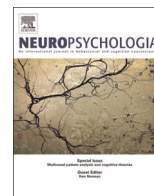




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Parsing cognitive and emotional empathy deficits for negative and positive stimuli in frontotemporal dementia [☆]

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ABSTRACT

Objectives: Behavioural variant frontotemporal dementia (bvFTD) is a debilitating neurodegenerative disorder characterized by frontal and temporal lobe atrophy primarily affecting social cognition and emotion, including loss of empathy. Many consider empathy to be a multidimensional construct, including cognitive empathy (the ability to adopt and understand another's perspective) and emotional empathy (the capacity to share another's emotional experience). Cognitive and emotional empathy deficits have been associated with bvFTD; however, little is known regarding the performance of patients with bvFTD on behavioural measures of emotional empathy, and whether empathic responses differ for negative versus positive stimuli.

Methods: 24 patients with bvFTD and 24 healthy controls completed the Multifaceted Empathy Test (MET; Dziobek et al., 2008), a performance-based task that taps both cognitive and emotional facets of empathy, and allows for the discrimination of responses to negative versus positive realistic images. MET scores were also compared with caregiver ratings of patient behaviour on the Interpersonal Reactivity Index, which assesses patients' everyday demonstrations of perspective taking and empathic concern.

Results: Patients with bvFTD were less accurate than controls at inferring mental states for negative and positive stimuli. They also demonstrated lower levels of shared emotional experience, more positive emotional reactions, and diminished arousal to negative social stimuli relative to controls. Patients showed reduced emotional reactions to negative non-social stimuli as well. Lastly, the MET and IRI measures of emotional empathy were found to be significantly correlated within the bvFTD group.

Conclusions: The results suggest that patients with bvFTD show a global deficit in cognitive empathy, and deficient emotional empathy for negative, but not positive, experiences. Further, a generalized emotional processing impairment for negative stimuli was observed, which could contribute to the emotional empathy deficit. This work highlights potential treatment targets and a means to assess the impact of novel therapies on socioemotional impairment in bvFTD.

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1. Introduction

Frontotemporal dementia (FTD) is a debilitating neurodegenerative disorder characterized by progressive deterioration of the frontal and temporal lobes, for which there is presently no cure. There are several variants of FTD, including behavioural variant (bv) FTD, semantic dementia, and progressive non-fluent aphasia (PNFA). Patients with bvFTD present with early, strikingly dysfunctional social and emotional behaviour, including disinhibition

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and impulsivity, lack of insight, and emotional blunting, callousness, and a loss of empathy (Gustafson, 1987; Neary et al., 2005). Notably, patients with semantic dementia with right temporal lobe atrophy also tend to demonstrate similar behavioural symptoms early in the course of illness (Bozeat et al., 2000; Seeley et al., 2005; Snowden et al., 2001), and all three subtypes can include these behavioural abnormalities (Neary et al., 1998; Rosen et al., 2006).

One of the core diagnostic features of bvFTD is a loss of empathy, exhibited by decreased social interest, diminished responsiveness to the feelings of others, and increased coldheartedness (Perry and Miller, 2001; Rascovsky et al., 2011). Empathy has been defined as “an affective response more appropriate to another’s situation than one’s own” (Hoffman, 1987, p. 48), or an affective response similar to another individual’s feelings based on the comprehension of their emotional state (Eisenberg et al., 1991). It is considered to be a multidimensional construct by many, including both cognitive and emotional facets (Davis, 1980; Eslinger, 1998). Some have argued for the existence of an additional facet termed motor empathy, referring to inherent mirroring of the movements and facial expressions of others (e.g., Blair, 2005), though cognitive and emotional aspects are more traditionally considered. Cognitive empathy is sometimes used interchangeably with theory of mind (Blair, 2005; Lawrence et al., 2004), and refers to the ability to adopt another individual’s perspective, and thereby infer their mental or emotional state. Emotional empathy refers to the capacity to share and react affectively to the emotional experience of another individual. The dissociation of these facets is supported by behavioural, functional imaging, and lesion studies. For example, an emotional empathy deficit but intact cognitive empathy has been demonstrated in individuals with high psychopathic traits, whereas individuals with high autistic traits have been found to show the reverse pattern (Lockwood et al., 2013). Further, tasks tapping cognitive empathy versus emotional empathy have been found to result in different patterns of activation (Fan et al., 2011; Shamay-Tsoory, 2011). Accordingly, patients with lesions to the ventromedial prefrontal cortex have shown impaired cognitive empathy and intact emotional empathy, whereas patients with inferior frontal gyrus lesions have demonstrated an emotional empathy deficit but intact cognitive empathy (Shamay-Tsoory et al., 2009).

