Psychiatry Research 186 (2011) 219–224

Contents lists available at ScienceDirect

Psychiatry Research

journal homepage: www.elsevier.com/locate/psychres

Delusion-prone individuals: Stuck in their ways?

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ARTICLE INFO

Article history:
Received 5 July 2010
Received in revised form 26 September 2010
Accepted 30 September 2010

Keywords:
Delusions
PDI-21
Executive function
Suggestibility
Confabulation
Orbitofrontal cortex

ABSTRACT

Although false memories and confabulation have been linked to both executive dysfunction and greater suggestibility, similar associations with the emergence of delusional thinking remain unexamined. We therefore compared healthy individuals who scored high and low on the Peters Delusional Inventory (PDI: Peters et al., 1999) on measures of set-shifting (the intra–extradimensional set shift task: IED) planning (the Stockings of Cambridge Task: SOC). Additionally, we examined whether high delusion-prone individuals show greater suggestibility on the Gudjonsson Suggestibility Scale (GSS 2: Gudjonsson, 1987). On the IED task, the high group made more pre-extradimensional shift errors than the low PDI group, and this was especially notable for reversal learning. By contrast, no differences emerged on any aspect of the SOC. Finally, and intriguingly, the high PDI group was less likely than the low PDI group to change their responses after receiving suggestive negative feedback. We propose that delusional-style thinking may be underpinned by an orbitofrontal-based reversal learning difficulty affecting the flexibility to adapt responses to changing contingencies and external pressure.

1. Introduction

Delusions are present in virtually all persons with schizophrenia at some time and delusions are surprisingly common in the general nonclinical population. Indeed, estimates suggest that 1%–3% of the nonclinical population have delusions comparable in severity to clinical cases, with a further 5%–6% having a delusion of lesser severity, and a further 10%–15% have fairly regular delusional ideation (Freeman, 2006). Little consensus exists about the psychological or neuropsychological basis of delusions in clinical cases (Gilleen and David, 2005). Nonetheless, the study of delusion-prone healthy individuals provides an approach to the study of delusional thinking that is uncontaminated by other symptoms, medication, and the cognitive deficits typically linked to full-blown psychosis; and potentially a means to examine how certain cognitive problems may predate and lead to actual symptom formation (Laws et al., 2008).

Functional imaging studies reporting hypofrontality (for a review, see Hill et al., 2004) and poor performance on executive tests such as the Wisconsin Card Sort Test (WCST), word fluency, Stroop and Trail Making (Heinrichs and Zachzanis, 1998; Laws, 1999) point to the frontal lobes as a key area of brain dysfunction in schizophrenia. Almost as widespread is the belief that dysfunction of the frontal lobes underpins some of the main symptoms of the disorder (Liddle, 1987; for a review, see Dibben et al., 2009). Indeed, neuroimaging studies report reduced prefrontal and anterior cingulated cortex activity in individuals who experience delusions (Schröder et al., 1996; Erkwoh et al., 1997; Sabri et al., 1997; Blackwood et al., 2004; Lahti et al., 2006).

Poorer frontal/executive test performance has also been documented in people who score highly on psychometric measures of schizotypy, with evidence of increased WCST perseverative errors (Spaulding et al., 1989; Raine et al., 1992; Poreh et al., 1995; Suhr, 1997; Daneluzzo et al., 1998; Gooding et al., 1999; Tallent and Gooding, 1999), fewer completed categories and more failures in maintaining set (Lyons et al., 1991; Gooding et al., 1999), as well as deficits on Trail making (Poreh et al., 1995) and the Stroop (Suhr, 1997). Despite these findings, no previous study has examined whether executive/frontal dysfunction is associated with the reporting of specific schizophrenia-like symptoms in healthy individuals. Recent studies have, however, reported findings that would appear to be consistent with an executive/frontal dysfunction in delusion-prone individuals. These include reports of significantly greater false recall and false recognition in healthy individuals who score highly on the Peters Delusional Inventory (PDI: Peters et al., 1999) measure of delusion proneness (Laws and Bhatt, 2005; Dehon et al., 2008; Bhatt et al., 2010) as well as a greater confidence in such false memories (Laws and Bhatt, 2005; Bhatt et al., 2010). Parallels have been drawn between delusions and the confabulatory memories that sometimes emerge in neurological patients especially following frontal lobe injury. For example, Gilboa and Moscovitch (2002) reviewed studies of confabulators and reported that 81% had damage to the prefrontal cortex with orbitofrontal and ventromedial damage being the most common (see also Schnider, 2003). In the context of false memories, it is also worth considering the role of suggestibility (Gudjonsson, 2003) which has been linked to false

