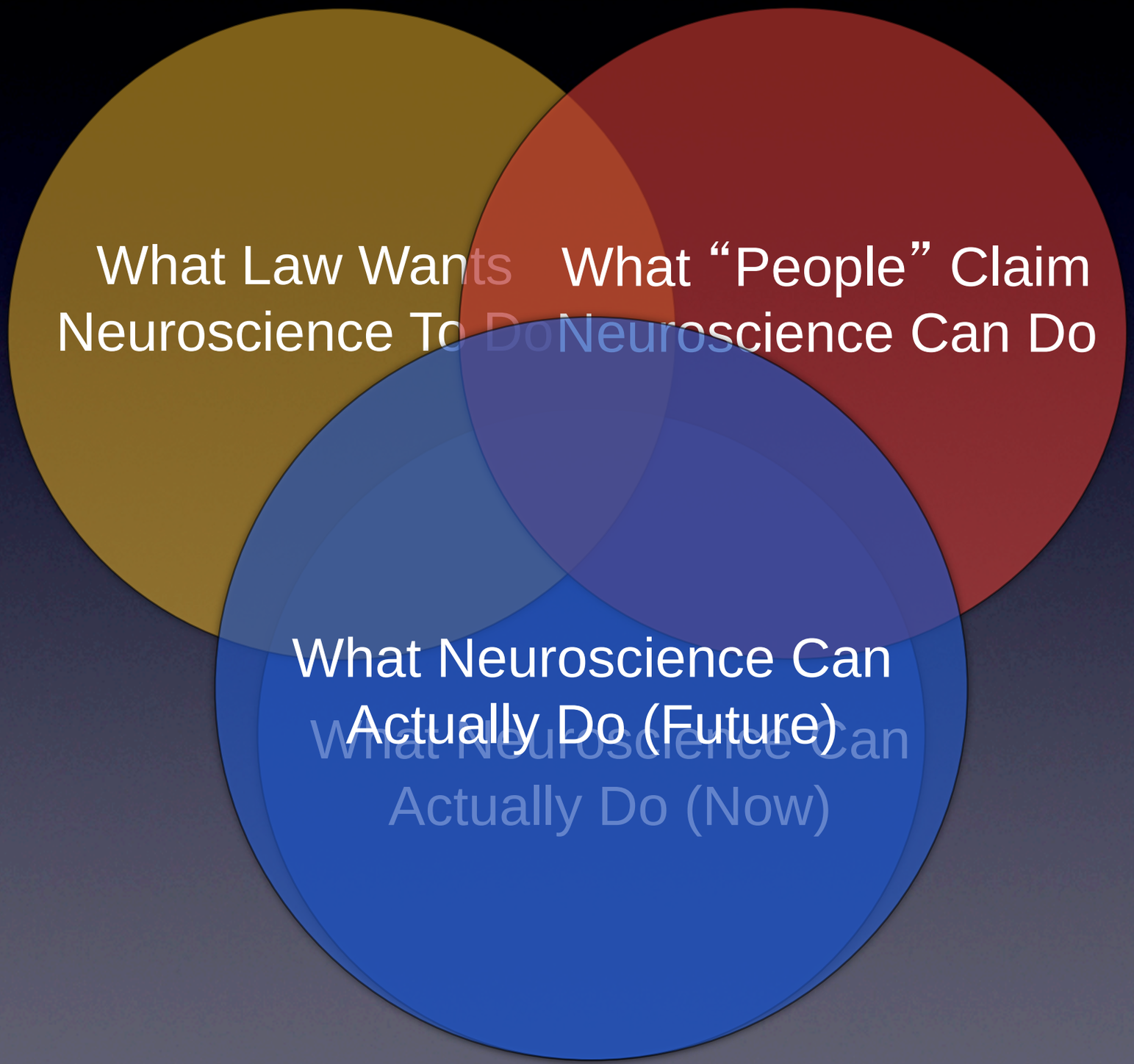
SNPLab
Systems Neuroscience of Psychopathology Lab

Joshua W. Buckholtz

Fuzzy Laws, Broken Brains, and Bad Behavior:
Big Problems for Neuroscience and Law

The *Big* Big Problem



Domains of Engagement

Mental States

Intent

P v. K. v. R. v. N.

Bias

Suffering

Lying

Domains of Engagement

Mental States

Debate on brain scans as lie detectors highlighted in Maryland murder trial

Cereb Cortex. 2008 Feb;18(2):451-5. Epu

Lie-specific involvement of dorsolateral prefrontal cortex in deception.

