A Neurodevelopmental Perspective on Male Violence

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Early Origins of Male Violence, Santa Fe, May 1, 2019
A NEURODEVELOPMENTAL PERSPECTIVE ON VIOLENCE

1. The neurodevelopmental perspective
2. Early influences on development
3. Neural mechanisms
4. Neuromoral perspective
5. Prevention strategies
6. Why males?
Antisocial Personality as a Neurodevelopmental Disorder
Raine (2018), *Annual Review of Clinical Psychology*

1. Originates often before grade school
2. Abnormalities in brain structure / function
3. Accompanied by neurocognitive impairments
4. Significant genetic basis
5. Runs relatively stable developmental course without remission / relapse
6. Continues into adulthood resulting in social, academic, and occupational functioning.
   + + + + +
   a. invariably, but not exclusively, a male condition
   b. low base rate
   c. comorbidity with other neurodevelopmental disorders
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Minor Physical Anomalies

- Low Seated Ears
- Furrowed Tongue
- Single Palmar Crease
- Curved 5th Finger
- Third Toe Longer than Second
- Fine Hair
- Abnormal Head Size
- Big gap between 1\textsuperscript{st} and 2\textsuperscript{nd} toe

Waldrop et al. (1978); Halverson & Victor, (1976); Paulus & Martin, (1986); Mednick & Kandell (1988); Brennan et al. (1993); Pine et al. (1997); Arseneault et al. (2000); Ryan et al. (2012); Teny et al. (2015); Dyshniku et al., (2015)
Lead – Assault Correlations at City Levels

Cecil (2008)
Lead levels at 2-3 years and brain volume
Birth x Rejection interaction (p < .002)

Raine et al. (1994)

Piquero and Tibbetts (1999)
Brennan, Mednick et al. (1999)

- 4,169 males born 1959-1960 in Copenhagen

> 20 other studies find same relationship
Prenatal Nutrition and Adult Antisocial Personality

Prenatal Exposure to Wartime Famine and Development of Antisocial Personality Disorder in Early Adulthood

Context: Several observational epidemiological studies report an association of pregnancy and obstetric complications with development of antisocial personality disorder (ASPD) in offspring. However, the precise nature and timing of the hypothesized biological insults are not known.
FETAL ALCOHOL SYNDROME (FAS)

Streissguth et al. (1996): N = 473

- 61% rate of delinquency
- 58% police contacts in adulthood
- 54% males (33% females) arrested / convicted after age 12
Jamillah Falls, Memphis, TN

Baby girl born July 5, 2014
Baby tested positive for heroin & marijuana
Convicted of assault - 6 months in prison

PARENTAL RESPONSIBILITY
OR ...
HELP, NOT HANDCUFFS
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Prefrontal Dysfunction in Murderers

Raine et al., 1994, Biological Psychiatry, 42, 495-508

41 controls                          41 murderers

NORMAL                          MURDERER

NORMAL CONTROL    REACTIVE MURDERER    PROACTIVE MURDERER
Psychopathy: Striatum and Rewards

**Structure**
Glenn et al. (2010)
*Biol. Psychiatry, 67, 52-58*

- 9.6% volume *increase* in psychopaths

**Function**
Buckholtz et al. (2010)
*Nat. Neuro. 13, 419-421*

- Psychopathy and reward hypersensitivity
Cavum Septum Pellucidum (CSP)

The relationship between large cavum septum pellucidum and antisocial behavior, callous-unemotional traits and psychopathy in adolescents

Cavum Septum Pellucidum is associated with:

- higher psychopathy scores
- increased proactive aggression
- diagnosis of disruptive behavior disorder

1,432 male prisoners: CSP and ↑ psychopathy (Crooks et al., 2018)
355 female prisoners: CSP and ↑ psychopathy (Crooks et al., 2019)
Amygdala and Psychopathy

Yang et al., (2009).
Archives of General Psychiatry, 66, 986-994.

