

Traumatic brain injury, prisoners and impulsivity

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Overview

- ▶ Definitions and Background
- ▶ Hunter Forensic Head Injury Project
 - New Study 1
- ▶ Offending and impulsivity
 - New Study 2

**Traumatic Brain Injury (TBI):
clinical case definition**

'an occurrence of injury to the head (arising from blunt or penetrating trauma or from acceleration–deceleration forces) that is associated with symptoms or signs attributable to the injury: decreased level of consciousness, amnesia, other neurological or neuropsychological abnormalities, skull fracture, diagnosed intracranial lesions—or death' (2006)

The Centers for Disease Control and Prevention 2006

Impulsivity

- ▶ 'a predisposition toward rapid, unplanned reactions to internal or external stimuli without regard to the negative consequences of these reactions to the impulsive individual or to others'
Moeller, Barrett, Dougherty, Schmitz, & Swann, 2001
- ▶ Validated questionnaires include the Barrett Impulsivity Scale (BIS11)

**Rates of reported TBI within prisoner
populations are very high**

- ▶ USA studies 87% (Slaughter et al. 2003)
- ▶ New Zealand 86% (Barnfield and Leathem 1998)

Rates of reported TBI in non-prisoner populations are much lower

- ▶ ‘Have you ever had a severe head injury that was associated with loss of consciousness or confusion?’ (NIMH Epidemiological Catchment Area Study, Silver et al. Brain Injury 2001;15:935)
 - 8.5% over 18 y
- ▶ ‘Have you ever had a head injury associated with LOC of at least 15 minutes?’ (Canberra Longitudinal Study, Butterworth et al. J Clin Epi 2004;57:742)
 - 5.6–6% in three age-specific cohorts

Association between TBI and psychiatric conditions

adjusted for socio-demographic variables and quality of life age
Silver et al. Brain Injury 2001;15:935

	Odds Ratio	95% Confidence Interval
Major Depression	2.4	1.7-3.4
Dysthymia	2.0	1.2-3.1
Bipolar Disorder	1.4	0.6-3.0
OCD	2.1	1.3-3.4
Panic	2.8	1.5-5.2
Any phobia	1.7	1.3-2.4
Drug abuse/dependence	1.8	1.2-2.5
Alcohol abuse/dependence	2.2	1.7-2.8
Schizophrenia	1.8	1.0-3.3
Suicide attempt	5.7	3.7-8.7

The Hunter Forensic Traumatic Brain Injury Study

Schofield et al. Brain Injury 2006; 20:499–506
Schofield et al. Brain Injury 2006; 20:1409–1418
Schofield et al. Brain Injury; in press
Perkes et al. Brain Injury; in press

Principal Aims

- ▶ Determine rates of TBI and recurrent TBI among individuals entering the criminal justice system and obtain an index of their severity
- ▶ Determine the neuropsychiatric correlates of reported TBI among those recently received into the criminal justice system
- ▶ Assess the validity of self-reported TBI
- ▶ Use the information as a basis for service development

Methods: study participants

- ▶ Participants recruited randomly from among males recently received into local jail (Newcastle police station) or prison (State Prison approximately 50 miles from Newcastle)
- ▶ Questions about TBI and neuropsychiatric symptoms were 'piggybacked' onto an existing 'reception' assessment questionnaire administered to all individuals who are received into police custody
- ▶ Validation of reported past episodes of TBI attempted by accessing hospital records

TBI Questionnaire: elements

- ▶ Frequency of TBI with loss of consciousness (LOC)
- ▶ Frequency of TBI 'that caused you to be dazed and confused but without loss without LOC'
- ▶ Details of first, most recent, and 3 most severe TBI
- ▶ Duration of LOC, if any
- ▶ Side-effects of TBI such as memory problems, headaches, etc
- ▶ Medical treatment/ hospital attendance

Reception questionnaire: elements

- ▶ Basic demographics
- ▶ General health status
- ▶ Drug use
- ▶ Alcohol use (AUDIT)
- ▶ Previous withdrawal symptoms
- ▶ Suicide risk
- ▶ Kessler (psychological distress screener (K10))
- ▶ Community interaction & relationships
- ▶ Psychosis screen
- ▶ Depression screen
- ▶ Personality disorder screen

Results

Participant characteristics n=200 'receptions'

- ▶ All male
- ▶ Age: mean 30 years (SD: 8, range 18–56 years)
- ▶ Education: 58% reached year 10 or less
- ▶ No. of times arrested: mean 17 (SD: 25, range 1–200)
- ▶ 43% were most recently arrested for violent activity
- ▶ No. times previously in prison: mean 3.9 (SD 3.5 range 0–20)