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doi:10.1016/j.psychres.2010.09.018

memory, but remains unexamined as a factor in delusional thinking. In this context, a relevant recent study by Gudjonsson and Young (2010) did find a positive relationship between suggestibility and confabulation, while confabulation and IQ were inversely related. Although the clinical presentations of delusions and confabulations can be quite similar (Turner and Coltheart, 2010) differences do exist with some arguing that confabulation typically involves the executive system, while delusions are more thematic and unrelated to the executive system (Kopelman, 2010).

2. Methods

2.1. Participants

One hundred healthy participants (41 males and 59 females) with a mean age of 29.64 (S.D. = 13.01) participated in the study (range 18 to 62). All participants had English as a first language and none had a history of mental illness. This sample was divided at the median into two non-overlapping groups consisting of 48 who had high PDI scores (6–21) and 52 with low (0–5) PDI scores. Previous large-scale studies using the PDI-21 have revealed mean PDI scores of 4.2 in a sample of 790 people attending a GP practice in France (Verdoux et al., 1998) and 4.1 in 2120 twins from the Institute of Psychiatry Volunteer Twin Register (Linney et al., 2003). Our *high* (9.42) and *low* (3.00) PDI groups fall clearly on either side of these benchmarks established in large samples of healthy individuals.

Table 1 shows the characteristics of the two samples. The high PDI group was significantly younger and had significantly lower NART (National Adult Reading Test: Nelson, 1982) scores than the low PDI group. Consequently, we ran all analyses without and with age and NART IQ as covariates — the pattern of the results was not changed and so, we report the non-adjusted means.

2.2. Tests and procedures

2.2.1. The 21 item Peters Delusional Inventory (PDI-21: Peters et al., 1999)

The PDI-21 is a self-administration questionnaire for assessing unusual thoughts ranging from religious beliefs to classical delusional thinking: for example, do you ever feel as if people are reading your mind? Do you ever feel as if you could read other people's mind? For each of the 21 questions, positive endorsements indicate delusional-prone thinking. Each affirmative response may also then be rated (1 to 5) separately for the degree of distress, preoccupation and conviction.

2.2.2. Intra–extradimensional set shift (IED)

The intradimensional/extradimensional shift task is a touch-screen adaptation of the Wisconsin Card Sorting Test (WCST) that assesses the ability to shift attentional set. The display (see Fig. 1) features stimuli in the form of shapes and lines that appear randomly in two of four possible locations on the computer screen. The participant touches the stimulus in one location and feedback is provided so they may learn which stimulus of the two is correct. To pass each stage, six consecutive correct responses are required within 50 trials; otherwise, the task terminates. The task is graded and contains nine stages that increase in complexity. These include learning to change responses when stimuli are no longer relevant (reversal learning), learning to generalize responses from a particular stimulus to others in the same category or dimension (rule abstraction), and shifting attention to a different stimulus dimension when the current dimension is no longer fruitful (attentional set-shifting). There are two critical parts of this test: first, to maintain attention to different examples of stimuli within the same dimension (shapes), while distracting stimuli of a different dimension are present (lines), intradimensional shifts (IDS); and second, to shift attention to the previously irrelevant dimension (lines) and ignore the previously relevant dimension (shapes), extradimensional shifts (EDS).

The measures derived from this task included the number of errors at each stage, the number of stages reached, the number of errors at extradimensional shift and errors up to the extradimensional shift stage.

2.2.3. Stockings of Cambridge Task (SOC)

The SOC is a computerised touch-screen adaptation of the Tower of London/Hanoi Tests. The SOC assesses spatial planning and spatial working memory and requires participants to execute a series of increasing difficult problems causing them to think ahead. The participant is presented with a split screen; the top half of which displays three coloured discs in a target arrangement and the bottom half of which contains the discs in a starting arrangement (see Fig. 2).

Table 1
Demographic characteristics of low and high PDI groups.

