

Can Neuroscience Help Understand Risk For Homicide?

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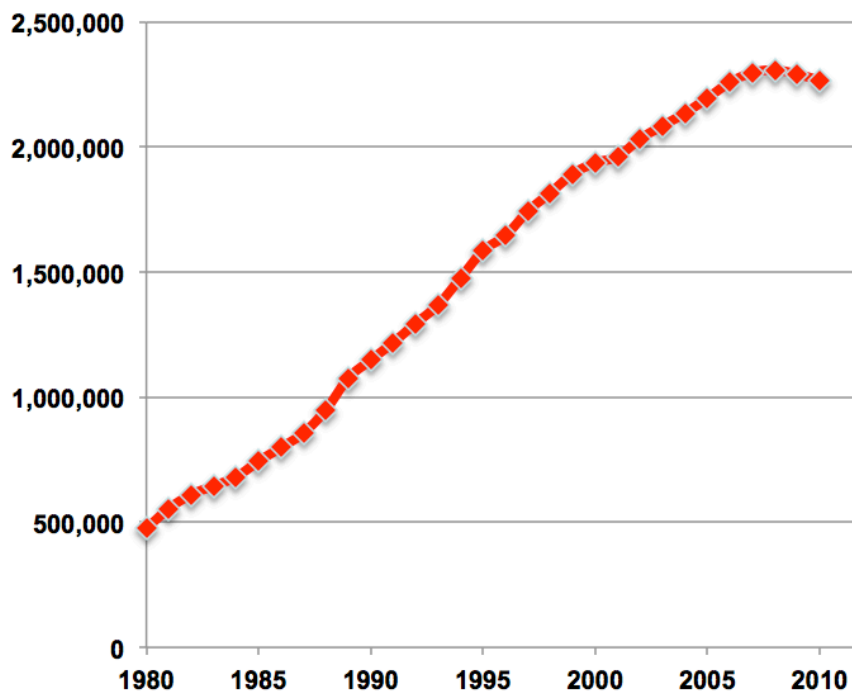


The **Mind**
RESEARCH NETWORK
FOR NEURODIAGNOSTIC DISCOVERY



Burden of Crime in the United States

Incarceration rate in
the United States
from 1980-2011



- Societal cost of crime estimated to be \$3.2 Trillion/yr in the United States (Anderson, 1997; 2011)
- >\$10,000 for every man, woman, and child in United States
- 200 new jail/prison cells built every day in the United States

Prediction is Everywhere

- Intake: bail, drug court, diversion programs
- Custody: sentence length, security level, parole, civil commitment
- Release: treatment program assignments, medication, SVP status

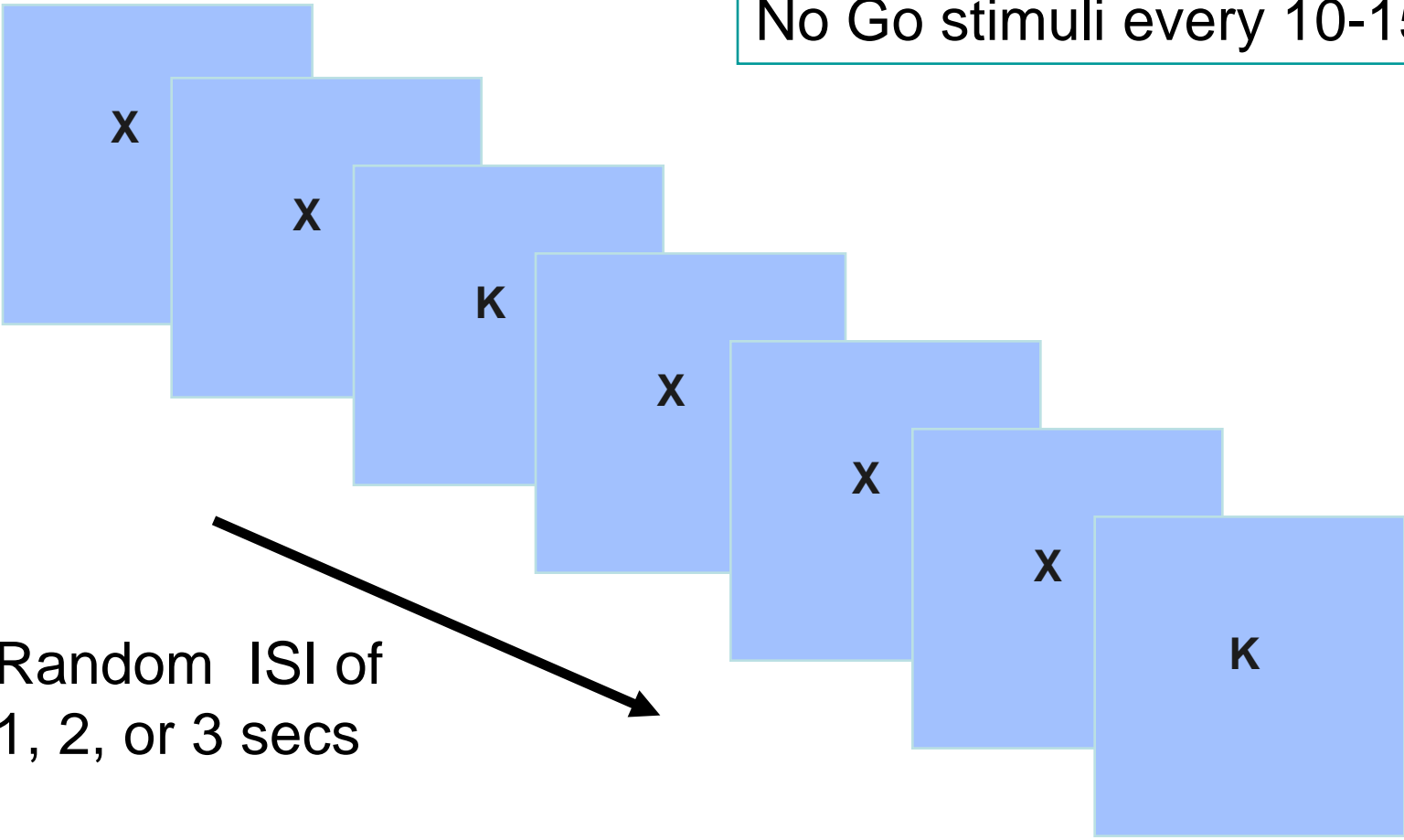
Actuarial Prediction

Risk & Protective Factors

- Age
- Genetics
- Age at first offense
- Index offense type
- Mental Illness
- Alcohol/Substance abuse/dependence
- Employment
- Social support
- Psychopathy Checklist-Revised (PCL-R)
- **Impulsivity**

Inhibitory Function: Go/ No Go Task

3 Go stimuli every 6 seconds
80%Go; 20% No Go
No Go stimuli every 10-15 secs

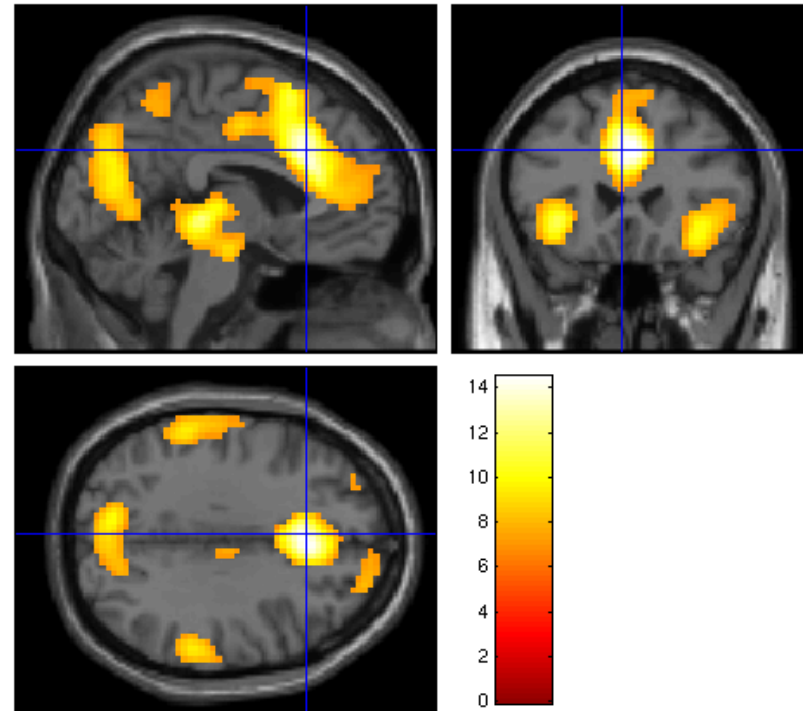


Offender Sample: Mistakes vs Correct

- N = 96
- Rearrest rate: 53.13%

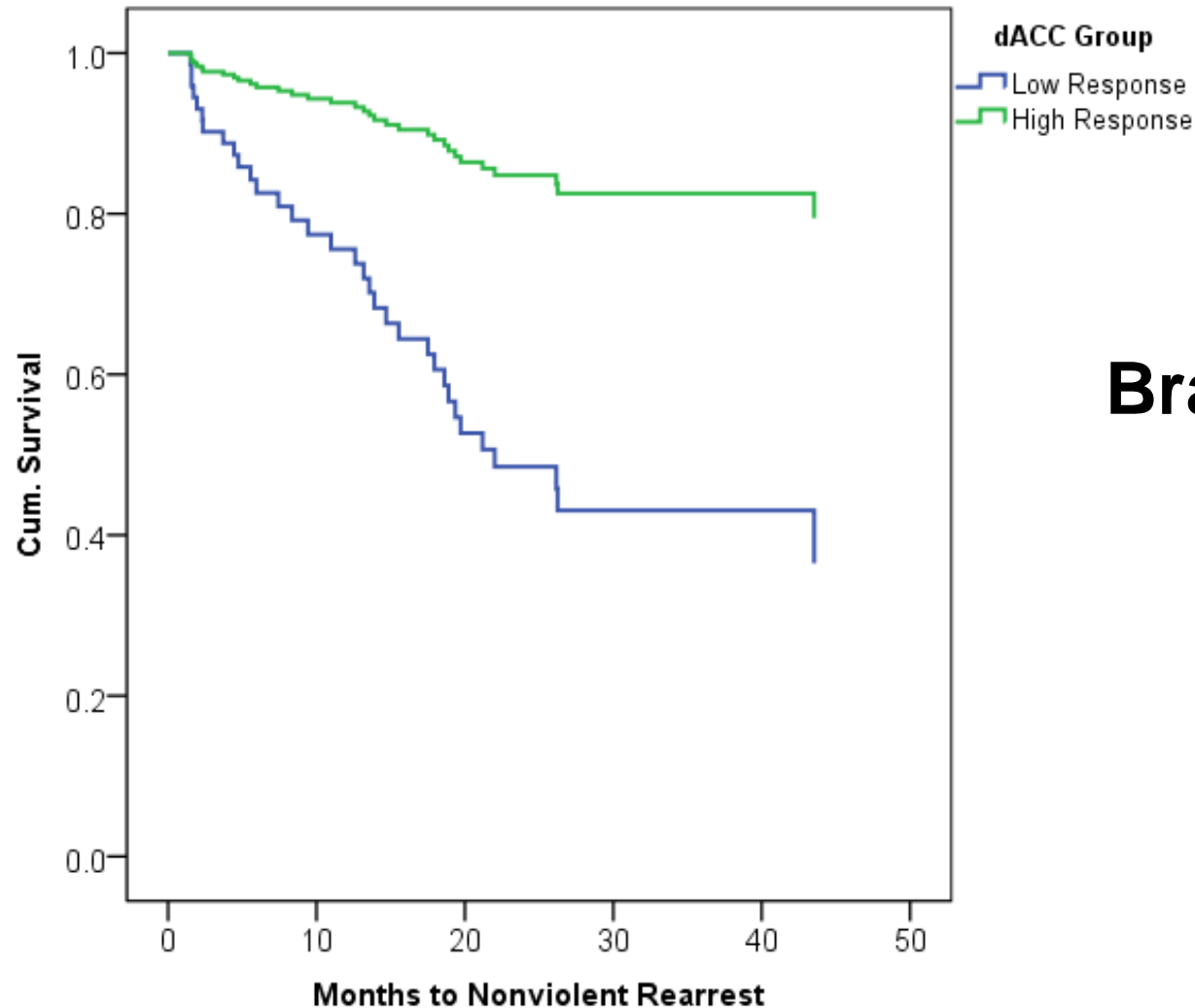
False Alarm Rate:

- Low ACC = 27%
- High ACC = 23%



- Peak: +3, 24, 33

Cox Survival Analysis



Brain Scans Predict Recidivism

Crimes (Nonviolent) (ACC split)
O.R. = 4.4**

Test controls for:

- Age at release, PCL-R & factors, Alc & Drug problems, Trait anxiety, FA rate.

