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Contextual Influences on Distress Intolerance: Priming Effects on Behavioral Persistence

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Abstract

Distress intolerance (DI), the inability to tolerate stressful experiences, has been linked to multiple psychiatric conditions and maladaptive coping patterns. Although DI is often considered a trait-like variable, evidence indicates that self-report and behavioral indices of DI can be manipulated by contextual factors. Understanding such contextual influences is important given evidence of unexpected variability in these presumed trait-like measures over brief intervals. The current study examined the influence of context (manipulated by priming concepts of “Interminability” and “Brevity”) in predicting behavioral persistence, in relation to self-reported DI. Results indicated that priming Brevity was associated with terminating a cold-pressor task more quickly. Self-reported DI was linked to earlier termination, but there was no interaction between self-reported DI and priming condition. Results indicate that contextual cues modulate performance on behavioral measures of DI. Hence, models of DI should consider both trait-like and contextual factors in understanding variability in DI measures.

Keywords

Distress Intolerance; Priming; Behavioral Persistence; Contextual Factors; Measurement Variability

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Disclosures

Conflicts of Interest

In the past 2 years, Dr. Michael Otto has served as a paid consultant for MicroTransponder Inc., Concert Pharmaceuticals, and ProPhase; provided expert consensus opinion for Otsuka Pharmaceuticals, received royalty support for use of the SIGH-A from ProPhase, and received book royalties from Oxford University Press, Routledge, and Springer. Ms. Kristin Szuhany has no conflicts to report.

This manuscript is original research, has not been previously published, and is not under concurrent consideration for publication elsewhere. These data have been presented in a symposium at the 2014 annual meeting of the Association of Behavioral and Cognitive Therapies in Philadelphia, PA.

Informed Consent

The Boston University Institutional Review Board (IRB) approved this study and all procedures. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

Animal Rights

This article does not contain any studies with animals performed by any of the authors.

Introduction

Distress intolerance (DI), the perceived inability to tolerate distressing states, has been conceptualized as a transdiagnostic variable underlying multiple psychological disorders and maladaptive coping behaviors (see Leyro, Zvolensky, & Bernstein, 2010). High levels of DI are hypothesized to motivate escape- and avoidance-based coping due to amplification of the aversiveness of negative emotional and somatic states (McHugh, Reynolds, Leyro, & Otto, 2013). DI has been linked to substance use for coping motives (Abrantes et al., 2008; Brown, Lejuez, Kahler, Strong, & Zvolensky, 2005; Buckner, Keough, & Schmidt, 2007; Dennhardt & Murphy, 2011; Johnson, Mullin, Marshall, Bonn-Miller, & Zvolensky, 2010; Kaiser, Milich, Lynam, & Charnigo, 2012; Zvolensky et al., 2004), dysfunctional eating (Anestis, Selby, Fink, & Joiner, 2007; Hearon, Quatromoni, Mascoop, & Otto, 2014; Kozak & Fought, 2011), procrastination (Harrington, 2005), and risky behaviors such as hurried driving, fighting, and gambling (Beck, Daughters, & Ali, 2013; MacPherson et al., 2010). Additionally, DI appears to be an important element in the development and maintenance of psychiatric disorders, such as anxiety (Schmidt, Richey, Cromer, & Buckner, 2007; Schmidt, Richey, & Fitzpatrick, 2006), posttraumatic stress (Tull, Gratz, Coffey, Weiss, & McDermott, 2012), and personality disorders (Bornovalova, Matusiewicz, & Rojas, 2011; Daughters, Sargeant, Bornovalova, Gratz, & Lejuez, 2008; Iverson, Follette, Pistorello, & Fruzzetti, 2012; Sargeant, Daughters, Curtin, Schuster, & Lejuez, 2011). Consequently, interventions targeting DI have demonstrated successful outcomes in clinical trials (Bornovalova, Gratz, Daughters, Hunt, & Lejuez, 2012; Norr, Allan, Macatee, Keough, & Schmidt, 2014).

Though DI has been implicated as a factor impacting the development and maintenance of numerous psychiatric disorders, there is disagreement in the field of the operationalized definition of DI (Leyro et al., 2010) as well as its nature as a stable, trait variable (e.g., Broman-Fulks, Berman, Martin, Marsic, & Harris, 2009). Indeed, multiple indices examining tolerance of distressing states have been developed, such as the Anxiety Sensitivity Index (ASI), which assesses fear of internal sensations; the Frustration Discomfort Scale (FDS), which assesses intolerance of frustrating situations; and the Distress Tolerance Scale (DTS), which assess a general perception of being “distressed” or “upset.” These indices have been conceptualized as specific measures of DI in previous research (McHugh & Otto, 2012b); however, there exists disagreement in the field over this conceptualization (Leyro et al., 2010). Additional research has found that DI varies based on domain of distress being assessed (e.g., pain vs. frustration; McHugh & Otto, 2011). Further, research has identified that DI may vary depending on whether it is assessed via self-report (i.e., perceived inability to withstand negative emotional and/or aversive states) or behaviorally (i.e., act of not behaviorally persisting when in context of distressing internal or external states; Leyro et al., 2010).

