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Gray matter abnormalities in patients with narcissistic personality disorder

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ABSTRACT

Background: Despite the relevance of narcissistic personality disorder (NPD) in clinical settings, there is currently no empirical data available regarding the neurobiological correlates of NPD. In the present study, we performed a voxel-based morphometric analysis to provide initial insight into local abnormalities of gray matter (GM) volume.
Methods: Structural brain images were obtained from patients with NPD ($n = 17$) and a sample of healthy controls ($n = 17$) matched regarding age, gender, handedness, and intelligence. Groups were compared with regard to global brain tissue volumes and local abnormalities of GM volume. Regions-of-interest analyses were calculated for the anterior insula.
Results: Relative to the control group, NPD patients had smaller GM volume in the left anterior insula. Independent of group, GM volume in the left anterior insula was positively related to self-reported emotional empathy. Complementary whole-brain analyses yielded smaller GM volume in fronto-paralimbic brain regions comprising the rostral and median cingulate cortex as well as dorsolateral and medial parts of the prefrontal cortex.
Conclusion: Here we provide the first empirical evidence for structural abnormalities in fronto-paralimbic brain regions of patients with NPD. The results are discussed in the context of NPD patients' restricted ability for emotional empathy.

1. Introduction

As stated by the DSM-IV-TR, "a pervasive pattern of grandiosity, need for admiration, and lack of empathy" are defining features of narcissistic personality disorder (NPD; American Psychiatric Association, 2000), a serious mental disorder with a median lifetime prevalence of 1% in the general population (Pincus and Lukowitsky, 2010). Previous findings have highlighted the relevance of NPD for mental health services by showing that NPD is associated with severe impairments in psychosocial functioning (Miller et al., 2007), a high co-morbidity rate of affective as well as substance use disorders (Ritter et al., 2010; Stinson et al., 2008), and an increased rate of suicidal behavior (Blasco-Fontecilla et al., 2009; Ronningstam et al., 2008). Nonetheless, up to now, there has been a severe lack of empirical research investigating psychological and neurobiological factors related to the clinical presentation of NPD (Miller and Campbell, 2010). In particular, neurobiological abnormalities in patients with NPD are, to the best of our knowledge, currently unknown, both at a structural and a functional level. In the present study, we aimed to provide initial insight into brain structural abnormalities in patients with NPD and compared local GM volume between patients with NPD and healthy controls using voxel-based morphometry (VBM). Given the lack of previous neurobiological investigations, our main hypothesis regarding group differences in GM volume focused on a highly characteristic and experimentally supported feature in patients with NPD: "lack of empathy".

Impaired empathy is unequivocally considered to be highly characteristic of patients with NPD and has a longstanding tradition in theoretical conceptualizations of this mental disorder (Akhtar

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and Thomson, 1982; Blais et al., 1997; Kernberg, 1970; Ronningstam, 2010). However, it was only recently that an experimental study explicitly investigated empathic abilities in patients with NPD (Ritter et al., 2011). In accordance with multidimensional models of empathy (Blair, 2005; Decety and Meyer, 2008; Singer, 2006), Ritter et al. examined the ability to infer mental states of another person (i.e., cognitive empathy; Baron-Cohen and Wheelwright, 2004) as well as emotional responses regarding the observed emotional state of another person (i.e., emotional empathy; Eisenberg and Miller, 1987; Mehrabian and Epstein, 1972). The experimental investigation indicated that NPD patients have impaired emotional empathy, whereas cognitive aspects of empathy were found to be unaffected (Ritter et al., 2011). In other words, patients with NPD are not characterized by a general impairment in empathy, but rather a specific deficit in their ability to emotionally respond to the observed emotional state of another person.

The neural representation of empathy has received considerable attention in recent years (for meta-analyses, see Fan et al., 2011a; Lamm et al., 2011). Meta-analytic evidence of functional neuroimaging findings highlighted the bilateral anterior insula, anterior and median parts of the cingulate cortex, and the supplementary motor area to represent a core network activated during empathy related processes (Fan et al., 2011a). Complementary evidence regarding the neural representation of empathy was provided by volumetric studies in patients with neurodegenerative diseases (Rankin et al., 2006) and mental disorders such as schizophrenia and autism (Hadjikhani et al., 2006; Hooker et al., 2011). For example, smaller GM volume in the ventromedial prefrontal cortex of individuals with schizophrenia significantly contributed to deficits in theory-of-mind skills (i.e. cognitive empathy, Hooker et al., 2011). Impairments in emotional empathy, in contrast, were related to smaller GM volume of the bilateral insula in adolescents with conduct disorder (Sterzer et al., 2007).

