Psychological Medicine, 2006, **36**, 1109–1118. © 2006 Cambridge University Press
doi:10.1017/S003329170600794X First published online 31 May 2006 Printed in the United Kingdom

Reasoning under uncertainty: heuristic judgments in patients with persecutory delusions or depression

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ABSTRACT

Objective. The substantial literature examining social reasoning in people with delusions has, to date, neglected the commonest form of decision making in daily life. We address this imbalance by reporting here the findings of the first study to explore heuristic reasoning in people with persecutory delusions.

Method. People with active or remitted paranoid delusions, depressed and healthy adults performed two novel heuristic reasoning tasks that varied in emotional valence.

Results. The findings indicated that people with persecutory delusions displayed biases during heuristic reasoning that were most obvious when reasoning about threatening and positive material. Clear similarities existed between the currently paranoid group and the depressed group in terms of their reasoning about the likelihood of events happening to them, with both groups tending to believe that pleasant things would not happen to them. However, only the currently paranoid group showed an increased tendency to view other people as threatening.

Conclusion. This study has initiated the exploration of heuristic reasoning in paranoia and depression. The findings have therapeutic utility and future work could focus on the differentiation of paranoia and depression at a cognitive level.

INTRODUCTION

Understanding of the cognitive processes involved in the formation and maintenance of persecutory delusions has grown steadily in recent years (see Bentall *et al*. 2001; Blackwood *et al*. 2001; Freeman *et al*. 2002). However, no research has directly examined the type of reasoning that characterizes everyday social decision making, even though this type of reasoning is likely to feed the belief systems that underpin delusional thinking.

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Heuristic reasoning

Inductive inferences are drawn after referral to past experience (Sternberg, 1977). The inferential processes associated with social situations are constrained by limited time, knowledge and computational capacity. Tversky & Kahneman (1974) argued that in these conditions heuristics or 'rules of thumb' are invoked to aid decision making by drawing on the contents of memory stores to produce 'best-guess' interpretations of ongoing events. The *availability heuristic* is invoked to judge the likelihood of events. Estimates are made according to the ease with which similar events are remembered. Common events will be remembered most readily but other factors, such as the personal significance

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of an event, can also influence the availability of recollections. Heightened recall of events will bias the inductive reasoning process (e.g. Gabrielcik & Fazio, 1984).

In using the *anchoring and adjustment heuristic*, an event that is analogous to the ongoing event is retrieved from episodic memory. This recollection becomes the anchor from which adjustments are made to account for the unique features of the novel event. In judging other's behaviour, the most obvious anchor to apply is knowledge about the self (Fiske & Taylor, 1991). Conclusions arrived at through this heuristic can be wrong because judgments may be anchored by irrelevant information (e.g. using information that is specific to oneself to inform judgments about another) or adjustments from the anchor may be inappropriate (e.g. Ross *et al.* 1977).

The *representativeness heuristic* draws on personal semantic memory. It is invoked when people judge whether an exemplar belongs to a particular category by assessing the degree to which it shares salient features of that category. For example, we are more likely to conclude that a young woman is a librarian if she is socially retiring rather than an outgoing. Among the findings on the use of this heuristic is the tendency of people to ignore relevant base rate information when arriving at a decision about class membership (e.g. Hamill *et al.* 1980).

Inductive and heuristic reasoning in persecutory delusions

While heuristic reasoning has not been studied in psychosis, there has been interest in the inductive reasoning skills of this population. John & Dodgson (1994) showed that people with delusions displayed data-gathering and hypothesis-testing irregularities and Chiappelli & Giusberti (2001) drew similar conclusions about people with paranoid delusions. Corcoran (2001, 2003) argued that the theory of mind difficulties of people with schizophrenia could be understood as problems of inductive reasoning. There has also been recent interest in determining the neural correlates of inductive reasoning (e.g. Voltz *et al.* 2003; Blackwood *et al.* 2004; Huettel *et al.* 2005). Among the areas of cortex activated is an area of medial prefrontal cortex also implicated in theory of mind (Voltz *et al.* 2003).

Kahneman *et al.* (1982) demonstrated the fallibility of heuristic reasoning in healthy adults. In the context of psychosis, the opportunity for errors may be enhanced by neurodevelopmental abnormalities (e.g. Murray, 1994), which impoverish social functioning and reduce the pool of experiences from which this reasoning draws; by negative life experiences (e.g. van Os *et al.* 2000), which affect the availability of negative events and bias decision making; and by the heightened attention to threat in paranoia (e.g. Bentall & Kaney, 1989), which may bias the decisions drawn. Some of these factors may produce state-related effects while others may result in trait effects.