TBI history

- ▶ History of TBI of any severity (i.e. dazed or confused, LOC) in 82%
- ▶ History of TBI with LOC in 64%
- ▶ Median number of TBIs (any severity) was 3 (range 0–250)
- ▶ 43% reported 4 or more TBIs
- ▶ 18% reported 4 or more TBIs with LOC

Association between any TBI and neuropsychiatric features

Odds ratio (95% CI)

	Any TBI vs no TBI
Daily drug use	2.5 (1.1- 5.3)
Screen positive on psychosis screener	3.0 (1.1-8.3) *
Screen positive for Major Depression	5.4 (0.6-42.1) *
Dissocial PD	1.4 (.7-3.0) *

* Adjusted for age, drug use

Summary

- ▶ High prevalence of reported past TBI, consistent with other studies
- ▶ Very high rates of recurrent TBI
- ▶ High levels of ongoing symptoms attributable to TBI
- ▶ TBI associated with daily illicit drug use, psychosis screen positivity, depression

What is the relationship between TBI and offending?

- ▶ 'a head injury leads victims to participate in more than half of the crimes that come to the attention of the police and that result in incarceration' (Sarapata et al. Brain Injury 1998;12:821-42)

Risk factors for TBI are very similar to risk factors for Incarceration

- ▶ Age: 15-24 y at highest risk
- ▶ Male gender
- ▶ Substance abuse
- ▶ Socioeconomic status (lower income)
- ▶ Previous TBI
- ▶ Psychiatric illness

Krass and Chu 2005

Traumatic brain injury rates and sequelae: A comparison of prisoners with a matched community sample in Australia

IAIN PERKES¹, PETER W. SCHOFIELD², TONY BUTLER³, & STEPHANIE J. HOLLIS⁴

Brain injury: in press

Control population for Hunter Forensic Traumatic Brain Injury Study

- ▶ 200 community-dwelling men, matched for location of usual residence with prisoner sample, screened by telephone interview
- ▶ Exclusionary criteria included ever having been arrested
- ▶ Screened for past TBI, neuropsychiatric conditions

Results

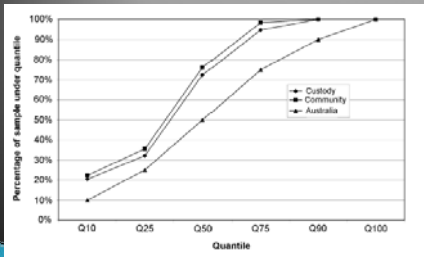
Telephone contact log

Outcome of call	n	%
No males between 18-56 years of age	750	37.2
Telephone disconnected	321	15.9
No answer ^a	235	11.6
Answering machine ^a	137	6.8
Reschedule call	87	4.3
Business telephone or fax number	82	4.1
Unusual dial tone	48	2.4
Previously arrested ^b	42	2.1
Constantly engaged telephone ^a	36	1.8
Personal refusal	27	1.3
Household refusal	26	1.3
Respondent unavailable	22	1.1
Terminated by interviewers	5	0.2
Completed interviews	200	9.9
Total	2018	100.0

^aAfter seven attempts.

^bSubjects met inclusion criteria but were excluded due to previous arrest.

Prisoner and community samples were equally disadvantaged based on Socio-Economic Indexes for Areas (SEIFA)



Perkes et al. Brain Injury, in press

TBI variables significantly higher in prisoner population than in community controls

- ▶ Any TBI
 - 82% vs 72%, (Chi squared 6.18, p=0.018)
- ▶ HI with LOC
 - 65% vs 35%, (Chi squared 34.31, p<0.001)
- ▶ Four or more TBIs
 - 42% prisoners vs 15% (Chi squared 36.16, p<0.001)

Other measures significantly higher in prisoner population than community controls

- ▶ Impulsivity (Chi-Squared 102, p <0.001)
- ▶ Dissocial personality (Chi-Squared 107, p<0.001)
- ▶ Alcohol misuse/abuse (Chi-Squared 97, p<0.001)
- ▶ Illicit drug use (Chi-Squared 59.1, p<0.001)
- ▶ Low educational attainment (Chi-Squared 144, p<0.001)

