

Cognitive Neuroscience of Craving

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Cognitive Neuroscience of Craving

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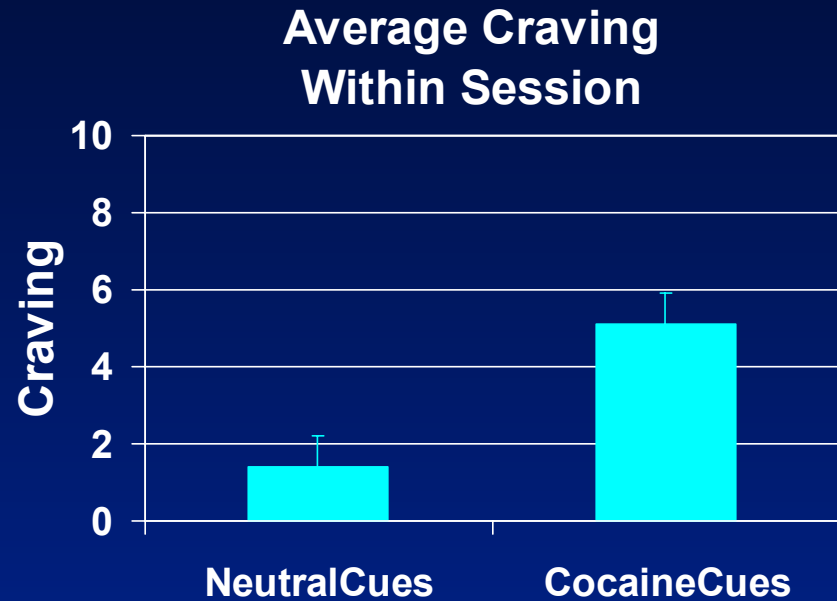
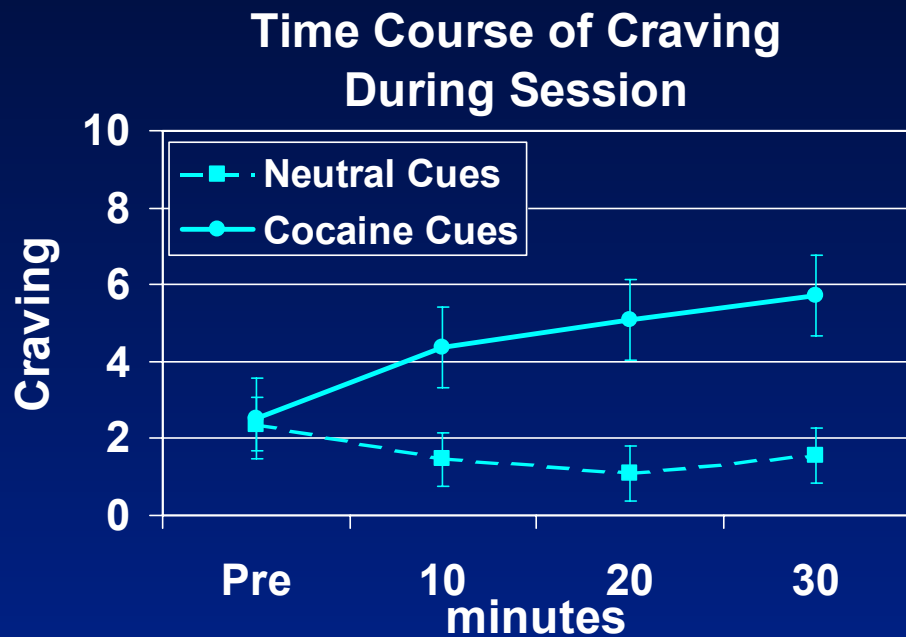
Jennifer Bragg, Varughese Kurian, M.S., CNMT, Mark Waller, CNMT

What is Craving ?

State evoked by People, Places and Things associated with drug use



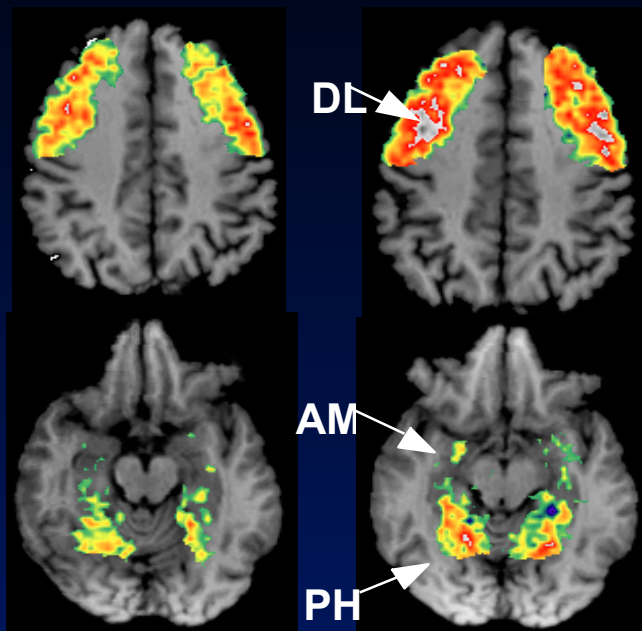
Time Course of Craving



Bonson, et al
Neuropsychopharmacology, 2002

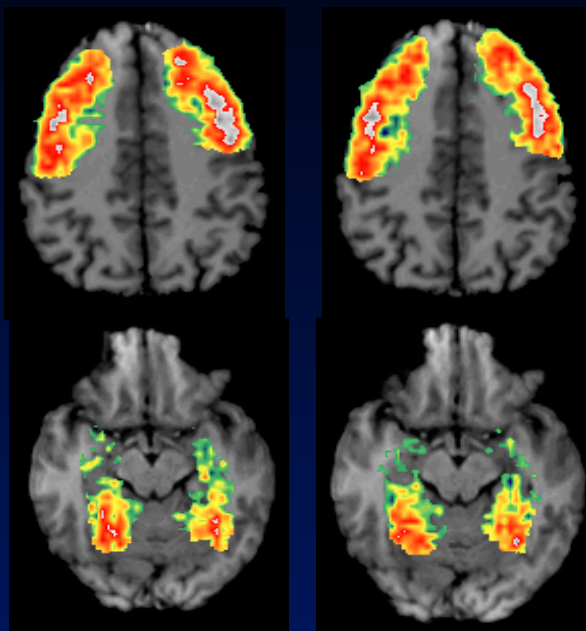
● HIGH CRAVER

● LOW CRAVER



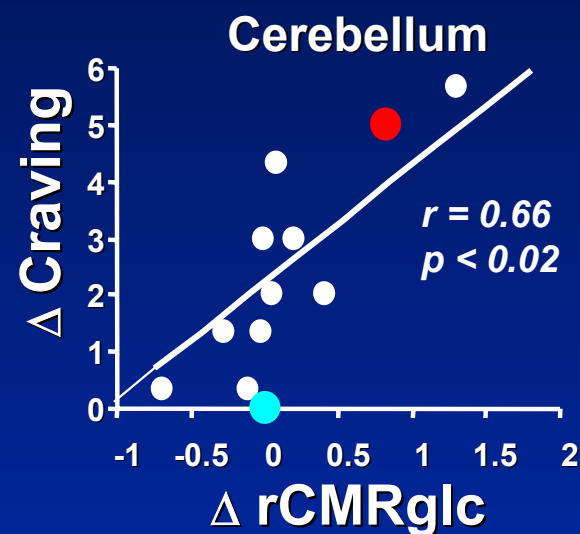
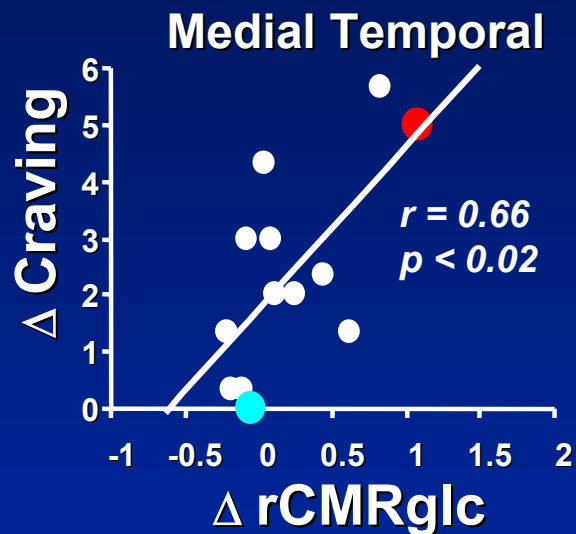
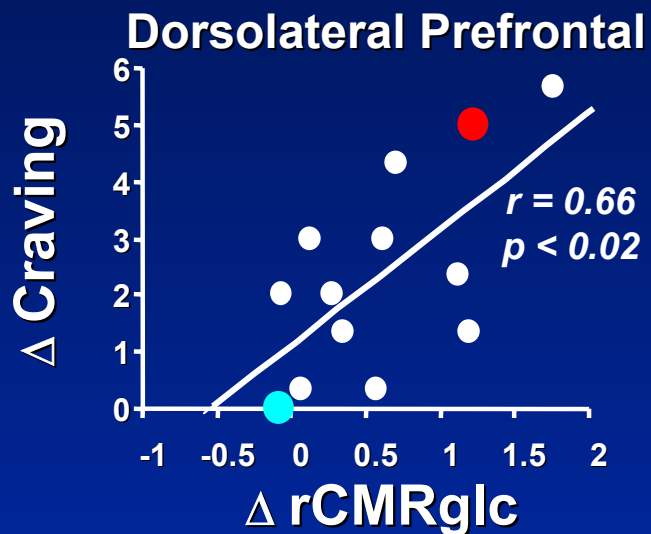
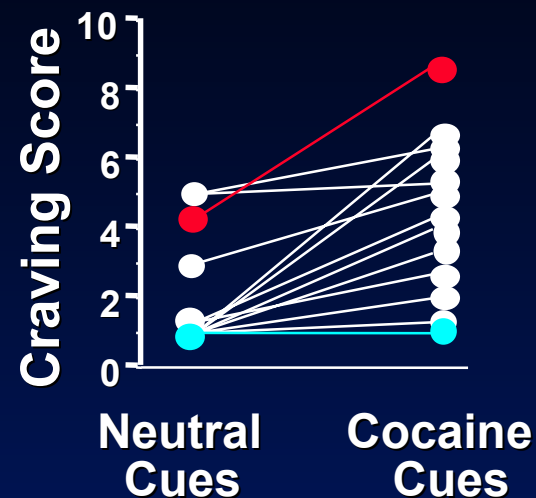
Neutral

