# Gambling distortions and the brain reward system

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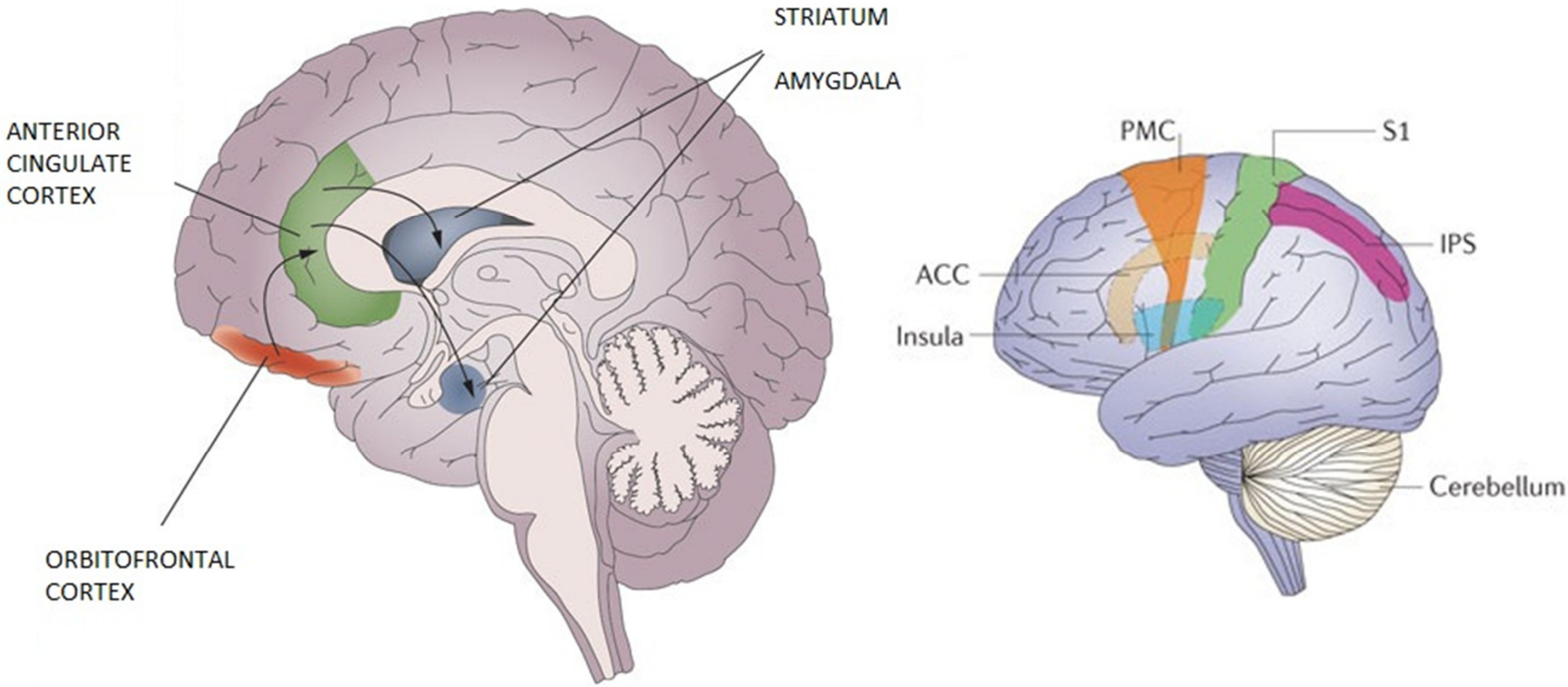
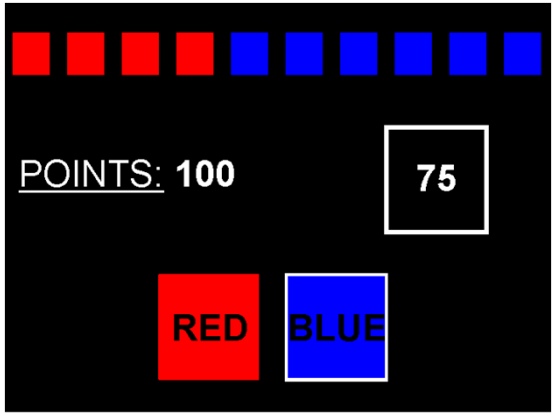
LARGE
LABORATORY FOR AFFECT, RISK AND GAMBLING EXPERIMENTS