Symptoms of Psychopathy from Hare PCL-R

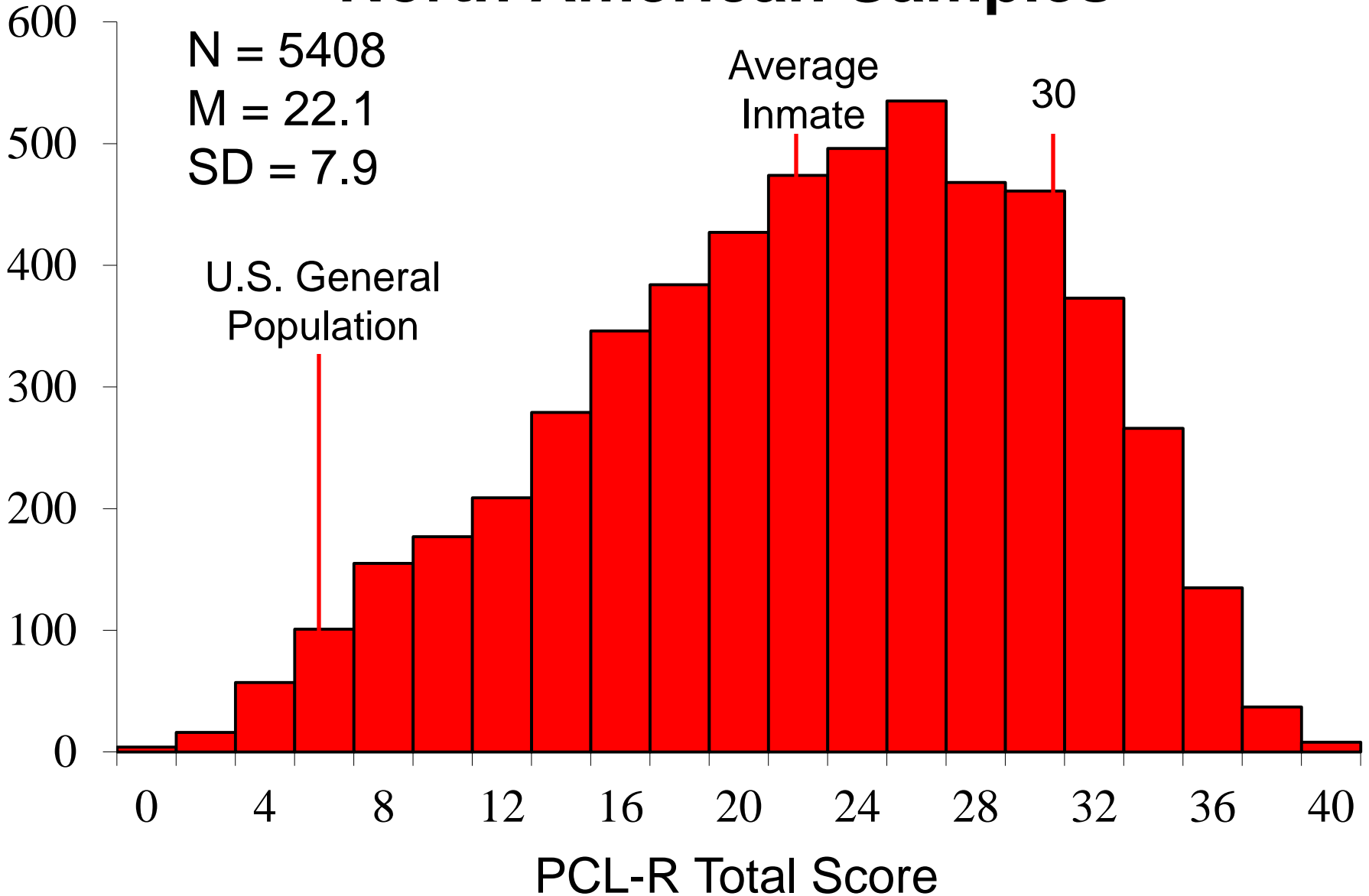
Interpersonal/Affective Factor 1

- 1) Glib/ superficial
- 2) Grandiose
- 3) Pathological liar
- 4) Conning/Manipulative
- 5) Lack of Remorse/ Guilt
- 6) Shallow affect
- 7) Callous/ Lacks empathy
- 8) Lack of realistic long term plans
- 9) Failure to accept consequences of actions
- 10) Irresponsibility

Impulsive/Behavioral Factor 2

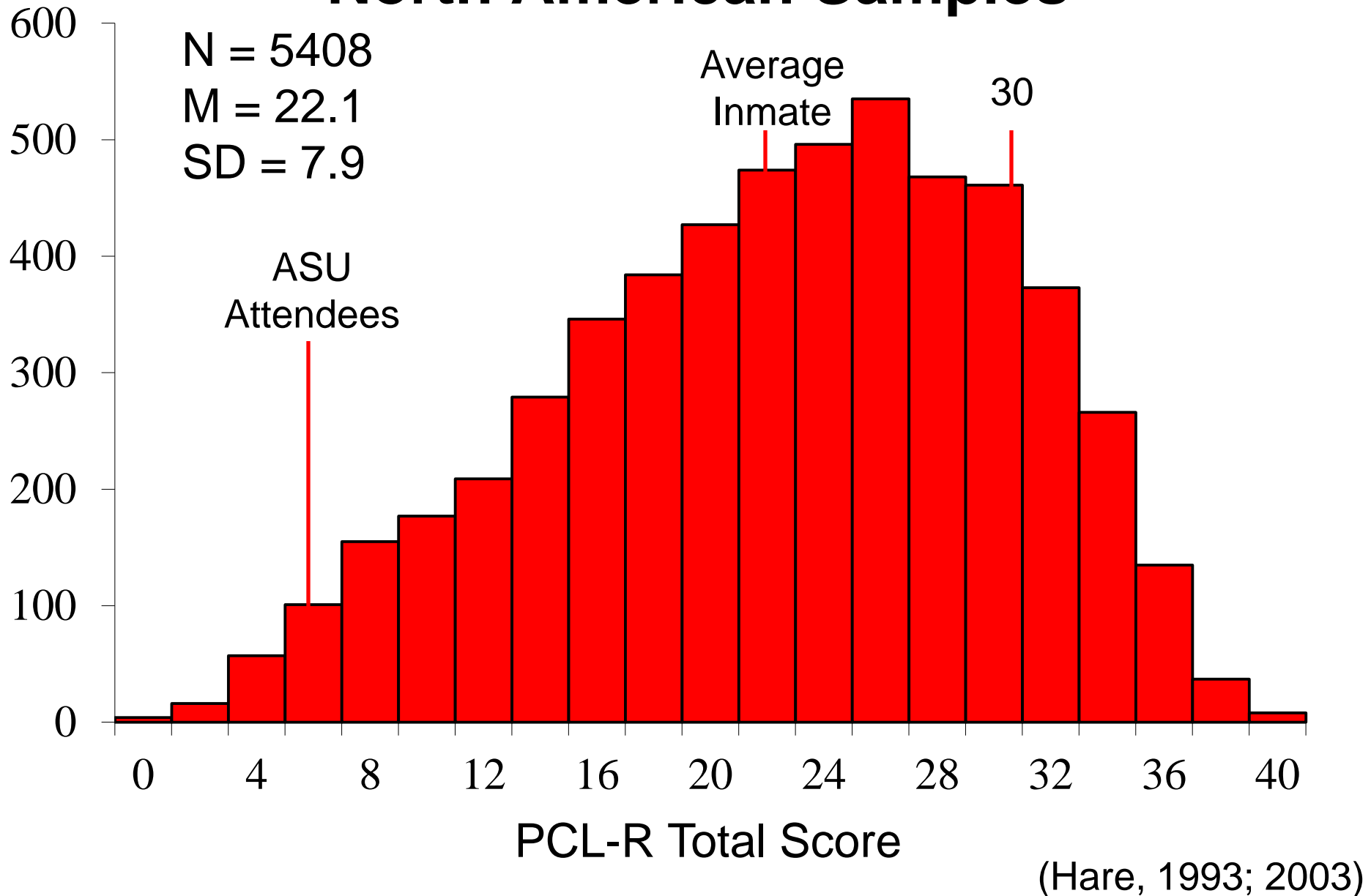
- 11) Need for stimulation
- 12) Parasitic lifestyle
- 13) Impulsivity
- 14) Sexual promiscuity
- 15) Many marital relationships
- 16) Poor behavioral controls
- 17) Early behavioral problems
- 18) Juvenile Delinquency
- 19) Recidivist
- 20) Criminal versatility

Psychopathy scores (PCL-R): North American Samples

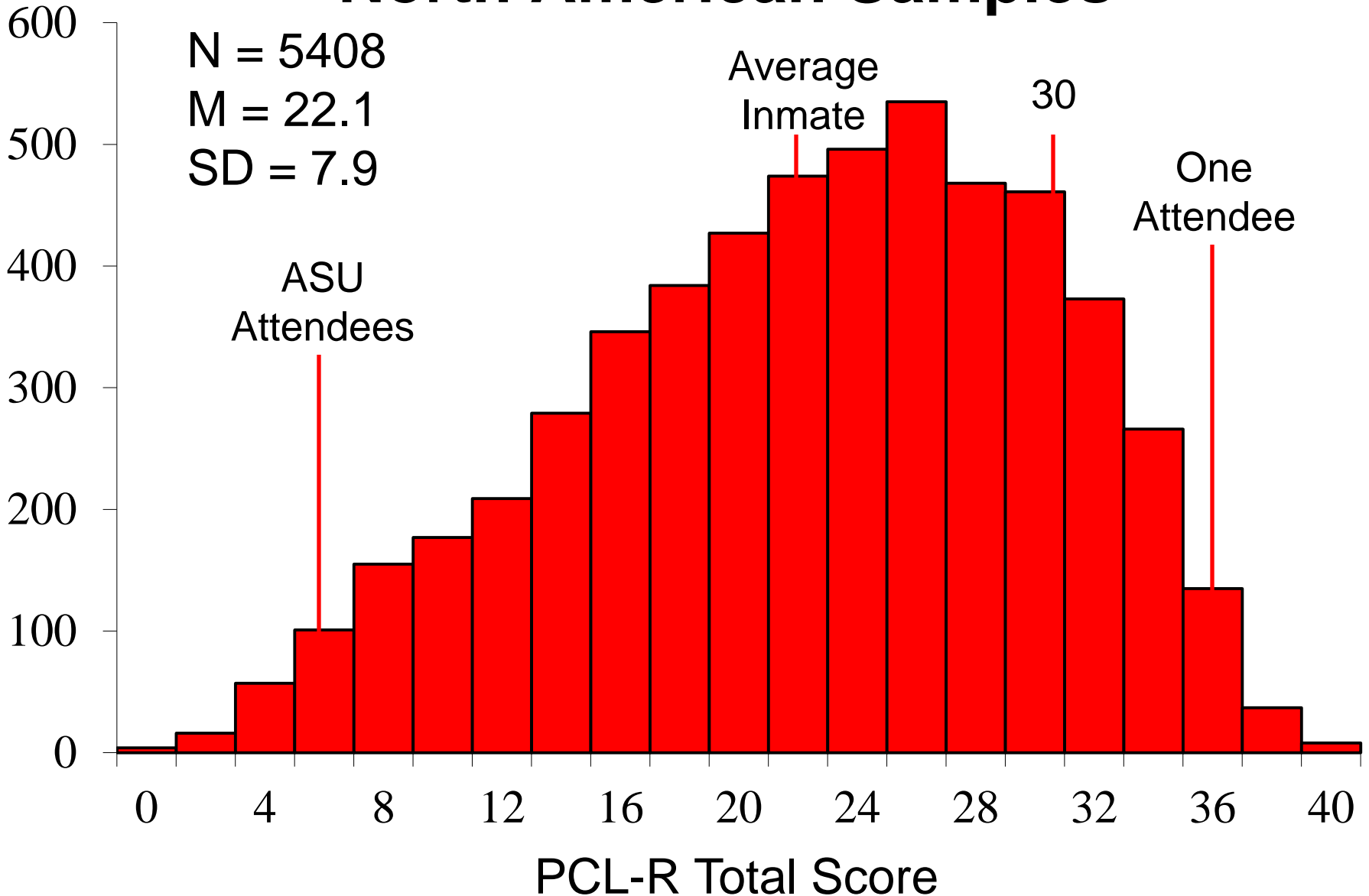


(Hare, 1993; 2003)