Cocaine

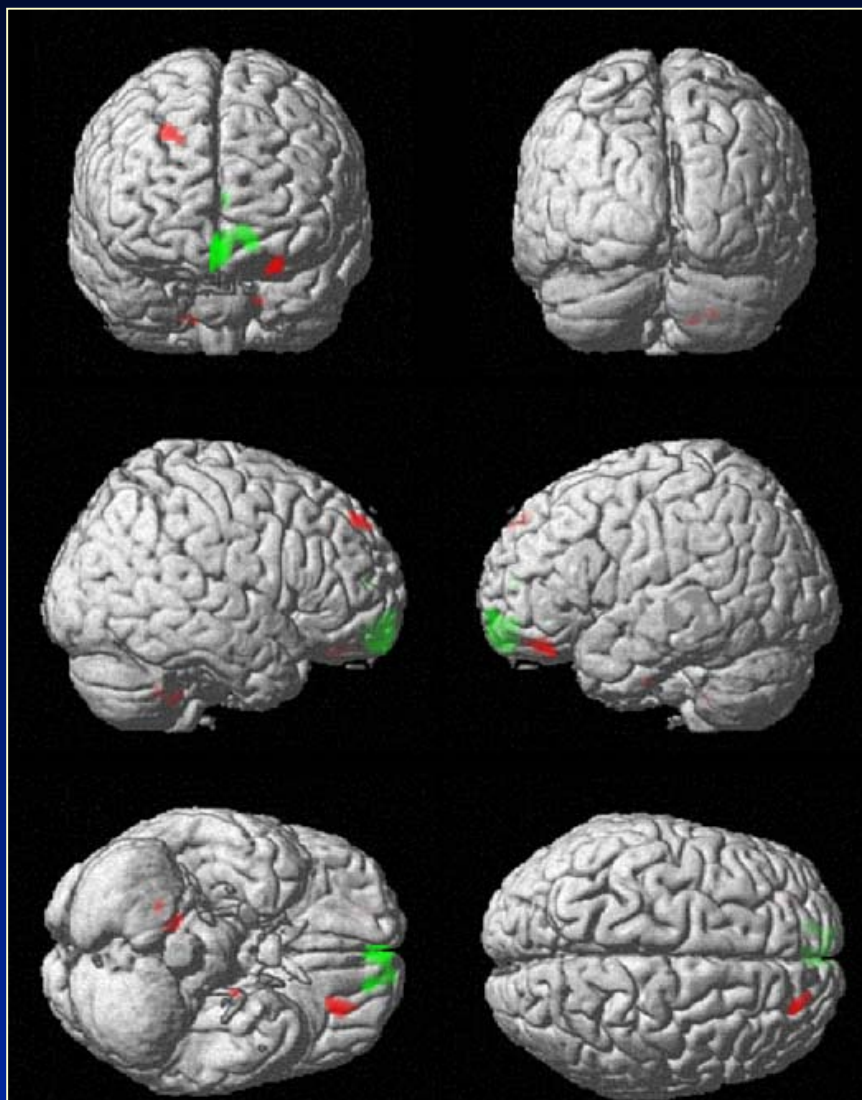


Neutral

Cocaine



Activations and Deactivations During Presentation of Cocaine Cues

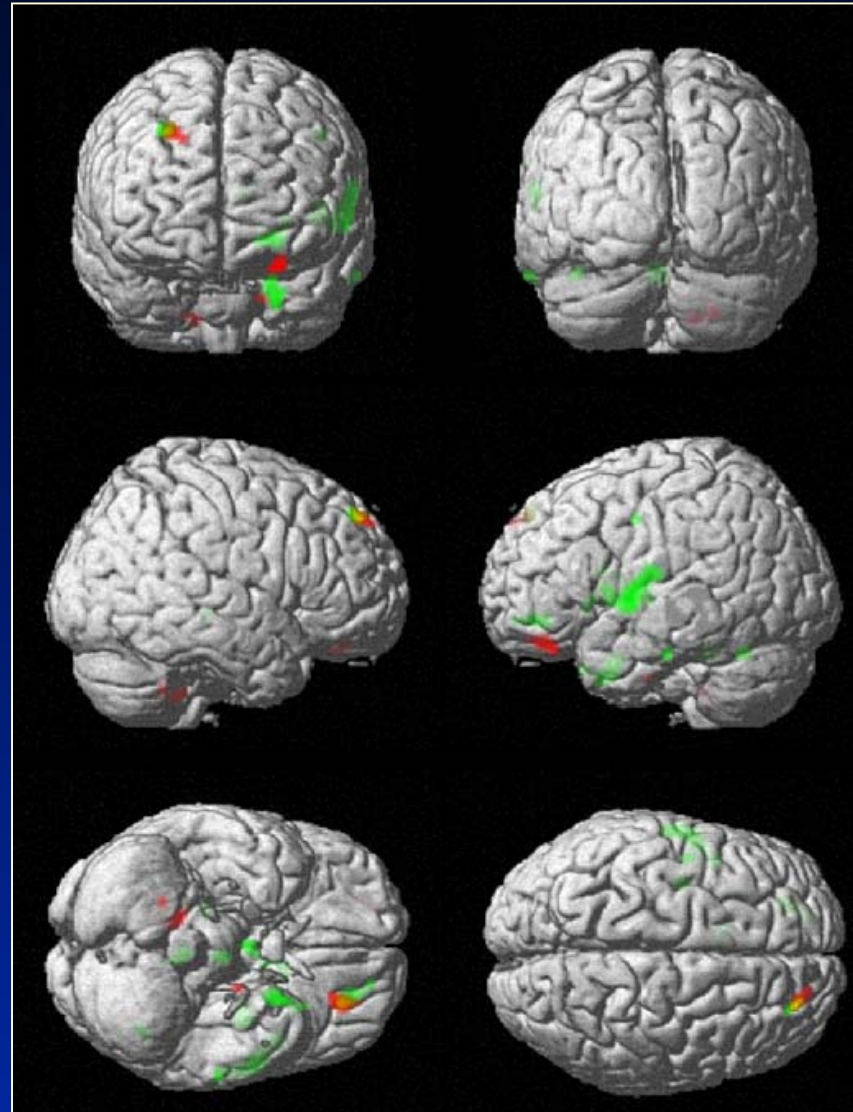


■ Activation
■ Deactivation

Bonson, et al
Neuropsychopharmacology,
2002

$p < 0.005$, uncorrected.
Extent = 10 pixels. N = 11

Overlap of Activations and Correlations with Craving

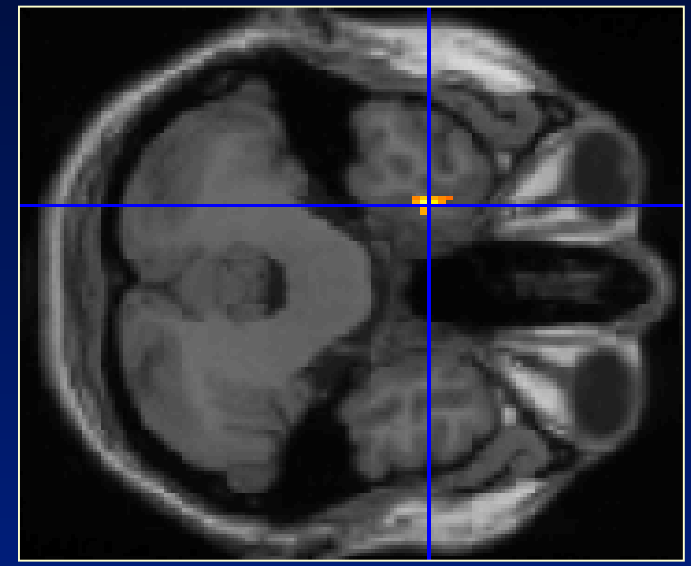
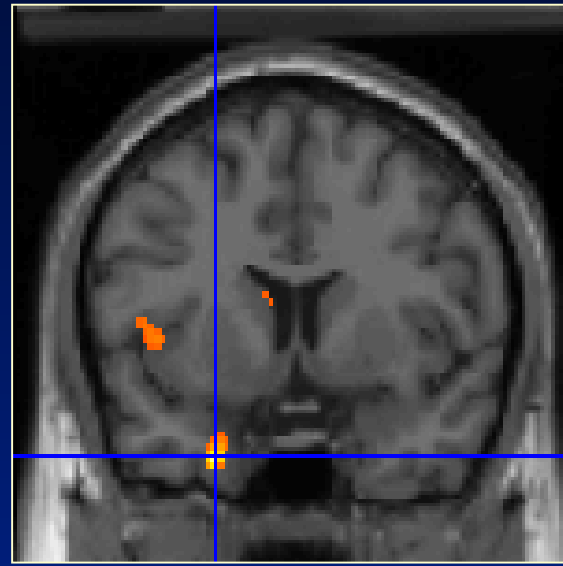
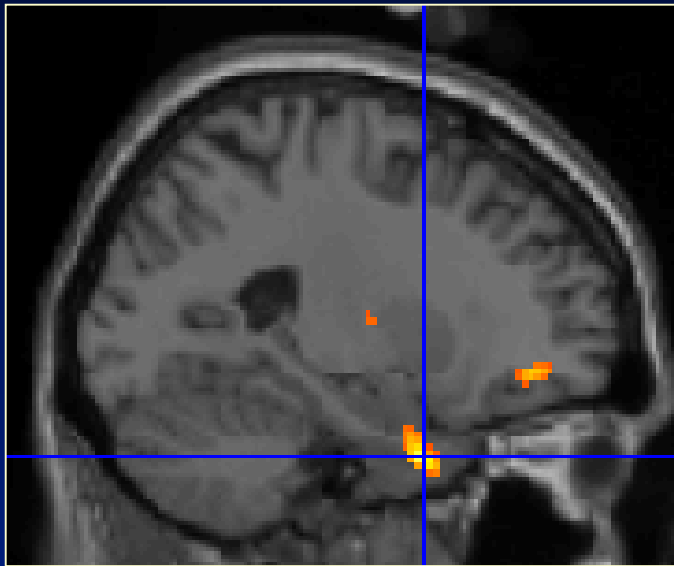


■ Activation
■ Correlation
($r > 0.7$)

Bonson, et al
Neuropsychopharmacology,
2002

$p < 0.005$, uncorrected.
Extent = 10 pixels. N = 11

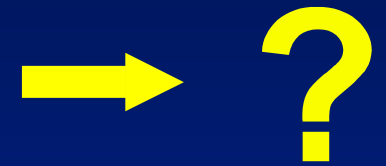
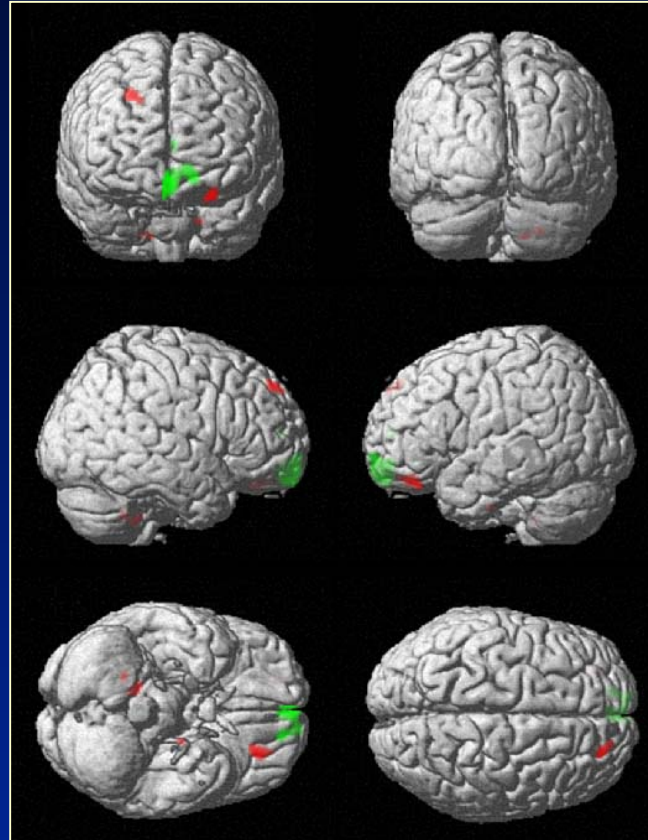
Positive Correlation with Craving in Left Amygdala/Perirhinal Cortex



Bonson, et al
Neuropsychopharmacology,
2002

$p < 0.005$, uncorrected.
Extent = 10 pixels. N = 11

What Does Craving Do ?

