A Neuropsychiatric Perspective on Gambling and Morality

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Boisi Conference, October 25, 2007

Disclosures

- Advisory Board/Consultant to Boehringer Ingelheim
- Financial Interests in Somaxon
- Consultant to Law Firms and Federal Defenders Office on Issues Related to Impulse Control Disorders

What is Morality?

- Morality - “a doctrine or system of virtuous, right or ethical conduct” (Miriam-Webster, 2007)
- Derived from Latin *moralis* - “consensus of manners or customs within a social group, or an inclination to behave in some ways but not others” (Moll et al, 2005)
- Historical Shifts in Usage of Term (Moll, 2005)
  - Deductive Logical Approaches to Identify Universal Principles to Guide Human Behavior
  - Emerging Investigations into Brain Function Underlying Moral and Immoral Behaviors

Aided by brain imaging advances, scientists are looking for evidence that compulsive nondrug behaviors lead to long-term changes in reward circuitry

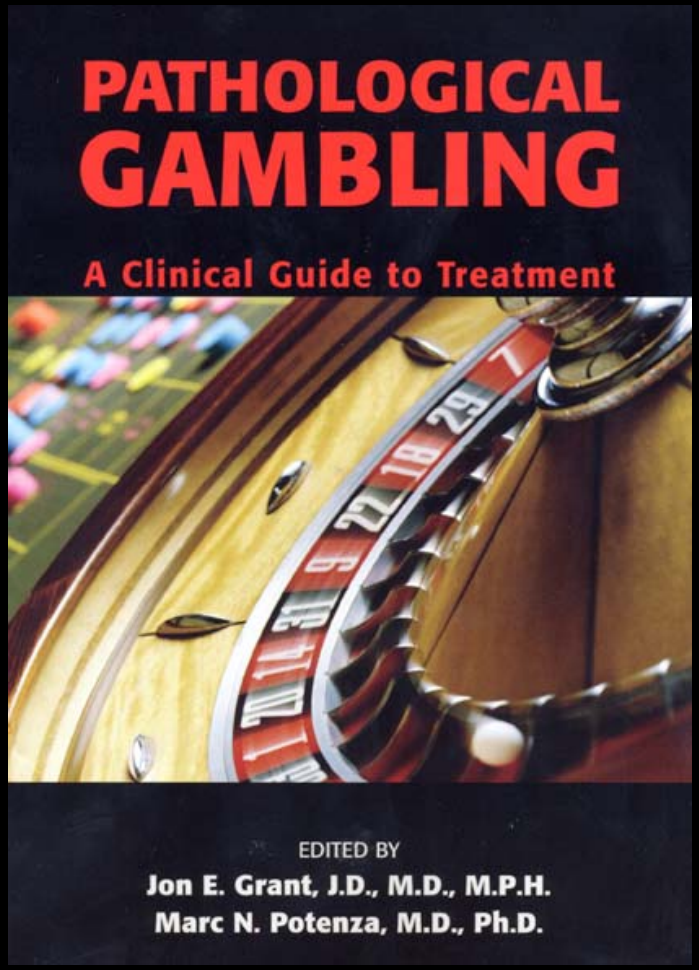
'Behavioral' Addictions: Do They Exist?

ADDICTION

The concept of addiction is changing, as this special news package describes: There's more emphasis on how drugs and even behaviors may wreak long-term damage to the brain.

COMPULSIVE BEHAVIORS

LONG-TERM CHANGES



Holden, Science, 2001; Grant and Potenza, 2004

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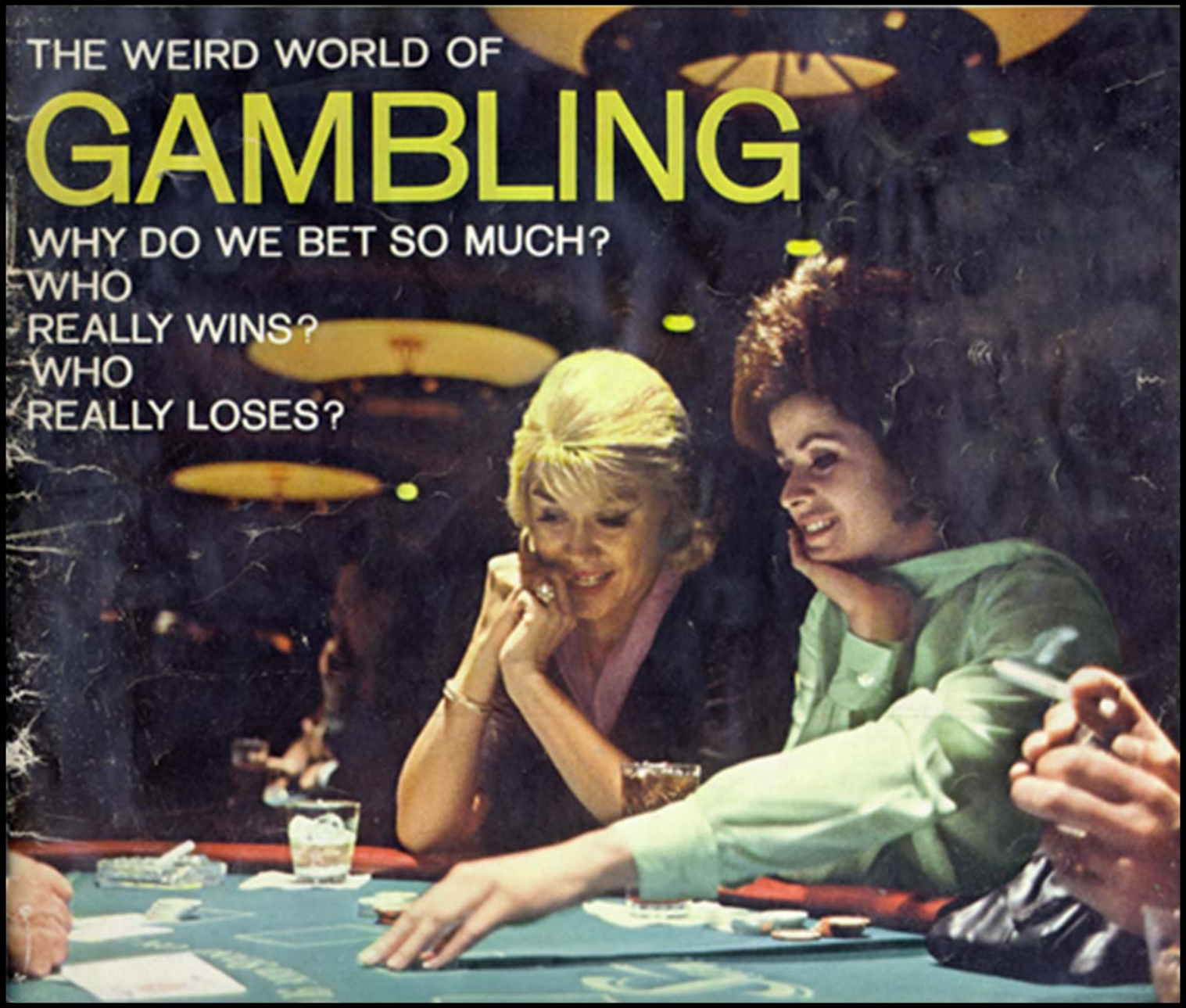
What is Addiction?

- Addict (verb) - “to devote or give (oneself) habitually or compulsively”; from Latin *addicere* - bound to or enslaved
- Historical Shifts in Usage of Term
- Core Components of Addiction (Shaffer, 1999)
  - Continued Behavior Despite Adverse Consequences
  - Diminished or Lost Control / Compulsive Engagement
  - Craving or Urge State Component



Source: Look Magazine, March, 1963

What is Gambling?

- Gambling Is Placing Something of Value at Risk in Hopes of Achieving Something of Greater Value (Potenza et al, *JAMA*, 2001)
- Perception Influenced by the Relative Amounts of Risk and Reward
  - Mutual Funds Vs. Day Trading

When Is Gambling a Problem?