Psychopathy scores (PCL-R): North American Samples



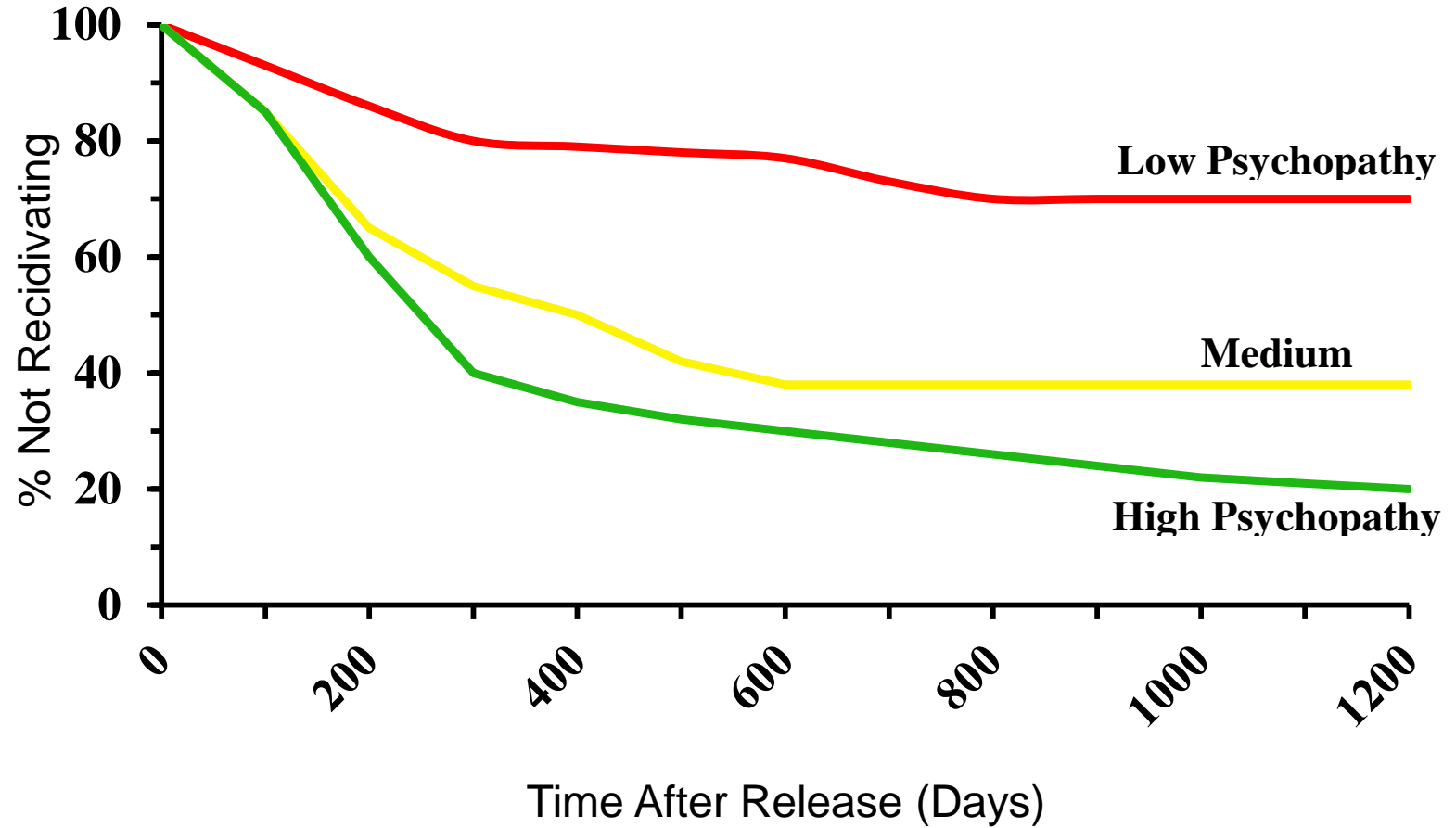
Psychopathy scores (PCL-R): North American Samples



(Hare, 1993; 2003)

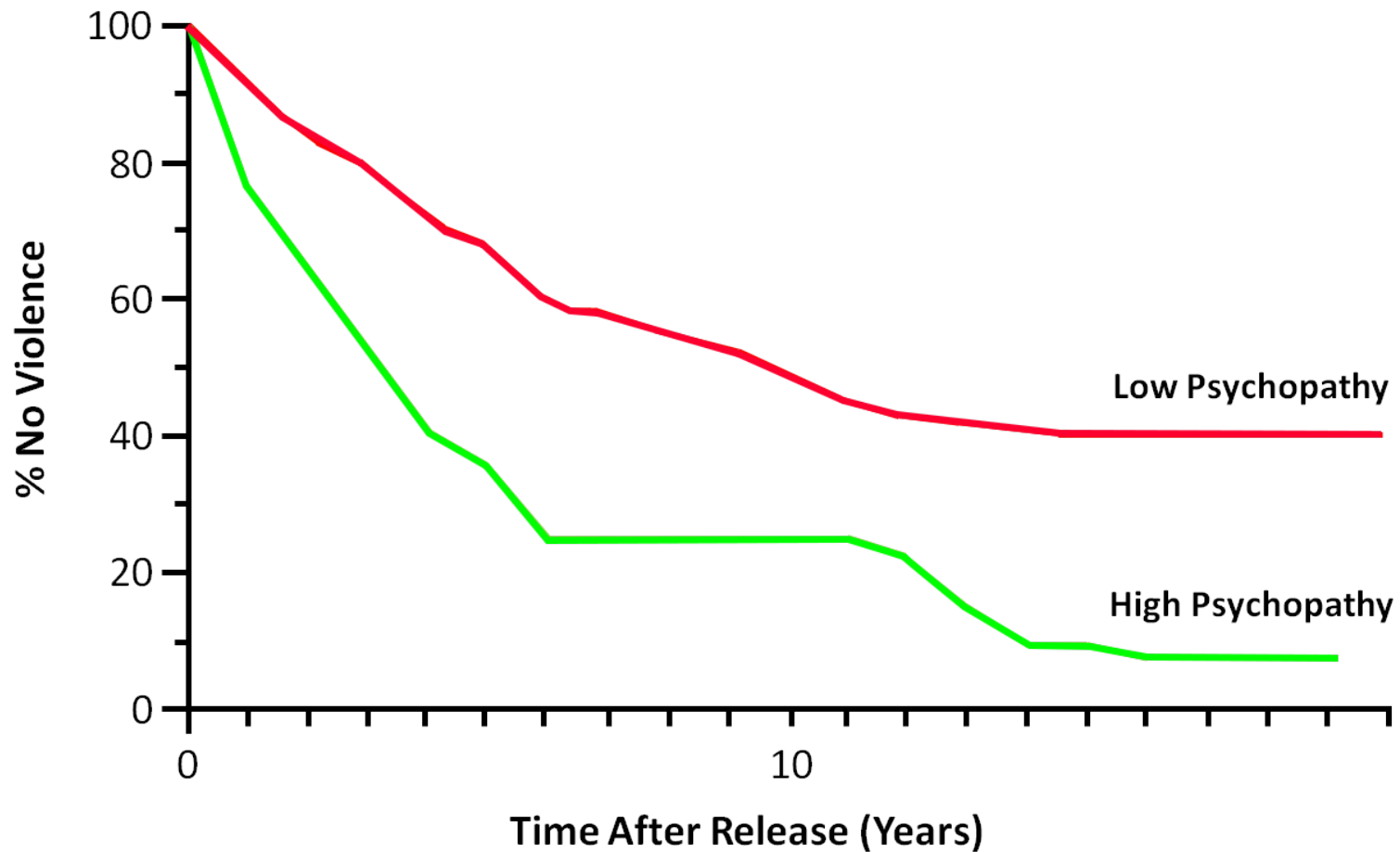
“Why”?

Recidivism and Psychopathy



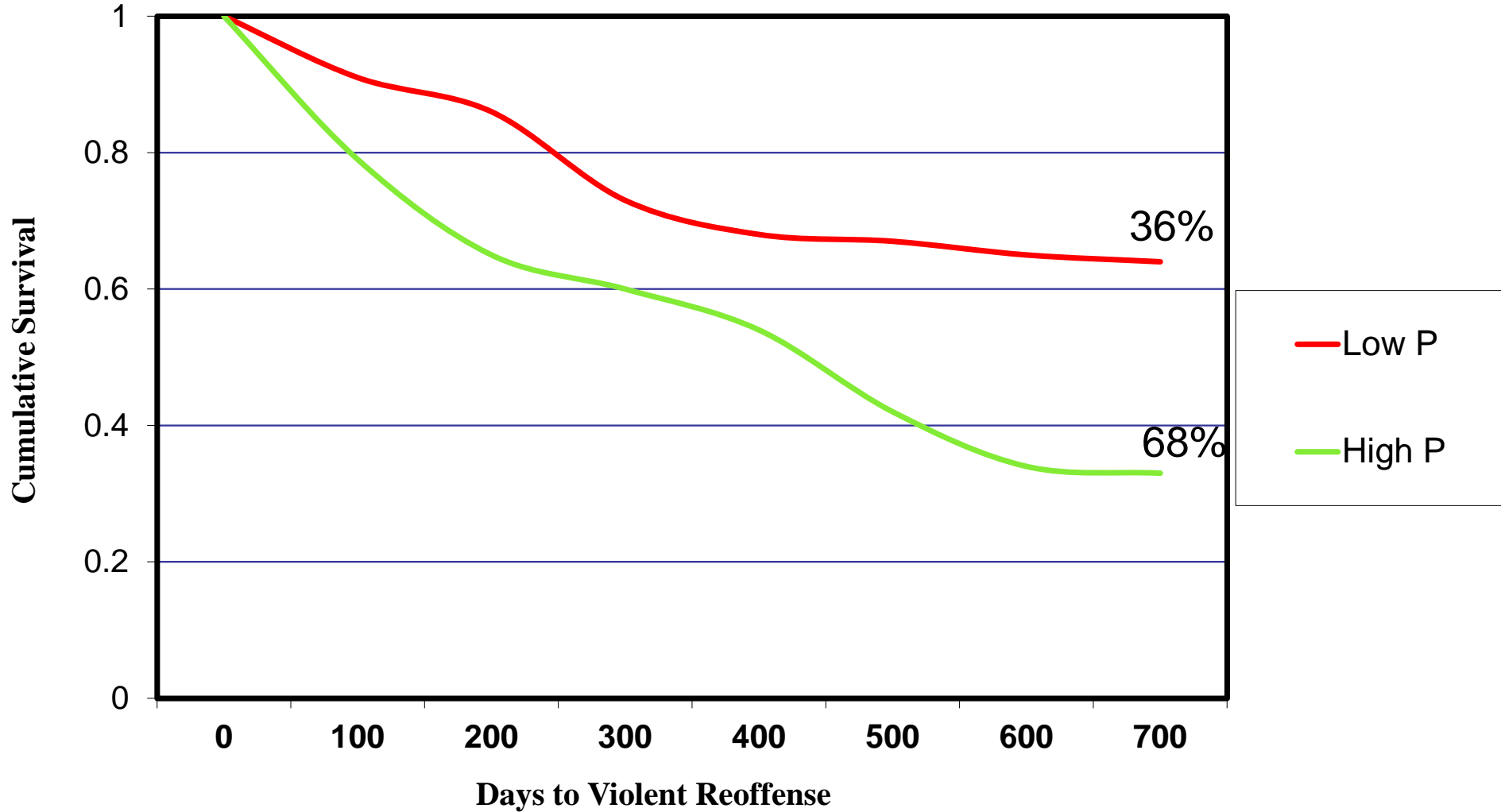
(Hodgins, Cote & Ross, 1992)

Violent Recidivism and Psychopathy



(Rice & Harris, 1997)

Psychopathy and **Violent** Recidivism in Youth



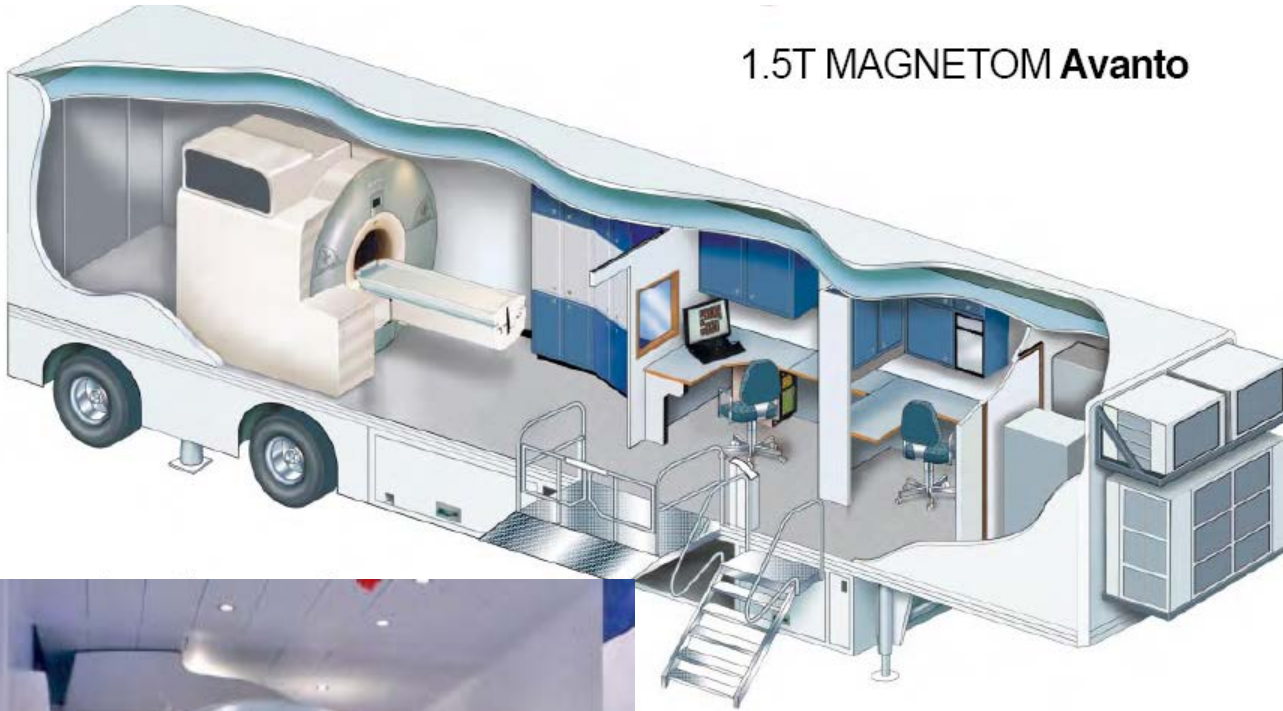
(Vincent et al., 2003)

Can Neuroscience Inform This Case?



