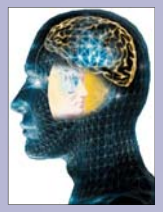

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Decision Making, Personality and Physiological Arousal in Students with Mild Head Injury

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Introduction

➢It is estimated that 80-90% of the 57 million hospitalized persons following a traumatic brain injury (TBI) can be classified as mild head injury (MHI)[1]. While much of the literature has focussed on the wide range of physical, cognitive, behavioural and affective deficits[1, 2] following moderate-severe TBI, there is a paucity of literature on the potential ramifications of milder forms of injury.

➢Due to the acceleration/deceleration forces generated during impact trauma, the Ventromedial Prefrontal Cortex (VMPFC) is particularly susceptible to damage due to its proximal relation to the orbital protrusions of the skull[3, 25]. In studies on moderate to severe brain injuries, damage to this area has been associated with significant personality changes, such as a general dampening of emotional experience, poorly modulated emotional reactions, lack of empathy, socially inappropriate behavior, lack of insight and aggression[4]. Such behavioural tendencies especially **manifest** themselves when confronted with complex social decisions (e.g., uncertainty, morality). It has been found that individuals with severe VMPFC injury are more likely to commit personal moral violations (i.e. make utilitarian decisions) than impersonal violations and take less time in doing so, relative to healthy controls[5].

➢To explain the neurobehavioral deficits observed in these individuals, it has been proposed that "somatic markers" or "gut" feelings influence decision making in complex/uncertain situations[6] . This physiological input is disrupted with VMPFC injury rendering the individual physiologically underaroused, such that due to lack of physiological (visceral) feedback, individuals make "un-informed" decisions.

➢Similarly, recent findings with high functioning individuals (university students) who report a history of mild head injury experience cognitive variances[7] , reduced sympathetic arousal[8] and are more likely to make utilitarian decisions relative to their non-injured cohort[9]. Thus, even in persons with mild head injuries, moral decision making is altered.

➢Therefore, the current study aims to further explore these effects of mild head injury on moral decision making and physiological arousal to elucidate the effects of MHI on cognitive, social, and emotional functioning by examining the influences of the types of dilemmas (as a function of intentionality and transgression outcome) as well as individual differences (as in personality and emotional expression).

Hypotheses

Relative to their no MHI cohorts, we expect persons who have experienced an MHI to:

1. **be more likely to endorse personal moral violations i.e. intentional (direct) violations leading to physical harm;**
2. **to make riskier decisions reporting a greater erratic lifestyle, higher likelihood to engage in antisocial behaviour and a tendency to react aggressively;**
3. **to report themselves as equally capable problem solvers in social situations as the no MHI group;**
4. **be physiologically under-aroused, even as severity of transgression outcome increases from indirect non-moral to direct physical harm.**

Method

PARTICIPANTS

➢University students (53 females, 30 males), 30% self reporting a history of mild head injury. Mean age = 20.8 years (*SD* = 4.1).

MEASURES AND PROCEDURE

➢**Moral Decision Making Task[10]:** Scenarios of moral dilemmas that were modified to vary as a function of *transgression outcome* (non-moral consequence, nonphysical harm outcome, physical harm outcome) and *intentionality* (direct versus indirect).

➢**Physiological Measures:** pulse rate, electrodermal activity [EDA], and respiration[11, 24] using the *Polygraph Professional* system; Self report ratings of stress.

➢**Questionnaires:** The Buss Perry Aggression Questionnaire (BPAQ) [12], State Trait Anxiety Inventory (STAXI-2)[13], Self-report Psychopathy Checklist (SRP III)[14], Social Problem Solving Inventory (SPSI-R)[15], Post–Concussive Symptoms Checklist (PCSC)[16], and the Brock Neuropsychology Cognitive Research Laboratory Demographic Questionnaire (BNCRLDQ)[17]

➢**Neuropsychological Measures:** subtests of the Wechsler Memory Scale-III[18], the Delis Kaplan Executive Function System[19], and the Comprehensive Test of Nonverbal Intelligence[20]

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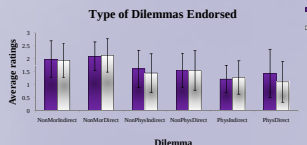
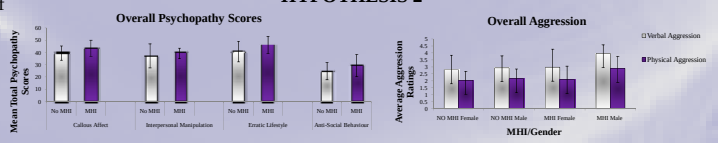
Results

