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Probabilistic reasoning in obsessive–compulsive and delusional disorders

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ABSTRACT

Background. Delusional disorder (DD) and obsessive–compulsive disorder (OCD) have been investigated in previous studies using probabilistic reasoning paradigms and abnormalities in each group have been reported. No study to date has compared results between these groups. This study compares patients with these disorders with those who have both phenomena.

Methods. Thirty subjects with DD, 29 with OCD and 16 with obsessive and delusional features were compared with 30 normal controls in a study of probabilistic reasoning using two different computer-based tasks involving a Bayesian paradigm.

Results. Deluded subjects showed a 'jump to conclusions' reasoning style, but on a test that added a consequence to their choices did not differ from normals. OCD subjects deviated from Bayesian and control norms to a greater degree than did DD subjects. In subjects with mixed psychopathology, the presence of both phenomena appeared to 'normalize' these probability estimates.

Conclusions. Our findings extend those of others but require cautious interpretation as to the role of probabilistic reasoning in the genesis of delusions or obsessions. Obsessionals in both the OCD and Mixed groups, showed substantial deviation from Bayesian norms, suggesting that obsessionality leads to a reasoning style that is less 'normal' than that of delusionals. Further work is required to investigate clinical correlates of these findings which provide modest support for the proposal that the combination of obsessions and delusions confers greater functional advantages than simply having delusions or obsessions.

INTRODUCTION

Obsessive–compulsive disorder (OCD) and delusional disorder (DD: previously paranoia) emerged as individual entities from the various classificatory systems of the nineteenth century. While at times considered to have a common psychological aetiology, the work of Kraepelin and Freud and the re-definition of the terms neurosis and psychosis in the early years of this century led to perceptions that they were radically different disorders, with OCD being seen as a neurosis and DD as a psychosis. The subsequent dominance of the schizophrenia paradigm eclipsed interest in both conditions, which came to be seen as relatively uncommon. However, there has been a recent rekindling of interest in both disorders, which has led to an increased rate of diagnosis for both conditions and recognition of commonalities between them (Fear *et al.* 1995).

Research attention has turned to the cognitive processes presumed to be involved in the aetiology of both obsessions and delusions. Early work with paranoid schizophrenics demonstrated biases of attribution and attention and significant levels of schizotypal ideation (Bentall, 1995). Fear *et al.* (1996) have replicated these findings and found high levels of dysfunctional attitudes in a group of patients with delusional disorder (DD), whose schizotypal scores were indistinguishable from normals. Obsessionals, however, while revealing attentional disturbances and high levels of dysfunctional attitudes comparable to those in

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DD, have an essentially normal attributional style (Fear, 1995).

Reasoning and decision-making have also been investigated and there is some evidence that both are disturbed in DD and OCD. Research into the probabilistic reasoning style of patients with OCD (Volans, 1976), has been applied to deluded patients in an effort to test the hypothesis that delusions are formed upon the basis of faulty reasoning about normal perceptions (Garety, 1991). Such studies have demonstrated reasoning abnormalities in deluded patients, principally schizophrenics. Huq and colleagues (1988), gave a probabilistic reasoning task to 15 deluded schizophrenics and found that deluded patients request less information before reaching a decision (they jump to conclusions), express higher certainty levels, and are over-confident in their estimates of the probabilities of future events than either normal or psychiatric control groups. Garety and colleagues (1991), using the same paradigm, found a similar 'jump to conclusions' style in DD subjects, but this was less marked than in schizophrenics. The significance of these findings has been disputed on the basis that the number of draws taken by deluded subjects to reach certainty was closer to Bayesian norms than the number taken by normals, suggesting that deluded subjects could be seen as more 'rational' than the normals, arguably a *reductio ad absurdum* (Maher & Spitzer, 1983).

Given the recognition of commonalities between OCD and DD, it is of some interest that the probabilistic reasoning test used by Garety and colleagues was derived from one developed by Volans (1976) to test probabilistic reasoning in obsessionals compared with phobics and normals. Her results were suggestive of a trend towards obsessionals requiring more evidence before making a judgement than did either of the other groups. This effect became even more pronounced as subjects were exposed to the increased pressure of giving a probabilistic judgement regarding their certainty with each successive draw, rather than simply controlling the number of draws made. Obsessive subjects made less certain estimates with each draw than did phobics or normals.