Mind Research Network Mobile Imaging System

1.5T MAGNETOM Avanto



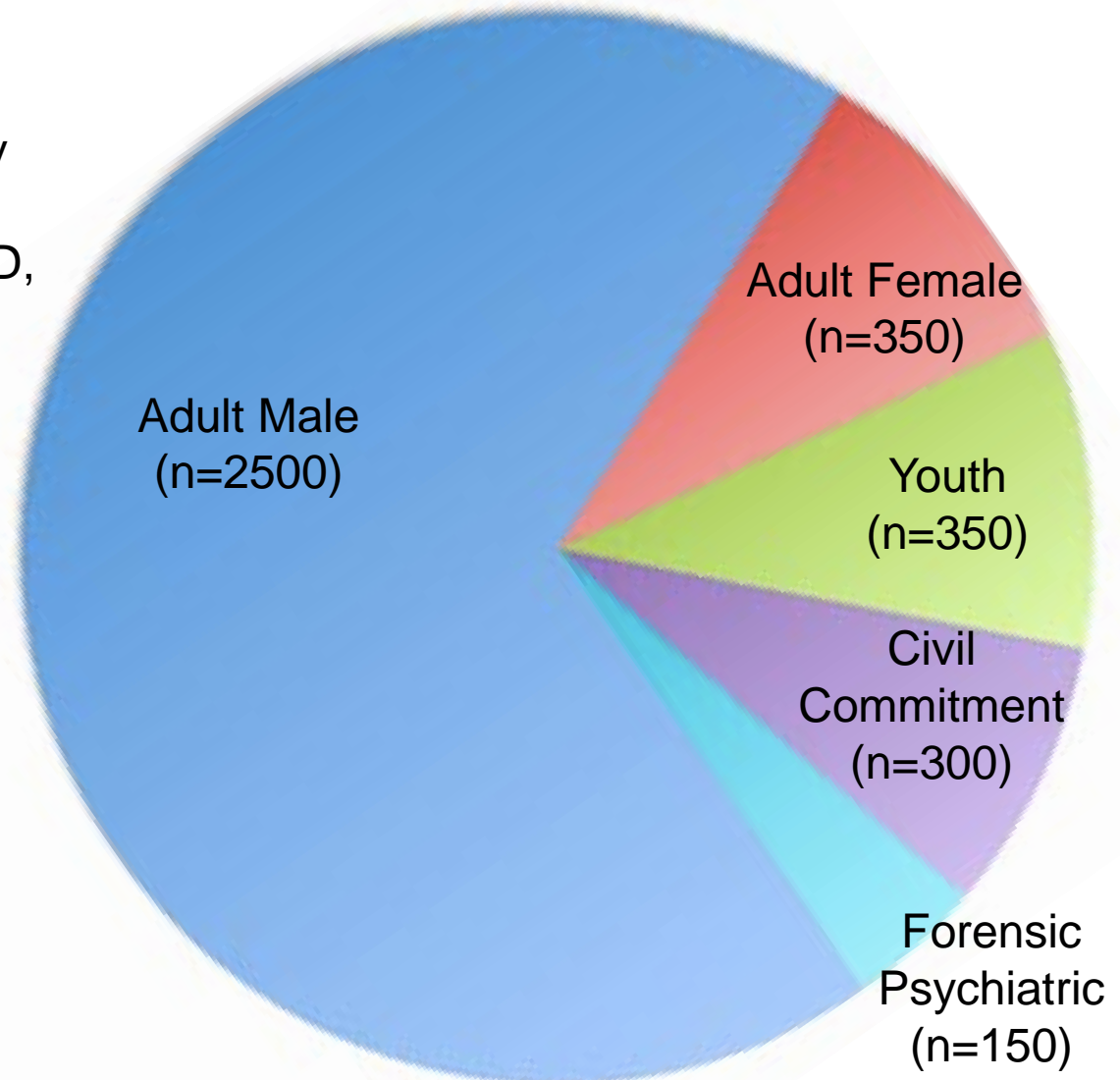
Sample Characteristics (n>3500)

Adults – psychopathy,
substance abuse, trauma,
decision-making, impulsivity

Youth – development, ADHD,
CU/CD Traits, empathy

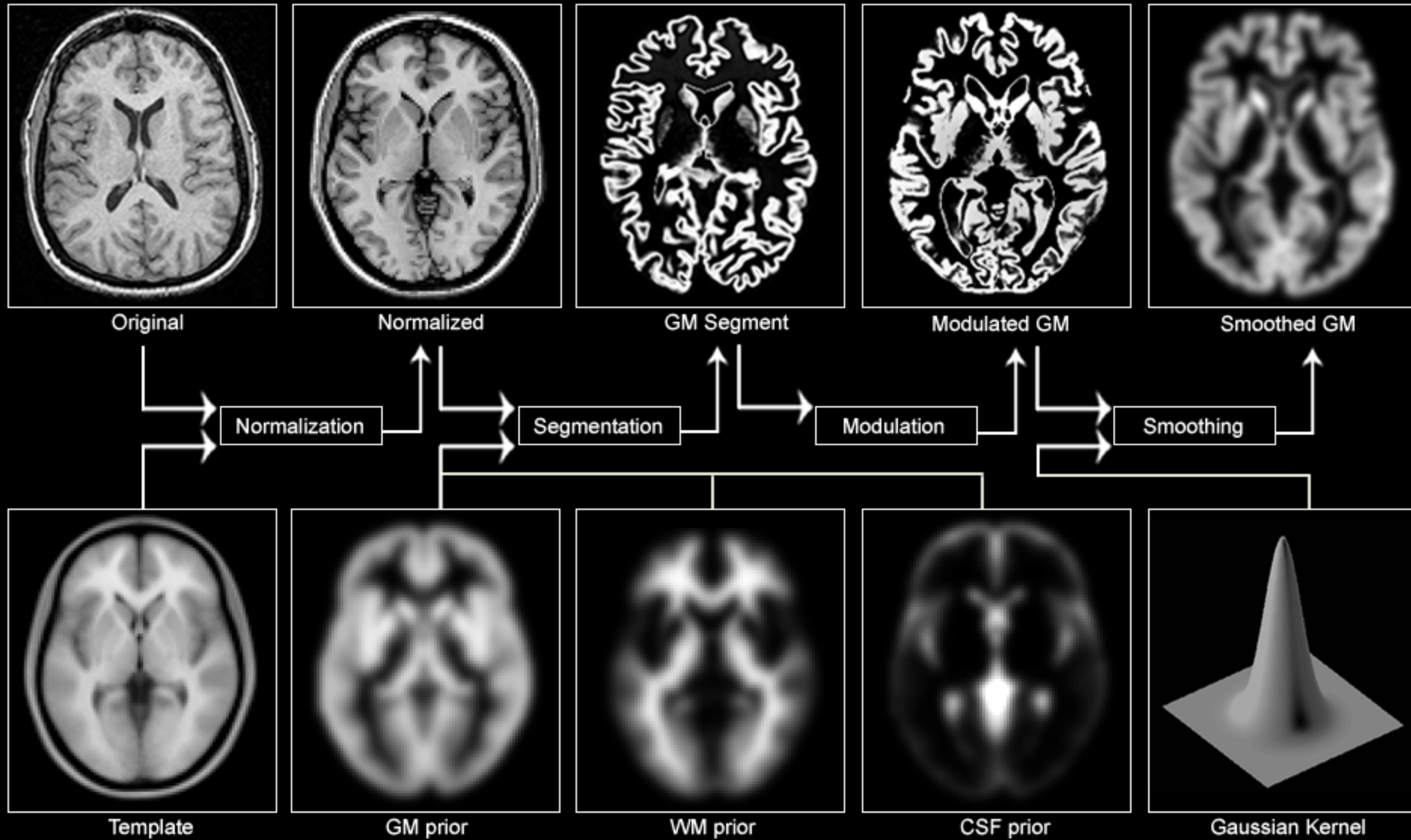
Forensic Psychiatric –
psychosis, depression,
impulsivity

Civil Commitment – IQ,
paraphilia



Voxel-Based Morphometry

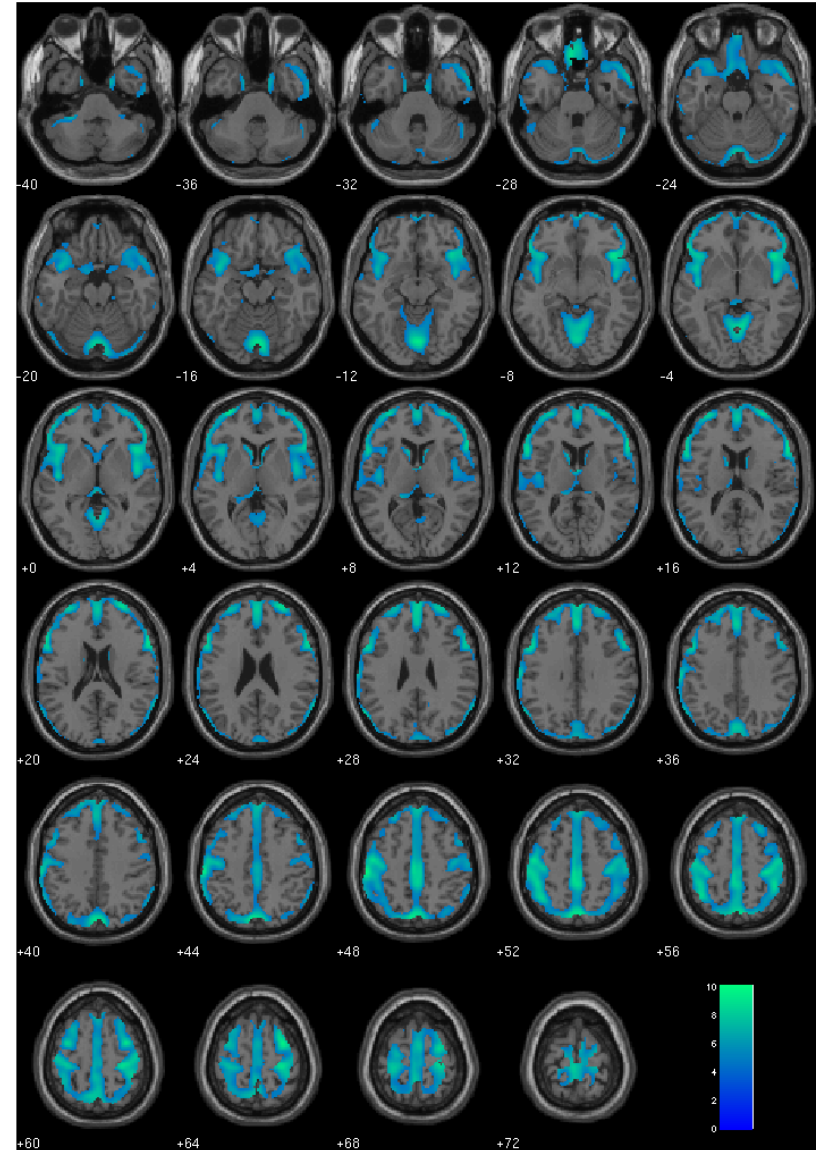
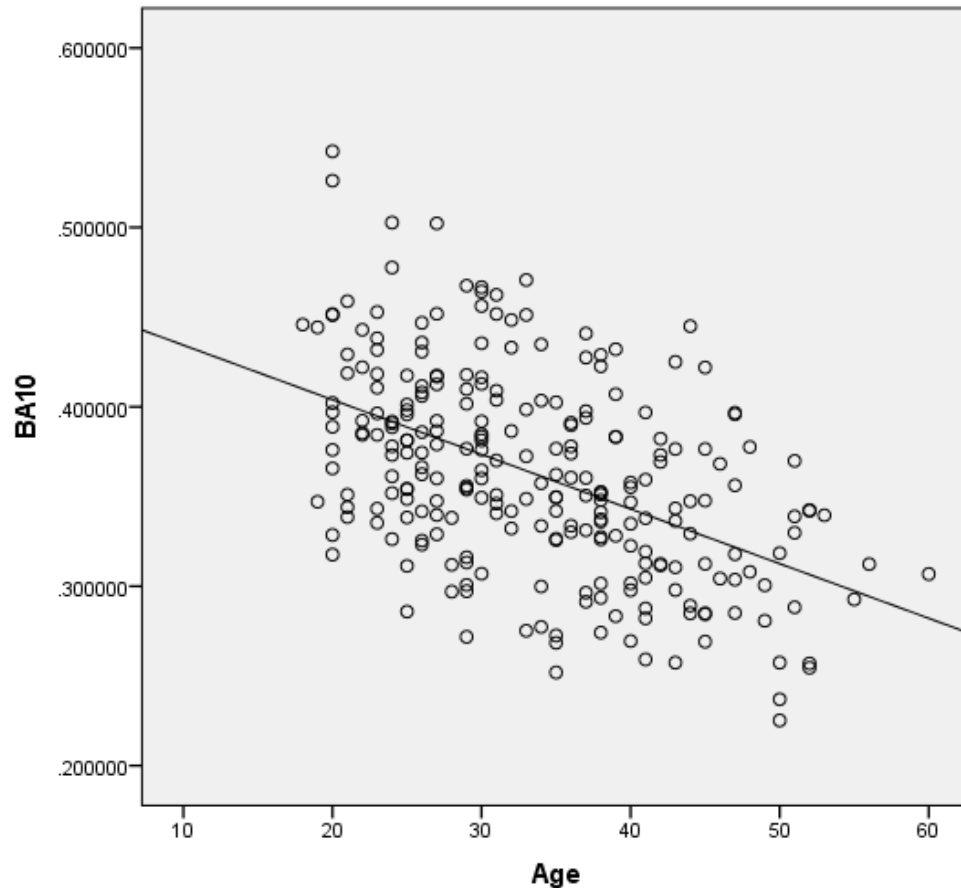
Pre-processing Overview



