Modulation of the ERN in Lose / Lose Trials in Individuals with Obsessive – Compulsive and Depressive Symptomology

Theo O.J. Gründer¹ James F. Cavanagh² Michael J. Frank² & John J.B. Allen²

¹Max-Planck-Institute for Neurological Research ²University of Arizona

Abstract

- ERN amplitude has been shown to predict accuracy in avoiding punishment during probabilistic learning. Obsessive Compulsive (OC) Disorder and related symptomology have been shown to predict a larger ERN amplitude. This experiment sought to examine the effect of OC symptom scores on punishment learning.
- Contrary to expectations, OC symptomology predicted smaller ERN amplitudes. There was no effect of OC on punishment learning accuracy.
- Unexpected results may be due to the neural systems underpinning the ‘ERN’ in probabilistic learning: it has not been shown how probabilistic learning ERPs may differ from the ERN elicited due to motor error commission.
- The influence of co-morbid depressive symptomatology was also examined, revealing no effect of OC on probabilistic learning deterrents which may be unique to mood.
- Follow-up studies are currently underway to explain OC and depression effects on reinforcement learning using the ERN, including a study which will directly compare ERNs between a Flanker task and this probabilistic learning task.

Background

- Excessive medio-frontal activity in the Anterior Cingulate Cortex (ACC) and other structures had been observed in Obsessive-Compulsive Disorder (OCD).
- Consequently, a negative cortical-striatal-thalamic-cortical feedback circuit in OCD had been proposed.
- This excessive neural activity is thought to underlie, in part, a ‘hypervactive error signal’.
- Four previous studies using Stroop, Flanker, and NoGo Paradigms found enhanced ERN amplitudes in OCD patients and OC symptom samples (Gehring et al., 2000; Johannes et al., 2001; Racine et al., 2005; Hajcak & Simons, 2002).
- A study using a reinforcement learning paradigm failed to replicate this effect (Nieuwenhuis et al., 2005).

Methods

- Participants
  - 120 undergraduate students screened for OC symptoms to identify low, medium, and high OC individuals.
  - 74 students selected and tested. Included in this analysis are participants without who learned the easiest symbol pair in the first and second task, and produced over 30 errors overall.

- Probabilistic selection

  - A probabilistic learning task (Frank et al. 2004) proven to elicit response ERN and feedback-related negativity differences.
  - During the testing phase the 3 pairs of Japanese Targets chance must be learned solely due to the feedback provided after a forced choice.

- Resting EEG data were examined for tonic differences in resting ACC theta current density which may underlie OCERF effects and ERN modulation.

- ERP & sLORETA measurement

  - Correct and incorrect responses to the designated/better choice in a symbol pair were averaged.
  - The ERN Amplitude was defined as peak-to-peak difference between the highest negative deflections at Cz between 0-300 ms post-trial onset, excluding P300 (if present) and P500 (if present).

- SLORETA reveals lower resting dorsal ACC theta current density to participants scoring high (OCI-R) compared to low (OCI-R) on the OCI-R scale (33). The authors wish to thank all of the undergraduate RAs and graduate students affiliated with the U of A psychophysiology laboratory who assisted with this project, especially Antonia Kaczkurkin and Christine Figueroa.

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