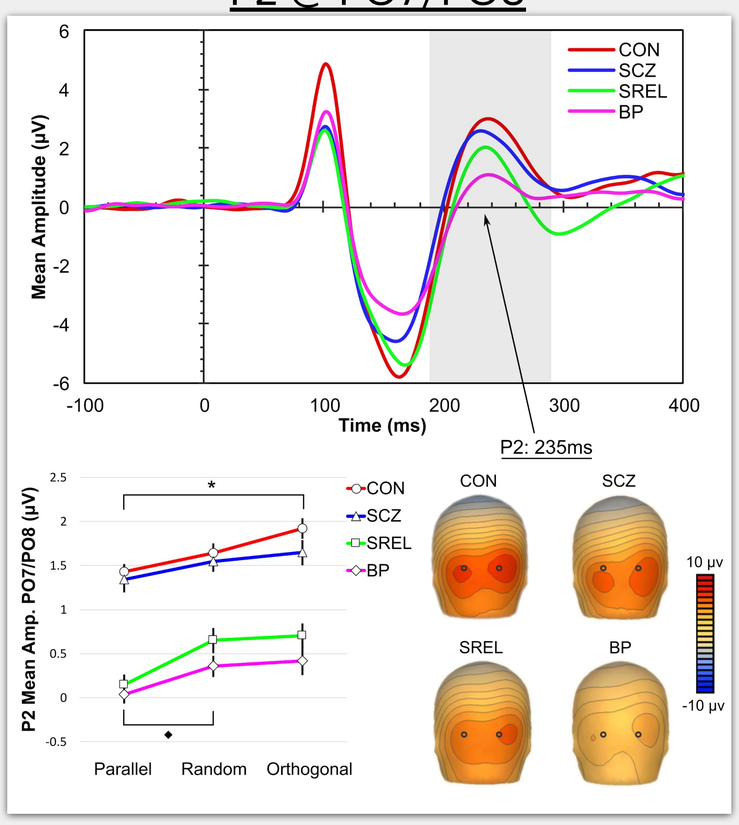
All data are presented as Mean (Standard Deviation), unless otherwise noted. SCZ = patients with schizophrenia , BP = patients with bipolar disorder, SREL = first degree relatives of patients with schizophrenia, CON = healthy controls. WAIS-III = Wechsler Adult Intelligence Scale, 3rd edition. BPRS = 24-item brief psychiatric Rating Scale. SPQ = Schizotypal Personality Questionnaire. SGI = Sensory Gating Inventory.

a. There was a significant difference in gender distribution for SCZ compared to SREL, FDR corrected $p = .012$.
b. Estimated IQ was significantly lower in SCZ as compared to CON, Tukey's HSD, p = .022.
c. BPRS scores were higher in SCZ as compared to BP, SREL and CON, Tukey's HSD, *p*s < .006.
d. BPRS scores for BP were significantly higher than CON, Tukey's HSD, $p = .003$.
e. SPQ scores were higher for both patient groups as compared to CON and SREL, Tukey's HSD, *p*s < .001
f. SGI scores were higher for both patient groups as compared to CON, Tukey's HSD, *p*s <.03.