- **Pathological Gambling (PG) (Level 3)**
  - Most Disordered Form of Gambling
  - DSM-IV-TR Disorder
  - Analogous to “Substance Dependence”
- **Problem Gambling (Level 2)**
  - Widely Used But Not a DSM-IV-TR Disorder
  - Analogous to “Substance Abuse”

Impulse Control Disorders As "Behavioral Addictions"

- "ICDs Not Elsewhere Classified"
  - Pathological Gambling, Kleptomania, Pyromania, Intermittent Explosive Disorder, Trichotillomania, ICD NOS
- ICDs Under Consideration
  - Compulsive Buying, Compulsive Sexual Behavior, Compulsive Computer Use
- ICDs Common in Hospitalized Psychiatric Pts
  - Among 204 Adult In-pts, 31% Had a Current ICD, with <2% Diagnosed Upon Admission (Grant et al, *Am J Psych*, 2005)
  - Among 102 Patients Adolescent In-pts, 40% Had a Current ICD, with <1% Dx'ed Upon Admission (Grant et al, *J Clin Psych*, in press)

Mr. Volcano

PSV-044

[Pyro]
This seemingly mild-mannered creature has an extremely volatile temper.

ATK/2100 DEF/1300

31477025 ©1996 KAZUKI TAKAHASHI

Rush Recklessly

[Magic Card]

SDP-033

Increase 1 monster's ATK by 700 points during the turn this card is activated.

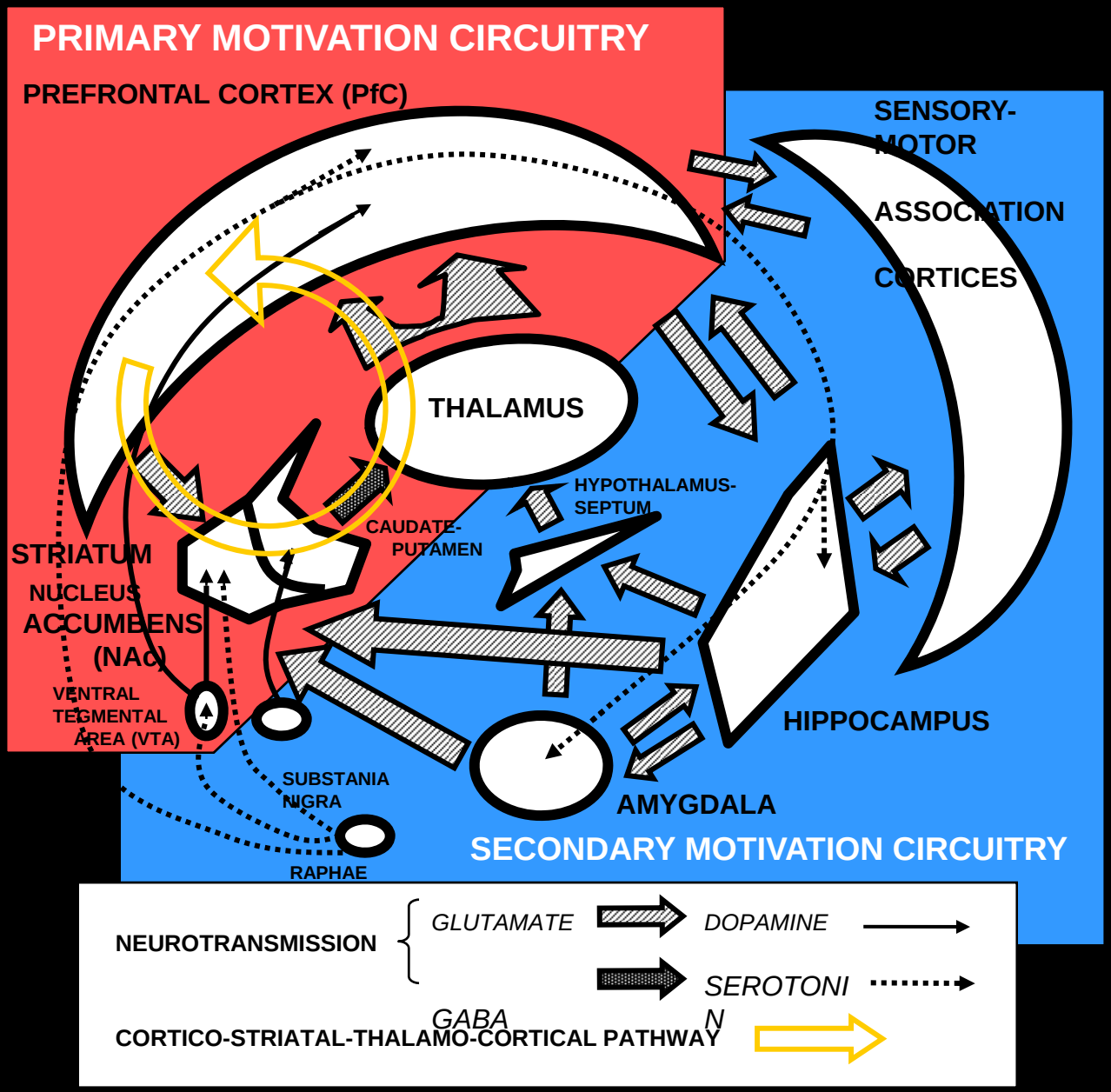
70046172 ©1996 KAZUKI TAKAHASHI

Impulsivity as an Endophenotype

- Defining Impulsivity (Moeller et al, 2001)
  - "A Predisposition Toward Rapid, Unplanned Reactions to Internal or External Stimuli [With Diminished] Regard to the Negative Consequences of These Reactions to the Impulsive Individual or to Others"
- Impulsivity Across Psychiatric Groups
  - ICDs, SUDs, Bipolar D/O, ADHD, ASPD, BPD, Suicidality, SIB
- Behavioral Measures of Impulsivity
  - Risk/Reward Assessment & Decision-Making Paradigms (Monetary Reward/Punishment, Discounting, Gambling Tasks)
  - Response Disinhibition/Attentional Paradigms (Go/No-Go, Stroop)

Neural Systems and Addiction

- Mesocorticolimbic Dopamine System ("Overactive Motor")
  - Ventral Tegmental Area, Nucleus Accumbens
- Frontal Serotonin Systems ("Bad Brakes")
  - Frontal/Prefrontal Cortical Function
- Role for Neurotransmitter Systems Modulating DA, 5HT Function
  - GABA, Glutamate, Opioids, ...



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Chambers, Taylor & Potenza, Am J Psychiatry, 2003

Roles for Neurotransmitters

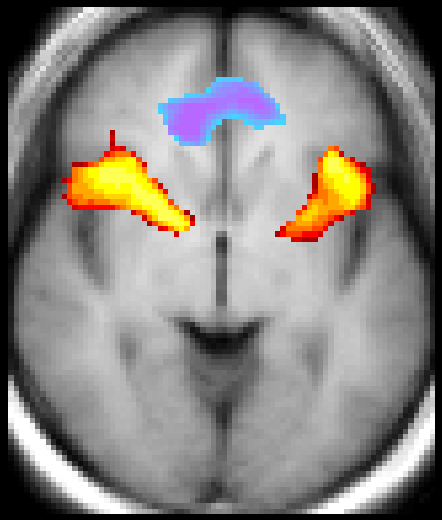
Neurotransmitter	Role in Impulse Control
Norepinephrine (NE)	Arousal, Excitement
Serotonin (5HT)	Behavior Initiation/Cessation
Dopamine (DA)	Reward, Reinforcement
Opioids	Pleasure, Urges

Potenza and Hollander, 2002

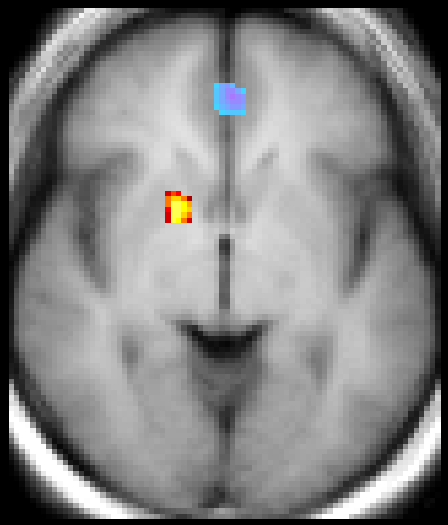
5-HT & Impulse Control

- Low CSF 5-HIAA Associated w/ Impaired Impulse Control (Potenza and Hollander, 2002)
- Altered Biochemical and Behavioral Responses to m-CPP (5HT1R and 5HT2R Partial Agonist) (DeCaria et al, 1998)
- Blunted 5HT Response in vmPFC in Impulsive Aggression (Siever et al, 1999; New et al, 2002)

