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Evaluation of Behavioral Distress Tolerance Task Stability Across Settings

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EVALUATION OF BEHAVIORAL DISTRESS TOLERANCE TASK STABILITY ACROSS SETTINGS

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at Virginia Commonwealth University.

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Distress tolerance (DT) is considered to be a trait-like factor encompassing an individual's behavioral and/or perceived ability to withstand negative affective states. Behavioral measures of DT are being increasingly utilized, however, these tasks have been implemented in studies prior to thoroughly establishing the psychometric properties. The present study aimed to evaluate the reliability of two DT behavioral tasks (Breath-Holding Task [BHT], computer-based Paced Auditory Serial Addition Task [PASAT-C]) in different settings (laboratory, online) among a sample of college students. Participants completed the tasks during two sessions, approximately one week apart. 52 participants were in the laboratory condition, and 65 were in the online condition. There were three main findings: a) test-retest reliability estimates were within acceptable ranges for both the BHT and PASAT-C, b) BHT performance differed significantly by modality while PASAT-C performance did not, c) number of distractors endorsed was not significantly associated with quit latency on either task.

Evaluation of Behavioral Distress Tolerance Task Stability Across Settings

Distress Tolerance and Methods of Measurement

Distress tolerance (DT) is conceptualized as the behavioral or perceived capacity to tolerate negative internal states and has been shown to account for some individual differences in the appraisal of psychological discomfort (Simons & Gaher, 2005). Specifically, it is believed to be trait-like in nature with high levels exerting a protective influence and low levels acting as a risk factor associated with maladaptive coping skills, increasing vulnerability to psychopathology (Lynch & Bronner, 2006; Zvolensky & Otto, 2007). Recognizing the extent of potential impact on psychopathology symptomology, continued research regarding DT could provide insight into underlying mechanisms associated with the development and maintenance of psychological disorders, particularly anxiety disorders wherein heightened and distressing emotions are hallmark symptoms of the conditions. Affective DT is viewed to impact multiple levels of anticipation and experience of negative emotions, potentially influencing the perceived intensity and aversiveness of negative emotional states, including (a) tolerability; (b) assessment and acceptability of emotional states; (c) allocation of attentional resources and disruption of functioning caused by negative emotions; and (d) regulation strategies and resulting actions to avoid or minimize distress (Simons & Gaher, 2005).

Although the most commonly studied form of DT is centered on affective tolerance, the construct is thought to be multi-faceted in nature consisting of two conceptually distinct forms subsumed under the umbrella of DT (i.e., affective and behavioral). Affective DT is believed to tap into the perceived ability to tolerate negative internal states. Conversely, behavioral DT refers to an individual's behavioral demonstration of ability to withstand distress elicited by a stressor (Zvolensky et al., 2010). Several methods of assessment exist aimed at measuring each

of these facets. DT self-report measures have been developed to specifically tap into the beliefs and perceptions concerning ability to withstand negative or aversive states held by individuals (Leyro, Bernstein, Vujanovic, McLeish, & Zvolensky, 2011). These measures are intended to assess the stable, trait-like nature of perceived DT and has fallen under many labels (e.g., discomfort intolerance, intolerance of uncertainty, tolerance of ambiguity). Discomfort intolerance is operationalized as the capacity to tolerate uncomfortable physical sensations (Schmidt & Lerew, 1998). Intolerance of uncertainty concerns an individual's perceived inability to experience vaguely defined events and situations (Buhr & Dugas, 2002). Tolerance of ambiguity refers to how situation or stimulus information is processed when it is vague or foreign in nature (Furnham & Ribchester, 1995). Each of these self-report DT measures have demonstrated good test-retest reliability (e.g., Distress Tolerance Scale intra-class r = .61 over a 6 month interval [Simons & Gaher, 2005], Measure of Ambiguity Tolerance Scale r = .63 (Sütterlin et al., 2013)), suggesting a reasonable level of temporal stability. Although each of these self-report measures is thought to assess the broad affective DT construct, only modest correlations between the measures have been identified (r = -.31 between Distress Tolerance Scale and Discomfort Intolerance Scale [(Marshall-Berenz, Vujanovic, Bonn-Miller, Bernstein, & Zvolensky, 2010)], r = -.25 between Distress Tolerance Scale and Discomfort Intolerance Scale [(Howell, Leyro, Hogan, Buckner, & Zvolensky, 2010; McHugh & Otto, 2011)]). Thus, it is unclear whether these measures are tapping into a common DT latent factor, or if they are assessing unique facets of DT.

Behavioral measures have also been utilized to assess the behavioral facet of the construct. Theory underlying DT suggests that the use of a behavioral paradigm to elicit a significant stress response and an individual's ability to tolerate the resulting distress, usually

quantified as the persistence on a task despite the experience of stress, may provide an index of behavioral DT (Zvolensky, Vujanovic, Bernstein, & Leyro, 2010). Use of behavioral tasks to asses DT allow for objective measurement of outcomes beyond that possible through use of self-report measures, however, the degree to which other variables,(e.g., motivation and experimental demand characteristics) may also influence performance remains unknown (Simons & Gaher, 2005).

The extant literature suggests that an individual's perceived ability to tolerate distress as assessed via self-report measures may differ significantly from behavioral demonstrations of one's ability to withstand distress. Specifically, self-report DT measures have been found to be modestly correlated with one another, and behavioral measures have been found to be modestly correlated with one another, but a lack of significant correlation between the two assessment methods has been demonstrated (McHugh & Otto, 2011). These findings may support the theory that the two forms of DT are conceptually distinct or suggest that the different methods of assessment are tapping into different constructs altogether. Given these differences based on measurement method enlisted, use of multi-method assessment of DT has been emphasized encompassing the theorized two dimensions of the DT construct (i.e., affective and behavioral). However, Zvolensky and colleagues (Zvolensky, et al., 2010) additionally state that changes in the theoretical understanding of the construct may be necessary as each facet may represent similar yet conceptually distinct latent factors. Therefore, although DT may pose as a potential mechanism contributing to individual differences in psychopathology, significant uncertainty regarding the conceptualization of the construct remains and warrants further clarification (Bardeen, Fergus, & Orcutt, 2013). Furthermore, it is an open question as to where DT fits in relation to other conceptually related factors.

DT and Theoretically Relevant Variables

Not unlike other related domains in the field of psychology (e.g., stress, coping), the empirical and theoretical literature on DT has struggled with how to best conceptualize this construct within the broad landscape of the field. The current state of the science generally categorizes DT as falling under the umbrella of emotion regulation, which refers to methods of influence relating to the experience and expression of emotions, as well as the times in which emotions occur (Amstadter, 2008; Rottenberg & Gross, 2003). Furthermore, emotion regulation is thought to be a continuum accounting for varying levels of experience and expression of positive and negative emotions (Walden & Smith, 1997). Failure to enlist appropriate regulation techniques would result in emotion dysregulation which encompasses difficulties in emotional functioning and control including issues in affective regulation and control over behaviors resulting from emotional states (Gross, 1998; Mennin, 2004). Perceptions regarding high intensity of emotional states paired with poor emotional understanding and discomfort in emotional situations may result in maladaptive methods of coping with aversive states (Mennin, 2004). It has been posited that deficits in DT would fall under the broad category of emotion dysregulation as one of many components rather than as an entirely separate construct (Leyro, Bernstein, Vujanovic, McLeish, & Zvolensky, 2011). In this way, low levels of DT may factor into the perceptions of increased aversive emotional state intensity and negative appraisal in turn contributing to the use of avoidant or escape coping strategies. Further research is necessary to determine if and how DT contributes to models of emotion dysregulation.

Numerous other factors are also categorized under emotion regulation as the nomological net of emotion regulation/dysregulation is considered to be quite broad (Amstadter, 2008; Gross & John, 2003). As such, these theoretically related variables will be introduced briefly here and

discussed in comparison with DT. These potentially imbricating variables include experiential avoidance and anxiety sensitivity. However, theoretical distinctions have been made between the associated variables with each uniquely contributing to psychopathology (Zvolensky, Bernstein, & Vujanovic, 2011)

Experiential avoidance (i.e., reactions attempting to alter negative emotion states and the situations in which they occur; Hayes et al., 1999) and DT are frequently considered to be overlapping constructs. Inability to tolerate negative affective states may influence reactions to negative stimuli contributing to maladaptive coping strategies such as efforts to avoid (e.g., disengagement coping) (Zvolensky, Bernstein, et al., 2011). Conversely, experiential avoidance could significantly contribute to how distress is tolerated with the implementation of avoidance strategies affecting the degree of DT experienced in response to internal states believed to be unbearable (Leyro, et al., 2011). DT processes may involve effortful attempts to inhibit negative emotional states, which may overlap with the avoidance strategy of emotional suppression or the conscious attempts to inhibit aversive states (Gross, 1998). Further examination is necessary to identify whether DT is a specific type of experiential avoidance.

DT is also related to anxiety sensitivity, defined as the fear of bodily sensations associated with anxiety provoking stimuli (Reiss, Peterson, Gursky, & McNally, 1986). Anxiety sensitivity is frequently assessed in studies focusing on panic disorder and panic symptoms (McNally, 2002). Although internal assessment of emotional responses is a core feature of each concept, a clear distinction can be made in that DT does not apply to strong aversion to bodily sensations associated with anxiety. DT and anxiety sensitivity appear to be inversely related, with levels of anxiety sensitivity increasing as DT decreases and each construct seems to address different aspects of emotion regulation (Keough, Riccardi, Timpano, Mitchell, & Schmidt,

2010). Increased attention has been placed on the examination of the potential phenotype of low DT and high anxiety sensitivity in relation to psychopathology, specifically in substance abuse (Zvolensky et al., 2009). Research indicates that both DT and anxiety sensitivity are implicated in motives for alcohol and substance use but affect separate pathways, with anxiety sensitivity having a greater impact on conformity motives and DT demonstrating increased influence on coping motives (Howell, Leyro, Hogan, Buckner, & Zvolensky, 2010). The extant literature on the relationship between AS and DT has relied heavily on self-report of DT variables which would be a strength of the proposed study in that behavioral DT would be assessed in relation to AS.

In sum, the umbrella of emotion regulation/dysregulation is quite broad and encompasses many constructs that have demonstrated relationships with psychopathology, including DT. Although uncertainty surrounds DT and conceptually relevant variables regarding the extent to which they overlap with one another, each possess discrete characteristics and more research is necessary to adequately determine the boundaries of each construct. Recognizing these boundaries would play an important role in evaluating the unique and shared contributions these factors provide to the etiology and maintenance of psychopathology (Leyro, et al., 2011).

Distress Tolerance and Psychopathology

It is posited that the affective processes of emotion regulation are attributable, in part, to negative reinforcement in that it drives an individual to utilize emotion regulation techniques to alter their current affective state. Methods of withdrawal provide momentary relief from distress and act as negative reinforcers that maintain dysregulatory techniques (Thompson et al., 2012). Stemming from negative reinforcement theory whereby actions of avoidance and escape are core motivations for behavior in the presence of negative stimuli (Daughters et al., 2009), individuals

exhibiting low levels of DT would theoretically perceive negative internal states as overwhelming and unbearable with such negative evaluation extending to overall perceptions of coping abilities. Moreover, concerns regarding inability to withstand distress and poor emotional appraisal would contribute to avoidant behaviors and/or maladaptive means of alleviating negative emotions. If efforts of alleviation are unsuccessful, individuals with low DT would be characterized by significant disruption in functioning as attentional resources are consumed by distressing stimuli (Simons & Gaher, 2005).

DT is best conceptualized under the negative reinforcement model, which implicates attempts to escape and avoid as core motivations driving behavior in the presence of aversive emotional states (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004; Metcalfe & Mischel, 1999). This drive to escape and avoid leads DT and other conceptually relevant variables to be frequently associated with deficits in affect, emotion, and stress regulation (Vujanovic, Bonn-Miller, Potter, Marshall, & Zvolensky, 2011). Following, deficits in DT have been implicated in various forms of psychopathology symptomology including externalizing (e.g., substance use) and internalizing disorders (e.g., depression) (Daughters, et al., 2009). Specifically, low levels of DT have been associated with borderline personality disorder (Bornovalova, Matusiewicz, & Rojas, 2011), self-harm (Slee, Garnefski, Spinhoven, & Arensman, 2008), eating disorders (Hambrook et al., 2011), and obsessive-compulsive disorder (Cougle, Timpano, Sarawgi, Smith, & Fitch, 2012). DT has additionally been shown to be significantly associated with alcohol use, potentially as a means of coping (Vujanovic, et al., 2011). Previous research has noted that inability to withstand negative affective states associated with depression may contribute to the use of alcohol as a coping mechanism, which would potentially lead to a pattern of reliance and eventual abuse and dependence (Gorka, Ali, & Daughters, 2012; Kassel, Jackson, & Unrod,

2000). Moreover, low DT levels may be particularly relevant in the study of anxiety as enhanced sensitivity to anxiety provoking stimuli and inability to tolerate heightened levels of resulting distress may contribute significantly to the etiology of many anxiety disorders and maladaptive coping behaviors and thus will be the focus of the present study (Bernstein et al., 2010).

The relationship between low levels of DT and anxiety symptoms has received increased attention, aimed at elucidation of how DT contributes as a risk and/or maintenance factor in the development of anxiety disorders. Individuals low in DT are thought to be more susceptible to anxiety-related problems due to their perception that anxiety symptoms are overwhelming and uncontrollable (Keough, et al., 2010). Keough et al. (2010) noted that low DT was associated with increased vulnerability to symptoms of panic, generalized anxiety, social anxiety, and obsessive-compulsive anxiety. Additional research has demonstrated a link between DT and panic symptoms, with panic attacks during a first hyperventilation challenge significantly predicting decreased behavioral DT, defined as latency to termination of a second hyperventilation challenge, above and beyond baseline levels of self-reported DT (Marshall et al., 2008). This study provided further support that inability to tolerate stressful states is related to the presence and severity of anxiety symptoms and that panic processes and DT may exert bidirectional influences on one another. Additionally, associations have been made between DT and various internalizing disorders. Daughters et al. (2009) noted that girls with behaviorally determined low levels of DT were more likely to endorse internalizing symptoms than those exhibiting high levels of DT.

The relationship between DT and posttraumatic disorder (PTSD) symptoms of re-experiencing (e.g., intrusive thoughts), avoidance (e.g., attempts to avoid thoughts related to the traumatic experience) and hyperarousal (e.g., hypervigilence) has become a topic of heightened

attention over the past several years. Vujanovic et al. (2011) found that individuals demonstrating deficits in DT were more likely to report PTSD symptoms at higher levels, particularly symptoms within the hyperarousal cluster. These results indicate that perceptions regarding ability to tolerate negative emotional states may be associated with the experience of hyperarousal symptoms but additional research is necessary to elucidate this connection. Further evidence suggests that perceived (i.e., self-reported) distress intolerance may be more relevant to PTSD symptom expression than behavioral DT. After controlling for the variance explained by other factors, including number of traumatic life events, neuroticism, sex, and the shared variance accounted for by the other DT measures, perceived DT derived from the self-report Distress Tolerance Scale (Simons & Gaher, 2005) was shown to be significantly inversely associated with severity of PTSD symptoms while a significant effect was not noted in the behavioral means of measurement (Marshall-Berenz, et al., 2010). Perception of low DT may influence the use of maladaptive coping strategies (e.g., avoidance) following trauma exposure, potentially contributing to increased PTSD symptom severity.

