EEG oscillations link impulsivity and aggression in early phase psychosis

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Aim

The present study investigated impulsivity and its resting-EEG correlates to improve our understanding of its apparent potentiating role in the risk for violent behavior in schizophrenia and early psychosis (Witt, Van Dorn et al., 2013).

Hypothesis

Focus is put on the proposition that impulsivity and antisocial behavior are consequent to a disagreeable under-aroused physiological and cortical state at rest (Eysenck, 1997; Houston & Stanford, 2005). Thus, we hypothesized that patients with increased impulsivity and violent behaviors would exhibit cortical hypo-functioning with increased low-frequency oscillations.

Methods

Sample: 22 male patients in the early phase of psychosis were recruited (aged 23.8±5 years) from the TIPP program-Lausanne. The sample is a mixture of 11 violent patients (VP) and 9 non-violent patients (NVP). VP had committed physical aggression against people qualified as "serious violence" (Large and Nielssen, 2011). **Measures:** Impulsivity was assessed by the Impulsivity Rating Scale (IRS) (Lecrubier, Braconnier et al. 1995). Continuous electroencephalographic data at rest (EEG, 64 electrodes), eyes-opened, were acquired and segmented offline into epochs of 1000ms, and re-referenced to Cz. Spectral power was extracted for 8 frequency bands (FFT, BrainVision Analyzer2): delta (1-3Hz), theta (4-7Hz), alpha (7-12Hz), beta (13-30Hz), and gamma (31-49Hz). Delta, theta and alpha frequencies were considered as low-frequency bands, with power inversely related to cortical activity (Neuper and Pfurtscheller, 2001). **Analysis:** Power scalp distribution and its expected relation with impulsivity were analyzed at 10 anterior-to-posterior distributed electrodes (F3, C3, T7, P3, O1 for the left hemisphere; F4, C4, T8, P4, O2 for the right hemisphere) for each frequency band separately. A mixed model repeated measure analysis of variance compared both groups (VP, NVP) in a hemisphere (2) x topography (5) factorial design. Regression analysis and correlation matrices identified potential relations between spectral power and measure of impulsivity.

Discussion & Conclusion

The current results support there being links between aggression and impulsive dimensions in resting-state EEG of early phase psychosis subjects.

Enhanced theta EEG-resting power, also known to be linked to low feedback reaction (reward or punishment) (Massar, Kenemans, & Schutter, 2014) correlates positively with impulsivity in our data. Additionally, reduced alpha activity over the right-hemiscalp, already shown to be linked to high trait anger (Jaworska, et al., 2012), is founded here to be in relation with impulsivity scores.

➢ In line with the recent psychological multidimensional description of impulsivity (Moeller, et al., 2014), this pilot study suggests the presence of at least two distinct oscillatory markers of impulsivity during resting state, in the theta as in the alpha frequency bands.
➢ These correlates may involve specifically the right hemisphere, known to be dysfunctional in schizophrenia (Cutting, 1994; Barnett, et al., 2005), and may increase the risk of aggression against others in the early phase of schizophrenia.

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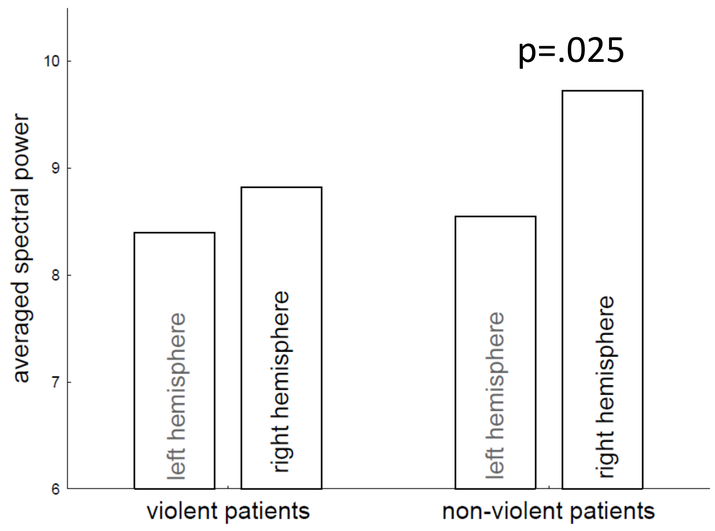
Results

