

Cognitive Processes, Reasoning Biases and Persecutory Delusions: A Comparative Study

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Abstract. This study investigated whether reasoning biases are specific to people with delusions and the role of emotional material on “jumping to conclusions”. Associations between reasoning and cognitive factors as well as other top-down factors such as metacognition were also explored. A comparative design was used to investigate group differences between people with persecutory delusions, people with panic disorder and non-patient controls. A probabilistic reasoning task involving three types of material was utilized to investigate the effect of emotional content on reasoning. Participants also completed questionnaire measures to explore whether hasty decision making was associated with measures of mood or cognitive processes. The results of the reasoning task showed that there was no main effect of group. However, all participants requested significantly less information on the two types of emotional material. None of the questionnaire measures were associated with performance on the reasoning task. Aspects of metacognition were found to be associated with ratings of delusions. This study suggested that between group differences in reasoning were small but that emotional content increases haste of decision making across all groups.

Keywords: Persecutory delusions, psychosis, reasoning, cognition, emotion.

Introduction

Psychological theories of delusions that have gained popularity in recent years have drawn on a variety of approaches i.e. neuropsychology (Frith, 1987, 1992), attributional style (Bentall, Kinderman and Kaney, 1994) and reasoning biases (Huq, Garety and Hemsley, 1988). A considerable body of research has been built up investigating differences in the reasoning processes of people with delusions. Studies have looked at different types of reasoning including inductive reasoning (John and Dodgson, 1994), hypothesis testing (Young and Bentall, 1995, 1997b) and selection tasks (Dudley, Young, John and Over, 1998); however, the majority of studies have focused on probabilistic reasoning.

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Huq et al. (1988) compared people with delusions with a mixed psychiatric group and normal controls on a neutral probabilistic reasoning task (the bead task). It was found that the participants with delusions, on average, requested significantly less information than the two control groups. In addition, they were overconfident in their estimates of probabilities of future events. This finding was replicated and extended by Garety, Hemsley and Wessely (1991) who found people with delusions requested less information but, in contrast to the hypotheses, rather than clinging to their beliefs the delusions groups were more ready to change their estimates on the basis of disconfirmatory information. It is of note that paranoid patients requested more information than those with a diagnosis of schizophrenia; however, these groups were combined for statistical analysis so this effect was masked.

Despite what appears to be compelling evidence of a reasoning bias in people with delusions, these results need to be treated with some caution. In both of these studies there was large group variation, especially within the delusions groups. The findings suggest that only a minority of the deluded sample showed evidence of a reasoning bias, with up to two-thirds of the participants with delusions responding normally. In addition, studies using variations on the probabilistic reasoning task have failed to demonstrate evidence of jumping to conclusions (i.e. Young and Bental, 1997a; Kemp, Chua, McKenna and David, 1997).

Dudley and his colleagues carried out a series of studies using probabilistic reasoning tasks to investigate the reasoning of people with delusions (Dudley, John, Young and Over, 1997a, b). They concluded that people with delusions have a data-gathering bias rather than an abnormality in reasoning and that when required to reason with the emotional material all groups reduced the amount of evidence requested before making a decision. Hence, Dudley et al. suggested that the delusional system may predispose people to find personal significance in neutral stimuli.

In a theoretical review of the area, Dudley and Over (2003) suggested that people with delusions may have different goals in their reasoning rather than faulty reasoning. Drawing on research that has demonstrated that non-clinical samples show a tendency to use a confirmatory reasoning style when dealing with danger or threat material, whilst a disconfirmatory style is utilized when reasoning with claims about safety (de Jong, Mayer and van den Hout, 1997), they propose that people with delusions tend to apply this confirmatory reasoning style when dealing with objectively neutral material. This suggests that people with delusions perceive danger where others do not. Dudley and Over (2003) view this threat confirmation as reaching a form of closure and cite the studies of Bental and Swarbrick (2001) and Colbert and Peters (2002), which have demonstrated a relationship between persecutory delusions and delusion proneness respectively, and a need for closure. Dudley and Over (2003) suggest that this greater need for closure may explain the tendency to jump to conclusions.