Limitations in DT Measurement

Recognition of DT as an important factor in the development of psychopathology has led to increased interest in methodologies to measure DT. Although self-report measures were the original means of quantifying levels of DT, there were inherent limitations in these forms of assessment. Lack of objectivity related to reporting biases created the need for more objective measurement of DT (Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005; Kline, Sulsky, & Rever-Moriyama, 2000). Previous research regarding method variance, defined as variance attributable to errors associated with measurement method rather than the variable being measured (Bagozzi & Yi, 1991) has noted distinct effects of method biases such as social

desirability and transient mood states (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). An individual's desire to respond in ways perceived to be socially appropriate and impact of confounding factors outside the individual's normative realm of daily events (e.g., argument with family member, generally bad day) may create significant errors in self-report responding (Podsakoff, et al., 2003). Although many limitations exist in standard self-report, the measures do provide a valuable means of assessing perceived DT levels or how much distress an individual felt could be withstood.

Recognizing the many facets of DT, strides have been made to adequately quantify one's level of DT from a behavioral rather than a self-report paradigm. To overcome biases associated with subjective means of assessment, behavioral methods have been enlisted to address behavioral levels of DT via translational and experimental assessment. The use of behavioral tasks within laboratory settings provides an analog test of escape/avoidance behavior under distressing conditions and allows for direct demonstration of an individual's DT levels (MacPherson, Stipelman, Duplinsky, Brown, & Lejuez, 2008). Computerized behavioral tasks of significant difficulty, such as the Paced Auditory Serial Addition Task (PASAT-C; Lejuez, Kahler, & Brown, 2003) and Mirror Tracing Persistence Task (MTPT-C; Strong et al., 2003), have been incorporated into the study of behavioral ability to tolerate distress. As these tasks progress and increase in difficulty, the participant is given the option to discontinue and time spent completing the task is used as a behavioral marker of DT. Results on the PASAT-C and MTPT-C have been related to prior smoking quit attempt abstinence (Daughters, Lejuez, Kahler, Strong, & Brown, 2005) and has predicted sustained abstinence after controlling for smoking severity, respectively (Brandon et al., 2003).

The Paced Auditory Serial Addition Task (PASAT) was originally developed to assess information-processing capacity (Gronwall, 1977), yet as the frustration and aversiveness experienced by patients became more apparent (Aupperle, Beatty, Shelton, & Gontkovsky, 2002; Diehr et al., 2003; Holdwick & Wingenfeld, 1999), the task began being utilized as a method of inducing psychological distress (Lejuez, et al., 2003). Previous research has demonstrated high test-retest reliability coefficients for the original PASAT audio recording version with intervals ranging from seven days to three months (α=.90-.97; McCaffrey & Westervelt, 1995; Schachinger, Cox, Linder, Brody, & Keller, 2003; Sjogren, Thomsen, & Olsen, 2000; Stuss et al., 1989). A computerized version of the PASAT later became available allowing for random presentation of numbers (ForThought, 1993/1996). The performance on the computerized version was found comparable to previous normative data collected utilizing the audio versions of the PASAT (e.g., number of correct responses, errors, no responses) suggesting that the computerized version could be considered as an alternative method (Wingenfeld, Holdwick, Davis, & Hunter, 1999). A thorough examination of the psychometric properties including the test-retest reliability of the PASAT-C has not been performed. Given that the test-retest for the original to the audio version were quite high, paired with the knowledge of comparability between the audio and computerized versions, leads to so hypothesize that the reliability will be comparable for the PASAT-C.

As the PASAT-C assesses an individual's ability to tolerate affective distress, the Breath Holding Task (BHT) taps into the more physical domain of DT (i.e., ability to tolerate distress discomfort and pain). In this task participants are asked to "hold your breath for *as long as possible*" across two trials and thus provides a means of assessing the degree to which an individual will withstand physical discomfort and associated distress (Hajek, Belcher, &

Stapleton, 1987). BH duration has been frequently used to examine the role of DT in smoking relapse (Brown, Lejuez, Kahler, & Strong, 2002; 2005; Brown et al., 2009; Howell, et al., 2010) and has been found to be a significant factor associated with earlier smoking lapse. Brown et al., (2009) also noted that although BH duration was found to significantly predict smoking relapse, PASAT-C performance did not further highlighting the potential differences between affective and physical DT. The BHT was not correlated with age, years of education, or smoking variables (i.e., number of cigarettes smoked per day, number of years as regular smoker), however, gender was significantly correlated with quit latency with males persisting longer than females (Brown et al., 2009). Moreover, individual differences associated with lung capacity may also influence BH duration, further highlighting the need for multi-method assessment including multiple physical behavioral DT tasks during future examination of the construct (Marshall-Berenz, et al., 2010). Much like other measures of behavioral DT, limited work has been done to examine the test-retest reliability of the BHT. Only one study to date has examined the test-retest reliability of the BHT, finding a high test-retest reliability ($r = .67$, $p < .001$) when examined across a one-year time period (Sütterlin, et al., 2013). However, time spans of shorter duration have not been examined.

Such behavioral methodologies have garnered widespread use in DT assessment (Leyro, et al., 2011) yet continued research regarding the validity and reliability of such assessment is necessary. Concerns exist regarding whether behavioral tasks measuring DT actually measure the same intended construct as self-report assessments of DT. Previous research has noted significant relationships among self-report measures of DT and among behavioral measures of DT, but not between the two modalities (Anestis et al., 2012; Marshall-Berenz, et al., 2010; McHugh et al., 2011). It has been hypothesized that the two means of assessment are measuring

two distinct aspects of DT. Examining the nature of self-report (perceived DT) and behavioral measures may provide insight into how these constructs may contribute to the etiology and maintenance of psychopathology.

Multiple investigations have demonstrated an increase in negative affect associated with completion of behavioral tasks of distress tolerance (e.g., PASAT-C, MTPT-C, BIRD; Bornovalova et al., 2008; Brown, et al., 2002; Daughters, et al., 2009), raising questions as to whether the tasks are merely measures of negative affect rather than DT. Although increased levels of negative affect were consistent across participants suggesting tasks evaluating distress tolerance were effective in eliciting distress, persistence on such tasks was not predicted by the amount of negative affect experienced. (McHugh & Otto, 2011) noted that self reported distress levels associated with performance on two DT behavioral tasks were uncorrelated with persistence on each of the tasks, which was used as an index of distress tolerance. Amstadter and colleagues (Amstadter et al., 2012) also demonstrated that low levels of persistence on a computerized task assessing distress tolerance were not indicative of higher negative affect levels. Specifically, no relationship was observed between change in distress ratings obtained pre and post task and task termination. Furthermore, negative affect was unrelated to time to quite the PASAT-C in a study examining the relationship between distress tolerance and failure to complete a smoking cessation program following completion of an initial intake assessment/screening (MacPherson, Stipelman, Duplinsky, Brown, & Lejuez, 2008). These findings give credence to the distress tolerance construct as a separate entity from negative affect.

Evaluation of DT in Different Settings

As behavioral methodologies are increasingly utilized in the study of DT, additional research is required to evaluate the reliability of behavioral DT tasks conducted in different settings, particularly in home environments. As computerized assessment in home environments becomes a more common and efficient method of data collection (Riva, Teruzzi, & Anolli, 2003b; Strecher, 2007), evaluating the psychometric properties of home administration in relation to the laboratory method traditionally utilized is of increasing importance. Computerized assessment allows for the administration of measures in different locations providing convenience and anonymity for participants and creating more opportunity to gather data. Although increased efficiency on both sides of the research process may be associated with such assessment, there are weaknesses associated with potentially confounding environmental variables (Epstein & Klinkenberg, 2001). Such confounds (e.g., noise level, speaking on phone while performing the task, interruptions caused by friends/roommates) could have a significant impact on the reliability between measurements taken within different settings, diminishing inter-method consistency. To date, a comparison of the home and laboratory methods has not been conducted, and the reliability of behavioral DT assessments via in different settings-administration has yet to be established. This gap in the DT literature establishes the need for checklist development outlining possible environmental variables that may influence behavioral DT performance.

With increased interest in the utility of the Internet as a research tool, significant research has been conducted concerning the comparability of computerized measures to those presented in a more traditional pencil-paper format (Naus, Philipp, & Samsi, 2009). Researchers cite a variety of benefits associated with computer-based administrations, including standardized presentation of surveys, ease of data storage and analysis, and general participant preference for computerized

versions of measures (Davis & Cowles, 1989; Lukin, Dowd, Plake, & Kraft, 1985). Although the potential advantages are apparent, certain concerns still remain regarding the equivalency of administration types, suggesting that the comparability of formats cannot be assumed (Buchanan, 2003). Potential discrepancies include limited experimental control and differences that may exist between various computer systems, for example, monitor brightness and system sound level (Riva, Teruzzi, & Anolli, 2003a). Although concern exists that differences associated with administration modality may have a significant impact on the psychometric properties of measures, previous studies have noted high correlations between performance on conventional methods and computerized versions highlighting the viability of online versions as an alternative to pencil-paper methods (Basnov, Kongsved, Bech, & Hjollund, 2009; Campos, Zucoloto, Bonafe, Jordani, & Maroco, 2011; Davis & Cowles, 1989; Davis & Wood, 1999; Hirai, Vernon, Clum, & Skidmore, 2011; King & Miles, 1995; Wilson, Becker, & Tinker, 1995). Examination of equivalence across modalities in different settings, laboratory and natural home environments, also provides further support for inclusion of research conducted online and within the home (Fortson, Scotti, Ben, & Chen, 2006; Vallejo, Jordan, Diaz, Comeche, & Ortega, 2007; Weigold, Weigold, & Russell, 2013).

In two studies conducted by (Ryan, Wilde, & Crist, 2013) the comparability of computerized laboratory and online home versions of a task asking participants to rate disgust and levels of fear associated with insect images were evaluated. Each study displayed main effects of gender, frighteningness, and disgustingness. Additionally, both groups responded similarly with females providing higher hostility ratings (Study 1: $M = 7.40$, $SE = .17$; Study 2: $M = 7.40$, $SE = .17$) than males (Study 1: $M = 6.21$, $SE = .33$; Study 2: $M = 6.21$, $SE = .33$). The insects deemed high frightening based on previous studies received higher hostility ratings (Study 1: $M = 7.17$, $SE =$

.19; Study 2: *M* = 6.83, *SE* = .08) than those deemed low frightening (Study 1: *M* = 6.44, *SE* = .26; Study 2: *M* = 6.34, *SE* = .08). Finally, insects identified as high disgusting received higher hostility ratings (Study 1: *M* = 7.21, *SE* = .18; Study 2: *M* = 7.15, *SE* = .07) than those considered low disgusting (Study 1 - *M* = 6.40, *SE* = .25; Study 2 - *M* = 6.02, *SE* = .08; Ryan, et al., 2013). No interaction effects were present in the first laboratory study but they were present for the second online study, which (Ryan, et al., 2013) attributed to the larger sample size possible by incorporating online resources. The data suggests that although minimal differences may exist associated with mode of administration, the benefits of online research and potentially greater power may outweigh any variance. Additional research concerning associative learning within a laboratory and home setting demonstrated a main effect of location that did not reach statistical significance, *F* (1, 93) = 3.45, *MSE* = 0.03, *p* = .07, further supporting the similarities between methods of administration (Vadillo & Matute, 2009). Although the literature suggests that behavioral tasks administered within the home setting are a potentially viable method of data collection, more research is necessary to assess the psychometric properties of specific behavioral tasks prior to implementation in study protocols.

Study Overview

Given the gaps within the existing literature on DT, the present study assessed the test-retest reliability of DT administration in two settings (i.e., laboratory, online) by employing a between-subjects two-group design. Participants were recruited via a university-based research participation system (SONA), which provided a description of the study protocol and an option to register for Session 1, in which informed consent and a battery of self-report measures were completed. Sessions 2 and 3, in which the behavioral measures of DT were completed via computerized administration either in the laboratory or online, were scheduled, with the goal of

one week between each session. Participants completed a study-specific checklist at the end of each behavioral task session that was developed to identify potentially confounding factors that may impact task performance.

Objectives of the Proposed Study

Aim 1: Test-retest reliability of behavioral DT tasks and differences in performance across modalities. The primary goal of this study was to assess the test-retest reliability of DT behavioral tasks (BHT, PASAT-C) in two modalities (laboratory, online) within an undergraduate student sample. It was hypothesized that the highest correlation between performances on the DT behavioral tasks would be between participants in the laboratory condition, followed by the online condition. In other words, the sessions conducted within the laboratory condition would yield the most consistent results because of the increased structure and control provided by the condition reducing potential experimental noise that may be more present within the online modality.

Aim 2: Behavioral DT administration checklist. A secondary aim of this study was to develop a DT checklist that could be incorporated in future administrations of DT behavioral tasks. A checklist was made for this study that includes specific environmental factors that may impact study outcomes (e.g., noise level in lab or at home, fatigue, speaking on phone while performing the task, interruptions caused by friends/roommates). It was hypothesized that higher numbers of distractors endorsed would be correlated with earlier quit latency, thereby warranting the need for a checklist for online administration of measures. Further, it was expected that participants in the online sessions would report more distractors than the laboratory condition participants, as the laboratory environment is more controllable.

Aim 3: Exploratory aims. Participants completed a battery of self-report questionnaires assessing the various facets of DT, other aspects of emotion regulation (e.g., anxiety sensitivity), and psychopathology (e.g., internalizing symptoms, substance use) affording the ability to examine the potential overlap between DT measures and related constructs, as well as between these emotion regulation measures and psychopathology symptoms. Following, there were two exploratory hypotheses utilizing this data. First, it was hypothesized that moderate correlations would be found between self-reported emotion regulation measures, self-report DT measures and behaviorally assessed DT. Second, it was hypothesized that behavioral assessment of DT would account for unique variance over and above that accounted for by other measures of emotion regulation in the prediction of psychiatric symptoms.

Methods

Participants

Subjects registered in the SONA system, a university-based research participation system that students have access to once enrolled in a psychology course, were recruited for potential participation ($N = 231$). Inclusion criteria included being of 18 years of age or older and capable of providing informed consent. Furthermore, it was required that all participants had access to the Internet and a fully functioning computer with a working sound system in order to complete the behavioral tasks.

Procedure

The study consisted of a single one-hour self report assessment session (Session 1) and two thirty-minute behavioral task sessions (Sessions 2 and 3), separated by at least one-week interval, which were conducted in the laboratory or online, based on group assignment. A description of the study concept and procedure was provided online and once a participant

registered via the SONA system, Session 1 options became available for registration. During Session 1, explanation of procedures was provided and informed consent was obtained. Upon completion of consent, each participant was asked to complete a self-report battery assessing demographics, personality traits, perceived DT levels, theoretically relevant variables assessing other aspects of emotion regulation, and symptoms of psychopathology. Next, participants were assigned into study groups: (a) laboratory, (b) online. Although randomization to group modality would have been ideal, due to significant delays in translation of the tasks to the online modality, when data collection began all participants were assigned to the laboratory condition until it was full. However, as described in the results section, the groups did not differ on any demographic variables or key study variables. Following completion of Session 1, participants in the laboratory condition were asked to schedule their Sessions 2 and 3, with at least one week separating the two sessions. 107 participants were assigned to the laboratory condition.