Hypotheses

We expected that people with paranoid tendencies would use the availability heuristic but that the presence of persecutory delusions would have a distinct biasing effect, leading to higher estimates of the likelihood of future threatening events. We also expected that people with paranoid tendencies would use information about themselves as anchors to inform decisions about others but that the presence of persecutory delusions would have a distinct separable effect upon the estimates of threatening events happening to others. Finally, we anticipated that patients with paranoid tendencies would show a marked bias resulting from the use of the representativeness heuristic when considering potentially threatening person-related material and would be less inclined to adjust the decision drawn through the representativeness heuristic in response to salient base rate information.

METHOD

Participants

Data were collected from 62 people with a DSM-IV diagnosis of schizophrenia, schizoaffective disorder or delusional disorder (APA, 1994). Diagnoses were confirmed by case-notes and current symptoms assessed using the Schedule for Clinical Assessment in Neuropsychiatry Version 2.1 (SCAN-2.1; WHO, 1999). All participants were aged between 18 and 65 years with an estimated full-scale IQ > 80 (Quick Test; Ammons & Ammons, 1962). All 56 participants were in-patients taking mostly atypical antipsychotic medication. Thirty-two

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participants met criteria for inclusion in the currently paranoid group by endorsing item 19.012 of the SCAN at interview ['Does anyone seem to be trying to harm you (trying to poison or kill you)?']. Clinical staff confirmed the presence of persecutory delusions. Patients who reported significant negative mood (assessed by section 6 of the SCAN) were excluded from this group. This group comprised 25 men and seven women with a mean age of 37·7 years (S.D. = 8·9). Negative signs and formal thought disorder were exclusion criteria.

Inclusion in the remitted group was determined by a positive score on SCAN item 19.012 for a representative episode indicating a history of persecutory delusions but no paranoid beliefs during the preceding 2 weeks. The positive history of persecutory delusions was confirmed by case-notes. Any patients with significant negative mood were excluded from this group, which comprised 23 men and seven women with a mean age of 33·8 years (S.D. = 9·7). Patients included in this group were not in full remission of positive symptoms and typically endorsed hallucinations items on the SCAN. Negative signs and formal thought disorder were exclusion criteria.

Twenty-six people with a DSM-IV diagnosis of major depressive disorder without psychotic symptoms also took part. This group was included because research has highlighted cognitive similarities between depression and paranoia (e.g. Zigler & Glick, 1988; Bentall, 1994) and therefore an examination of the performance of depressed patients on these tasks could prove enlightening. Ward staff identified suitable participants and section 6 (Depressed Mood and Ideation) of the SCAN confirmed diagnosis. This group comprised 18 men and eight women all taking antidepressant medication with a mean age of 43·6 years (S.D. = 10·4).

The healthy adult group comprised 23 men and eight women. The sample was collected from hospital auxiliary staff and non-academic university staff. The mean age of this group was 33·8 years (S.D. = 11·8).

A significant between-group difference existed for age with Tukey's *post hoc* comparisons indicating that the depressed group was significantly older than the remitted paranoid and the healthy adult groups [$F(3, 115) = 5{\cdot}64$, $p < 0{\cdot}005$]. Age was therefore considered as a potential confound in the analyses.

The tests

The test battery was split up into two sessions, taking place, whenever possible, over consecutive days.

Standardized measures

As the representativeness test involved a significant narrative memory load, a story recall test was used to assess immediate narrative recall (Coughlan & Hollows, 1985). The Cognitive Estimates Test (Shallice & Evans, 1978) was included to gauge any executive deficits that could impact upon ability to give reasonable estimates about little known facts. The Quick Test (Ammons & Ammons, 1962) was used to provide an estimate of current intellectual functioning. This test requires the ability to reason inductively and is therefore a well-chosen measure of IQ for this study.

Heuristic reasoning tests

The availability test

This test provided data on the use of both the availability and the anchoring and adjustment heuristics by exploring the relationships between estimates of the prior occurrence of events and predictions about the future likelihood of those events happening to the self and another person.