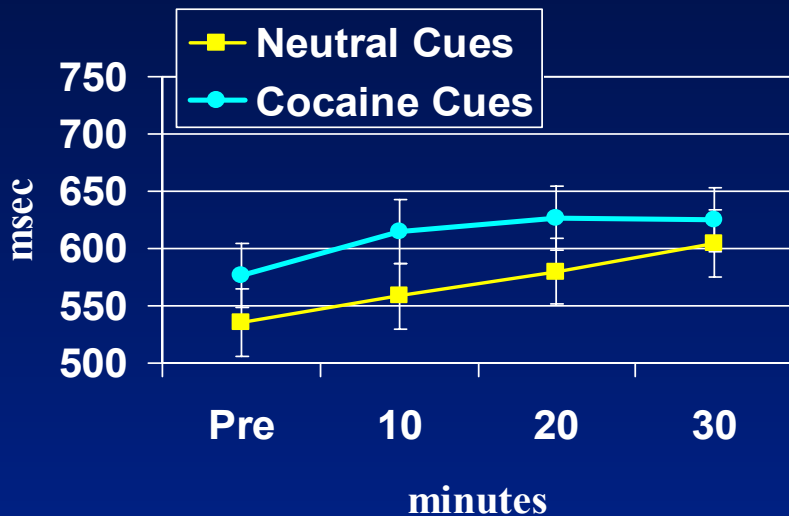


Craving Captures Attention

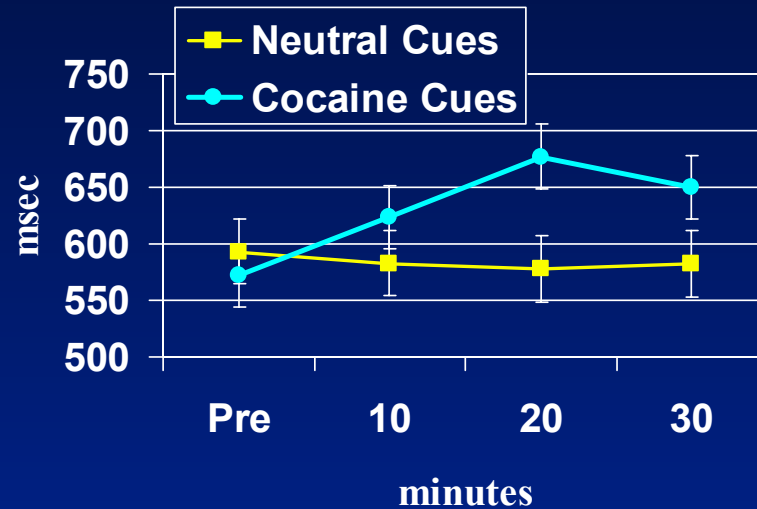
Cues + Continuous Performance Task

N= 12 Cocaine Abusers N= 10 Controls

Average Session RT
Controls



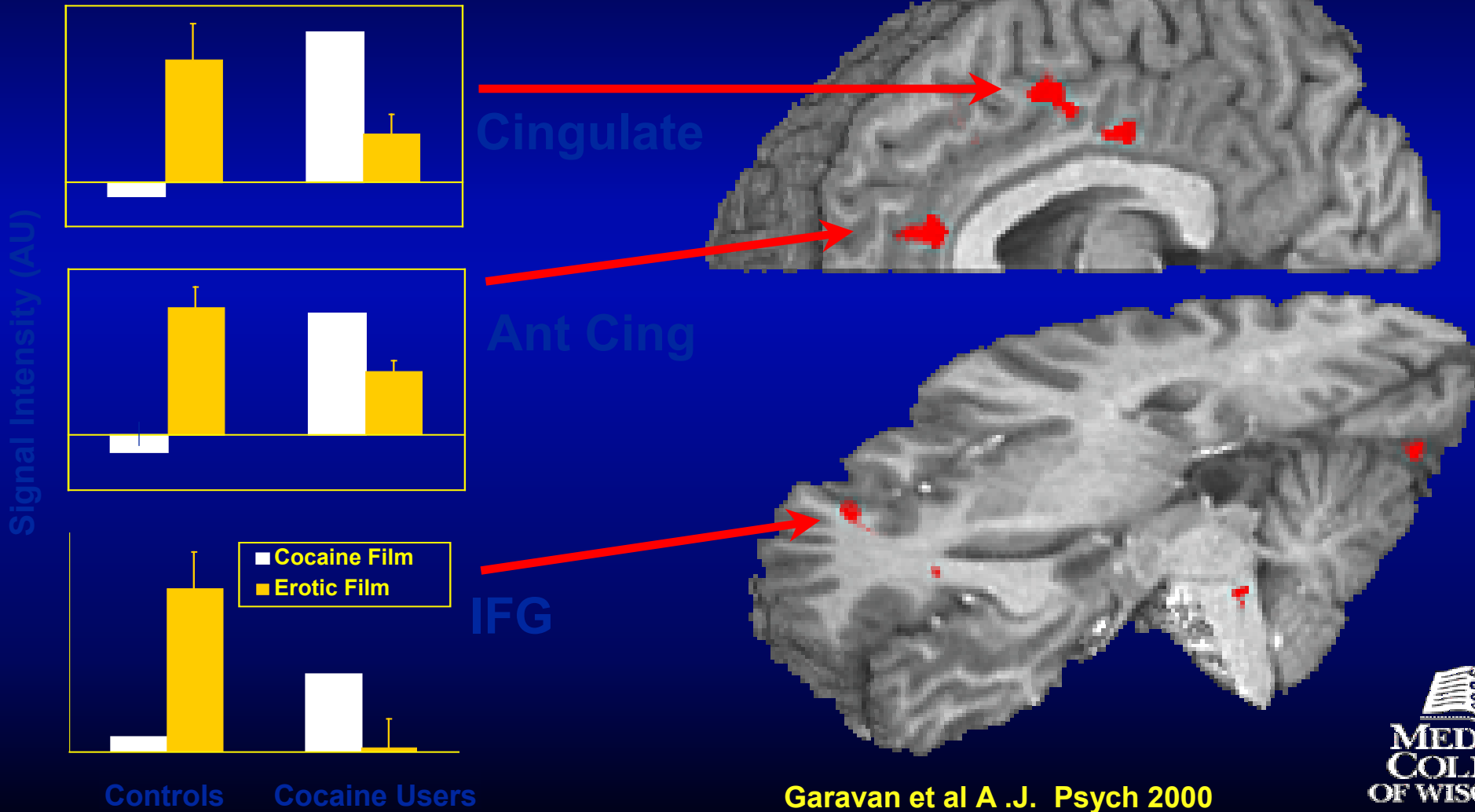
Average Session RT
Cocaine Abusers



Group X Session X Time $p < 0.03$

Cocaine Craving:

Population (Cocaine Users, Controls) x Film (cocaine, erotic)



Garavan et al A .J. Psych 2000

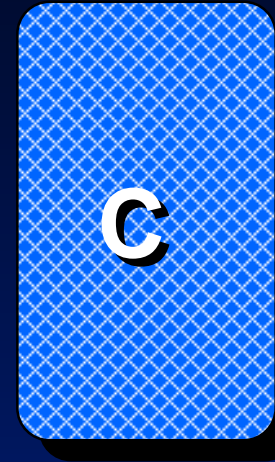
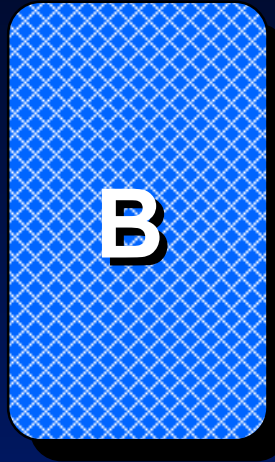
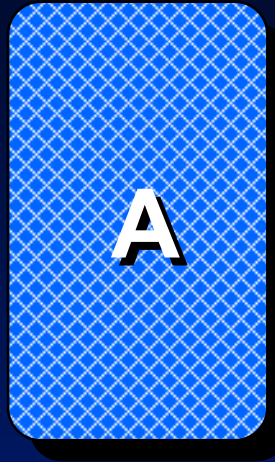
Craving Influences Decision-Making

- **Drug Abusers show abnormal brain activity in Ventral Prefrontal Cortex**
- **Craving alters brain activity in Ventral Prefrontal Cortex**
- **Lesions of Ventral Prefrontal Cortex lead to impaired judgment of future consequences.**
- **Continued drug use despite adverse consequences (DSM IV) is hallmark of addiction.**