Priori A, Mameli F, Cogiamanian F, Marceglia S, Tiriticco M, Mrakic-Sposta S, Ferrucci R, Zago S, Polezzi D, Sartori G.

Department of Neurological Sciences, University of Milan, Fondazione IRCCS Ospedale Maggiore Policlinico, Mangiagalli e Regina Elen

J Forensic Sci. 2009 Jan;54(1):220-31. Epub 2008 Nov 29.

Functional MRI detection of deception after committing a mock sabotage crime.

Kozel FA,

Departmer

Neuroscientists: Mercenaries in the Courtroom

Using brain imaging to select jurors and more could have disastrous results.

By David DiSalvo | Posted Thursday, Oct. 18, 2012, at 8:22 AM ET

Neuron. 2009 Dec 10;64(5):756-70.

The neural circuitry of a broken promise.

Baumgartner T, Fischbacher U, Feierabend A, Lutz K, Fehr E.

Institute for Empirical Research in Economics, Laboratory for Social and Neural Systems Research, University of Zurich, Switzerla

fMRI Lie Detection Gets Its Day in Court

Through a Scanner Darkly: Functional Neuroimaging as Evidence of a Criminal Defendant's Past Mental States

Domains of Engagement

Capacity (for "Self-Control")

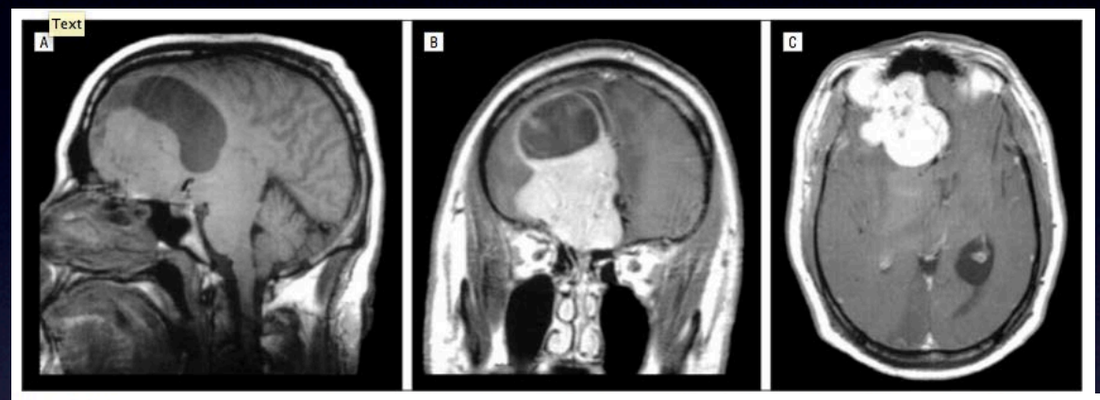
Maturity

Impairment

Psychosis

Domains of Engagement

Capacity (for "Self-Control")



Brain tumour causes uncontrollable paedophilia

Psychopaths Get a Break from Biology

JUDGES REDUCE SENTENCES IF GENETICS, NEUROBIOLOGY ARE BLAMED

Neuroethics
May 2011

The Monoamine Oxidase A (MAOA) Genetic Predisposition to Impulsive Violence: Is It Relevant to Criminal Trials?

Lighter sentence for murderer with 'bad genes'

Italian court reduces jail term after tests identify genes linked to violent behaviour.

Domains of Engagement

Prediction and Prevention

Future Dangerousness

Treatment Response

Domains of Engagement

Prediction and Prevention

June 12, 2011

Criminal Minds

Adrian Raine thinks brain scans can identify children who may become killers

Should We Screen Kids' Brains and Genes To ID Future Criminals?

Screening IDs kids prone to be criminals, ASU professor says

where several leading experts of genetics will be attending. Marchant said he plans to explore the possibility of screening young children for the MAO-A allele.

"If [the results] show that there are children demonstrating a very high risk of committing crime, and there was an effective intervention for them, whether it be pharmaceutical or behavioral, it could save a lot of grieving," he said.