The task incorporates seven neutral, seven positive, and seven threatening events used by Kaney *et al*. (1997). The stimuli were presented in one of two fixed pseudo-random sequences. Participants were asked to predict, using a scale of 1 (not at all) to 7 (very likely), the likelihood of each event happening to them, and to another unspecified person, in the coming week (in-patients were asked to estimate for the week they leave hospital). Following this, the standardized measures were administered over 5–10 minutes before participants reconsidered the availability task items. This time they were asked to estimate the number of times similar events had happened to them in the past month (the month prior to admission for in-patients) with no constraints placed on the range of estimates allowed.

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A Cronbach's α of 0·78 indicated acceptable levels of internal reliability for the items in this task.

The representativeness test

This test explored the tendency to make category decisions based on stereotypical information about threatening and non-threatening characters, and subsequently evaluated the impact of base rate information on these decisions. In the first part of the test, participants were presented with descriptions of a person and a choice of a threatening (e.g. street robber) and a benign occupation (e.g. builder) to which that person belonged. Participants were asked to indicate how sure they felt that the character belonged to each of the two occupations using a 0–100 scale. Half of the descriptions provided stereotypical information about the character suggesting that they belonged to the threatening occupation. The other half provided stereotypical information implying that the character belonged to the benign occupation. In the second part of the test, identical information was presented to the participants but base rate information was also provided in the form of the total number of people in each profession within a sample of 100 individuals comprising only people from the two occupations. The base rate information was always discordant with the stereotypical description. The test consisted of six items and two practice items (see Appendix). Cronbach's α coefficient indicated an acceptable level of internal reliability ($\alpha = 0{\cdot}67$) for the test items.

RESULTS

Background cognitive functioning

Summary data for the standardized measures are given in Table 1. A one-way analysis of variance (ANOVA) with Tukey's *post hoc* comparisons revealed significant differences between the groups for IQ [$F(3, 115) = 5{\cdot}3$, $p < 0{\cdot}005$], accounted for by the healthy adults scoring higher than the remitted paranoid group ($p < 0{\cdot}005$). Group differences also existed on cognitive estimates [$F(3, 107) = 7{\cdot}35$, $p < 0{\cdot}0001$]. Dunnett's T3 *post hoc* comparisons showed that the healthy participants differed from the paranoid group ($p < 0{\cdot}05$) and the remitted group ($p < 0{\cdot}005$) on this measure, with the depressed patients also performing better than the remitted patients ($p < 0{\cdot}005$). As IQ and cognitive estimation could affect performance on the heuristics tasks, they were included as independent variables in regression analyses and as covariates in between-group analyses. For story recall, Dunnett's T3 *post hoc* comparisons following a significant ANOVA [$F(3, 115) = 7{\cdot}4$, $p < 0{\cdot}0001$] indicated that there were differences between the healthy participants and both the paranoid group ($p < 0{\cdot}005$) and the remitted group ($p < 0{\cdot}005$). This measure was therefore included as a covariate when analysing the representativeness test.

Table 1. *Descriptive statistics on background cognitive tests*

	Estimated IQ[a]	Story recall[b]	Cognitive estimates[c]
Paranoid ($n = 32$)	99·8 (8·9)	16·3 (7·0)	8·1 (5·0)
Remitted ($n = 30$)	96·4 (8·8)	16·0 (7·9)	9·5 (5·1)
Depressed ($n = 26$)	100·5 (9·0)	20·8 (9·7)	5·2 (4·5)
Controls ($n = 31$)	105·3 (8·6)	25·6 (11·7)	4·6 (2·8)

Values are mean (S.D.).
[a] $F(3, 115) = 5{\cdot}3$, $p < 0{\cdot}005$; healthy controls > remitted group.
[b] $F(3, 115) = 7{\cdot}4$, $p < 0{\cdot}0001$; healthy controls > paranoid and remitted.
[c] $F(3, 107) = 7{\cdot}35$, $p < 0{\cdot}0001$; healthy controls > paranoid and remitted, depressed > remitted.

The availability heuristic

Table 2 gives summary statistics for the components of this test. As estimates of the frequency of past events were positively skewed, they were log transformed to enable parametric analyses to be performed (skewness: positive = 2·8, S.E. = 0·23; threatening = 5·4, S.E. = 0·23; neutral = 3·07, S.E. = 0·23).