No studies to date, however, have looked at probabilistic reasoning in patients who are both obsessive and deluded. The possibility of delusional or 'psychotic' change in OCD was widely recognized in the last century (Fear *et al*. 1995). In the 1950s obsessional symptoms were sometimes seen as an early manifestation of schizophrenia (Rosen, 1957). Obsessionality is not now, however, thought to be prodromal of schizophrenia and there has been a resurgence of interest in the possibility of delusional change in obsessive conditions with a number of descriptive and theoretical papers addressing this phenomenon (Insel & Akiskal, 1986; Kozak & Foa, 1994).

Against this background, our study aimed to assess probabilistic reasoning in three groups of patients, a group with OCD, a group with DD and a group having both obsessions and delusions, comparing these to each other and to a group of normals. All four groups were given the same task under the same conditions.

METHOD

Subjects

Referrals were sought from North Wales psychiatric teams of patients with a clear diagnosis of OCD or DD and patients with obsessional features whose diagnosis may be uncertain due to the concurrent or previous presence of delusions. There were 96 referrals; these were assessed independently by both authors who agreed that 75 satisfied entry criteria, 30 meeting DSM-III-R (American Psychiatric Association, 1987) criteria for DD, 29 for OCD and 16 having a mixture of obsessive and delusional features. The latter group contained subjects meeting DSM-III-R criteria for OCD who had met criteria for DD for at least 6 months at some point during their illness, and patients with DD who scored more than 16 on the Yale–Brown Obsessive–Compulsive Scale (YBOCS) (Goodman *et al*. 1989). Some subjects dropped out of the study because they found it difficult to understand the task, leaving 26 OCD, 22 DD and 15 Mixed diagnosis patients. These were compared with a control group of 30 normals drawn from hospital staff and their relatives or acquaintances.

Assessments

Obsessive–compulsive symptoms were recorded using the YBOCS, a two-part instrument comprising first a symptom checklist, and second a

10-point questionnaire on which aspects of the phenomena are scored to give a rating of severity for obsessions and compulsion separately. These scores are summed to give an overall rating. Delusions were assessed using the Maudsley Assessment of Delusions Schedule (MADS) (Wessely *et al.* 1993) in which a principle delusion is identified in a semi-structured interview and rated on subscales of conviction, maintenance, affect, action, idiosyncrasy, preoccupation, systematization and insight, which are summed to give an overall severity rating. Pre-morbid IQ was measured using the National Adult Reading Test (NART) (Nelson, 1982).

Procedure

The probabilistic reasoning method and measures used were substantially those of Garety and colleagues (1991), which will not be described here in detail. The order of the ball colours drawn was identical to their study in both conditions. The principle difference involved the presentation of the test on an Apple Mackintosh™ 'Powerbook 140/170' portable computer. The black and white monitor limited the colours which could be used in the two conditions with black : white ball ratios of 85 : 15 in jar A and 15 : 85 in jar B. Subjects received a pictorial representation, throughout the study, of these jars with the ball ratios in proportion but there was no indication as to which jar had been chosen for the draws. Pre-study testing of the computer formulation showed that it was more reliable for the computer to be operated by the investigator rather than the subject so that during the study subjects were asked to tell the investigator their choices so that these could be entered. The computer was operated throughout by the first author.

The presentation of the tests followed the same pattern in both conditions. First, the subject was asked to read a screen of instructions which were then explained to ensure comprehension. In Condition 1 they were first asked to estimate the chance that the first draw, from either jar, would be black, and then to decide from which jar the computer had chosen to draw the balls on the basis of the colour order of the balls drawn. Here, they could ask to see as many draws as they wished by asking the investigator to click on the button 'More balls, please'. Once the investigator was asked to click on the button 'No more balls, please, I've decided', the task ended and the number of draws and jar chosen were recorded. In Condition 2, the subject was told that 20 balls would be drawn and that they would be asked to indicate, using the scales, the relative chance of their having come from each jar. This generated the outcome variables discussed below.

Although subjects were given no feedback as to their performance, discussion afterwards suggested that they found Condition 2 appreciably more stressful than Condition 1. This perception appears to have resulted from the belief that their estimate of probability was somehow confirmed or repudiated by the colour of the next ball drawn. This is recognized in the design of the test since two of the outcome variables, response to confirmatory or disconfirmatory evidence, are based upon the supposition that subjects see the colour of the next ball drawn as indicative of the correctness, or otherwise, of their choice.

Statistical methods

Demographic data were compared using analysis of variance (ANOVA) for parametric and chi-squared test for non-parametric data. Since the probabilistic data is subject to large variance, a non-parametric ANOVA was used: the Kruskal–Wallis one-way ANOVA (KW).