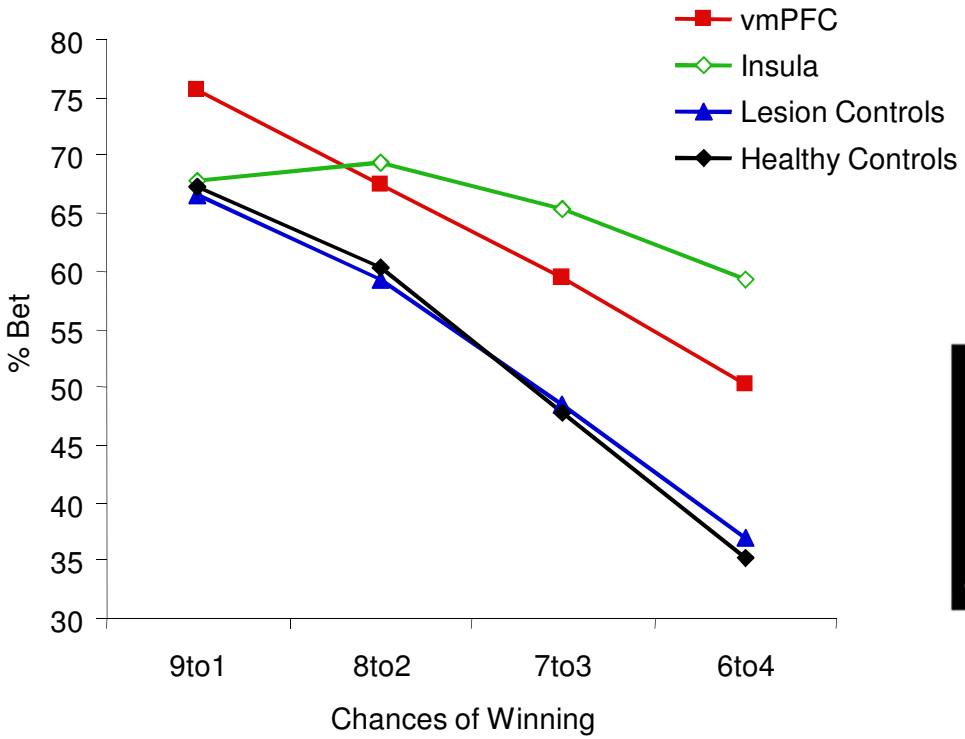


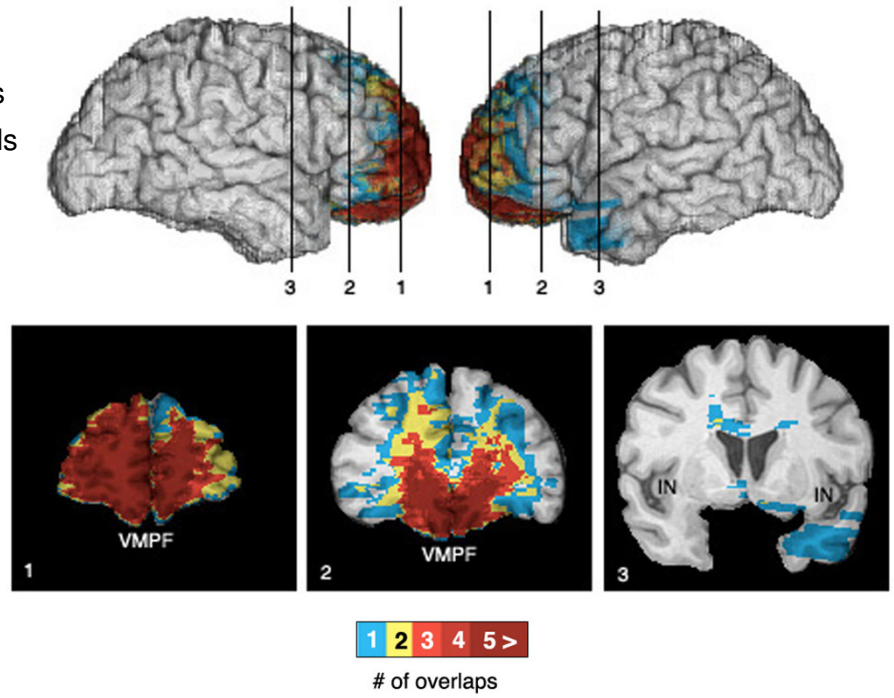

- Impulsive choice in PG as possible index of vmPFC dysfunction
- Functional imaging of gambling near-misses
- Gambling distortions following brain injury (ventromedial PFC vs insula damage)

# Impulsive Choice in PG: the Cambridge Gamble Task

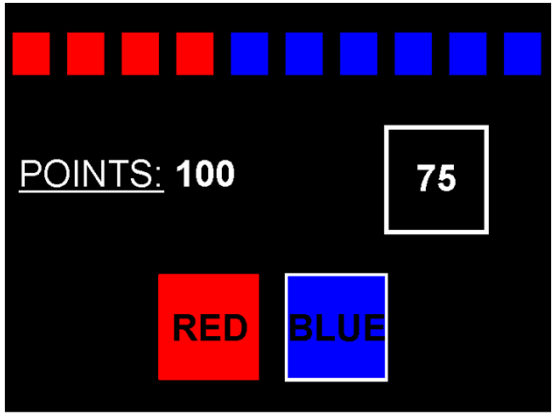



- well-established neuropsychology probe of vmPFC function (Clark et al 2008 *Brain*)



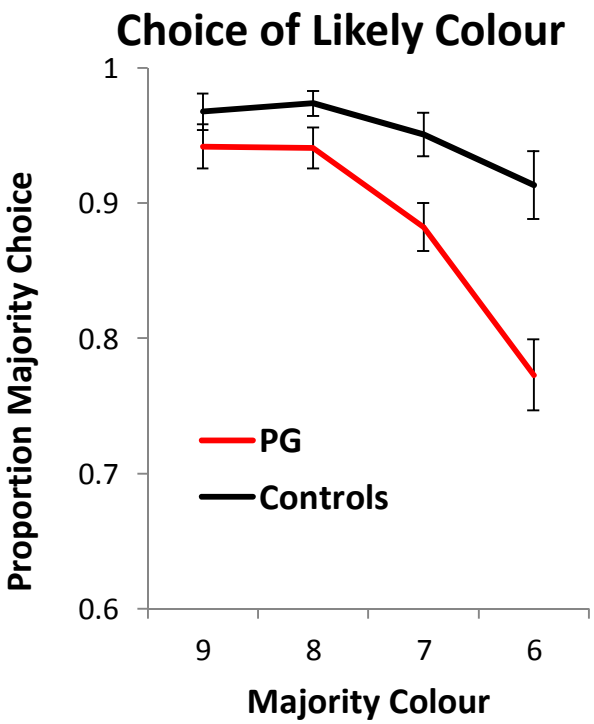



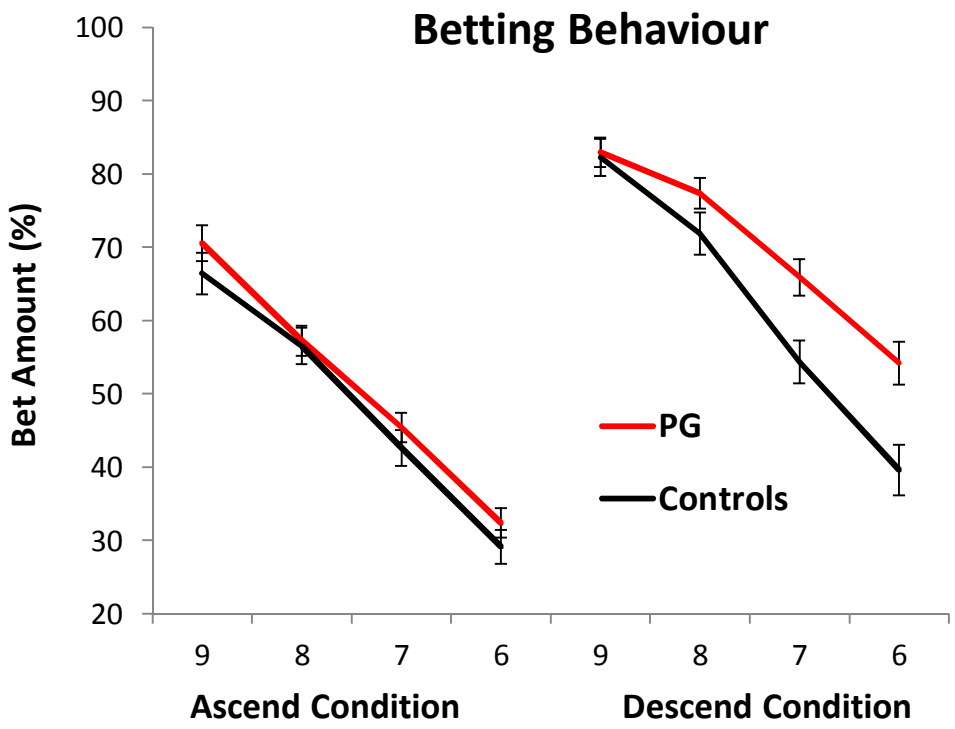
# Impulsive Choice in PG: the Cambridge Gamble Task