The relationships between past estimates and future estimates of events were explored first through group correlations (see Table 2). On the whole, these support the use of the availability heuristic in the groups. However, in the depressed group the correlations for neutral and negative events failed to achieve significance, as did the correlation for neutral events in the currently paranoid group. Additionally, three multiple regressions including all participants were conducted with estimates of the likelihood of future events as the dependent variables. The following independent variables were entered simultaneously as predictors: the reported

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Table 2. *The components of the availability test*

	Paranoid ($n=29$)	Remitted ($n=27$)	Depressed ($n=24$)	Healthy ($n=28$)
Positive past self[a]	4·40 (7·1)	5·55 (9·6)	8·86 (11·6)	12·31 (15·1)
Positive future self[b]	3·36 (1·6)	4·34 (1·3)	3·33 (1·2)	4·22 (0·9)
Positive future other	4·74 (1·5)	4·83 (1·1)	4·43 (1·0)	4·04 (0·7)
Negative past self	9·38 (22·6)	2·64 (5·3)	6·58 (22·0)	3·03 (4·5)
Negative future self	3·64 (1·6)	3·02 (1·5)	2·73 (1·1)	2·78 (1·0)
Negative future other	3·60 (1·7)	3·42 (1·5)	2·65 (0·9)	2·86 (0·9)
Neutral past self	3·15 (6·6)	4·52 (8·5)	6·82 (8·9)	4·10 (3·9)
Neutral future self	3·0 (1·3)	3·65 (1·2)	3·04 (1·0)	3·44 (0·8)
Neutral future other	4·68 (1·4)	4·38 (1·3)	4·08 (1·0)	3·94 (0·9)
Correlations for past and future self-estimates[c]	(1) 0·30 ($p=0·12$)	(1) 0·42 ($p<0·05$)	(1) 0·36 ($p<0·1$)	(1) 0·45 ($p<0·05$)
	(2) 0·47 ($p<0·05$)	(2) 0·55 ($p<0·05$)	(2) 0·44 ($p<0·05$)	(2) 0·48 ($p<0·05$)
	(3) 0·41 ($p<0·05$)	(3) 0·49 ($p<0·05$)	(3) 0·21 (N.S.)	(3) 0·51 ($p<0·01$)
Correlations for self-and other estimates[c]	(1) 0·08 (N.S.)	(1) 0·54 ($p<0·005$)	(1) 0·49 ($p<0·05$)	(1) 0·52 ($p<0·005$)
	(2) 0·04 (N.S.)	(2) 0·28 ($p=0·15$)	(2) 0·13 (N.S.)	(2) 0·46 ($p<0·05$)
	(3) 0·26 ($p=0·18$)	(3) 0·83 ($p<0·001$)	(3) 0·24 ($p=0·26$)	(3) 0·49 ($p<0·01$)

Values are mean (S.D.).
[a] Past estimates were derived from an open-ended scale and were subjected to log transformations prior to parametric analyses.
[b] Future estimates were derived from a 1- to 7-point Likert scale.
[c] 1 = neutral events, 2 = positive events, 3 = threatening events.

frequency of occurrence of the same events in the past (with a significant β value providing *prima facie* evidence of the use of the availability heuristic), estimated IQ, performance on the cognitive estimates test, age, and dummy variables for the experimental group (i.e. currently paranoid or not, history of paranoia or not, and currently depressed or not), making it possible to assess the extent to which the presence of paranoia or depression or a vulnerability to paranoia influenced estimates of the future likelihood of events over and above the availability of those events in memory. For positive events, the regression equation was significant [$r^2=0·46$, $F(7,88)=10·6$, $p<0·001$], with estimates of past positive events ($\beta=0·62$, $t=6·6$, $p<0·001$), IQ ($\beta=-0·24$, $t=-2·5$, $p<0·05$), current paranoia ($\beta=-0·23$, $t=-2·4$, $p<0·05$) and current depression ($\beta=-0·24$, $t=-2·3$, $p<0·05$) making significant contributions to the model. For neutral events, the regression equation was also significant [$r^2=0·32$, $F(7,88)=5·9$, $p<0·001$], with estimates of past neutral events the sole predictor ($\beta=0·49$, $t=5·1$, $p<0·001$). The regression for negative events was again significant [$r^2=0·55$, $F(7,84)=5·3$, $p<0·001$], with only estimates of past negative events significantly predicting judgments about the future ($\beta=0·50$, $t=5·2$, $p<0·001$).