RESULTS

Demographic data

Population demographics for the subjects who completed the test are shown in Table 1. The excluded DD subjects differed from those

Table 1. *Demographic data*

	Control ($N = 30$)	OCD ($N = 26$)	DD ($N = 22$)	Mixed ($N = 15$)
Age (years)	40·6 (12·7)	38·0 (14·2)	48·4 (14·3)	38·9 (14·5)
Sex				
Male	13	13	16	10
Female	17	13	6	5
IQ	114·9 (7·8)	112·6 (8·4)	110·6 (9·1)	109·8 (9·0)
Age at onset*	—	21·8 (5·3)	34·7 (15·1)	26·7 (9·7)
Duration	—	16·2 (17·7)	13·7 (12·4)	12·1 (13·3)
MADS†	—	—	39·8 (7·13)	33·7 (7·9)
YBOCS	—	22·2 (4·4)	—	22·0 (4·4)

* $F[2, 60] = 8{\cdot}780$, $P = 0{\cdot}0005$: DD *v.* OCD $P < 0{\cdot}05$.
† $F[1, 35] = 5{\cdot}260$, $P = 0{\cdot}028$.

included only in gender ratio, showing a preponderance of females ($\chi^2 = 4{\cdot}42$, df = 1, $P = 0{\cdot}036$) and in the OCD group, a two-way ANOVA showed the excluded subjects to be of significantly lower intelligence ($F[1, 29] = 6{\cdot}23$, $P = 0{\cdot}019$). Of those completing the test, OCD subjects were significantly younger than DD at the onset of their illness ($F[2, 60] = 8{\cdot}780$, $P = 0{\cdot}0005$). There were higher MADS scores from DD as compared with Mixed subjects ($F[1, 35] = 5{\cdot}26$, $P = 0{\cdot}028$), reflecting the fact that five of the Mixed subjects were not actively deluded at the time of the study. There were no other statistically significant differences in subject demographics.

Condition 1 (Table 2)

(*a*) *Initial certainty* (*the* a priori *estimate of a black ball on the first draw*)

All groups approximated to the Bayesian normative estimate of 50 %.

(*b*) *Draws to decision*

The DD group required significantly less draws than the Control (KW $\chi^2 = 11{\cdot}932$, df = 1, $P = 0{\cdot}0006$), OCD (KW $\chi^2 = 11{\cdot}941$, df = 1, $P = 0{\cdot}0005$) and Mixed groups (KW $\chi^2 = 5{\cdot}897$, df = 1, $P = 0{\cdot}015$). In the DD group, 16 subjects (73 %) reached a decision after the first draw but no factors (including age, sex, duration, age of onset of illness, IQ and MADS scores) appeared to distinguish these responders from the others.

(*c*) *Jar chosen*

The majority of subjects in all three groups chose the correct jar but a greater proportion of the DD group decided upon jar B (the 'wrong' choice). This result differed significantly only from Controls ($\chi^2 = 4{\cdot}677$, df = 1, $P = 0{\cdot}042$: Fisher's Exact Test).

Condition 2 (Table 2)

(*d*) *Initial posterior estimate* (*Bayesian normative estimate* 85 %, *estimates below or above this representing under- or over-confidence*)

OCD patients were under-confident compared with Control (KW $\chi^2 = 6{\cdot}910$, df = 1, $P = 0{\cdot}0086$), DD (KW $\chi^2 = 18{\cdot}523$, df = 1, $P < 0{\cdot}0001$) and Mixed groups (KW $\chi^2 = 14{\cdot}257$, df = 1, $P = 0{\cdot}0002$). DD and Mixed subjects were not significantly overconfident when compared with normals.

(*e*) *Draws to certainty* (*number of draws to give one* 100 % *or two estimates of* 85 % *or greater in favour of jar A*)

OCD subjects required more draws than Control (KW $\chi^2 = 19{\cdot}386$, df = 1, $P < 0{\cdot}0001$), DD (KW $\chi^2 = 20{\cdot}068$, df = 1, $P < 0{\cdot}0001$) or Mixed subjects (KW $\chi^2 = 5{\cdot}047$, df = 1, $P = 0{\cdot}025$).

(*f*) *Effect of confirmatory evidence* (*a positive value indicates greater confidence*)

There was a smaller effect of receiving confirmatory evidence in the Mixed group than Controls (KW $\chi^2 = 5{\cdot}122$, df = 1, $P = 0{\cdot}024$) or DD subjects (KW $\chi^2 = 5{\cdot}748$, df = 1, $P = 0{\cdot}017$).