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

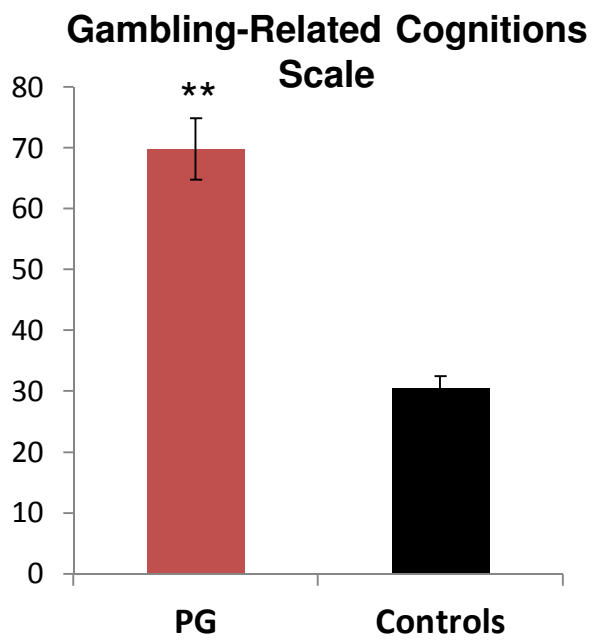
- Sharman, Bowden-Jones, Clark: Clinical PG: 86 male PG vs 45 healthy controls

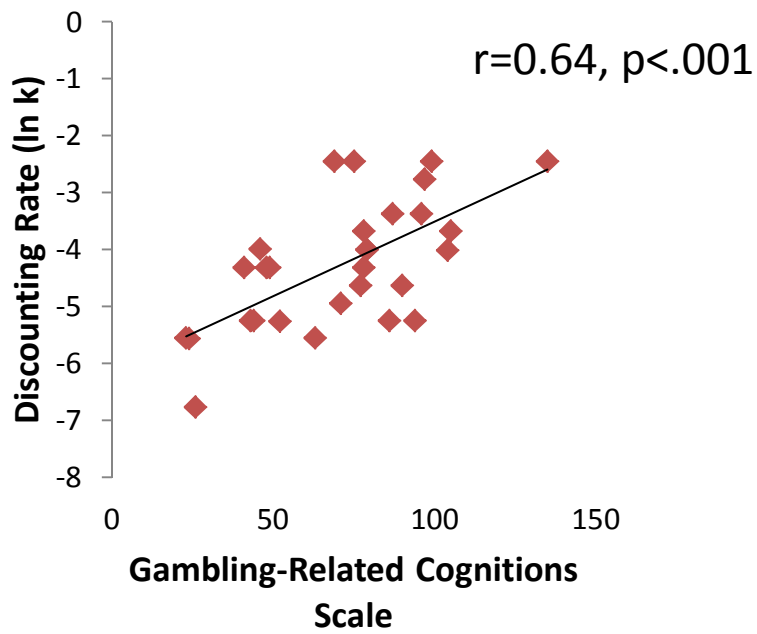


# Cognitive Approach to Gambling

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

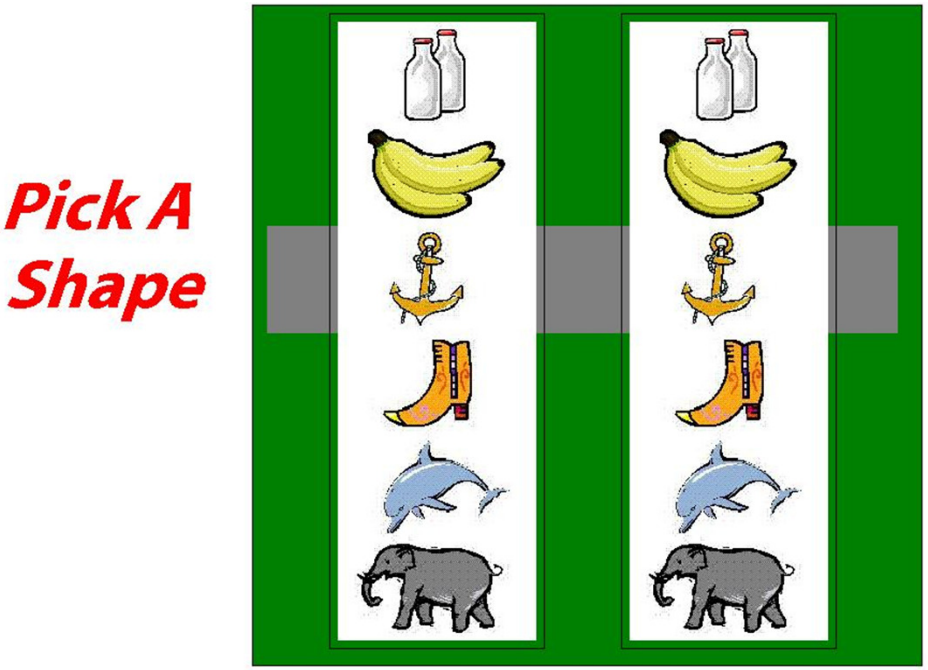


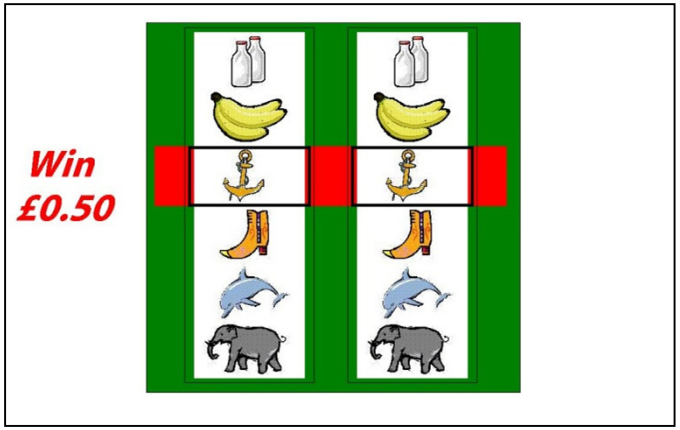

*Michalczuk et al (2011 Psychol Med)*

# Near-Misses

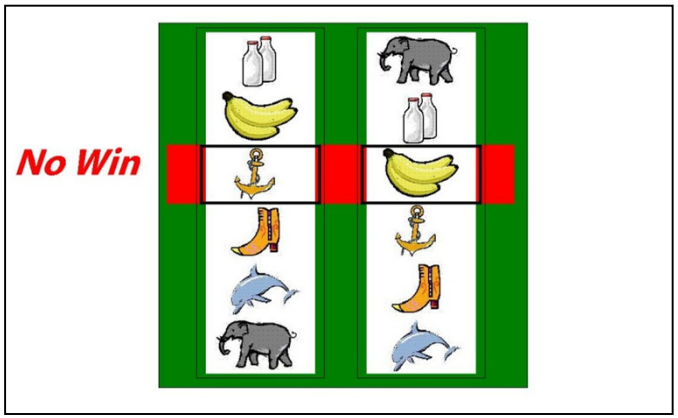
"A special kind of failure to reach a goal, one that comes close to being successful" (Reid 1986)