The anchoring and adjustment heuristic

The relationships between self-estimates and estimates provided for another were explored first through group correlations (see Table 2). These suggest that the currently paranoid group do not use self-estimates as anchors from which to make predictions about another person. The same is also true for the depressed group when considering emotional material. To follow-up, three multiple regressions including all participants were conducted with the dependent variable being predictions about events happening to another person. The following independent variables were entered into the model simultaneously: predictions of those same events happening to self (with significant β values providing prima facie evidence of anchoring), estimated IQ, performance on the cognitive estimates test, age and dummy group variables. For positive events, the regression equation failed to reach significance [$r^2=0·12$, $F(7,93)=1·7$, $p=0·1$]. However, the individual β values indicated that history of paranoia clearly predicted estimates given for events happening to another ($\beta=0·37$, $t=2·4$, $p<0·05$) and the β associated with current depression was marginally significant ($\beta=0·27$, $t=1·97$, $p=0·05$). For neutral events, the regression equation was significant [$r^2=0·15$, $F(7,93)=2·3$, $p<0·05$], with self-estimates for neutral events ($\beta=0·31$, $t=3·1$, $p<0·005$) accounting for the significance of the overall model. The regression for negative events was also significant [$r^2=0·31$, $F(7,93)=5·9$, $p<0·001$], with self-estimates for negative events ($\beta=0·45$, $t=5·0$, $p<0·001$) and cognitive estimates performance ($\beta=0·31$, $t=3·0$,

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Table 3. *Estimated marginal means (and standard errors) for the components of the representativeness task*

	Paranoid ($n=30$)	Remitted ($n=28$)	Depressed ($n=25$)	Healthy ($n=30$)
First estimate for threat group membership (%)[a]	70·5 (3·6)	64·5 (3·8)	68·2 (4·0)	55·4 (4·0)
Second estimate for threat group membership (%)[b]	53·25 (3·4)	66·7 (3·6)	54·0 (3·7)	56·3 (3·8)
First estimate for benign group membership (%)	77·7 (2·5)	84·0 (2·65)	78·8 (2·8)	79·5 (2·8)
Second estimate for benign group membership (%)	64·7 (3·5)	61·0 (3·8)	65·3 (3·8)	66·6 (3·8)

[a] Significant effect of group ($p<0·05$), paranoid > healthy adults.
[b] Significant effect of group ($p<0·05$), paranoid < remitted.

$p<0·005$) significantly predicting estimates about the likelihood of negative events happening to another person.

The representativeness heuristic

The use of the representativeness heuristic was evaluated by examining the extent to which participants were influenced by threatening and non-threatening stereotypic information when making class judgments. In addition, the incorrigibility of the decision was explored by examining the extent to which the subsequent presentation of base rate information affected estimates about group membership. Summary data for the components of the task are given in Table 3.

Univariate analyses of covariance (ANCOVAs) were conducted to establish whether group differences existed for estimates given for both threatening and benign characters. A significant effect of group was found for initial estimates of threatening group membership [$F(3, 101)=2·81$, $p<0·05$] but not for benign group membership. Pairwise comparisons indicated that the significant difference lay between the currently paranoid group and the healthy adults, with the former providing higher first estimates for threatening characters ($p<0·05$). None of the covariates considered had a significant impact on these estimates.

A significant effect of group was also found for the second estimates given for threatening characters following base rate information [$F(3, 99)=3·03$, $p<0·05$]. This survived correction for differences in first estimates and IQ that both impacted on second estimates [first estimates: $F(1, 99)=57·2$, $p<0·001$; IQ: $F(1, 99)=5·1$, $p<0·05$]. Pairwise comparisons demonstrated that the differences in second estimates existed between the paranoid group and the remitted group ($p<0·05$), with the paranoid group shifting the most and the remitted participants shifting the least in response to base rate information. By contrast, no group differences were found in second estimates for benign characters [$F(3, 99)=0·37$, N.S.], but first estimates did significantly covary with second estimates [$F(1, 99)=19·9$, $p<0·001$], as did IQ [$F(1, 99)=13·85$, $p<0·001$].