Other than looking at “need for closure”, as yet little research has focused on trying to establish whether cognitive processes and top down factors are influential in the formation and maintenance of delusions or the tendency to “jump to conclusions”. Recently, Morrison (2001) has suggested a role for top down processes in the formation of delusions. He argues that delusions and other psychotic symptoms may result from information that is accurately perceived but misinterpreted due to faulty self and social knowledge. Drawing on recent research, which has highlighted the similarities between psychotic symptoms and anxiety disorders (Baker and Morrison, 1998; Freeman and Garety, 1999), Morrison proposes that these beliefs are then maintained by the same processes that have been shown to be operating in the maintenance of anxiety disorders. More specifically, research has implicated a role

for metacognition in the development of other psychotic symptoms such as hallucinations (Baker and Morrison, 1998). Wells and Matthews (1994) described metacognition as beliefs about thoughts that determine the selection of particular cognitive regulatory processes. They proposed a self-regulatory executive function (S-REF) model of emotional disorders that incorporates the interactions between appraisals, attentional control, and beliefs.

Metacognition may also play an important role in delusions with specific beliefs leading the individual to engage in ineffective or counterproductive attempts at control that may be involved in the maintenance of the delusional belief. It is possible that individuals' metacognitive beliefs may lead them to use specific strategies in order to try to reduce internal inconsistencies. This is similar to the idea suggested by Dudley and Over (2003) that a greater need for closure may explain jumping to conclusions. It is possible that the internal distress or anxiety caused by uncertainty may lead people with vague delusional ideas to use a confirmatory evidence gathering style and hasty decision making. Whilst this would lead to crystallization of the delusional belief, the removal of uncertainty and associated anxiety would reinforce the use of such strategies.

Freeston, Rheaume, Letarte, Dugas and Ladouceur (1994) have investigated the role of "intolerance of uncertainty" in Generalized Anxiety Disorder (GAD) and developed a questionnaire to measure this. Given that recent research has demonstrated a number of similarities between GAD and delusions (Freeman and Garety, 1999), this may indicate that intolerance of uncertainty has a role in the formation or maintenance of delusions.

Based on the possibility that different processes may operate in the formation of different types of delusion it was considered important to focus on a specific subtype. In addition, the use of a single type of delusion allowed investigation of the impact of emotionally salient material. This study compared people with persecutory delusions with panic disorder and non-patient controls. Most previous studies have used depressed controls; however, given that recent research has demonstrated a number of similarities between anxiety disorders and psychotic symptoms, this may be a more stringent test of whether reasoning biases are specific to delusions. This study also investigated the impact of emotional content on reasoning by using emotionally salient material. Material was chosen to focus on the concerns of the group of people with persecutory delusions and those with panic disorder. It was hypothesized that whilst the persecutory delusions group would request significantly less information than the other two groups on the neutral and personality characteristic material, the panic disorder group would request the least information on the panic related material. Measures were used to explore whether "jumping to conclusions" is associated with cognitive factors or influenced by top down factors such as metacognitive beliefs. It was predicted that group differences on the reasoning task would reduce once intolerance of uncertainty and mood were statistically controlled and that high scores on intolerance of uncertainty would be associated with jumping to conclusions. In addition, exploratory analyses were used to investigate associations between the questionnaire measures and performance on the reasoning task. Associations between the ratings of delusions and scores on the questionnaire measure and the reasoning task were also looked at.

Method

Participants

This study compared three groups of participants: people with persecutory delusions, people with panic disorder, and non-patient controls. The size of groups was determined on the basis

of past studies (Young and Bentall, 1997a; Dudley et al., 1997b), which provide estimates for the typical performance of people with delusions as well as depressed and non-patient comparisons on “jumping to conclusions” tasks. These studies suggested expected effect sizes of $f = 0.4044$ for three group comparisons (mean of experimental group = 4.2, mean of depressed controls = 7.1, mean of non-patient controls = 7.3 with a group SD of 3.13). Power calculations suggest that with an alpha of .05, such effect sizes will provide a power of > 0.8 for samples of 15 or more participants per group.

The experimental group was made up of 15 people with persecutory delusions. The group consisted of 9 males and 6 females. They aged between 20 and 61 years, with a mean age of 38.47 ($SD = 12.73$). Their IQ derived by the National Adult Reading Test (NART, Nelson 1982) ranged between 91 and 120 with a mean of 106.93 ($SD = 9.18$). To meet the inclusion criteria participants had to: (1) currently be experiencing persecutory delusions assessed on the basis of interview and case notes; (2) have a diagnosis of delusional disorder or schizophrenic spectrum disorder based on DSM-IV (APA, 1994) criteria; (3) be aged between 18 and 65 years; (4) show no evidence of organic brain damage. Non-English speakers were excluded in all groups as the questionnaires had been standardized in English.

