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Enhancing the ecological validity of the Beads Task as a behavioral measure of intolerance of uncertainty

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ABSTRACT

To broaden the measurement of intolerance of uncertainty (IU) beyond self-report methods, recent research has examined the Beads Task as a behavioral measure of IU. In the present study, we enhanced this task to increase its ecological validity by maximizing decisional uncertainty and the importance of a correct response. Undergraduate participants ($n = 102$) completed the Beads Task with instructions that they would complete the Cold Pressor Task (CPT) if they answered incorrectly. As hypothesized, baseline CPT endurance time and self-reported pain level were weakly associated with later Beads Task distress during the decision-making process. Furthermore, *in vivo* Beads Task distress was associated with self-report inhibitory IU, which measures avoidance and paralysis in the face of uncertainty, but not with prospective IU, perfectionism, or general psychological distress after making statistical adjustments for multiple comparisons. Comparisons to previous work using the Beads Task, clinical implications, and avenues for future research are discussed.

1. Introduction

Intolerance of uncertainty (IU) is a cognitive bias that affects how a person experiences, interprets, and responds to situations that are ambiguous or have indefinite outcomes (Dugas, Schwartz, & Francis, 2004; Obsessive Compulsive Cognitions Working Group [OCCWG], 1997). IU involves both *prospective* (*i.e.*, discomfort due to future unknowns) and *inhibitory* (*i.e.*, avoidance and paralysis in the face of ambiguity) components (Birrell, Meares, Wilkinson, & Freeston, 2011; Carleton, Norton, & Asmundson, 2007; McEvoy & Mahoney, 2011). Individuals who are high in IU tend to (a) have a lower perceptual threshold of ambiguity, (b) make threatening interpretations of ambiguous information, (c) find uncertainty to be distressing, unmanageable, and something that should be avoided, and (d) have difficulty functioning in uncertain or ambiguous situations (Bredemeier & Berenbaum, 2008; Buhr & Dugas, 2002; Krohne, 1993; Ladouceur, Talbot, & Dugas, 1997).

IU is also a transdiagnostic vulnerability factor for the development of anxiety and related disorders (Boswell, Thompson-Hollands, Farchione, & Barlow, 2013; Carleton, 2012; Carleton, Mulvogue et al., 2012; Einstein, 2014). It is associated with symptoms of OCD (*e.g.*, Tolin, Abramowitz, Brigidi, & Foa, 2003), GAD (*e.g.*, Buhr & Dugas, 2006), panic disorder (*e.g.*, Carleton et al., 2014), health anxiety (*e.g.*, Fergus & Valentiner, 2011), and social phobia (*e.g.*, Boelen & Reijntjes, 2009). In fact, IU predicts anxiety symptoms above and beyond other cognitive vulnerability factors such as anxiety sensitivity, distress tolerance, and trait anxiety (Norr et al., 2013). Indeed, many behaviors observed in these conditions (*e.g.*, safety behaviors, reassurance seeking, rumination, compulsions, avoidance) can be conceptualized as attempts to obtain certainty and reduce anxious arousal (*e.g.*, Behar, DiMarco, Hekler, Mohlman, & Staples, 2009; Einstein, 2014; Holaway, Heimberg, & Coles, 2006).

An important limitation of the existing research on IU, however, is that studies rely almost exclusively on self-report measures, such as the Intolerance of Uncertainty Scale (IUS-12; Carleton et al., 2007) and the Perfectionism/Certainty subscale of the Obsessive Beliefs Questionnaire (OBQ-PC; OCCWG, 2005). Although there is strong evidence for the construct validity of these instruments, the literature would benefit from methodologically varied measurement of this cognitive bias. Specifically, these questionnaires are limited in that they are trait measures, which merely capture participants' self-reported stable beliefs about uncertainty. They do not, however, lend themselves well to use as dependent variables in studies seeking to examine predictors and moderators of *state* IU (*i.e.*, feelings of IU-related distress captured in the moment). Some research, however, has evaluated laboratory paradigms as *in vivo*

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measures of IU, by quantifying the relationship between self-report IU and performance on behavioral tasks involving uncertainty or ambiguity (*e.g.*, decisions made during a laboratory gambling task; Luhmann, Ishida, & Hajcak, 2011). These tasks have the advantage of experimentally inducing uncertainty in the laboratory and capturing participants' cognitive, emotional, and behavioral responses to actual ambiguous scenarios.

One such behavioral measure is the Beads Task (Huq, Garety, & Hemsley, 1988; Phillips & Edwards, 1966), utilized by three studies to date to examine how performance on this task may be related to IU. The Beads Task is a probabilistic inference task in which participants are shown two jars on a computer screen. Each jar contains 100 beads of two different colors in a particular ratio (*e.g.*, 85:15 red beads to blue beads *vs.* 85:15 blue to red). Participants are told that beads will be drawn one by one with replacement from one of the jars (the sequence of beads is predetermined using a random number generator), and that each jar is equally likely to be chosen. The participant's task is to determine from which jar the beads are being drawn (*e.g.*, the mostly red jar or the mostly blue jar). Participants are told that they can request as many beads as necessary to correctly decide. Outcome measures include: (a) the number of beads requested before feeling "certain" about making a decision (*i.e.*, draws to decision; DTD), (b) the time taken to decide, and (c) self-reported distress during the task. IU is expected to be associated with greater DTD, time to decision, and distress.