(*g*) *Effect of disconfirmatory evidence* (*a positive value indicates reduced confidence*)

OCD (KW $\chi^2 = 5{\cdot}636$, df = 1, $P = 0{\cdot}018$) and DD subjects (KW $\chi^2 = 6{\cdot}917$, df = 1, $P = 0{\cdot}009$) reduced their levels of certainty significantly as compared with Controls.

(*h*) *Error at draw ten* (*the Bayesian normative estimate approximating to* 100 % *is used here as opposed to the* '*greater than* 85 %' *used in previous studies*)

OCD subjects showed significantly less certainty than either Controls (KW $\chi^2 = 10{\cdot}905$, df = 1, $P = 0{\cdot}001$) or DD subjects (KW $\chi^2 = 4{\cdot}154$, df = 1, $P = 0{\cdot}042$).

(*i*) *Draws from ten to change*/(*j*) *size of first estimate change*

No significant difference was found in the number of draws required for each subject group to switch their judgement in favour of jar B or in the size of this first change of estimate.

(*k*) *Choice of jar based on evidence received*

Subjects were approximately equal in their conclusion that neither jar could be chosen on the strength of the evidence received.

(*l*) *Mean time taken per draw decision*

OCD (KW $\chi^2 = 25{\cdot}273$, df = 1, $P < 0{\cdot}0001$) and Mixed group (KW $\chi^2 = 15{\cdot}783$, df = 1,

Table 2. *Dependant variables for Conditions* 1 *and* 2

	Control ($N = 30$)	OCD ($N = 26$)	DD ($N = 22$)	Mixed ($N = 15$)
Condition 1				
(a) Initial certainty	0·54 (0·10)	0·53 (0·18)	0·51 (0·06)	0·52 (0·17)
(b) Draws to decision*	2·6 (1·3)	3·4 (2·5)	1·5 (0·9)	2·7 (1·8)
(c) Jar chosen – A : B	29 : 1	24 : 2	17 : 5	14 : 1
Condition 2				
(d) Initial posterior estimate**	0·70 (0·21)	0·58 (0·13)	0·79 (0·12)	0·79 (0·14)
(e) Draws to certainty***	3·4 (1·9)	7·0 (2·8)	3·1 (1·4)	4·8 (3·3)
(f) Confirmatory effect†	0·08 (0·08)	0·05 (0·10)	0·12 (0·12)	0·02 (0·08)
(g) Discomfirmatory effect††	0·04 (0·08)	019 (0·23)	0·19 (0·26)	0·15 (0·21)
(h) Error at draw ten†††	0·04 (0·10)	0·23 (0·25)	0·09 (0·15)	0·13 (0·25)
(i) Draws from ten to change	3·2 (2·6)	3·1 (2·7)	3·2 (3·0)	3·1 (2·9)
(j) Size of first estimate change	0·05 (0·41)	0·22 (0·21)	0·16 (0·20)	0·24 (0·26)
(k) Final decision	0·58 (0·21)	0·48 (0·21)	0·44 (0·27)	0·47 (0·26)
(l) Time taken§	10·08 (4·43)	17·28 (5·16)	12·22 (4·91)	18·37 (9·09)

* KW $\chi^2 = 15{\cdot}979$, df $= 3$, $P = 0{\cdot}0007$.
** KW $\chi^2 = 21{\cdot}897$, df $= 3$, $P = 0{\cdot}0001$.
*** KW $\chi^2 = 25{\cdot}609$, df $= 3$, $P < 0{\cdot}0001$.
† KW $\chi^2 = 8{\cdot}756$, df $= 3$, $P = 0{\cdot}033$.
†† KW $\chi^2 = 8{\cdot}780$, df $= 3$, $P = 0{\cdot}032$.
††† KW $\chi^2 = 11{\cdot}789$, df $= 3$, $P = 0{\cdot}008$.
§ KW $\chi^2 = 31{\cdot}859$, df $= 3$, $P < 0{\cdot}0001$.