GAMBLING TASK

“Bad” Decks

“Good” Decks



Payoff /Card

\$100

\$100

\$ 50

\$ 50

Loss /10 Cards

\$1250

\$1250

\$250

\$250

Profit/10 Cards

-\$250

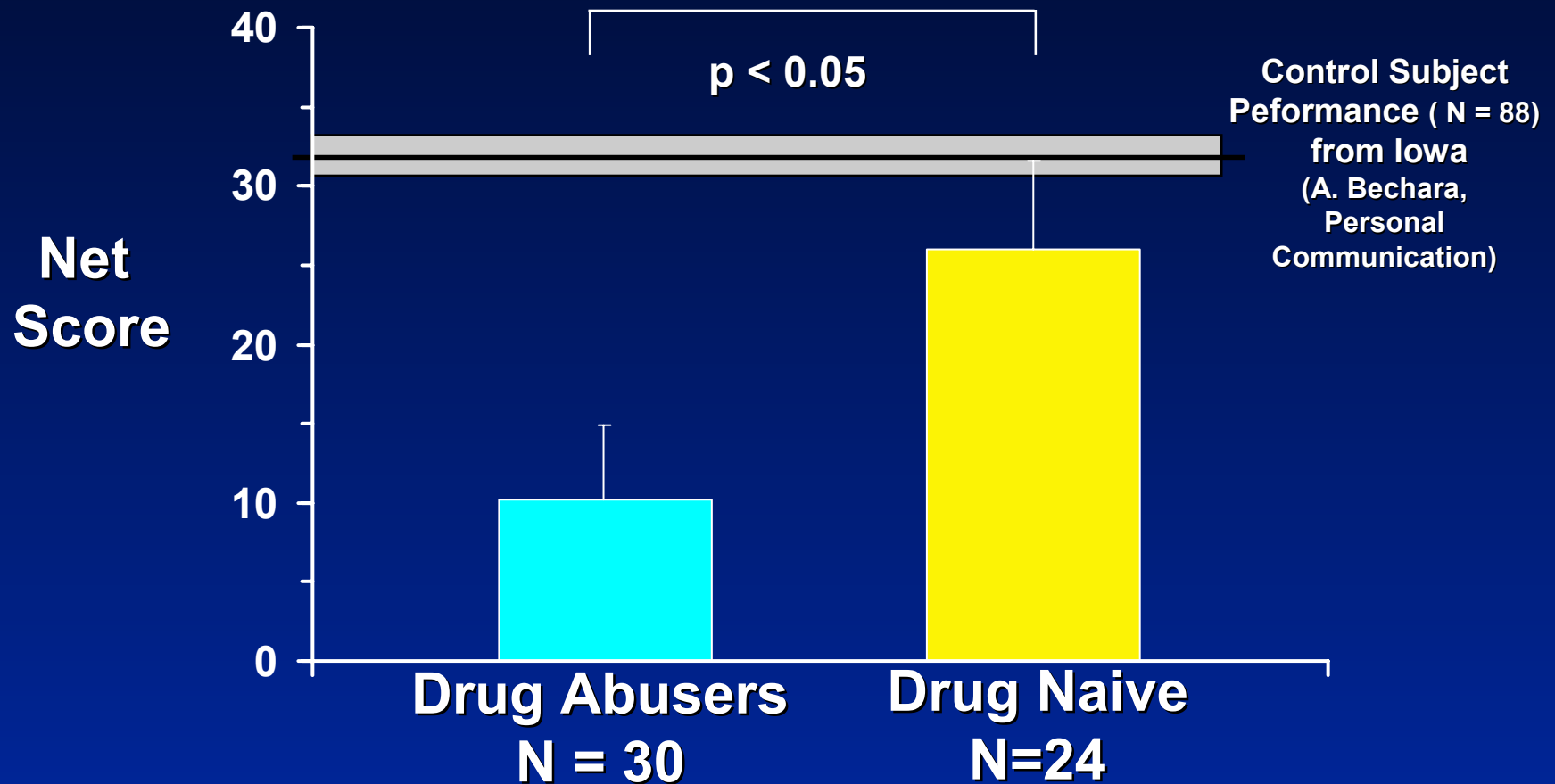
-\$250

\$250

\$250

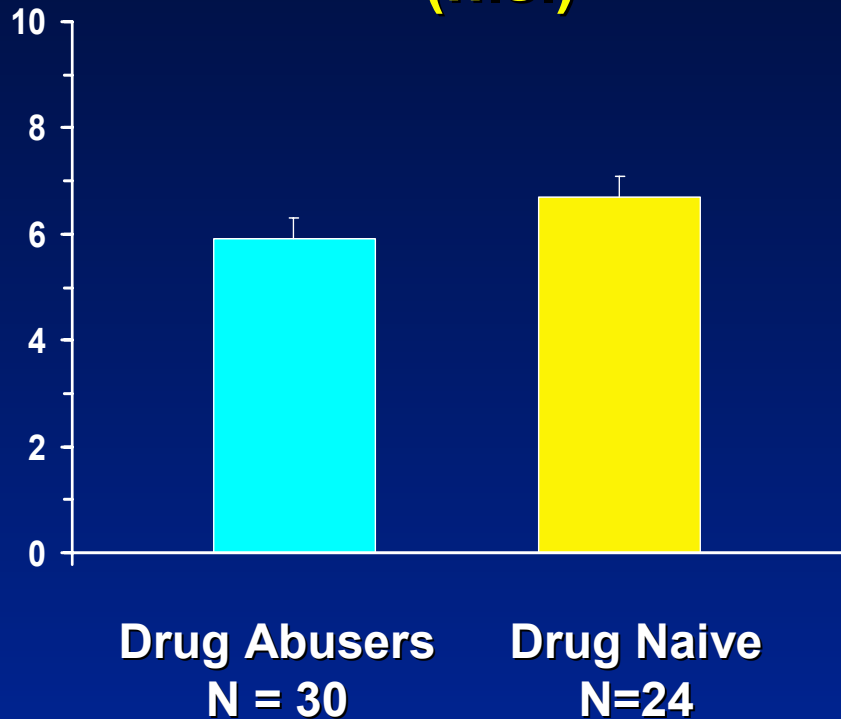
$$\text{NET SCORE} = (C+D) - (A+B)$$

DRUG ABUSERS SHOW MARKED IMPAIRMENT ON GAMBLING TASK

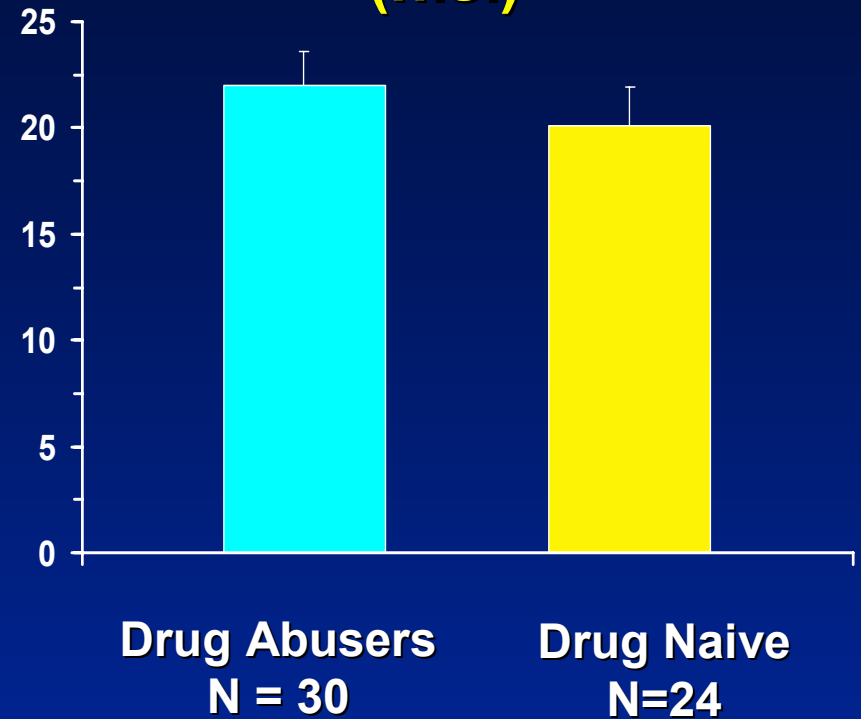


SUBSTANCE ABUSERS SHOW NO IMPAIRMENT ON WCST

Categories Completed (n.s.)



Perseverative Errors (n.s.)

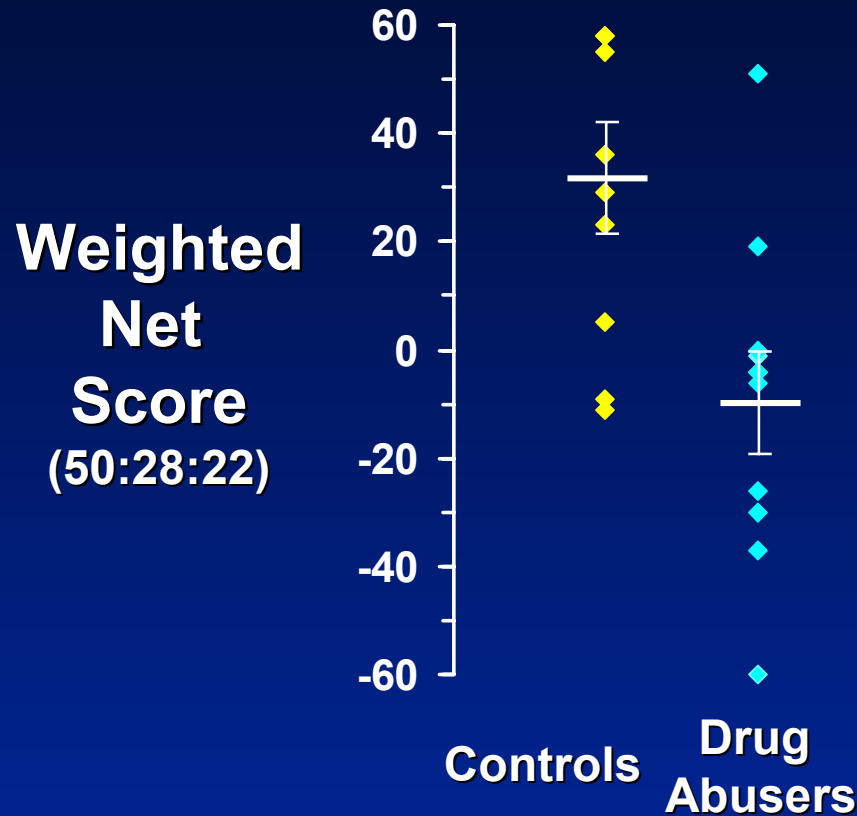


IMAGING HYPOTHESES

- **Is VmPFC activated during performance of Gambling Task ?**
- **Is VmPFC activation correlated with performance of Gambling Task**
- **What other areas are activated during performance of Gambling Task ?**

