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Research Letter

From stress to paranoia: an experimental investigation of the moderating and mediating role of reasoning biases

The threat anticipation model by Freeman *et al*. (2002) proposes two pathways for the development of persecutory beliefs. In one, stress-induced arousal produces an increase of negative affect which the individual misinterprets as evidence for objective threat. The other pathway proposes an increase in reasoning biases as a reaction to stress which then entails delusional interpretations of ambiguous information. Two prominent reasoning biases that have been associated with paranoid delusions are jumping-to-conclusions and personalizing attributions for negative events (Kinderman & Bentall, 1997; Freeman, 2007). Both biases have occasionally been demonstrated in psychosis-prone healthy individuals (Colbert & Peters, 2002; Freeman *et al*. 2008; Ziegler *et al*. 2008) and might represent vulnerability factors for the development of paranoia. We hypothesized that reasoning biases mediate the relationship between stress and paranoia and that individuals with pronounced reasoning biases will show a stronger increase of paranoia under stress.

The sample consisted of 64 undergraduate students who took part in a stress or a non-stress condition in random order. Both conditions required the completion of reasoning tasks and symptom ratings. The conditions only differed in that for the stress condition annoying building site noise (75 dB) was induced along with some difficult knowledge questions. The time interval between conditions was 4–6 days. Details on the sample and the design have been reported (Lincoln *et al*. 2009).

Baseline vulnerability was assessed with the 42-item Community Assessment of Psychic Experiences (CAPE; Stefanis *et al*. 2002). Paranoia was assessed with an adapted version of the 18-item self-report Paranoia Checklist (Freeman *et al*. 2005). Jumping-to-conclusions was assessed using a computerized version of the beads task developed by Todd S. Woodward. Participants were shown two lakes with coloured fishes in opposing ratios (80% red and 20% grey, and vice versa). Fish were caught one by one from one lake and participants were asked to decide from which lake the fish were caught, being allowed to request as many fish as they wanted before deciding. Two parallel versions of the task were employed. Outcome measures for this task were presence of Jumping to Conclusions (JTC = decision after the first or second fish) and Draws to Decision (DTD = number of fish required before deciding).

Attributional style was assessed using a modified version of the Internal, Personal and Situational Attributions Questionnaire (IPSAQ; Kinderman & Bentall, 1996; modification: S.M.). The score calculated for this study was the sum of percentage estimates of external personal attributions for negative events (PANE). The 32 original items were split into two parallel 16-item versions.

Paired *t* tests with Bonferroni correction were used to test for differences in reasoning biases and paranoia within subjects (stress *v*. non-stress) and multilevel linear modelling (MLM) to test for interaction effects. MLM was implemented through SPSS Mixed Models, version 15 (SPSS Inc., USA) and conducted according to established guidelines (Hox, 2002).

A mediation effect occurs when (1) the independent variable (IV) significantly affects the dependent variable (DV) in the absence of the mediator, (2) the IV significantly affects the mediator, (3) the mediator has a significant effect on the DV, and (4) the effect of the IV on the DV shrinks or disappears when the mediator is added to the model (Muller *et al*. 2005). In Table 1 it can be seen that the score for paranoia was significantly higher in the stress condition than in the non-stress condition. Thus, condition (1) was fulfilled. However, there was no significant difference between the stress and non-stress conditions for attribution and even a trend towards less DTD in the non-stress condition. Thus, condition (2) was not fulfilled and the mediation hypothesis must be discarded.

To test for the moderating effect of reasoning biases we disaggregated the scores, using the mean score of each individual in reasoning tasks across the two conditions. Stress was entered as fixed and as a random predictor in Model 1 and then reasoning biases and interaction terms of reasoning biases x stress were added in separate models. Neither DTD or JTC, nor their interactions with stress, were significant predictors of paranoia. PANE was negatively related to paranoia (coefficient = -0.02, S.E. = 0.01, $p < 0.01$), indicating that persons with more personal attributions for negative events showed higher paranoia scores, but the interaction PANE × stress was not negatively related.