Given evidence of variability in DI measures over time (see Broman-Fulks, Berman, Martin, Marsic, & Harris, 2009; Maltby, Mayers, Allen, & Tolin, 2005; Marsic, Broman-Fulks, & Berman, 2011) and across mood states (e.g., Otto, Pollack, Fava, Uccello, & Rosenbaum, 1995), investigations of state influences on both self-report and behavioral measures of DI are warranted. Contextual factors, such as administration of clinical measures, mood, or

presence of cueing items in the room, appear to be important in these changes. For example, Maltby and colleagues (2005) found that scores on the self-report Anxiety Sensitivity Index (ASI) from screening to baseline evaluations decreased specifically in the context of a diagnostic interview, indicating the interview context may change the meaning of symptoms or the motivation to report concern over symptoms in subsequent evaluations. The time course of this change in responding to self-report questions can occur quickly, with documentation of changes in less than 10 minutes (Broman-Fulks et al., 2009). Similar findings note the effect of computer-based informational programs on ASI scores. Indeed, Schmidt and colleagues (2007) found that both a targeted, anxiety-specific psychoeducational program as well as a general health and nutrition program induced unexplained reductions in ASI scores. Finally, current mood may influence self-report measures of DI; for example, depressed individuals treated with antidepressants evidenced significant reductions in ASI scores following treatment (Otto et al., 1995). Given the recent attention to these potentially context-induced changes in DI, further evidence is required to evaluate these influences in the laboratory.

Priming, a social psychological strategy which non-consciously evokes certain conceptual frameworks, can promote such an evaluation (Bargh, 1990). Conceptual priming, specifically, involves presenting stimuli related to an underlying trait, attitude, or framework for expectations (Bargh, 2006). Studies have shown that priming of various conceptual frameworks affects behavioral outcomes. For example, presenting words related to rudeness, such as “rude,” “bold,” or “bother,” led participants to interrupt more frequently in subsequent conversations with experimenters (Bargh, Chen, & Burrows, 1996). In addition, presenting words priming an elderly stereotype led college student participants to walk more slowly down a hallway (Bargh et al., 1996). There also exists preliminary evidence for the interaction between behavioral primes and DI. For example, individuals with high (vs. low) scores on the cardiac items from the ASI, who underwent a biological challenge of breathing 35% carbon dioxide, were more likely to discontinue the experiment (i.e., had lower behavioral persistence) when perceptions of medical risk were primed by the presence of a defibrillator (Telch et al., 2010). A similar study noted that instructional sets (i.e., expected arousal vs. expected relaxation) impacted emotional responding (i.e., having a panic attack) specifically in a group with high anxiety sensitivity in the expected arousal priming condition (Telch, Harrington, Smits, & Powers, 2011). A behavioral persistence measure of DI has also been shown to be manipulated by smoking deprivation/withdrawal context. For example, Bernstein and colleagues (2008) found that smokers who had not smoked for 12 hours prior to the experimental manipulation exhibited less behavioral persistence in a breath holding test than those allowed to smoke freely during the day and the experimental session.

The current study is devoted to expanding upon this literature, with particular focus on identifying whether conceptual priming can create variability in behavioral persistence measures of DI, similar to the variability noted for self-report indices. Reports indicate that assumptions of interminability enhance the aversiveness of an experience (Fry, Crisp, & Beard, 1991; Turk, 1999; Turner, Jensen, Warm, & Cardenas, 2002). Accordingly, we hypothesized that activation of an interminability frame of reference would motivate individuals to escape an aversive task more quickly. Specifically, we examined the effects of

priming concepts of “Interminability” versus “Brevity” on behavioral persistence. Interminability was defined as a feeling of endlessness, whereas Brevity was defined as shortness of time (see description of priming words in Methods section). DI can manifest differently across various domains of distress (e.g., pain, frustration, anxiety, etc.; McHugh & Otto, 2011); therefore, both cold-pressor and mirror-tracing tasks (see McHugh & Otto, 2011), behavioral persistence measures of DI in the domains of pain (i.e., physiological distress) and frustration (i.e., psychological distress), respectively, were utilized in the current study.

We hypothesized that, in addition to a general association between self-report and behavioral indices of DI (Daughters et al., 2005; McHugh & Otto, 2012a;2012b), conceptual priming would influence the subsequent behavioral persistence measures. Because we anticipated that individuals with higher self-reported DI may be more susceptible to primes associated with physical and psychological distress, we hypothesized that, in addition to a main effect of priming, individuals high in self-reported DI in the Interminability condition would exhibit shorter persistence with the distressing tasks.

Methods

Participants

A total of 52 undergraduate students participated in the experiment in partial fulfillment of a course research requirement. The sample was 73% female and predominantly Caucasian (62%) and Asian (35%) with a mean age of 18.8 ($\pm$ 1.2) years. In order to meet eligibility criteria, all participants were required to be at least 18 years of age, able to read and understand English, and be familiar with a computer keyboard and mouse. In addition, participants with a past history of or current frostbite, Raynaud’s disease, a history of a cardiovascular disorder, fainting or seizures, or injury on the hand to be immersed were excluded from study participation in order to avoid potential injury.

Measures

Participants completed a self-report measure (i.e., DII) as well as information about demographics (i.e., age, sex, educational attainment, race/ethnicity) prior to participating in the experimental manipulation.

The Distress Intolerance Index (DII; McHugh & Otto, 2012b) is a 10-item self-report measure of an individual’s perceived ability to tolerate distressing states, including items like “I can’t handle feeling distressed or upset” and “I can’t bear disturbing feelings.” Individuals respond from 0 (very little) to 4 (very much) with higher scores indicating less ability to tolerate distressing states. This measure was developed in the context of a factor analysis of the most commonly applied measures of distress intolerance, namely the Anxiety Sensitivity Index (Peterson & Reiss, 1992), Distress Tolerance Scale (Simons & Gaher, 2005), and Frustration Discomfort Scale (Harrington, 2005). The DII has demonstrated strong internal consistency (α = .92; McHugh & Otto, 2012b) as well as construct validity relative to behavioral measures of DI (McHugh & Otto, 2011).

