

## **Critical Review: Does impaired Theory of Mind contribute to Behavioural Disturbance following Adult Traumatic Brain Injury?**

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This critical review examines the evidence regarding impaired Theory of Mind following adult Traumatic Brain Injury and its effect on behavioural disturbance. Study designs include case controls and case reports. Overall, the evidence gathered from this review is inconclusive. Recommendations for future research and clinical practice are provided.

### ***Introduction***

Changes in social, emotional, and physical behaviour following adult Traumatic Brain Injury (TBI) are devastating to the individual, their family, and significant others (Dyer, Bell, McCann, & Rauch 2006; Ylvisaker, Turkstra, Coehlo, Yorkston, Kennedy, Sohlberg, McKay, & Avery, 2007). Common behavioural disturbances following adult TBI include inappropriate or disinhibited social behaviour, egocentrism, immature behaviour, social awkwardness, depression and social withdrawal (Ylvisaker et al., 2007; Blair & Cipolotti, 2000). Due to the impact of these behavioural changes, management of behavioural disturbances is a frequently cited rehabilitation goal (Dyer et al., 2006).

Effective rehabilitation of behavioural disturbance following TBI depends on the identification of factors that contribute to behavioural disturbance (Bach, Happe, Fleming, & David, 2006). Current research suggests that Theory of Mind (ToM), or the ability to make inferences on others' mental states, their feelings, thoughts and actions, is impaired in adults following TBI (Bibby & McDonald, 2003; Henry, Phillips, Crawford, Ietswaart & Summers, 2006). Research into other disorders, such as Autism, has investigated the relationship between impaired ToM and social behaviour skills (Bibby & McDonald, 2003; Henry et al., 2006). Current research is considering whether this similar presentation of problematic social interaction and disturbed behaviour following TBI is associated with impaired ToM.

Cognitive-communication impairments and concomitant behavioural changes hinder the assessment and rehabilitation of TBI patients (Bach et al., 2006; Bibby & McDonald, 2003). Therefore, it is important to examine the existing literature to determine whether cognitive-communication intervention may be warranted in the area of ToM for adults following TBI in order to reduce the impact of

behavioural disturbances on their rehabilitation, and their social and vocational futures.

### ***Objectives***

The primary objective of this paper is to critically evaluate existing literature regarding the impact of impaired ToM on behaviour in adults following TBI. The secondary objective is to provide recommendations for clinical practice and future research.

### ***Methods***

*Search strategy:* Articles related to the topic of interest were found using the following computerized databases: Medline, CINAHL, PsychINFO, and PubMed. Keywords used for the database search were as follows:

[(brain injur\$) or (TBI) and (theory of mind)]  
[(brain injur\$) or (TBI) and (behaviour)].

The search was limited to articles written in English.

*Selection Criteria:* Studies selected for inclusion in this critical review were required to investigate both ToM and behaviour disturbance following adult TBI.

*Data Collection:* Results of this literature search yielded four articles congruent with the aforementioned selection criteria. Two of the studies employed a case control design. The other two studies relied on case reports.

### ***Results***

#### **Case Control Studies**

Case control studies are an appropriate design for rare disorders such as TBI. However they are inherently subject to biases, particularly of recall and selection. With this design, case and control groups that are representative of the greater

population are difficult to accomplish. Therefore, the conclusions drawn from these studies cannot always be generalized.

Milders, Fuchs and Crawford (2003) conducted a case control study to investigate the relationship between neuropsychological impairments and changes in social and emotional behaviour following severe TBI. A case group of 17 TBI patients was matched to a control group of 17 healthy subjects. Results of the study indicated a higher incidence of behavioural disturbance following TBI, particularly of pragmatism; a deficit in pragmatics, and depression. The detection of Social Faux Pas task, which relies on a high level of ToM, had the strongest correlation with behavioural changes ( $r = -0.61$ ).

The selection criteria for both case and control subjects was reported in detail, with case controls matched according to age, gender, and education. While the objective of this study was to investigate *severe* TBI, the subject selection had a large variance based on severity variables such as post-traumatic amnesia, and the Glasgow Coma Scale. Therefore, the subjects chosen may not be representative of *severe* TBI. The researchers acknowledged one selection bias; that case subjects were selected from a facility that prepares TBI adults to return to work. Thus, the level of behavioural disturbance was likely underestimated compared to the general severe TBI population.

