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Research report

The role of the orbitofrontal cortex in affective theory of mind deficits in criminal offenders with psychopathic tendencies

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ABSTRACT

Individuals with psychopathy show impaired emotional and social behavior, such as lack of emotional responsiveness to others and deficient empathy. However, there are controversies regarding these individuals theory of mind (ToM) abilities and the neuro-anatomical basis of their aberrant social behavior. The present study tested the hypothesis that impairment in the emotional aspects of ToM (affective ToM) rather than general ToM abilities may account for the impaired social behavior observed in psychopathy and that this pattern of performance may be associated with orbitofrontal cortex (OFC) dysfunction.

To assess the emotional and cognitive aspects of ToM we used a task that examines affective versus cognitive ToM processing in separate conditions. ToM abilities of criminal offender diagnosed with antisocial personality disorder with high psychopathy features were compared to that of participants with localized lesions in the OFC or dorsolateral, participants with non-frontal lesions, and healthy control subjects. Individuals with psychopathy and those with OFC lesions were impaired on the 'affective ToM' conditions but not in cognitive ToM conditions, compared to the control groups. It was concluded that the pattern of mentalizing impairments in psychopathy resembles remarkably that seen in participants with lesions of the frontal lobe, particularly with OFC damage, providing support for the notion of amygdala–OFC dysfunction in psychopathy.

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1. Introduction

Psychopathy is a developmental disorder characterized in part by callousness, diminished capacity for remorse, impulsivity, and poor behavioral controls (Hare, 1991). The definition of psychopathy involves two core components – emotional dysfunction and antisocial behavior (Harpur et al.,

1989; Frick et al., 1994). It has been shown that psychopathy is an extreme form of antisocial personality disorder (APD) and that approximately 25% of individuals classified with APD will show psychopathic tendencies (Hart and Hare, 1989).

Different cognitive models were proposed in an attempt to explain psychopaths' violation of social rules and the disregard for other people's emotions. One explanation is that

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psychopaths have impaired theory of mind (ToM) abilities. ToM refers to the capacity to make inferences regarding others' mental states: their knowledge, needs, intentions and beliefs (Premack and Woodruff, 1978). It was suggested that since psychopathic individuals are deficient in their ToM abilities, they are less likely to empathize with the other, and are thus less likely to inhibit antisocial behaviors (Richell et al., 2003). However, inconsistent with this account is the fact that psychopaths are extremely good manipulators and deceivers, which indicates that they are actually quite good at making inferences regarding other people's mental states. Indeed, numerous studies report no impairment in the ability to represent mental states of others in psychopathy (Widom, 1978; Blair et al., 1995; Richell et al., 2003; Dolan and Fullam, 2004).

If so, what can be the source of the social and moral deviations observed in psychopathy?

It has been recently suggested that ToM is not a monolithic process and that it comprised cognitive (cognitive ToM) as well as emotional aspects (affective ToM). The concept of 'affective ToM' is quite similar to that of empathy (Shamay-Tsoory et al., 2005) which has been reported to be deficient in psychopathy (Blair, 1995). Currently there is a lack of a clear distinction between empathy and ToM concept leading some researchers to use these terms interchangeably (Kaland et al., 2002). As depicted in Fig. 1, it had been suggested that cognitive ToM is a pre-requisite for affective ToM and is roughly equivalent to the purely cognitive aspects of empathy (Shamay-Tsoory et al., 2008).

Our basic theoretical framework assumes that while "cognitive ToM" refers to our ability to make inference regarding other people's beliefs, "affective ToM" refers to inference one makes regarding others' emotions. The process of affective ToM may require integration of emotional and cognitive aspects of empathy (see Fig. 1). Thus, "affective ToM" is related to cognitive empathy but also to emotional empathy to some extent. It appears that the centrality of emotion distinguishes between the affective and cognitive aspects of empathy and ToM. There is another aspect of empathy, not examined or discussed in the current study involving emotional contagion, a system thought to support

our ability to simulate the other emotional states (Preston and de Waal's, 2002).