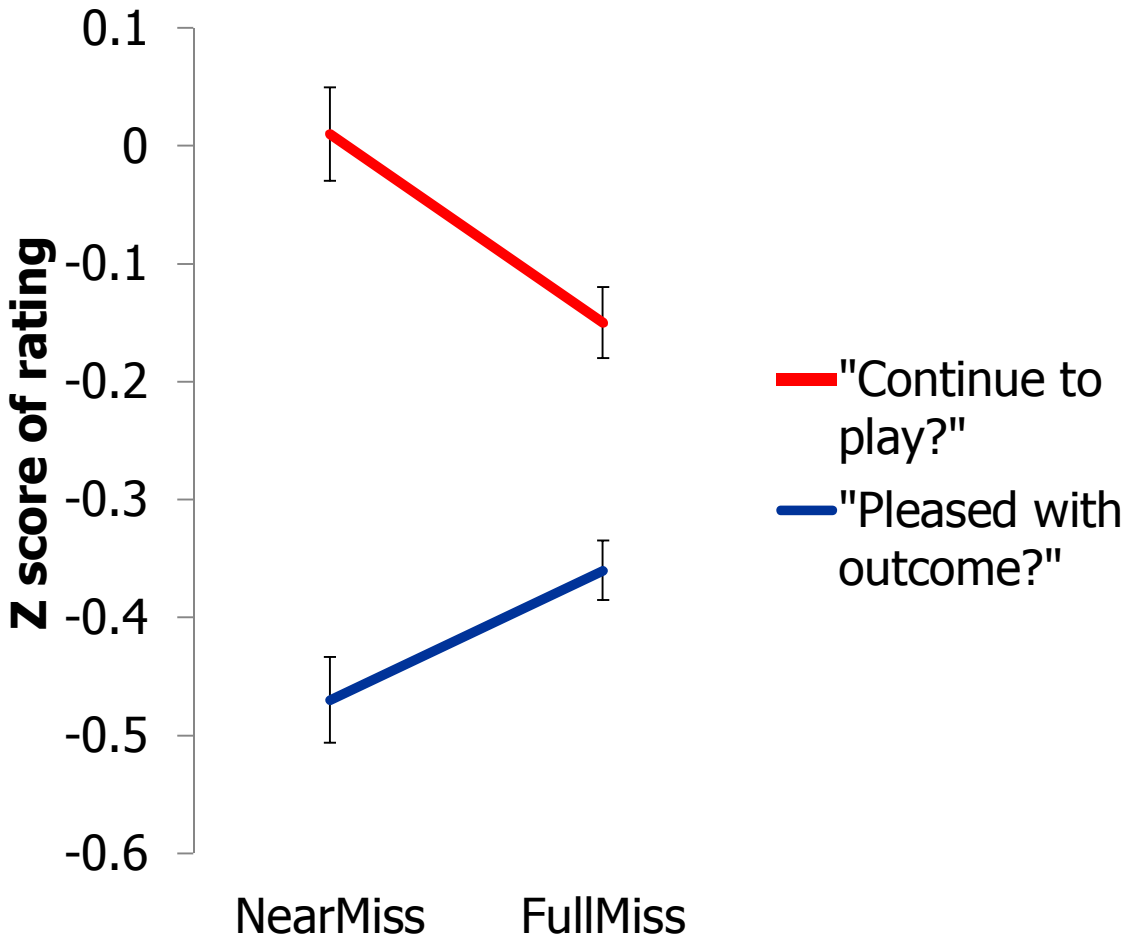

WIN




NEAR-MISS

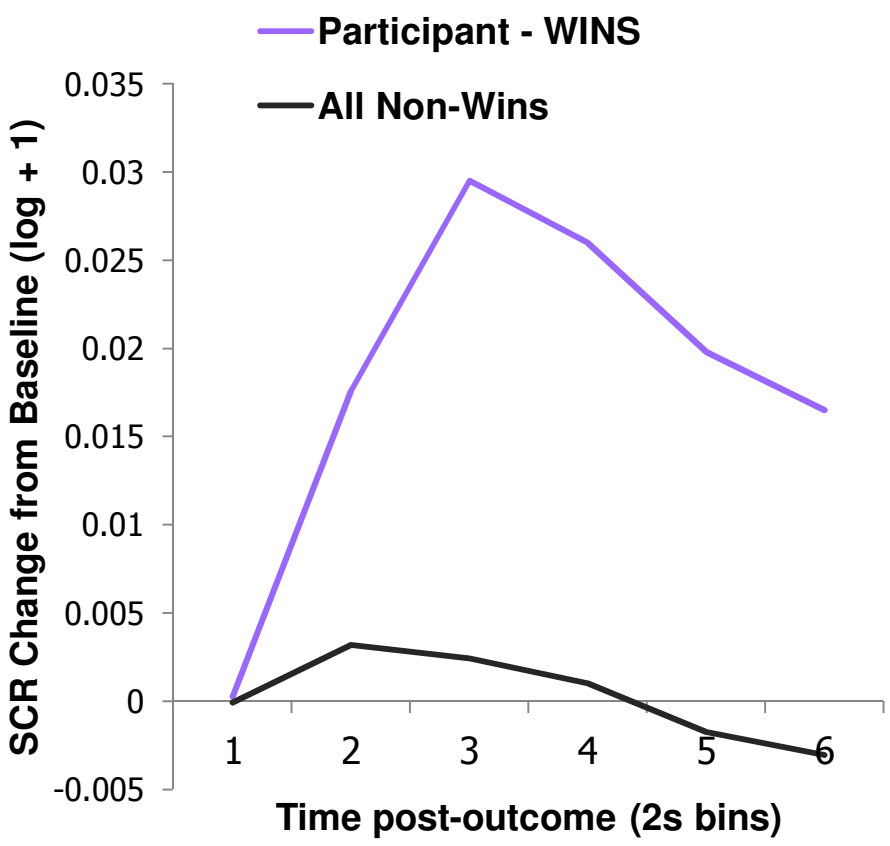


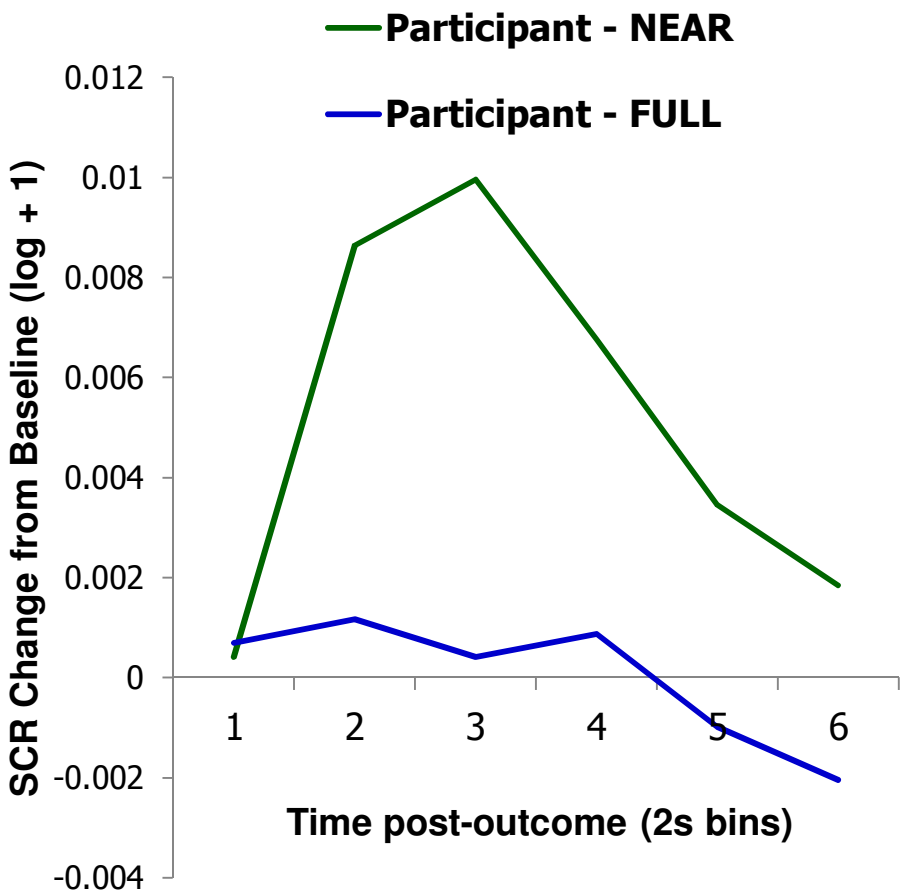