Table 3. *Subject scores and Bayesian normative values for Condition* 2

Draw	Control ($N = 30$)	OCD ($N = 26$)	DD ($N = 22$)	Mixed ($N = 15$)	Bayesian normative values
1	0·74 (0·19)	0·58 (0·13)	0·73 (0·17)	0·79 (0·14)	0·85
2	0·81 (0·16)	0·71 (0·16)	0·85 (0·15)	0·80 (0·15)	0·97
3	0·89 (0·15)	0·71 (0·20)	0·90 (0·14)	0·86 (0·10)	0·99
4	0·86 (0·15)	0·60 (0·32)	0·73 (0·25)	0·71 (0·27)	0·97
5	0·89 (0·12)	0·72 (0·23)	0·84 (0·21)	0·79 (0·19)	0·995
6	0·95 (0·06)	0·77 (0·23)	0·91 (0·16)	0·87 (0·18)	0·999
7	0·98 (0·04)	0·81 (0·17)	0·94 (0·14)	0·87 (0·21)	0·999
8	0·97 (0·06)	0·81 (0·23)	0·94 (0·14)	0·85 (0·28)	0·999
9	0·96 (0·07)	0·70 (0·35)	0·87 (0·19)	0·81 (0·29)	0·999
10	0·96 (0·10)	0·79 (0·24)	0·92 (0·14)	0·86 (0·25)	0·999
11	0·94 (0·12)	0·70 (0·32)	0·89 (0·18)	0·82 (0·17)	0·999
12	0·92 (0·14)	0·64 (0·35)	0·82 (0·22)	0·67 (0·22)	0·997
13	0·81 (0·17)	0·67 (0·30)	0·71 (0·23)	0·71 (0·25)	0·986
14	0·82 (0·19)	0·74 (0·21)	0·72 (0·20)	0·73 (0·25)	0·998
15	0·77 (0·19)	0·66 (0·25)	0·63 (0·28)	0·65 (0·31)	0·986
16	0·70 (0·20)	0·58 (0·24)	0·57 (0·29)	0·56 (0·30)	0·93
17	0·64 (0·20)	0·53 (0·24)	0·49 (0·30)	0·53 (0·30)	0·69
18	0·60 (0·22)	0·48 (0·23)	0·41 (0·32)	0·47 (0·26)	0·28
19	0·61 (0·21)	0·65 (0·22)	0·46 (0·29)	0·50 (0·26)	0·69
20	0·58 (0·21)	0·48 (0·21)	0·45 (0·27)	0·47 (0·26)	0·28

$P = 0{\cdot}0001$) subjects took significantly longer considering each draw than did Controls. Also, they took longer to reach decisions than did DD subjects (OCD *v.* DD, KW $\chi^2 = 9{\cdot}762$, df $= 1$, $P = 0{\cdot}002$; Mixed *v.* DD, KW $\chi^2 = 6{\cdot}592$, df $= 1$, $P = 0{\cdot}050$).

Bayesian normative values

Table 3 and Fig. 1 show the mean probabilities estimated for each draw of Condition 2 by subject group, together with the Bayesian normative values. The Bayesian normative values show a rapid rise to 'certainty' within two draws with the probability estimates barely dropping below 99 % until draw 15. The control group were closest to this, with estimates rising comparatively quickly to certainty, remaining there until a similar amount of evidence accrues in favour of the alternative hypothesis, whereupon they adopt this view with similar rapidity. DD patients mirror the controls closely but with slightly less certainty and a quicker, larger swing to the alternative hypothesis. Their reasoning is therefore essentially 'normal' in this condition but slightly more susceptible to the influence of contrary evidence. Subjects with OCD provided the greatest deviation both from the normative data and the estimates of the normal group. They remained excessively unsure and indecisive throughout.

Mixed group subjects were slightly less certain than DD subjects, perhaps reflecting the influence of obsessional uncertainty, although their estimates approximated to the reasoning of DD subjects more than to that of OCD subjects.

