Probability estimations and delusion-proneness

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ABSTRACT

The present study investigated the reasoning of high and low-delusion-prone individuals on probability estimation tasks using emotionally neutral and delusional narratives. Undergraduate students ($N = 33$) who were classified as high-delusion-prone or low-delusion-prone based on their scores on a widely used measure of delusion-proneness in reasoning research (the Peters et al. Delusions Inventory) were asked to rate the probability that five neutral and eight unusual situations, presented in narratives that ranged in terms of degree of likelihood, could be true. Results indicated that compared to low-delusion-prone participants, high-delusion-prone participants assigned equivalent probability estimations to neutral narratives, but considered delusional narratives to be more likely ($p < .001$). Differences emerged between groups at all probability levels for delusional narratives except the least likely. Findings support the presence of a reasoning bias among high-delusion-prone individuals for delusional material similar to that previously found among actively delusional individuals. Results are discussed as they relate to reasoning, psychosis and delusion-proneness.

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1. Introduction

Examination of delusion-proneness, or high levels of unusual beliefs in non-clinical populations (Peters, Joseph, & Garety, 1999), has become a popular way to examine the continuum of psychosis and to understand cognition in individuals believed to share features with individuals with psychosis (e.g., Linney, Peters, & Ayton, 1998). A number of researchers promote studying delusion-proneness to determine what sorts of cognitive biases may be present *before*, as opposed to just after, the onset of delusions (Colbert & Peters, 2002). If delusion-prone individuals have cognitive biases similar to delusional individuals, it may be possible to target such biases before the onset of psychosis and delay or avoid transition to psychosis. Indeed, there is evidence delusion-prone and delusional individuals have similar reasoning biases, though the tasks used to examine delusion-prone individuals have been limited to neutral or minimally emotionally salient stimuli (e.g., Colbert & Peters, 2002; Warman & Martin, 2006). While such investigations are useful in understanding general cognitive biases for delusion-prone individuals, they do not demonstrate delusion-prone individuals are actually biased about unusual experiences or believe unusual situations to be more likely than do low-delusion-prone individuals, a documented bias for individuals with delusions (McGuire, Junginger, Adams, Burright, & Donovick, 2001). In an effort to answer this important question, the aim of the present study was to determine if high-delusion-prone individuals overes-

timate the likelihood of unusual events relative to low-delusion-prone individuals.

Studies investigating individuals with schizophrenia spectrum disorders with active delusions have demonstrated robust differences between how individuals with delusions reason when compared to individuals with other psychiatric disorders and to normal controls (e.g., Huq, Garety, & Hemsley, 1988; Peters & Garety, 2006). For example, individuals with delusions request significantly less information before making decisions than psychiatric and normal controls, often asking for only one or two stimuli before making decisions when much more information is available (e.g., Garety et al., 2005; Moritz & Woodward, 2005). Using similar or identical probabilistic reasoning tasks to those used to investigate reasoning biases in delusional populations, studies have demonstrated support for such data gathering biases in delusion-prone individuals when the stimuli presented are emotionally neutral, such as presentation of beads in a jar (Colbert & Peters, 2002), and when stimuli are emotionally salient, such as a "survey task" in which participants are told to decide which of two surveys a word is coming from when the survey is described as conducted about a person very much like the participant (Warman & Martin, 2006). Results, however, are not entirely consistent, suggesting much remains unclear about reasoning and delusion-proneness (e.g., Warman, Lysaker, Martin, Davis, & Haudenschield, 2007).

Although asking individuals to make decisions about surveys hypothetically conducted about a person like the participant is likely more emotionally salient than making judgments about beads, the stimuli in the survey task are not related to

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understanding how delusion-prone individuals reason about a primary variable of interest – delusional material. McGuire et al. (2001) conducted an important study targeting this issue for delusional individuals by examining how individuals with delusions reasoned about the likelihood certain delusional narratives could be true. They found individuals with delusions assigned significantly higher probabilities to delusional narratives (i.e., thought the delusional narratives were more likely to be true or possible) than psychiatric and normal control groups. Of note, when they examined how individuals with delusions performed when narratives included only non-delusional, emotionally neutral material (colored balls), they performed similarly to all other groups studied, indicating their findings cannot be attributed to delusional individuals assigning higher probabilities to narratives in general. In sum, McGuire and colleagues demonstrated that individuals with delusions reason effectively when neutral stimuli are presented when no direct data gathering is required, but their reasoning is significantly affected when the stimuli presented are of delusional content. While previous research has demonstrated many similarities in how delusional and delusion-prone individuals reason (e.g., Colbert & Peters, 2002), we know of no published studies that have investigated how delusion-prone individuals reason about delusional material, such as assessing how they rate the probabilities that delusional narratives are true.[1] Given delusional beliefs are more related to interpretations of situations, not to determining from which of two jars beads are being drawn (Warman & Martin, 2006), an investigation of how delusion-prone individuals perceive unusual events appears essential.