The Scrambled Sentence Test (Srull & Wyer, 1979), a frequently used measure in priming literature (Bargh et al., 1996; Branaghan & Gray, 2010; Dijksterhuis & van Knippenberg, 1998; Roberts & Gettman, 2004), was used as the priming manipulation. It was presented as a test of language ability to shield participants from the true intent of priming conceptual frameworks. For each of the 12 items, participants were instructed to use four of the five words listed to construct a grammatically correct four-word sentence as quickly as possible, while being timed by the experimenter. The five words presented in a given test item were in scrambled order, such as “train missed endless he the.” The unused word in the sentence (e.g., “endless” in the previous example) was intended to have the priming effect.

Participants in this study were randomized to one of two opposing sets of primes: Interminability or Brevity. For both the Interminability and Brevity priming versions, 9 of the 12 items contained an adjective semantically related to the trait being primed, consistent with other priming studies of this kind (Bargh et al., 1996; Bry, Meyer, Oberle, & Gherson, 2009). The other 3 items contained an extra word of neutral valence. Examples of stimuli for the Interminability prime include endless, eternal, and unending. Stimuli in the Brevity prime included brief, fleeting, and transient among others. Priming cues were chosen using synonyms of key constructs (i.e., Interminability, Brevity) specifically for this study, given no previous studies using Interminability or Brevity primes, and were inserted into scrambled sentences used in previous studies (Bargh et al., 1996).

Two behavioral persistence tasks were administered that assessed pain and frustration, the cold-pressor test and the Computerized Mirror Tracing Persistence Task (MTPT-C; Strong et al., 2003), respectively. Time to discontinuation was used as a measure of behavioral persistence for each of these tasks. The cold-pressor has been widely used in the literature as a safe and noninvasive method for pain induction (Tousignant-Laflamme, Page, Goffaux, & Marchand, 2008). In this task, participants were asked to submerge their non-dominant hand, up to the wrist, in an ice water bath (with temperature between 0 and 4 degrees Celsius) for as long as possible, with a maximum of 90 seconds (to reduce risk of injury from the task). In the MTPT-C, participants moved a dot along the shape of a star using the computer mouse; however, all visual feedback was reversed (as would occur if a person were looking at the to-be-traced object in a mirror). As mistakes in tracing occurred, computerized auditory feedback (a loud buzz-like sound) was provided. The task was ended by the experimenter after 7 minutes, if participants did not discontinue earlier. This task is commonly used to evoke frustration (Brandon et al., 2003; Matthews & Stoney, 1988; Tutoo, 1971). Participants were not informed of the upper time limits of either the cold-pressor or mirror-tracing tasks.

To examine whether we were able to impact participants' judgments of time through priming, we included a timing estimation task as an additional assessment to evaluate the breadth of the priming effect. Participants were asked to estimate the length of time that elapsed from the point of completion of the Scrambled Sentence Test to the completion of the behavioral persistence tasks. The experimenter kept track of the exact amount of time using a stopwatch.

Procedures

The Boston University Institutional Review Board approved the procedures of this study. Upon arrival to the laboratory, participants received an explanation of the study procedures and provided informed consent. Prior to study participation, each participant was randomly assigned to one of the two priming conditions. After completing the questionnaire measures, participants were administered the priming manipulation (i.e., Scrambled Sentence Test) while being timed by the experimenter.

At this point, the experimenter began the stopwatch for the timing estimation, without indicating this information to the participant. Then, participants completed the two behavioral persistence measures. First, they were administered the cold-pressor task. The experimenter read aloud the task instructions, which informed the participant about the nature of the task as well as the incentive for engaging in the task (i.e., earning an opportunity to be entered into a raffle for a \$50 gift card for superior task performance). In actuality, all participants were entered into the raffle. Participants were also informed that they could discontinue the task at any time if they were too uncomfortable. Following completion of the cold-pressor task, participants were read the instructions for the mirror-tracing task (MTPT-C), with similar instructions about raffle entry and discontinuation of the task, and immediately completed this task. To reduce the complexity of the design related to carryover effects, we did not counterbalance completion of the cold-pressor task and MTPT-C.

Following the completion of the MTPT-C, participants were asked to estimate the amount of time that had passed from the Scrambled Sentence Test to the end of the mirror-tracing task. Participants then were read a debriefing form, informing them of the true intent of the priming task, and the experimenter granted them credit.

Data Analysis

First, we used hierarchical multiple regression analyses to examine whether the priming condition significantly impacted persistence in the behavioral persistence tasks (i.e., cold-pressor and MTPT-C) when covarying for self-reported DI. In this regression model, the DII total score and priming condition were included in the first step of the regression. To examine whether DII and priming condition interacted to predict persistence, a DII total score by priming condition interaction term was entered in step two. DII total scores were mean centered in this model.

Second, we examined the effect of the priming condition on timing estimation, a novel assessment of priming effects. To do this, we calculated the difference between actual amount of time elapsed and estimated amount of time elapsed. Then, we divided this answer by actual amount of time elapsed to derive a percentage difference. An independent samples t-test was utilized to evaluate if difference in estimates was significant between priming conditions.

Results

Descriptive Statistics

Participants randomly assigned to the Interminability and Brevity priming conditions did not significantly differ in any demographic variables (i.e., sex, race, ethnicity, or age).

Participants reported a mean ($\pm$ SD) DII total score of 10.1 ($\pm$ 7.0), with no significant differences between groups ($p > .05$). In this sample, the DII exhibited good internal consistency ($\alpha = 0.91$). Mean time to discontinuation was 67.8 ($\pm$ 27.3) seconds and 250.7 ($\pm$ 135.1) seconds for the cold-pressor and mirror-tracing tasks, respectively, with significant differences between groups for the cold-pressor task only ($p < .001$), with the Brevity group discontinuing more quickly than the Interminability group. (See Table 1 for more details.)

