Cognitive Reasoning in Affective and Social Awareness related to Mild Head Injury

van Noordt, S.[1], BA (Hons.) Student, & Good, D.[2], Ph.D., C. Psych.

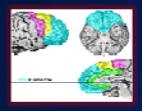
[1]Department of Psychology, Brock University

[2]Department of Psychology and Centre for Neuroscience, Brock University

Background

It is well established that numerous individuals suffer traumatic brain injury (TBI) annually with consequent complex sequelae of affective, behavioural, and cognitive symptoms.[1, 2]

Deficits include impaired abstract and social reasoning, cognitive inflexibility, and an inability to accurately discriminate and categorize emotions.[3]



The prefrontal cortex (PFC) is a neural substrate mediating higher-order abilities (e.g. reasoning, affect recognition, cognitive and behavioural flexibility) and is highly vulnerable to impact injury when mechanical forces are applied to the head.[4]

Relative to controls, those suffering head injury have shown lower performance on tasks assessing emotional awareness, especially when judging expressions of anger and emotions negative in valence. [3, 5, 6]

Mild Head Injury (MHI) puts the PFC at risk for homeostatic dysregulation which can produce an altered state of consciousness sufficient to introduce neuropsychological dysfunction.[7]

Subtle differences in neuropsychological and electrophysiological functioning have been implicated in competent individuals (e.g. university students), and empirical investigations into such performance effects are required. [8, 9]

Purpose:

To examine the relationship between performance on standardized neuropsychological tests assessing cognitive flexibility, abstract and social reasoning, and affect recognition, in university students reporting history of MHI.

Hypotheses

1. Cognitive abilities will be predictive of emotional awareness.
2. Those reporting history of MHI will be significantly challenged at recognizing emotions, relative to those with no MHI, with particular difficulty recognizing negative emotions.
3. Beyond the executive status of abstract and social reasoning, MHI will predict cognitive flexibility and affect recognition.

Methods

Participants

Brock University students
- N=40; 15 Males & 25 Females
- 40% reporting MHI

MHI Criterion:
Have you ever had a head injury resulting in an altered state of consciousness (including: vomiting, dizziness, seeing stars, confusion)?

Measures

Neuropsychological Tests

Letter-Number Sequencing [10] *(Cognitive Flexibility)*

Comprehensive Test of Non-Verbal Intelligence [11] *(Abstract Reasoning)*

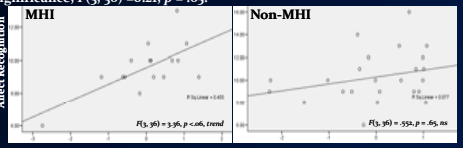
Picture Arrangement Task [12] *(Social Reasoning)*

Affect Recognition [13] *(Emotional Awareness)*

Results

Hypothesis 1: Cognitive abilities in relation to affect recognition

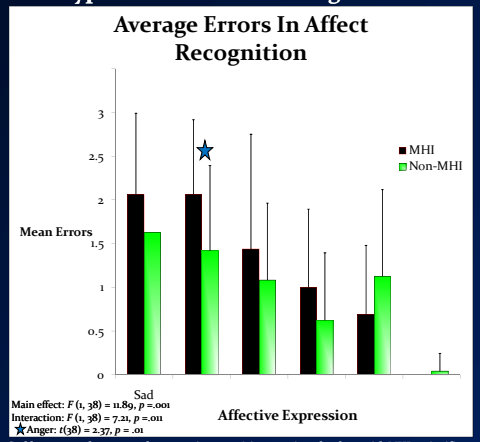
Regression model for entire sample did not achieve statistical significance, $F(3, 36) = 0.21$, $p = .65$.



Predictors; Cognitive Flexibility, Abstract Reasoning, Social Reasoning

Cognitive abilities show trend ($p<.06$) in predicting affect recognition, uniquely in the MHI group.

Hypothesis 2: Affect Recognition



Stable pattern of poorer performance in recognizing emotions for those with MHI, a significant interaction, and particularly more errors made for angry expressions.

Hypothesis 3: Cognitive flexibility and emotional awareness in MHI

Predictor	B	SE B	β	sr
Step 1				
Abstract Reasoning	.51	.15	.50	.49
Social Reasoning	-.04	.15	-.04	.06
Step 2				
Abstract Reasoning	.54	.15	.53	.49
Social Reasoning	-.43	.14	-.42	.06
MHI	.95	.62	.22	.15

Step 1: $\Delta R^2 = .24$, $p<.01$; Step 2: $\Delta R^2 = .05$, *ns*

Outcome Variable: Cognitive Flexibility - $F(3, 36) = 4.88$, $p<.01$

Predictor	B	SE B	β	sr
Step 1				
Abstract Reasoning	-.23	.12	-.29	-.33
Social Reasoning	-.14	.12	-.18	-.24
Step 2				
Abstract Reasoning	-.19	.12	-.25	-.33
Social Reasoning	-.15	.11	-.18	-.24
MHI	1.10	.49	.33**	.36

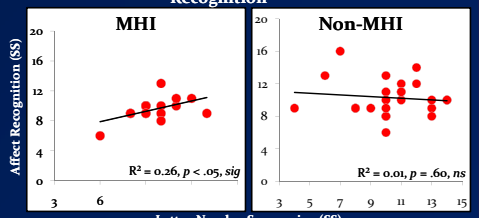
Step 1: $\Delta R^2 = .14$, *ns*; Step 2; $\Delta R^2 = .11$, $p<.05$

Outcome Variable: Anger Recognition – $F(3, 36) = 3.88$, $p = .02$

**$p<.01$

MHI does not add unique variance to cognitive flexibility performance after controlling for reasoning capacity. However, MHI is predictive of anger recognition over and above reasoning.