- ▶ All the above variables were also associated with TBI

Multivariate analyses: Logistic regression with group the outcome

- ▶ Neither frequency of TBI, nor TBI with LOC (OR 1.32, 95% CI 0.56-3.12) was associated with custody status
- ▶ The following measures were independently associated with custody status:
 - education <10 years (OR 3.01, 95% CI 2.17-7.14)
 - illicit drug use (OR 3.19, 95% CI 1.59-6.40)
 - alcohol abuse (audit harmful: OR 10.07, 95% CI 3.26-31.09)
 - impulsivity (OR 4.40, 95% CI 2.03-9.99)
 - dissocial personality (OR 7.14, 95% CI 2.44-20.90)

Interpretation

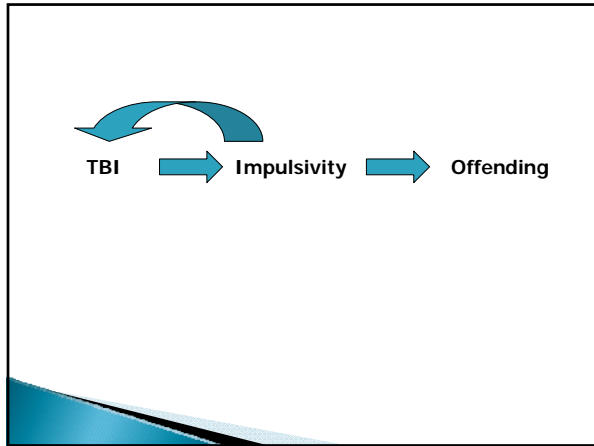
- ▶ The results do not support the hypothesis that TBI leads to offending behaviour
- ▶ Highlights the potential importance of neighbourhood for risk of TBI
- ▶ BUT limitations include:
 - Cross sectional nature of data, uncertainty regarding temporal sequence
 - Uncertainty regarding the severity of TBI
 - Validity of self report?

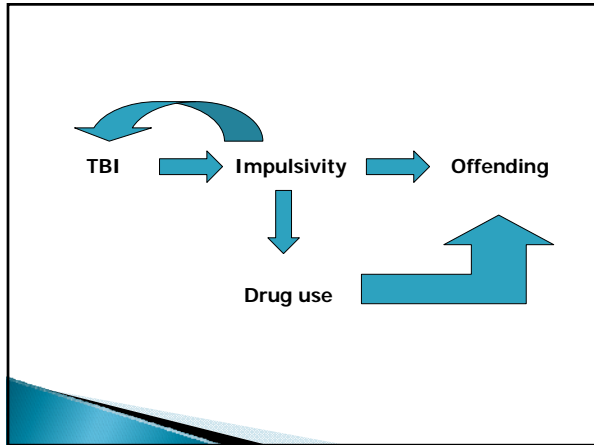


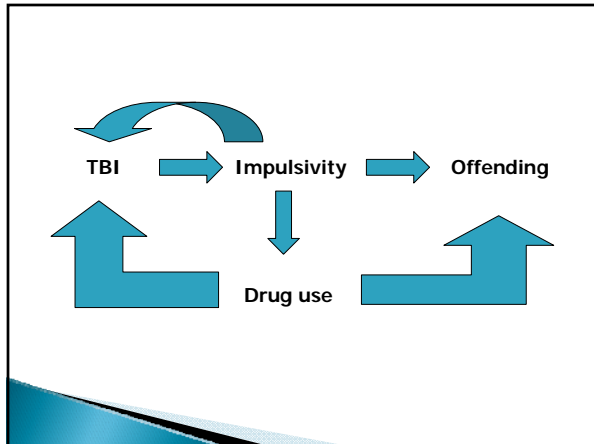
Possible relationships between TBI and offending