Behavioral Performance



P2 @ PO7/PO8



Findings

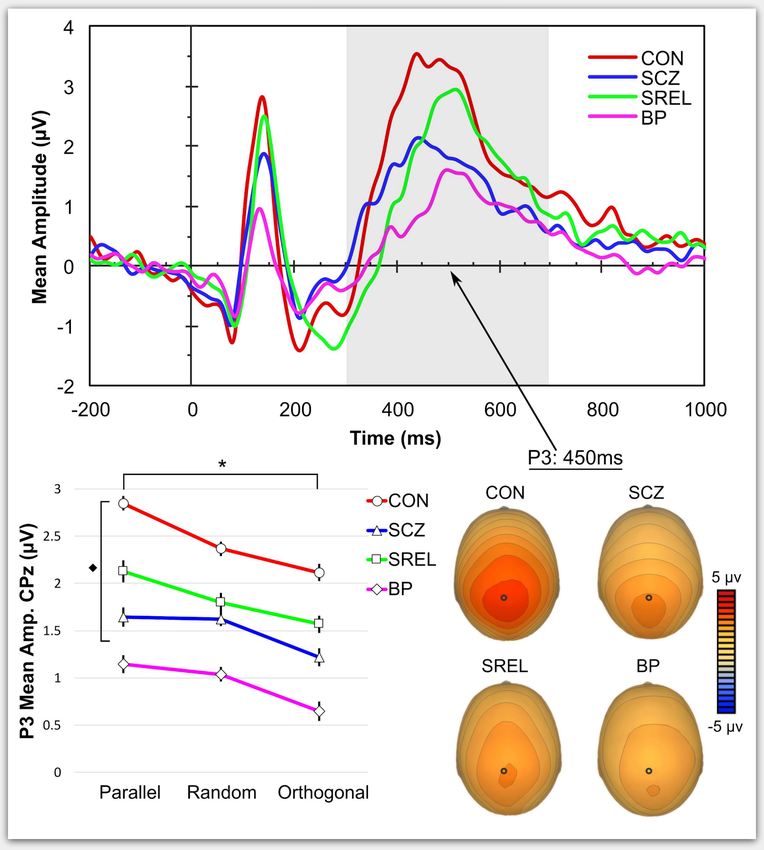
Behavioral:

- SCZ exhibited impaired contour detection across all conditions as compared to CON and SREL; BP exhibited intermediate performance
- SCZ exhibited weakened contextual suppression compared to other groups
- SREL exhibited weakened facilitation compared to CON

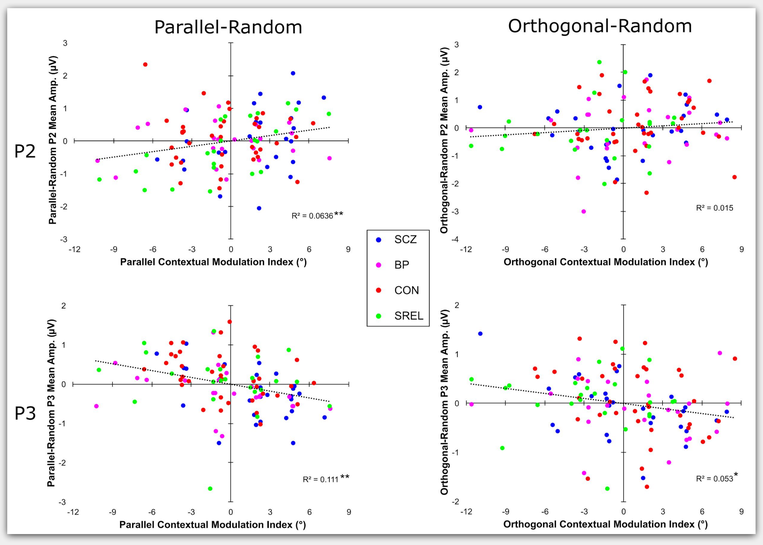
EEG:

- Later components (P2 & P3) showed more robust flanker and group main effects than earlier components (P1 & N1)
- For P2, patients did not modulate amplitudes significantly between conditions while CON and SREL did
- For P3, SCZ and SREL did not modulate significantly between conditions while BP and CONT did
- Irrespective of group, P2 and P3 amplitudes correlated with contextual modulation indices

P3 @ CPz



P2/P3 Amplitude And Contextual Modulation Indices



Conclusions

- Neural correlates of surround suppression suggest that abnormal contextual processing may be associated with later, higher order sensory processes (as opposed earlier, lower order processes).
- Abnormal contextual modulation effects were primarily associated with SCZ and SREL suggesting contextual modulation impairment is specific to schizophrenia.
- BP did, however, exhibit intermediate contour detection performance and attenuated P2 and P3 amplitudes
- Correlations between contextual modulation indices and contextual modulation amplitudes suggest that later EEG component amplitude predicts contextual modulation effects

Citations

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2. Silverstein, S. M., Hatashita-Wong, M., Schenkel, L. S., Wilkniss, S., Kovács, I., Fehér, A. Savitz, A. (2006). Reduced top-down influences in contour detection in schizophrenia. *Cognitive Neuropsychiatry*, *11*(2), 112–132.
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