Neuroscience 2015

Presentation Abstract

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Program#/Poster#:	558.03
Presentation Title:	Bringing order to the neurophysiological chaos underlying sensory processing dysfunction in schizophrenia
Location:	S102
Presentation time:	Tuesday, Oct 20, 2015, 1:30 PM - 1:45 PM
Topic:	++C.15.d. Human behavior and clinical studies
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Abstract:	There is compelling evidence that sensory processing impairments contribute to the cognitive and psychosocial dysfunction affecting the majority of schizophrenia (SZ) patients. An informative probe for sensory processing dysfunction in neuropsychiatric disorders is event-related potentials (ERPs) time-locked to presentations of deviant stimuli interspersed in a train of standard tones, which elicits a response complex dominated by two peaks, labeled mismatch negativity (MMN) and P3a positivity. Conventional approaches to electrocephalogram (EEG) analysis do not access the full wealth of information

contained in the ERPs. We have used a new method to analyze EEG data based on nonlinear data analysis that extracts the dynamical structure of the data, which allows for classification of raw data in nearly real time and is highly generalizable across patients. Delay Differential Analysis (DDA) is a time domain classification framework based on embeddings in chaos theory (Lainscsek and Sejnowski, 2015). An embedding reveals the nonlinear invariant properties of an unknown dynamical system (here the brain) from a single time series (here EEG data). The embedding in DDA serves as a low-dimensional nonlinear functional basis onto which the data are mapped. Since the basis is built on the dynamical structure of the data, preprocessing of the data (such as filtering) is not necessary. DDA yields a small number of features (around 4), far fewer than traditional spectral techniques, which greatly reduces the risk of overfitting. We applied DDA to EEG data segments from 1630 subjects (normal control subjects n=753, SZ n=877) who underwent MMN testing as part of a Consortium on the Genetics of Schizophrenia (COGS-2) study. Receiver operating characteristic (ROC) curves were used to evaluate the extent to which DDA and traditional ERP components differentiated the 2 groups. The results of the present study show that DDA improved the differentiation of SZ from NCS (area under the ROC curve was 0.80) relative to conventional ERP analysis (area under the ROC curve was 0.75). Perfect discrimination occurs with the area under the ROC curve is 1. In conclusion, DDA is a powerful technique that capitalizes on information contained in entire EEG signal, revealing hidden information about nonlinear couplings that are not apparent in conventional ERP analyses. Moreover, DDA does not require data cleaning, extensive data processing or computational demands for rapid analysis of EEG results. Lainscsek, C. Sejnowski, T. J. Delay Differential Analysis of Time Series, Neural Computation, 27, 594-614, 2015

Disclosures:	**C. Lainscsek:** None. **A. Sampson:** None. **T. COGS Investigators:** None. **G. Light:** None. **T.J. Sejnowski:** None.

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