What do Neuroscientist's know about "Gray Matter"

The Bad News:

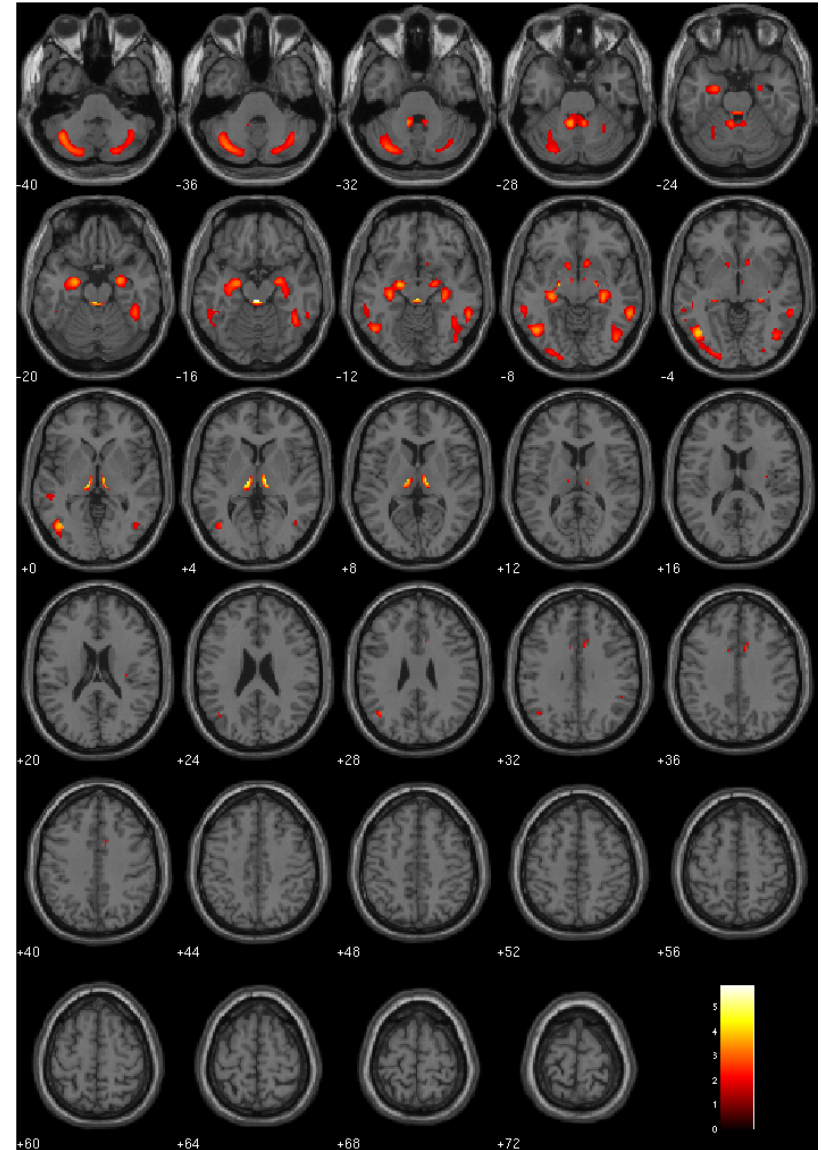
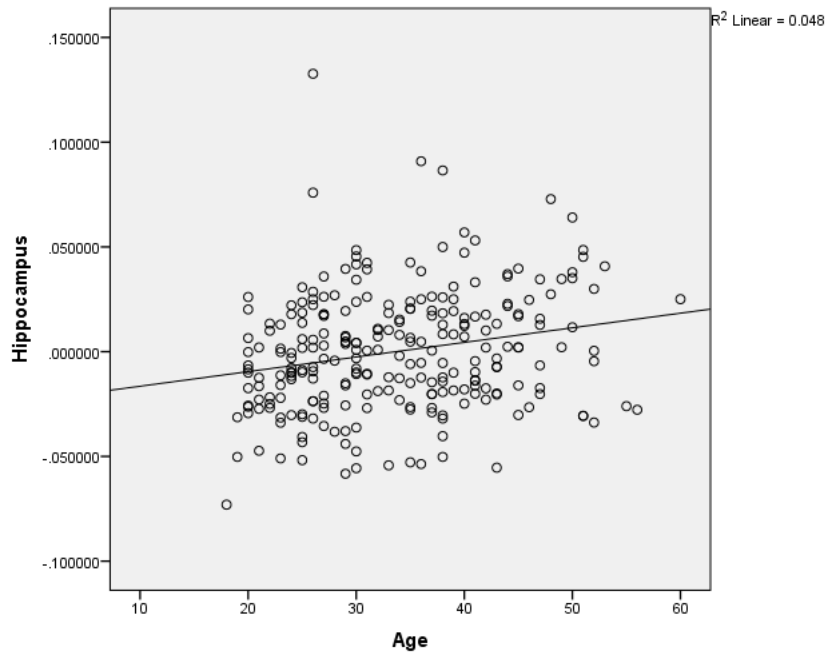
As age goes up, gray matter goes down



What do Neuroscientist's know about "Gray Matter"

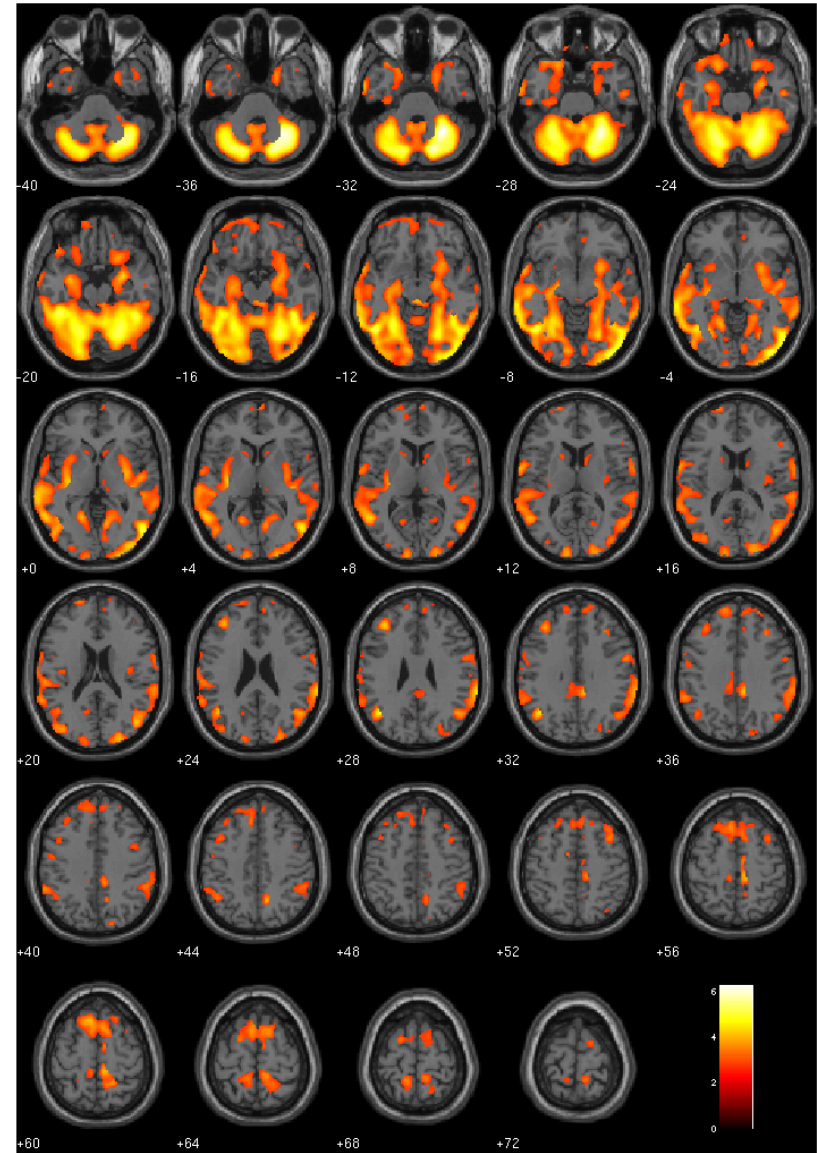
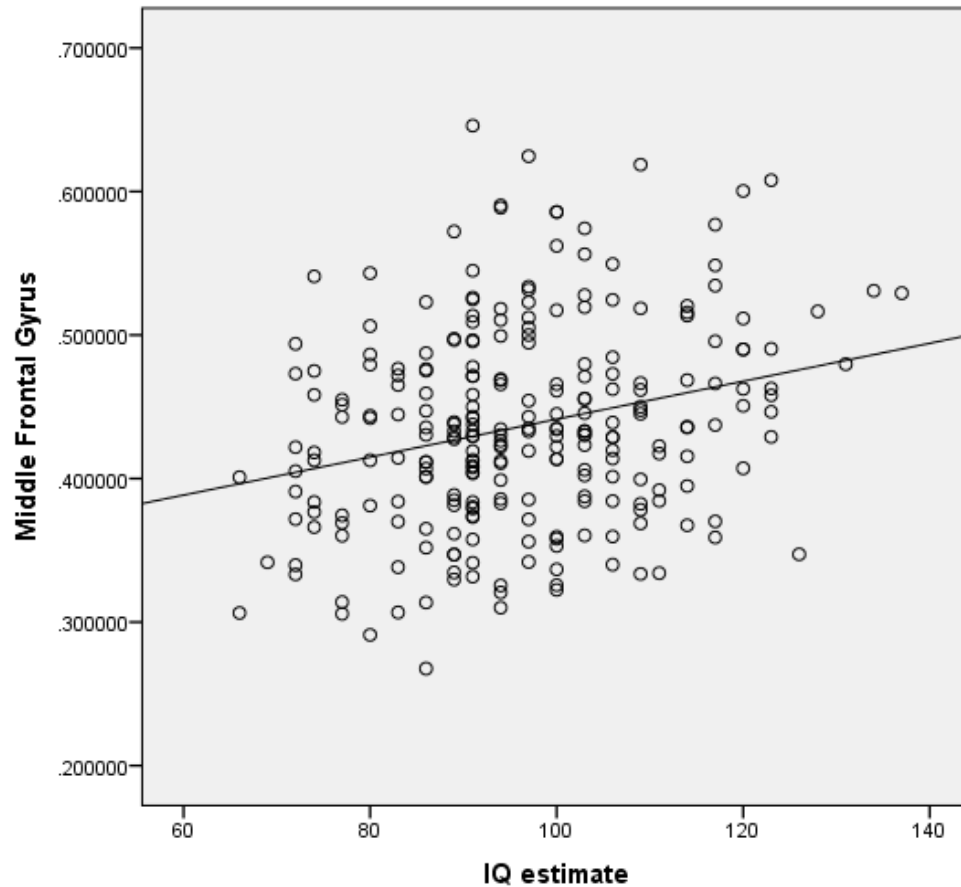
The Good News:

As age goes up, some gray matter goes up too!!!