The zero-order correlations between discontinuation scores for the cold-pressor and mirror-tracing task for all groups was nonsignificant ($r(51) = 0.20$, $p = .16$). Given previous findings of an association between these two measures (e.g., McHugh & Otto, 2011), we conducted separate correlational analyses dividing participants by condition. Here, the correlation between the cold-pressor and mirror-tracing task discontinuation scores approaches significance for the Interminability group ($r(24) = .33$, $p = .10$), but remains non-significant for the Brevity group ($r(24) = .02$, $p = .91$). Zero-order correlations between demographic variables and outcome measures did not yield any significant results; however, there was a significant correlation between DII total score and sex ($r(50) = 0.29$, $p = .04$).

Prediction of Behavioral Persistence

A hierarchical multiple regression analysis indicated significant main effects of DII total score and condition on behavioral persistence in the cold-pressor task. Though the time to discontinuation data for both the cold-pressor and the mirror-tracing task were skewed due to maximum cutoff times, Games (1984) reports that effects of skewness in regression analyses are trivial with adequate sample size. Therefore, we did not transform the data prior to analysis. However, scores on the DII were mean-centered prior to analysis. Results of a linear regression indicated three predictors explaining 31.3% of the variance in behavioral persistence in the cold-pressor task ($R^2 = 0.31$, $F(3, 51) = 7.30$, $p < .001$). Individuals with higher DII total scores discontinued the task sooner than those with lower scores ($\beta = -0.30$, $p = .02$, $d = -0.72$). Additionally, individuals in the Brevity condition discontinued the task more quickly than those in the Interminability condition ($\beta = 0.50$, $p < .001$, $d = 1.19$; See Table 2). However, there was no significant interaction between DII total scores and condition ($\beta = 0.19$, $p = .11$, $d = 0.47$), although the effect size for the interaction was in the moderate range, reflecting an association between DII and persistence only for the Brevity condition ($r = .43$ for Brevity, and $r = .17$ for Interminability). Due to the significant correlation between DII score and sex, we ran the regression with sex and sex by condition as covariates; however, neither of these variables was statistically significant and main effects remained significant. No significant effects of DII total score ($\beta = -0.16$, $p = .28$, $d = 0.31$), condition ($\beta = 0.20$, $p = .17$, $d = 0.39$), or their interaction ($\beta = -0.19$, $p = .18$, $d = 0.38$) were evident in the mirror-tracing task. (See Table 3.)

Results of an independent samples t-test indicated that percentage time difference estimates did not significantly differ between the Interminability and Brevity priming conditions ($t(50) = .32, p = .75, d = .09$).

Discussion

Research has demonstrated that the inability to tolerate distressing experiences, or distress intolerance, appears to be an important factor in the development and maintenance of a range of psychiatric disorders and maladaptive coping responses (see Leyro et al., 2010). As such, these self-report and behavioral measures of DI are used as both selection factors and outcome measures in psychopathology studies (for review, see Marsic et al., 2011). Few studies, however, have examined the effect of contextual influences on distress intolerance. The aim of the current study was to investigate the influence of contextual factors in relation to trait-based self-reported DI on individuals' abilities to tolerate stressful states.

First, our study revealed the expected association between a self-report measure of DI and behavioral measures. Specifically, individuals with higher levels of DI displayed less persistence during the cold-pressor task, removing their hands from the ice water bath more quickly than individuals with lower levels of DI. Nonetheless, this association was not evident for our other measure of behavioral persistence, the mirror-tracing task. Other studies have identified similar divergence between self-report and behavioral measures of DI, particularly for this task (McHugh et al., 2011). These findings support the conceptualization of DI as a multidimensional construct, therefore underscoring the importance of considering domain specificity when DI and behavioral persistence are assessed.

Second, counter to our hypothesis, the Interminability prime did not lead to quicker task discontinuation; instead, task persistence was significantly shorter following the Brevity prime. Indeed, on the cold-pressor task, 12 of 26 participants in the Interminability condition persisted to the maximum allowable time on the task, as compared to only 5 of 26 in the Brevity condition. We had hypothesized that the Brevity condition would influence the evaluation of the painful stimulus (i.e., "the pain will not last forever"), but instead it appears to have been interpreted as a request for action (i.e., "act with brevity,"), resulting in quicker cessation of the task. The results of the timing estimation are consistent with this interpretation: there was no effect on the estimation of the length of time engaged with the stimulus, consistent with the effects of the prime on behavioral action rather than stimulus perception. Similarly, unexpected influences of priming effects have been documented in a number of other studies. For example, in a study priming participants with unhealthy words (e.g., fat, sluggish), individuals committed to the goal of healthy eating chose unhealthy snacks rather than a healthy option, contrary to the investigators' hypotheses (Adams, Kaiser, Moss, Cole, & Giesler, April 2012). Hence, priming works, but investigators may not accurately predict the conceptual frame invoked by the prime.

Priming effects may also be short-lived across tasks. We observed no significant effects of the Brevity prime on the mirror-tracing task, the second persistence task completed by participants. The null result on this task may be due to a washing out of the priming effect

from the salience of the painful cold-pressor task. Alternatively, persistence time is a much more salient feature of the cold-pressor task; efforts at errorless task completion may have made the mirror-tracing task less susceptible to an “act with brevity” cue. Future studies should consider counterbalancing administration of the behavioral DI tasks to evaluate this potential source for null results.