# Near Misses are Aversive but Enhance Motivation to Play




*Clark et al (2009 Neuron)*

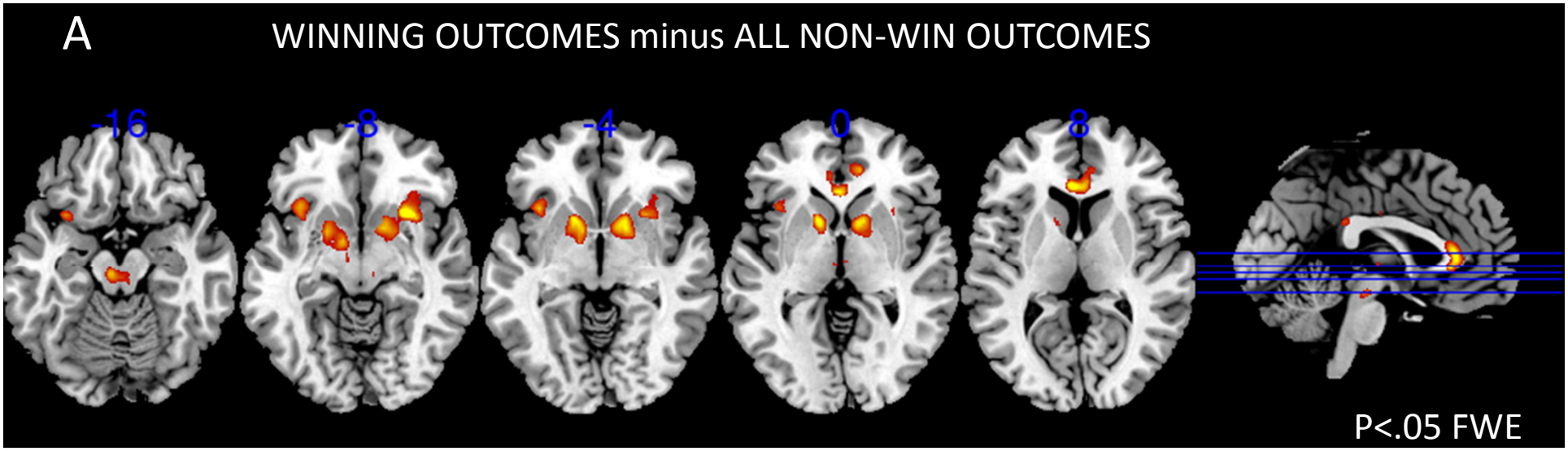
# Arousal Responses to Wins and Near-Misses