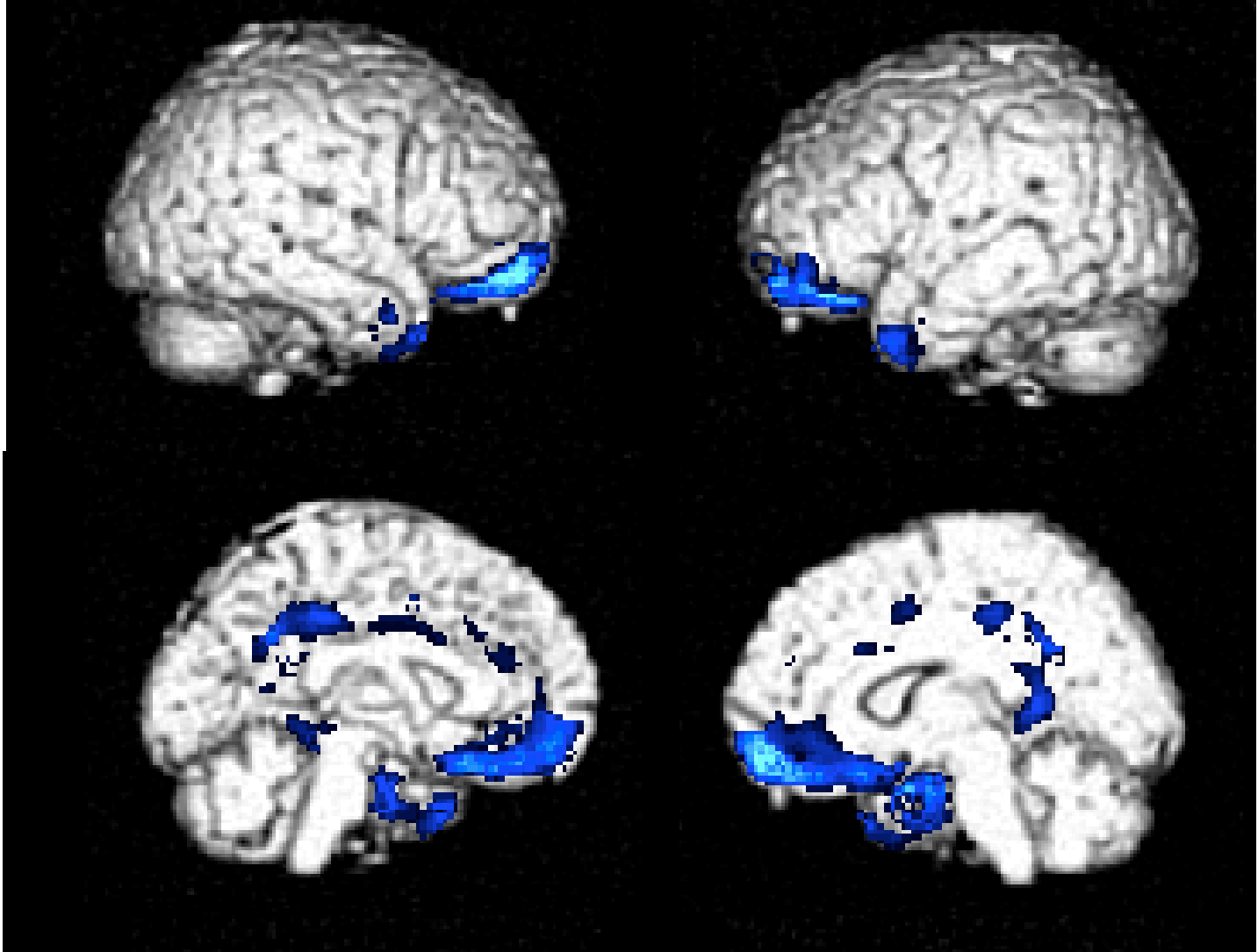


What do Neuroscientist's know about "Gray Matter"

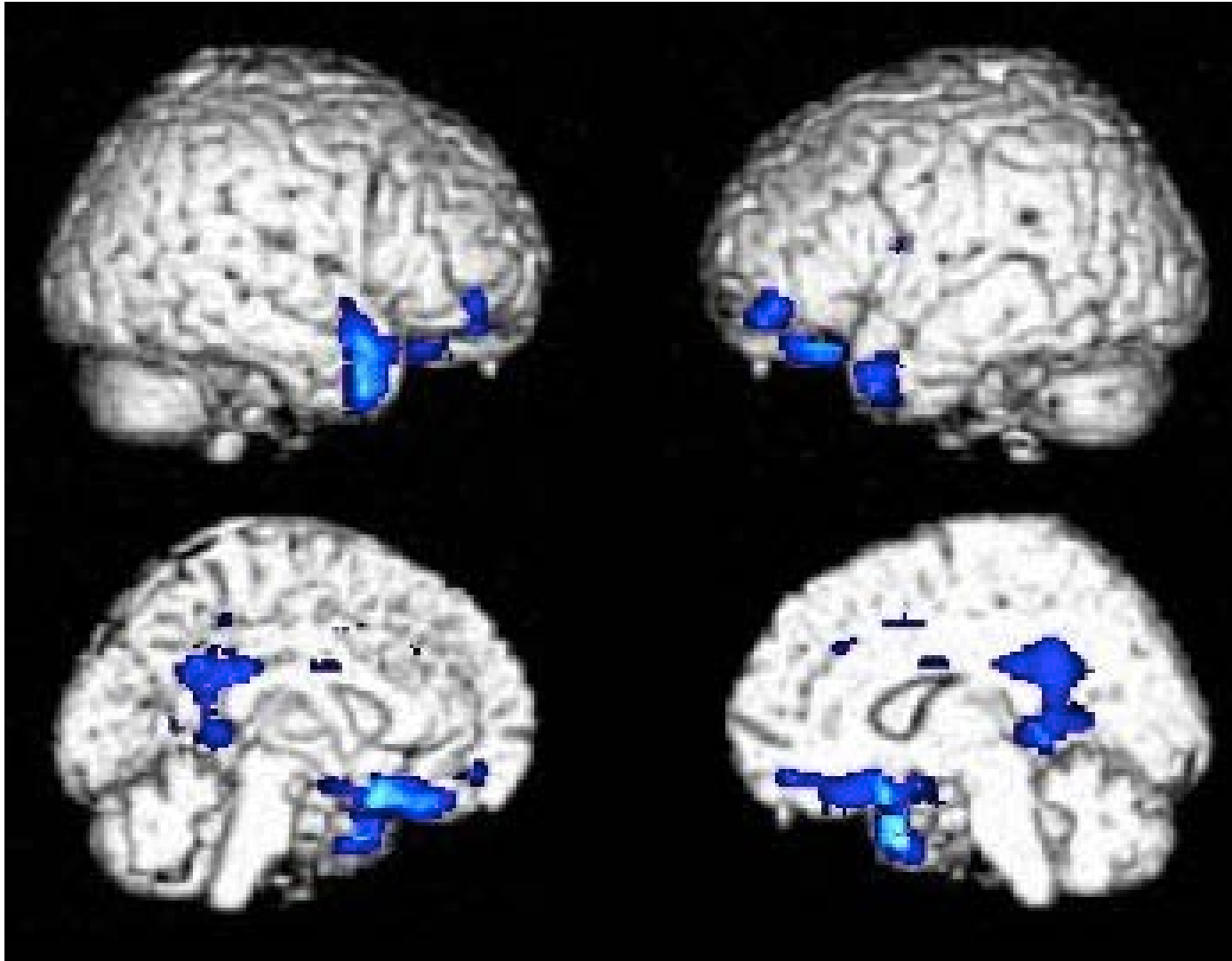
IQ highly correlated with Gray Matter



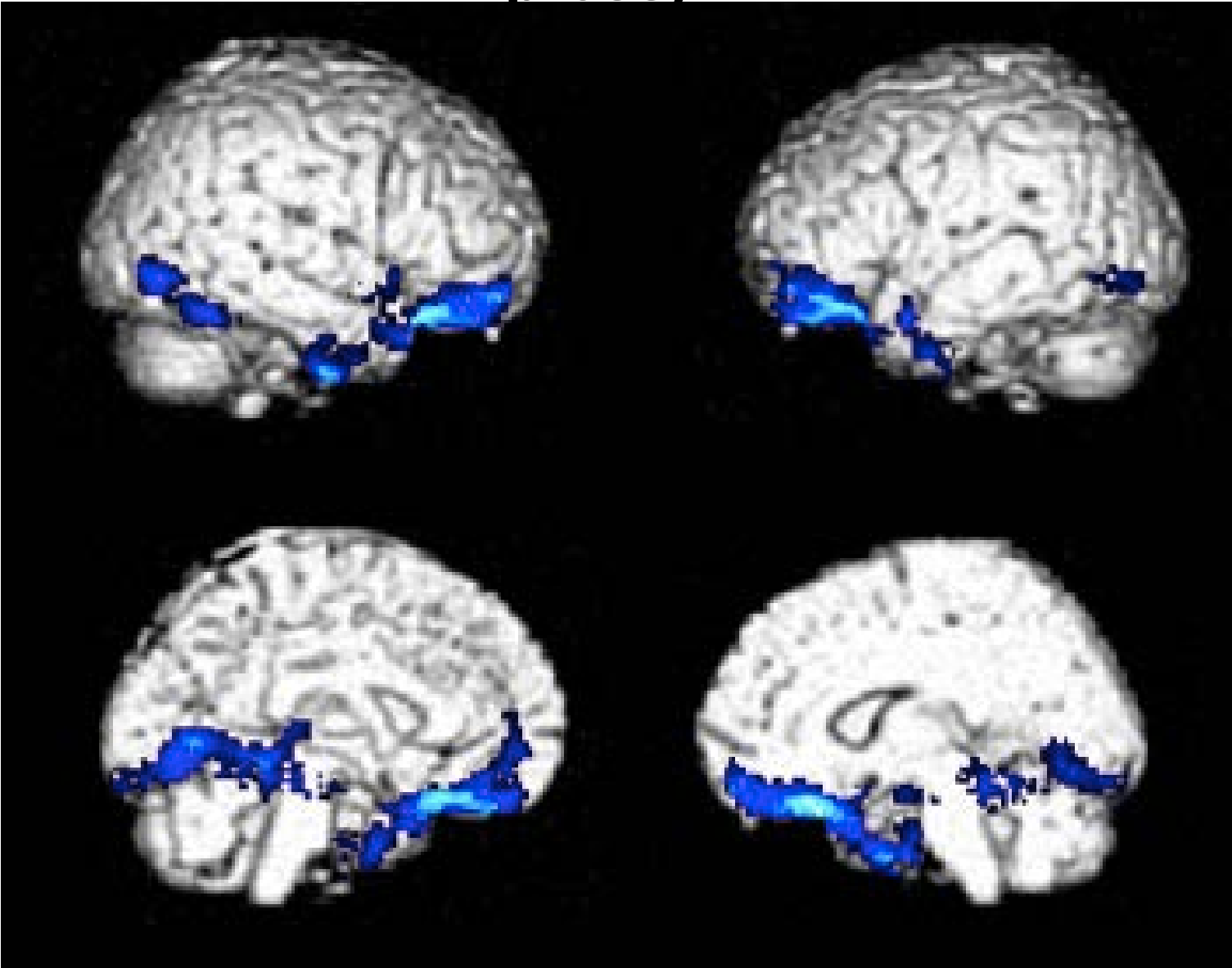
Brain gray matter abnormalities in **adult males** with psychopathy (n=298; Ermer et al., 2012)



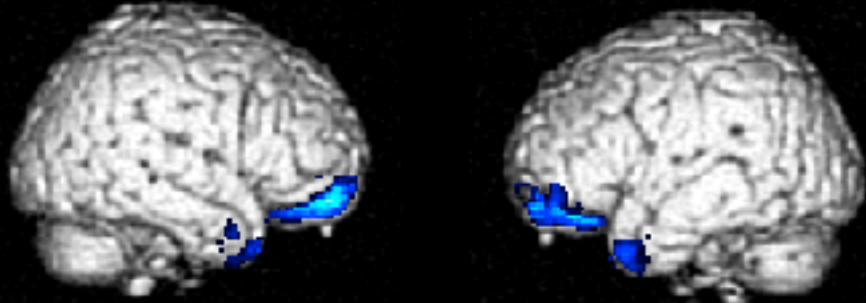
**Brain gray matter abnormalities in boys with
Callous/Unemotional Traits (n=199; Ermer et al.,
2013)**