Ladouceur et al. (1997) found a positive association between scores on the IUS and DTD using a non-clinical sample; yet a separate team was unable to replicate this finding in a sample of participants with eating disorders (Sternheim, Startup, & Schmidt, 2011). Neither study, however, assessed relationships between self-reported IU and time to decision or *in vivo* distress. Thus, using a sample of individuals diagnosed with anxiety disorders, Jacoby, Abramowitz, Buck, and Fabricant (2014) found that self-reported IU as measured by the OBQ-PC was correlated with DTD and distress during the Beads Task. Furthermore, the distress variable distinguished individuals with anxiety disorders from healthy controls.

Jacoby et al. (2014) also raised two issues necessitating further investigation of the Beads Task as a viable paradigm for studying IU. First, IU, in the context of anxiety disorders, typically focuses on the possibility of a feared negative consequence (Nelson & Shankman, 2011). However, the ecological validity of the Beads Task was limited in that there were no meaningful negative consequences for an incorrect response. Accordingly, this may explain why participants self-reported relatively little distress while completing the task. Second, because the OBQ-PC, used in Jacoby et al. (2014), assesses both IU and perfectionism, it is important to clarify the extent to which each construct might be uniquely associated with outcomes on the Beads Task.

Accordingly, the present study aimed to enhance the ecological validity of the Beads Task as an analog for how individuals with anxiety disorders manage uncertainty. Specifically, we sought to heighten the importance of a correct response (and corresponding *in vivo* distress) by introducing the threat of an aversive outcome—the Cold Pressor Task (CPT; submerging one's dominant hand in a cooler of ice water for as long as is tolerable; described in Section 2.3). All participants completed the CPT prior to the Beads Task, and were informed they would have to repeat the CPT if they guessed the incorrect jar. We also maximized uncertainty of the decision by using a completely ambiguous version of the Beads Task with 50/50 probabilistic ratios. We hypothesized that: (a) lower baseline CPT endurance time (*i.e.*, seconds immersed in the cold water) and higher self-reported pain levels after completing the CPT would be associated with more DTD, time to decision, and distress during the Beads Task, and (b) Beads Task outcomes would be positively associated with self-reported IU. We also included a measure of perfectionism and a general measure of psychological distress in order to explore the extent to which these constructs related to Beads Task outcomes.

2. Material and methods

2.1. Participants

One-hundred and ten undergraduate students recruited from Introduction to Psychology classes at the University of North Carolina at Chapel Hill (UNC-CH) participated in this study. Eight participants were removed for the following reasons: (a) they provided information during debriefing suggesting that they knew they would not need to put their hand back in the ice water or that they would simply refuse to do so if asked ($n = 3$), (b) they told the researcher that they were looking forward to repeating the CPT (and thus did not perceive the paradigm to be aversive, $n = 3$), (c) they shared that they did not understand the rules of the Beads Task ($n = 1$), and (d) the experimenters noted that the participant seemed to rush through the procedures ($n = 1$). Accordingly, the final sample size for data analysis was 102.

The sample was primarily female (61.8%, $n = 63$), White (77.5%, $n = 79$; 6.9% Black or African American, 7.8% Asian, 3.9% bi- or multiracial, and 3.9% other), non-Latino (94.1%, $n = 96$), right-handed (88.2%, $n = 90$), and first-year students (66.7%, $n = 68$; 16.7% sophomore, 10.8% junior, 5.9% senior) with a mean age of 18.93 years old (SD = 1.14; range 17–22); which is comparable to the demographics of our Introduction to Psychology participant pool at large. Due to the use of the Beads Task and CPT, the following exclusion criteria were present for the study: (1) being color-blind, (2) history of hypertension, peripheral vascular disease, cold urticaria, cold sensitivity, or Raynauds syndrome, and (3) open cuts or lesions on the hands.

2.2. Measures

2.2.1. Intolerance of Uncertainty Scale, short form (IUS-12; Carleton et al., 2007)

The IUS-12 is a shortened version of the original 27-item IUS (Freeston, Rhéaume, Letarte, & Dugas, 1994) that measures reactions to uncertainty, ambiguity, and the future. The measure consists of two subscales: (a) *Prospective IU* measures desire for predictability, preferences for knowing what the future holds, anxiety about future uncertain events, and active engagement in seeking information to increase certainty (*e.g.*, "I always want to know what the future has in store for me"), and (b) *Inhibitory IU* measures avoidance and paralysis in the face of uncertainty (*e.g.*, "When I am uncertain I can't function very well"). Participants rate each item from 1 (*Not at all characteristic of me*) to 5 (*Entirely characteristic of me*). The IUS-12 has good psychometric properties in both clinical and non-clinical samples (Carleton, Mulvogue et al., 2012; Carleton et al., 2007; Helsen, Van, Vlaeyen, & Goubert, 2013; Jacoby, Fabricant, Leonard, Riemann, & Abramowitz, 2013; Khawaja & Yu, 2010; McEvoy & Mahoney, 2011). Internal consistency of the IUS-12 subscales in the present sample was good to excellent ($\alpha = 0.85$–0.90).

2.2.2. Frost Multi-Dimensional Perfectionism Scale (FMPS-22; Cox, Enns, & Clara, 2002)

The FMPS-22 is a revised version of the original 35-item FMPS (Frost, Marten, Lahart, & Rosenblate, 1990) assessing multiple dimensions of perfectionism including: concerns over making mistakes (*e.g.*, "If I fail partly, it is as bad as being a complete failure"), doubts about actions (*e.g.*, "I tend to get behind in my work because I repeat things over and over"), high personal standards (*e.g.*, "I set higher goals for myself than most people"), high parental expectations and criticism (*e.g.*, "As a child, I was punished for doing things

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