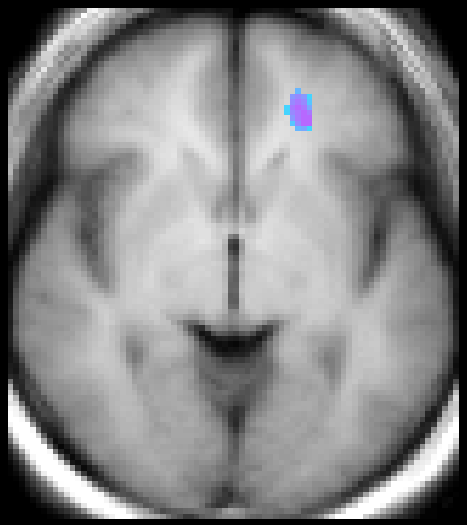
Left vmPFC Implicated During Stroop Performance In ICDs



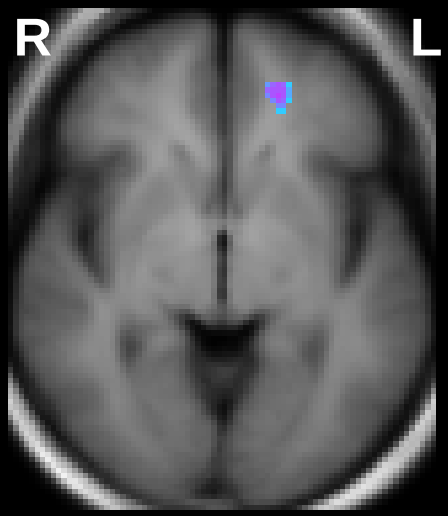
PG
(Potenza et al, 2003, *Am J Psychiatry*)



Control
(Potenza et al, 2003, *Am J Psychiatry*)

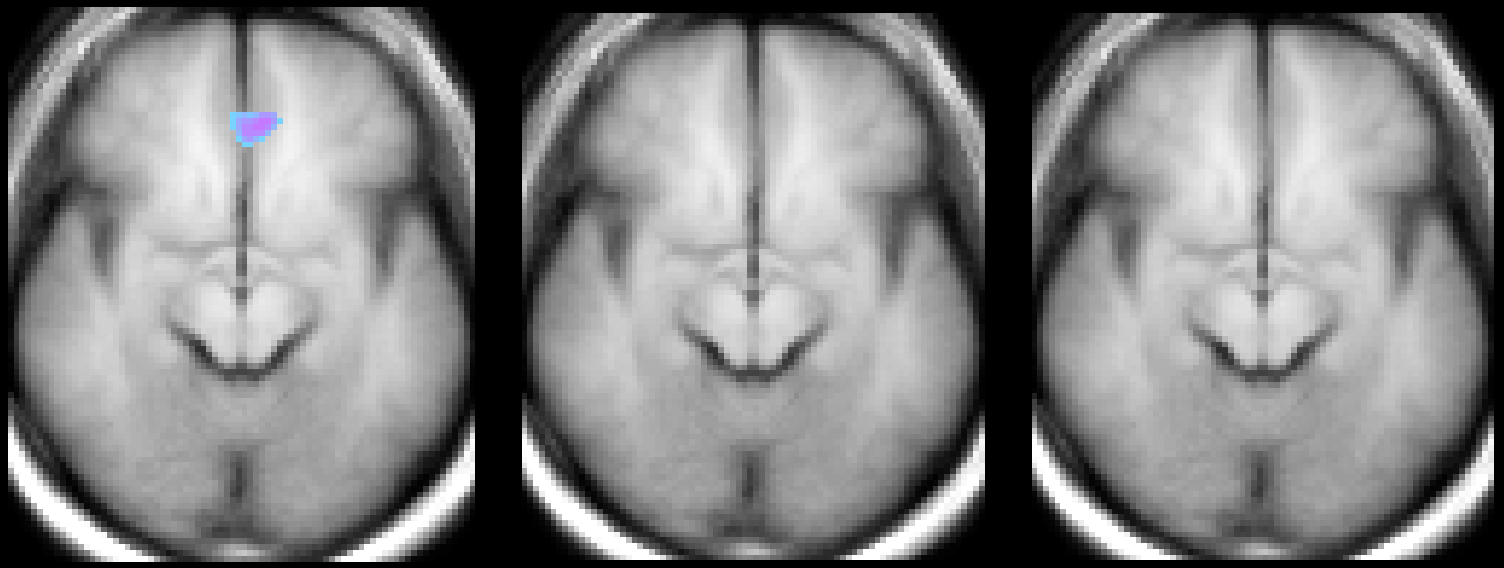


PG - Control
(Potenza et al, 2003, *Am J Psychiatry*)



Bipolar - Cont
(Blumberg et al, 2003, *Arch Gen Psychiatry*)

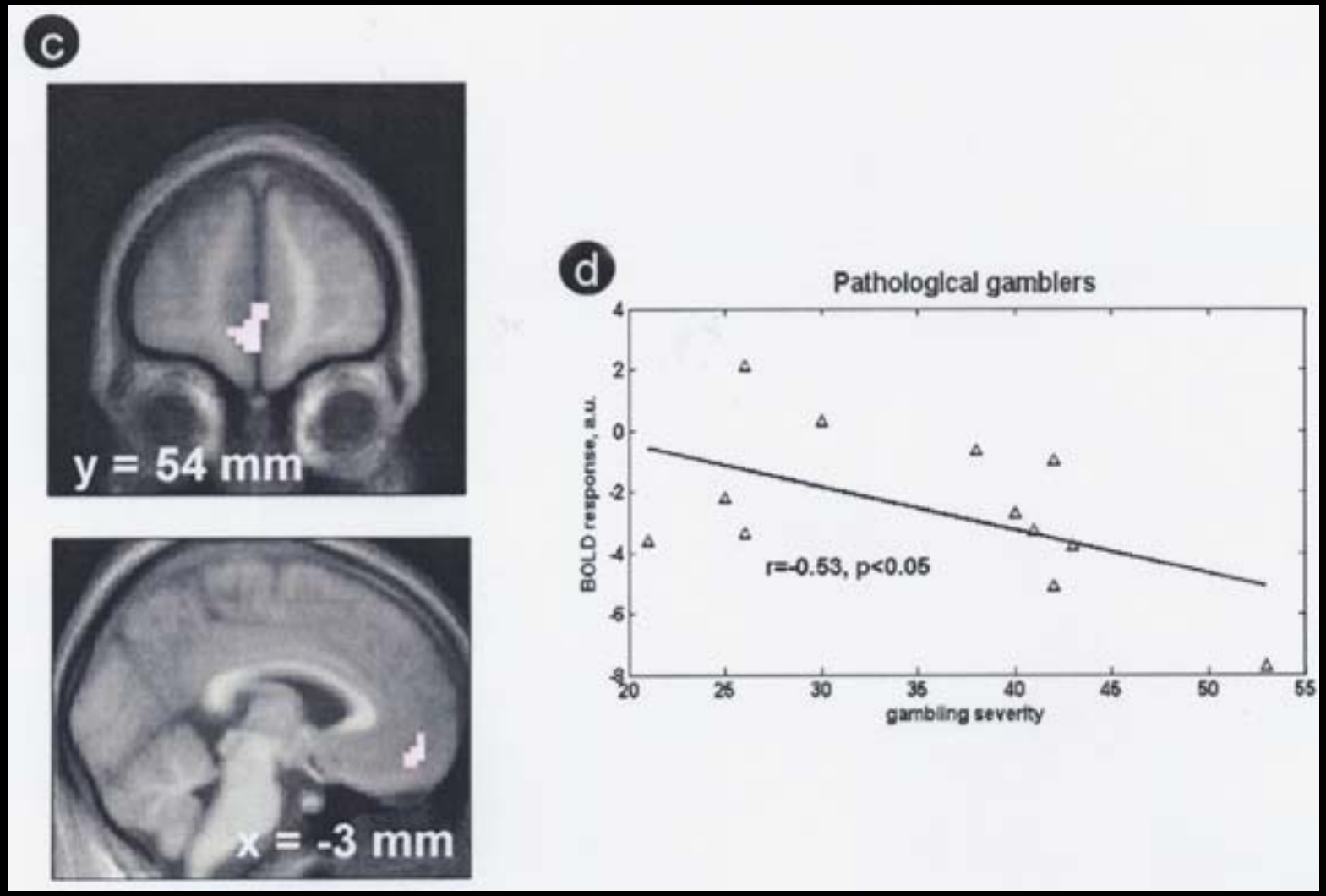
Decreased vmPFC Activity in Men with PG Viewing Final Part of Gambling Videotapes