The results of a recent study indicated neurofunctional abnormalities of empathy-related brain regions in healthy individuals with marked narcissistic personality traits (Fan et al., 2011b). More specifically, narcissistic participants were found to exhibit abnormal functioning of the anterior insula when asked to emotionally empathize with other individuals. Consequently, the results of this study stress again the importance of abnormalities in emotional empathy and highlight anterior parts of the insular cortex to represent a potential neurobiological correlate of these impairments in narcissism.

In light of the findings presented above, and due to a lack of available neurobiological studies investigating healthy and pathological narcissism, we specifically investigated gray matter abnormalities in the anterior insula of NPD patients. To more closely associate GM abnormalities of the anterior insula with impaired emotional empathy in NPD, we additionally assessed the correlation between GM volume of this brain region and self-reported emotional empathy, as measured by the Interpersonal Reactivity Index (IRI; Davis, 1983; Sterzer et al., 2007). Finally, exploratory whole-brain analyses were calculated to provide further indications of structural abnormalities in NPD.

2. Methods

2.1. Participants

Seventeen patients with a primary diagnosis of NPD (12 male, 5 female) and 17 healthy individuals (12 male, 5 female) were enrolled in the study. All participants were right-handed. Healthy controls were recruited via public advertising and NPD patients were recruited from in- and out-patient treatment facilities. All patients had a history of psychiatric inpatient treatment. However, at the time of study participation, just one NPD patient was in inpatient psychiatric care, whereas all other patients were in outpatient psychiatric or psychotherapeutic care. Both groups were matched on basic demographic parameters, such as age and intelligence (all $ps > .5$). Descriptive results are presented in Table 1.

All participants underwent diagnostic screening with the German versions of the Mini-International Neuropsychiatric Interview (M.I.N.I., Sheehan et al., 1998) for Axis-I Mental Disorders and the Structured Clinical Interview for Axis-II Personality Disorders (SCID-II, Fydrich et al., 1997). Diagnostic interviews were conducted by clinically experienced psychologists and psychiatrists. Diagnoses of NPD were verified with the patients' therapist (psychiatrists or psychologist) and the supervisor of this study (last author, senior psychiatrist). Inter-rater reliability of SCID-II personality diagnosis of NPD was previously assessed for a sample of eight patients by pairwise diagnostic interview. Three interviewers blind to the diagnosis were asked to rate these interviews. Kappa was acceptable, $\kappa = 0.797$ (Vater et al., 2013).

Healthy controls were only included if they did not take any psychotropic medication and had neither a current nor a lifetime diagnosis of mental or neurological disorders. Exclusion criteria for NPD patients were past or present diagnosis of a psychotic disorder, bipolar disorder, substance-associated disorders within three months prior to data acquisition, cognitive disorders (e.g., delirium, dementia), or neurological diseases (e.g., traumatic diseases of the central nervous system). The most frequent ($n > 1$) co-morbid Axis-I diagnoses of NPD patients were depression ($n = 5$ current, $n = 8$ lifetime diagnosis), polytoxicomania ($n = 5$ lifetime) and substance abuse ($n = 3$ lifetime). The most frequent co-morbid Axis-II disorders in our sample of NPD patients were borderline personality disorder ($n = 4$) and antisocial personality disorder ($n = 3$). Thirteen patients with NPD were free of psychotropic medication. One patient received citalopram once per day, another patient received fluoxetine once per day, one patient received quetiapine, and the final patient received paroxetine and methylphenidate.

Individual differences in cognitive and emotional empathy were assessed with the German version of the Interpersonal Reactivity Index (IRI: Davis, 1983; German Version: Paulus, 2006). The subscales "perspective taking" and "empathic concern" are commonly used to capture cognitive and emotional aspects of empathy (e.g., Rankin et al., 2006; Ritter et al., 2011). Questionnaire scores were not available for two patients with NPD. Descriptive results of both scales are presented in Table 1. In short, NPD patients describe motivational deficits for cognitive empathy ($t_{30} = 2.08$, $p = .046$), while impairments in emotional empathy failed to reach significance ($t_{30} = 1.43$, $p = .162$).

All participants provided written informed consent after the procedures had been fully explained and received financial

Table 1
Demographic and psychometric results of healthy controls (HC) and patients with narcissistic personality disorder (NPD). Group comparisons were conducted using *t*-tests.

	HC		NPD		*T*	*P*	*d*
	Mean	SD	Mean	SD			
Demography							
Gender (female/male)	5/12		5/12				
Handedness (left/right)	0/17		0/17				
Age	35.2	7.3	36.4	8.5	**-0.43**	**.67**	**-0.15**
Intelligence quotient	114.1	7.4	112.1	9.7	**0.65**	**.52**	**0.23**
Self-reported empathy							
Perspective taking	24.9	4.5	21.1	5.8	**2.08**	**.05**	**0.73**
Empathic concern	24.3	5.2	21.5	5.7	**1.43**	**.16**	**0.51**

Note. Intelligence was measured using the German Wortschatztest (Schmidt and Metzler, 1992).

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