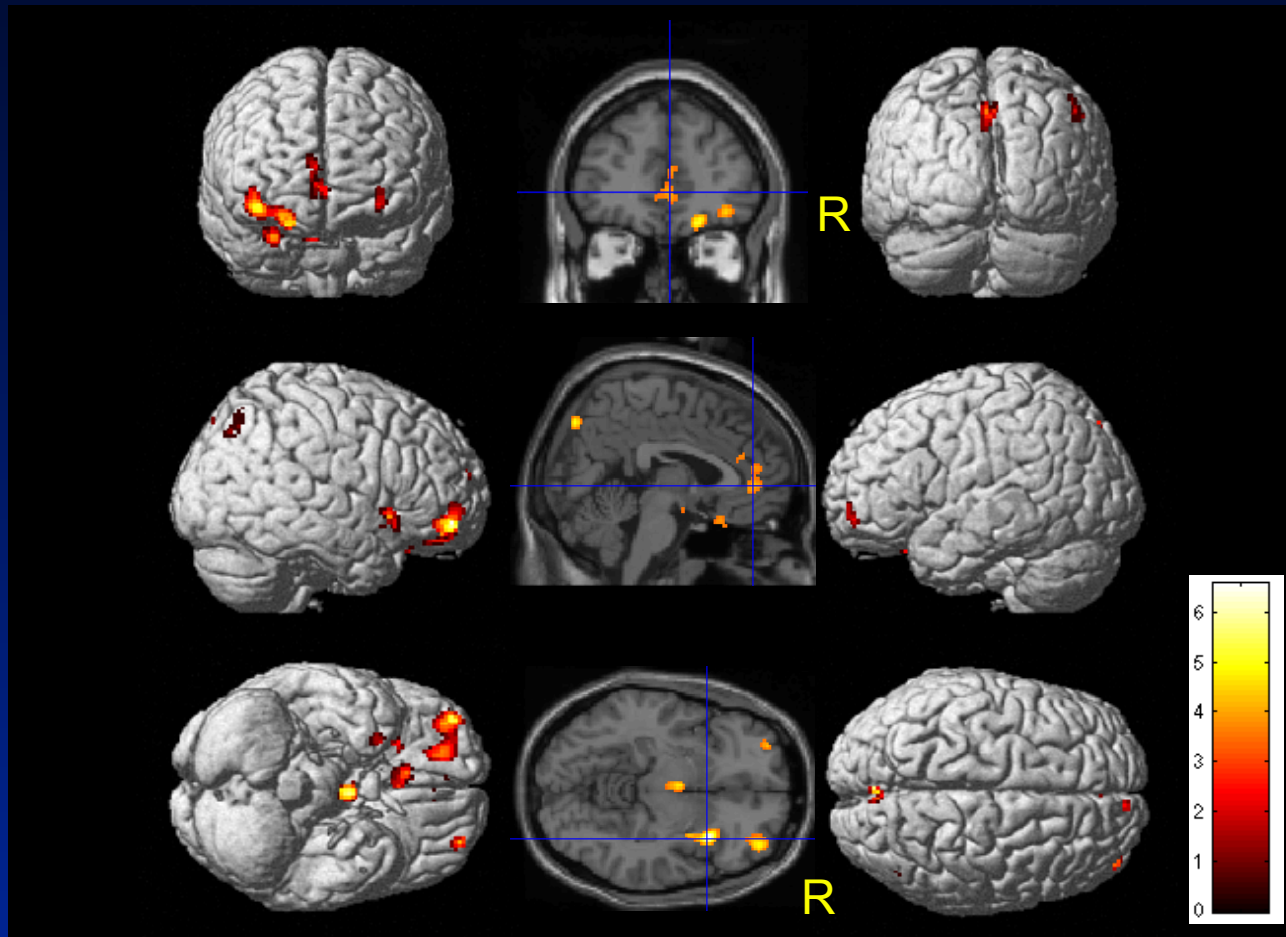
GAMBLING TASK PERFORMANCE

300 Cards



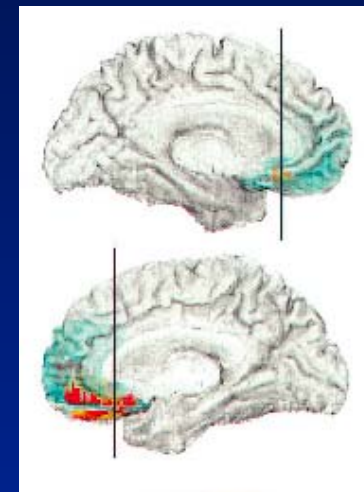
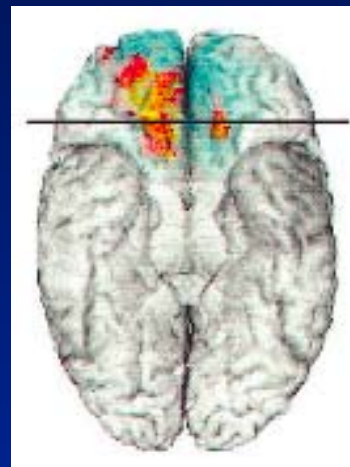
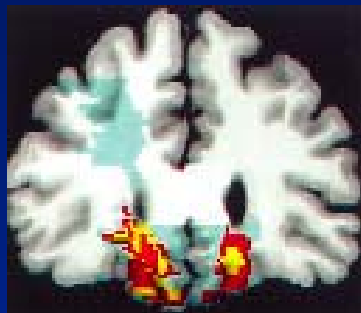
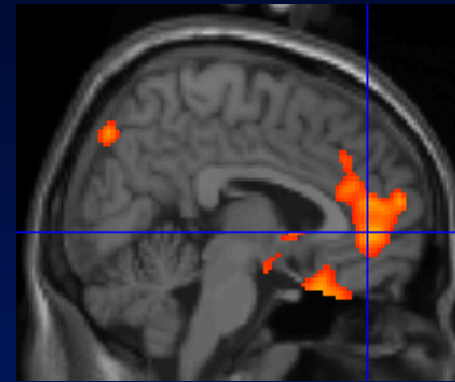
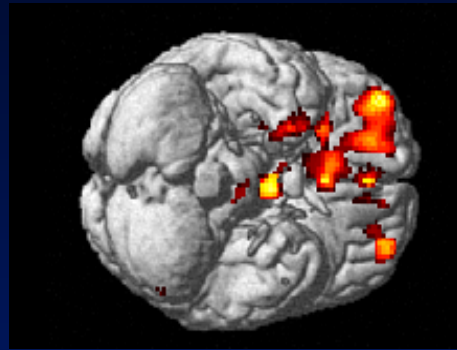
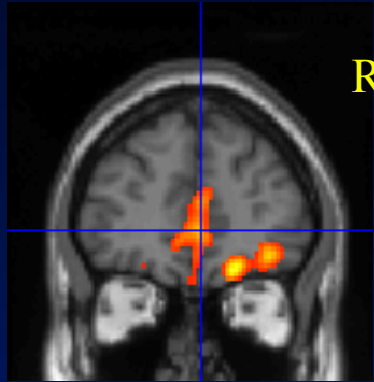
Controls > Drug Abusers $p < 0.001$

CORTICAL ACTIVATION DURING GAMBLING TASK