Overall, the study provides further evidence that the meaning of a cue is dependent on the context surrounding the task. In this study, the prime appeared to change the expectation/motivation for persistence on the task, whereas in other studies cues change such things as the tolerability or importance of subsequent stimuli by the inclusion of an emergency medical cue (Telch et al., 2010), or, perhaps, the completion of a diagnostic interview (Maltby et al., 2005).

This study underscores the notion that presumed trait-based measures, such as behavioral persistence measures of DI, can be manipulated by context. Indeed, other presumed trait measures have been shown to vary by mood state (e.g., mood effects on the NEO-Five Factor Model; Jain, Blais, Otto, Hirshfeld, & Sachs, 1999). Given the importance of behavioral and self-report DI assessments to the field (Broman-Fulks et al., 2009; Maltby et al., 2005; Marsic et al., 2011; Otto et al., 1995) and this and other evidence that DI as measured by both self-report and behavioral measures is susceptible to contextual influences, additional research on the impact of contextual cues is warranted.

A relative weakness in our study was the failure to attend to the potential time course of the prime; future studies may include an additional priming task between outcome measures to refresh the conceptual prime for participants. Also, for our priming task, we utilized only 12 sentences, which represents the lower range typically used in priming studies (Bargh et al., 1996; Branaghan & Gray, 2010; Bry et al., 2009; Roberts & Gettman, 2004). Incorporating 20 to 30 priming sentences may have provided a more sustainable or stronger priming effect. Our method of priming also included use of synonyms for the target concepts of Interminability and Brevity. Other studies suggest that conceptual priming fares better when using not only synonyms but other conceptual level terms (Bargh, Raymond, Pryor, & Strack, 1995). For example, the Interminability condition could have included words such as hours, years, or millennia to signify lengthy measurements of time. In addition, we did not assess whether or not individuals were savvy to the priming manipulation. Other studies have included debriefing questionnaires assessing whether individuals noticed the priming words (Aarts, Custers, & Wegner, 2005; Bargh & Chartrand, 2000). Individuals who had conscious awareness of the primes may not have been as affected as those with non-conscious awareness.

Given the relatively low DI scores of the current sample, future research should also investigate similar conceptual priming manipulations with clinical samples. DI may be particularly malleable in clinical samples as studies show that DI often changes dramatically with psychotherapeutic (Gallagher et al., 2013; Shear, Houck, Greeno, & Masters, 2001; Smits, Berry, Tart, & Powers, 2008) and pharmacological (Otto et al., 1995) interventions as well as with exercise interventions (Broman-Fulks & Storey, 2008; Smits, Powers, Cho, & Telch, 2004). As noted, the concepts of Interminability and Brevity may be particularly

relevant due to propensity for anxious or depressed individuals to respond to aversive situations with escape-based coping. Researchers may also consider priming other relevant concepts, such as danger versus safety, or emotional states, such as sadness versus happiness.

Conclusions

In sum, the results of our study provide additional documentation of the contextual dependency of measures of DI. Though most previous studies (Broman-Fulks et al., 2009; Maltby et al., 2005; Marsic et al., 2011) specifically report on issues with DI assessment stability in self-report measures, this study demonstrates that behavioral measures are also susceptible to state influences. We showed that even subtle conceptual/contextual cues, such as nine words hidden in sentences, significantly influenced behavioral measures of distress intolerance. This finding has implications for the assessment of DI; it reminds researchers that assessment is almost always context-specific. For example, simply answering a gender question on a demographics questionnaire has been shown to negatively impact females' performances on math tests (Jamieson & Harkins, 2012). Likewise, there is evidence of performance-enhancing prime effects as well (Bry et al., 2009; Shalev & Bargh, 2011; Shantz & Latham, 2011). Given that subtle, non-conscious cues affect performance, it is important that these considerations be integrated into assessment strategies (see Broman-Fulks et al., 2009; Marsic et al., 2011).

References

- Aarts H, Custers R, Wegner DM. On the inference of personal authorship: Enhancing experienced agency by priming effect information. *Consciousness and Cognition*. 2005; 14:439–458. [PubMed: 16091264]
- Abrantes AM, Strong DR, Lejuez CW, Kahler CW, Carpenter LL, Price LH, Brown RA. The role of negative affect in risk for early lapse among low distress tolerance smokers. *Addictive Behaviors*. 2008; 33:1394–1401. [PubMed: 18684569]
- Adams, K.; Kaiser, E.; Moss, N.; Cole, H.; Giesler, RB. Using Non-Conscious Priming to Alter Snack Choice; Paper presented at the Meeting of the Society of Behavioral Medicine; New Orleans, LA. Apr. 2012
- Anestis MD, Selby EA, Fink EL, Joiner TE. The multifaceted role of distress tolerance in dysregulated eating behaviors. *International Journal of Eating Disorders*. 2007; 40:718–726. [PubMed: 17868125]
- Bargh, JA. Auto-motives: Preconscious determinants of social interaction. In: Higgins, ET.; Sorrentino, RM., editors. *Handbook of Motivation and Cognition*. Vol. 2. Guilford Press; New York: 1990. p. 93-130.
- Bargh JA. What have we been priming all these years? On the development, mechanisms, and ecology of nonconscious social behavior. *European Journal of Social Psychology*. 2006; 36:147–168. [PubMed: 19844598]
- Bargh, JA.; Chartrand, TL. The mind in the middle: A practical guide to priming and automaticity research. In: Reis, H.; Judd, C., editors. *Handbook of Research Methods in Social Psychology*. Cambridge University Press; New York: 2000. p. 37-58.
- Bargh JA, Chen M, Burrows L. Automaticity of social behavior: direct effects of trait construct and stereotype-activation on action. *Journal of Personality and Social Psychology*. 1996; 71:230–244. [PubMed: 8765481]