Gambling Tape PG-Control | **Happy Tape PG-Control** | **Sad Tape PG-Control**

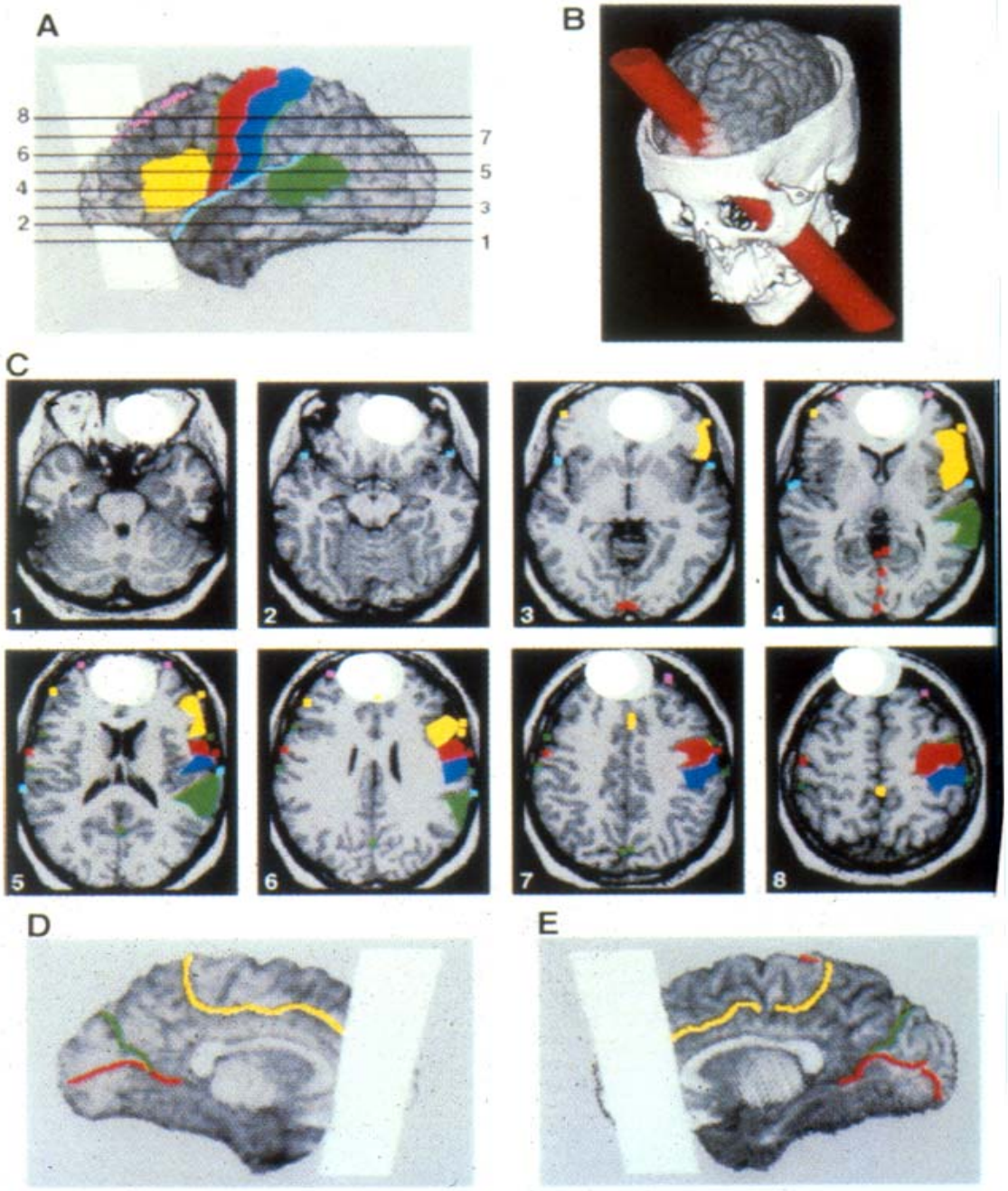
Potenza et al, *Arch Gen Psychiatry,* 2003

vmPFC Activation During Gambling (Winning vs. Losing) in PG



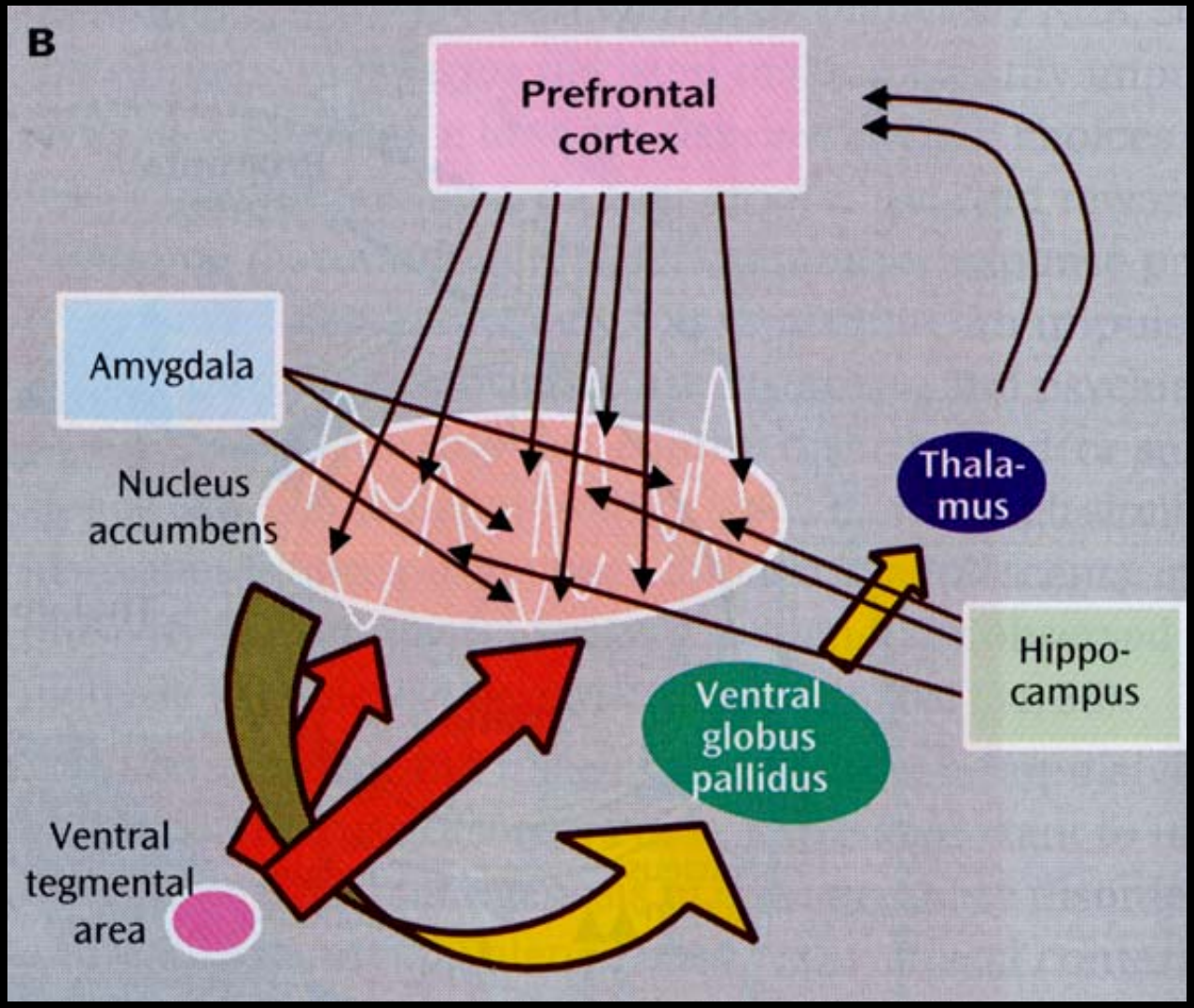
Reuter et al, 2005

Fig. 5. Normal brain fitted with the five possible rods. The best rod is highlighted in solid white [except for (**B**), where it is shown in red]. The areas spared by the iron are highlighted in color: Broca, yellow; motor, red; somatosensory, green; Wernicke, blue. (**A**) Lateral view of the brain. Numbered black lines correspond to levels of the brain section shown in (**C**). (**D** and **E**) Medical view of left and right hemispheres, respectively, with the rod shown in white.