Exploratory Analysis: Cognitive Flexibility and Affect Recognition



Cognitive flexibility is significantly related to affect recognition abilities, specifically in those reporting MHI.

Discussion & Implications

Cognitive abilities did not predict affect recognition for non-MHI group, whereas a notable significant trend was observed for those reporting MHI.

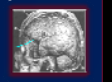
Individuals with MHI were less proficient in their ability to discriminate emotions in general, and made significantly higher errors when judging expressions of anger, relative to the non-MHI group.

Reasoning abilities predicted cognitive flexibility, however, MHI did not add unique variance.

MHI predicted success interpreting anger, over and above reasoning abilities and exploratory analyses revealed that within the MHI group cognitive flexibility accounted for approximately 25% of the variance in overall affect recognition ability.

Successful social interactions rely on the ability to discriminate subtle and dynamic expressions[14] and require a properly functioning PFC.

Findings support MHI being related to dysfunction of the PFC, particularly implicating ventral regions involved in social-emotional awareness. [15, 16]



MHI in competent populations is clearly multidimensional since self-report of mild injury significantly predicts aspects of emotion recognition, over and above executive skills such as reasoning.

Due to the heterogeneity in the etiology and impairments associated with MHI, affective, behavioural, and cognitive difficulties persist in the absence of well understood causes for the limitations.

Conclusion

Injuries to the head which introduce an altered state of consciousness are not inconsequential, as they are sufficient to produce detectable changes in neuropsychological functioning well beyond the "concussive" phase. These findings in highly competent university students indicate the usefulness of classifying head injury on a continuum of severity as milder injuries can produce similar neurobehavioural consequences as traumatic cases.

References

[1] Ford, M., Baroski, C., Ehert, A. D., Grubich, C., Symowitz, H., & Wallesch, C. W. (2005). Neuropsychological sequelae of diffuse traumatic brain in jury. *Brain Injury, 19*(2), 101-108.
[2] Turner, G.R., & Levine, B. (2004). *Cognitive and behavioural rehabilitation: From neurobiology to clinical practice.* Disorders of executive functioning and self-awareness. New York, NY: Guilford Press.
[3] Bornhofen, C. & McDonald, S. (2008). Emotion perception deficits following traumatic brain injury: A review of the evidence and rationale for intervention. *Journal of the International Neuropsychological Society, 14*, 511-525.
[4] Bernstein, D. M. (1999). Recovery from mild head injury. *Brain Injury, 13*(3), 151-72.
[5] Calder, A., Keane, J., Lawrence, A., & Manes, F. (2004). Impaired recognition of anger following damage to the ventral striatum. *Brain, 127*, 1958-1969.
[6] Hopkins, M. J., Dywan, J., & Segalowitz, S. J. (2002). Altered electrodermal response to facial expression after closed head injury. *Brain Injury, 16*(3), 245-257.
[7] Hayes, R. L., & Dixon, C. D. (1994). Neurochemical changes in mild head injury. *Seminars in Neurology, 14*(1), 25-31.
[8] Segalowitz, S. & Lawson, S. (1993). Subtle symptoms associated with self reported mild head injury. *Journal of Learning Disabilities, 28*, 309-319.
[9] Segalowitz, S. J., Bernstein, D. M., & Lawson, S. (2001). P300 event-related potential decrements as well-functioning university students with mild head injury. *Brain and Cognition, 45* (3), 342-356.
[10] Delis, D. C., Kaplan, E., & Kramer, J. H. (2001). *Delis Kaplan Executive Function System.* San Antonio, TX: Psychological Corporation.
[11] Hammill, D. D., Pearson, N. A., & Wiederholdt, J. L. (1996). *Comprehensive Test of Nonverbal Intelligence.* Austin, TX: PRO-ED.
[12] Wechsler, D. (1997). Wechsler Memory Scale – Third Edition. San Antonio, TX: Psychological Corporation.
[13] Korkman, M., Kirk, U., & Kemp, S. (2007). NEPSY II – Second Edition. *A Developmental Neuropsychological Assessment Manual.* San Antonio, TX: Harcourt Assessment Inc.
[14] Wood, J. N. (2003). Social cognition and the prefrontal cortex. *Behavioural and Cognitive Neuroscience Reviews, 2*(2), 97-114.
[15] Blair, R. (2004). The roles of orbital frontal cortex in the modulation of antisocial behaviour. *Brain and Cognition, 55*, 198-208.
[16] Milders, M., Ietswaart, M., Crawford, J., & Currie, D. (2008). Social behaviour following traumatic brain injury and its association with emotion recognition, understanding of intentions, and cognitive flexibility. *Journal of the International Neuropsychological Society, 14*, 318-326.

Acknowledgments

- Jenna Gilchrist and Lindsay Benson, Brock University
- Anthony DeBono, M.A. (Ph.D. Student, York University)
- Brock University Neuropsychology Cognitive Research Lab (BUNCRL)
- Ontario Neurotrauma Foundation (ONF)