The psychiatric control group consisted of 15 people who met DSM-IV criteria for panic disorder. The group was made up of 3 males and 12 females. They aged between 20 and 62 years with a mean age of 41 ($SD = 10.70$). The mean NART derived IQ score was 111.27 ($SD = 8.22$) and ranged between 100 and 127. The exclusion criteria for participants in this group was: (1) the presence of delusions or (2) a first degree relative with a diagnosis of schizophrenia.

The second comparison group was made up of people who were recruited via an advertisement for volunteers, and informal contacts. This group was made up of 15 people, and consisted of 9 males and 6 females. Participants were aged between 23 and 62 with a mean age of 40.4 ($SD = 12.61$). IQ scores ranged between 97 and 124 with a mean of 113.53 ($SD = 7.60$). Non-patient controls were selected according to the following criteria: (1) no history of psychiatric or psychological treatment; (2) never experienced panic attacks; (3) absence of delusional ideas, and (4) no family history of schizophrenia in a first degree relative.

Measures

Probabilistic reasoning task. This study used a card version of the neutral and self-referent material trials described in Dudley et al. (1997b) to measure participants’ tendencies to “jump to conclusions” on different types of materials. In the neutral version people were shown a number of children’s names and asked to decide whether the children came from a mainly boys school or a mainly girls school. The personality characteristic material was made up of positive and negative attributes or personality traits, and the participant had to decide whether these comments came from a mainly positive or mainly negative survey. Trials all had a ratio of 60:40 i.e. half the neutral trials had a ratio of 60% boys names and 40% girls names, and the other neutral trials were made up of 60% girls names and 40% boys names. Participants were shown a total of 12 trials; of these four trials involved neutral material, four trials comprised personal characteristics material and the other four trials contained panic related material. The items (i.e. boys or girls names; and positive or negative characteristics) were printed on flash cards using two colours of ink to help the participants distinguish between the items. The measure of “hastiness” was how many items the person asked to see before they made their decision.

The third set of trials was devised specifically for this study to measure haste of decision making on panic related material. The aim of this material was to be more salient to the psychiatric control group of people with panic disorder. The lists of words used in the panic trials were obtained from studies of cognitive processing of emotional information in people with panic disorder (McNally et al., 1994, McNally, Riemann, Louro, Lukach and Kim, 1992). These studies demonstrated a Stroop interference effect for negative panic associated words such as fear, dizzy and faint, when compared to positive words associated with panic, or neutral words. Positive words associated with panic were near antonyms of the negative panic words and included safe, relaxed and calm. Neutral words were unconnected to panic such as plate, button and snowy. Both positive and negative panic related words were allocated to the panic trials of this study through a process of stratified randomization to ensure a ratio of 60:40 to match the neutral and self-referent trials. Order of word presentation was matched between the three types of trial and they did not differ in terms of word length or frequency of usage ($p > .05$, Carroll, Davis and Richman, 1971).

Questionnaire measures

To establish diagnosis in the psychiatric control group and the presence of delusions in the experimental group, the following diagnostic and symptom measures were used:

Psychotic Symptoms Rating Scales (PSYRATS; Haddock, McCarron, Tarrier and Faragher, 1999). To measure the severity of delusions, the delusional subscale of the Psychotic Symptoms Rating Scale was used in the experimental group only. This measures six dimensions of delusions: amount of preoccupation, duration of preoccupation, amount of distress, intensity of distress, conviction, and disruption. Factor analysis identifies two factors; a cognitive interpretation factor (factor1) and an emotional characteristics or distress factor (factor 2). This scale demonstrates good inter-rater reliability, with estimates of reliability around 0.9.

Structured Clinical Interview for DSM-IV (SCID, Spitzer and Williams, 1997) – Panic Disorder Section. This section of the clinical interview was used to establish the presence of panic disorder in the psychiatric control group. This interview schedule is based on the diagnostic criteria of DSM-IV (APA, 1994).

A number of measures were used to establish the comparability of the groups and to identify and control for possible confounding variables:

National Adult Reading Test (NART; Nelson, 1982). This measure was used to provide an estimate of pre-morbid intelligence to establish intellectual comparability across the groups. In this test the participant is required to read 50 irregular words. This assesses familiarity with the words rather than ability to use grapheme-phoneme rules. The total number of errors on the NART is used to predict full scale IQ. Previous research has demonstrated that the NART is correlated with other measures of current intelligence (Crawford, Parker, Stewart and Besson, 1989).