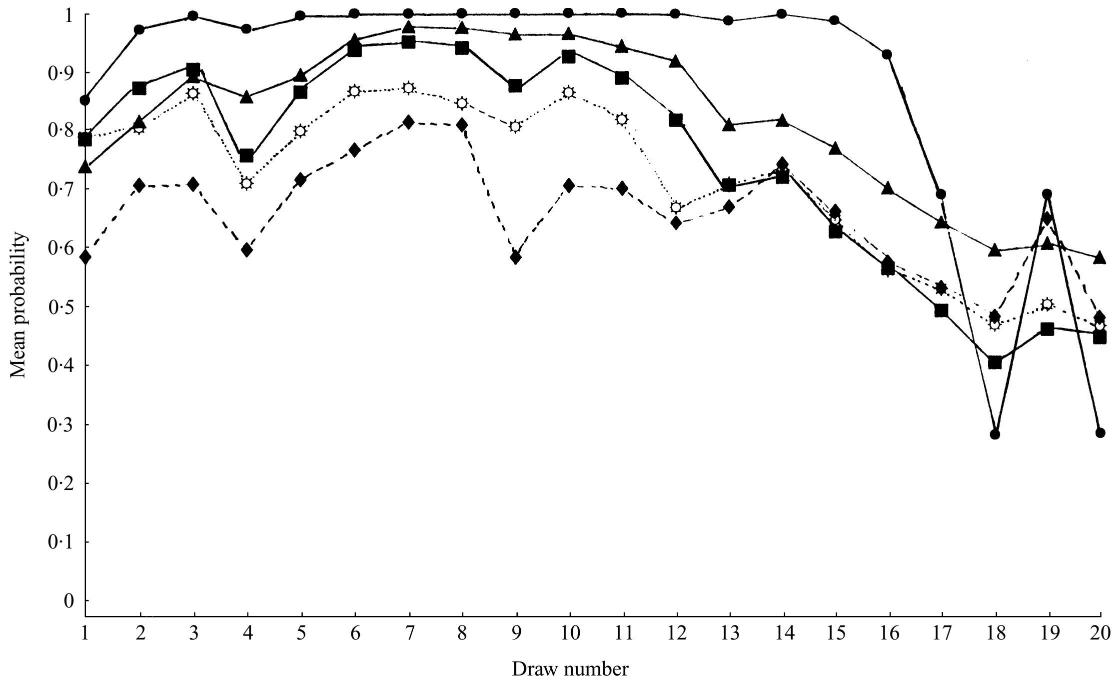

FIG. 1. Study group estimates for Condition 2 compared with Bayesian normative values (●, Bayesian probability; ✡, Mixed group; ◆, OCD group; ■, DD group; and ▲, Control).

DISCUSSION

We believe that this study is the first to compare the probabilistic reasoning styles of obsessional and delusional disorder patients with those of normal controls, using the same test battery and procedure for all subjects and the first to explore probabilistic reasoning in patients with both obsessional and delusional phenomenology.

In Condition 1, there is an overall positive skew of the data, which is considerably more marked in the DD group (Fig. 2). This is the 'jump to conclusions' style reported in previous studies (Huq *et al.* 1988; Garety, 1991; Garety *et al.* 1991). These investigators found schizophrenic subjects to require less draws than DD patients and concluded that the 'jump to conclusions' style is more marked in schizophrenics. Our DD subjects, however, showed the reverse, requiring less draws (mean 1·5) than the schizophrenics (mean 2·2) to reach certainty. Further, Garety and colleagues found that only 29% of their DD patients reached a decision in Condition 1 after a single draw compared with 45% of schizophrenics, whereas over 70% of our DD sample gave this extreme response. These data, therefore, support the contention that patients with 'pure' delusions make up their minds on the basis of less information than do schizophrenics. The impetuous DD subjects could not be differentiated from the more cautious DD subjects on the basis of demographic data, or the conviction subscale score on the MADS. In addition, it can be noted that the tendency to 'jump to conclusions' was also shown by 20% of normals. Furthermore, 'jumping to conclusions' was not a matter of making a quick judgement, in that DD subjects took more to make decisions than normals.

As discussed in the Method section, subjects reported a greater perception of pressure when doing Condition 2. It appeared that they felt that the accuracy of their estimate of the particular jar they had chosen was supported or repudiated by the colour of the next draw, even though there was no direct feedback as to their performance and they were, throughout, instructed to view the pattern of draws as a whole rather than to focus upon individual draws. While mathematically the appearance of