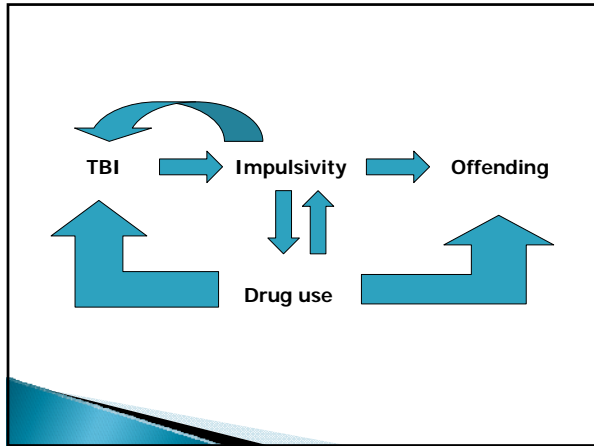


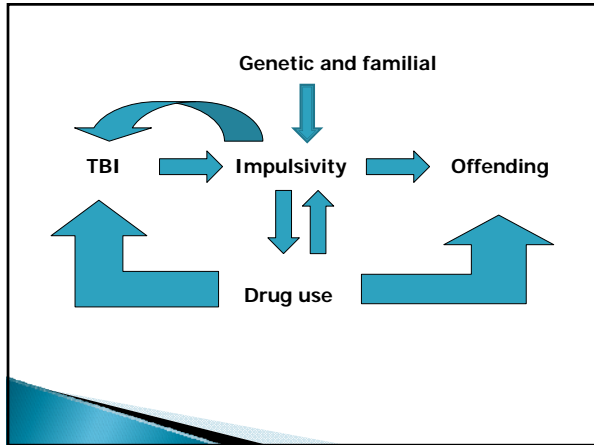
- ▶ 'Before the accident , I engaged in hostile behaviour when I wanted to and when it served my purpose; now I have no control over when I explode' (Silver et al. 2005)

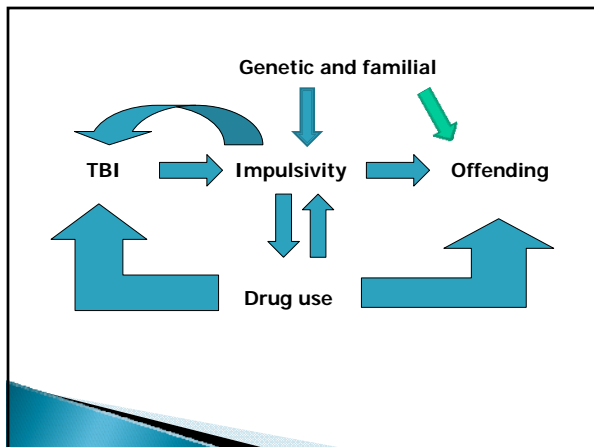












New Study 1

Does traumatic brain injury lead to offending?

- ▶ NH&MRC funded grant CIs: Butler, Schofield, Preen, Tate
- ▶ Record linkage study in progress
- ▶ Birth cohort 1980-85 Western Australia
- ▶ All cases of TBI registered in hospital records
- ▶ Two control groups
 - General population (3 per case, age, gender matched)
 - Same sex siblings within 3 years of age
- ▶ Outcome: recorded conviction

Additional linked data

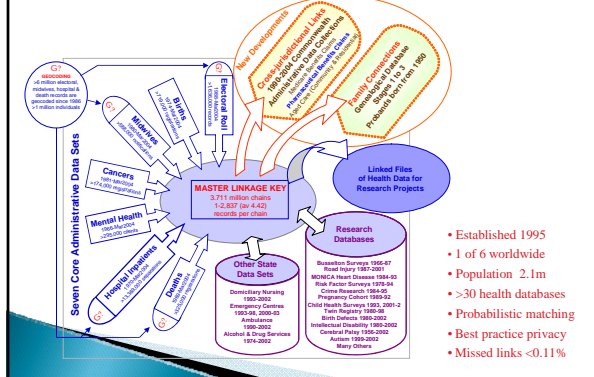
- ▶ Maternal, antenatal, delivery, perinatal data
 - Smoking, health complications
 - Head circumference, birth weight, Apgar score
- ▶ Parental offending history
- ▶ Mental health, substance abuse

Strengths

- ▶ Highly objective index of TBI
- ▶ Temporal sequence assured
- ▶ Sibling controls

Western Australian Data Linkage System

(www.populationhealth.uwa.edu.au/welcome/research/dlu/linkage)



Impulsivity and offending

- ▶ Impaired impulse control seen by many as a fundamental construct underpinning much criminal and antisocial behaviour

Violence and impulsivity

- ▶ Two broad types of violence
 - Affective, reactive, impulsive aggression
 - Thought to account for most social problems associated with aggression
 - Serotonin system implicated
 - Predatory, non-impulsive aggression
 - Different neurobiology, not implicating serotonin

Nelson and Trainor Nature Neuroscience 2007

Violence, impulsivity and serotonin

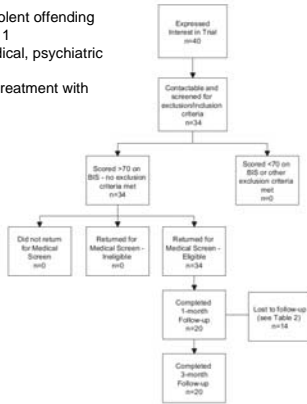
- ▶ Studies on CSF levels of 5-HIAA (a serotonin metabolite)
 - Low levels associated with
 - violent (not non-violent) suicide attempts Asberg et al. 1976
 - Impulsive offender status Lidberg et al. 1985
 - Impulsive fire setters Virkunen et al. 1987
- ▶ Neuroendocrine challenge. Fenfluramine releases 5HT which increases prolactin which can be measured
 - Prolactin response has been inversely correlated with
 - aggression Manuck et al 2000
 - brain activation of key brain regions important for behavioural regulation Siever et al. 1999
- ▶ Genetic studies
- ▶ Intervention studies (SSRI) Coccaro 1997, Reist 2003

