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An investigation into reasoning biases, mood and cognitive state, and subclinical delusional ideation

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ABSTRACT

Following research on reasoning and the continuum of delusional ideation, the present study attempted to investigate the impact of different experimentally-induced states (stress, paranoia, and neutral) on the jumping-to-conclusions reasoning bias in individuals with varying levels of subclinical delusional ideation (SDI). Participants ($N=117$) completed a measure of subclinical delusional ideation (the Peters et al. Delusions Inventory or PDI; Peters et al., 1999); and were randomly assigned to receive one of two experimental inductions (stress or paranoia), or no experimental induction; their performance on two probabilistic reasoning tasks – one easy and one challenging – was assessed. Although no differences were found between individuals with high vs. low subclinical delusional ideation in the no induction condition or following the paranoia induction, in the stress-induction condition, individuals with high levels of subclinical delusional ideation were significantly *less* likely to jump to conclusions on the easy reasoning task. No significant effects emerged on the more challenging task. Assessment of post-test paranoid thinking indicated our paranoia induction did not have its intended effect. Importantly, because there was no pre-test of anxiety, paranoid thinking, or reasoning to determine if they shifted after the inductions, results need to be interpreted with caution.

1. Introduction

Individuals with delusions have considerable biases in their reasoning, as has been demonstrated in decades of studies using probabilistic reasoning tasks (e.g., Huq et al., 1988; Garety et al., 2013). Relative to healthy and psychiatric controls, individuals with delusions jump to conclusions (JTC) on tasks that ask participants to decide how much data they need before making a decision, and they frequently make extremely hasty decisions, often requesting only one or two stimuli before making their decision (e.g., Dudley et al., 1997; Warman et al., 2007; Dudley et al., 2013). In the hopes of increasing understanding of delusional thinking, attention has been paid to individuals lower on the continuum of psychosis – individuals in the general population who do not have psychotic disorders but who endorse a high level of unusual beliefs (e.g., Peters et al., 1999). Results from reasoning studies have revealed some, but far less robust, evidence for the JTC bias for these individuals (e.g., Colbert and Peters, 2002; Warman and Martin, 2006; Zawadzki et al., 2012), indicating that variation in levels of subclinical delusional ideation (SDI) may be a useful way of understanding the process of delusions, though conclusions to date have been inconsistent. Specific factors related to the JTC bias for individuals who have delusions and who are high in subclinical delusional ideation have received considerable attention recently, as examination may shed light on the various processes that exacerbate or reduce the bias (e.g., Ellett et al., 2008; So et al., 2008; Keefe and Warman, 2011; Lee et al., 2011; Freeman et al., 2013; Warman et al., 2013) and, thus, aid in cognitive theories of the acquisition and maintenance of delusions (e.g., Garety and Freeman, 2013).

Considering the situations likely to evoke emotion and, potentially, delusional thinking, it may not be surprising that "stressful" situations have received the most attention in reasoning studies that have used experimental inductions to determine their impact on the JTC bias (e.g., Ellett et al., 2008). Although results have not been entirely consistent (e.g., So et al., 2008), there does appear to be evidence that stress exacerbates the already robust relationship between delusions and JTC (e.g., Ellett et al., 2008; Moritz et al., 2009). There appears to be an important relationship between stress and subclinical delusional ideation as well. For example, Keefe and Warman (2011), who induced stress using a speeded subtraction task, found no relationship between subclinical delusional ideation and reasoning under normal (emotionally neutral) conditions, but following the stress induction, high-SDI individuals (individuals high in subclinical delusional ideation) were overconfident in decisions relative to their low-SDI peers. Similarly, White and Mansell (2009) found high-SDI individuals JTC relative to low-SDI individuals, and found these individuals felt rushed; it seems possible they were in a stressed state during the task. Importantly, just

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as the results for delusions and stress have been inconsistent in terms of the impact on JTC, the same is true for studies of subclinical delusional ideation (e.g., Lincoln et al., 2010b), indicating the relationship between mood or cognitive state and delusions is complex and in need of further investigation.

As noted, the relationship between JTC and delusions is quite clear, but the impact of induced mood or cognitive state is less so. One possible explanation for the inconsistency in studies on delusions/subclinical delusional ideation and reasoning is that JTC is simply not as strongly related to mood or cognitive state as might be expected. Another possibility is that how mood or cognitive state is induced has been so varied across studies that conclusions are hard to draw. Indeed, experimental manipulations or inductions have been conducted in a number of ways, including a stressful test (a speeded subtraction task; Keefe and Warman, 2011), buying a newspaper in a busy shopping area (Ellett et al., 2008), asking participants to describe an anxiety-provoking situation they experienced (Lincoln et al., 2010a), a loud noise (Lincoln et al., 2010b), and anxiety-evoking music (Moritz et al., 2009). This variability has, perhaps, made conclusions challenging to draw. In addition, direct comparisons of various induced unpleasant mood or cognitive states have not, to date, been investigated (see Lee et al., 2011), though such comparisons may help illuminate relationships between them and the JTC bias. Two states hypothesized to be particularly relevant to delusions are anxiety or stress (Moritz et al., 2009) and also paranoia, which can range from social evaluative concerns to concerns of severe threat (see Green et al., 2011; Garety and Freeman, 2013). Their theoretical relationship with the continuum of delusional ideation suggests that these states would provide a useful comparison in terms of reasoning evoked.