Beck Depression Inventory – 7 items (BDI-7; Beck, 2000). This questionnaire was used to measure current severity of depressive symptoms. Each item consists of four statements that reflect different intensities of depressive symptoms. Participants are asked to choose the statement that best describes how they felt over the previous 2 weeks. Responses are scored on a 4-point scale (0-3) and totalled to provide an overall score.

State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg and Jacobs, 1983). Trait anxiety was measured on the trait anxiety subscale of this inventory. This subscale contains 20 items that comprise statements depicting how the individual may feel. There are four response categories from “almost never” to “almost always”. Scores range from 20 (almost never anxious) to 80 (almost always anxious). The subscale has an alpha of 0.90 in college students.

Questionnaire measures were also employed to obtain measures of cognitive processes:

Intolerance of Uncertainty Questionnaire (IU; Freeston et al., 1994). This questionnaire measures the individual’s reactions to uncertainty and was used to investigate the association between cognitive style and reasoning bias. This questionnaire comprises 27 statements that assess emotional, cognitive and behavioural reactions to ambiguous situations. Participants have to rate the statements on a 5-point Likert scale according to whether they are “characteristic of them”. The psychometric properties of this questionnaire have been established for people with generalized anxiety disorder, and demonstrate high internal consistency (0.91).

Meta-Cognitions Questionnaire (MCQ; Cartwright-Hatton and Wells, 1997). This scale measures meta-cognitive beliefs, or beliefs regarding worrying thoughts. It contains five subscales: (1) positive beliefs; (2) beliefs about uncontrollability and danger of thoughts; (3) cognitive confidence; (4) need for control, responsibility, and punishment; (5) cognitive self-consciousness. This questionnaire contains 65 statements that the participant is asked to rate on a 4-point scale according to how much they agree with the statement; 1 = do not agree, 2 = agree slightly, 3 = agree moderately, and 4 = agree very much. The subscales exhibit good internal consistency (alphas ranged between 0.72 and 0.89) and test-retest reliability (coefficients ranged between 0.76 and 0.94).

Procedure

Participants were told that they were participating in a study investigating the different ways people think. The reasoning tasks were completed first; however, the order of the presentation of the different materials was varied to control for fatigue or practice effects. In each of the groups, five participants received the trials in the order: neutral, personality characteristics and finally panic related trials. Five were presented with the personality characteristics trials first, then the panic related and then the neutral trials. The remaining five participants were given the panic related trials followed by the neutral trials and then the personality characteristics trials. Once the participant had completed the reasoning task they were asked to complete the NART and the other self-report questionnaires. The order of these measures was fixed to ensure that those considered most important to the study were completed first in order to minimize the impact of people wishing to withdraw early from the study.

Statistical analysis

Data were analysed using SPSS (version 9) for Windows. All variables were normally distributed; consequently parametric statistical analysis could be performed throughout.

Table 1 Mean number (and standard deviation) of items requested by group and type of stimuli

Variables	Delusion group	Panic control group	Non-patient control group
Characteristic trials	4.17 (3.02)	6.15 (4.17)	5.60 (2.98)
Panic trials	4.20 (3.07)	6.00 (4.20)	5.38 (3.00)
Neutral trials	4.63 (2.89)	6.63 (3.78)	6.60 (3.01)
Overall mean	4.33 (2.81)	6.26 (3.89)	5.86 (2.88)

Table 2 Results of two-way analysis of variance – effects of group and type of stimuli

Effects	<i>df</i>	<i>F</i>	Significance
Effect of group	2	1.48	0.24
Effect of stimuli	1	6.48	0.02*
Group-stimuli interaction	2	0.47	0.63

* $p < .05$.

Results

Results of reasoning task

The analysis of the reasoning task involved comparison of the mean number of items viewed before reaching a decision. Scores for each participant were derived by obtaining the mean of the four neutral trials, the four personality characteristics trials and the four panic related trials. Table 1 shows the mean number (and standard deviations) of items requested by the three different groups for each of the types of stimuli.

A two-factor analysis of variance was performed to investigate the effects of group (three levels: delusion, panic control and non-patients) and the effect of type of stimuli on reasoning (three levels: neutral, personality characteristic and panic related material). Visual inspection of the group means suggests that there was a trend for participants in the delusions group to ask for the least items before reaching a decision. Panic controls requested the most information. However, statistical analysis showed that there was no significant main effect for group ($F(2,42) = 1.48, p = .24, NS$).