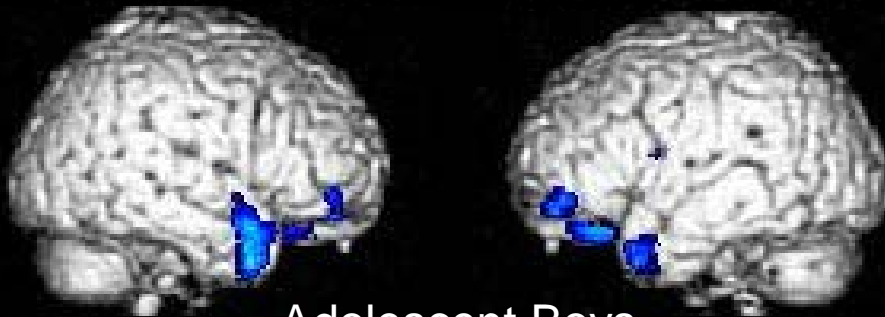
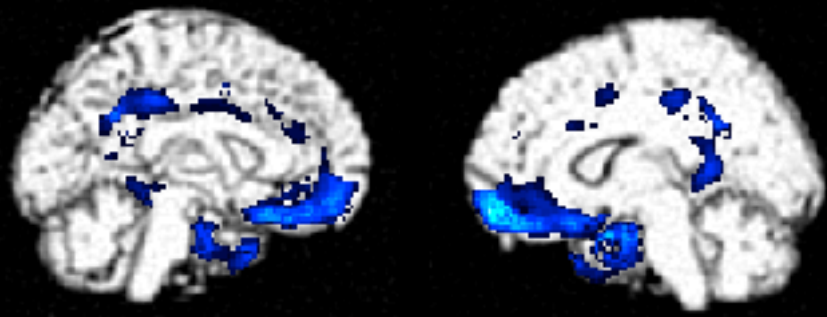
Brain gray matter abnormalities in **girls with
Callous/Unemotional Traits (n=39; Cope et al., in
press)**



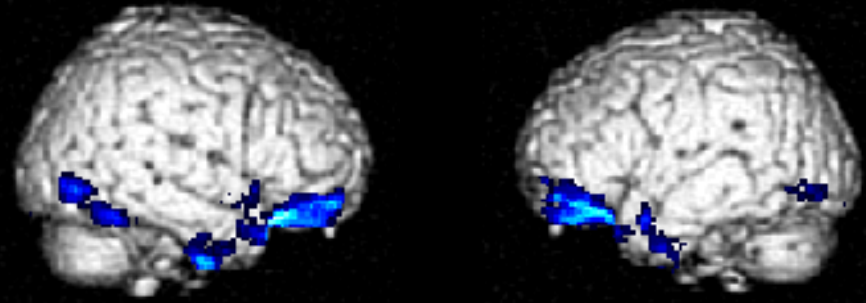
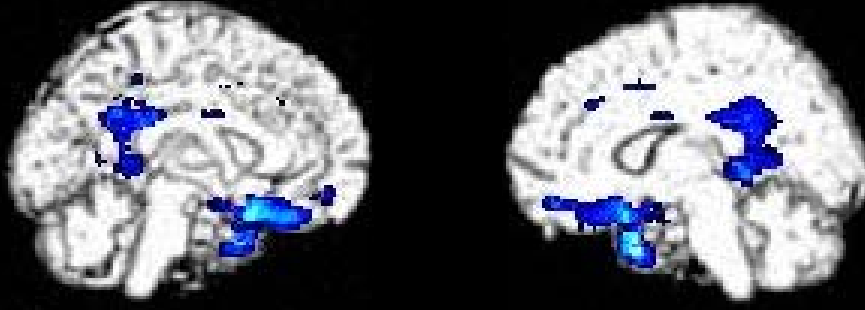
**Summary: Brain Gray Matter x
Psychopathic Traits in Incarcerated
Adult Males and Adolescent Males
and Females; Sample size n>500**



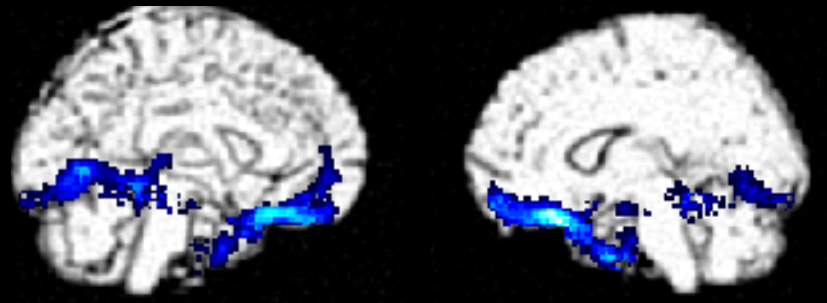
Adult Males



Adolescent Boys



Adolescent Girls





"Preventing Violence Through Research and Community Education"

Jeremy and Jennifer Richman created the foundation following the loss of the 26 child/educators at Sandy Hook elementary school.

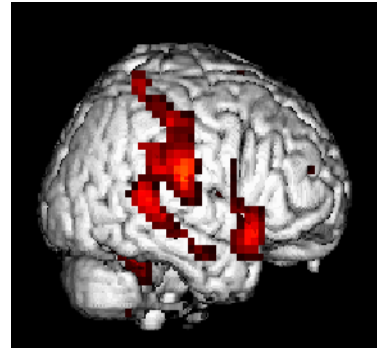
Foundation Mission is to raise awareness and funding to study relationship between mental illness and violence with ultimate goal to improve outcomes.

Epidemic of Mass Shootings

- 1/25,000 is the relative risk for homicide in the United States population
- 1/629 presentations of first-episode psychosis will result in a homicide in the next year (Nielsen & Lange, 2010)
- Almost 50% of homicides committed by psychotic patients occur prior to treatment
- With treatment the risk of homicide in patients with psychosis drops to 1/9090 (Nielsen & Lange, 2010).

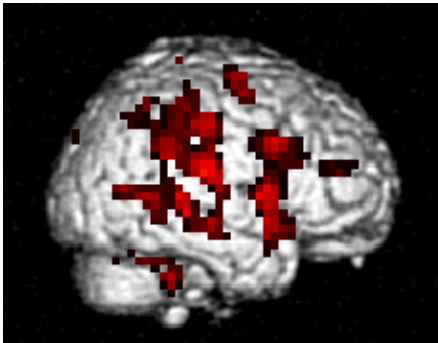
PSYCHIATRIC DIAGNOSIS

First episode patient

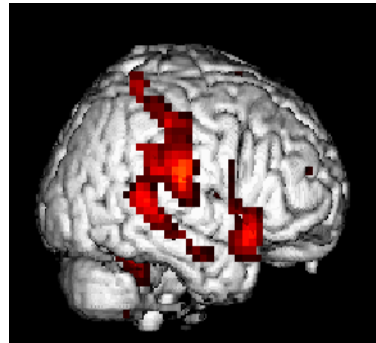


Database of other first episode patients

Bipolar



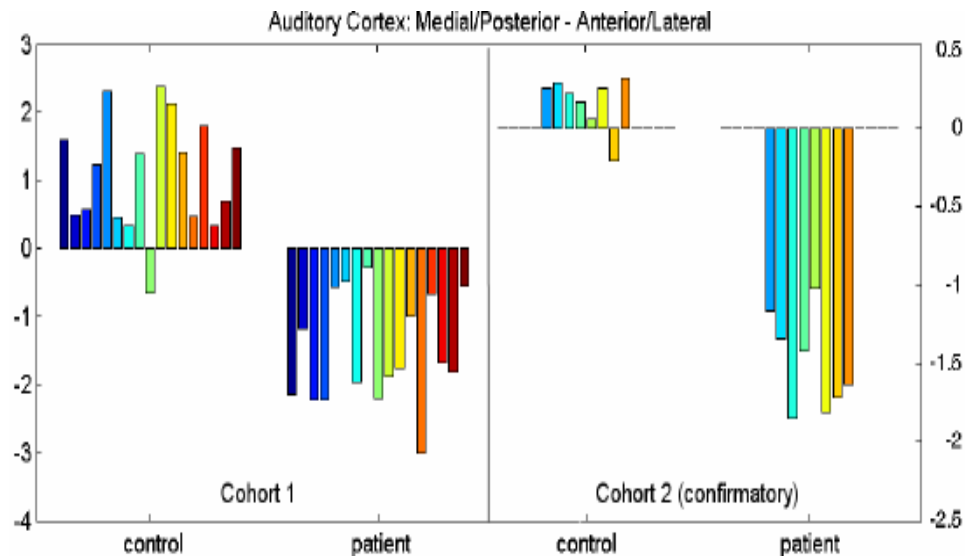
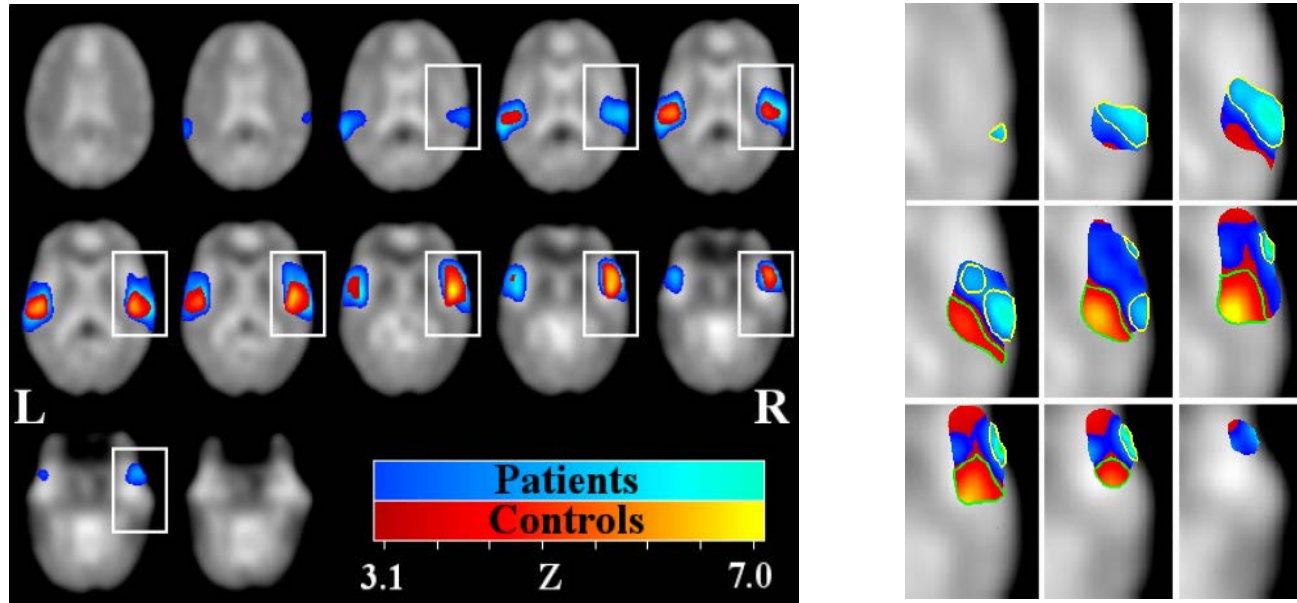
Schizophrenia



Affective



Brain Scans Discriminate Patients with Schizophrenia/Bipolar from Healthy Controls



Brain Scans Discriminate Patients with Schizophrenia/Bipolar from Healthy Controls



NeuroImage

Volume 57, Issue 3, 1 August 2011, Pages 839–855

Special Issue: Educational Neuroscience



♦ Human Brain Mapping 29:1265–1275 (2)

Temporal Lobe and “Default” Hemodynamic Brain Modes Discriminate Between Schizophrenia and Bipolar Disorder

Vince D. Calhoun,^{1,2,3,4*} Paul K. Maciejewski,²
Godfrey D. Pearlson,^{1,2} and Kent A. Kiehl^{1,2,3,5}

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⁵Department of Psychology, University of New Mexico, Albuquerque, New Mexico

Discriminating schizophrenia and bipolar disorder by fusing fMRI and DTI in a multimodal CCA+ joint ICA model

Jing Sui^a, , Godfrey Pearlson^{b, c}, Arvind Caprihan^a, Tülay Adalı^d, Kent A. Kiehl^{a, e}, Jingyu Liu^{a, f}, Jeremy Yamamoto^a, Vince D. Calhoun^{a, b, c, f}



NeuroImage

Volume 66, 1 February 2013, Pages 119–132



Three-way (N-way) fusion of brain imaging data based on mCCA + jICA and its application to discriminating schizophrenia