Thus, neither the mediation nor the moderation hypotheses were confirmed. Stress did not impact on

Table 1. *Paranoia and reasoning biases in the stress and non-stress condition*

	No stress		Stress		Statistics	
	Mean	S.D.	Mean	S.D.	*t*	*p*
Paranoia Checklist	24.91	5.39	26.52	7.42	−2.49	0.015*
Reasoning biases						
Draws to Decision	3.38	1.8	3.78	2.0	−2.22	0.030
Jumping to Conclusions	36%	48	27%	45	1.94	0.057
Extenal Personal Attributions for Negative Events	277.7	85.7	281.0	86.6	−0.32	0.750

p = two-tailed significance value.
* $p \leqslant 0.05$ after α-adjustment.

reasoning biases in the expected way; in the beads task, participants even tended towards more cautious decisions during the stress compared to the non-stress condition. Moreover, persons with more pronounced reasoning biases did not show a stronger increase of paranoia under stress.

This result is in seeming contrast to the Camberwell walk study (Ellett *et al*. 2008) which found an increase in jumping to conclusions in a clinical sample after brief exposure to a stressful urban environment. Similarly, Mujica-Parodi *et al*. (2002) found that their healthy subjects, when aroused, tended to slightly restrict the amount of available information and that this pattern was intensified in participants with delusions. Although several studies have demonstrated that stress exposure is a risk factor for transition to psychosis in subclinical samples (e.g. Miller *et al*. 2001; van Os *et al*. 2003) the mechanisms underlying increased paranoia in non-clinical populations are not necessarily the same as those involved in psychosis. Possibly, healthy individuals compensate for lack of control in overtaxing situations by more cautious decisions and non-clinical participants with elevated paranoia scores are likely to possess some resilience or protective factors so that symptoms rest at a benign level. However, in persons with a pronounced vulnerability, schizophrenia patients or their biological relatives, or in situations with more severe and perhaps less obvious stressors, a critical threshold might be reached where cognitive control can no longer be exerted and reasoning biases become more pronounced. Thus there might be a curvilinear relationship between reasoning biases and delusion proneness, explaining why some studies fail to find linear associations in healthy samples (McKay *et al*. 2005; Janssen *et al*. 2006). The CAPE scores in this sample were in the range of those found in the population (Konings *et al*. 2006). Selecting a sample at higher risk might have produced different results.

Overall, our study supports the notion that stress enhances paranoid ideation, but could not substantiate the presumed relevance of reasoning biases as a mediating mechanism or moderator. However, this does not exclude the possibility that reasoning biases are involved in the pathway from stress to psychosis in more vulnerable individuals or at later stages of transition.

Declaration of Interest

None.

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Letter to the Editor

Mind the translation gap: problems in the implementation of early intervention services

In recent years there have been calls for a paradigm shift in psychiatry from treating established illnesses towards early and preventive intervention (McGorry & Killackey, 2002). These calls have been associated with the development and proliferation of services providing early and preventive intervention for psychosis (Lester *et al*. 2009). However, it is often not appreciated that this is not a new approach: it was proposed at least 100 years ago (Maudsley, 1909). In his paper published in 1909 Maudsley outlined the need for psychiatric services to focus on treating people early in their illnesses because this is when he thought there was the best chance of recovery and cure, stating: 'the right treatment is to stop the beginnings of mischief' and 'early treatment … will prevent the necessity … of placing some patients in a lunatic asylum' (Maudsley, 1909). In the last 100 years considerable evidence has accrued indicating that he was right – early and preventive intervention is associated with better outcomes and reduced admission rates (for review see McGorry, 2005). However, there appears to be a gap in translation: many health services have implemented cheaper hybrid and hub-and-spoke models rather than the comprehensive stand-alone early intervention team structures evaluated in the evidence base (Lester *et al*. 2009). The study by Valmaggia *et al*. (2009) is striking in providing evidence that better outcomes can also be cost effective. We hope that health-care commissioners take note that this was achieved with a comprehensive stand-alone team (Valmaggia *et al*. 2009). Other team structures may not be as effective – a cheaper service may cost more in the long run. Hopefully it will not take another 100 years for the funding to follow the evidence.

Declaration of Interest

Dr Howes works in the OASIS service providing preventive intervention for people at clinical risk of psychosis.

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