On the two-way repeated measures analysis of variance a significant main effect was found for stimuli ($F(2,42) = 6.48, p = .02$). Post hoc analysis indicated that the number of items requested on the neutral stimuli was significantly greater than on the panic related and personality characteristics stimuli. In contrast to the hypotheses there was no group by stimuli interaction ($F(2,42) = 0.47, p = .63, NS$). Thus stimuli had an effect on all groups reasoning processes, with all participants making decisions based on less information when that information was of an emotional nature.

These results do not show the patterns of results that were predicted and suggest that there are only small between group differences on this reasoning task. Thus the findings do not appear to support the hypotheses, which predicted that people with delusions would request less information than the panic disorder controls and the non-patient controls. In addition, it was hypothesized that there would be a specific effect of type of stimuli, and that people with delusions would request less information on the personality characteristic trials, whilst the people with panic disorder were predicted to request the least information on the panic related

Table 3 Results of analysis of variance comparing means (and standard deviations) of questionnaire measures for the three groups

Variables	Delusion group	Panic control group	Non-patient control group	df	F	p
Intolerance of uncertainty	81.80 ^a (25.18)	79.20 ^a (25.82)	43.67 ^b (11.79)	2, 42	14.19	.000**
MCQ factors: Positive beliefs about worry	41.85 ^a (16.09)	31.67 ^a (9.17)	28.40 ^b (6.92)	2, 40	5.45	0.008**
Beliefs about controllability	39.00 ^a (15.52)	46.93 ^a (11.62)	24.20 ^b (5.62)	2, 40	15.26	0.000**
Metacognitive efficiency	21.46 ^a (8.65)	23.33 ^a (5.35)	16.33 ^b (5.25)	2, 40	4.65	0.015*
Negative beliefs inc responsibility + superstitions	30.38 ^a (10.27)	27.27 ^a (8.63)	18.27 ^b (3.75)	2, 40	9.05	0.001**
Cognitive self-consciousness	19.38 ^a (5.01)	18.40 ^a (6.53)	13.20 ^b (4.21)	2, 40	5.57	0.007**
STAI	52.29 ^a (14.90)	56.80 ^a (8.61)	30.47 ^b (4.24)	2, 41	29.03	0.000**
BDI-7	9.29 ^a (6.18)	5.67 ^a (3.44)	0.33 ^c (0.72)	2, 41	18.08	0.000**

* $p < .05$, ** $p < .01$.

a,b,c indicates location of significant differences as revealed using post hoc multiple comparisons.

trials. These hypotheses were not supported by the data, which demonstrated the emotional content had a general effect across all three groups and increased the hastiness with which all participants reached decisions.

Results of questionnaire measures of cognitive processes

The three groups' responses on the Meta-Cognitions questionnaire and Intolerance of Uncertainty questionnaire were also compared. Analysis of variance was performed to investigate group differences on these measures. As can be seen in Table 3, there were significant group differences on the measure of intolerance of uncertainty and on all of the subscales of the MCQ. Post hoc analysis using the least significant difference revealed that on the Intolerance of Uncertainty the non-patient control group scored significantly lower than both the delusions group and the panic disorder control group. There was no significant difference between the scores of the two patient groups on this measure. This pattern of differences was also found for four of the MCQ subscales; beliefs about controllability, metacognitive efficiency, negative beliefs including responsibility and superstition, and cognitive self-consciousness. On the MCQ subscale, positive beliefs about worry, the delusions group obtained significantly higher scores than both control groups.

Relationships between reasoning task and questionnaire measures

It was predicted that group differences on the reasoning task would be reduced once Intolerance of Uncertainty scores and mood were statistically controlled and that high scores on the Intolerance of Uncertainty questionnaire would be associated with increased reasoning bias.

Table 4 Pearson correlation coefficients between reasoning task and questionnaire measures