Milders et al. (2003) clearly defined the neuropsychological areas investigated and provided adequate information in their proceedings such that the measures were well understood and the study could be replicated. Both questionnaires included “before” and “after” measures of behaviour in order to attribute change in behaviour to TBI. The three measures of ToM were of varying difficulties such that a mild impairment of ToM could be detected, and are all considered valid measures. However, the tests were conducted in a clinical environment and due to their format (written and pictorial), may not truly reflect the dynamic nature of social interaction and therefore the external validity of the results needs to be considered. Milders et al. (2003) included control questions for comprehension of the Social Faux Pas stories, which was measured and did not confound ToM. However, from the information provided, other confounding variables were not controlled for, particularly non-mental inferencing. As a result, this study is unable to distinguish ToM from a general inferencing impairment. Finally, as is common with information collected from significant others, the behaviour questionnaires were subject to recall bias and likely underestimated behaviour disturbances (Dyer et al, 2006).

While this study did not report corrections to establish normal distribution, the appropriate statistical tests were conducted based on the assumption of normalized data. However, confidence intervals were not reported for the data, which limits the credibility of the statistical results. Furthermore, it should be noted that high standard deviations were reported which reflects the heterogeneity of this population, and limits universal interpretation of results.

While the design employed is appropriate for this population and provides a moderate strength of evidence, the above-mentioned weaknesses in subject selection and methodology need to be considered when implementing the results into clinical practice.

Bach et al. (2006) presented findings of a case control study in which they hypothesized that TBI patients with behavioural disturbance would exhibit ToM deficits. Twenty TBI patients with behavioural disturbance were compared to a control group of twenty TBI patients without behavioural disturbance. Bach et al. (2006) concluded that ToM was found to be intact in both groups, suggesting that behavioural disturbance can occur without impaired ToM.

Information on subject selection was limited with no data on subjects’ age, gender, severity of injury, history of psychiatric disorder or post-traumatic amnesia, all important control variables. The classification into the two groups is also problematic due to informant bias and underestimated behaviour by informants. Due to these biases in the selection criteria some individuals may be inaccurately grouped as either “behavioural” or “non-behavioural”.

The tests and procedures reported in this study are well-established valid measures of ToM, however only one measure of ToM was used, which reduces the impact of their findings. While other studies (Milders et al., 2003) considered executive functions as variables to behavioural disturbances, they did not account for their impact on ToM. Bach et al. (2006) increased the validity of their findings by correlating executive function tasks and ToM. However, the validity of behavioural measurements is reduced, as a retrospective measure of behaviour was not taken. As a result, disordered behaviour cannot be directly attributed to TBI. Finally, the methodology of this study could have been improved with the blinding of researchers to group status.

Appropriate statistical analysis was conducted, with the understanding that corrections were calculated for normal distribution. Confidence intervals of 95% were reported which increases the credibility of the results. While no significant results

were found between ToM and behavioural disturbance, Bach et al. (2006) report that impaired ToM should not be disregarded clinically as a contributor to behavioural disturbance. Statistical analysis supports this, seen in the high range of scores on ToM tasks.

The level of evidence offered by this study is moderate. However, selection bias and intrinsic limitations of case control studies reduce the clinical application of results.

### Case Reports

Case reports are often necessary and beneficial to direct future research in rare and heterogeneous populations such as TBI. However, they are inherently limited in external validity, as inferences cannot be made from one case to a larger population.

Bach, Happe, Fleming, and Powell (2000) investigated ToM in a 59-year-old male following TBI who presented with significant cognitive and behavioural impairments. Based on their assessment and clinical observation, ToM was not impaired, and it was therefore concluded that ToM did not contribute to his disordered behaviour.