Genetic Variation in KCNH2 Associated With Expression in the Brain of a Unique hERG Isoform Modulates Treatment Response in Patients With Schizophrenia

Dopamine D2 receptor genetic variation and clinical response to antipsychotic drug treatment: A meta-analysis

Jian-Ping Zhang, MD, PhD, Todd Lencz, PhD, and Anil K. Malhotra, MD

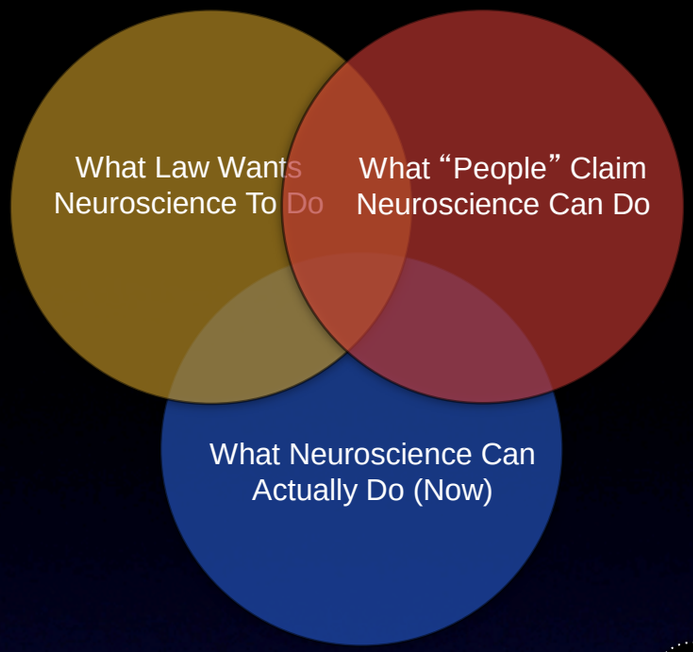
Domains of Engagement

Mental States

Capacity

Prediction


STOP



Plan of Attack

Clarify Relevant Legal Standards

Articulate What Law Wants From Science

Is It Operationalize-able?

Is Person-Level Inference Valid?

Is Brain Better Than Behavior?

Plan of Attack

Translation

- Clarify Relevant Legal Standards
- Articulate What Law Wants From Science
- Is It Operationalize-able?

Validation

- Is Person-Level Inference Valid?
- Is Brain Better Than Behavior?

Translation Issues

Self-Control

Irresistible Impulse

Volitional Impairment

Appreciate Wrongfulness of Conduct

Control Complex Bodily Functions

Premeditate

Contemplate Consequences

Waiting
(e.g. CPT)

Reversing
(e.g. WCST)

Suppressing
(e.g. Stroop)

Delaying
(e.g. temporal discounting)

Stopping
(e.g. SSRT)

Not Starting
(e.g. Go/NoGo)

Translation Issues

Self-Control

"Substantial inability to conform behavior to the requirements of the law"

- Waiting (e.g. CPT)
- Reversing (e.g. WCST)
- Suppressing (e.g. Stroop)
- Delaying (e.g. temporal discounting)
- Stopping (e.g. SSRT)
- Not Starting (e.g. Go/NoGo)

Validation Issues

The *G2i* Problem

"*Science* attempts to discover the universals hiding among the particulars; *Trial courts* attempt to discover the particulars hiding among the universals."

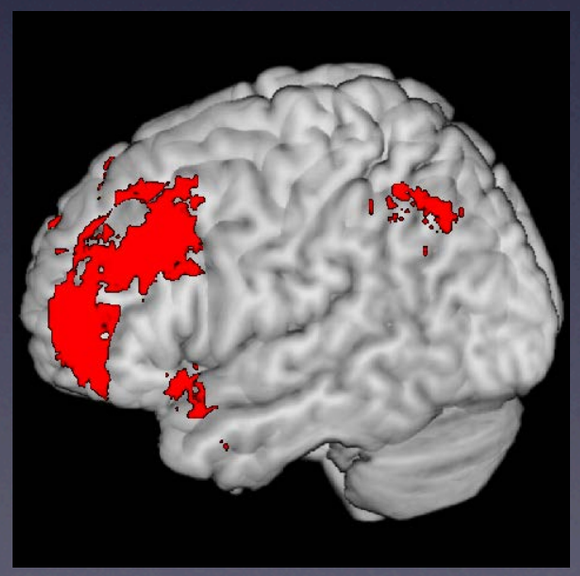
Faigman 1999

Validation Issues

The *G2i* Problem

Condition 1: “Tell the Truth”

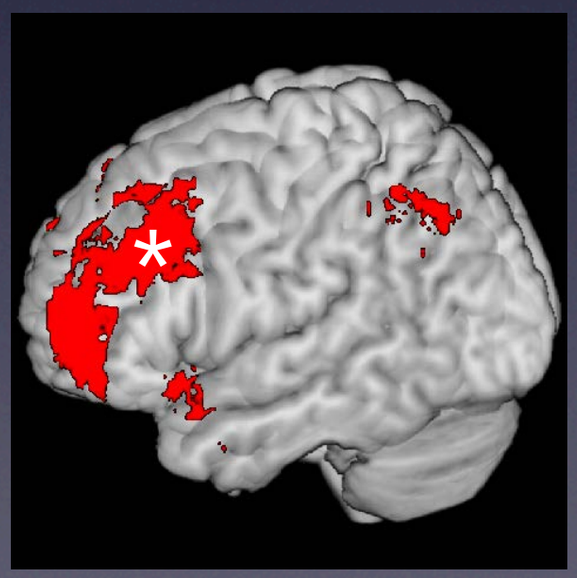
Condition 2: “Tell a Lie”