DISCUSSION

Validity of the measures

As the experimental tasks used were novel, some consideration of the validity of the assumptions made about them is necessary. The Cronbach's α statistics associated with these tasks indicated that they have acceptable internal reliability. Furthermore, the tasks have good face validity as they clearly involve decision making under conditions of uncertainty. It therefore seems reasonable to assume that abnormal performance by the clinical groups on these tasks reflects either the abnormal use of heuristic strategies or the effect of using them with abnormal information. However, the healthy adult group performed better than some of the clinical groups on background cognitive functioning, which could influence performance on the heuristics tests. Differences in verbal memory and executive function are consistent with prefrontal and medial temporal dysfunction in schizophrenia (Callicott *et al.* 2003; Seidman *et al.* 2003) and so may be inevitable. However, it is clear that

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the pattern of performance on the heuristics tasks does not mirror that seen on the background cognitive tasks. Although the remitted group had the most obvious cognitive impairment, they tended to perform most like the healthy control group on the heuristics tasks. The depressed group, however, performed well on the background measures but in a more anomalous manner on the heuristics tests. Furthermore, there was little compelling evidence in the analyses to support the argument that differential performance on these cognitive measures could explain performance on the heuristics tasks.

Study findings

The availability test

We predicted that the clinical groups included here would rely on the same heuristic strategies during inductive reasoning as healthy adults do. However, we anticipated that biases during the retrieval of threatening events, in particular (Kaney *et al*. 1992; Bentall *et al*. 1995), would lead people with persecutory delusions to generate higher estimates about the future likelihood of threatening events happening to them than would be expected solely from their estimated experience of these events in the past. The within-group correlations supported the use of the availability heuristic in the currently paranoid and remitted paranoid group but not in the depressed group. The subsequent regression analyses indicated that the availability heuristic was being used by most participants as estimates of past threatening events predicted estimates about the likelihood of these events happening in the future. However, there was no support for the hypotheses that the presence of paranoid delusions would make a separate contribution to the prediction of future negative occurrences. In fact, both depression and current paranoia made contributions over and above the availability heuristic (amply demonstrated by within-group correlations and the regression for positive events) to predictions about positive events happening in the future. Therefore, both depression and paranoia tend to make people think that they will experience fewer positive events in the future than would be predicted by their recollection of similar events in the past. This pessimistic style is not seen in those whose paranoid delusions are in remission, suggesting that this cognitive bias is liable to change and could therefore become a useful focus in psychological treatments for both depression and paranoia.

In exploring the anchoring and adjustment heuristic, we expected that patients with paranoid delusions would 'anchor' in the same way as healthy adults do (i.e. by using predictions about self to inform predictions about another) but that the presence of paranoia would have a distinct biasing effect on reasoning associated with threatening material. On the whole, these predictions were not supported by the data. Evidence for anchoring was markedly absent in the correlations for the currently paranoid group across all types of material, while the use of anchoring in the depressed group occurred convincingly only for neutral material. There is therefore little in these data to support the hypothesis that people with paranoia make judgments in the same way as healthy adults in this context. In depression, the altered style appears to occur only when reasoning about emotional information. In paranoia, however, the style is different, irrespective of material. These data therefore show that people with current paranoia do not use information about themselves to inform judgments about other people. Under the circumstances this may be a reasonable approach to adopt, but focusing on differences as opposed to similarities between one's own experiences compared to those of another is likely to inflame feelings of isolation, depression or paranoia rather than ameliorate them. Psychological therapy could aim to redress this.

The behaviour of the remitted paranoid group is rather different. This group shows no convincing anchoring for positive events but very marked anchoring for negative events, suggesting that there may be some process at work in the remission period that minimizes perceived differences between the threatening experiences that occur to oneself compared to those that occur to other people. This optimistic shift, which characterizes remission, again suggests opportunities for psychological therapy in this group.

Although the regression analyses of the anchoring data provided no evidence that estimates of positive events happening to the self

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were used as anchors for estimating how often the same positive events would happen to another person, it was evident in the negative and neutral experiences data. Instead, the implication from the regression analyses was that vulnerability to paranoia (and perhaps current depression) is associated with the expectation that pleasant events are more likely to happen to other people, providing more context from which psychological therapy could draw. This is reinforced by the lack of anchoring seen across all clinical groups when positive material was being processed.

We found that scores on the cognitive estimates test predicted higher estimates of unpleasant things happening to others. It is surprising that this measure of executive dysfunction did not feature more often in relation to performance on our experimental tasks and it is not clear why the estimates of unpleasant events should be more sensitive to this effect than estimates of pleasant and neutral events. One possibility is that this reflects the differential impact of executive functioning on particular types of material (Docherty *et al.* 1994; Haddock *et al.* 1995; Tai *et al.* 2004; Fotopoulou & Conway, 2005).