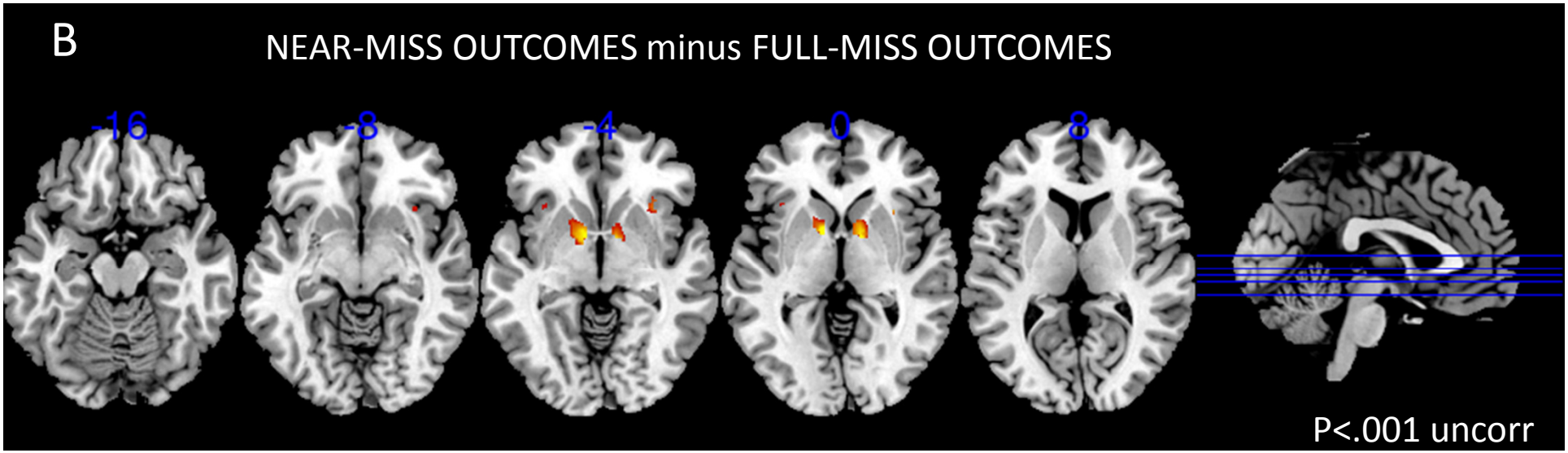




*Clark et al (2012 JoGS)*

# fMRI Responses to Wins and Near-Misses




Dopaminergic Midbrain | Anterior Insula | Ventral Striatum | mPFC

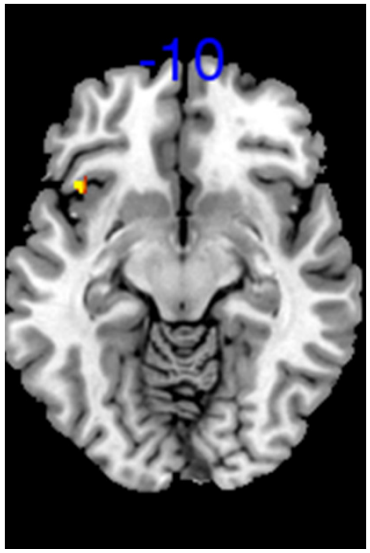


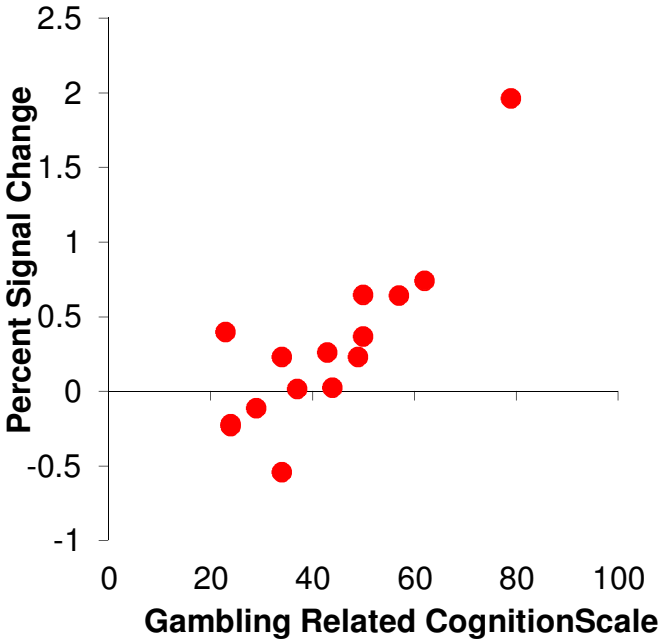

*Clark et al (2009 Neuron)*

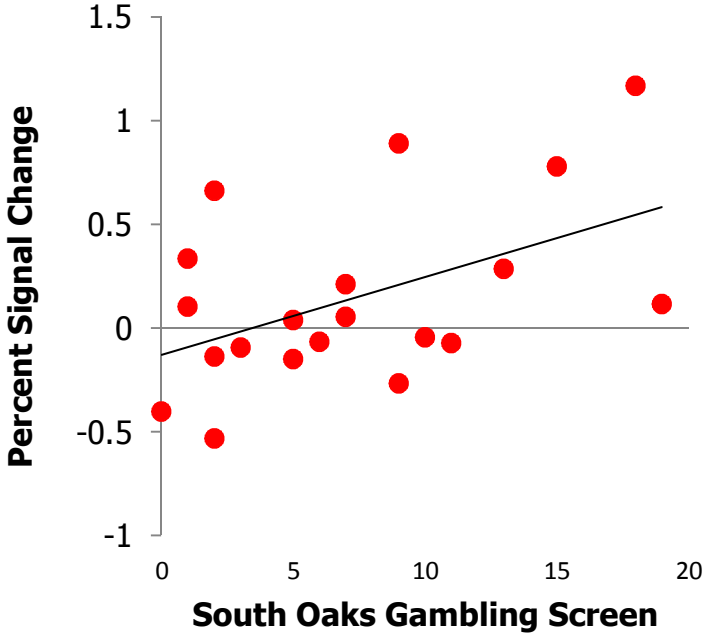
# Gambling Involvement and Near-Misses

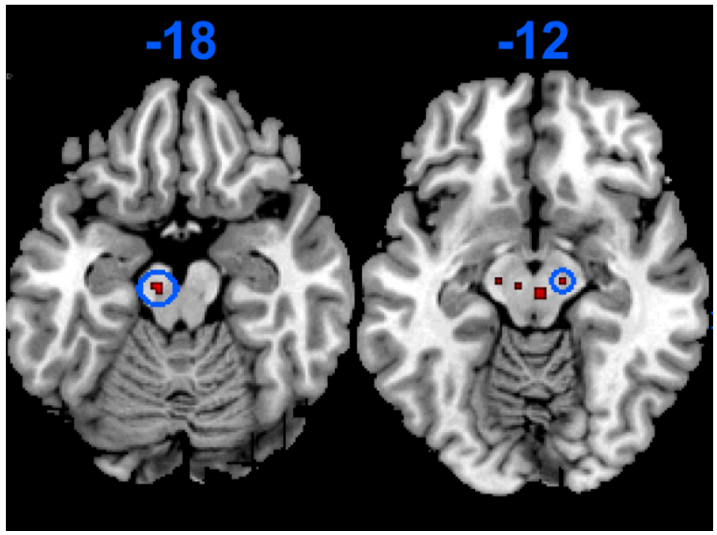
Clark et al (2009): Insula response to near misses and trait gambling cognitions

