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Research report

Understanding deficits in empathy after traumatic brain injury: The role of affective responsivity

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ABSTRACT

People with traumatic brain injury (TBI) often find social situations challenging because they can no longer respond to the emotional state of the people they are with. Many also lack emotional empathy in their social interactions. But are these problems related? The present study addressed this question by examining psychophysiological indices of emotional responding, including facial electromyography (EMG) and skin conductance during exposure to happy and angry facial expressions, in addition to self-rated emotional empathy in 21 adults with severe TBI and 22 control participants. In comparison to control participants, those in the TBI group displayed a reduction in the ability to empathize emotionally, and showed reduced physiological responding to the emotional expression of anger. By contrast, the control group spontaneously mimicked the emotional expressions they were exposed to, regardless of affective valence, and also demonstrated higher skin conductance responsivity to angry faces. The data further suggested that a loss of emotional empathy plays a role in the emotional response deficits to angry facial expressions following TBI. The results have implications for understanding the impaired social functioning and poor quality of interpersonal relationships commonly seen as a consequence of TBI.

1. Introduction

It is widely documented that individuals who have sustained a severe traumatic brain injury (TBI) exhibit significant social problems such that they are egocentric, self-centred, and insensitive to the needs of others (Elsass and Kinsella, 1987; Grattan and Eslinger, 1989; Newton and Johnson, 1985). This pattern has been attributed, at least in part, to a reduction in empathy. For example, preliminary evidence to date suggests that a large proportion of individuals with TBI report a loss of empathy (Williams and Wood, 2009; Wood and Williams, 2008), as measured by the Balanced Emotional Empathy Scale (BEES; Mehrabian, 2000). Empathy is a critical component necessary for successful interpersonal function, however, the reasons why adults with TBI lose the ability to empathize are not clear.

A critical aspect of empathy is emotional responsivity to another person's feelings. From an early age, the normative response is to feel what another person is feeling; for example, happiness when someone is noticeably happy. Such heightened sensitivity to someone's display of emotion has been dubbed ''emotional'' empathy (Mehrabian and Epstein, 1972).

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Indeed, burgeoning evidence in the psychological literature suggests that emotional responsivity is an imperative component in the empathy process (e.g., Bavelas et al., 1986, 1988; de Wied et al., 2006; Hatfield et al., 1994; Hoffman, 2000; Nummenmaa et al., 2008; Shamay-Tsoory et al., 2008; Sonnby-Borgström, 2002; Sonnby-Borgström et al., 2003). As early as 1906, empathy was viewed as an involuntary response to an individual's emotional expression, which arose from the automatic imitation or "mimicry" of an emotional facial display (see Hoffman, 1984 for a review). Certainly empirical evidence for facial mimicry is now well established in the literature demonstrating that merely observing facial expressions causes analogous facial activity in the observer (McHugo and Smith, 1996). This process of mimicking behaviour or "facial mimicry" has typically been measured using electromyography (EMG), via recording activity of the zygomaticus major (cheek) and corrugator supercilii (eyebrow) muscles. Research in this domain (e.g., Dimberg, 1982, 1988, 1990; Dimberg and Lundquist, 1990) demonstrates that people tend to show increased zygomaticus activity when viewing happy faces and increased corrugator activity when viewing angry faces; an effect that occurs rapidly (Dimberg and Thunberg, 1998), automatically (Dimberg et al., 2002), and even without conscious awareness (Dimberg et al., 2000).

Recent research provides support for the conjecture that emotional empathy and emotional responsivity are indeed linked. For instance, Sonnby-Borgström et al. (Sonnby-Borgström, 2002; Sonnby-Borgström et al., 2003) found an association between facial mimicry and self-reported emotional empathy in a non-clinical student population, such that participants high in emotional empathy displayed stronger, automatic and spontaneous mimicry responses to both happy and angry facial expressions compared to participants low in emotional empathy. Furthermore, recent neuroimaging investigations (Nummenmaa et al., 2008; Schulte-Rüther et al., 2007; Shamay-Tsoory et al., 2008) have implicated the mirror neuron system (which is primarily responsible for action imitation, including emotional mirroring, Rizzolatti and Craighero, 2004), located in the inferior parietal lobule and inferior frontal gyrus, as part of the emotional empathy network. In line with this finding, Kaplan and Iacoboni (2006) demonstrated a relationship between activity in the inferior frontal gyrus while watching action sequences and scores on a self-report measure of emotional empathy.

Physiological reactions in cardiovascular and electrodermal systems have also been observed in response to emotional facial expressions (see McHugo and Smith, 1996 for a review). For instance, the viewing of angry facial expressions has been shown to elicit larger skin conductance (Esteves et al., 1994a, 1994b) and deceleratory heart rate responses (Dimberg, 1988) compared to the viewing of happy facial expressions. Interestingly, greater skin conductance and heart rate responses has been shown to occur in people with high compared to low self-rated emotional empathy (for an overview, see Mehrabian et al., 1988).

Assuming that emotional responsivity is a component process of emotional empathy, there is reason to believe that emotional processing difficulties, such as the inability to respond physiologically to another person's emotional display, may be attributable to changes in emotional empathy following TBI. Emotional responsivity is thought to engage the brain networks involved in emotional processing, including the insula, thalamus and inferior frontal gyrus (Nummenmaa et al., 2008; Shamay-Tsoory et al., 2008). Given that these brain structures are vulnerable to TBI (Shamay-Tsoory et al., 2007), impairment to the emotional components of empathy may be anticipated. Certainly, it is well established that people with TBI display abnormal affective responsivity, particularly to aversive stimuli (Saunders et al., 2006). Specifically, TBI has shown to impair skin conductance responses (Blair and Cipolotti, 2000; Hopkins et al., 2002; Sánchez-Navarro et al., 2005), as well as startle potentiation and subjective arousal ratings (Saunders et al., 2006) while viewing negatively charged emotional stimuli including unpleasant pictures and facial expressions.

Taken together, the evidence suggests that people with TBI not only report an inability to empathize, but also experience response deficits to emotional displays. However, to date there has been no evidence to demonstrate that the two are related, i.e., is it the case that TBI individuals with poor emotional empathy are also unable to respond normally to emotions? To the authors' knowledge, there has been no attempt to examine the relationship between emotional empathy and emotional responsivity in patients with TBI. This was the main aim of the present study.

1.1. *The present study*

The first goal of the current investigation was to confirm a lack of emotional empathy following TBI. Second, it was of prime interest to examine the relationship between emotional empathy and emotional responsivity in a TBI compared to a demographically matched healthy control group.

On the basis of existing literature, the following hypotheses were proposed. First, consistent with previous research (Williams and Wood, 2009; Wood and Williams, 2008), it was hypothesized that the TBI group would report lower levels of emotional empathy, as measured by the BEES (Mehrabian, 2000), compared to the control group. Secondly, following the results of Sonnby-Borgström (2002), normal non-brain damaged participants higher in emotional empathy were expected to display stronger, automatic facial EMG responses and skin conductance changes to happy and angry facial expressions compared to participants lower in emotional empathy. Finally, it was proposed that participants with TBI who were low in emotional empathy would show little to no responsivity to emotional faces. However, the extent to which this pattern mirrors that seen in normal low emotional empathy individuals is unknown.

2. Method

2.1. *Participants*

2.1.1. *TBI group*

28 individuals with TBI (5 female, 23 male) participated in the study. They were recruited from several brain injury units in