Damasio et al, 1994

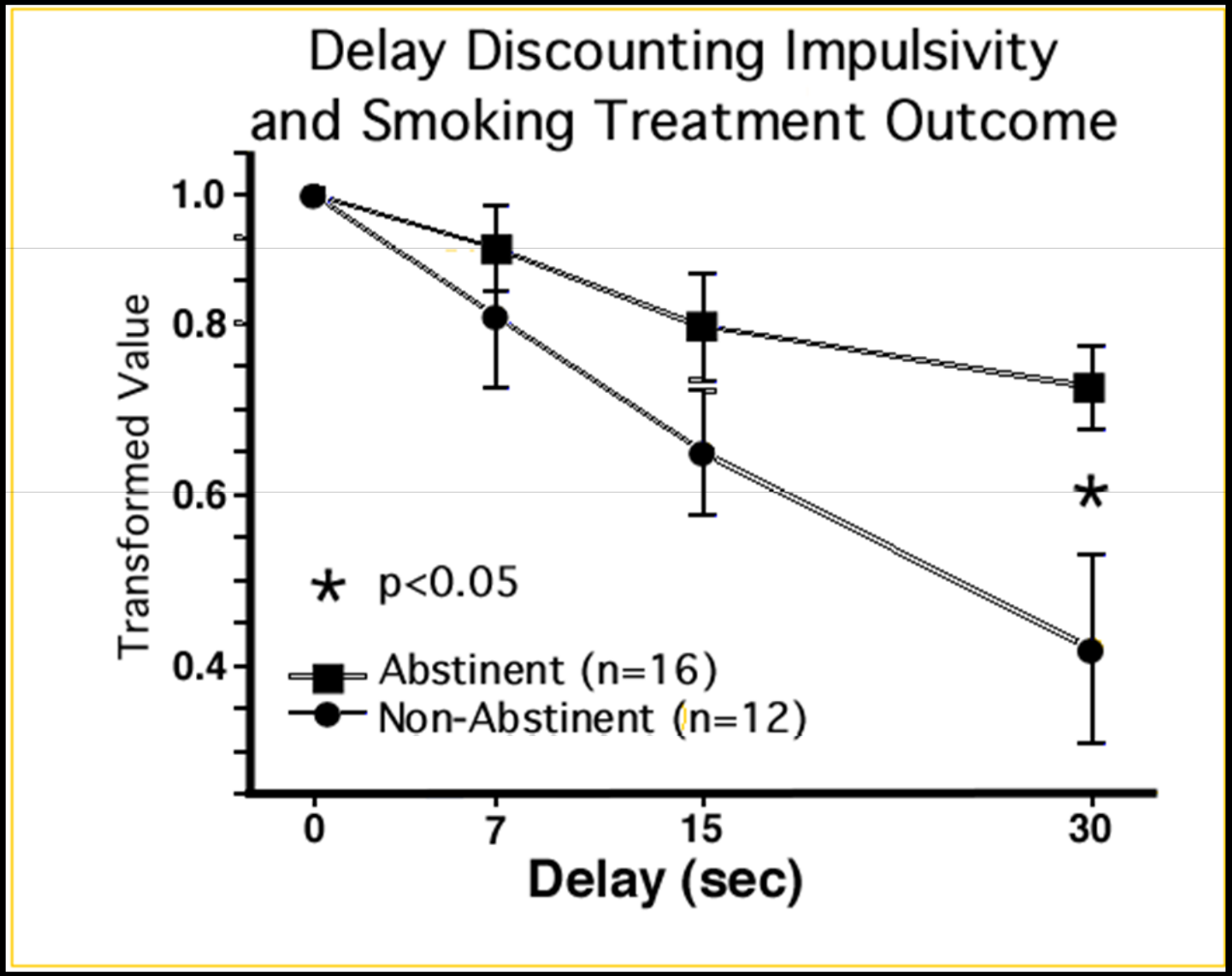
Ventral Striatum (NAc) in Motivation: Reward Processing



Chambers, Taylor & Potenza, Am J Psychiatry, 2003

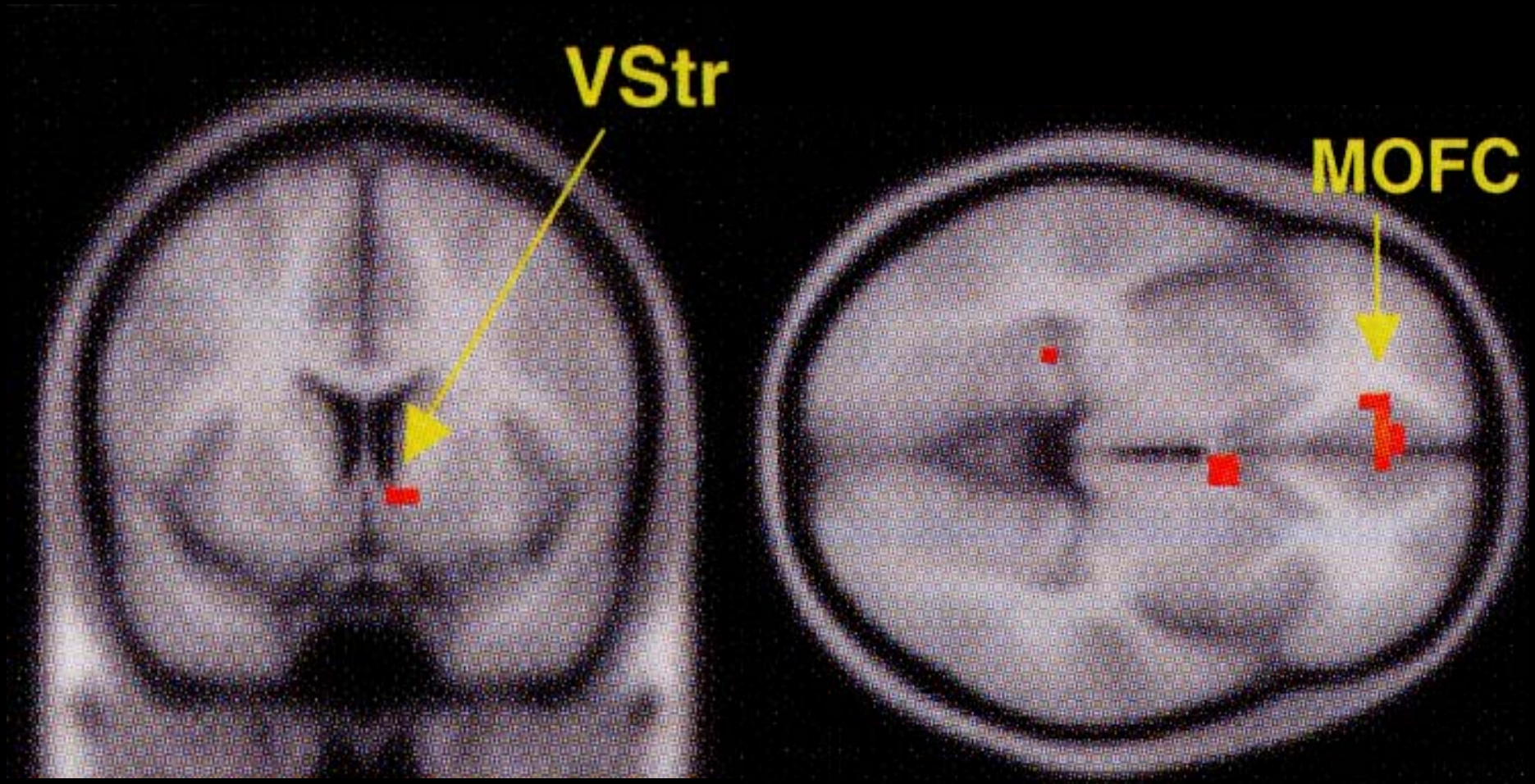
Risk/Reward Decision-Making, Reward Processing & Addiction