$p < 0.001$, Extent = 10 pixels, uncorrected (11 Abusers + 11 Controls)

PET Activation vs Ventromedial Prefrontal Lesions

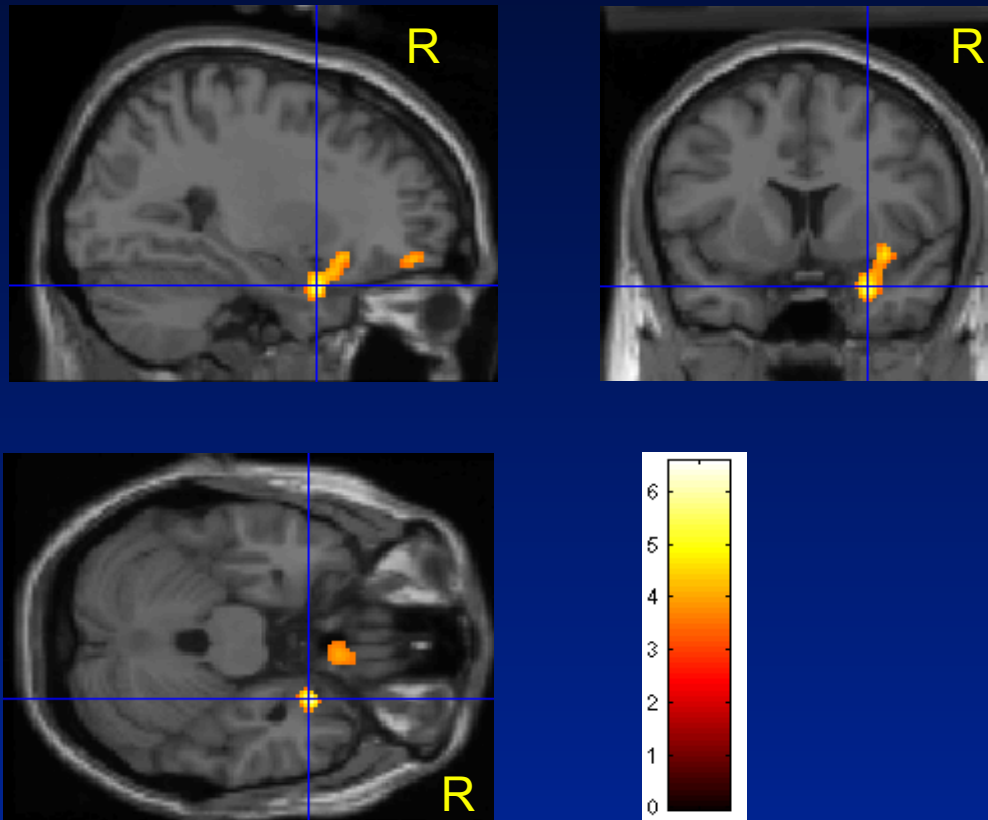


Bechara, et al., 1999

$p < 0.005$, Extent = 20 pixels, uncorrected (11 Abusers + 11 Controls)

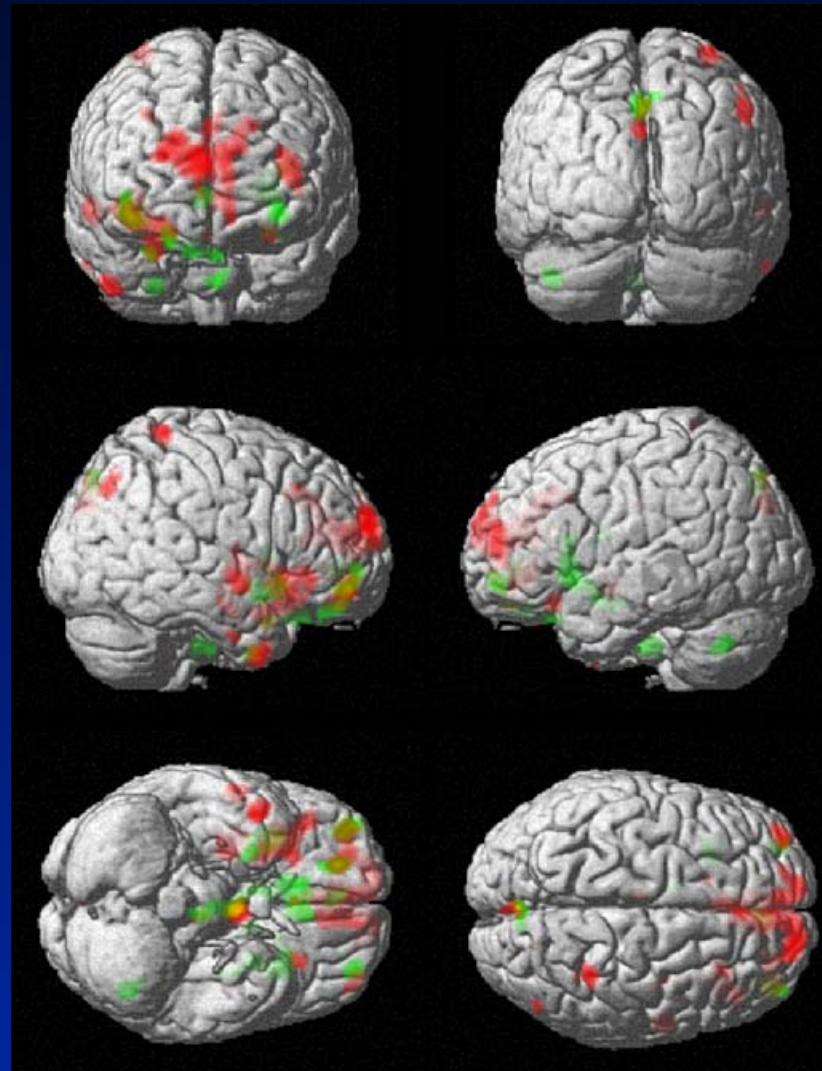
SUB-CORTICAL ACTIVATION DURING GAMBLING TASK

Extended Amygdala ?