The present study examined how delusion-prone individuals reason about delusional material. All participants were undergraduate students with no history of psychotic disorder. Participants completed the Peters et al. Delusions Inventory (PDI; Peters et al., 1999), a popular instrument to assess delusion-proneness in reasoning research (Linney et al., 1998; Warman et al., 2007), and assigned probability ratings (i.e., endorsed how much they believed various delusional scenarios were likely) to each of the narratives used in the McGuire et al. (2001) study. It was expected individuals classified as high-delusion-prone would assign higher probability ratings to delusional material (i.e., be biased in that they would have elevated beliefs that unusual scenarios are likely) than low-delusion-prone individuals. Further, it was predicted high and low-delusion-prone participants would reason equivalently for neutral narratives, mirroring the results McGuire and colleagues found for the delusional group when compared to healthy controls. Because McGuire et al. found familiarity with delusional narratives was linked with higher probability ratings (though a significant relationship between delusional status and probability ratings was present even when familiarity with the narratives was controlled for) we, similarly, assessed participants' familiarity with the narratives.

2. Method

2.1. Participants

Participants (N = 33) were undergraduates at a small liberal arts college enrolled in a psychology course and received course credit for participation. Inclusion criteria consisted of: absence of any history of a psychotic disorder, ability to speak English fluently, and being at least 18 years old.

2.2. Materials

The Peters et al. Delusions Inventory (PDI; Peters et al., 1999) is a self-report instrument that provides a multidimensional view of delusional ideation among the general population, or, as has been termed in the literature, "delusion-proneness" (e.g., Colbert & Peters, 2002; Linney et al., 1998). The instrument consists of 40 unusual beliefs such as, "Do you ever think that people can communicate telepathically?" Participants respond whether or not they have experienced the beliefs listed and then, for each item positively endorsed, rate on a 5-point Likert scale their level of distress, preoccupation, and conviction in the item, each of which can be scored as separate dimensions. The PDI has an internal consistency of .88 and test–retest reliability of .82 (Peters et al., 1999). Concurrent validity was determined by examining the relationship between scores on the PDI and three measures assessing similar constructs (the STA, MgI, and DSSI) and shared common variances of at least 52% (Peters et al., 1999). The PDI is a widely used instrument in studies of sub-clinical delusional ideation and reasoning (e.g., Linney et al., 1998; Warman, 2008; Warman & Martin, 2006) and is considered a useful way to investigate the continuum of psychosis (Johns & Van Os, 2001). Although the PDI contains items related to grandiosity and paranoia, none of the items are identical in content to any of the delusional narratives used for the present study.

2.3. Procedures

After informed consent was completed, participants completed the PDI. Following the procedures of McGuire et al. (2001), participants completed a neutral training item that had a correct answer of 50% probability to train how to assign probability estimates before completing the narratives. If the participant answered correctly, the narratives were presented, but if the participant provided an incorrect answer (a response outside a 40–60% probability range), the experimenter explained why 50% was accurate until the participant understood how to use the scale. Consistent with McGuire et al., participants completed five neutral narratives and eight delusional narratives. Order of administration of neutral and delusional narratives was counterbalanced, though the sequence of narratives within delusional and neutral categories was fixed. Counterbalancing differs from McGuire et al., who presented the delusional narratives before the neutral narratives. This modification was made to ensure that there was no order effect, as a recent study of delusion-proneness and reasoning indicated delusion-prone individuals reasoned differently to initial stimuli presented (Warman, 2008). Consistent with McGuire and colleagues, participants completed familiarity ratings to determine whether they had experience with the delusional narratives. Familiarity ratings followed each delusional narrative.

2.3.1. Neutral narrative probability tasks

McGuire et al.'s (2001) neutral narratives were used for the present study. Probability levels, which included 0, 25, 50, 75, and 100, were a function of the percentages of colored balls in a bag and indicate the likelihood that a particular color of ball could be randomly selected. For example, at the 50% probability level, which means there is a 50% probability a ball of a particular color would be selected, the following narrative was presented: "She had a bag with 100 balls, and only 100 balls. 50 balls were black. 50 balls were red. She said that without looking she could pick out a red ball." Participants were asked to rate the probability from 0% to 100% each narrative could be true, with 0 indicating impossible and 100 indicating definitely true.

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[1] While we were unable to locate any published studies of delusion-proneness and probability estimations for delusional narratives, one unpublished dissertation (Malosh, 2004) did address this issue with some methodological differences.