Since cognitive ToM abilities appear to be intact in psychopathy, it may be speculated that impaired 'affective ToM' rather than a general ToM deficit may account for the aberrant behavior observed in psychopathy. In line with this notion, we have recently reported that participants with damage involving the ventromedial prefrontal cortex show impaired affective ToM while presenting with intact cognitive ToM (Shamay-Tsoory and Aharon-Peretz, 2007). Interestingly, one area in the ventromedial prefrontal cortex, namely the orbitofrontal cortex (OFC) has been consistently implicated as dysfunctional in psychopathy (Blair et al., 2006).

There is ample evidence that the OFC mediates affective information, emotional stimuli and social behavior. For example, it has been found that lesions in the OFC result, among other things, in impaired empathy (Eslinger, 1998; Shamay-Tsoory et al., 2004) deficits in complex ToM abilities (Stone et al., 1998) and even in 'acquired sociopathy' (Blair and Cipolotti, 2000; Tranel et al., 2002), a term denoting aberrant behavior, high levels of aggression and a callous disregard for others following OFC lesions. In line with this term is a case study of a 50-year-old male patient (MGS) with a right frontal ventromedial lesion who showed preserved general cognitive, abstract thinking and problem-solving abilities, in contrast to remarkable impairment in his social competence, social decision making and social conduct (Dimitrov et al., 1999). Nonetheless, regardless of the similarities between acquired frontal lesions and developmental psychopathy, comparison between groups should be treated with caution as important differences exist between these individuals. For example, while both groups of patients may demonstrate reactive aggression, instrumental aggression which is typically reported in developmental psychopathy is rarely reported after OFC damage (Mitchell et al., 2006a, 2006b).

An additional line of evidence for the involvement of the OFC in psychopathy is found in brain lesion studies which point to comparable performance of psychopaths and individuals with OFC damage in various tasks. For example, it has been found that psychopaths – both clinical (Blair et al., 2001a; Mitchell et al., 2002) and sub-clinical (Van Honk et al., 2002) are impaired in the Iowa Gambling Task, which was found sensitive to lesions to ventral and OFC cortices (Van Honk and Schutter, 2006). Furthermore, it was found that adult psychopaths present with impaired performance in tasks that involve reversal learning (Newman et al., 1987; Mitchell et al., 2002), which is a well established measure of OFC dysfunction (Rolls, 1996). Nonetheless, although abnormal function or activation in psychopathy has been demonstrated in the OFC (Kiehl et al., 2001; Völlm et al., 2004; Birbaumer et al., 2005; Rilling et al., 2006), there is limited evidence of anatomical pathology of this brain area in these individuals (Blair, 2007).

Taken together, it appears that a dysfunction in the OFC may underlie impaired social behavior in psychopathy. While studies to date have examined general ToM abilities in psychopaths (Blair et al., 1995; Richell et al., 2003; Dolan and Fullam, 2004), their affective ToM abilities as compared to their cognitive ToM abilities have never been examined before. Furthermore, no previous study has directly compared these individuals' performance on ToM tasks to that of

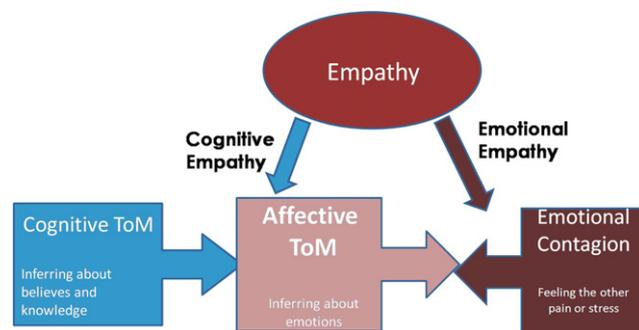


Fig. 1 – A model of the relationship between empathy and ToM. As depicted in the model “affective ToM” involves cognitive aspects of empathy (e.g., “I understand how you feel”) and interacts with emotional empathy. “Cognitive ToM” is a pre-requisite for affective ToM.

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