- Bargh JA, Raymond P, Pryor JB, Strack F. Attractiveness of the underling: An automatic power→ sex association and its consequences for sexual harassment and aggression. *Journal of Personality and Social Psychology*. 1995; 68:768. [PubMed: 7776181]
- Beck KH, Daughters SB, Ali B. Hurried driving: Relationship to distress tolerance, driver anger, aggressive and risky driving in college students. *Accident Analysis & Prevention*. 2013; 51:51–55. [PubMed: 23182783]
- Bernstein A, Trafton J, Ilgen M, Zvolensky MJ. An evaluation of the role of smoking context on a biobehavioral index of distress tolerance. *Addictive Behaviors*. 2008; 33:1409–1415. [PubMed: 18657912]
- Bornoalova MA, Gratz KL, Daughters SB, Hunt ED, Lejuez CW. Initial RCT of a distress tolerance treatment for individuals with substance use disorders. *Drug and Alcohol Dependence*. 2012; 122:70–76. [PubMed: 21983476]
- Bornoalova MA, Matusiewicz A, Rojas E. Distress tolerance moderates the relationship between negative affect intensity with borderline personality disorder levels. *Comprehensive Psychiatry*. 2011; 52:744–753. [PubMed: 21257162]
- Branaghan RJ, Gray R. Nonconscious activation of an elderly stereotype and speed of driving. *Perceptual and Motor Skills*. 2010; 110:580–592. [PubMed: 20499567]
- Brandon TH, Herzog TA, Juliano LM, Irvin JE, Lazev AB, Simmons VN. Pretreatment task persistence predicts smoking cessation outcome. *Journal of Abnormal Psychology*. 2003; 112:448. [PubMed: 12943023]
- Broman-Fulks JJ, Berman ME, Martin HM, Marsic A, Harris JA. Phenomenon of declining anxiety sensitivity scores: a controlled investigation. *Depression and Anxiety*. 2009; 26:E1–9. [PubMed: 18956473]
- Broman-Fulks JJ, Storey KM. Evaluation of a brief aerobic exercise intervention for high anxiety sensitivity. *Anxiety, Stress, & Coping*. 2008; 21:117–128.
- Broman-Fulks JJ, Berman ME, Martin HM, Marsic A, Harris JA. Phenomenon of declining anxiety sensitivity scores: a controlled investigation. *Depression and Anxiety*. 2009; 26:E1–E9. [PubMed: 18956473]
- Brown RA, Lejuez CW, Kahler CW, Strong DR, Zvolensky MJ. Distress tolerance and early smoking lapse. *Clinical Psychology Review*. 2005; 25:713–733. [PubMed: 16023275]
- Bry C, Meyer T, Oberle D, Gherson T. Effect of priming cooperation or individualism on a collective and interdependent task: changeover speed in the 4 × 100-meter relay race. *Journal of Sport & Exercise Psychology*. 2009; 31:380–389. [PubMed: 19798999]
- Buckner JD, Keough ME, Schmidt NB. Problematic alcohol and cannabis use among young adults: the roles of depression and discomfort and distress tolerance. *Addictive Behaviors*. 2007; 32:1957–1963. [PubMed: 17258398]
- Daughters SB, Lejuez C, Bornoalova MA, Kahler CW, Strong DR, Brown RA. Distress tolerance as a predictor of early treatment dropout in a residential substance abuse treatment facility. *Journal of Abnormal Psychology*. 2005; 114:729. [PubMed: 16351393]
- Daughters SB, Sargeant MN, Bornoalova MA, Gratz KL, Lejuez CW. The relationship between distress tolerance and antisocial personality disorder among male inner-city treatment seeking substance users. *Journal of Personality Disorders*. 2008; 22:509–524. [PubMed: 18834298]
- Dennhardt AA, Murphy JG. Associations between depression, distress tolerance, delay discounting, and alcohol-related problems in European American and African American college students. *Psychology of Addictive Behaviors*. 2011; 25:595–604. [PubMed: 21988480]
- Dijksterhuis A, van Knippenberg A. The relation between perception and behavior, or how to win a game of trivial pursuit. *Journal of Personality and Social Psychology*. 1998; 74:865–877. [PubMed: 9569649]
- Fry RPW, Crisp AH, Beard RW. Patients' illness models in chronic pelvic pain. *Psychotherapy and Psychosomatics*. 1991; 55:158–163. [PubMed: 1891563]
- Gallagher MW, Payne LA, White KS, Shear KM, Woods SW, Gorman JM, Barlow DH. Mechanisms of change in cognitive behavioral therapy for panic disorder: The unique effects of self-efficacy and anxiety sensitivity. *Behaviour Research and Therapy*. 2013; 51:767–777. [PubMed: 24095901]