After the laboratory group was full, the online tasks were prepared and all remaining participants were assigned to this modality (n = 124). Participants in the online condition were emailed links to the behavioral tasks, separated by at least one week. The BHT was presented first followed by the PASAT-C for all participants. Reminders were set in place for all sessions, either detailing date, time, and location of laboratory session or providing date, time, and the link to complete the online sessions. Reminders were also in place to provide specific guidelines regarding timeframe for completion of the second and third sessions of the study. Participants completing the tasks within a laboratory setting were under the supervision of a research assistant and provided adequate space to ensure privacy. Additionally, participants were assigned unique identification codes to ensure anonymity and extra credit was provided through the SONA system following participation in each session.

Session 1 Measures

Basic demographic data were collected including gender, race, age, marital status, and smoking status.

DT measures. The Distress Tolerance Scale (DTS) is a 15-item self-report instrument designed to measure the extent to which individuals can withstand distressing affective states (Simons & Gaher, 2005). Responses are made on a Likert scale ranging from strongly agree (1) to strongly disagree (5). The scale consists of four types of items tapping into perceived tolerability of affective distress (e.g., "I can't handle feeling distressed or upset"), acceptability of distress (e.g., "My feelings of distress or being upset are not acceptable"), allocation of attentional resources (e.g., "When I feel distressed or upset, I cannot help but concentrate on how bad the distress actually feels"), and regulation strategies utilized to alleviate distress (e.g., "When I feel distressed or upset I must do something about it immediately"). The scale has been found to have good test-retest reliability (intra-class r = .61), convergent validity (r = .26–.54), and discriminant validity (r = −.52–−.59) with established mood measures (Simons & Gaher, 2005). The scale possesses good internal consistency (α = .91) within the present sample.

The Discomfort Intolerance Scale (DIS) is a 5-item self-report instrument designed to measure the amount of physical distress an individual believes they can tolerate (Bardeen, et al., 2013). Responses are made on a 7-point Likert scale ranging from strongly agrees (0) to strongly disagree (6). A higher score on the DIS is indicative of a higher level of discomfort intolerance. The first of the two factors contained in the DIS is the ability to tolerate physical distress, for example having a high pain threshold. The second factor is the avoidance of physical discomfort (e.g., "I am more sensitive to feeling discomfort compared to most persons"). The scale also possessed good internal consistency (α =.64) in the present study.

Measure of Ambiguity Tolerance Scale 20-Item (MAT-20) is a 20-item instrument designed to measure ambiguity across various domains including but not limited to interpersonal communication (e.g., "It bothers me when I don't know how other people react to me"), problem solving (e.g., "A problem has little attraction for me if I don't think it has a solution"), and habit (e.g., "Nothing gets accomplished in this world unless you stick to some basic rules") (Zvolensky, Bernstein, et al., 2011). Responses are made by selecting either "True" or "False". The scale has been found to have good test–retest reliability (r = .63) (Sütterlin, et al., 2013). The scale also possessed good internal consistency (α =.67) in the present study.

Intolerance of Uncertainty (IUS-12) is a 12-item self-report instrument designed to assess prospective (e.g., Uncertainty keeps me from having a full life) and inhibitory anxiety (e.g., Unforeseen events upset me greatly) (Stommel & Willis, 2004). Responses are made on a 5-point Likert scale ranging from not at all (1) to entirely characteristic of me (5). The scale possessed good internal consistency (α = .86) within the present sample.

Measures of emotion regulation. Anxiety Sensitivity Index (ASI) is a 16-item self-report instrument designed to measure the degree to which individuals fear the consequences derived from bodily sensations originating from anxiety (Reiss, et al., 1986). Responses are made on a 5-point Likert scale from very little (0) to very much (De Bellis et al.). The three factors contained in the ASI are physical, concerns (e.g., "It scares me when my heart beats rapidly"), mental incapacitation concerns (e.g., "It scares me when I am unable to keep my mind on a task"), and social concerns (e.g., "Other people notice when I feel shaky"). The ASI is scored as a sum of all the items and may range from 0 to 64 (Bernstein, Zvolensky, Vujanovic, & Moos, 2009). The scale possesses good test-retest reliability (kappa = .75) and excellent convergent validity (r > .70) with other established measures of anxiety (Kokotailo et al., 2004; Schloss & Haaga, 2011).

The scale also demonstrated good internal consistency (α =. 89) within the present sample.

Acceptance and Action Questionnaire-II (AAQ-II) is a 7-item self-report measure developed to assess experiential avoidance (Timpano, Buckner, Richey, Murphy, & Schmidt, 2009). Responses are made on a 7-point Likert scale of 1 (never true) to 7 (always true). The scale used in this study contains items on negative evaluations of feelings (e.g., "I am afraid of my feelings") and items on behavioral adjustment amidst challenging thoughts or feelings (e.g., "My painful memories prevent me from having a fulfilling life"). The questionnaire possesses good test-retest reliability (kappa = .79) (Timpano, et al., 2009). The scale also demonstrated good internal consistency (α =. 90) within the present sample.

Measures of psychiatric functioning. Symptom Checklist-27 (SCL-27) is a 27-item self-report instrument based on the Symptom Checklist-90 designed to measure depression (10 items), somatization (5 items), anxiety (7 items), and phobic anxiety (5 items) over the past month. Responses are made on a Likert scale of 1 (not at all) to 5 (extremely) (Hardt & Gerbershagen, 2001). The checklist possesses good internal consistency (α =. 94) within the present sample.

Alcohol Use Disorders Identification Test (AUDIT) is a 10-item self-report measure designed to identify individuals experiencing alcohol problems by the World Health Organization (Babor, de la Fuente, Saunders, & Grant, 1992). Responses are made on a 5-point Likert scale ranging from never (0) to 4 or more times a week (4). The total score is representative of the total problematic alcohol use. The AUDIT contains items on harmful patterns of alcohol use (e.g., "Have you or someone else been injured as a result of your drinking?") and current alcohol dependence symptoms (e.g., "How often during the last year

have you found that you were not able to stop drinking once you had started?"). The test possesses good internal consistency (α = .82) within the present sample.

The Life Events Checklist (LEC) is a 17-item self-report instrument designed to identify categories of potential trauma exposure (Blake et al., 1995). Participants may select multiple options for each trauma type including (1) Happened to me, (2) Witnessed it, (3) Learned about it, (De Bellis, et al.) Not sure, and (5) Doesn't apply. The LEC has good test-retest reliability, good convergent validity with the other measures of potentially traumatic events (Kubany et al., 2000), and is significantly correlated with PTSD symptom severity (Gray, Litz, Hsu, & Lombardo, 2004).

PTSD Checklist (PCL) is a 17-item self-report measure designed to assess PTSD symptoms according to the DSM-IV criteria (Weathers, Litz, Herman, Huska, & Keane, 1993). Responses are made on a Likert scale from 1 (not at all) to 5 (extremely) based on symptom severity experienced within the past month. The total can be used dimensionally or categorically with individuals considered to meet PTSD criteria if scores reach beyond 50 (Weathers, et al., 1993). The checklist possessed good internal consistency (α =. 93) within the present sample.

Sessions 2 and 3 Measures

Behavioral DT tasks. The Breath-Holding Task (BHT) is a behavioral assessment of physical distress tolerance based on breath-holding duration. The BHT was the first behavioral DT task presented and participants were asked to use an online stopwatch to record the duration in which they were able to hold their breath. During the task participants were asked to breathe normally for 30 seconds, to completely exhale when instructed, and inhale then hold their breath for *as long as possible*. The task was repeated once more following a 60 second rest period and the participant was asked to record each time in an excel document. The average duration of

breath holding over the two trials was used as an index of distress tolerance (Hajek, 1991; Hajek, Belcher, & Stapleton, 1987; Zvolensky, Feldner, Eifert, & Brown, 2001).

The Paced Auditory Serial Addition Task (PASAT-C) is a computerized behavioral measure of distress tolerance and was presented after the BHT. Participants performed the task by adding a number presented on a screen to the one displayed immediately beforehand and clicking on the correct answer from the options provided at the bottom of the screen. Participants were then asked to disregard the sum and add the number currently displayed on the screen to the one previously presented. Correct responses received one point and incorrect responses result in an aversive "explosion" sound effect. The PASAT-C consists of three rounds whereby the time between presentation of numbers decreased and length of rounds increased as the task progresses. The latency between number presentations was 3 seconds for round 1, 1.5 seconds for round 2, and 1 second for round 3. In the final round an option to quit is presented at the bottom of the screen. The time in seconds it took for the participant to quit was used as an index of DT (Lejuez, et al., 2003). Round 1 was 3 minutes, round 2 was 5 minutes, and the final round was 10 minutes in duration. Participants could persist through the full 10 minutes (600 seconds) of the final round although they were not informed of the time limit beforehand. All participants, regardless of amount of time spent in round 3 were included in the analyses thus the range of responses could be between 0 – 600 seconds.

Self-report measure of distress. Subjective Units of Distress Scale (SUDS) is a self-report instrument designed to measure subjective distress levels on a scale of no distress at all (0) to extreme distress (10) following a potentially anxiety provoking stimuli. The measure was presented prior to beginning and immediately following each behavioral task.

Behavioral distress tolerance checklist. The Checklist, created for this study, included a

list of potential confounding factors that participants were asked to check off if encountered during assessment at the end of Session 2 and Session 3 (Appendix 1). Each item endorsed was coded as a "1" and any item not endorsed was coded as a "0".

Data Analytic Plan

Due to delays in translation of the behavioral task code to work on an online modality, randomization to condition was not done. Therefore potential differences that may have existed across groups were examined via t-tests and chi-square analyses to determine if any systematic differences existed across conditions (i.e., whether participants would be more willing to complete the tasks depending on whether they were in the laboratory or online condition, gender, age, race, marital status, and smoking status). Moreover, average scores on the self-report measures completed in Session 1 were compared across groups. Finally, predictors of attrition were examined via t-tests and chi-square analyses to determine if gender, age, race, marital status, smoking status, and self-report measures significantly predicted whether a participant would complete all three sessions or not.

Aim 1: Test-retest reliability of behavioral DT tasks and differences in performance across modalities. Although 231 participants completed at least a single session, the analyses were conducted among participants completing all three sessions (n = 117), hereafter referred to as 'completers'. Descriptive statistics and Pearson correlations were calculated within each group (i.e., laboratory, online) in order to assess test-retest reliability of the behavioral measures of DT (i.e., BHT, PASAT-C). Furthermore, paired samples t-tests were conducted to determine if a significant change in subjective distress was present pre-post BHT and PASAT-C completion. Pearson correlations were also conducted to determine if a relationship was present between subjective distress experienced and quit latencies for each behavioral DT task. Finally, two two-

way repeated measures ANOVAs were conducted to examine the influence of time and modality on performance of each behavioral DT task (i.e., BHT, PASAT-C).

Aim 2: Behavioral DT administration checklist. Among completers (n = 117), frequencies were computed for each item on the checklist in each session (i.e., Session 2, Session 3) and each modality (i.e., laboratory, online). A sum score was also calculated based on number of distractors endorsed by participants and Pearson correlations were conducted to determine the degree to which number of distractions were associated with quit latency on the BHT and PASAT-C in each session and within each modality (i.e., laboratory, online). Finally, the mean number of distractors endorsed in each modality and in each session were compared via a repeated measures analysis of variance.

Aim 3: Exploratory aims. The exploratory analyses were conducted using data from Session 1 self-report measures and Session 2 BHT and PASAT-C performances (n = 117). Use of the first administration of the DT measures was chosen to remain consistent with the literature that frequently examines only one session of DT behavioral task data (e.g., PASAT-C, MTPT-C, BIRD; Bornovalova, et al., 2008; Brown, et al., 2002; Daughters, et al., 2009),

3a. Relationship between self-report measures of emotion regulation, self-report measures of DT, and behavioral measures of DT. Pearson correlations were conducted to examine the relationships between self-report measures of DT (i.e., Measure of Ambiguity Tolerance Scale, Distress Tolerance Scale, Intolerance of Uncertainty Scale, Session 2 BHT, Session 2 PASAT-C) and other measures of emotion regulation (i.e., Acceptance and Action Questionnaire, Anxiety Sensitivity Index).

3b. Relationship between self-report measures of emotion regulation, self-report measures of DT, behavioral measures of DT and psychopathology (n = 117). Three four-step

hierarchical linear regressions were conducted with the psychopathology measures (i.e., alcohol use, PTSD, global distress) as the dependent variables to determine the amount of variance accounted for by behavioral DT tasks above and beyond that of self-report DT and emotion regulation measures. Gender was entered at step one as a covariate given the relationship between gender and differential psychiatric symptom expression (Buckner, Keough, & Schmidt, 2007), self-report emotion regulation measures were entered in step 2 (i.e., Acceptance and Action Questionnaire, Anxiety Sensitivity Index), self-report DT measures were entered in step 3 (Measure of Ambiguity Tolerance Scale, Intolerance of Uncertainty Scale, Distress Tolerance Scale), and behavioral DT measures (Session 2 BHT, Session 2 PASAT-C) were entered in step 4. The variables were entered in such a manner as to remain consistent with the current theoretical understanding of behavioral DT within the field (i.e., behavioral DT taps into a facet of the DT construct believed to be qualitatively different from affective DT as assessed by self-report measures, all of which fall under the umbrella of emotion regulation). The four-step hierarchical linear regression conducted with PTSD symptoms as the dependent variable was completed among participants endorsing at least one lifetime traumatic event (n = 107).

Results

Sample Characteristics and Predictors of Attrition

231 participants were consented and completed Session 1 consisting of self-report measures of emotion regulation, self-report measures of DT, and psychopathology. The mean age of participants was 20.65 (SD = 4.45). The majority of participants were female (71%), 45.8%, reported their race as Caucasian, 28.6% as African American, 15.9% as Asian, and 9.7% as other. The distribution properties of each self-report measure were examined for excessive kurtosis and/or skewness and no transformations were necessary.

Due to delays in translation of the behavioral task code to work on an online modality, randomization to task condition (online or laboratory) was not done. Thus, the first 107 participants who were consented and completed Session 1 were assigned to the laboratory condition. Of the 107 participants that were assigned the laboratory condition, 63 (59%) completed at least one behavioral task session, and 52 (49%) completed both behavioral task sessions (i.e., Sessions 2 and 3). After the first 107 participants, all remaining participants to complete Session 1 were assigned to the online condition (n = 124). Of the participants in the online condition, 69% (n = 85) completed at least one behavioral task session, and 52% (n = 65) completed both behavioral task sessions. Participants assigned to the online modality were not significantly more likely than those assigned to the laboratory condition to participate in Session 2 (χ^2 (1, 231) = .99, $p > .05$) or complete all three sessions (χ^2 (2, 231) = 1.02, $p > .05$). Following, it can be concluded that assignment to the laboratory or online condition did not influence study completion. In total, 117 participants completed all three sessions in both conditions (52 lab and 65 online) and thus will be referred to as "completers". Among completers, the average amount of time between Session 2 and Session 3 was 8.88 (SD = 6.62) days in the laboratory modality and 8.54 (SD = .54) days in the online modality (all completers in both modalities M = 8.49, SD = 4.37). The days between completion of the two behavioral task sessions in each group were not significantly different (t (116) = .50, $p > .05$).

