PROBLEM GAMBLING AND THE FRN

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BACKGROUND

The feedback-related negativity (FRN) is a negative deflection in the scalp waveforms observed 200-350ms following the presentation of the outcome on that trial.[1] Previous research identified the anterior cingulate cortex (ACC) to be the generator of the FRN,[1,2] which has been hypothesized to represent the dopaminergic prediction error signal originating in the basal ganglia.[3] The FRN has been shown to be larger following negative events (e.g., loss)[2,4] and unexpected events[5] as well as being sensitive to participant's engagement in the task[6], sense of responsibility over the outcome[7] and personality characteristics.[8]

Maladaptive gambling behavior has been associated with altered reactivity of the reward network.[9,10] These changes are reflected in the FRN amplitude, which was shown to be attenuated[11] and to occur earlier[12] in pathological gamblers compared to healthy controls.

Our study was conducted to examine how the sensitivity of the FRN to expectation about winning and perceived sense of control over the outcome relates to problem gambling (PG) behavior.

METHODS

*Participants (*grouped using CPGI[13]):

- Not at risk for PG (nPG): *n* = 22, 13 males (59%)
  - 31.1 years (range 19 to 50)
- At risk for PG (PG): *n = 19,* 15 males (79%)
  - 5 low-risk, 6 moderate-risk, 8 high-risk
  - 30.1 years (range 19 to 44)

Procedure

- Tasks were counterbalanced
- 128 channel Biosemi sensor net
- Processed using EEGLab (ICA to remove eye and muscle artifact)
- Segmented around feedback (-200ms to +1000ms)

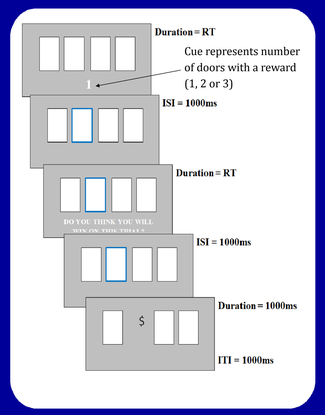
Statistical Analysis

- 2 (Gambling group) x 2 (Task) x 2 (Expectations) x 2(Valence) x 3(Channel) ANOVA was conducted on the peak FRN amplitude.
  - group by task by expectation (F (1,39) = 4.56, p = .039, $p\eta^2$ = .105)
  - group by valence by channel (F (2,78) = 3.43, p = .057, $p\eta^2$ = .081)

METHODS: TASKS

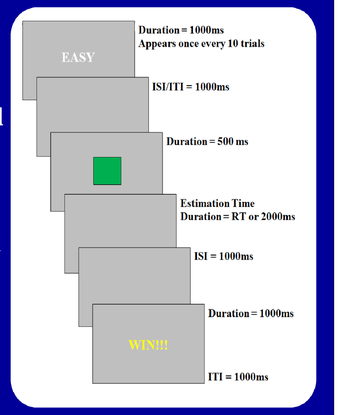
Gambling (Doors) Task[14]

- Low perceived sense of control (self-report)
- Probability based expectations (consistent with behavioral predictions)
- Outcomes were divided based on prediction (e.g., unpredicted win = unexpected win)

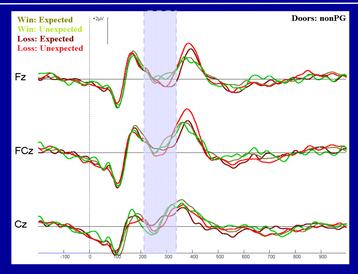
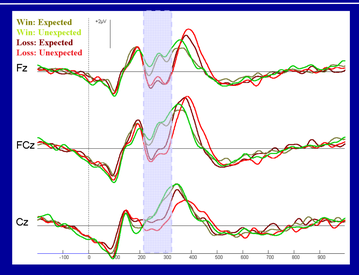
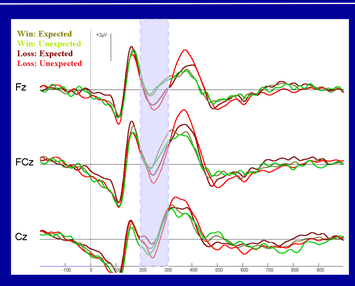
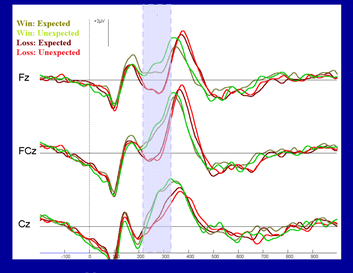


Time Estimation Task[1]

- Higher perceived sense of control (self-report)
- Instructions based expectations (consistent with self-report)
- Outcomes divided by expectation based on cues (e.g., win on an easy cue = expected win)



RESULTS

	Gambling (Doors) Task	Time Estimation Task
nPG		
	Expectation effects: F (1,21) = 6.56, p = .018, $p\eta^2$ = .238. No Valence effects: F (1,21) = 0.94, p = .762, $p\eta^2$ = .040.	No Expectation effects: F (1,21) = 2.31, p = .144, $p\eta^2$ = .099. **Valence effects**: F (1,21) = 14.76, p = .001, $p\eta^2$ = .413.
PG		
	Expectation effects: F (1,18) = 14.91, p = .001, $p\eta^2$ = .453. **Valence effects**: F (1,18) = 5.49, p = .031, $p\eta^2$ = .234.	No Expectation effects: F (1,18) = 0.24, p =.631, $p\eta^2$ = .013. **Valence effects**: F (1,18) = 8.70, p = .009, $p\eta^2$ =.326.

Follow up analysis showed that individuals at-risk for PG were more sensitive to the valence of the outcomes in the gambling task compared to nPG group.

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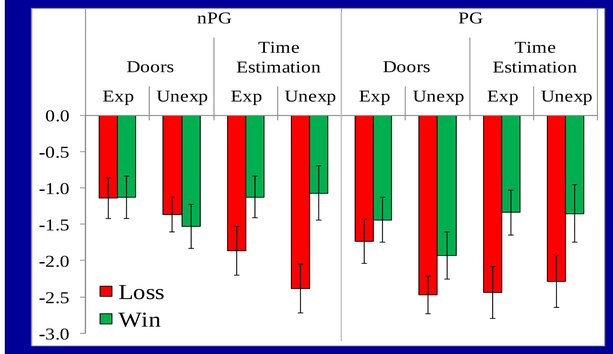
RESULTS (cont'd)

Figure 7. Peak FRN amplitude averaged across midline channels and broken down by group, task and expectation.



Two repeated measures ANOVAs (one for losses and one for wins) were conducted to examine the task by valence interaction observed in the mixed ANOVA analysis. The data was also broken down by group. Expectation and valence effects in the PG group were driven by changes in FRN following wins , rather than losses as was observed in the nPG group (Figure 7).

CONCLUSIONS

- Individuals at risk for PG showed an increased sensitivity to reward characteristics and a decreased response to loss outcomes
- Failure to replicate previous research examining severe pathological gamblers reporting a general attenuation of the FRN, suggesting that a general reduction in the FRN can be observed only after behaviour becomes clinically maladaptive.

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