Variables	Neutral trials mean	Characteristics trials mean	Panic trials mean	Overall mean
BDI-7	-0.30 <i>p</i> = .005 <i>N</i> = 44	-0.22 <i>p</i> = .15 <i>N</i> = 44	-0.23 <i>p</i> = .14 <i>N</i> = 44	-0.26 <i>p</i> = .09 <i>N</i> = 44
STAI	-0.19 <i>p</i> = .22 <i>N</i> = 44	-0.10 <i>p</i> = .52 <i>N</i> = 44	-0.12 <i>p</i> = .44 <i>N</i> = 44	-0.14 <i>p</i> = .36 <i>N</i> = 44
Intolerance of uncertainty	-0.12 <i>p</i> = .44 <i>N</i> = 45	-0.00 <i>p</i> = .99 <i>N</i> = 45	-0.01 <i>p</i> = .97 <i>N</i> = 45	-0.04 <i>p</i> = .78 <i>N</i> = 45
MCQ factors: Positive beliefs about worry	-0.20 <i>p</i> = .20 <i>N</i> = 43	-0.13 <i>p</i> = .42 <i>N</i> = 43	-0.17 <i>p</i> = .29 <i>N</i> = 43	-0.17 <i>p</i> = .27 <i>N</i> = 43
Beliefs about controllability	-0.11 <i>p</i> = 0.48 <i>N</i> = 43	0.01 <i>p</i> = .96 <i>N</i> = 43	-0.04 <i>p</i> = .81 <i>N</i> = 43	-0.05 <i>p</i> = .76 <i>N</i> = 43
Metacognitive efficiency	-0.05 <i>p</i> = .75 <i>N</i> = 43	-0.01 <i>p</i> = .95 <i>N</i> = 43	0.03 <i>p</i> = .84 <i>N</i> = 43	-0.01 <i>p</i> = .95 <i>N</i> = 43
Negative beliefs inc responsibility + superstitions	-0.12 <i>p</i> = .45 <i>N</i> = 43	0.04 <i>p</i> = .80 <i>N</i> = 43	-0.01 <i>p</i> = .96 <i>N</i> = 43	-0.03 <i>p</i> = .86 <i>N</i> = 43
Cognitive self-consciousness	-0.24 <i>p</i> = .12 <i>N</i> = 43	-0.07 <i>p</i> = .67 <i>N</i> = 43	-0.11 <i>p</i> = .48 <i>N</i> = 43	-0.14 <i>p</i> = .36 <i>N</i> = 43
NART error score	-0.08 <i>p</i> = .59 <i>N</i> = 45	-0.09 <i>p</i> = .58 <i>N</i> = 45	0.01 <i>p</i> = .94 <i>N</i> = 45	-0.05 <i>p</i> = .73 <i>N</i> = 45

However, no reliable between group differences were found on the reasoning task, meaning that the hypothesis regarding reduced group differences was not applicable.

Since there was no main effect for group on the two-factor analysis of variance, the groups were combined in order to investigate any associations between the reasoning task and the questionnaire measures. This was carried out in order to test whether high scores on Intolerance of Uncertainty would be associated with increased reasoning bias, and to identify whether any of the measures could be used as predictors of “jumping to conclusions”.

Pearson correlation coefficients were calculated to identify any relationships between performance on the reasoning task and the questionnaire measures of mood and cognitive processes. NART error score was also included to investigate whether IQ was associated with reasoning processes. The results of these analyses can be seen in Table 4.

Using two-tailed analysis, none of the questionnaire measures significantly correlated with the overall number of items requested on the reasoning task, nor any of the individual means for the different types of stimuli. However, the correlation between BDI-7 score and mean of neutral trials is approaching significance, which would fit with Beck’s cognitive theory of depression that identifies jumping to conclusions as a typical depressive thinking error.

Table 5 Pearson correlation coefficients between ratings of delusions and other measures

Variables	PSYRATS Factor 1 – cognitive interpretation	PSYRATS Factor 2 – distress	PSYRATS total score
MCQ factors: Positive beliefs about worry	0.37 $p = .22$ $N = 13$	0.50 $p = .09$ $N = 13$	0.42 $p = .15$ $N = 13$
Beliefs about controllability	0.59* $p = .03$ $N = 13$	0.59* $p = .04$ $N = 13$	0.60* $p = .03$ $N = 13$
Metacognitive efficiency	0.48 $p = .10$ $N = 13$	0.55 $p = .05$ $N = 13$	0.51 $p = .74$ $N = 13$
Negative beliefs inc responsibility + superstitions	0.60* $p = .03$ $N = 13$	0.68* $p = .01$ $N = 13$	0.64* $p = .02$ $N = 13$
Cognitive self-consciousness	0.56* $p = .045$ $N = 13$	0.62* $p = .02$ $N = 13$	0.59* $p = .03$ $N = 13$

* $p < .05$, ** $p < .01$.

The results from this study do not support the hypothesis that high scores on Intolerance of Uncertainty would be associated with increased reasoning bias.

Relationships between ratings of delusions and metacognition

As previous research had demonstrated a link between metacognition and psychotic symptoms (Baker and Morrison, 1998) and as it was recognized that numbers were small, exploratory analysis was conducted to tentatively explore the relationships between the ratings of delusions and metacognition. Using the delusions group only, Pearson's correlations were used to investigate associations between the ratings on the PSYRATS and the MCQ (Table 5).