While the authors acknowledge the inherent limitations of a single case report design, the strength of evidence (either in support of their hypothesis or not) could have been improved with a case series design by incorporating multiple single case reports. While subject selection in case reports is often based on opportunistic selection, there are some problematic aspects in this particular case. Primarily, there is a lack of premorbid social and medical information. Furthermore, the subject reported a family history of psychiatric illness (others studies have included this as exclusion criteria). Finally, his premorbid personality (stubborn, difficulty maintaining relationships) decreases the ability of the study to attribute behavioural disturbance to TBI.

The methodology of this case report has strengths, including controls for non-mental inferencing in ToM tasks as well as the repeated measures of executive function and ToM at 6 months and 1-year post injury, which increase reliability. However, the same criteria and standards are not met for the measurement of behaviour. The patient's behaviour was assessed solely by clinical observation, which has reduced reliability. The validity of this study could have been further improved with the selection of matched controls.

Statistical analysis was limited; with only mean and standard deviation reported based on control groups from other studies.

While there are inherent limitations to single subject case reports, further statistical analysis along

with adjustments made to the methodology and subject selection could have strengthened the validity, the level of evidence, and thus the clinical relevance obtained from this study.

Blair and Cipolotti (2000) conducted a comparative case report on a 56-year-old male who, following TBI, exhibited "acquired sociopathy". Results of a single ToM task indicated no impairment relative to control groups; it was therefore concluded that ToM did not contribute to his disordered behaviour.

The case subject was compared to another single control subject with dysexecutive syndrome without behavioural disturbance along with 10 healthy controls. By implementing comparison subjects, the researchers strengthened the level of evidence provided by this case report. It is presumed that the case subject was selected as he presented an interesting case for investigation. However, limited information is provided on the selection process for control subjects.

The methodology employed by this study was limited as only one measure of ToM was used, however, it was a valid tool and the researchers appropriately tested for reading comprehension, and non-mental inferencing along with ToM to reduce the effect of confounding variables. Furthermore, the DSM-IV, a valid tool, was used along with clinical observation, to measure behaviour. Behavioural disturbance following TBI was also well established, as sufficient information was obtained on the subject's premorbid behaviour.

Blair and Cipolotti (2000) used appropriate nonparametric statistics (chi-square analysis) to measure for significant difference between the case subject's performance on the ToM tasks and control groups. Further statistical analysis was not conducted due to the nature of the study.

While Blair and Cipolotti (2000) increased the strength of evidence by incorporating control subjects and valid measures of behaviour and ToM, the inherent limitations in case studies result in a weak level of evidence provided by this study.

### ***Recommendations***

Three of the four studies reviewed found no correlation between ToM and behavioural disturbance following adult TBI. However, inherent limitations of the designs employed, weaknesses in subject selection and methodology reduce the strength of evidence obtained from the studies.

#### *Future research considerations:*

It is recommended that further research be conducted to clarify and confirm the relationship

between impaired ToM and behavioural disturbance following adult TBI. In order to improve the level of evidence provided by the existed literature, it is recommended that future research take the following into consideration:

- a) Future research should employ study designs that offer a stronger level of evidence as well as larger sample sizes, such that results can be more appropriately applied to clinical practice.
- b) Non-mental inferencing tasks should be incorporated in order to distinguish ToM from general inferencing impairment.
- c) Future studies should include more than one measure of ToM and behaviour in order to detect mild impairments and to increase reliability of results.
- d) Incorporating measures of executive function as confounding variables for ToM is necessary in order to confirm the independent relationship of ToM to behavioural disturbance.
- e) Video-based or interactional ToM measures can be employed in future studies to increase external validity of results.
- f) Future research should be conducted into ToM intervention with TBI patients based on techniques developed for individuals with Autism due to the similar expression of ToM impairment.

### ***Clinical Implications***

Due to the limited strength of evidence provided by the articles reviewed, it is recommended that clinicians be cautious when implementing the findings of these studies into clinical practice.

While the current critical review did not identify a strong level of evidence to support the relationship between ToM and behavioural disturbance, clinicians should be cognizant of the heterogeneity of this population. Therefore, impaired ToM may impact the social and emotional behaviour of some TBI patients. Due to the potential impact on social communication and behaviour, ToM should be an important consideration in the cognitive-communication assessment and rehabilitation of TBI patients.

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