Lying > Truth

Validation Issues

The *G2i* Problem



Lying > Truth

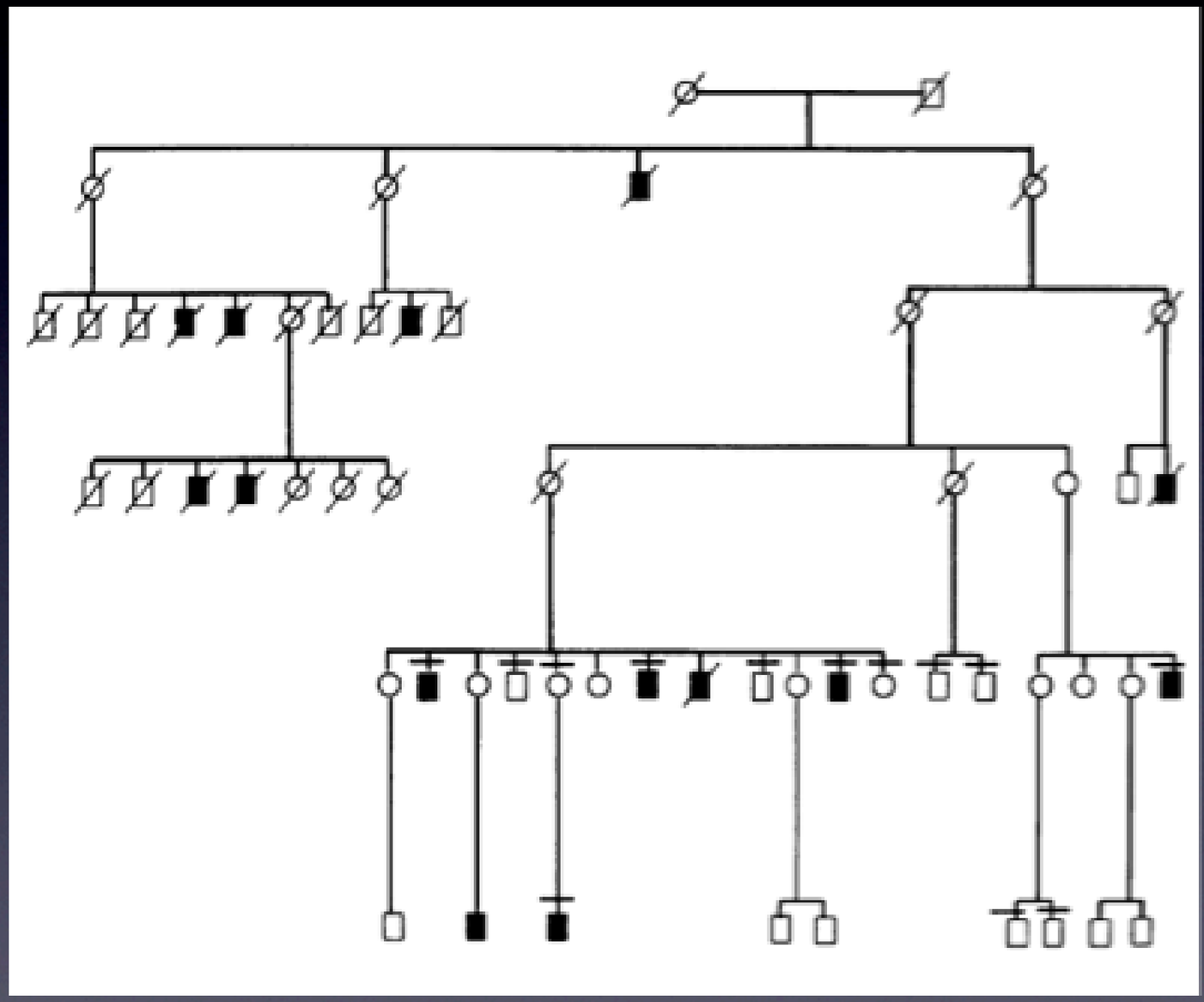
Subject	Truth	Lying
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