A number of associations were identified between ratings of delusions and subscales of the Meta-Cognitions questionnaire. All of the PSYRATS scores were significantly correlated with the sub-scales beliefs about controllability, negative beliefs including responsibility and superstition, and cognitive self-consciousness.

Discussion

The results of this study showed a trend for the people with persecutory delusions to request the least information; however, this difference did not reach statistical significance. This is in contrast to the studies by Dudley et al. (1997b), Garety et al. (1991) and Huq et al. (1988) which all found statistically significant findings. As in this study, Young and Bentall (1997a) also failed to find evidence of jumping to conclusions. Although this difference may reflect the different methodology used by Young and Bentall, when taken together with the results of this study this may indicate that if differences do exist in the reasoning of people with delusions they are likely to be small.

One possible explanation for the apparent contradictory findings may be the different types of delusions included in the experimental group. This study only included people with persecutory delusions, as did the study by Young and Bentall (1997a). Whereas the studies carried out by Dudley et al. (1997b) and Huq et al. (1988) included a mix of different delusions such as persecutory and grandiose. Garety et al. (1991) initially included two deluded groups, one with a diagnosis of schizophrenia and the other with delusional disorder/paranoia. Contrary to Garety's hypothesis, the paranoid patients actually requested more information on the probabilistic task than the group of people with schizophrenia. However, the two groups were combined in the statistical analysis, and any differences between these groups may have been masked. Thus the findings of this study may indicate that there are differences in the reasoning of people with persecutory delusions and those with other delusional themes.

An alternative explanation of these results is that they are actually not that different from those found in previous research. The study by Huq et al. (1988) did find a significant difference between the deluded group and the normal controls at the 0.05 significance level. However, they predicted the direction of difference and employed a one-tailed test, yet there was no previous research on which to base this assumption. This is consistent with the findings in this study as, although there was no overall effect of group when the delusions and non-patient group were compared on the neutral trials using a one-tailed t-test, this did just reach the level required for statistical significance. This demonstrates that the differences found in previous studies are obviously quite small and thus may not be reliable.

The results from Dudley et al.'s (1997b) study appear more robust with larger differences between the group of people with delusions and the two control groups. When the mean numbers of items requested in the different trials in this study are compared with those of Dudley et al., it appears that the results for the delusions groups are similar. However, the mean items requested by the two control groups in Dudley et al.'s study are noticeably higher than those found in this study. This may reflect differences in the psychiatric controls used. Whereas this study employed anxious controls, depressed controls were used in Dudley's study. This could be interpreted as suggesting that people with anxiety are also quicker at reaching a decision. With reference to the non-patient controls, those from Dudley et al.'s (1997b) study were non-academic university staff, whereas in this study volunteers were recruited from a non-related workplace. It is possible that the controls in Dudley's study were more highly motivated to achieve a "correct answer" and thus requested more information than those in the present study.

What was clearly evident from the results of this study was the effect of emotional content on reasoning. Analysis of variance showed that there was a significant main effect of stimuli, with significantly more items requested on the neutral trials than either of the two types of emotional stimuli. This has also been replicated by other studies (e.g. Dudley et al., 1997b; Kemp et al., 1997; Young and Bentall, 1997a) which have demonstrated that emotional content has an impact on reasoning. No significant difference was found between the personality characteristic and panic related trials, suggesting that emotional content had a general effect rather than being limited to the specific concerns and beliefs of the individual. The lack of a group by stimuli interaction suggests that emotional content has an equal impact on the reasoning processes of all groups.

Thus it appears that people with delusions are susceptible to the same biases as non-deluded people when reasoning with emotional material. It is likely that the "jumping to conclusions" bias seen in some people with delusions is actually a normal reasoning bias,

which is activated by emotionality. It is possible that this increased hastiness on emotional material may lead to increased errors. If this is the case then this bias could play a role in the formation and maintenance of delusions. However, it could equally play a role in the maintenance of misinterpretations in other emotional disorders. Thus it is unlikely that this bias is specifically associated with beliefs that are labelled delusional.