Given that randomization was not completed, a series of analyses were conducted comparing the laboratory group to the online group to determine if systematic differences between groups were present on demographics or key study variables (Table 1). Among completers, the mean age in each modality was not significantly different (t (115) = .67, $p > .05$). As shown in Table 1, groups did not differ significantly with regard to race, marital status, or

smoking status (χ^2 (3, 113) = 2.02, χ^2 (2, 117) = 2.48, χ^2 (2, 117) = 2.25, *ps* > .05). The average scores of all self-report measures completed in Session 1 were also compared between groups. No significant differences existed among groups based on self-report responses with the exception of the Measure of Ambiguity Tolerance Scale (t (115) = 2.47, $p < .05$) with the laboratory condition having a higher mean score measure when compared to the online group (M = 29.56, 28.05; SD = 2.67, 3.71, respectively)[1]. Thus, although randomization was not done, the groups did not differ systematically on key demographics or study variables and therefore use of covariates to control for differences between groups was not employed.

[1] However, upon correcting for multiple testing (adjusted significance threshold $p < .01$), this difference was no longer significant.

Table 1.

Sample Characteristics Among Laboratory and Online Modalities.

	Laboratory Version (*n* = 52)	**Online Version (*n* = 65)**	χ^2	*t*	*p*
Sex			.21	-	.65
Male	26.9%	30.8%			
Female	73.1%	69.2%			
Ethnicity			2.02	-	.57
Caucasian	51.9%	52.5%			
African American	25.0%	21.3%			
Asian	13.5%	21.3%			
Other	9.6%	4.9%			
Age (M, SD)	20.73(4.50)	20.18(4.25)	-	.67	.50
Marital Status			2.48	-	.29
Never married	96.2%	93.8%			
Separated/divorced	1.9%	0.0%			
Currently married/cohabitating	1.9%	6.2%			
Smoking Status			2.25	-	.32
Never	67.3%	78.5%			
Past, but not now	17.3%	13.8%			
Current	15.4%	7.7%			
Self-report Measures					
Acceptance and Action Questionnaire	18.85 (8.07)	21.85 (8.07)	-	-1.28	.21
Anxiety Sensitivity Index	22.63 (10.85)	23.88 (13.53)	-	-.54	.59
Measure of Ambiguity Tolerance Scale	29.56 (2.67)	28.05 (3.71)	-	2.47	.02
Distress Tolerance Scale	3.24 (.83)	3.10 (.93)	-	.83	.41
Distress Intolerance Scale	16.83 (5.34)	15.92 (5.63)	-	.89	.38
Intolerance of Uncertainty Scale	32.49 (9.48)	32.83 (8.62)	-	-.19	.85

Predictors of attrition (Table 2). To account for potential differences between individuals that completed all three sessions and those that only completed only Session 1 and/or Session 2, a series of analyses were conducted to determine if the group composition differed on demographics or key study variables (Table 2). The mean age for completers versus non-completers was not significantly different (t (229) = .77, $p > .05$). Completers versus non-completers were also not significantly different by race, marital status, or smoking status (χ^2 (3, 227) = 6.56, χ^2 (2, 230) = 1.16, χ^2 (2, 230) = .48, $ps > .05$). Additionally, the average scores of all self-report measures completed in Session 1 were not significantly different between completers versus non-completers. Finally, no significant differences were present between those that only completed Session 2 and those that completed all three sessions for both the BHT and PASAT-C (ts (2, 146) = -.2.22, .04, $ps > .05$, respectively). In sum, completion status was not influenced by any study variables and was likely driven by unmeasured external factors (e.g., varying need of extra credit, timing of participation in the study in the semester). Following, the analyses were completed without adjustment of covariates.

Table 2.

Predictors of Attrition.

	Completers (*n* = 117)	**Non-completers (*n* = 114)**	χ^2	***t***	***p***
Sex			.00	-	.99
Male	29.1%	28.9%			
Female	70.9%	71.1%			
Ethnicity			6.56	-	.087
Caucasian	52.2%	39.5%			
African American	23.0%	34.2%			
Asian	17.7%	14.0%			
Other	7.1%	12.3%			
Age (M, SD)	20.43(4.36)	20.88(4.55)	-	.77	.44
Marital Status			1.16	-	.56
Never married	94.9%	93.8%			
Separated/divorced	.90%	2.7%			
Currently married/cohabitating	4.3%	3.5%			
Smoking Status			.48	-	.79
Never	73.5%	77.0%			
Past, but not now	15.4%	12.4%			
Current	11.1%	10.6%			
Self-report Measures					
Acceptance and Action Questionnaire	20.05(9.17)	20.14(9.34)	-	.07	.94
Anxiety Sensitivity Index	23.32(12.37)	23.03 (12.90)	-	-.18	.86
Measure of Ambiguity Tolerance Scale	28.72(3.37)	28.11(3.05)	-	-1.43	.15
Distress Tolerance Scale	3.16(.89)	3.26(.76)	-	.85	.37
Distress Intolerance Scale	16.32(5.50)	16.20(5.44)	-	-.17	.87
Intolerance of Uncertainty Scale	32.69(8.94)	33.27(8.40)	-	.50	.62

Aim 1. Test-retest Reliability

All analyses were conducted among completers (52 lab and 65 online).

Laboratory modality (*n* = 52). As shown in Table 3, the mean quit latencies, in seconds, on the BHT for Sessions 2 and 3 were 48.11 (*SD* = 21.76, *range* = 13.50 – 102.50) and 46.04 (*SD* = 23.19, *range* = 16.50 – 127.50), respectively. The mean quit latencies on the PASAT-C (out of a maximum of 600 seconds before program terminated) for Sessions 2 and 3 were 180.81 (*SD* = 219.56, *range* = 1 - 600) and 128.35 (*SD* = 214.04, *range* = 0 - 600) seconds, respectively. Longer latencies (in seconds) are thought to behaviorally demonstrate greater ability to tolerate distress and are used here as an index of DT (Lejuez, Kahler, & Brown, 2003). To determine if the PASAT-C and BHTs were indeed considered distressing, pre-post SUDs for each task were compared (Table 3). The BHT completed in the laboratory was not found to be significantly distressing in either Session 2 or 3 (*ts* (48) = .27, .36 *ps* > .05, respectively) and Pearson correlations demonstrated that pre-post change in subjective task-related distress was related to quit latency on the BHT in Session 2 (*r* (48) = -.32, *p* = .03), but not Session 3 (*r* (48) = .04, *p* > .05). However, the PASAT-C was found to be distressing by participants in the laboratory condition, as indicated by a significant pre-post change in distress during both Session 2 and Session 3 (*t*s (46) = 7.55, 7.00, *ps* < .001, respectively). Importantly, Pearson correlations demonstrated that pre-post change in subjective task-related distress was unrelated to PASAT-C quit latency in sessions 2 and 3 (*rs* (46) = .26, .23, *ps* > .05, respectively), indicating that lower persistence on the PASAT-C was not simply a measure of increased distress. To examine test-retest reliability, a Pearson correlation was used. The correlation estimate for the breath-holding mean quit latency in the laboratory modality between Session 2 and Session 3 was significant

and within the acceptable range (r (52) = .58, p < .01). The correlation for the PASAT-C quit latency in the laboratory condition sessions was within the moderate range (r (52) = .74, p < .01).

Table 3.

PASAT-C and BHT Quit Latencies Across Modalities.

	Laboratory Version (*n* = 52)	**Online Version (*n* = 65)**	***t***	***p***
Breath Holding Task Session 2 (M, SD)	48.11 (21.76)	31.58 (18.21)	4.39	.00
Breath Holding Task Session 3 (M, SD)	46.04 (23.19)	24.85 (17.79)	5.43	.00
PASAT-C Session 2 (M, SD)	180.81 (219.56)	147.01 (125.31)	.99	.33
PASAT-C Session 3 (M, SD)	128.35 (214.04)	117.97 (128.10)	.31	.76

Note: Data presented in seconds.

Online modality (*n* = 65). As shown in Table 3, the mean quit latencies on the BHT for Sessions 2 and 3 were 31.58 (*SD* = 18.21, *range* = 1.90 - 102.50) and 24.85 (SD = 17.79, *range* = 1.34 – 90.90) seconds, respectively. The mean quit latencies on the PASAT-C for Sessions 2 and 3 were 147.01 (*SD* = 125.31, *range* = 0 - 600) and 117.97 (*SD* = 128.10, *range* = 0 - 600) seconds, respectively. Similar to the laboratory condition, in the online condition, the BHT was not found to be significantly distressing (*t*s (63) = 2.02, .50, *ps* > .05, respectively) and Pearson correlations demonstrated that pre-post change in subjective task-related distress was not related to quit latency on the BHT in Session 2 or Session 3 (*rs* (63) = .18, .22, *p* > .05). Moreover, the PASAT-C was found to be distressing, as indicated by a significant pre-post change in distress during both Session 2 and Session 3 *(ts* (62) = 8.41, 5.67, *ps* < .001, respectively) (Table 4). Consistent with results from the laboratory condition, the pre-post change in subjective task-related distress was not significantly correlated with PASAT-C quit latency in Sessions 2 or Session 3 (*rs* (62) = .09, .05, *ps* > .05, respectively), suggesting that lower persistence on the PASAT-C is not merely an indicator of increased distress. To examine test-retest reliability, a

Pearson correlation was used. The correlation estimate for the breath-holding mean quit latency in the online modality between Session 2 and Session 3 was significant (r (65) = .56, $p < .01$). The correlation between PASAT-C quit latencies in the online condition was also significant (r (65) = .52, $p < .01$).

Table 4.

Comparison of Subjective Units of Distress Scale Ratings (Laboratory and Online).

	Pre BHT	**Post BHT/Pre PASAT-C**	**Post-PASAT-C**
Laboratory (*n* = 52)			
Session 2 SUDS *M, (SD)*	3.33 (2.34)	3.27 (2.10)	6.00 (2.67)
Session 3 SUDS *M (SD)*	3.20 (2.36)	3.15 (2.07)	4.76 (3.40)
Online (*n* = 65)			
Session 2 SUDS *M (SD)*	3.63 (2.73)	3.05 (2.31)	5.81 (3.00)
Session 3 SUDS *M (SD)*	3.56 (2.87)	3.41 (2.67)	5.68 (2.79)

Note: Although analyses were run among all completers (n = 52 in the laboratory condition and n = 65 in the laboratory condition), due to missing data the lowest n in the analysis was 46 in the laboratory condition and 62 in the online condition.

Comparisons across modalities. Repeated measures analysis of variance was conducted to examine the influence of time and modality on performance of the BHT with both sessions (i.e., Session 2, Session 3) and modality (i.e., laboratory, online) entered into the analysis. The analysis demonstrated a main effect of session on BHT quit latency (F (1, 115) = 5.45, $p < .05$), with participants spending more time on the task during the first administration than the second. The results also demonstrated a main effect of modality on BHT quit latency (F (1, 115) = 40.36, $p < .001$) with longer quit latencies present within the laboratory modality compared to those exhibited in the online modality. There was no significant interaction between BHT quit latency across session and modality (F (1, 115) = 2.48, $p = .12$), suggesting that the combined effects of session and modality did not significantly influence performance.

Repeated measures analysis of variance was also conducted to examine the influence of time and modality on performance of the PASAT-C with both sessions (i.e., Session 2, Session

3) and modality (i.e., laboratory, online) entered into the analysis. The analysis demonstrated a main effect of session on PASAT-C quit latency (F (1, 115) = 8.97, $p < .01$), with participants spending more time on the task during the first administration than the second. However, a main effect of modality was not present on PASAT-C quit latency (F (1, 115) = .01, $p = .96$). There was no significant interaction between PASAT-C quit latency across session and modality (F (1, 115) = .13, $p = .62$), suggesting that the combined effects of time between task performance and modality did not significantly influence performance. In sum, completion of the task in either the laboratory or online modality did not yield significant differences in the quit latencies for the PASAT-C across sessions.

Aim 2: Behavioral DT Administration Checklist (n=117) (Tables 5 and 6).

Frequencies for each item are presented in Table 5. A sum score was calculated based on number of distractors endorsed by participants and Pearson correlations were conducted to determine the degree to which number of distractions endorsed were associated with quit latency on the BHT and PASAT-C in each session and within each modality (i.e., laboratory, online). Finally, a repeated measures analysis of variance was conducted to determine if the mean number of distractors was significantly influenced by time and modality (i.e., session [Session 2 and Session 3] and modality [laboratory and online] entered as independent variables with number of distractors as dependent variable).

Laboratory modality (Table 6). The average number of distractors endorsed by participants was 2.15 (*SD* = 3.10, *range* = 0 - 16) in Session 2 and 1.98 (*SD* = 2.73, *range* = 0 - 15) in Session 3. Pearson correlations demonstrated no significant relationship between number of distractors endorsed and quit latencies of the BHT (rs (52) = -.03, .06 $ps > .05$) and PASAT-C in Session 2 or 3 (rs (52) = -.11, -.07, $ps > .05$, respectively). "Tired/lack of energy" and

"disinterest in the task" were the most highly endorsed items in each session within the laboratory modality.

Online modality (Table 6). The average number of distractors endorsed by participants was 2.91 (*SD* = 2.40, *range* = 0 - 11) in Session 2 and 2.89 (*SD* = 2.41, *range* = 0 - 8) in Session 3. Similar to the laboratory condition, there were no significant correlations between number of distractors endorsed and quit latencies of the BHT for sessions 2 or 3 (*rs* (65) = .12, .11 *ps* > .05, respectively) and PASAT-C in either Session 2 or 3 (*rs* (65) = -.09, .18, *ps* > .05, respectively). Similar to the laboratory modality, "tired/lack of energy" and "disinterest in the task" were the most highly endorsed items in each session within the online modality. However, "outside noise", "music", and "texting" were also endorsed by over 20% of the sample in each session within the online modality.

Comparisons across modalities. Repeated measures analysis of variance was conducted to examine the influence of time and modality on mean number of distractors reported with both sessions (i.e., Session 2, Session 3) and modality (i.e., laboratory, online) entered into the analysis. The analysis did not demonstrate a main effect of session (F (1, 115) = .18, p = .67) or modality (F (1, 115) = 3.60, p = .06) on number of distractors endorsed. Moreover, there was no significant interaction between number of distractors endorsed across session and modality (F (1, 115) = .13, p = .73), suggesting that the combined effects of session and modality did not significantly influence number of distractors reported.

Table 5.

Sessions 2 and 3 Behavioral DT Administration Checklist Items Endorsed in each Modality.

	Laboratory (*n* = 52)		**Online (*n* = 65)**	
	Session 2	**Session 3**	**Session 2**	**Session 3**
Item	**%**	**%**	**%**	**%**
Outside Noise	19.2	19.2	26.2	21.5
Someone knocking on door	5.8	0	3.1	4.6
Pet	1.9	1.9	3.1	6.2
Music	9.6	5.8	24.6	23.1
Roommates	0	3.8	20	16.9
Significant other	3.8	5.8	3.1	6.2
Friends	7.7	5.8	12.3	12.3
Caring for family/children	1.9	3.8	3.1	4.6
Television	3.8	1.9	16.9	20
Talking on phone	3.8	3.8	1.5	1.5
Texting	9.6	11.5	23.1	26.2
Social media	3.8	3.8	6.2	9.2
Video games	0	1.9	1.5	1.5
Class Work	7.7	9.6	1.5	6.2
Eating food	5.8	3.8	12.3	7.7
Cooking/Baking	3.8	1.9	1.5	0
Alcohol/Drug use	0	0	0	0

Table 5 continues

Table 5 continued

Speaker volume issues	5.8	5.8	7.7	3.1
Internet Connection Difficulties	5.8	7.7	6.2	3.1
Computer Dying	1.9	1.9	3.1	4.6
Not allocating enough time to complete	15.4	9.6	16.9	20.0
Having to use the restroom	7.7	1.9	7.7	6.2
Remembering something that needed to be done at the house	17.3	15.4	12.3	3.2
Tired/lack of energy	36.5	34.6	44.6	49.2
Disinterest in task	34.6	26.5	36.9	32.3

Table 6.