- Individuals with PG or SUDs Perform Disadvantageously or Impulsively on Gambling Tasks, and Performance Correlates with Real-Life Measures (Petry et al, 2001; Bechara, 2003)
- Individuals with PG or SUDs Discount Rewards Rapidly Over Time (Bickel et al, 1999; Petry et al, 2001)
- Behavioral Measures of Reward Discounting Are Associated with SUD Tx Outcome (Krishnan-Sarin et al, 2007)



Krishnan-Sarin et al, Drug Alc Depend, 2007

Small, Immediate Rewards Preferentially Activate Ventral Striatum and vmPFC



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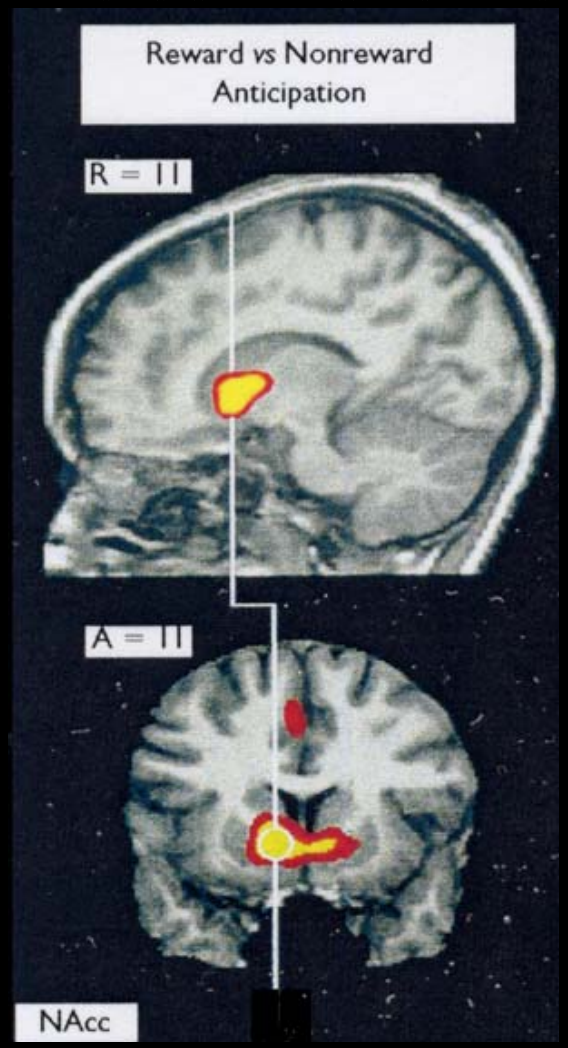
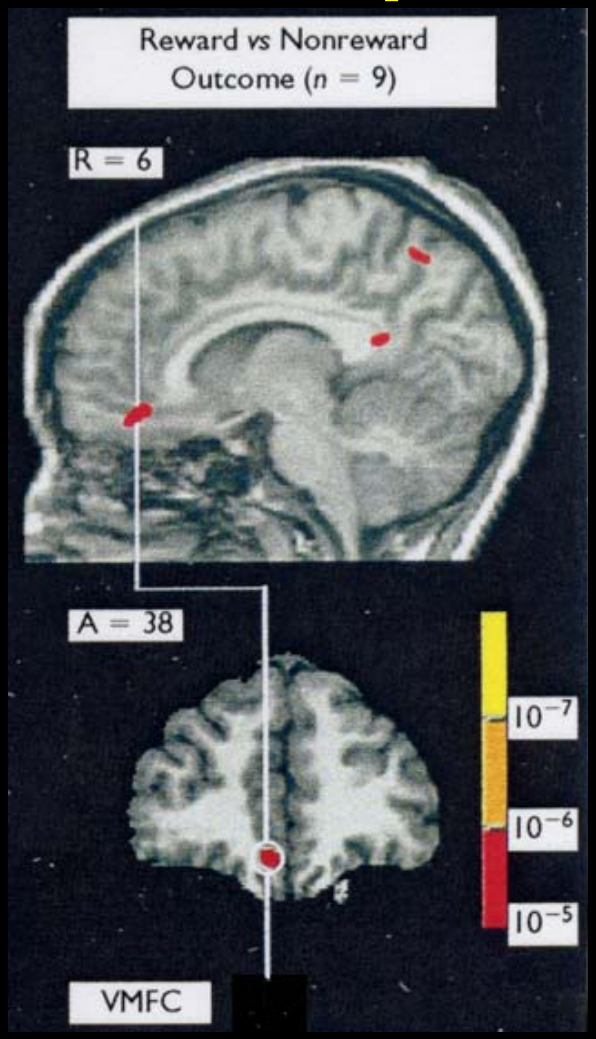
McClure et al, 2004