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



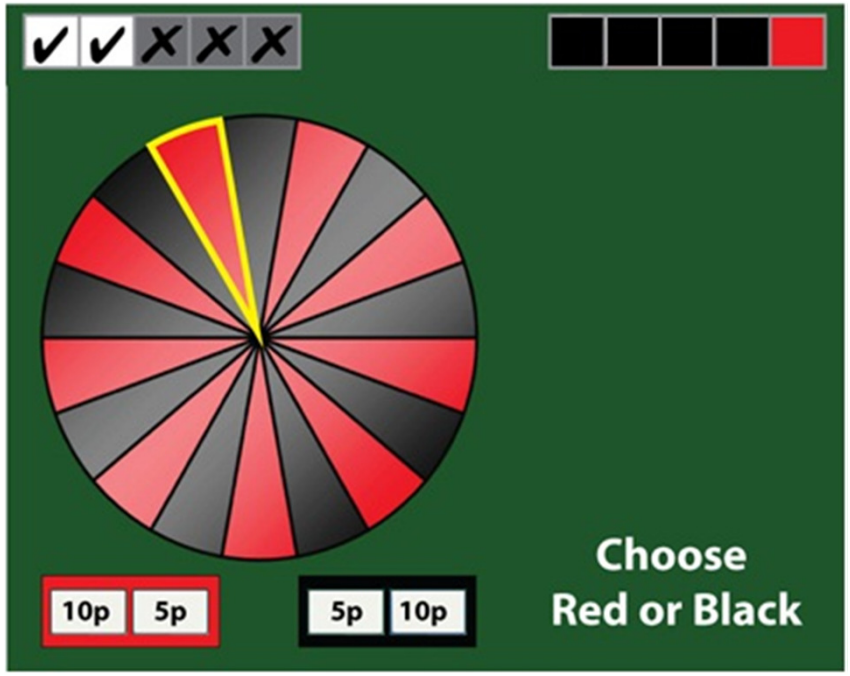
# Near Misses and Skill

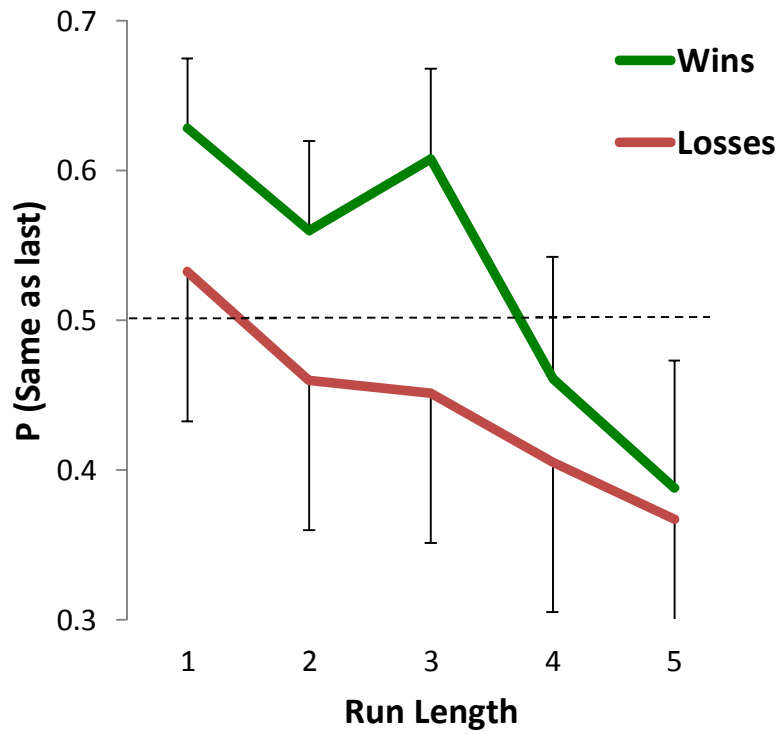
- Near misses are falsely interpreted as signals of skill acquisition, and thus fuel the illusion of control.

  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*

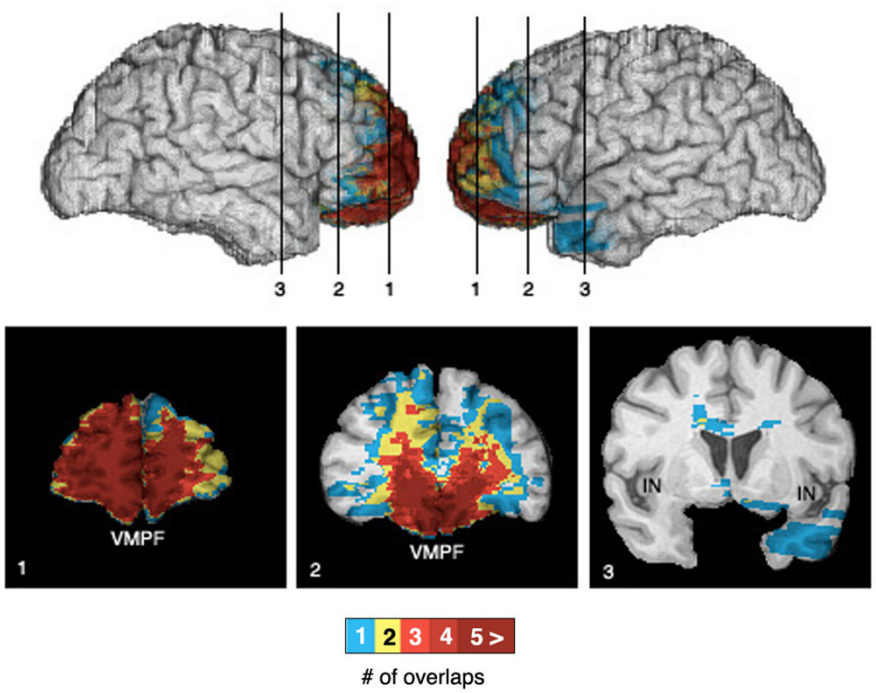
# Gambling Distortions following Brain Injury