- Games PA. Data transformations, power, and skew: A rebuttal to Levine and Dunlap. *Psychological Bulletin*. 1984; 95:345–347.
- Harrington N. The frustration discomfort scale: Development and psychometric properties. *Clinical Psychology & Psychotherapy*. 2005; 12:374–387.
- Hearon BA, Quatromoni PA, Mascoop JL, Otto MW. The role of anxiety sensitivity in daily physical activity and eating behavior. *Eating Behaviors*. 2014; 15:255–258. [PubMed: 24854814]
- Iverson KM, Follette VM, Pistorello J, Fruzzetti AE. An investigation of experiential avoidance, emotion dysregulation, and distress tolerance in young adult outpatients with borderline personality disorder symptoms. *Personality Disorders: Theory, Research, and Treatment*. 2012; 3:415–422.
- Jain U, Blais MA, Otto MW, Hirshfeld DR, Sachs GS. Five-factor personality traits in patients with seasonal depression: treatment effects and comparisons with bipolar patients. *Journal of Affective Disorders*. 1999; 55:51–54. [PubMed: 10512606]
- Jamieson JP, Harkins SG. Distinguishing between the effects of stereotype priming and stereotype threat on math performance. *Group Processes & Intergroup Relations*. 2012; 15:291–304.
- Johnson K, Mullin JL, Marshall EC, Bonn-Miller MO, Zvolensky M. Exploring the mediational role of coping motives for marijuana use in terms of the relation between anxiety sensitivity and marijuana dependence. *The American Journal on Addictions*. 2010; 19:277–282. [PubMed: 20525036]
- Kaiser AJ, Milich R, Lynam DR, Charnigo RJ. Negative urgency, distress tolerance, and substance abuse among college students. *Addictive Behaviors*. 2012; 37:1075–1083. [PubMed: 22698894]
- Kozak AT, Fought A. Beyond alcohol and drug addiction. Does the negative trait of low distress tolerance have an association with overeating. *Appetite*. 2011; 57:578–581. [PubMed: 21801773]
- Leyro TM, Zvolensky MJ, Bernstein A. Distress tolerance and psychopathological symptoms and disorders: a review of the empirical literature among adults. *Psychological Bulletin*. 2010; 136:576–600. [PubMed: 20565169]
- MacPherson L, Reynolds EK, Daughters SB, Wang F, Cassidy J, Mayes LC, Lejuez CW. Positive and negative reinforcement underlying risk behavior in early adolescents. *Prevention Science*. 2010; 11:331–342. [PubMed: 20309633]
- Maltby N, Mayers MF, Allen GJ, Tolin DF. Anxiety sensitivity: Stability in prospective research. *Journal of Anxiety Disorders*. 2005; 19:708–716. [PubMed: 15927783]
- Marsic A, Broman-Fulks JJ, Berman ME. The effects of measurement frequency and timing on anxiety sensitivity scores. *Cognitive Therapy and Research*. 2011; 35:463–468.
- Matthews KA, Stoney CM. Influences of sex and age on cardiovascular responses during stress. *Psychosomatic Medicine*. 1988; 50:46–56. [PubMed: 3344302]
- McHugh RK, Daughters SB, Lejuez CW, Murray HW, Hearon BA, Gorka SM, Otto MW. Shared variance among self-report and behavioral measures of distress intolerance. *Cognitive Therapy and Research*. 2011; 35:266–275. [PubMed: 23894216]
- McHugh RK, Otto MW. Domain-general and domain-specific strategies for the assessment of distress intolerance. *Psychology of Addictive Behaviors*. 2011; 25:745–749. [PubMed: 21823763]
- McHugh RK, Otto MW. Profiles of distress intolerance in a substance-dependent sample. *The American Journal of Drug and Alcohol Abuse*. 2012a; 38:161–165. [PubMed: 22185368]
- McHugh RK, Otto MW. Refining the measurement of distress intolerance. *Behavior Therapy*. 2012b; 43:641–651. [PubMed: 22697451]
- McHugh RK, Reynolds EK, Leyro TM, Otto MW. An Examination of the Association of Distress Intolerance and Emotion Regulation with Avoidance. *Cognitive Therapy and Research*. 2013; 37:363–367.
- Norr AM, Allan NP, Macatee RJ, Keough ME, Schmidt NB. The effects of an anxiety sensitivity intervention on anxiety, depression, and worry: mediation through affect tolerances. *Behaviour Research and Therapy*. 2014; 59:12–19. [PubMed: 24949907]
- Otto MW, Pollack MH, Fava M, Uccello R, Rosenbaum JF. Elevated anxiety sensitivity index scores in patients with major depression: Correlates and changes with antidepressant treatment. *Journal of Anxiety Disorders*. 1995; 9:117–123.