Reward Anticipation and Outcome Activate VS and vmPFC, Respectively



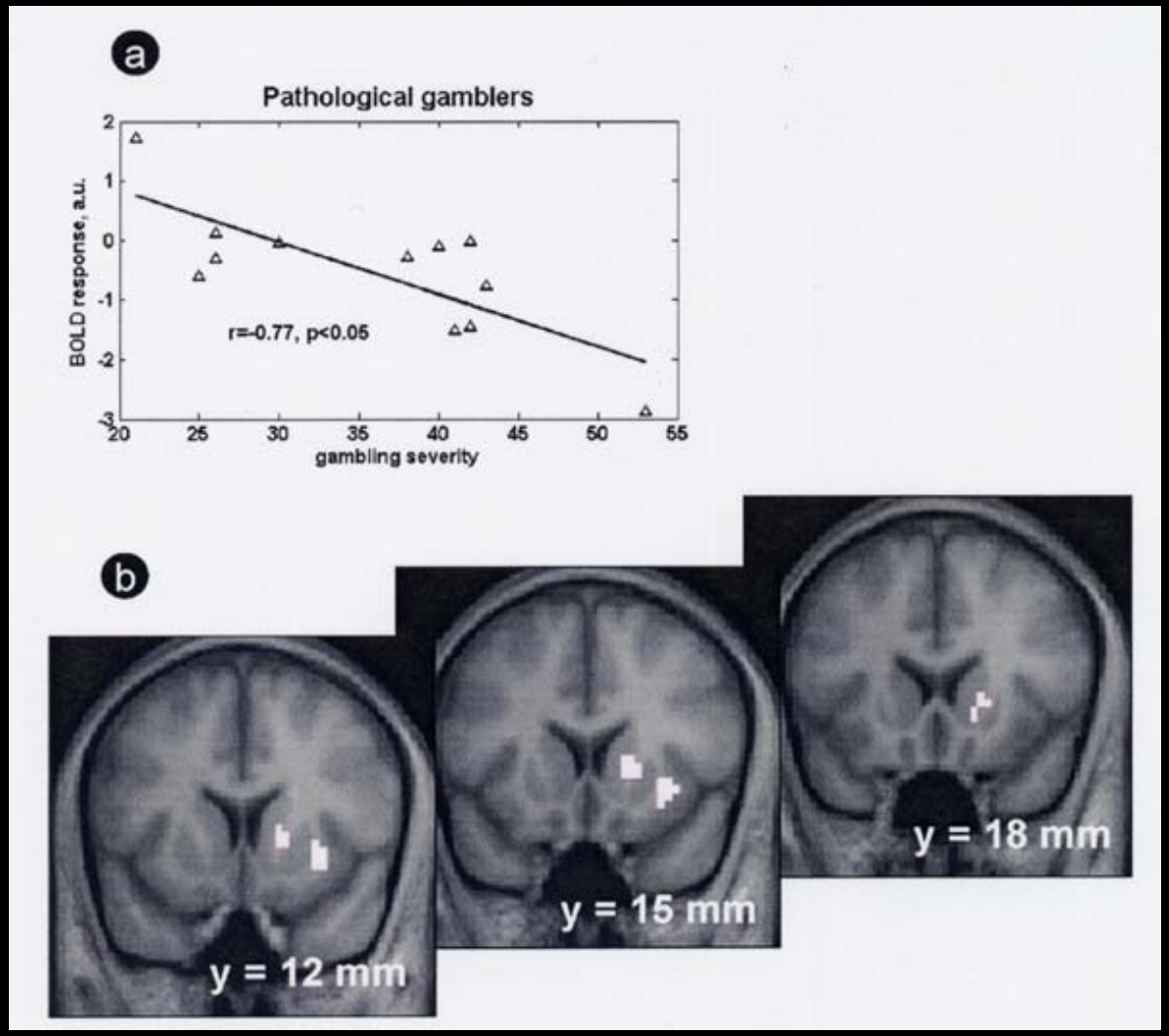


Knutson et al, 2001

Reward Processing in Addiction

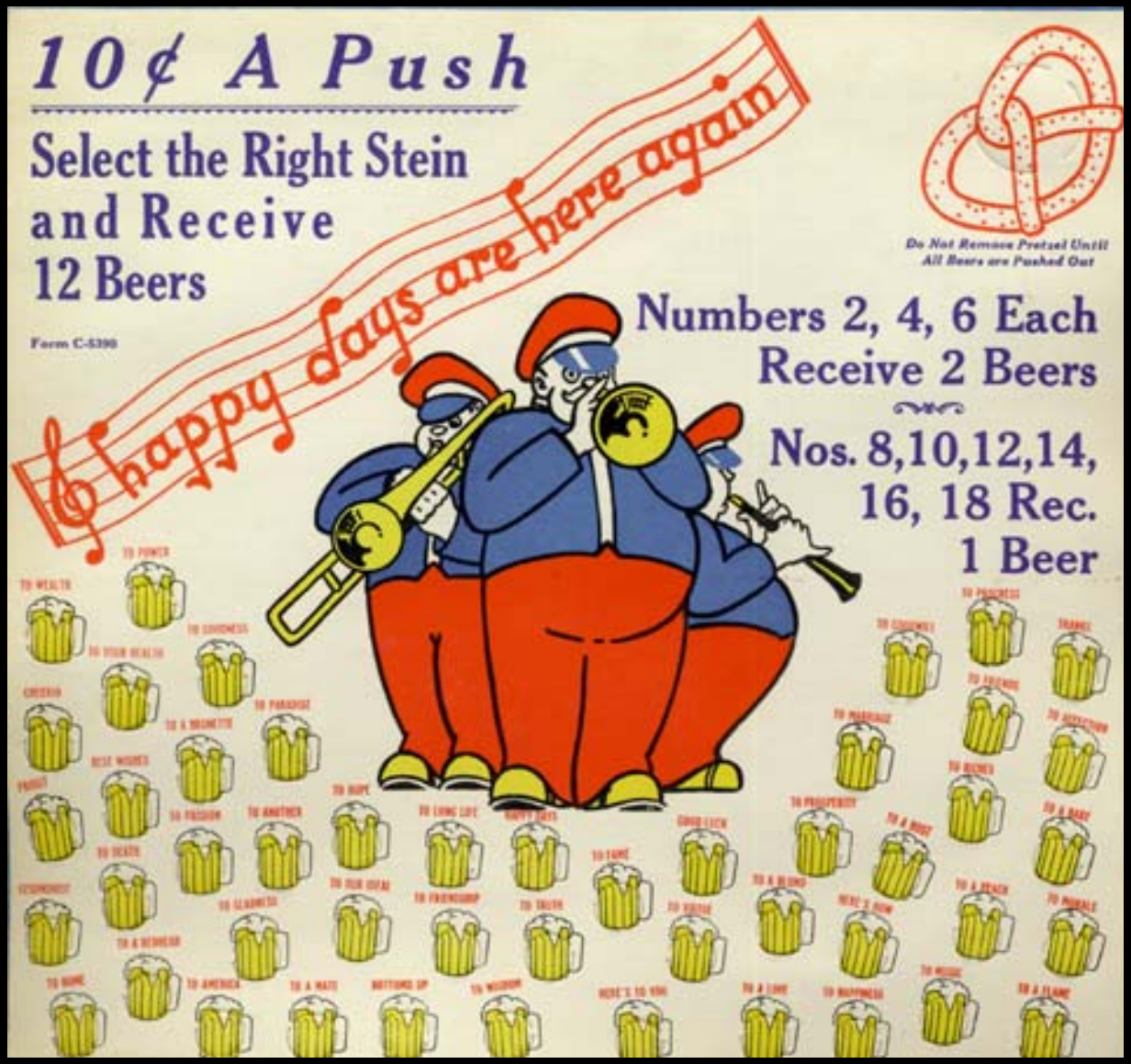
- Adults w/ AD vs Those w/o AD Show Less Activation of NAc in Anticipation of Working for Monetary Reward (Hommer et al, 2004)
- Similar Findings in Adolescents and Adults FH+ Vs. FH- for AD (Hommer et al, 2004)
- Extends Across Addictions - Less Activation of NAc in PG vs. Control During Monetary Wins vs. Losses (Reuter et al, 2005)

