



Long-term ability to interpret facial expression after traumatic brain injury and its relation to social integration

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ABSTRACT

There is considerable evidence that individuals with traumatic brain injury (TBI) experience problems interpreting the emotional state of others. However, the functional implications of these changes have not been fully investigated. A study of 13 individuals with severe TBI and an equal number of matched controls found that TBI participants had significantly more difficulty interpreting facial expression and matching emotions to social situations. A significant relationship was also established between social integration and ability to interpret facial expression for TBI participants. These results support the inclusion of therapy targeting this area within rehabilitation programs for individuals with TBI.

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1. Introduction

It is well documented that individuals who sustain a severe TBI demonstrate significantly impaired social functioning (Douglas & Spellacy, 2000; Elsass & Kinsella, 1987; Hammond, Hart, Bushnik, Corrigan, & Sasser, 2004; Ponsford, Olver, & Curran, 1995). Individuals with TBI frequently report social isolation and a loss of friends following TBI, and research suggests that social integration may decrease as length of time living in the community increases (Burleigh, Farber, & Gillard, 1997; Koskinen, 1998; Morton & Wehman, 1995; Oddy, Humphrey, & Uttley, 1978). Despite these findings, the range and nature of behaviours that contribute to this difficulty are still not well understood. However, researchers have suggested that changes in the social and emotional functioning of individuals with TBI, including an impaired ability to interpret facial expression, are among the major barriers to successful community reintegration (Crocker & McDonald, 2005).

There is now a considerable body of research investigating the interpretation of facial expression in individuals who have sustained a TBI. Much of the initial literature focussed on the neural process by which the brain recognises and interprets facial expression. A consistent and significant finding from clinical and imaging studies is that the right hemisphere has preferential involvement in processing emotions (Borod, Koff, Perlman-Lorch, & Nicholas, 1986; DeKosky, Heilman, Bowers, & Valenstein, 1980; Mandal, Mohanty, Pandey, & Mohanty, 1996; Perry et al., 2001). More recently, the occipitotemporal and orbitofrontal cortices, limbic system and basal ganglia have all been found to play a critical role in

the interpretation of facial expression (Adolphs, 2002; Adolphs, Damasio, Tranel, & Damasio, 1996). As damage to these regions is often associated with severe TBI, it is not surprising that individuals who sustain a TBI are likely to experience difficulties in interpreting facial expression.

In experimental studies, individuals with TBI are consistently found to perform more poorly than control participants on tests of facial expression interpretation. In a seminal study, Prigatano and Pribram (1982) compared the ability of 20 individuals with brain injury (including TBI, stroke and brain tumour) to interpret and recall facial expression. The authors found that the participants with TBI performed considerably more poorly than participants with other forms of injury on both the perception and recall of facial affect. Although these authors and subsequent researchers have expressed suspicions about a potential link between deficits in the interpretation of facial expression and poor social outcomes, these are rarely confirmed through direct measurement.

Subsequent studies have revealed similar findings to those reported originally by Prigatano and Pribram (1982). Jackson and Moffat (1987) compared the ability of 15 participants with severe brain injury and an equal number of control participants to recognise and interpret facial expression and emotionally toned postures. Participants with brain injury scored significantly more poorly across all tests compared with the control group, suggesting that their recognition of affect was impaired. This result held when affect was conveyed both via facial expression and posture cues. Similarly, Braun, Baribeau, Ethier, Daigneault, and Proulx (1989) confirmed that severe TBI results in impaired processing of facial expression. However, the authors also examined participants' ability to match contextual phrases of emotion with their correspond-

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ing emotion and found no impairment in the processing of affective contexts suggested by short phrases. These findings indicated that the impaired processing of emotional information was limited to facial expression, although subsequent researchers have largely failed to confirm or refute this suggestion.

Few researchers examining the interpretation of facial expression in individuals with TBI have controlled for time post-injury. However, as Green, Turner, and Thompson (2004) contend, the ability of individuals with acute and chronic TBI to interpret facial expression is likely to differ due to factors such as the functional reorganisation of the brain, and ability to use compensatory strategies. In a study involving participants with a recent TBI, Green et al. (2004) found that TBI participants (on average 2.6 months post-injury) performed significantly more poorly than did matched controls on both emotional face discrimination and emotional face labelling tasks. Similarly, Borgaro, Prigatano, Kwasnica, Alcott, and Cutter (2004) investigated the perception of facial expression in 27 participants within 60 days of their injury. Again, the TBI group achieved a significantly lower score than the control group. Whilst these results clearly support the existence of a deficit in interpreting facial expression, in the early recovery period after TBI, they have limited application in examining the long-term presentation of the disorder and its functional impact.

