MILD HEAD INJURY AND EXECUTIVE FUNCTION AS PREDICTORS OF BEHAVIOURAL DISINHIBITION

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Background

Previous research has consistently shown that the frontal lobes, particularly the prefrontal cortex (PFC), are most susceptible to damage during a traumatic brain injury. After the injury, patients with TBI exhibit difficulties with planning, memory and other executive functions. It has also been established that severe damage to the PFC, more specifically the orbitofrontal cortex (OFC), leads to uninhibited and maladaptive behaviour and is often described as impulsivity. Given that 5 - 10% of persons who have sustained a mild head injury (MHI) also experience persistent neurocognitive and physical complaints, it is possible that MHI can lead to behavioral dyscontrol but to a lesser degree than severe TBI. Furthermore, impulsivity is a multidimensional construct, that ranges from behavioural disinhibition such as purchasing items on a whim to an inability to delay gratification.

The purpose of this study was to investigate the relationship between executive function, several dimensions of impulsivity and mild head injury (MHI).

Hypothesis 1:

People who report sustaining at least one MHI will also report higher levels of impulsivity, and more specifically behavioural disinhibition.

Hypothesis 2:

MHI history will predict higher levels of impulsivity, even after accounting for any effects of executive functions.

Method

Participants

Brock University Students (N = 87)

- 51 % (n = 39) reported at least one MHI
  - 31.1% (n = 28) reported sustaining a concussion

Methods and Procedure

Indicators of previous MHI - Self-reported experience of altered state of consciousness:

- Have you ever hit your head against a hard surface sufficient to alter your consciousness (i.e. loss of consciousness, vomiting, dizziness)? Did it result in a concussion?

Measures of Executive Function:

- Working memory:
  - manipulation - Mental Control (WMS-III)
  - anticipation - Trails (DKEFS)
- Sustained attention: auditory attention and response set (NEPSY)
- Reasoning: pictorial analogies subtest (CTONI)

Measures of Impulsivity:

- Decision making: Delayed Discounting Task
- Behavioural Disinhibition: BIS-11

Results

Hypothesis 1:

Participants with a history of MHI reported higher levels of impulsivity as measured by the BIS-11 (F (1,87) = 6.46, p = .013) and this effect was primarily due to behavioural disinhibition (i.e., BIS-M; F (1,87) = 12.01, p = .001) as the groups did not differ on the attention or non-planning subscales (F (1,87)=3.12, p =.081 and F (1,87) = 0.51, p=.476, respectively). The two groups also did not differ on the ability to delay gratification (F (1,77)=0.46, p =.501).

The MHI group was split into two subgroups: MHI with and without a report of concussion. Participants with a history of MHI who also reported a concussion reported significantly higher levels of disinhibition than their no MHI and MHI no concussion counterparts (p < .05). As can be seen in Figure 1 self-reported impulsivity as measured by BIS-11 increases with severity of injury.

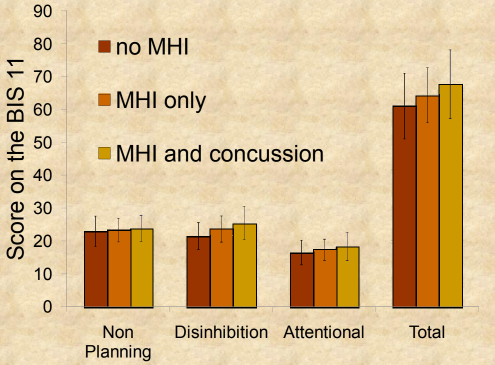

Figure 1: Self reported impulsivity levels split by severity of MHI

Hypothesis 2:

Executive function (assessed by four measures) significantly predicted impulsivity, as measured by BIS-11, and ability to delay gratification. History of MHI did not predict ability to delay gratification over and above measures of executive function (ΔR^2=.003, p=.623); however, it did accounted for a significant portion of the variance in BIS-11 scores over and above measures of executive function (ΔR^2=.046, p=.038; Table 1). Furthermore, as expected, severity of injury significantly predicted behavioural inhibition over and above executive function (Figure 2).

Predictor	β	B	SE B	sr^2	ΔR^2	df	F	p
Step 1								
Reasoning	-0.17	-0.26	0.17	0.03				
Manipulation (WM)	0.14	0.09	0.07	0.02	0.11	4, 82	2.56	0.044
Anticipation (WM)	-0.29	-0.16	0.06	0.08				
Sustained Attention	0.11	0.13	0.13	0.01				
Step 2								
MHI	0.32	2.94	0.92	0.10	0.10	5, 81	4.31	0.002

R^2 = 0.21, F (5,81) = 4.31, p = .002

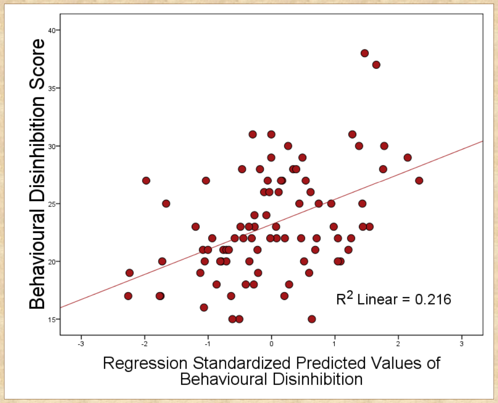

Figure 2: Self-Reported Behavioural Disinhibition for no MHI and MHI with/without concussion

Discussion

In summary, history of MHI was associated with an inability to withhold responding (disinhibition) but not any other dimension of impulsivity (i.e., planning, attention or ability to delay gratification). Furthermore, impulsivity levels increased as a function of severity of injury.

The results provide support for the multidimensional nature of impulsivity, but also demonstrate that MHI is linked to only a subset of these dimensions; specifically it is associated with the behavioural presentation of impulsive actions. Although participants in the MHI group reported higher levels of impulsivity across all subscales of the BIS-11, they did not present with an impulsive personality and differed significantly only on the measure of behavioural dyscontrol.

Thus, cognitively competent university individuals who have experienced mild, but notable, head injury, report higher levels of behavioural dyscontrol, indicative of detectable and persistent effects compatible with OFC disruption; and this capacity increases proportionally with indicators of increased severity of injury.

Conclusion

Mild injuries to the head may be subtle, but clearly are not trivial since simply acknowledging a history of a notable impact injury to the head is sufficient to produce measurable changes in self-reported behavioral dyscontrol.

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