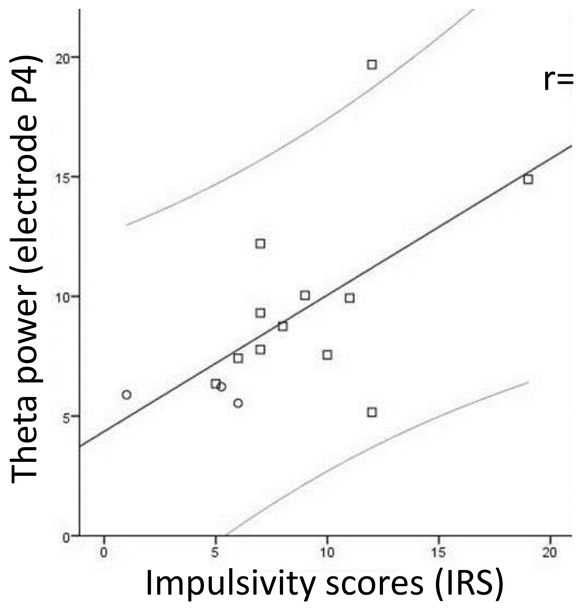
Psychometrics: Lecrubier impulsivity scores was higher in Violent than Non-Violent patients sample (9.4±3.6 vs. 4.1±2.7; $p < .04$).
Resting EEG oscillations: (A) Main effect of hemispheric asymmetry was founded for non-violent patients only. Linear correlations with impulsivity were observed in the theta (B) as in alpha frequency bands (C).

(A)



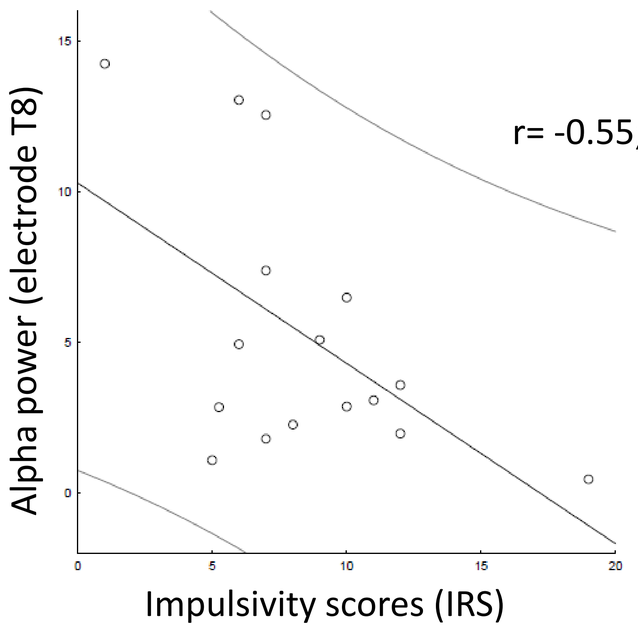
➢ Main effect of hemispheric asymmetry is observed in resting-EEG for non-violent patients only (left-H =8.5μ^2/Hz ±0.7; right-H =9.7μ^2/Hz ±0.8).

(B)



➢ Low cortical activity (4-7 Hz) and impulsivity scores correlated positively: to elevated theta power corresponds high impulsivity scores over right posterior electrode sites.

(C)



➢ Negative correlations between alpha power and impulsivity were found all over the right hemisphere's electrodes sites (F4, C4, T8, O2; r_{min}= -.51; $p_{max} < .04$): the less the alpha power was, the more impulsive the patients were.

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