Jing Sui^a, , Hao He^{a, b}, Godfrey D. Pearlson^{c, d}, Tülay Adalı^e, Kent A. Kiehl^{a, f}, Qingbao Yu^a, Vince P. Clark^{a, f}, Eduardo Castro^{a, b}, Tonya White^{g, h}, Bryon A. Mueller^g, Beng C. Hoⁱ, Nancy C. Andreasenⁱ, Vince D. Calhoun^{a, b, e}

frontiers in
HUMAN NEUROSCIENCE

METHODS ARTICLE
published: 04 June 2012
doi: 10.3389/fnhum.2012.00145



High classification accuracy for schizophrenia with rest and task fMRI data

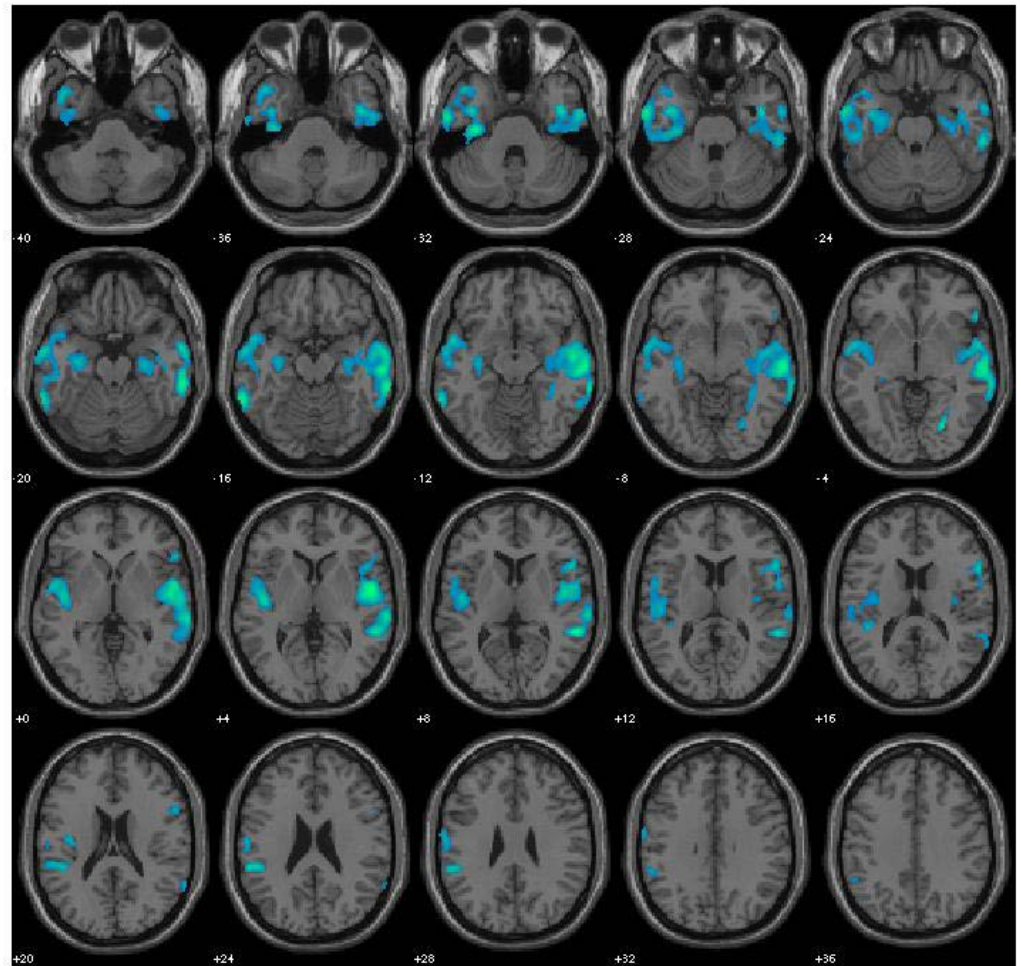
Wei Du^{1*}, Vince D. Calhoun^{2,3}, Hualiang Li¹, Sai Ma¹, Tom Eichele⁴, Kent A. Kiehl², Godfrey D. Pearlson^{5,6}
and Tülay Adalı^{1*}

Is there anything 'special' about people who commit homicide?

Youth Incarcerated Sample

Homicide (n=20) vs
not (n=135)

VBM results, controlling for
brain volume, PCL-YV,
substance abuse.



Burden of Crime in Wisconsin

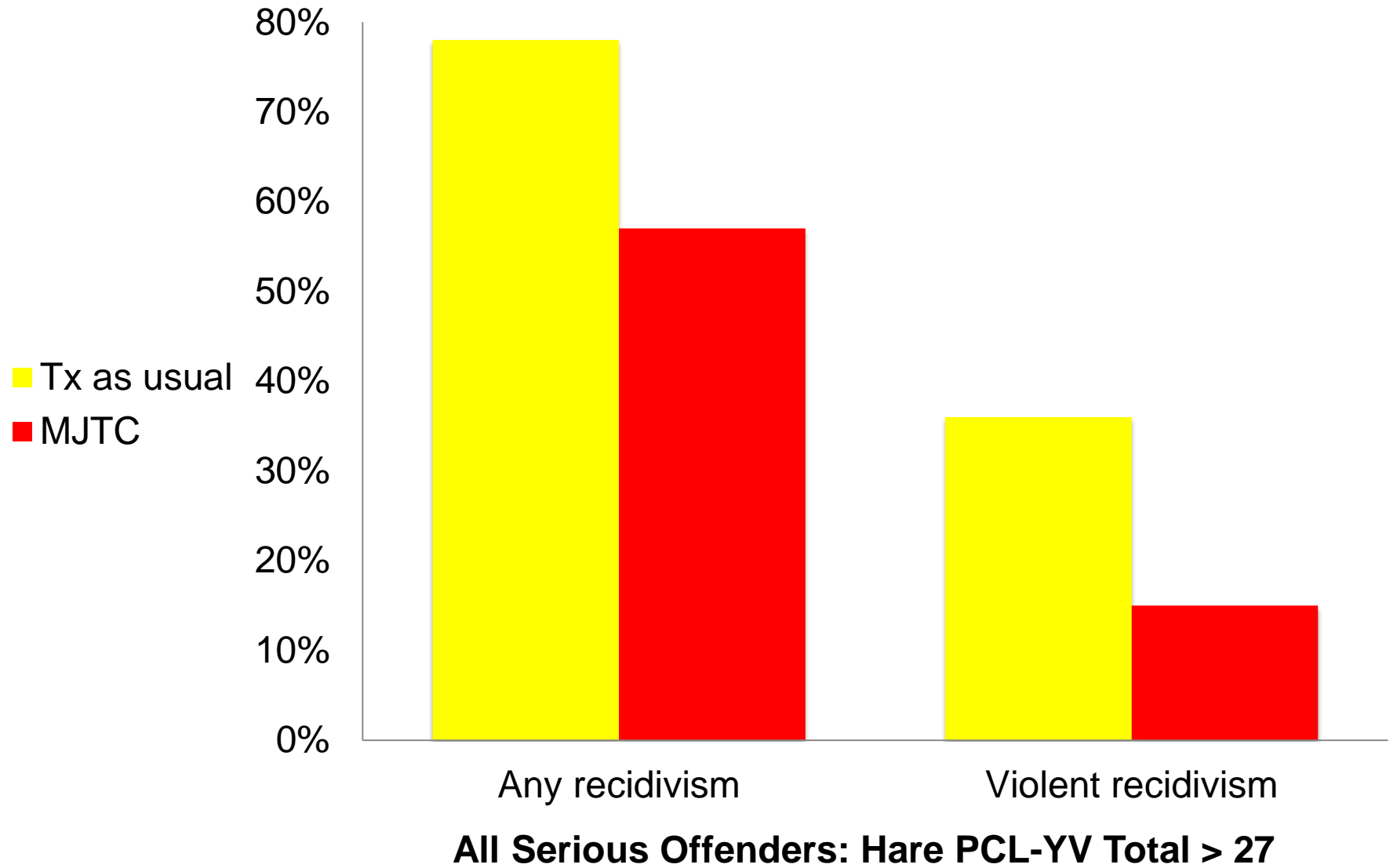
- Wisconsin budget is \$1.1 billion for the 180,000 students in the University of Wisconsin system (\$6000/per)
- State of Wisconsin spends \$1.0 billion on 22,000 inmates; over 45,000 per inmate
- 7.5x the cost per inmate as UW student!

Burden of Crime in Arizona

- State of Arizona budget is \$700,000,000 for the 136,000 students at ASU, U of A, & NAU; \$5,000 per student
- State of Arizona spends ~\$1 billion on 40,000 inmates; over \$25,000 per inmate
- 5x the cost per inmate as an Arizona student!

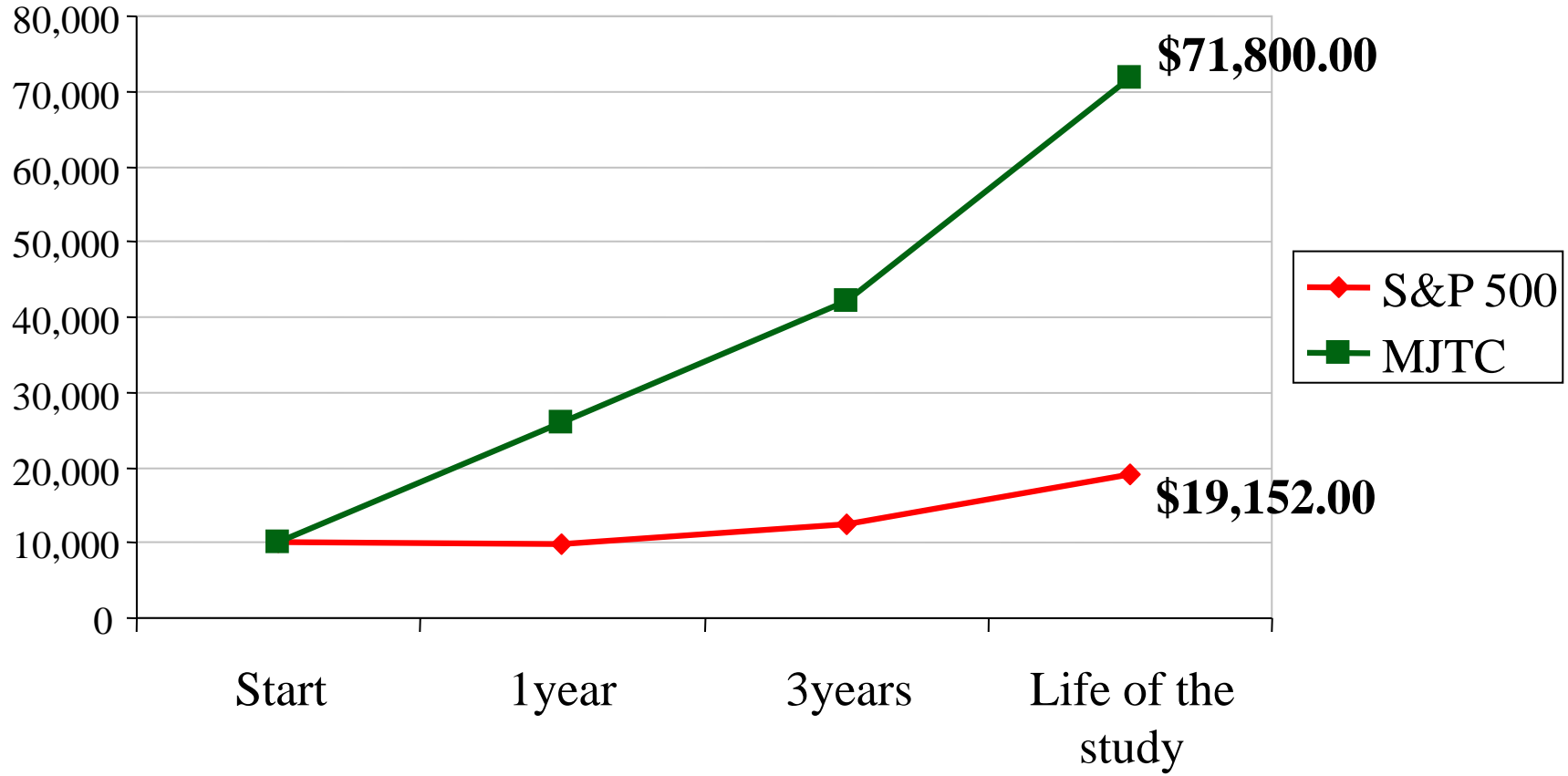
Importance of Early Intervention

Youth Treatment Study (2-year follow-up)



(Caldwell et al., 2006)

Return on \$10,000 investment in treatment



Acknowledgments

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- **Washington University** – Ben Shannon and Marc Raichle
- **UCSB** – Scott Grafton, Mike Miller, and Mike Gazzaniga
- **UMass** – Gina Vincent
- **Yale/Institute of Living** - Adam Jaffe, Charles Wilber
- **UW Madison** – Joe Newman, Mike Koenigs

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- **More details:** email kkiehl@unm.edu