HYPOTHESIS 1



An ANOVA assessing subjects' endorsements of moral dilemmas revealed a significant Group x Intentionality x Moral Outcome interaction (F (2, 162)=2.53, p=.03). Post hoc analysis showed that students who reported no history of MHI were most likely to endorse non-moral over moral transgressions that involved nonphysical outcomes (e.g. stealing), which in turn were endorsed more likely than dilemmas that led to physical harm. However, students with a prior history of MHI were more likely to endorse non-moral dilemmas over other transgressions, but did not differentiate in their endorsements of non-physical and physical dilemmas. MHI students endorsed more intentional violations that lead utilitarian outcomes than students with No-MHI (p<.05).

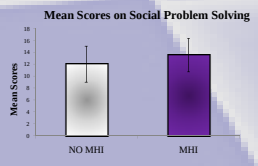
HYPOTHESIS 2



University students with a history of MHI relative to their no MHI cohort, scored higher on Erratic Lifestyle and Anti-social Behaviour (Secondary Psychopathy), F (1,48) = 4.17, p < .05.

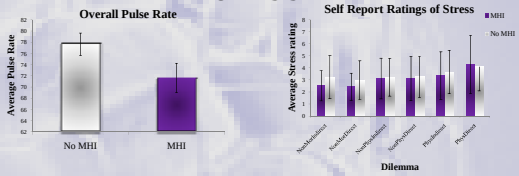
Participants self reporting a history of MHI were significantly more likely to endorse aggression items on the Buss Perry inventory (Physical/Verbal subscales) compared to their non-MHI comparisons (p = .002). Likewise, a similar gender effect was found for males endorsing more items (p = .002).

HYPOTHESIS 3



Despite scoring higher on components of psychopathy (erratic lifestyle, antisocial behaviour, & callous affect) as well as endorsing greater intentional moral transgressions leading to physical harm, individuals with a history of MHI report themselves as better problem solvers than their no MHI cohort, F (1,49) = 1.63, p > .05.

HYPOTHESIS 4



The MHI group was relatively underaroused compared to those without a history of head injury. Collapsed across different conditions, individuals with a history of MHI showed a reduced pulse rate, F (1,47) = 3.35, p < .05, relative to their no MHI cohorts. Furthermore, they reported significantly lower stress than the no-MHI groups even as the severity of transgression outcome increased, F (1,79) = 3.048, p < .02.

Discussion

Current findings challenge the dichotomy between brain and head injury and suggest that even subtle trauma to the head, in the absence of major neuronal loss, can cause differential responding amongst participants. Consistent with our hypotheses, participants reporting a history of mild head injury were more likely to endorse direct (intentional) violations leading to physical harm relative to their no MHI cohort. They also scored higher on components assessing erratic lifestyle and anti-social behavior and reported a greater tendency to react aggressively (physical and verbal aggression). Interestingly, despite reporting greater likelihood of taking riskier decisions and anti-social behavior, while endorsing more direct-physical moral transgressions (and providing less justification in reaching those decisions), individuals with a history of MHI report themselves to be better problem solvers relative to their no MHI cohorts. This may reflect the lack of insight observed in individuals with more serious brain injury[4, 21]. Furthermore, we replicated previous findings from our lab[8, 22, 23] and found that individuals with a history of MHI were physiologically underaroused relative to their noninjured peers. By targeting a competent university sample, our findings suggest that it is not a matter of intellect but emotional input that guides decision making in ambiguous and emotionally pressing social (or moral) situations, putting such individuals at risk of physical/emotional harm within the social domain.

Conclusions

The present findings indicate that the social behavior of students with mild trauma mirrors those of persons with more moderate to severe trauma to the VMPFC. While viewing themselves as more competent social problem solvers than their non-injured counterparts, ***university students with a history of MHI, endorse more direct violations leading to physical harm, report a more erratic lifestyle, a greater likelihood to engage in anti-social behaviors, and a tendency to react aggressively.*** Additionally, ***students with a history of MHI demonstrated lowered physiological arousal as well as reported feeling lower levels of stress during exposure to the various violations except those that that are committed intentionally and lead to physical harm.***

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