Sessions 2 and 3 Behavioral DT Administration Checklist Sum Score Correlations.

	Breath Holding Task				**PASAT-C**			
	Laboratory (*n* = 52)		**Online (*n* = 65)**		**Laboratory (*n* = 52)**		**Online (*n* = 65)**	
	r	***p***	***r***	***p***	***r***	***p***	***r***	***p***
Session 2: Number of Distractors	-.03	.86	.12	.34	-.11	.94	-.09	.46
Session 3: Number of Distractors	.06	.68	.11	.39	-.07	.62	.18	.15

Aim 3: Exploratory Aims (*n* = 117).

Prior to examining the correlations among self-report emotion regulation measures, self-report DT measures, and behavioral measures, the present sample means and standard deviations on each measure were compared to those in the literature and are presented in Table 7. As is shown in Table 7, most of the present sample means and standard deviations on each measure are comparable to those identified in previous studies. However, the present sample exhibited significantly different scores on the Measure of Ambiguity Tolerance Scale, Discomfort Intolerance Scale, and Intolerance of Uncertainty Scale. Thus, the results must be viewed in light of these differences.

Next, a series of correlations were conducted to examine the relationships between the self-measures of emotion regulation, self-report measures of DT, and behavioral measures of DT in exploratory aim 3a. Furthermore, the measures of psychopathology are also included in Table 8 to aid in interpretation of findings form the series of hierarchical regressions completed for exploratory aim 3b.

Table 7.

Comparisons of Population and Present Sample Means and Standard Deviations.

	Means and SD from Literature				Present Sample		Significantly Different
	M	*SD*	*N*	*Population*	*M*	*SD*	
Action and Acceptance Questionnaire	18.51	7.05	432	College students (Bond et al., 2011)	19.93	9.24	t (547) = 1.80, p = .07
Anxiety Sensitivity Index	22.20	9.00	229	College students (Stewart, Karp, Pihl, & Peterson, 1997)	23.17	12.32	t (344) = .83, p = .41
Measure of Ambiguity Tolerance Scale	8.84	2.90	789	College students (Sütterlin, et al., 2013)	10.51	3.32	t (904) = 5.70, p <.001
Discomfort Intolerance Scale	13.00	5.71	265	College students (Buckner, et al., 2007)	16.29	5.48	t (380) = 5.25, p <.001
Distress Tolerance Scale	3.30	.90	265	College students (Timpano, et al., 2009)	3.17	.89	t (380) = 1.31, p = .19
Intolerance of Uncertainty Scale	45.15	12.80	156	Non-anxious college students (Holaway, Heimberg, & Coles, 2006)	32.98	8.65	t (271) = 8.87, p < .001

Table 8.

Zero-order Correlations between Self-Report Emotion Regulation Measures, Self-Report DT Measures, Behavioral DT Tasks, and Measures of Psychopathology.

	1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**
1. Acceptance and Action Questionnaire	-										
2. Anxiety Sensitivity Index	.52***	-									
3. Measure of Ambiguity Tolerance Scale	-.08	.22*	-								
4. Discomfort Intolerance Scale	-.11	-.21*	.25**	-							
5. Distress Tolerance Scale	-.60***	-.46***	.23*	.25**	-						
6. Intolerance of Uncertainty Scale	.25*	.44***	-.46***	-.29**	-.39***	-					
7. PASAT-C Session 2	.07	-.16	.11	.05	.13	-.07	-				
8. Breath Holding Task Session 2	.01	-.14	.16	-.01	-.02	-.02	.13	-			
9. AUDIT sum score	.05	.09	.02	.14	-.25*	.06	-.10	.03	-		
10. PCL sum score	.44***	.33***	.02	-.22*	-.42***	.17	-.04	.19	.23*	-	
11. SCL sum score	.60***	.52***	-.09	-.16	-.49***	.23*	.06	.05	.15	.64***	-

Note: n = 117, $^{\square}p$ <.05, $^{\square\square}p$ <.01, ***p<.001. Analysis conducted among participants completing all three sessions (n=117); however, due to missing data on the Intolerance of Uncertainty Scale the final n for correlations including that measure is 109.

3a. Relationship between self-report measures of emotion regulation, self-report measures, and behavioral measures of DT. As shown in Table 8 the Distress Tolerance Scale was negatively associated with the Acceptance and Action Questionnaire (r (117) = -.60, p < .001), Anxiety Sensitivity Index (r (117) = -.46, p < .001), and the Intolerance of Uncertainty Scale (r (109) = -.39, p < .001). These inverse relationships suggest that an individual with greater ability to tolerate distress will likely endorse lower levels of experiential avoidance, anxiety sensitivity, and uncertainty intolerance. Conversely, the Distress Tolerance Scale was significantly positively correlated with the Measure of Ambiguity Tolerance Scale (r (117) = .23, p < .05) and the Discomfort Intolerance Scale (r (117) = .25, p < .01). The Intolerance of Uncertainty Scale was negatively correlated with the Measure of Ambiguity Tolerance Scale (r (109) = -.46, p < .001) and the Discomfort Intolerance Scale (r (109) = -.29, p < .01). The Anxiety Sensitivity Index was significantly positively correlated with the Acceptance and Action Questionnaire (r (117) = .52, p < .001).

The modest correlations between the self-report DT measures are consistent with the extant literature (Marshall-Berenz, et al., 2010); (Howell, et al., 2010) which suggest that self-report measures of DT may tap into overlapping yet distinct dimensions of the DT construct associated with one's ability to tolerate potentially negative internal states (i.e., ability to withstand negative affective states as assessed by the Distress Tolerance Scale and the Measure of Ambiguity Tolerance Scale) and physical states (i.e., ability to tolerate discomfort and pain as assessed by the Discomfort Intolerance Scale). The behavioral DT tasks were not correlated with one another (r (117) = .13, p > .05). Moreover, Session 2 BHT and PASAT-C quit latencies were not significantly correlated with any self-report measure of DT, suggesting that

the behavioral DT tasks may be tapping into a facet of DT that is not accessed via self-report or an entirely different construct all together.

3b Relationship between self-report measures of emotion regulation, self-report measures of DT, behavioral measures of DT, and alcohol use (Table 9). Consumption of at least one alcoholic beverage within an individual's lifetime was endorsed by 72.6% of participants completing all three sessions. On the AUDIT, 74.4% fell under the low risk category, 18.7% in the risky/hazardous category, 6% in the high-risk/harmful category, and .9% in the high-risk/possible dependence category of drinking (Babor, et al., 1992). A four-step hierarchical multiple linear regression was conducted with the AUDIT sum score as the dependent variable. Gender was entered at step one, self-report emotion regulation variables were entered at step two (Acceptance and Action Questionnaire and Anxiety Sensitivity Index), self-report DT variables at step three (Distress Tolerance Scale, Discomfort Intolerance Scale, Measure of Ambiguity Tolerance Scale, Intolerance of Uncertainty Scale) and behavioral DT variables at step four (Session 2 PASAT-C, Session 2 BHT). The regression showed that step one did not significantly contributed to the model (F (1,107) = 4.06, $p > .05$) and accounted for 3.7% of variation in AUDIT scores. Step two also did not significantly contribute to the model (F (2,105) = 2.75, $p > .05$) and accounted for .1% of variation in AUDIT scores. The addition of self-report DT variables to the model was significant (F (3,101) = 2.70, $p < .05$) and accounted for 11% of variation in AUDIT scores. Introducing behavioral DT variables explained and additional .6% of variation and the change in R^2 was not significant (F (2, 99) = 2.16, $p > .05$). When all nine independent variables were included in the model, self-report Distress Tolerance Sum score remained significant (β = -.39, $p < .01$) indicating that greater levels of self-reported

DT were associated with lower scores on the AUDIT. Together all nine independent variables accounted for 16.3% of variance present within AUDIT sum scores.

Table 9.

Relationship between Measures of Emotion Regulation, Distress Tolerance, and Alcohol Use

	β	***R^2 Change***	***R^2***	***p***
Step 1: Covariates		.04	.04	
Gender	-.19			.05
Step 2: Other Measures of Emotion Regulation		.01	.05	
Gender	-.20			.04
Anxiety Sensitivity Index	.10			.39
Acceptance and Action Questionnaire	.01			.91
Step 3: Measures of Distress Tolerance		.11	.16	
Gender	-.17			.07
Anxiety Sensitivity Index	.06			.60
Acceptance and Action Questionnaire	-.18			.15
Distress Tolerance Scale	-.40			<.01
Measure of Ambiguity Tolerance Scale	.09			.41
Intolerance of Uncertainty Scale	.03			.83
Distress Intolerance Scale	.18			.07
Step 4: Behavioral DT Tasks		.01	.16	
Gender	-.18			.07

Table 9 continues

Table 9 continued

Anxiety Sensitivity Index	.07			.57
Acceptance and Action Questionnaire	-.18			.18
Distress Tolerance Scale	-.39			<.01
Measure of Ambiguity Tolerance Scale	.08			.48
Intolerance of Uncertainty Scale	.02			.89
Distress Intolerance Scale	.18			.08
Breath Holding Task	.07			.46
PASAT-C	-.04			.68

Note: Analysis conducted among participants completing all three sessions however due to missing data on the Intolerance of Uncertainty Scale the final n = 109.

Relationship between self-report measures of emotion regulation, self-report measures of DT, behavioral measures of DT, and posttraumatic stress disorder (Table 10). Exposure to at least one lifetime traumatic event was endorsed by 86.1% (n=199 of participants). Of the whole sample, 27% reported an accidental trauma (i.e., car accident, natural disaster) as their worst experience, 24.3% reported an interpersonal trauma (i.e., sexual assault, physical assault), and 20.4% reported a significant loss (i.e., loved one) as their worst lifetime experience per the Life Events Checklist (LEC). A four-step hierarchical multiple linear regression was conducted among individuals completing all three sessions and endorsing at least one lifetime traumatic event (n = 107) with the PTSD Checklist (PCL) sum score as the dependent variable. Gender was entered at step one, self-report emotion regulation variables were entered at step two (Acceptance and Action Questionnaire and Anxiety Sensitivity Index), self-report DT variables

at step three (Distress Tolerance Scale, Discomfort Intolerance Scale, Measure of Ambiguity Tolerance Scale, Intolerance of Uncertainty Scale) and behavioral DT variables at step four (Session 2 PASAT-C, Session 2 BHT). The regression showed that step one did not significantly contributed to the model (F (1,99) = 1.98, $p > .05$) and accounted for 2.0% of variation in PCL sum scores. However, step two did significantly contributed to the model (F (2,97) = 7.42, $p < .001$) and accounted for 16.7% of variation in PCL scores. The addition of self-report DT variables to the model accounted for 6% of variation in PCL scores but was not significant (F (4, 93) = 4.25, $p > .05$). Introducing behavioral DT variables explained an additional 4% of variation and the change in R^2 was not significant (F (2,91) = 3.96, $p > .05$). When all nine independent variables were included in the model, no variables remained significant. Together all nine independent variables accounted for 28.1% of variance present within PCL sum scores.

Table 10.

Relationship between Measures of Emotion Regulation, Distress Tolerance, and Posttraumatic Stress Disorder Symptoms.

	β	***R^2 Change***	***R^2***	***p***
Step 1: Covariates		.02	.02	
Gender	.14			.16
Step 2: Other Measures of Emotion Regulation		.17	.19	
Gender	.09			.32
Anxiety Sensitivity Index	.10			.36
Acceptance and Action Questionnaire	.35			<.01
Step 3: Measures of Distress Tolerance		.06	.25	
Gender	.08			.37
Anxiety Sensitivity Index	.10			.39
Acceptance and Action Questionnaire	.23			.06
Measure of Ambiguity Tolerance Scale	.10			.34
Intolerance of Uncertainty Scale	-.09			.42
Distress Intolerance Scale	-.16			.11
Step 4: Behavioral DT Tasks		.04	.28	
Gender	.06			.51
Anxiety Sensitivity Index	.13			.25

Table 10 continues

Table 10 continued

Acceptance and Action Questionnaire	.23			.07
Distress Tolerance Scale	-.19			.11
Measure of Ambiguity Tolerance Scale	.07			.49
Intolerance of Uncertainty Scale	-.11			.35
Distress Intolerance Scale	-.17			.08
Breath Holding Task	.19			.06
PASAT-C	-.01			.89

Note: Analysis conducted among participants completing all three sessions and endorsing at least one lifetime traumatic event; however, due to missing data on the Intolerance of Uncertainty Scale the final $n = 101$.

Relationship between self-report measures of emotion regulation, self-report measures of DT, behavioral measures of DT, and global distress (Table 11). A four-step hierarchical multiple linear regression was conducted among the whole sample with the SCL-27 Global Index sum score as the dependent variable. Gender was entered at stage one, self-report emotion regulation variables were entered at stage two (Acceptance and Action Questionnaire and Anxiety Sensitivity Index), self-report DT variables at stage three (Distress Tolerance Scale, Discomfort Intolerance Scale, Measure of Ambiguity Tolerance Scale, Intolerance of Uncertainty Scale) and behavioral DT variables at stage four (Session 2 PASAT-C, Session 2 BHT). The regression showed that stage one did not significantly contributed to the model ($F(1,107) = .30$, $p > .05$) and accounted for none of the variation in SCL-27 sum scores. The

regression showed that stage two significantly contributed to the model (F (2,105) = 26.77, p < .001) and accounted for 43.1% of variation in SCL-27 scores. The addition of self-report DT variables to the model accounted for 1.7% of variation in SCL-27 scores but was not significant (F (4, 101) = 11.84, p > .05). Introducing behavioral DT variables also explained an additional 1.7% of variation and the change in R^2 was not significant (F (2,99) = 9.68, p > .05). When all nine independent variables were included in the model, the self-report Acceptance and Action Questionnaire sum score and Anxiety Sensitivity Index sum score remained significant (βs = .30, .37, ps < .01) indicating that greater levels of self-reported avoidance and sensitivity to anxiety were associated with greater global distress. Together all nine independent variables accounted for 46.8% of variance present within SCL sum scores.

Table 11.

Relationship between Measures of Emotion Regulation, Distress Tolerance, and Global Mental Health.

	β	***R^2 Change***	***R^2***	***p***
Step 1: Covariates		<.01	<.01	
Gender	.05			.59
Step 2: Other Measures of Emotion Regulation		.43	.43	
Gender	-.05			.51
Anxiety Sensitivity Index	.27			<.01
Acceptance and Action Questionnaire	.48			<.001
Step 3: Measures of Distress Tolerance		.02	.45	
Gender	-.04			.57
Anxiety Sensitivity Index	.26			<.01
Acceptance and Action Questionnaire	.40			<.001
Distress Tolerance Scale	-.16			.10
Measure of Ambiguity Tolerance Scale	.01			.98
Intolerance of Uncertainty Scale	-.05			.57
Distress Intolerance Scale	-.03			.76
Step 4: Behavioral DT Tasks		.02	.47	
Gender	-.06			.47

Table 11 continues

Table 11 continued

Anxiety Sensitivity Index	.30			<.01
Acceptance and Action Questionnaire	.37			<.01
Distress Tolerance Scale	-.17			.08
Measure of Ambiguity Tolerance Scale	-.02			.84
Intolerance of Uncertainty Scale	-.07			.845
Distress Intolerance Scale	-.03			.68
Breath Holding Task	.11			.14
PASAT-C	.07			.36

Note: Analysis conducted among participants completing all three sessions; however, due to missing data on the Intolerance of Uncertainty Scale the final $n = 109$.