- Peterson, R.A.; Reiss, S. Anxiety Sensitivity Index manual. 2nd. International Diagnostic Systems; Worthington, OH: 1992.
- Roberts T, Gettman JY. Mere exposure: Gender differences in the negative effects of priming a state of self-objectification. *Sex Roles*. 2004; 51:17–27.
- Sargeant MN, Daughters SB, Curtin JJ, Schuster R, Lejuez CW. Unique roles of antisocial personality disorder and psychopathic traits in distress tolerance. *Journal of Abnormal Psychology*. 2011; 120:987–992. [PubMed: 21668082]
- Schmidt NB, Eggleston AM, Woolaway-Bickel K, Fitzpatrick KK, Vasey MW, Richey JA. Anxiety Sensitivity Amelioration Training (ASAT): A longitudinal primary prevention program targeting cognitive vulnerability. *Journal of Anxiety Disorders*. 2007; 21:302–319. [PubMed: 16889931]
- Schmidt NB, Richey JA, Cromer KR, Buckner JD. Discomfort intolerance: evaluation of a potential risk factor for anxiety psychopathology. *Behavior Therapy*. 2007; 38:247–255. [PubMed: 17697850]
- Schmidt NB, Richey JA, Fitzpatrick KK. Discomfort intolerance: Development of a construct and measure relevant to panic disorder. *Journal of Anxiety Disorders*. 2006; 20:263–280. [PubMed: 16564432]
- Shalev I, Bargh JA. Use of priming-based interventions to facilitate psychological health: Commentary on Kazdin and Blase (2011). *Perspectives on Psychological Science*. 2011; 6:488–492. [PubMed: 26168201]
- Shantz A, Latham G. The effect of primed goals on employee performance: Implications for human resource management. *Human Resource Management*. 2011; 50:289–299.
- Shear MK, Houck P, Greeno C, Masters S. Emotion-focused psychotherapy for patients with panic disorder. *American Journal of Psychiatry*. 2001; 158:1993–1998. [PubMed: 11729015]
- Simons JS, Gaher RM. The Distress Tolerance Scale: Development and validation of a self-report measure. *Motivation and Emotion*. 2005; 29:83–102.
- Smits JA, Berry AC, Tart CD, Powers MB. The efficacy of cognitive-behavioral interventions for reducing anxiety sensitivity: A meta-analytic review. *Behaviour Research and Therapy*. 2008; 46:1047–1054. [PubMed: 18687421]
- Smits JA, Powers MB, Cho Y, Telch MJ. Mechanism of change in cognitive-behavioral treatment of panic disorder: evidence for the fear of fear mediational hypothesis. *Journal of Consulting and Clinical Psychology*. 2004; 72:646. [PubMed: 15301649]
- Srull TK, Wyer RS. The role of category accessibility in the interpretation of information about persons: Some determinants and implications. *Journal of Personality and Social Psychology*. 1979; 37:1660–1672.
- Strong, DR.; Lejuez, CW.; Daughters, SB.; Marinello, M.; Kahler, CW.; Brown, RA. The computerized mirror tracing task version 1. 2003. Unpublished manuscript
- Telch MJ, Harrington PJ, Smits JA, Powers MB. Unexpected arousal, anxiety sensitivity, and their interaction on CO₂-induced panic: Further evidence for the context-sensitivity vulnerability model. *Journal of Anxiety Disorders*. 2011; 25:645–653. [PubMed: 21474277]
- Telch MJ, Smits JA, Brown M, Dement M, Powers MB, Lee H, Pai A. Effects of threat context and cardiac sensitivity on fear responding to a 35% CO₂ challenge: a test of the context-sensitivity panic vulnerability model. *Journal of Behavior Therapy and Experimental Psychiatry*. 2010; 41:365–372. [PubMed: 20430368]
- Tousignant-Laflamme Y, Page S, Goffaux P, Marchand S. An experimental model to measure excitatory and inhibitory pain mechanisms in humans. *Brain Research*. 2008; 1230:73–79. [PubMed: 18652808]
- Tull MT, Gratz KL, Coffey SF, Weiss NH, McDermott MJ. Examining the interactive effect of posttraumatic stress disorder, distress tolerance, and gender on residential substance use disorder treatment retention. *Psychology of Addictive Behaviors*. 2012; 27:763–773. [PubMed: 22946858]
- Turk DC. The role of psychological factors in chronic pain. *Acta Anaesthesiologica Scandinavica*. 1999; 43:885–888. [PubMed: 10522734]
- Turner JA, Jensen MP, Warms CA, Cardenas DD. Catastrophizing is associated with pain intensity, psychological distress, and pain-related disability among individuals with chronic pain after spinal cord injury. *Pain*. 2002; 98:127–134. [PubMed: 12098624]

- Tutoo DN. Psychodiagnostic applications of the mirror tracing test. *Indian Educational Review*. 1971; 6:293–303.
- Zvolensky MJ, Baker KM, Leen-Feldner E, Bonn-Miller MO, Feldner MT, Brown RA. Anxiety sensitivity: association with intensity of retrospectively-rated smoking-related withdrawal symptoms and motivation to quit. *Cognitive Behaviour Therapy*. 2004; 33:114–125. [PubMed: 15471381]

Table 1

Demographic characteristics and outcome measures

Variable	Interminability (n = 26) n (%) / mean (SD)	Brevity (n = 26) n (%) / mean (SD)
Age	18.92 (1.38)	18.62 (0.85)
Gender (females)	19 (73%)	19 (73%)
Race		
Caucasian	16 (62%)	16 (62%)
Asian	10 (38%)	8 (31%)
African American	0 (0%)	2 (7%)
Ethnicity		
Non-Hispanic	25 (96%)	26 (100%)
Hispanic	1 (4%)	0 (0%)
DII total score	11.38 (7.25)	8.73 (6.71)
Time to discontinue cold pressor (in seconds)	79.70 (17.90)*	55.80 (29.96)*
Time to discontinue mirror tracing (in seconds)	272.82 (142.33)	228.51 (126.24)

Note. DII: Distress Intolerance Index

* Significant difference between groups ($p < .05$)

Table 2

Summary of hierarchical regression analysis for variables predicting behavioral persistence on coil-pressor task (N = 52)

Variable	B	SE(B)	β	t
Step 1				
DII Total	-1.11	0.48	-0.29	-2.32*
Priming Condition	26.86	6.69	0.50	4.02**
Step 2				
DII Total	-1.17	0.47	-0.30	-2.48*
Priming Condition	27.02	6.58	0.50	4.11**
DII $\times$ Priming Condition	0.77	0.47	0.19	1.62

Note. DII: Distress Intolerance Index

*
p < .05

**
p < .01

Table 3

Summary of hierarchical regression analysis for variables predicting behavioral persistence on mirror-tracing task (N = 52)

Variable	B	SE(B)	β	t
Step 1				
DM Total	-3.25	2.71	-0.17	-1.20
Priming Condition	52.94	37.84	0.20	1.40
Step 2				
DII Total	-3.00	2.70	-0.16	-1.10
Priming Condition	52.18	37.53	0.20	1.39
DII $\times$ Priming Condition	-3.66	2.70	-0.19	-1.36

Note. DII: Distress Intolerance Index, * $p < .05$, ** $p < .01$