The people with delusions did not significantly differ from the panic controls on any of the questionnaire measures except for the MCQ subscale positive beliefs about worry. Apart from this scale, the pattern of responding indicated that both patient groups differed significantly from the non-patient controls. These results demonstrate that there are clear differences between the patient groups and the non-patient controls, whereas the patient groups responded similarly on a number of measures of mood state and cognitive processes. This is not surprising given recent research that has highlighted a number of similarities between psychotic symptoms and anxiety disorders. These findings are consistent with the study carried out by Freeman and Garety (1999) that found that people with persecutory delusions were similar to patients with generalized anxiety disorder on a number of measures of anxiety and worry. These findings are important as depression and anxiety in people with delusions have often been neglected. However, it is likely that affect will be involved in the formation and maintenance of delusions and recent models have begun to incorporate a role for mood in delusions (i.e. Garety and Hemsley, 1994; Morrison, 2001). The measures of cognitive processes used also demonstrated similarities between the delusions group and the people with panic disorder. Again this adds support to theories such as Morrison (2001) that suggest similar processes are operating in anxiety and psychotic symptoms.

The lack of group differences meant that it was possible to combine the groups to investigate whether high scores on Intolerance of Uncertainty would be associated with increased reasoning bias. Again the results did not support this hypothesis and further investigation showed that when using 2-tailed analysis none of the questionnaire measures employed were associated with performance on the reasoning task. This suggests that contrary to what was hypothesized, level of anxiety and inability to tolerate this does not appear to drive people to make hasty decisions. In addition, metacognitive beliefs as measured by the MCQ do not appear to explain the use of a jumping to conclusions reasoning style.

Correlational analysis was carried out using the ratings of delusions completed by the people in the delusions group only. This demonstrated that the ratings of delusions on the PSYRATS were associated with the following MCQ scales: general negative beliefs including responsibility and superstition, beliefs about controllability and cognitive self-consciousness. The measures of delusions were not associated with performance on the reasoning task or any of the measures of mood. This finding that MCQ scores were associated with PSYRATS scores suggests that the S-Ref model (Wells and Matthews, 1994) may be useful in understanding the development and maintenance of persecutory delusions.

This is consistent with experimental findings, which found an association between self-focused attention and increased tendency to perceive oneself as the target (Fenigstein, 1984) and Freeman and Garety's (1999) finding that meta-worry was highly correlated with delusional distress. Although both the present study and that carried out by Freeman and Garety have involved small numbers, when the findings are considered together they appear to demonstrate an important role for metacognition in the experience of persecutory delusions. Freeman and Garety (1999) confine their speculations on the role of meta-worry to the impact of the delusion. However, metacognitive beliefs may be influential in the development and

maintenance of delusions through the selection of processing strategies and allocation of attentional resources. This is consistent with theories of delusions that include a role for top down processes (e.g. Bentall et al., 1994; Morrison, 2001) and the S-REF model proposed by Wells and Matthews (1994). It is possible that similar to emotional disorders, persecutory delusions may be associated with a cognitive-attentional syndrome characterized by self-focused attention, attentional bias and activation of dysfunctional metacognitive beliefs.

This study focused specifically on persecutory delusions, and it is unclear whether these results would generalize to individuals with other types of delusion. In addition, the decision to use a selection criteria based on symptom rather than diagnostic category meant that the people in the delusions group had a number of diagnoses. A further criticism could be made regarding sample size, although previous reasoning studies have employed similar numbers. Furthermore, the impact of practice effects on the results is unknown.

Small sample size and the lack of significant between group differences on the reasoning task led to the decision to combine groups to investigate associations between the questionnaire measures and jumping to conclusions. Although this approach is consistent with the continuum approach to delusions, this may have obscured any associations that were group specific. In addition, small numbers may have been an issue when identifying associations between metacognitive beliefs and the ratings of delusions. Thus these should be treated as indicators for further research.

These results raise further questions about the reliability of findings that have demonstrated abnormalities in the reasoning of people with delusions, and in particular persecutory delusions. It may be that reasoning biases play a role in the formation of some types of delusions, whilst in other types alternative processes are more important. In addition, further studies that investigate the interaction of emotion and reasoning in both normal and clinical populations may also be warranted.

This study also suggests that the area of metacognition in people with persecutory delusions warrants much more attention. Obviously it will be important to investigate metacognition in a larger sample of people with persecutory delusions in an attempt to replicate these findings. Comparisons of the metacognitive styles of people with persecutory delusions with people with other psychotic symptoms would highlight whether specific meta-cognitive beliefs play a role in specific symptoms or whether cognitive-attentional style operates as a general vulnerability factor. If metacognitive beliefs and attentional processes are important to the maintenance of persecutory delusions, then challenging these should impact on the delusion. Thus there may be opportunities to investigate these relationships through clinical trials and experimental designs that manipulate attention.

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