Decision-making Strategies in Persons with and without Mild Head Injury

Robb, Sean1, B.A. Candidate & Good, Dawn2, Ph.D., C. Psych.
1Department of Psychology – Neuropsychology Cognitive Research Lab, Brock University
2Centre for Neuroscience & Department of Psychology – Neuropsychology Cognitive Research Lab, Brock University


Background
It is estimated that approximately one third of all individuals will sustain a head injury before the age of twenty-five, and of this, 90% of these injuries will be classified as mild (i.e., concussion) [10]. The orbitofrontal/ventromedial prefrontal cortex (OFC/VMPFC): 

- Is particularly susceptible to biomechanical injury due to its close proximity to bony protrusions that surround the orbits [3, 4], even in persons with MHI [10].
- Is associated with impaired social decision-making and socio-emotional processes, despite preserved intellectual capacity [10].

According to the Somatic Marker hypothesis, bio-regulatory visceral states provide additional contextual information during these social-decisions in the form of sympathetic nervous system (SNS) physiological arousal or “gut-feelings” 7-9.

The Iowa Gambling Task

<table>
<thead>
<tr>
<th>Deck</th>
<th>High Freq. Punishment</th>
<th>Low Freq. Punishment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Lose more $ than Win</td>
<td>Higher Risk</td>
</tr>
<tr>
<td>B</td>
<td>Win more $ than lose</td>
<td>Lower Risk</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Individuals with OFC lesions have illustrated:
- Reduced physiological arousal, and lower arousal prior to make socially relevant decisions has been associated with riskier choices [7, 9].
- A pattern of decision-making with less attention devoted to prior losses [10].

Hypotheses
1. Individuals who have experienced a previous MHI will demonstrate riskier decision making than their non-MHI cohort by making a slower transition from disadvantageous (higher risk to advantageous (lower risk) decision selections.
2. Persons in the non-MHI group will demonstrate more explicit knowledge about the strategies they applied during decision selection than those with MHI.
3. MHI will be physiologically underaroused prior to making a decision in comparison to their non-MHI cohort.

Methods
Participants
22 Brock University Students (8 pending) - 7 individuals reporting a MHI (32%) - 3 males and 4 females - 3 had a LOC greater than 5 minutes - 2 had more than one injury - 4 treated medically but did not stay over night - 15 individuals not reporting a MHI (68%)

Measures
Neuropsychological:
- Iowa Gambling Task (IGT) [2]
- Electrodermal Activity (EDA) [3]

Physiological
- Questionnaire Based:
  - Explicit Knowledge/Strategy [12]
  - Demographics (i.e., MHI History, etc)

Results

Hypothesis 1: IGT Performance
Figure 1: MHI subjects illustrate a slower tendency in shifting from disadvantageous to advantageous deck selections (as a function of ratio) than their non-MHI cohort (F (4.51, 90.17) = 1.06, p = ns).
This is despite the two groups not differing in number of cards chosen from each deck (F (1, 20) = 0.30, p = ns).

Hypothesis 2: Explicit Knowledge
Figure 2: Participant’s explicit knowledge is insufficient to account for their learning to differentiate between advantageous and disadvantageous decks mimicking the dissociation between knowing and doing.

Hypothesis 3: Physiological Arousal
Figure 3: MHI present physiologically underaroused relative to their cohort at baseline and throughout the study (as predicted, F (1, 20) = 2.31, p = .14).

Conclusions & Implications
- Alterations in decision-making processes can occur even in mild forms of head injury. This has substantial implications for social decision-making (i.e., financial, interpersonal etc.) whereby individuals who have sustained mild injuries may be more inclined to make riskier decisions which, in turn, may lead to adverse outcomes.
- Further, participants’ knowledge about the outcomes associated with the various decks did not account for the choices they made, indicating that there is something other than rational monitoring guiding behaviour, such as implicit somatic markers. This mimics the dissociation between what participants know and how they behave.
- As expected, MHI were physiologically underaroused when making decisions as compared to their non-MHI cohort. This may reflect a neurally-based compromised affective sensitivity to consequences of decision outcomes (i.e., prior losses), resulting in lessened avoidance to disadvantageous decisions.
- Finally, observing behaviour in MHI individuals that mirror those with more severe trauma illustrates the neuropsychological continuum associated with traumatic acquired brain injury.

References

Figure 1: IGT Performance

Figure 2: Explicit Knowledge

Figure 3: Physiological Arousal

Figure 4: Decision-making results for Deck D