The representativeness test

We predicted that those with paranoid tendencies would produce more extreme estimates when considering person-related threatening information on this test. The group analyses were partially consistent with this hypothesis, with a pronounced effect of the use of this heuristic when threatening material was considered by the currently paranoid group. The effect of subsequent base rate information was indicative of the incorrigibility of the decision. The remitted group tended to ignore base rate information, sticking rigidly to their initial decisions (which were more in line with 'normal' performance). In this they differed significantly from the currently paranoid group, who tended to adjust their estimates the most in line with the base rate information. As normal samples tend to ignore base rates, the paranoid group was anomalous in shifting to the extent that they did. However, it is clear from the data that this added consideration brought the estimates provided by this group into line with those of the other groups and a thorough consideration of the implication of base rates reflects a more rational style of decision making.

Our findings from the representativeness test mirror those of Garety *et al.* (1991) using the 'beads in the jar' task. These authors showed that currently deluded individuals 'jump to conclusions' when generating initial hypotheses but change their minds very readily when subsequently presented with disconfirmatory information. In the present study, the currently paranoid patients showed the greatest shift away from their initial estimates on the representativeness task in response to relevant base rate information. This tendency only achieved significance for the threatening items and thus accords with Young & Bentall (1997), who found greater shifts in estimates on a threatening version of the beads task.

As with the findings from the availability test, clear foci for psychological treatment emerge from the representativeness data. Therapeutic strategies could attempt to curtail the tendency of currently paranoid patients to make biased judgments about the threat posed by other people, with follow-up techniques attempting to reduce the over-reaction to disconfirmatory information coming to light after the initial judgment. If successful, the end result would be a processing style similar to that seen in the healthy adult and the remitted sample, where thoughtful first estimates were not unduly altered by potentially disconfirmatory material arising later.

CONCLUSIONS

An interesting distinction has emerged in these data, indicating that different emotional biases may be at work with different material. When events or situations are considered, as in the availability test, there is a tendency for biases to emerge in the processing of positive material. By contrast, when person-related information is processed, as in the representativeness test, cognitive biases emerge for threatening material only. The bias in the processing of positive events characterizes both current paranoia and depression while the bias in processing of threatening person-related material is only characteristic of current paranoia. Both biases are pessimistic in nature and presumably contribute to different cognitive characteristics of

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the disorders. The view, seen in paranoia and shared by depression, that 'pleasant things are unlikely to happen to me' may speak to the 'latent depression' hypothesis of paranoia (Zigler & Glick, 1988; Bentall, 1994). However, the inference that 'other people are likely to be threatening' differentiates these two disorders. Thus, while depressed people reason that good things are not likely to happen to them, paranoid people reason that good things are not likely to happen to them and that other people are likely to be threatening.

Future work is needed to determine the extent to which inductive reasoning accounts can explain the cognitive anomalies associated with persecutory delusions and to delineate more clearly between state and trait effects. However, this inaugural study has demonstrated that an analysis of heuristic reasoning in psychiatric patients can provide clinical insights and inform therapeutic practice.

APPENDIX. One of the six items from the representativeness test

Part 1: First estimate based on representativeness heuristic

- Barry is either a builder or a street robber.
- Barry is a skinny rough-looking individual who keeps himself to himself. He is quite a selfish person and is not very considerate towards other people. Nonetheless, Barry has a high level of awareness for what is going on around him and his reflexes are very fast.
- On a scale of 0–100, how likely is it that Barry is a builder? On a scale of 0–100, how likely is it that Barry is a street robber?

Part 2: Introduction of base rates

- Barry is either a builder or a street robber. He was randomly picked from a group of 100 people that consisted of 70 builders and 30 street robbers.
- Barry is a skinny rough-looking individual who keeps himself to himself. He is quite a selfish person and is not very considerate towards other people. Nonetheless, Barry has a high level of awareness for what is going on around him and his reflexes are very fast.
- On a scale of 0–100, how likely is it that Barry is a builder? On a scale of 0–100, how likely is it that Barry is a street robber?

ACKNOWLEDGEMENTS

This research was supported by a grant from the Wellcome Trust to Dr R. Corcoran, Professor R. P. Bentall, Dr P. Kinderman, Dr N. Blackwood and Professor R. Howard.

DECLARATION OF INTEREST

None.

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