Gambling distortions and the brain reward system

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• Impulsive choice in PG as possible index of vmPFC dysfunction
• Functional imaging of gambling near-misses
• Gambling distortions following brain injury (ventromedial PFC vs insula damage)
Impulsive Choice in PG: the Cambridge Gamble Task

- well-established neuropsychology probe of vmPFC function (Clark et al 2008 *Brain*)
Impulsive Choice in PG: the Cambridge Gamble Task

- Lawrence et al (2009 *Addiction*) elevated betting & more bankruptcy in community problem gamblers (and alcohol-dep)

- Sharman, Bowden-Jones, Clark: Clinical PG: 86 male PG vs 45 healthy controls
Cognitive Approach to Gambling

- Gamblers experience distorted processing of chance and skill, causing over-estimated chances of winning
- Elevated in PG and correlated with impulsivity (delay discounting)

![Gambling-Related Cognitions Scale](Michalczuk et al (2011 Psychol Med))

\[ r = 0.64, \ p < .001 \]
Near-Misses

“A special kind of failure to reach a goal, one that comes close to being successful” (Reid 1986)
Near Misses are Aversive but Enhance Motivation to Play

Clark et al (2009 Neuron)
Arousal Responses to Wins and Near-Misses

Clark et al (2012 JoGS)
fMRI Responses to Wins and Near-Misses

A
WINNING OUTCOMES minus ALL NON-WIN OUTCOMES

B
NEAR-MISS OUTCOMES minus FULL-MISS OUTCOMES

Dopaminergic Midbrain Anterior Insula Ventral Striatum mPFC

P<.05 FWE

P<.001 uncorr

Clark et al (2009 Neuron)
Gambling Involvement and Near-Misses

Clark et al (2009): Insula response to near misses and trait gambling cognitions

Chase & Clark (2010): in regular players, midbrain response to near misses predicts PG symptoms
Near Misses and Skill

• Near misses are falsely interpreted as signals of skill acquisition, and thus fuel the illusion of control.

3 lines of evidence

• Near miss effect needs personal choice of play icon (Clark et al 2009)

• Individual differences in skill-oriented cognitions predict the potency of near misses (Billieux et al 2012 Brit J Psychol)

• Learning consequences on trials after a near-miss predict persistent play (Clark et al 2013 J Behav Dec Making)
The Gambler’s Fallacy

Binary choice guessing: RED or BLACK on roulette
Further effect of prior feedback (win-stay / lose-shift)

Limbrick-Oldfield, Aitken & Clark, in progress
Gambling Distortions following Brain Injury

Injury to ventromedial PFC n=18
Insula n=12
Amygdala n=7
Healthy controls n=16

Clark, Studer, Bechara, in prep
Gambling Distortions following Brain Injury

Effect of Run Length = Gambler’s Fallacy
Abolished in Insula lesion group

*Clark, Studer, Bechara, in prep*

Motivational Effect of Near Misses vs Full Misses
Abolished in Insula lesion group
Conclusions

• Two gambling distortions:
  – Motivational effects of near-misses
  – Sequential biases in random choice (Gambler’s Fallacy)

• These biases:
  – exist in healthy people and are enhanced in problem gamblers
  – are abolished in patients with damage to the insula, plausibly via damaged representations of bodily “excitement”

• Ongoing work:
  – fMRI of these biases in PG, unaffected relatives, alcohol abuse
  – Near-misses: more realistic simulations; vs near-losses (EEG); vs ‘Losses Disguised as Wins’
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