Discussion

This primary aim of the present study was to examine the test-retest reliability of the PASAT-C, and to compare modality of delivery in both the PASAT-C and BHT. In the present study, there were three main findings: a) test-retest reliability estimates were within acceptable ranges (Stommel & Willis, 2004) for both the BHT and PASAT-C, regardless of testing modality (laboratory or online), b) BHT performance differed significantly by modality, with longer quit latencies present within the laboratory modality compared to those exhibited in the online modality while PASAT-C performance was not significantly influenced by the modality, c) number of distractors endorsed was not significantly correlated with performance on behavioral

tasks within either modality, and furthermore the average number of distractors reported did not significantly differ between modality. Exploratory analyses demonstrated weak to moderate relationships among self-report measures of DT, behavioral measures of DT, and other measures of emotion regulation. However, a significant correlation was not present among self-report and behavioral measures of DT. Moreover, constructs encompassed under the umbrella of emotion regulation were significantly associated with alcohol use, PTSD symptom severity, and global distress, albeit not consistently. Each set of findings is discussed in turn.

Aim 1: Test-retest Reliability of Behavioral DT Tasks and Differences in Performance Across Modalities

Although the BHT and PASAT-C are both frequently used DT tasks in the literature (Lejuez, et al., 2003), the test-retest reliability of these tasks has not been examined, despite the fact that DT is thought to be a stable trait (Simons & Gaher, 2005). This is a critical gap in the literature because as behavioral DT tasks are increasingly used by investigators to examine the relationship between DT and psychopathology (Daughters, Lejuez, Kahler, et al., 2005); a better fundamental understanding of the construct is needed. Further, comparison of the stability of performance on these tasks on administration modalities other than in a structured laboratory environment has yet to be done. Given the benefits of online administration (e.g., ease of recruitment, time savings for the investigator, completion in settings other than laboratory) this is a needed step in this line of research. Thus, the main goals of the study were to establish the test-retest correlations of each task with approximately one week in between administrations, and further, to determine whether behavioral DT task performance was significantly influenced by modality (i.e., laboratory, online). This represents a crucial step in the literature, as DT has been demonstrated to be related to psychopathology (Lynch & Bronner, 2006; Zvolensky & Otto,

2007) and relapse after substance abuse treatment (Daughters, Lejuez, Kahler, et al., 2005), and despite these promising findings, the tasks used in these studies have not been examined for test re-test reliability.

To remain consistent with current theoretical understanding of DT and how it may be demonstrated behaviorally, each behavioral DT task should be found to elicit distress, as measured by subjective units of distress (SUDS) in order to create an opportunity to assess the degree to which an individual is willing to tolerate the distress experienced (e.g., tolerate physical distress induced by BHT, withstand frustration elicited by PASAT-C) (Zvolensky, et al., 2010). Thus, although a negative internal state is experienced, it should not be significantly associated with quit time on each task as the quit latency demonstrates the degree to which an individual is willing to persist at a task even in the face of distress. In the present study, only the PASAT-C (both in the laboratory and online) was considered distress inducing as evidenced by the change in self-reported distress pre and post task administration. Although task order was not counterbalanced, the minimal distress reported following completion of the BHT suggests that the PASAT-C was indeed distress inducing despite occurring following the BHT. However, this limitation should be taken into consideration during implementation of future studies. Although the task was perceived as distressing, quit latency was not associated with change scores, suggesting that the task is not simply a measure of negative affect. Moreover, given that the task was administered twice with approximately one week between administrations and that participants continued to endorse significant distress, these results speak to the tasks ability to elicit a stress response. If participants were not provided an opportunity to quit on the PASAT-C, the task may be successfully utilized as a stressor in a similar manner as the Trier Social Stress Test (Kirschbaum, Pirke, & Hellhammer, 1993). Although each task elicits stress via different

means (i.e., social for the Trier and frustration by the PASAT-C), each task may be used to examine stress reactions among participants. Comments regarding the tasks difficulty, for example "the task is unnecessarily stressful" (Stuss, Stethem, Hugenholtz, & Richard, 1989), additionally support the potential use of the task as a stressor that could be used to examine coping.

Although the PASAT-C was found to be distressing, the BHT was not found to create the same effect. Previous research has additionally posited that the BHT may not be sufficient in reaching the threshold necessary to create significant distress (McNally & Eke, 1996; Van Der Does, 1997). The differing levels of distress experienced in each task may lend credence to the evidence suggesting that the BHT and PASAT-C are tapping into different facets of distress tolerance, physical and emotional respectively (Leyro, et al., 2011). Conversely, it may suggest that BHT could be assessing an entirely different construct. Moreover, the influence of other variables such as motivation and interoceptive reactivity may greatly influence performance reducing the ability to directly examine the DT construct (Zvolensky, et al., 2010). Therefore, consideration must be placed into other factors that may influence performance of the BHT prior to its use as a means of assessing DT. Although assessment of the DT construct is continuing to evolve, the differences based on measurement method (i.e., self-report vs. behavioral, different forms of behavioral methods) underscore the continued need for multi-method assessment to further elucidate each task's ability to tap into the DT construct and/or the potential need to reevaluate our current conceptualization of the construct by considering alternative theories to explain the patterns within the data (i.e., lack of correlation between behavioral and self-report methods, modest correlations among measures believed to measure the same construct).

The PASAT-C test-retest reliability results within the laboratory and online conditions lend support to the growing literature characterizing DT as a relatively stable trait (Zvolensky, Leyro, Bernstein, & Vujanovic, 2011) although additional research is necessary to determine the stability across longer periods of time and to determine whether the construct being assessed by the PASAT-C is indeed DT. Moreover, although considered a trait-like characteristic, previous research also suggests that DT can be influenced by targeted interventions (Gorka, et al., 2012); (Hambrook et al., 2011). Therefore, behavioral DT tasks may provide a beneficial means of assessing the impact of interventions aimed at improving emotion regulation strategies, specifically one's ability to tolerate distress. For example, Brown and colleagues (2005) suggested that exposure therapy may greatly improve an individual's ability to cope with negative internal states, particularly as it concerns distress associated with smoking cessation. Given the stability of the PASAT-C, inclusion of behavioral measures of DT may be useful to researchers and clinicians alike in tracking progress within research settings and throughout treatment, respectively.

Given the significant uncertainty surrounding the construct and how best to measure it, further examination of the psychometric properties of behavioral tasks thought to assess DT and other variables that may influence performance is necessary. Although the DT literature remains in its nascent stage, continued effort to examine the relationship between various methods of measurement and conceptually similar constructs will improve our understanding of the construct either via refinement in existing theory or construction of a new theory that better explains differences existing between the multiple DT dimensions.

To the degree that the PASAT-C does indeed measure DT, the moderate PASAT-C test-retest reliability reinforces the potential utility of the task in the laboratory. The results

additionally demonstrate that online-based assessment may be a viable means of assessing DT given the lack of significant differences between the laboratory and online modalities on PASAT-C performance. Although small differences likely exist, the quit latency results do not appear to be compromised by the change in administration setting. As the field grows increasingly more interested in online methodologies given the ease of administrations and possibilities of reaching participants that may have not been possible previously (Scheeringa, Wright, Hunt, & Zeanah, 2006), examining the relationship between traditional methods and new online options will continue to remain a meaningful area of research. Although the PASAT-C performance did not differ significantly across modalities, the same did not hold true for the BHT. Given the physical nature of the BHT, the contribution of potentially confounding factors may be particularly relevant (Rassovsky, Kushner, Schwarze, & Wangensteem, 2000) which may have also contributed, in part, to the test-retest correlations being on the lower end of the acceptable range. Sutterlin and colleagues (Sütterlin, et al., 2013) noted levels of distress experienced during the BHT and posited that this may be due to the significant control participants possess while completing the task. The authors suggested that distress is not likely to occur as the participant may discontinue as soon as any discomfort is experienced even though instructions ask participants to hold their breath for *as long as possible*. Therefore, the BHT may be a better measure of other constructs, such as motivational processes, rather than tolerance of negative internal states (Zvolensky, et al., 2001; Zvolensky, et al., 2010).

In sum, both BHT and PASAT-C quit latencies within the laboratory and online modalities demonstrated acceptable test-retest reliability estimates across a time period of approximately one week. The mean duration of breath holding within the laboratory modality in the present sample is comparable to that identified in previous studies (M = 48.88, SD = 21.88

[McHugh, et al., 2011]). However the mean BHT performance in the online modality of the present study is much lower (M = 31.58, SD = 18.21). Previous literature on the PASAT-C mean quit latencies varies widely depending on population assessed (e.g., M = 208.7, SD = 165.2 for individuals in substance abuse treatment [Daughters et al., 2005]; M = 180.71 SD = 183.60 for trauma-exposed individuals in substance abuse treatment [(Anestis & Joiner, 2012)]; M = 250.74, SD = 178.32 for adult cigarette smokers [(Schloss & Haaga, 2011)]; M = 367.2, SD = 118.2 for adults recruited from the community [(Gorka, et al., 2012)]. However, there is limited data regarding the mean performance on the PASAT-C among undergraduate students. As demonstrated in the significant differences between self-report means and the present sample means, the present sample seems to be less tolerant of distress overall although this may also be attributable to motivational factors as well.

Aim 2: Behavioral DT Administration Checklist

Although increased interest has been placed on examining methods of implementing computerized tasks within settings outside of the laboratory, such a change increases risk of introducing confounds that may interfere with task performance and thus interpretation of results. However, examination as to whether number of distractors endorsed during the experimental session is correlated with quit latencies on behavioral DT tasks has not been examined. Thus, we attempted to create a checklist that could be easily administered following completion of behavioral DT tasks to assess for factors that may have influenced performance..

Contrary to the hypothesis, the number of predictors endorsed by participants was not significantly correlated with quit latencies on the BHT and PASAT-C. Distractors may have possessed less of an influence than originally expected or the lack of correlation could be due to the type of items selected for inclusion in the checklist. For instance, use of focus groups

consisting of college students may provide insight into additional items that should be considered for inclusion that may be more applicable to their daily lives. Additional instructions in the checklist regarding best times to complete the task may reduce the degree of distractions encountered. For example, given that one of the most highly endorsed items on the checklist included "tired/lack of energy", encouraging participants to avoid completing the tasks when fatigued could cultivate a situation where more focus could be placed on the behavioral task at hand.

Although the repeated analysis of variance did not identify a significant difference between completion of the task across time or in either modality, task completion within the laboratory setting may have also been influenced by social desirability due to the presence of a research assistant throughout task completion. Participants may have performed in a manner that they may not have otherwise done in a different setting. Perhaps a participant placed more effort in the task than they normally would have under alternate circumstances, conversely, some participants may have rushed to complete the task in order to leave the situation as soon as possible. To better understand how social desirability may play a role in performance, inclusion of a question regarding the degree of (dis)comfort experienced during the tasks and the perceived influence could be beneficial. Additionally, the self-report battery could benefit from inclusion of a social desirability scale, such as the Marlow-Crowne Social Desirability Scale (Crowne & Marlowe, 1960).

Aim 3: Exploratory Aims

3a. Relationship between self-report measures of emotion regulation, self-report measures of DT, and behavioral measures of DT. The multidimensional nature of the DT construct has given rise to multiple methods of assessing the various facets (i.e., emotional,

physical). In doing so, the aim is to identify an individual's perceived ability to tolerate distress or other negative internal states and to also examine behavioral demonstrations of DT. The many potential limitations inherent to traditional self-report measures (e.g., influence of social desirability, transient mood states, lack of insight into one's abilities) also contribute to the heightened interest in multi-method examination of DT. By reviewing the relationships between self-report measures and behavioral indices of DT, a better understanding can be cultivated regarding the simultaneously imbricating and distinct qualities of the construct.

Each of the DT self-report measures were significantly correlated with each other, albeit weakly, and in the direction expected (greater ability to tolerate distress positively correlated with greater ability to tolerate discomfort and ambiguity while the Intolerance of Uncertainty Scale was negatively correlated with the other measures). The lowest correlations existed among the Discomfort Intolerance Scale and the other self-report DT measures. Given that the Discomfort Intolerance Scale pertains to ability to tolerate pain and/or uncomfortable physical states, it seems that although it is correlated with the affective measures that it may be tapping into a different facet of DT. However, the Discomfort Intolerance Scale was not significantly related to BHT, a task that is also thought to tap into the physical domain of DT. It is perhaps the case that the Discomfort Intolerance Scale assesses an individual's beliefs regarding ability to tolerate physical distress while the BHT provides a behavioral demonstration of an individual's ability to tolerate such distress. The strength of the correlations found within the present study are consistent with those identified in the previous literature, further underscoring the similarities across the various measures of DT and the potential distinction between the affective and physical domains of the DT construct (Bernstein, et al., 2009; Marshall-Berenz, et al., 2010). However, although the correlations within the resent study are consistent with those identified

within the existing literature, determining whether DT is the specific construct being assessed by any of these various measures warrants further investigation. Although different domains may be tapped into via different methods of assessment, the weak correlations call into question whether the construct being assessed is in fact DT and the same construct being measured across each of the measures.

Although the self-report measures of DT were related, consistent with previous research (McHugh, et al., 2011), the behavioral and self-report DT measures were not significantly correlated. Although previous research has shown relationships between behavioral DT tasks, a correlation between the BHT and PASAT-C was marginally outside the level of significance. Again, the lack of significant relationship could be indicative of different constructs being assessed by each task. Additional examination of the BHT in relation to other tasks assessing motivational processes and other DT tasks may clarify our current understanding of DT. However, research in other areas has demonstrated that biological measures and self-report measures can differ greatly although they are tapping into the same construct. For example, objective measures of stress response (e.g., salivary cortisol levels) often do not correlate with subjective measures of stress (e.g., subjective units of distress) (Leininger & Skeel, 2012). Therefore, the lack of significant correlations between behavioral and self-report measures of DT warrants additional investigation; as a relationship may still be present yet exist as different dimensions of the same construct.

Greater reported levels of DT were significantly negatively and moderately associated with experiential avoidance and anxiety sensitivity as assessed via the Acceptance and Action Questionnaire and the Anxiety Sensitivity Index, respectively. These findings suggest that individuals possessing greater self-perceived DT are less likely to exhibit behaviors such as

avoidance and be less sensitive to the social, cognitive, and physical symptoms of anxiety. However, behavioral DT was not significantly associated with other emotion regulation measures, and the correlation between the BHT and PASAT-C was approaching significance. These results fall in line with the previous literature suggesting that DT lies under the umbrella of emotion regulation in addition to anxiety sensitivity and acceptance/avoidance coping and that the PASAT-C is tapping into a different facet of the DT construct (Leyro, Zvolensky, & Bernstein, 2010). This may be representative of perceived DT vs. behavioral demonstration of DT. For example, an individual may believe that they possess lower levels of DT than demonstrated by performance on a behavioral DT task, or vice versa, they may over-report their abilities on the self-report measures and demonstrate lower behavioral aptitude on the tasks.