A considerable difficulty in applying the results of the studies outlined above is that many of the researchers have employed static displays of facial expression. There has been some discussion in the literature as to the merits of static displays of emotional expression. Static images allow the viewer an indefinite exposure to a fixed emotional expression and “bear little resemblance to the complex spontaneous emotional displays that are encountered... as part of normal social interaction” (McDonald, Flanagan, Rollins, & Kinch, 2003, p. 220). Specifically, static images deny the viewer important information provided during facial motion that may assist in the recognition and interpretation of facial expression (Bassili, 1978). It has also been suggested that static and dynamic displays of emotional expression may be processed via different neural pathways (Adolphs, Tranel, & Damasio, 2003; Humphreys, Donnelly, & Riddoch, 1993). In addition, given that interpretation of dynamic displays of facial expression are likely to require increased attentional, working memory and informational processing demands, it would be expected that they may be more difficult for individuals with TBI (McDonald & Saunders, 2005). However, the presentation of facial expression in dynamic form yields a more naturalistic stimulus, and an investigation of individuals' ability to interpret facial expression in this format warrants further investigation.

A further complicating factor in interpreting the findings of studies investigating the processing of facial expression is the variable response modes that researchers have employed. For example, it has been shown that facial expression recognition tasks that require verbal responses activate different subcortical areas compared to those that do not (Morris, Oehman, & Dolan, 1998). Further, although difficulty with word retrieval is a common impairment after TBI (Douglas, 2004), participants have been required to name emotional expressions in a number of studies. This raises the question as to whether participants are displaying impairment in interpreting emotional expressions or in word retrieval. Clearly, it is important to consider not only the mode of presentation but also the response mode when investigating the ability to interpret facial expression.

Several authors have suggested that there is a relationship between the ability to interpret nonverbal cues and social competence (Karow & Connors, 2003; Spell & Frank, 2000). According to McDonald (2000), individuals must process a broad range of contextual cues, including facial expression, in order to fully understand a given utterance. Birdwhistell (1970) demonstrated that in

a typical dyadic conversation, verbal components convey only one-third of the social meaning, whilst the remaining two-thirds are conveyed in nonverbal components.

Based on these findings, researchers have proposed how an impaired ability to interpret affective information, including facial expression, may negatively impact on an individual's social or pragmatic communication. McDonald (2003) refers to three specific negative implications for an individual with an impaired ability to interpret facial expression: (1) they may not respond appropriately to others; (2) they are unable to gauge the appropriateness of their own behaviour; and (3) they may not fully understand the communication of others.

The ability to communicate effectively is fundamental to establishing and maintaining relationships, and participating in vocational and leisure activities (McDonald, Togher, & Code, 1999). Galski, Tompkins, and Johnston (1998) suggest that communication difficulties following TBI are a major barrier to community integration and may lead to social isolation. Despite this, few researchers have proceeded to examine this relationship. In a study of 12 participants with severe TBI and the same number of matched controls, Watts and Douglas (2006) found that there was a significant relationship between ability to interpret facial expression and communication competence (as rated by ‘close-others’ of TBI participants). However, the nexus between the ability to interpret facial expression and social functioning remains unclear.

Croker and McDonald (2005) and Milders, Fuchs, and Crawford (2003) attempted to establish a relationship between an impaired ability to interpret facial expression and poor social functioning. In both studies, TBI participants performed more poorly on tasks requiring them to label emotional facial expressions, and match facial expressions with an appropriate context. However, a correlation between impairments in recognising facial expression and decreased social functioning was not established. Part of this difficulty may be related to the tools chosen to measure social functioning. Specifically, Milders et al. (2003) employed the Community Integration Questionnaire (CIQ). Although sensitive to variability across individuals, the CIQ does have a ceiling effect and truncated range in measuring social integration in individuals with TBI (Hall et al., 1996). In contrast, Croker and McDonald (2005) recruited participants with TBI who were known to display poor social functioning. Participants were asked to report change in their emotional responsivity, with researchers hypothesising that reduced emotional experience may reflect reduced emotion recognition. Again, the lack of a significant finding in this study is likely to be related to the tool employed, given that the self-reports of individuals with TBI may be compromised due to deficits with awareness (Douglas, O’Flaherty, & Snow, 2000).

Although there is strong evidence that individuals with severe TBI have an impaired ability to recognise and interpret emotional facial expressions, there has been considerable variability in the methodology that researchers have employed. In particular, participant selection parameters, such as severity of injury and time post-injury, and the format of measures of interpretation of facial expression have varied widely across studies. Each of these factors may play an important role in influencing an individual's likely performance on the task and consequently the outcome of individual studies.

In addition, although the existing literature consistently finds that people with severe TBI perform more poorly on tests of interpretation of facial expression, it fails to examine adequately the functional impact of this deficit. The main objective of this research was to expand on the existing research by employing a more functionally based measure of facial expression and examining the relationship between a deficit in the ability to interpret facial expression and social participation. Specifically, the abilities of individuals with severe TBI and a matched control group to inter-

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