Reducing impulsivity in repeat violent offenders: an open label trial of a selective serotonin reuptake inhibitor

Tony Butler, Peter W. Schofield, David Greenberg, Stephen H. Allnutt, Devon Indig, Vaughan Carr, Catherine D'Este, Philip B. Mitchell, Lee Knight, Andrew Ellis

Australian and New Zealand Journal of Psychiatry 2010; 44:1137-1143

History of violent offending
>70 on BIS11
Passed medical, psychiatric
screening
Consent to treatment with
sertraline



Results

Table 3. Mean scores and percentage change at baseline, one, and three months for a range of psychological and behavioural measures

Measures	Baseline (n = 20)		1 month (n = 20)		3 months (n = 20)		p value	% change – baseline to 1 month	% change – baseline to 3 months
	Mean	SD	Mean	SD	Mean	SD			
Impulsivity ¹	89.7	11.5	70.4	10.3	58.5	9.7	<0.001	-21.5	-34.7
Attentional impulsivity	23.4	4.2	17.4	4.9	13.7	3.1	<0.001	-25.9	-41.7
Motor impulsiveness	32.2	3.8	25.6	4.1	21.5	4.4	<0.001	-20.4	-33.1
Non-planning impulsiveness	34.1	6.1	27.5	3.5	23.4	4.6	<0.001	-19.5	-31.5
Irritability ²	24.9	3.9	16.5	5.6	13.8	7.2	<0.001	-33.7	-44.8
Labile anger ³	15.9	4.3	9.8	4.6	6.0	5.6	<0.001	-38.2	-62.5
Direct assault ⁴	24.6	3.3	15.1	5.9	12.2	5.7	<0.001	-38.7	-50.6
Verbal assault ⁴	22.6	3.2	15.3	5.5	13.6	6.1	<0.001	-32.3	-39.8
Indirect assault ⁴	11.1	3.4	4.9	2.9	4.1	3.4	<0.001	-56.3	-63.1
Depression ⁵	21.4	9.5	8.2	5.8	8.2	11.2	<0.001	-61.8	-61.6
Psychological distress ⁴	26.7	7.3	27.9	11.7	26.2	13.5	0.8	4.5	1.7
Mental component score ⁶	32.7	8.7	44.6	10.3	47.7	12.9	<0.001	36.4	45.9
Physical component score ⁶	48.3	11.1	48.4	10.4	51.3	8.8	0.3	0.2	6.2

¹Barratt impulsiveness scale; ²Anger, irritability and aggression questionnaire; ³Beck depression inventory; ⁴Kessler psychological distress scale; ⁵Short-form 12.

Comment

- ▶ Open label study
- ▶ Self report
- ▶ Behavioural/social benefits unclear
- ▶ Significant drop out

- ▶ Participation implies some insight
- ▶ Anecdotes from partners very favourable
- ▶ All participants who completed three months wished to continue sertraline

New Study 2

Reducing impulsive behaviour in repeat violent offenders using a Selective Serotonin Reuptake Inhibitor (sertraline)

- ▶ NH&MRC funded study
- ▶ Randomized controlled Trial, NSW Australia
- ▶ Individuals recruited in prison just prior to release
- ▶ Entry criteria
 - Barrett Impulsivity Scale score >70
 - At least one violent offence

Reducing impulsive behaviour in repeat violent offenders using a Selective Serotonin Reuptake Inhibitor (sertraline)

- ▶ 230 in each arm (sertraline, placebo)
- ▶ Primary outcome: recidivism over one year
- ▶ Secondary outcomes
 - Impulsivity
 - Aggression
 - Depressive symptoms
 - Quality of life
 - Social functioning

Conclusions

- ▶ TBI is very common in offender populations but its relevance for offending behaviour is unclear
- ▶ The serotonergic system is implicated in impulsivity and aggression and is potentially amenable to intervention
- ▶ Two new studies should help to clarify the role of TBI in offending and the possible role of SSRIs in reducing criminal violence