3b. Relationship between various self-report measures of emotion regulation, self-report of DT, behavioral measures of DT and psychopathology. Deficits in constructs associated with emotion regulation, including DT, are considered to influence the perception and response to distress, which may be internal and/or external. Individuals possessing low DT may find negative internal states as unbearable which may in turn contribute to maladaptive coping behavior (e.g., avoidance; (Daughters, et al., 2009). This potential relationship has led investigator to examine levels of DT in relation to several forms of psychopathology including depression (Daughters, et al., 2009), anxiety disorders (Keough, et al., 2010), and eating disorders (Hambrook, et al., 2011). However, although one or two other emotion regulation measures are included in the analyses aimed at determining the contribution of emotion regulation and DT to psychiatric disorders, the constructs believed to overlap yet contribute independently (e.g., tolerance of uncertainty, discomfort intolerance) to symptoms have not been examined together in a single study. Moreover, determining if and how much variance in

psychiatric symptoms may be accounted for by behavioral DT tasks above that of multiple DT self-report measures has not occurred. By including measures of emotion regulation (e.g., anxiety sensitivity, experiential avoidance) and multiple methods of assessing DT (i.e., self-report, behavioral), the contribution of each of the factors can be examined in relation to one anther.

Alcohol use. Consumption of at least one alcoholic beverage was endorsed by 63.5% of participants. On the AUDIT, 74.4% would fall under the low risk category, 18.7% in the risky/hazardous category, 6% in the high-risk/harmful category, and .9% in the high-risk/possible dependence category of drinking (Babor, et al., 1992). The mean AUDIT score was 5.15 (*SD* = .37), which is slightly lower than previous work examining alcohol use in a college sample (*M* = 7.00, *SD* = .30; Kokotailo, et al., 2004). Self-report emotion regulation, self-report DT, and behavioral DT tasks accounted for approximately 18.1% of variance in AUDIT scores. Greater ability to tolerate distress as assessed via the DTS was associated with lower levels of alcohol use above and beyond the contribution of other self-report measures and behavioral DT tasks. Previous research has also noted the unique contribution of DT to alcohol coping motives above and beyond the variance accounted for by anxiety sensitivity and discomfort intolerance (Howell, Leyro, Hogan, Buckner, & Zvolensky, 2010). Taken together, these findings may suggest that DT is an underlying mechanism by which inability to tolerate distress contributes to self-medication via substance use; however, this theory is in need of empirical examination.

Although prior studies have demonstrated significant relationships between alcohol use outcomes and DT (Buckner, Keough, & Schmidt, 2007) there are numerous potential reasons why the present study only found a modest relationship. First, it could be that the population studied was not affected by severe psychopathology, and perhaps a relationship between DT and

alcohol use outcomes is moderated by psychopathology. For example, previous research suggests that the presence of low DT among depressed individuals may contribute to alcohol use (Buckner, et al., 2007; Gorka, et al., 2012). Therefore, it may be necessary to examine the contribution of DT in those experiencing significant distress, such as depression, in order to see larger effects. It is also possible that the demographics of population studied contributed to the modest findings. Given that the population examined in the present study consisted of young undergraduate students could suggest that the participants are early in there drinking career and not experiencing a significant amount of psychopathology, thereby influencing the ability to examine the true contribution of DT. Lastly, it could be that trait-level DT is not related to global alcohol use problems, but rather might be related to quantity/frequency of alcohol use, or reasons for alcohol use, such as drinking to cope (Howell, et al., 2010). Moreover, it may be that negative urgency plays a more significant role in substance use than distress tolerance when examining the impact of responding to negative affect (Kaiser, Milich, Lynam, & Charnigo, 2012).

Although modest, self-report DT as assessed via the Distress Tolerance Scale, was significantly correlated with alcohol use problems suggesting the targeted interventions aimed at elevating perceived levels of DT may aid in improving alcohol use difficulties. Studies implementing an adjunct DT intervention (Skills for Improving Distress intolerance; SIDI) within a clinical population in treatment for a substance use disorder found a significantly greater improvement in DT compared to treatment as usual and supportive counseling groups. DT was assessed via behavioral tasks (i.e., PASAT, MTPT) pre and post intervention and the results suggest that such behavioral tasks used within a clinical population may prove useful (Bornovalova, Gratz, Daughters, Hunt, & Lejuez, 2012). The intervention consisted of six

sessions that covered a range of techniques aimed at bolstering DT including "healthy distraction" and emotional exposure (Bornovalova, et al., 2012) however alcohol use was not a main outcome measures and follow-up to determine the long lasting effects of the intervention did not occur.

PTSD symptoms. Approximately 86% of the sample endorsed experiencing at least one traumatic event within their lifetime consistent with findings from previous epidemiological studies (Breslau, Davis, Andreski, Federman, & Anthony, 1998). Exposure to accidental trauma (e.g., serious accident at work, transportation accident) was the most frequently reported trauma (31.2%) and 18.1% of the sample met the cut-off score of 50 for PTSD on the Posttraumatic Stress Disorder Checklist (Weathers, et al., 1993). Prevalence of PTSD within the present sample is somewhat higher than those found in other college samples (12%, Bernat, Ronfeldt, Calhoun, & Arias; Watson & Haynes, 2007). However, the higher prevalence rate could be associated with a several other factors that were not assessed in the present study. Self-reported emotion regulation, self-reported DT, and behavioral DT tasks accounted for 28.1% of the variance in PTSD symptoms as assessed via the PCL. Although no single self-report emotion regulation measure, self-report DT measure, or behavioral DT measure was significantly associated with PTSD symptoms when all nine measures were included; the inclusion of self-report emotion regulation measures did significantly contribute to the model (e.g., Action and Acceptance Questionnaire). Previous research has suggested that self-perceived ability to cope with distress elicited by an event may be more important to the development of PTSD symptoms than demonstrated (i.e., behavioral) measures (Marshall-Berenz, et al., 2010). An individual's perception of ability to cope with a distressing event may be more relevant to the development of PTSD symptoms and other forms of psychopathology than exposure itself (Marx & Sloan, 2002)

Therefore an individual that views themselves as incapable of coping may be more inclined to utilize maladaptive behaviors such as avoidance, thereby increasing symptom severity.

Global distress. The mean score on the Global Scale Index of the SCL-27 within the present sample was .85 (*SD* = .05), which is similar to mean scores identified within non-clinical populations (Kuncewicz, Dragan, & Hardt, 2014). Emotion regulation, self-reported DT, and behavioral DT accounted for 45.1% of variance in SCL global distress scores. The amount of variance accounted for by the emotion regulation measures is more than that in the other forms of psychiatric symptoms examined in the present study (i.e., alcohol use, PTSD). This could be due to multiple possible reasons including the restricted sample size available in the PTSD analyses (completed in those that had experienced at least one lifetime traumatic event) and the lower levels of alcohol use present within the sample when the relationship between measures of emotion regulation and alcohol were reviewed. It could also be attributable to the notion that emotion regulation could be related to psychopathology more broadly, which was assessed with the Symptoms Checklist, rather than a specific fashion, which was examined in the previous two analyses. Perceptions of one's ability to cope may be more relevant to general internalizing disorder symptoms that a particular disorder or externalizing problems (Aldao, Nolen-Hoeksema, & Schweizer, 2010). Higher levels of avoidance and anxiety sensitivity were significantly associated with global distress, which is consistent with previous studies examining the contribution of emotion regulation to psychopathology (Leyro, et al., 2011; McNally, 2002). High degrees of avoidance may be indicative of psychological inflexibility where individuals select to avoid negative internal states which may reduce negative states in the present moment but contribute to greater distress in the long run (Timpano, et al., 2009). Moreover, strong sensitivity to physical symptoms associated with anxiety may contribute to efforts to avoid and

in turn increase distress experienced. Thus, sensitivity to the experience of anxiety may lead to alterations in how one copes with emotions; therefore additional examination of the causal pathways between distress, psychopathology, and emotion regulation is necessary to better understand of these factors.

Taken together, examination of the scales suggests that each construct pertains to small but significant aspects of emotion regulation and its contribution to mental health. Furthermore, not a single scale was consistently associated with all measures of psychopathology. As demonstrated by the correlation matrices between the DT measures, emotion regulation measures and the significant models predicting various forms of psychopathology, DT and other measures of emotion regulation are highly related and likely contribute to mental health although parsing out these individual components may prove ineffective. Previous work enlisting principle component analyses has demonstrated a higher order latent factor, encompassing both anxiety sensitivity and DT (Bernstein, et al., 2009). Although both anxiety sensitivity and DT are correlated and appear to be lower order factors under the same higher order factor, each is distinct in their contribution to mental health outcomes (Bernstein, et al., 2009). Given the findings of the present study, it would be beneficial to examine DT within the nomological net of emotion regulation to determine if a composite emotion regulation may better serve the function of predicting mental health issues.

Summary

The present study is the first to examine the test-retest reliability of the PASAT-C and to compare DT task performance on both PASAT-C and the BHT in two modalities (i.e., laboratory and online). The test-retest reliabilities for both DT tasks were within the acceptable range and the average quit latency on the PASAT-C did not differ significantly across modality and was

found to be significantly distressing in both settings as assessed by the pre-post distress ratings. However, the BHT performance did differ significantly across modality, which suggests that other factors may be more relevant in the online condition when compared to the laboratory condition (e.g., degree of effort). Moreover, the BHT also seemed to be heavily influenced, not from external factors but from potential internal variables such as motivation. The test-retest estimates were moderate and participants did not experience a significant increase in distress post task. Additional research is necessary to clarify our understanding as to whether the BHT is tapping into the DT construct or may be more representative of other underlying processes.

Contrary to hypothesis, number of predictors endorsed was not significantly associated with quit latencies on either DT task in either modality (i.e., laboratory, online). Moreover, the number of distractors reported was not significantly influenced by session, modality, or an interaction of the two. The most commonly cited distractors included "tired/lack of energy" and "disinterest in the task" in the laboratory modality and "outside noise", "music", and "texting" in the online modality, each being endorsed by over 20% of the sample.

Measures of DT were significantly correlated with one another and the behavioral measures of DT were correlated with one another yet the self-report and behavioral measures of DT were not significantly related to each other. As suggested by current conceptualization of the DT construct, these measures could be tapping into different facets of the same construct (i.e., behavioral and affective (Zvolensky, et al., 2010). This could also indicate that the measures are examining entirely different constructs altogether, thus additional examination of the relationship between these measures and their relationship to psychiatric outcomes is necessary. Finally, the present study contributed to the study the imbricating yet distinct constructs that accounted for a significant amount of variance in alcohol use, PTSD symptoms, and global psychiatric distress.

Limitations

Despite the promising results presented in this study, several note worthy limitations exist. First, the study was conducted within a small sample of undergraduate students consisting predominately of women, which limits generalizability to other populations. Second, randomization was not done due to difficulties to transitioning the task to the online modality. However, this limitation is somewhat mitigated by the fact that no significant differences existed between groups in regards to age, gender, marital status, smoking status, and responses to measures administered. Third, the order of the behavioral DT tasks was not randomized and a non-stress inducing task was not included in between BHT and PASAT-C tasks, thus, carry over effects could exist. This is unlikely, however, as the BHT did not elicit an increase in subjective distress levels. Fourth, additional research is necessary to examine these tasks in clinical populations where many of the symptoms assessed in the present study (i.e., problematic alcohol use, PTSD, global distress) may be more relevant. Fifth, the design of the present study is cross-sectional therefore causation cannot be inferred. Although it is hypothesized that DT is a stable trait that may influence how and individual copes with negative affect (Lynch & Bronner, 2006; Zvolensky & Otto, 2007) stressful events such as exposure to a potentially traumatic event could influence of DT and significantly impact post-trauma coping. Further, interventions have been found to be associated with changes in DT levels (Bornovalova, et al., 2012), thus, DT is amenable to influence by environmental factors. Future studies should employ a longitudinal design, which would provide an opportunity to examine the trajectory of DT across age and development, and further, would allow for examination of potential causal models of key events in association with DT (e.g., exposure to potentially traumatic events may alter DT levels). Finally, within the wider context of online administration, additional focus must be placed on

more practical issues including confounding factors that may significantly influence results, such as (e.g., completing in a quit location, not performing tasks on cell phone). Although the checklist provided did not account for a large amount of variance, it may be worthwhile to create a larger set of items that may be presented in larger studies in order to identify factors found to be most relevant to participants. For example, a qualitative portion where participants may provide any information that may have affected their performance could be examined and used to create a more formal scale.

Future Directions

These results hold promise regarding the utility of including behavioral tasks such as the PASAT-C in studies of distress tolerance. For example, previous research suggests a genetic contribution to distress tolerance. Given the potential utility of behavioral DT tasks in assessing the DT construct, these tasks could be administered online in the large samples necessary to conduct genetic analyses. In doing so, the relative contribution of genes to DT can be estimated. This would additionally aid in our understanding of DT as whole, further clarifying the contribution of environmental factors to the construct. Since minimal differences likely exist between the two modalities (laboratory and online), the larger sample sizes possible by incorporating online methodologies may outweigh the possible limitations.

Furthermore, recognizing the significant contribution of various emotion regulation measures (including DT) to psychopathology, it may be beneficial to utilize a number of emotion regulation relevant measures in the assessment of various forms of psychiatric symptoms rather than one factor independently. Although examination of potential DT interventions have begun (SIDI; (Bornovalova, et al., 2012), incorporating multiple measures of emotion regulation in addition to DT could improve our understanding of each of these factors, how they may

influence one another, and if treatments aimed at DT also improve other forms of emotions regulation.

Finally, use of structural equation modeling may prove beneficial in examining the complex relationship between various measures of DT and emotion regulation. Given that these constructs appear to overlap substantially, the use of more sophisticated modeling techniques could elucidate the relationships more thoroughly.

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Appendix A

Acceptance and Action Questionnaire-II

Instructions: Below you will find a list of statements. Please rate how true each statement is for you by circling the number next to it. Use the scale below to make your choice.

		Never True						Always True
1.	My painful experiences and memories make it difficult for me to live a life that I would value.	1	2	3	4	5	6	7
2.	I'm afraid of my feelings.	1	2	3	4	5	6	7
3.	I worry about not being able to control my worries and feelings.	1	2	3	4	5	6	7
4.	My painful memories prevent me from having a fulfilling life.	1	2	3	4	5	6	7
5.	Emotions cause problems in my life.	1	2	3	4	5	6	7
6.	It seems like most people are handling their lives better than I am.	1	2	3	4	5	6	7
7.	Worries get in the way of my success.	1	2	3	4	5	6	7

Appendix B

Anxiety Sensitivity Intolerance

Instructions: Please read each item and decide which response best represents the extent to which you agree with the item.

	Very Little				Very Much
1. It is important for me not to appear nervous.	0	1	2	3	4
2. When I cannot keep my mind on a task, I worry that I might be going crazy.	0	1	2	3	4
3. It scares me when I feel "shaky" (trembling).	0	1	2	3	4
4. It scares me when I feel faint.	0	1	2	3	4
5. It is important to me to stay in control of my emotions.	0	1	2	3	4
6. It scares me when my heart beats rapidly.	0	1	2	3	4
7. It embarrasses me when my stomach growls.	0	1	2	3	4
8. It scares me when I am nauseous.	0	1	2	3	4
9. When I notice that my heart is beating rapidly, I worry that I might have had a heart attack.	0	1	2	3	4
10. It scares me when I become short of breath.	0	1	2	3	4
11. When my stomach is upset, I worry that I might be seriously ill.	0	1	2	3	4
12. It scares me when I am unable to keep my mind on a task.	0	1	2	3	4
13. Other people notice when I feel shaky.	0	1	2	3	4
14. Unusual body sensations scare me.	0	1	2	3	4

15. When I am nervous, I worry that I might be mentally ill.	0	1	2	3	4
16. It scares me when I am nervous.	0	1	2	3	4

Appendix C

Alcohol Use Disorders Identification Test

Instructions: Please answer the questions below about your use of alcoholic beverages during the past year. “Alcoholic beverages” are considered beer, wine, vodka, etc.