The *G2i* Problem

MAOA: Requiem for A“ Violence” Gene

The *G2i* Problem

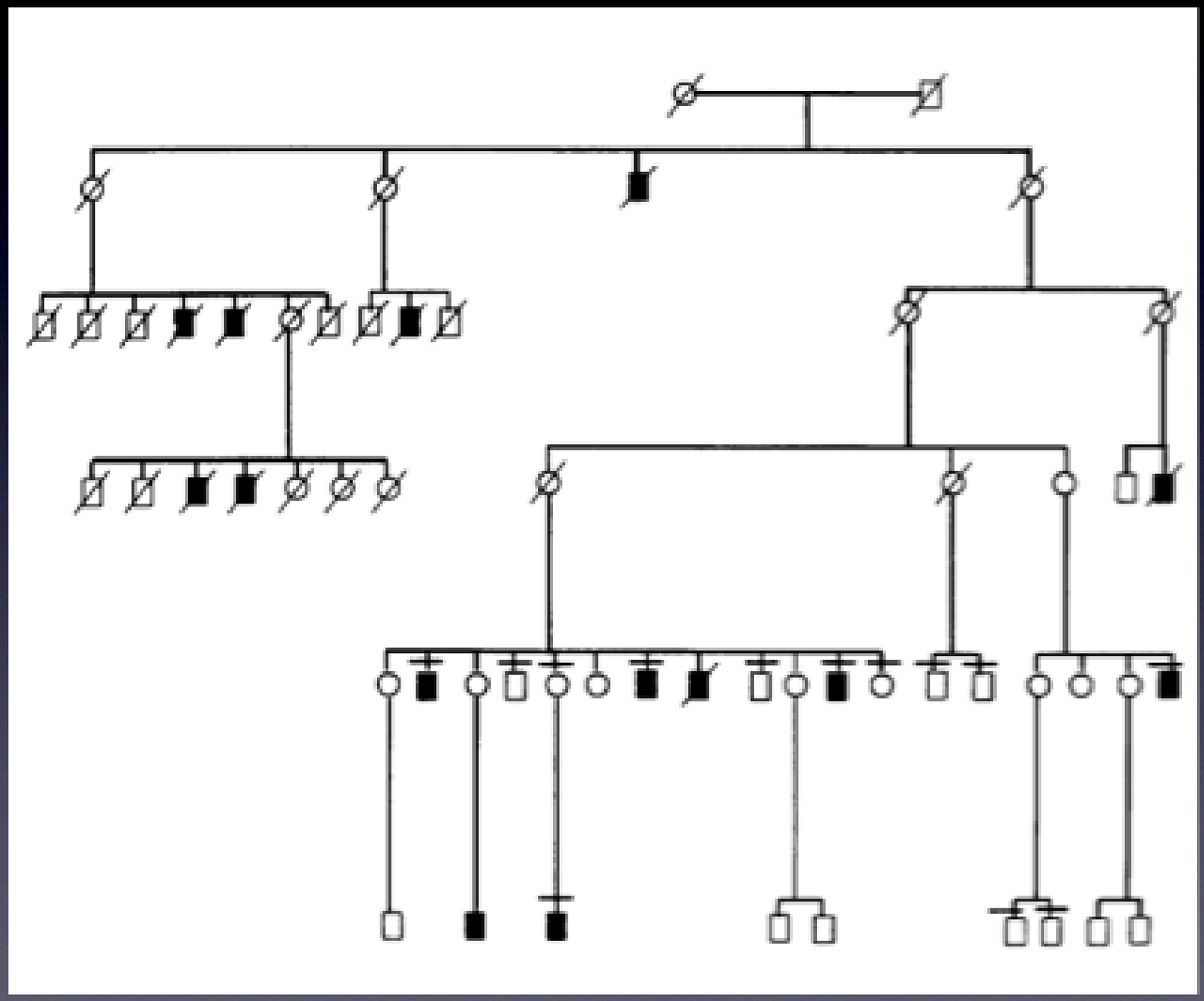
MAOA: Requiem for A “Violence” Gene



GENETIC PEDIGREE OF VIOLENT DUTCH FAMILY

The *G2i* Problem

MAOA: Requiem for A “Violence” Gene