	Low PDI ($N=52$)	High PDI ($N=48$)		P
Gender (M/F)	21/31	20/28	$\chi^2=0.02$	0.90
Age	32.1 (14.7)	26.9 (10.4)	$F=4.04$	0.050
NART IQ	109.5 (4.6)	106.6 (4.9)	$F=9.19$	0.003
PDI score (total max = 21)	3.0 (1.6)	9.4 (3.4)	$F=155.02$	<0.001
PDI distress	5.7 (3.5)	22.9 (13.5)	$F=78.32$	<0.001
PDI preoccupation	6.1 (3.8)	25.4 (14.8)	$F=82.77$	<0.001
PDI conviction	8.2 (5.1)	28.9 (14.3)	$F=97.07$	<0.001

Note. Values are N (sample size), and means and standard deviations are in parenthesis.

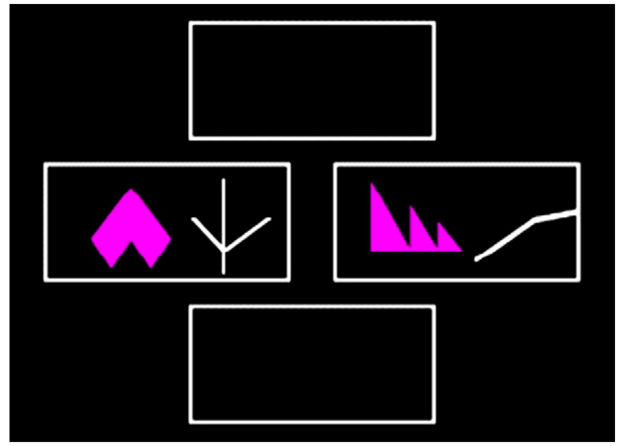

Fig. 1. A sample screenshot from the intra/extradimensional set-shifting task.

The participants are required to move the balls in the lower display to mimic the pattern shown in the upper display. The balls may be moved one at a time by touching the required disc, then touching the position to which it should be moved. Task difficulty is manipulated by increasing the number of moves required to complete each trial (between 2 and 5 moves). Each stage has a combined motor control condition that allows estimates of planning and thinking time to be calculated independently of movement time. The measures derived from this test included: initial thinking time for each problem (2–5) i.e. the time taken to make the first move; subsequent thinking time for each problem (2–5) i.e. time spent thinking about a problem during its execution; number of moves taken to complete each problem (2–5) and the number of problems solved within the minimum number of moves.

2.2.4. Gudjonsson Suggestibility Scale (GSS 2: Gudjonsson, 1987, 1997)

The GSS 2 is a measure of the extent to which a subject changes his/her recollection of a story in response to misleading interrogative statements and negative feedback from an interviewer. A fictional story (based on a short passage of prose about a boy falling off a bicycle) is read to the participant, following which the participant is asked to free-recall elements of the story (maximum score = 40). Then the participant is asked 20 yes–no questions pertaining to the details of the story. Fifteen of the questions are misleading questions and five are non-leading (the five non-leading questions are used as an estimate of memory ability). The number of leading questions endorsed by the participant is used to derive Yield 1. Approximately 50 min after the initial free-recall and Yield 1 testing, the participant is informed that she/he has made several errors (irrespective of whether errors were in fact made) and that the preceding 20 questions are to be re-administered. The number of leading questions that are endorsed during the second administration is used to derive Yield 2. The number of changed responses the participant manifests from time 1 to time 2 (across all 20 questions) is summed to form the 'Shift' measure. The scores associated with Shift are regarded as individual differences in susceptibility to interrogative pressure. Gudjonsson (1997) specified that Yield 1 and Shift can be added together to form a Total Suggestibility score.

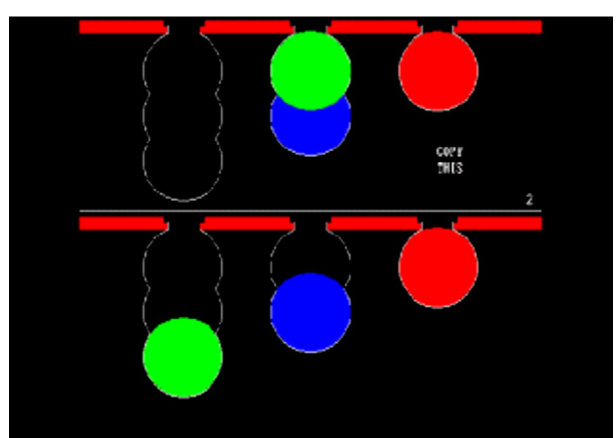

Fig. 2. A sample screenshot from the Stockings of Cambridge task.