The present study was designed to test a number of questions left unanswered in extant research—to investigate the relative impact of a stress induction, a paranoia induction, and no induction on the reasoning of individuals with varying levels of subclinical delusional ideation. It was expected, based on previous research (e.g., Colbert and Peters, 2002), that high-SDI individuals would JTC relative to low-SDI individuals. Further, following recent findings (e.g., Lincoln et al., 2010a; Keefe and Warman, 2011), it was expected that individuals who were given a stress induction would JTC relative to individuals in the no-induction condition and that this would be particularly prominent in high SDI individuals. Finally, due to the relationship between paranoia and delusional thought, and the possibility that induced paranoia influences how individuals with unusual beliefs process information and make decisions, it was expected that high-SDI individuals in the paranoia-induction condition would have the most profound JTC bias, relative to low-SDI individuals and also to high-SDI individuals in the other conditions. To decrease the transparency of the study (i.e., so participants would not find it obvious we were using manipulations to impact reasoning), no pre-test of anxiety or paranoia was conducted; instead, participants were randomly assigned to an experimental condition and their anxiety and paranoia were evaluated only after the induction was completed. Although this procedure likely made the participants less aware of the aims of the study, it does limit conclusions that can be drawn about whether findings are due to the actual inductions themselves.

2. Method

2.1. Participants

Individuals ($n=117$) were recruited from the community and from a university setting. Approximately 50% of the sample consisted of individuals in the general community ($n=59$), and the remainder were from an undergraduate student population ($n=58$). Although examining only undergraduates is a primary recruitment strategy in studies of subclinical delusional ideation (e.g., McKay et al., 2006; Lincoln et al., 2010a; Balzan et al., 2012), we recruited from the general population as well (through advertisements) in an effort to increase the generalizability of our findings. Participants were required to be at least 18 years of age, able to speak and read English, and able to provide written informed consent. Participants could not have a current or previous diagnosis of a schizophrenia-spectrum disorder or Bipolar Disorder. Participants from the community received $25.00, while college students received course credit for their participation in the study.

2.2. Materials

2.2.1. Peters et al. Delusions Inventory

Study participants completed the Peters et al. Delusions Inventory (PDI; Peters et al., 1999), a 40-item self-report instrument assessing for multiple dimensions of delusional ideation. The PDI has been used frequently in research on subclinical delusional ideation and reasoning (e.g., Warman et al., 2007; LaRocco and Warman, 2009; Lincoln et al., 2010c). The PDI has high internal consistency ($\alpha=0.88$) and test–retest reliability ($r=0.82$; Peters et al., 1999).

2.2.2. State-Trait Anxiety Inventory (STAI)

The State Anxiety scale of the STAI (Spielberger, 1983), a 20-item measure of state anxiety for adults, was used as a manipulation check to assess the degree of anxiety after the experimental inductions. The STAI has good psychometric properties, including test–retest reliability coefficients that range from 0.34 to 0.62.

2.2.3. Modified Paranoia Checklist

A modified version of the 18-item Paranoia Checklist (Freeman et al., 2005) was used to assess the degree of paranoia after the inductions. The original self-report measure was developed to measure paranoid ideation and has good internal consistency ($\alpha \geq 0.90$) and convergent validity. Following Lincoln et al., 2010a, this study employed a modified version of the scale that was designed to assess state paranoia. It was further modified to make the questions more applicable to nonclinical populations. Modifications from the original scale are italicized in the following example: "*At the moment, I believe that* people deliberately try to irritate me." Participants were asked to rate only conviction and distress for each item.

2.2.4. Filler task

A filler task in which participants sorted a stack of names (written one per index card) into alphabetical order was conducted simultaneously with the paranoia induction, in order to have the participants engaged in a relatively mindless activity. The filler task was administered to individuals in the no-induction condition as well, in order to maintain consistency in time requirements across conditions. The names used in this untimed task were selected through the use of a random (first) name generator (http://www.kleimo.com/random/name.cfm) that draws from a list provided by the U. S. Census Bureau.

2.3. Procedures

Within each sample type (community vs. college), participants were randomly assigned to one of the three experimental groups, to ensure equal representation of community and college student participants across the conditions. Following provision of informed consent, participants completed the PDI, followed by the experimental manipulations that are described in the following section. The filler task was administered concurrently with the paranoia induction. As indicated, participants in the "no induction" condition were also administered the filler task. Following the completion of the experimental manipulation (or no manipulation), all participants completed the reasoning tasks, followed by one assessment of anxiety state and one assessment of paranoid thinking.

2.3.1. Experimental manipulations

Participants within each group (community or college student) were randomly assigned to receive a stress induction, a paranoia induction, or no induction.

2.3.2. Stress induction

Following the design of Keefe and Warman (2011), participants randomly assigned to the stress induction completed a speeded subtraction task designed to be somewhat stressful (see Sgoutas-Emch et al., 1994; Tohill and Holyoak, 2000). During this task, a stopwatch was used to mark the elapsed time, and it was also expected to increase stress levels. Furthermore, mistakes were verbally corrected by the examiner as they occurred, and after 25 s elapsed, the participant was informed of the remaining time and told that he/she is "too slow." After 45 s elapsed, the participant was asked to stop and was told that the task would be repeated at the end of the experiment, although it was not actually repeated.

2.3.3. Paranoia induction

Individuals assigned to the paranoia induction completed the study in a room containing a two-way mirror. In this condition, the presence of the two-way mirror in the room was emphasized, as the use of a two-way mirror to heighten paranoia and self-focused attention has been successful in previous studies (e.g., Fenigstein and Vanable, 1992; Smari et al., 1994). Individuals were told before beginning the