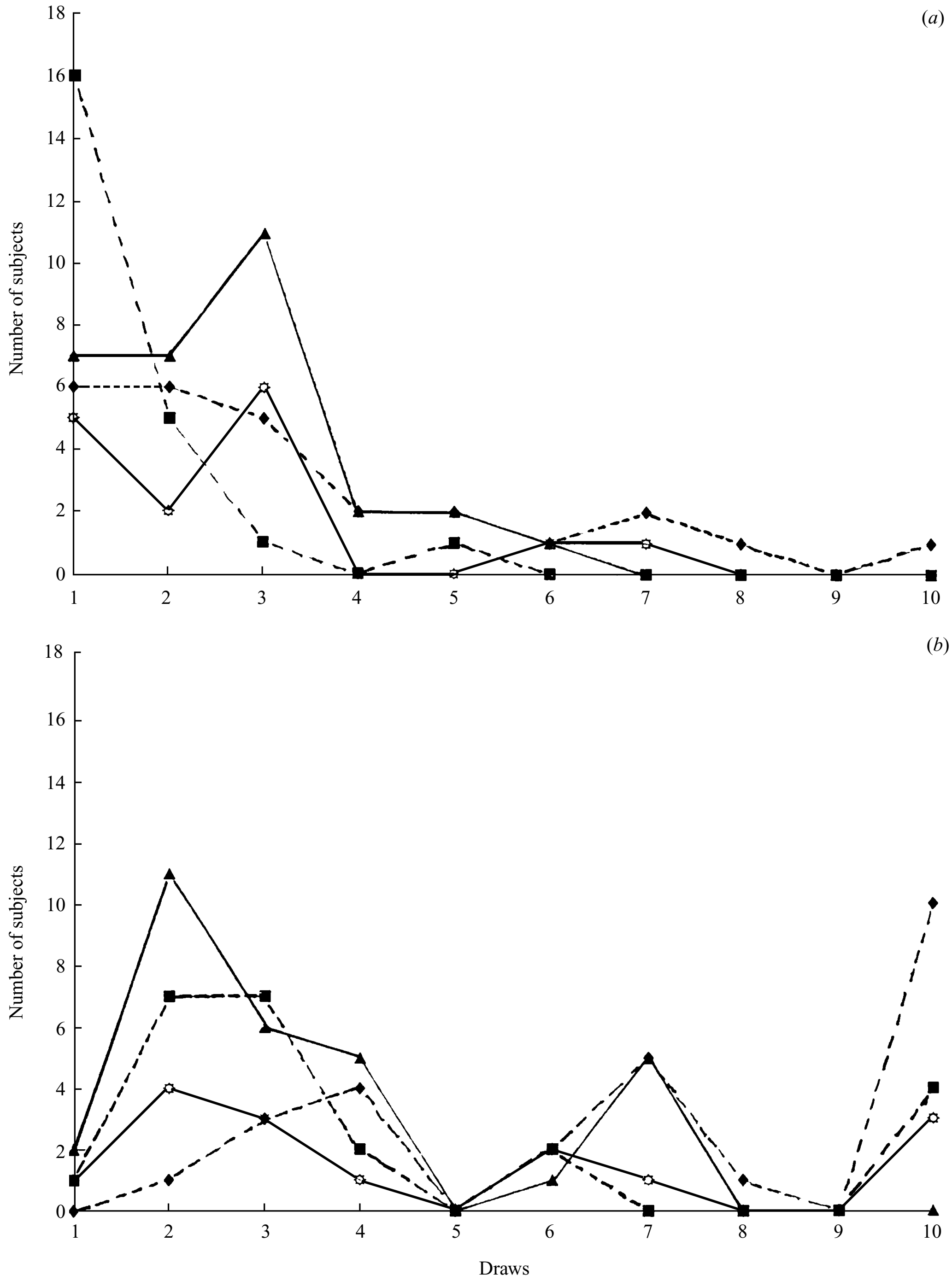

FIG. 2. Draws to decision for Condition 1 (*a*) and to certainty for Condition 2 (*b*) (◆, OCD; ■, DD; ▲, Control; and ✡, Mixed).

a ball of the minority colour does not indicate that the choice was 'wrong', the support which the appearance of a particular colour ball gives to an individual's hypothesis is clearly important and is integral to the measures of the effects of confirmatory and disconfirmatory evidence. The surprise here is that DD subjects under these conditions show an essentially normal reasoning style. In common with Garety *et al*. (1991), but on contrast to Huq and colleagues (1988), we found that deluded subjects did not show a greater effect of confirmatory evidence than controls and indeed they were more uncertain than controls when faced with contradictory evidence. While this effect was also present in our OCD subjects, it was not seen by Garety and colleagues in anxiety disorder patients (Garety *et al*. 1991) and it may, therefore, not be an effect common to all psychiatric disorders.

Given that a defining characteristic of delusions is their incorrigibility, it seems surprising that DD subjects are less certain in the face of contradiction than normals. In other probabilistic reasoning studies where the deluded subjects had schizophrenia, it was suggested that such findings indicate that delusions arise because such people are more influenced by their environment than by their own prior learning (Hemsley, 1987), or that they are more likely to focus on prominent rather than weaker stimuli and be influenced by abnormal experiences such as hallucinations for instance (Garety, 1991). DD sufferers, however, are not subject to the multiplicity of cognitive deficits found in schizophrenia and these explanations are thus difficult to sustain in this group. Furthermore, our Mixed group subjects, who were experiencing additional difficulties, do not show this pattern of reasoning. A possible hypothesis consistent with the data is that delusions involve emotional 'fixations' as opposed to primary reasoning anomalies. The central fixation in this scenario might be well defended by a reasoning style which, far from entailing dogged fixity, allows an individual faced with strong contrary evidence to set aside one set of defences and 'jump to' an alternative explanation in such a way as to evade the learning which would normally arise through experience. Of course, it might also be argued that the tests used here do not represent a valid measure of delusional thinking since delusions are only incorrigible when imbued with a personal salience that balls drawn from jars can never acquire. The results obtained from our OCD group, however, would seem to argue for the ecological validity of the task.