$p < 0.001$, Extent = 10 pixels, uncorrected (11 Abusers + 11 Controls)

Cortical Activations During Gambling Task: Controls vs. Drug Abusers



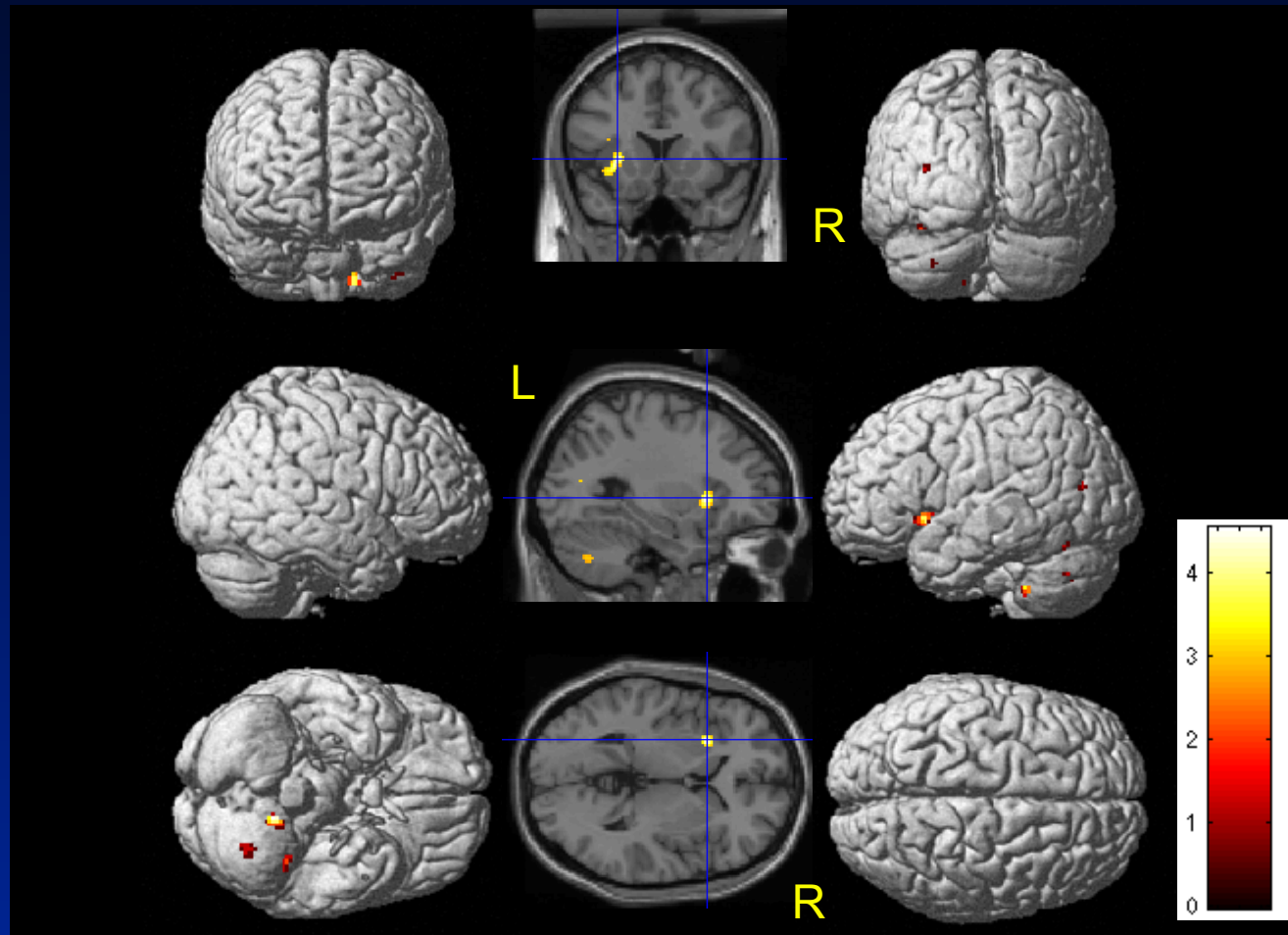
Controls (11)

Abusers (11)

Overlap

$p < 0.005$, uncorrected
Extent = 10 pixels

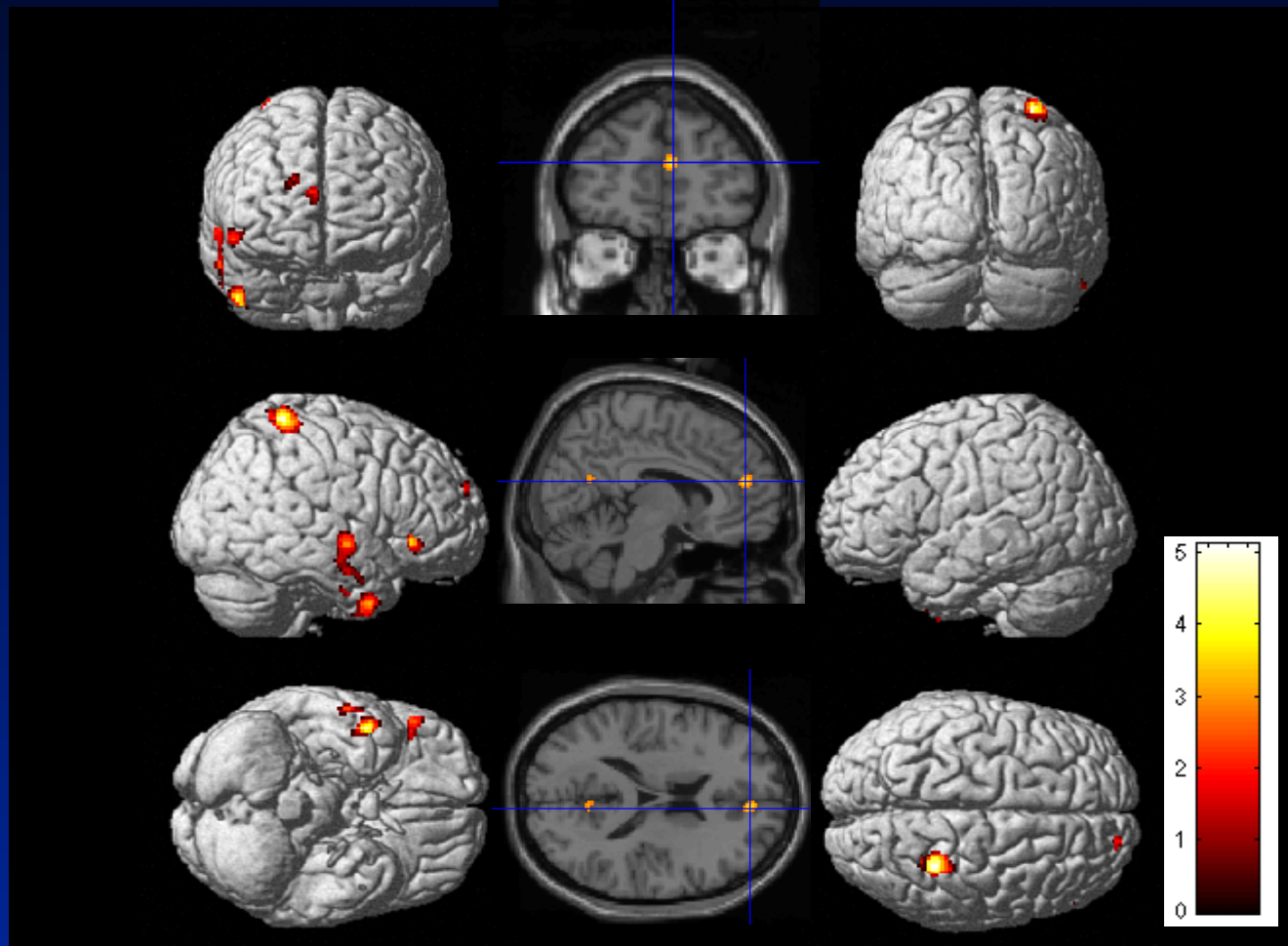
GROUP INTERACTION DURING GAMBLING TASK Controls > Abusers