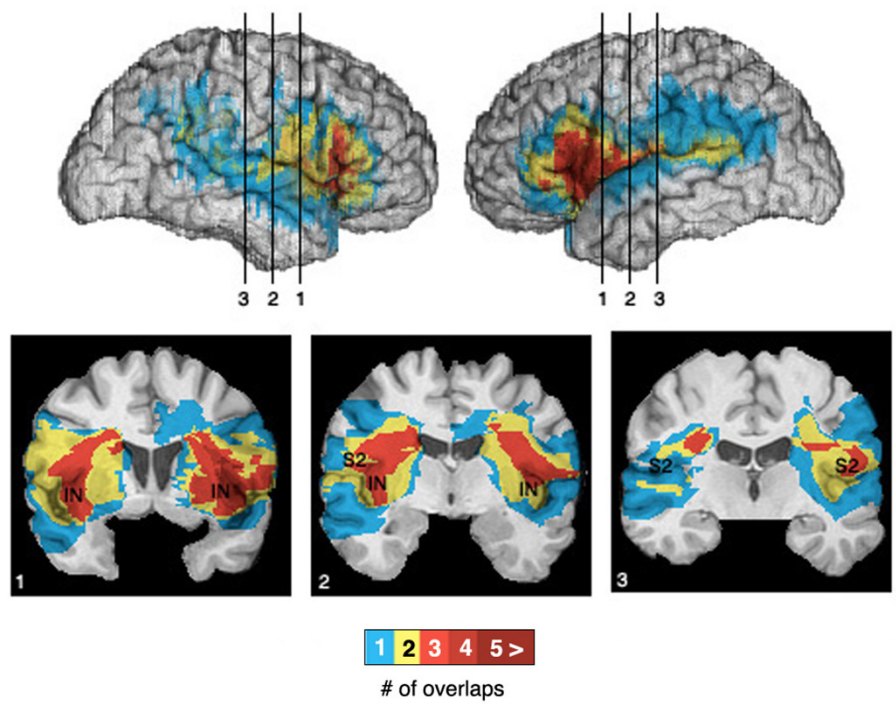
Injury to ventromedial PFC n=18

Insula n=12

Amygdala n=7

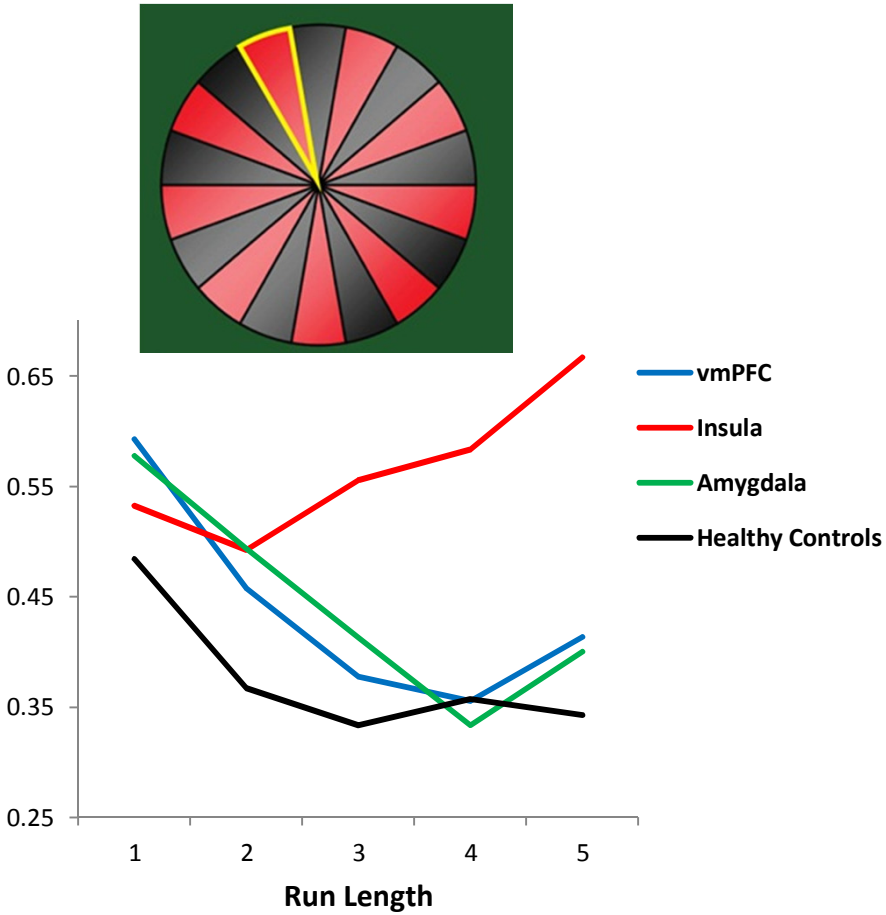
Healthy controls n=16

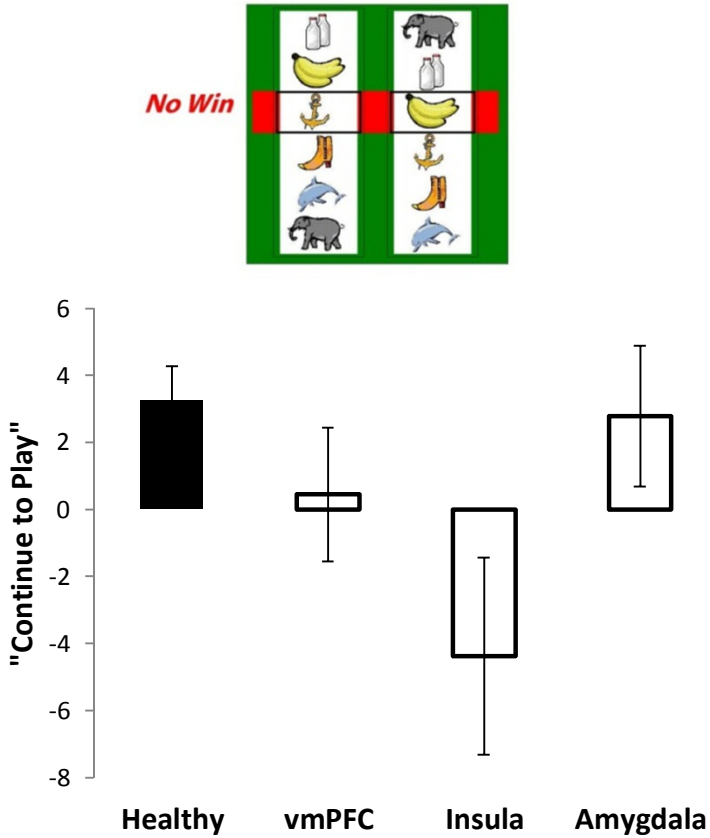



*Clark, Studer, Bechara, in prep*

# Gambling Distortions following Brain Injury




Effect of Run Length = Gambler's Fallacy

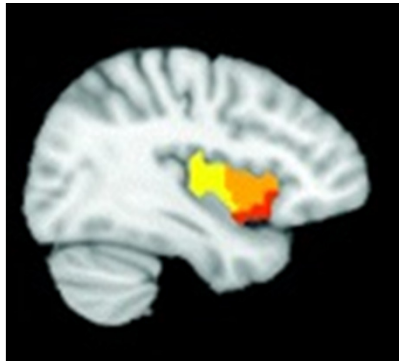
Abolished in Insula lesion group

*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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