Probabilistic reasoning in OCD

Unlike DD subjects, obsessionals deviated from normal in their responses to both Conditions 1 and 2, their tendency towards a greater number of draws to decision in Condition 1 being consistent with the number of draws they took to reach certainty in Condition 2 (Fig. 2). While showing a normal effect of confirmatory evidence, they were similar to DD subjects in showing a loss of certainty when faced with contradictory evidence. Obsessionals also took more time over each decision than other groups, which was consistent with clinical impressions of OCD as involving endless rumination. These results were also in line with the indecisive reasoning style reported in OCD patients by Volans (1976).

Applying the heuristic that Condition 2 involves a consequence for subjects, it can be seen that in this situation obsessionals require more information and are less certain in reaching a decision. This supports the proposal of Carr (cited in Beech & Liddell, 1974) that in a situation of perceived low risk obsessionals reason normally, whereas as risk increases obsessional reasoning becomes more vacillatory. Indeed, despite the fact that the 'threat' or consequence in Condition 2 was non-specific and unlikely to have much personal salience, 38% of OCD subjects did not achieve the threshold of certainty.

Most current classification systems include DD among the psychoses, implying an impairment of reality-testing, and OCD with the anxiety disorders, suggesting normal reality-testing. One might expect on this basis that DD patients would reason abnormally in comparison with OCD patients but this assumption is not borne out by the results of this study. While these findings apparently contradict contemporary classifications, they are quite consistent with the clinical pictures. It is a defining feature of DD patients that when they are not discussing their delusions they appear in all respects normal and that most do not act on their beliefs (Wessely *et al*. 1993). In contrast, most OCD patients do act upon their obsessions and in that sense are perhaps more severely disturbed.

Probabilistic reasoning in subjects who are both deluded and obsessive

Given the differences in reasoning style between OCD and DD subjects, it seemed probable that Mixed group subjects would be significantly impaired in their responses to both Conditions 1 and 2. In fact, the obsessionality of these patients appears to have 'normalized' the jumping to conclusions style in Condition 1. Similarly, the delusional ability to achieve certainty would seem to have modified the obsessional uncertainty in response to Condition 2 (see Fig. 2). The Mixed group behaved as obsessionals when it came to the time taken over each decision, but in all other respects the conjunction of obsessional and delusional phenomena appears to have balanced out the reasoning styles.

The Mixed group comprised a group of subjects with a primary diagnosis of OCD who had become deluded ($N = 5$) and a group of chronically deluded DD subjects who had YBOCS score indicative of OCD caseness ($N = 10$). It is possible that these two subgroups represented distinct entities, with either primarily obsessive or delusional reasoning styles respectively. This possibility was examined by comparing the subgroup responses on all reasoning variables using the Kolmogorov–Smirnov test (for small sample size). There were no significant differences on any of these variables. In addition, we have not found these subgroups to differ from each other across a range of attributional and attentional measures on which DD and OCD subjects differ distinctively (Fear *et al*. 1996, 1997).

Conclusion

These findings are broadly in line with and extend those of other authors. The fact that both DD, OCD and Mixed subjects have been studied using the same methods constrains the interpretation that can be put on the data as to the significance of any abnormalities in the genesis of the disorders being studied. Thus, while a high proportion of DD subjects displayed a 'jump to conclusions' style of reasoning, some were clearly deluded without showing any features of this style. In contrast, obsessionality, whether in the OCD or Mixed group, appeared to drag subjects away from Bayesian norms on the tasks employed. Further studies would seem to be called for to determine whether there are any clinical correlates of these findings. It might also be worth while to attempt to establish whether any of the brain circuits activated by this procedure can be mapped with functional neuroimaging and if so whether there is any correspondence between such circuits and the abnormalities of functioning which neuroimaging studies appear to be picking up in OCD. Finally, on the question of the co-occurrence of OCD and DD, a phenomenon that has been noted for more than a century (Fear *et al*. 1995), these data provide modest support for the proposal that the combination of obsessions and delusions may, in some cases, be facilitated in that this combination of psychopathological features might in some respects be more adaptive than simply being deluded or obsessional

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