Considerable evidence exists for impaired cognitive empathy and theory of mind in bvFTD, while a smaller number of studies have shown deficits on emotional empathy measures as well. Cognitive empathy impairments in bvFTD have been identified using both performance-based measures and caregiver ratings. For example, relative to controls, patients with bvFTD have demonstrated deficiencies in inferring the mental state, beliefs, and/or intentions of characters in false belief tasks (Lough et al., 2001), humorous cartoons (Lough et al., 2006; Snowden et al., 2003), and vignettes of social scenarios (Eslinger et al., 2007; Shany-Ur et al., 2012). During one such task, termed the Faux pas test (Stone et al., 1998), participants are read short stories. Patients with bvFTD have shown a deficit in understanding whether a social faux pas has occurred based on representing the mental states of characters in the stories (Gregory et al., 2002; Torralva et al., 2007). Patients with bvFTD have also exhibited impaired theory of mind via poorer performance on the Reading the Mind in the Eyes test (Baron-Cohen et al., 2001) relative to controls (Couto et al., 2013; Gregory et al., 2002; Torralva et al., 2007), in which participants are shown the eye region of a face and asked to best identify what the individual is feeling from two or four choices, and the Judgment of Preference Task, in which participants are presented with a face whose eyes are directed at one of four objects and asked which object the face likes best (Snowden et al., 2003). Additionally, patients with bvFTD have been found to score lower

on the Perspective Taking subscale of the Interpersonal Reactivity Index, according to caregiver ratings of patient behaviour, relative to controls (Eslinger et al., 2011; Rankin et al., 2006; Rankin et al., 2005) and patients with Alzheimer’s disease (Fernandez-Duque et al., 2010; Hsieh et al., 2013). While these studies confirm that patients with bvFTD have a cognitive empathy deficit, little is known about whether this impairment is present for both negative and positive mental states. Patients with bvFTD are known to have significant deficits in the recognition of negative facial expressions such as fear and sadness, whereas identification of positive expressions such as happiness is often relatively preserved (Fernandez-Duque and Black, 2005; Kipps et al., 2009; Kumfor et al., 2011; Lavenu et al., 1999; Lough et al., 2006). As facial expression processing is likely one important component of the recognition of other’s mental states, it is possible that patients with bvFTD may present with a more pronounced deficit in cognitive empathy for negative mental states. However, the distinction between cognitive empathy in response to negative versus positive stimuli has yet to be investigated in bvFTD.

Evidence of a deficit in emotional empathy, or the ability to share and react affectively to another individual’s emotional experience, has also been reported in bvFTD using caregiver measures and clinical assessments. However, there have been few performance-based assessments of emotional empathy in this patient group. Caregivers completing the Interpersonal Reactivity Index (IRI; Davis, 1980), a multidimensional questionnaire assessing four components of empathy, report lower scores on the Empathic Concern subscale (i.e., feelings of concern, warmth, and compassion for less fortunate others) for patients with bvFTD in comparison to controls (Eslinger et al., 2011; Lough et al., 2006; Rankin et al., 2006) and patients with Alzheimer’s disease (Fernandez-Duque et al., 2010; Hsieh et al., 2013). Reports of increased coldheartedness and emotional blunting also abound in detailed case descriptions (Lough et al., 2001; Snowden et al., 2001; Thibodeau and Miller, 2013). The paucity of objective measures of emotional empathy makes this a difficult dimension to objectively evaluate. Though emotion recognition likely captures aspects of emotional empathy and has been used as an index of emotional empathy in some populations (Blair, 2013), we are particularly interested in the affective response and/or shared emotional experience generated as a result of the emotional experience of another individual. Physiological measures, such as facial electromyography, skin conductance, heart rate, and blood pressure, are another avenue to assess emotional empathy or emotional reactivity. In patients with bvFTD, reduced blood pressure has been observed relative to controls in response to a disgust-eliciting video (Eckart et al., 2012). However, such techniques can be challenging in patients with bvFTD, and may require additional means to determine the specific emotional response reflected by changes in arousal and related psychophysiological measures. Furthermore, items on the Empathic Concern subscale of the IRI include predominantly negative scenarios, and do not assess the potential for empathy for positive mental states. Thus, similar to cognitive empathy, it is unclear whether emotional empathic deficits are specific to negative mental states of others, or may be found for both negative and positive states.

The present study was undertaken in order to examine empathy for negative and positive mental states in bvFTD using a performance-based measure, the Multifaceted Empathy Test (MET; Dziobek et al., 2008). The MET is a multidimensional empathy measure previously validated in healthy adults and patients with autism (Dziobek et al., 2008), which is designed to tap both cognitive and emotional facets of empathy in a dissociable way. Specifically, it includes questions that require mental state inference, and separate ratings of participants’ emotional responses to realistic emotionally charged images. However, it should be

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