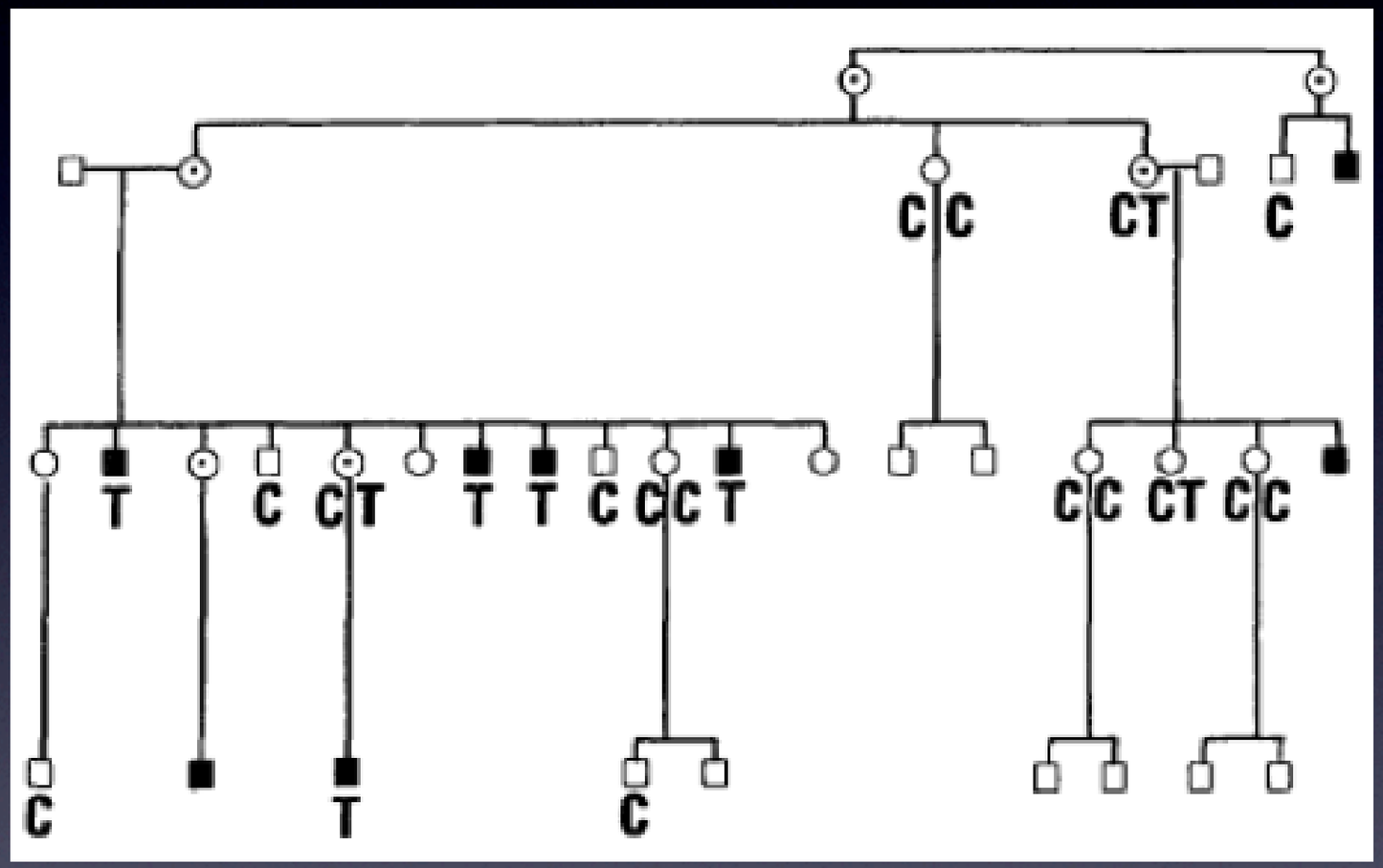


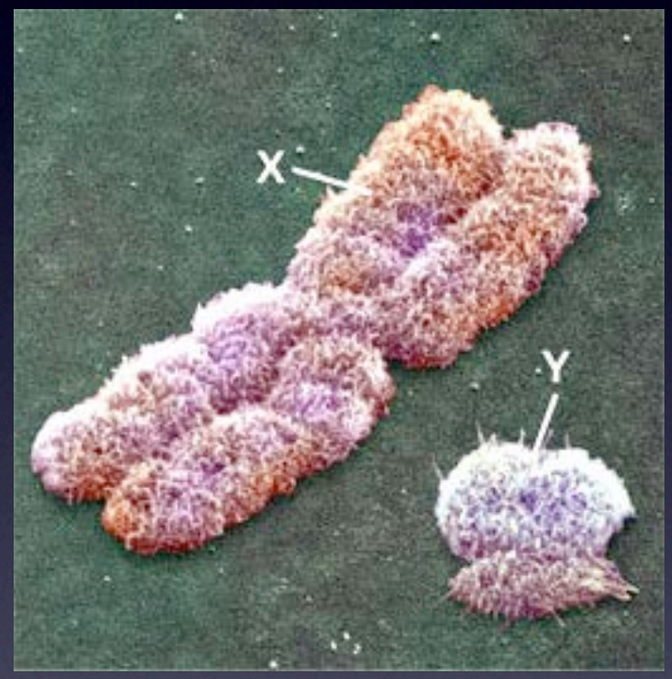
GENETIC PEDIGREE OF VIOLENT DUTCH FAMILY

Han Brunner

The *G2i* Problem

MAOA: Requiem for A “Violence” Gene



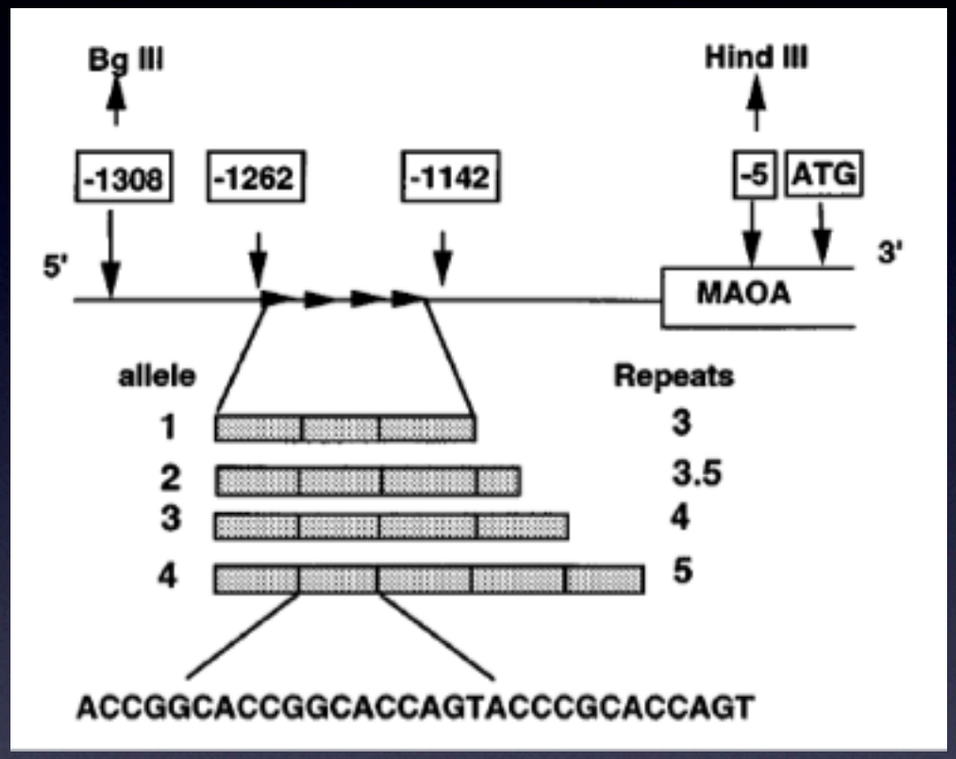


Premature STOP mutation in *MAOA*

Functional Human MAOA knockout