27 psychopaths vs. 32 non-psychopaths
Lack of Fear at Age 3 Predisposes to Adult Crime


N = 1,795 3-year-olds

**Criminal offenders** N = 137

**Matched controls** N = 274

Match on:
- sex
- ethnicity
- social adversity

\[ d = .35, p < .005 \]
“If not handled with great caution, neurobiological markers can easily be misused to stigmatize individuals who are perceived as a potential threat to society.”

“Neurobiological research offers a great chance to further our understanding of antisocial and criminal behavior.

This understanding should be used to benefit those children who are at greatest risk for a criminal career and to design interventions that are tailored to their needs”.
Amygdala, Moral Decision-Making & Psychopaths

Glenn et al. 2009, Molecular Psychiatry, 14, 5–9

Amygdala Activation

$r = -0.49$
$p < 0.05$

Psychopathy Score
Psychopaths may know right from wrong, but …

Do they having the feeling of what’s right and wrong?
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Neuromoral Theory of Antisocial Behavior

Raine (2019) *Psychiatry Research*

Moral + Antisocial

Moral only

Antisocial only

Darby et al. (2018). *PNAS, 115, 601-606*

All lesions functionally connected to:  
OFC, vmPFC, medial PFC, anterior temporal, NA
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Omega-3 and Child Antisocial Behavior


Group x Time, p = .0001

Child Antisocial Behavior

p < .025
d = .38
Transcranial Direct Current Stimulation (tDCS) and Criminal Intent

Choy et al. (2018) *J. Neuroscience*

Double-blind, stratified, randomized controlled trial

39 tDCS stimulation
42 sham stimulation

% intention to commit crime

47.5% reduction

69.8% reduction

Physical assault

Sexual assault
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Childhood Lead Exposure and Adult Brain Volume: Effect of Gender

Cecil (2008)

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead levels (3y)</td>
<td>13.6 (6.3)</td>
<td>13.1 (5.5)</td>
</tr>
</tbody>
</table>
Low Heart Rate Explains The Sex Difference in Violent Crime

Choy et al. (2017) Criminology, 55, 465-487

Age 0 Years

sex

d = -.69

Age 11 Years

heart rate

Heart Rate (11 y.)

d = -.52

Age 23 Years

crime

Violent Crime (23 y.)

d = 1.09

Low Heart Rate Explained 38.1% of the Sex Difference in Crime
Heart Rate Partially Explains Sex Differences in Child Callous-Unemotional Traits

Ling et al. (2019)

378 11-12 y old boys and girls in Philadelphia

Low heart rate explains 61.5% of the gender difference in callous-unemotional traits.
Sex Differences in Prefrontal Gray Volume
Raine et al. (2001). Molecular Psychiatry, 16, 227-236

Reduced prefrontal gray in antisocial personality disorder

Prefrontal gray volume – antisocial adult correlations

<table>
<thead>
<tr>
<th></th>
<th>Males (N = 72)</th>
<th>Females (N = 12)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>APD Score</td>
<td>Self-report</td>
</tr>
<tr>
<td>Orbito-frontal</td>
<td>-.37**</td>
<td>-.27*</td>
</tr>
<tr>
<td>Middle PFG</td>
<td>-.25*</td>
<td>-.34**</td>
</tr>
<tr>
<td>Superior PFG</td>
<td>-.09</td>
<td>-.18</td>
</tr>
<tr>
<td>Inferior PFG</td>
<td>-.09</td>
<td>.07</td>
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Sex differences in prefrontal gray

% reduction in sex difference after correcting for sex differences in brain volume

Orbital + Middle

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<th>APD</th>
<th>Self-Report</th>
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<tbody>
<tr>
<td>Females</td>
<td>Males</td>
</tr>
<tr>
<td>51.3</td>
<td>52.6</td>
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</tbody>
</table>

p = .40

Sex differences in antisocial behavior

Antisocial Score

p = .007

p = .02

Females Males
1. A neurodevelopmental perspective: Can it make a difference?

2. Early influences on development: MPAs, birth, nutrition, smoking, alcohol, responsibility

3. Neural mechanisms: Prefrontal, striatum, CSP, amygdala

4. Neuromoral perspective: Converging evidence

5. Prevention strategies: Omega-3, tDCS

6. Why males? Vulnerable male brain, low heart rate, prefrontal