Ventral Striatal Activation During Gambling (Winning vs. Losing) in PG



Reuter et al, 2005

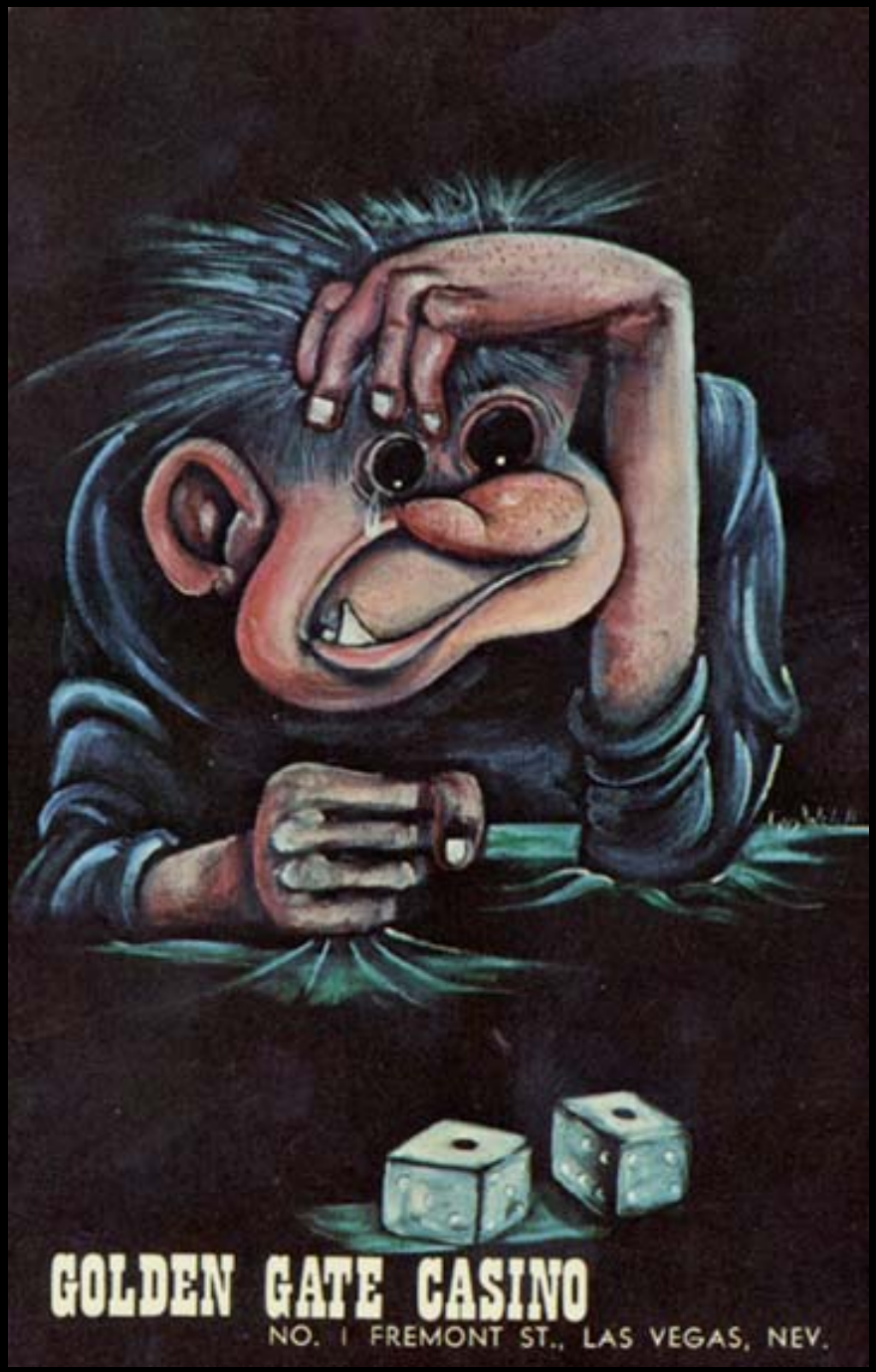
Alcohol Use and Gambling



Source: Push-tab Punchcard, ca 1950's

Genetics of PG, AD and AAB

- Shared Genetic Contributions to PG and AD
  - 12%-20% of Genetic Variation in the Risk for PG Accounted for by the Risk for AD (Slutske et al, 2000)
- Shared Genetic Contributions to PG and AAB
  - 16%-22% of Genetic Variation in the Risk for PG Accounted for by the Risk for Anti-Social Behaviors (Slutske et al, 2001)
- Shared Risks Suggest Shared Genetic Contributions to Risk for Impulsiveness



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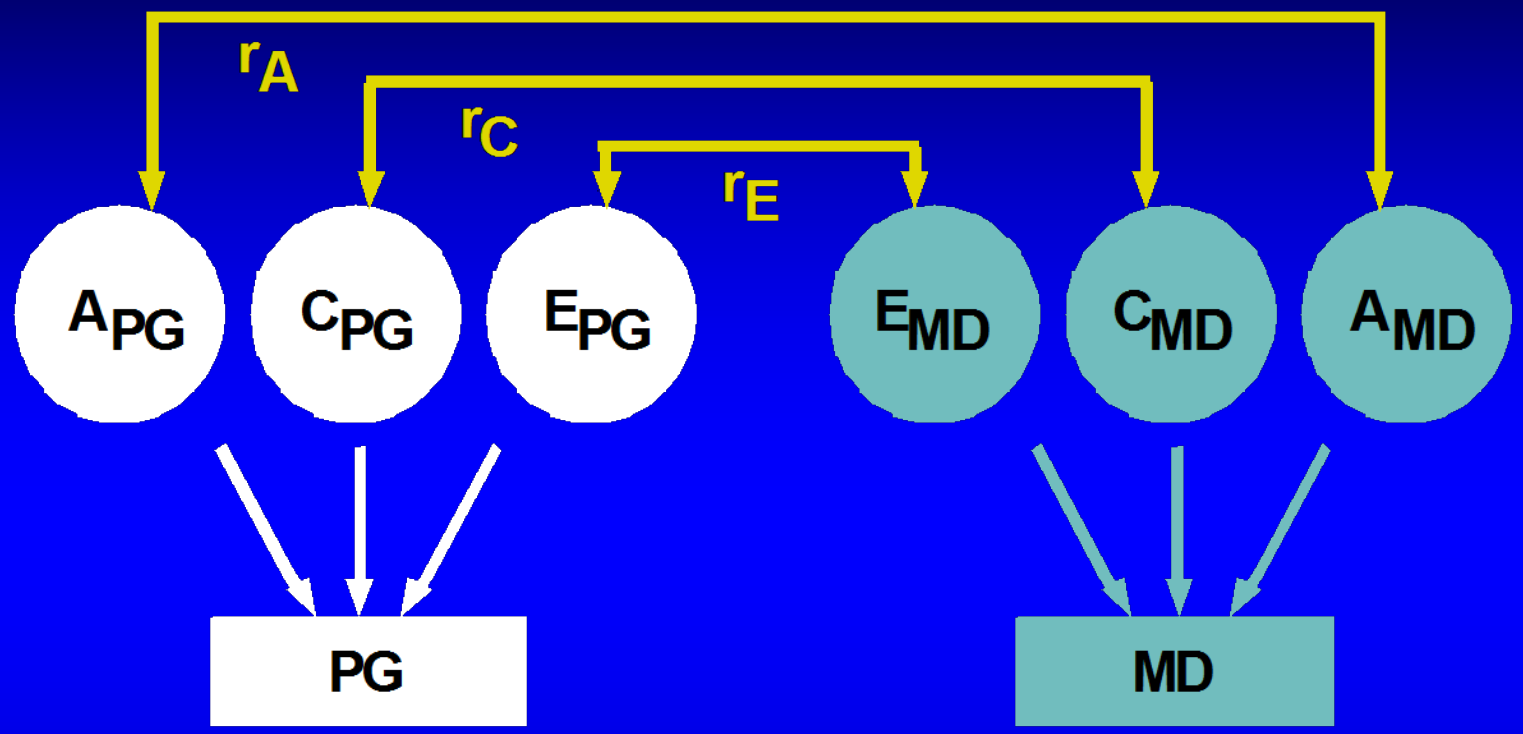
Bivariate Biometric Model for PG & MD



Parameter Estimates from Best Fitting Model

	a^2	c^2	e^2
PG	0.66*	0.0	0.34*
MD	0.41*	0.0	0.59*

r_A=0.58 *

r_C=0.0

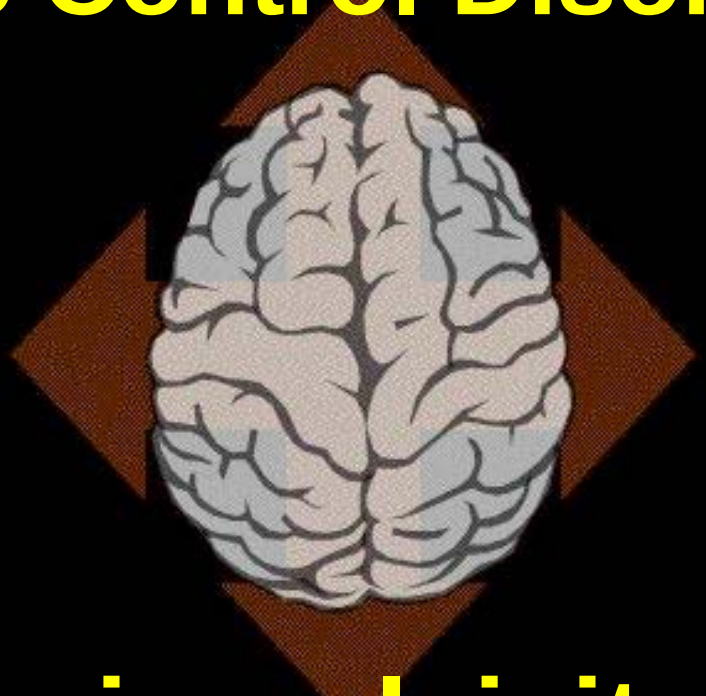
r_E=0. 0

Potenza et al, 2005, *Arch Gen Psychiatry*

Conclusions & Future Directions

- Technological Advances in Neuroscience Research are Providing Insight into Behaviors and Disorders Characterized as "Immoral"
- Information From These Investigations Hold Significant Potential to Advance Current Prevention and Treatment Strategies for a Broad Range of Mental Health Disorders
- How Best to Utilize This Information in Other Realms (e.g., Legal, Ethical, Public Health) Will Require Careful Consideration and Interdisciplinary Work

The International Society for Research on Impulsivity and Impulse Control Disorders (ISRI)



www.impulsivity.org

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WHR at Yale

and The American Moral Landscape

October 25 & 26, 2007

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www.bc.edu/gambling