The *G2i* Problem

MAOA: Requiem for A “Violence” Gene

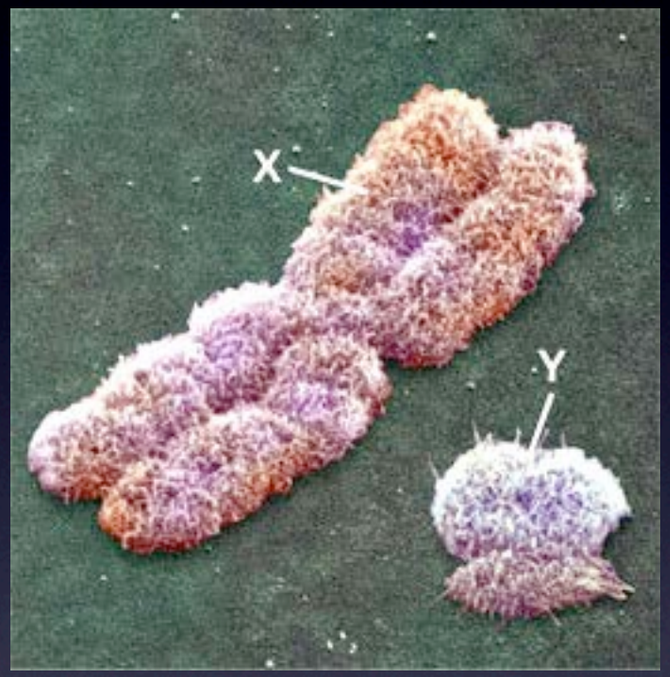


The MAOA uVNTR: A Common Functional Polymorphism

Repeats (allele)	3	3.5	4	5
Expression	LOW	HIGH	HIGH	LOW
5HT Levels	HIGH	LOW	LOW	HIGH
RISK	HIGH	LOW	LOW	HIGH