1. How often do you have a drink containing alcohol?
(0) Never (skip to questions 9-10)
(1) Monthly or less
(2) 2 to 4 times a month
(3) 2 to 3 times a week
(4) 4 or more times a week

2. How many drinks containing alcohol do you have on a typical day when you are drinking?
(0) 1 or 2
(1) 3 or 4
(2) 5 or 6
(3) 7, 8, or 9
(4) 10 or more standard drinks

3. How often do you have six or more drinks on one occasion?
(0) Never
(1) Less than monthly
(2) Monthly
(3) Weekly
(4) Daily or almost daily

4. How often during the last year have you found that you were not able to stop drinking once you had started?
(0) Never
(1) Less than monthly
(2) Monthly
(3) Weekly
(4) Daily or almost daily

5. How often during the last year have you failed to do what was normally expected from you because of drinking?
(0) Never
(1) Less than monthly
(2) Monthly
(3) Weekly

(4) Daily or almost daily

6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?
(0) Never
(1) Less than monthly
(2) Monthly
(3) Weekly
(4) Daily or almost daily

7. How often during the last year have you had a feeling of guilt or remorse after drinking?
(0) Never
(1) Less than monthly
(2) Monthly
(3) Weekly
(4) Daily or almost daily

8. How often during the last year have you been unable to remember what happened the night before because you had been drinking?
(0) Never
(1) Less than monthly
(2) Monthly
(3) Weekly
(4) Daily or almost daily

9. Have you or someone else been injured as a result of your drinking?
(0) No
(2) Yes, but not in the last year
(4) Yes, during the last year

10. Has a relative or friend or a doctor or another health worker been concerned about your drinking or suggested you cut down?
(0) No.
(2) Yes, but not in the last year
(4) Yes, during the last year

Appendix D

Behavioral Distress Tolerance Online Administration Checklist

Instructions: Please answer the following questions, then circle all items that may have affected your performance during the computerized task you just completed.

Were the behavioral tasks completed either within the laboratory or your home environment (e.g. dorm, apartment, family home)? YES NO

If no, where were the tasks completed and by what means (e.g. on phone while commuting to class)?

External Level Distractions

1. Outside Noise (e.g. children yelling outside)
2. Someone knocking on door (e.g. mailman)
3. Pet
4. Music (personal/others)
5. Ambulances/emergency vehicles/roadwork/construction

Social Level Distractions

6. Roommates
7. Significant other
8. Friends
9. Caring for family/children

Dual Attention Distractions

10. Television
11. Talking on phone
12. Texting
13. Social Media
14. Video games
15. Class work
16. Eating food
17. Cooking/baking
18. Alcohol/drug use

Computer Level Distractions

19. Internet connection difficulties
20. Computer Dying
21. Speaker volume issues

Internal Level Distractions

22. Not allocating enough time to complete (i.e. rushing)
23. Having to use restroom
24. Remembering something that needed to be done at the house (e.g. bills)
25. Tired/lack of energy
26. *Disinterest in task*
27. *Smoke break*
28. *Trouble understanding certain questions/tasks*

Other things that you believe may have affected your performance (please list below):

Appendix E

Discomfort Intolerance Scale

Instructions: Please read each statement below carefully and circle the number that best represents the degree to which you agree or disagree with the statement.

		Agree Strongly						Disagree Strongly
1.	I can tolerate a great deal of physical discomfort.	0	1	2	3	4	5	6
2.	I have a high pain threshold.	0	1	2	3	4	5	6
3.	I take extreme measures to avoid feeling physically uncomfortable.	0	1	2	3	4	5	6
4.	When I begin to feel physically uncomfortable, I quickly take steps to relieve the discomfort.	0	1	2	3	4	5	6
5.	I am more sensitive to feeling discomfort compared to most persons.	0	1	2	3	4	5	6

Appendix F

Distress Tolerance Scale

Instructions: Think of the times that you feel distressed or upset. Circle the number that best describes your beliefs about feeling distressed or upset.

		Strongly Agree		Neutral		Strongly Disagree
1.	Feeling distressed or upset is unbearable to me.	1	2	3	4	5
2.	When I feel distressed or upset, all I can think about is how bad I feel.	1	2	3	4	5
3.	I can't handle feeling distressed or upset.	1	2	3	4	5
4.	My feelings of distress are so intense that they completely take over.	1	2	3	4	5
5.	There's nothing worse than feeling distressed or upset.	1	2	3	4	5
6.	I can tolerate being distressed or upset as well as most people.	1	2	3	4	5
7.	My feelings of distress or being upset are not acceptable.	1	2	3	4	5
8.	I'll do anything to avoid feeling distressed or upset.	1	2	3	4	5
9.	Other people seem to be able to tolerate feeling distressed or upset better than I can.	1	2	3	4	5
10.	Being distressed or upset is always a major ordeal for me.	1	2	3	4	5
11.	I am ashamed of myself when I feel					

	distressed or upset.	1	2	3	4	5
12.	My feelings of distress or being upset scare me.	1	2	3	4	5
13.	I'll do anything to stop feeling distressed or upset.	1	2	3	4	5
14.	When I feel distressed or upset, I cannot help but concentrate on how bad the distress actually feels.	1	2	3	4	5

Appendix G

Intolerance of Uncertainty Scale

Instructions: Please read each statement below carefully and circle the number that best represents how characteristic the statement is of you.

	Not at All				Entirely Characteristic of Me
1. Unforeseen events upset me greatly.	1	2	3	4	5
2. It frustrates me not having all the information I need.	1	2	3	4	5
3. One should always look ahead so as to avoid surprises.	1	2	3	4	5
4. A small, unforeseen event can spoil everything, even with the best planning.	1	2	3	4	5
5. I always want to know what the future has in store for me.	1	2	3	4	5
6. I can't stand being taken by surprise.	1	2	3	4	5
7. I should be able to organize everything in advance.	1	2	3	4	5
8. Uncertainty keeps me from living a full life.	1	2	3	4	5
9. When it's time to act, uncertainty paralyzes me.	1	2	3	4	5
10. When I am uncertain, I can't function very well.	1	2	3	4	5
11. The smallest doubt can stop me from acting.	1	2	3	4	5
12. I must get away from all uncertain situations.	1	2	3	4	5

Appendix H

LIFE EVENTS CHECKLIST

PART 1: Listed below are a number of difficult or stressful things that sometimes happen to people. For each event check one or more of the boxes to the right to indicate that: (a) it *happened to you* personally, (b) you *witnessed it* happen to someone else, (c) you *learned about it* happening to someone close to you, (d) you're *not sure* if it fits, or (e) it *doesn't apply* to you. Please check *at least one box* for each type of event, even if you check *doesn't apply*.

Be sure to consider your *entire life* (growing up as well as adulthood) as you go through the list of events.

	Event	*Happened to me*	*Witnessed it*	*Learned about it*	*Not Sure*	*Doesn't apply*
1.	**Natural disaster (for example, flood, hurricane, tornado, earthquake)**					
2.	**Fire or explosion**					
3.	**Transportation accident (for example, car accident, boat accident, train wreck, plane crash)**					
4.	**Serious accident at work, home, or during recreational activity**					
5.	**Exposure to toxic substance (for example, dangerous chemicals, radiation)**					
6.	**Physical assault (for example, being attacked, hit, slapped, kicked, beaten up)**					
7.	**Assault with a weapon (for example, being shot, stabbed, threatened with a knife, gun, bomb)**					
8.	**Sexual assault (rape, attempted rape, made to perform any type of sexual act through force or threat of harm)**					
9.	**Other unwanted or uncomfortable sexual experience**					
10.	**Combat or exposure to a war-zone (in the military or as a civilian)**					

11.	**Captivity (for example, being kidnapped, abducted, held hostage, prisoner of war)**					
12.	**Life-threatening illness or injury**					
13.	**Severe human suffering**					
14.	**Sudden, violent death (for example, homicide, suicide)**					
15.	**Sudden, unexpected death of someone close to you**					
16.	**Serious injury, harm, or death you caused to someone else**					
17.	**Any other very stressful event or experience**					

********Please place a star next to next to the event that you consider to be the WORST (the one that has caused you the most problems.)********

PART 2 of Life Events Checklist:

A. If you checked anything besides *doesn't apply* for #17 in PART 1, briefly identify the event you were thinking of:

_____

B. If you have experienced more than one of the events in PART 1, think about the event you consider the *WORST* overall *(the one that you put a star next to).* Please answer the following questions about the worst event. If you have experienced only one of the events in PART 1, use that one as the worst event.

A. How did you experience the *worst event*? □ Happened to me □ Witnessed it □ Learned about it **B. Was anyone's life in danger?** □ Yes, my life □ Yes, someone else's life □ No	**C. Was anyone seriously injured or killed?** □ Yes, I was seriously injured □ Yes, someone else was seriously injured or killed □ No	**D. Was anyone threatened with serious physical harm, even if they weren't actually injured or killed?** □ Yes, I was □ Yes, someone else was □ No	**E. Did you feel terrified or horrified at what was happening?** □ Yes, as the event was happening □ Not at the time, but I did when I thought about it later □ No	**F. Did you feel completely helpless to change the situation?** □ Yes □ No **G. How old were you when this happened?** Age _____	**H. How many times have you experienced this kind of event (an event that was as stressful or nearly as stressful as the worst event)?** □ Worst event was the only time □ More than once (total # of times _____)

C. Please briefly describe the worst event in the space below *(for example, what happened, who was involved, etc.).*

_____

_____

_____

_____

D. If you have NEVER experienced any of the events listed above, please briefly describe the most stressful experience you have ever had in the space below *(for example, what happened, who was involved, etc.).*

_____

_____

_____

_____

Appendix I

Measure of Ambiguity Tolerance Scale

Instructions: Please do not spend too much time on the following items. There are no right or wrong answers and therefore your response is important. Mark *T* for true and *F* for false. Be sure to answer every question.

	True	False
1. A problem has little attraction for me if I don't think it has a solution.	T	F
2. I am just a little uncomfortable with people unless I feel that I can understand their behavior.	T	F
3. There's a right way and a wrong way to do almost everything.	T	F
4. I would rather bet 1 to 6 on a long shot than 3 to 1 on a probable winner.	T	F
5. The way to understand complex problems is to be concerned with their larger aspects instead of breaking them into smaller pieces.	T	F
6. I get pretty anxious when I'm in a social situation over which I have no control.	T	F
7. Practically every problem has a solution.	T	F
8. It bothers me when I am unable to follow another person's train of thought.	T	F
9. I have always felt that there is a clear difference between right and wrong.	T	F
10. It bothers me when I don't know how other people react to me.	T	F
11. Nothing gets accomplished in this world unless you stick to some basic rules.	T	F
12. If I were a doctor, I would prefer the uncertainties of a psychiatrist to the clear and definite work of someone like a surgeon or X-ray specialist.	T	F

13. Vague and impressionistic pictures really have little appeal for me. T F

14. If I were a scientist, it would bother me that my work would never be completed (because science will always make new discoveries). T F

15. Before an examination, I feel much less anxious if I know how many questions there will be. T F

16. The best part of working a jigsaw puzzle is putting in that last piece. T F

17. Sometimes I rather enjoy going against the rules and doing things I'm not supposed to do. T F

18. I don't like to work on a problem unless there is a possibility of coming out with a clear-cut and unambiguous answer. T F

19. I like to fool around with new ideas, even if they turn out later to be a total waste of time. T F

20. Perfect balance is the essence of all good composition. T F

Appendix J

PTSD Checklist

Instructions: Below is a list of problems and complaints that people sometimes have in response to stressful life experiences. Please read each one carefully and circle the number that indicates how much you have been bothered by that problem in the last month.

	Not at all	A little bit	Moderately	Quite a bit	Extremely
1. Repeated, disturbing memories, thoughts, or images of the stressful experience?	1	2	3	4	5
2. Repeated, disturbing dreams of the stressful experience?	1	2	3	4	5
3. Suddenly acting or feeling as if the stressful experience were happening again (as if you were reliving it)?	1	2	3	4	5
4. Feeling very upset when something reminded you of the stressful experience?	1	2	3	4	5
5. Having physical reactions (e.g., heart pounding, trouble breathing, or sweating) when something reminded you of the stressful experience?	1	2	3	4	5
6. Avoid thinking about or talking about the stressful experience or avoid having feelings related to it?	1	2	3	4	5
7. Avoid activities or situations because they remind you of the stressful experience?	1	2	3	4	5
8. Trouble remembering important parts of the stressful experience?	1	2	3	4	5
9. Loss of interest in things that you used to enjoy?	1	2	3	4	5

10. Feeling distant or cut off from other people?	1	2	3	4	5
11. Feeling emotionally numb or being unable to have loving feelings for those close to you?	1	2	3	4	5
12. Feeling as if your future will somehow be cut short?	1	2	3	4	5
13. Trouble falling or staying asleep?	1	2	3	4	5
14. Feeling irritable or having angry outbursts?	1	2	3	4	5
15. Having difficulty concentrating?	1	2	3	4	5
16. Being “super alert” or watchful on guard?	1	2	3	4	5
17. Feeling jumpy or easily startled?	1	2	3	4	5

Appendix K

Symptom Checklist-27

How much discomfort have you had because of _____ during the last 7 days?	Not at all	A little	Moderately	Quite a bit	Extremely
1. feeling very self-conscious with others	1	2	3	4	5
2. feeling blue	1	2	3	4	5
3. feeling afraid to go out of your house alone	1	2	3	4	5
4. feeling fearful	1	2	3	4	5
5. thoughts of death or dying	1	2	3	4	5
6. your mind going blank	1	2	3	4	5
7. trouble remembering things	1	2	3	4	5
8. feeling that people are unfriendly or dislike you	1	2	3	4	5
9. feeling low in energy or slowed down	1	2	3	4	5
10. nausea or upset stomach	1	2	3	4	5
11. hot or cold spells	1	2	3	4	5
12. others not giving you proper credit for your achievements	1	2	3	4	5
13. faintness or dizziness	1	2	3	4	5
14. feeling that people will take advantage of you if you let them	1	2	3	4	5
15. feeling hopelessness about the future	1	2	3	4	5
16. a lump in your throat	1	2	3	4	5

17. feeling that most people cannot be trusted	1	2	3	4	5
18. heart pounding or racing	1	2	3	4	5
19. having ideas or beliefs that others do not share	1	2	3	4	5
20. feeling afraid you will faint in public	1	2	3	4	5
21. feeling inferior to others	1	2	3	4	5
22. thoughts of ending your life	1	2	3	4	5
23. feeling uneasy when people are watching or talking about you	1	2	3	4	5
24. trouble concentrating	1	2	3	4	5
25. having to avoid certain things, places or activities that frighten you	1	2	3	4	5
26. trouble getting your breath	1	2	3	4	5
27. feeling afraid in open spaces or on the streets	1	2	3	4	5

Vita

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