$p < 0.005$, Extent = 10 pixels, uncorrected (11 Controls - 11 Abusers)

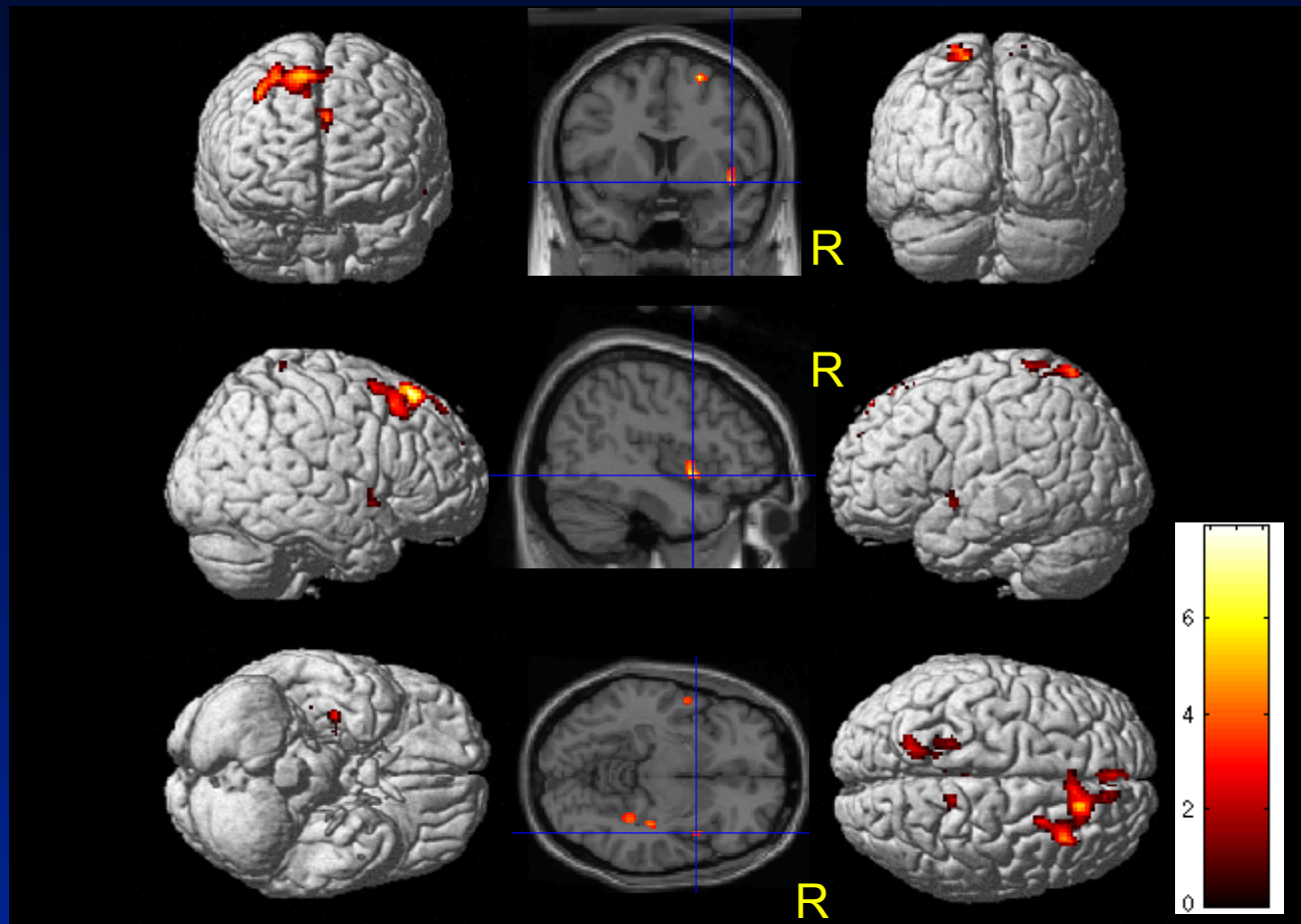
GROUP INTERACTION DURING GAMBLING TASK

Abusers > Controls



$p < 0.005$, Extent = 10 pixels, uncorrected (11 Abusers - 11 Controls)

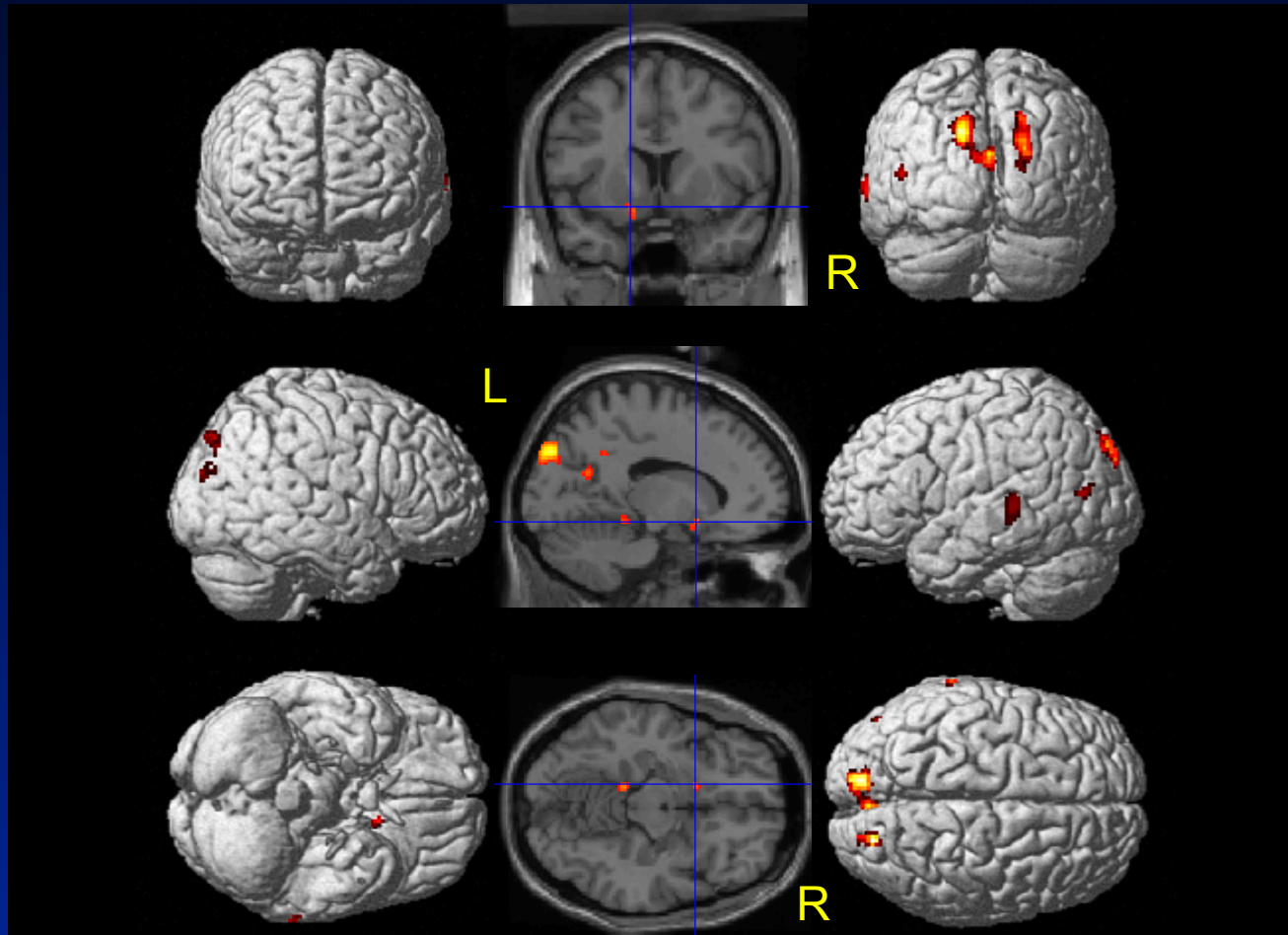
POSITIVE CORRELATIONS WITH GAMBLING TASK Controls $r > 0.73$



$p < 0.005$, Extent = 20 pixels, uncorrected (11 Controls)

NEGATIVE CORRELATIONS WITH GAMBLING TASK

Abusers $r < -0.73$



$p < 0.005$, Extent = 20 pixels, uncorrected (11 Controls)

Drug Abusers Use Different Brain Networks During Gambling Task

Controls

Activations

- L. Insula

Correlations (+)

- R. Insula
- R. Superior Frontal Cortex
- R. Hippocampus/
Parahippocampus
- R. Superior Parietal Cortex
- R. Inferior Temporal Cortex

Abusers

Activations

- R. Superior Parietal
- Anterior Cingulate
- R. Inf. Temporal Pole
- Visual Cortex

• Correlations (-)

- L. Basal Forebrain/
Nucleus Accumbens
- L. Parahippocampus
- L. Cuneus

What Does Craving Do ?

Dysregulation of Cognition

- Evokes Memory
- Captures Attention
- Biases Decision-Making