The *G2i* Problem

MAOA: Requiem for A “Violence” Gene

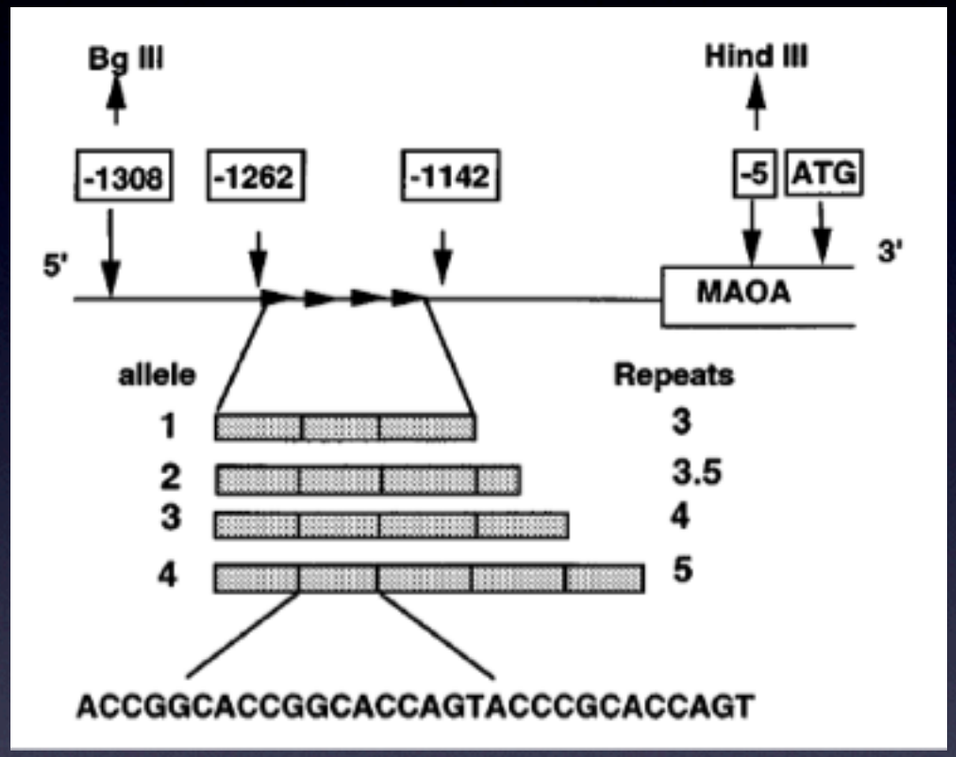


	Low Allele	High Allele
Violent	55%	50%
Not Violent	45%	50%

Repeats (allele)	3	3.5	4	5
Expression	LOW	HIGH	HIGH	LOW
5HT Levels	HIGH	LOW	LOW	HIGH
RISK	HIGH	LOW	LOW	HIGH

The *G2i* Problem

MAOA: Requiem for A “Violence” Gene



Associations to Aggressive Traits	[redacted]
Associations to Aggressive Behavior	[redacted]
Associations to “unrelated” phenotypes	[redacted]
Weak Effect Sizes	[redacted]
Null Findings	[redacted]

Repeats (allele)	3	3.5	4	5
Expression	LOW	HIGH	HIGH	LOW
5HT Levels	HIGH	LOW	LOW	HIGH
RISK	HIGH	LOW	LOW	HIGH

Are Legally Meaningful Inferences Valid?

G2I

- Intent
- Bias
- Suffering
- Lying
- Maturity
- Impairment
- Violence Prediction
- Treatment Prediction

- Multi-dimensionalConstructs Problems
- Bad Reverse Inference
- Face Validity Problems
- Thresholding/Cutoff Issues
- Sensitivity/ Specificity
- Polygenicity
- Pleiotropy

Neuroscience and Law: Tips for a Happy Marriage

Begin With Translation

Domain	Legal Standards	What Does Law Want Data to Say?	What Does Science Think It Can Say?	Incremental Validity?
				
				
				

Neuroscience and Law: Tips for a Happy Marriage

Solve the G2i Problem

Domain	Legal Standards	What Does Law Want Data to Say?	What Does Science Think It Can Say?	Incremental Validity?