Published in final edited form as:

J Trauma Stress. 2018 December ; 31(6): 876–885. doi:10.1002/jts.22349.

The Nomological Network of a Behavioral Distress Tolerance Task in Veterans

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Abstract

There is a relative lack of distress tolerance (DT) research in veteran samples, as well as a need for better understanding of behavioral measures of DT as they relate to theoretically similar constructs. The aims of the study were (1) to evaluate convergent and discriminant validity of a behavioral measure of DT compared to theoretically similar (i.e., self-report DT, negative urgency) and dissimilar (i.e., risk-taking) constructs and (2) to evaluate the concurrent validity of DT in relation to posttraumatic stress disorder (PTSD) and depressive symptoms in a veteran sample. A sample of veterans who served post-September 11, 2001 ($N = 306$, 89.9% male, aged 21–40 [$M = 30.2$, $SD = 4.5$]) completed self-report and behavioral measures of DT, risk-taking, impulsivity, and depressive symptoms, and completed a clinical interview for PTSD. Results of a multitrait-multimethod matrix found significant, yet minimal shared variance ($r^2 = .01$ to $.03$) between the self-report and behavioral DT measures. A series of multiple regressions examined the relative contribution of the behavioral and self-report DT measures in the prediction of PTSD and depressive symptoms. Self-reported, but not behavioral, DT accounted for unique variance in PTSD ($r^2 = .12$) and depressive symptoms ($r^2 = .23$). Participants with PTSD or higher depressive scores were more likely to report greater increases in frustration and irritability after completing the behavioral task. Results indicate that DT is not a unidimensional construct and must be considered in the context of specific emotions (e.g., tolerance of irritability vs fear) and contexts (e.g., behavioral, affective).

Distress tolerance (DT) is conceptualized as an individual's perceived or actual capacity to tolerate negative internal states (i.e., uncertainty, ambiguity, frustration, negative emotion, physical discomfort; Simons & Gaher, 2005). Predominant theories of DT posit that those

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with limited ability to tolerate distressing stimuli are prone to engage in maladaptive responding to avoid or escape distress, and this tendency may increase risk and serve to maintain psychopathology (Leyro, Zvolensky, & Bernstein, 2010). The empirical literature has demonstrated that low DT is associated with the development and maintenance of broad classes of psychopathology including posttraumatic stress disorder (PTSD), depression, anxiety, and substance use (e.g., Daughters et al., 2005; Keough, Riccardi, Timpano, Mitchell, & Schmidt, 2010; Marshall-Berenz, Vujanovic, Bonn-Miller, Bernstein, & Zvolensky, 2010; Williams, Thompson, & Andrews, 2013). DT plays a central role in some evidence-based treatments (Leyro et al., 2010), and studies have demonstrated that changes in DT are associated with treatment outcome, (Banducci et al., 2017; Bornoalova, Gratz, Daughters, Hunt, & Lejuez, 2012; McHugh et al., 2014), underscoring the clinical significance of this construct.

Despite this, there is much work to be done to empirically validate the broad construct and its measurement, particularly with regard to behavioral measures (Leyro, et al., 2010; Zvolensky, Vujanovic, Bernstein, & Leyro, 2010). Much of the DT literature has focused on self-report DT (i.e., perceived DT), most commonly utilizing the Distress Tolerance Scale (DTS; Simons & Gaher, 2005). The DTS conceptualizes DT as a multidimensional construct that captures a person's ability to *tolerate* distressing emotions (i.e., "tolerance"), their subjective beliefs about distress and their ability to cope (i.e., "appraisal"), the extent to which their attention is dominated by distressing emotion (i.e., "absorption"), and their efforts to reduce or escape from distress (i.e., "regulation"). However, research has raised concern over the problem of "conceptual circularity" between *self-report* DT and *self-report* psychiatric symptoms in which a person's perceived DT is influenced by their current psychological state or degree of distress (Leyro et al., 2010). Behavioral tasks have been developed to attempt to measure actual behavioral tendencies in an effort to circumvent this problem. Although behavioral measures of DT have demonstrated significant associations with risky sexual behavior, substance use, anti-social personality disorder, panic-specific fears, and obsessive-compulsive disorder (Brandt, Johnson, Schmidt, & Zvolensky, 2012; Cogle, Timpano, Sarawgi, Smith, & Fitch, 2013; Daughters et al., 2005; Daughters, Sargeant, Bornoalova, Gratz, & Lejuez, 2008; Tull & Gratz, 2013), there remain questions about what behavioral DT measures are indexing.

It is becoming increasingly evident from the extant literature that various measures of DT are not assessing the same single, global construct (e.g., Anestis, Selby, Fink, & Joiner, 2007; Marshall-Berenz et al., 2010; McHugh et al., 2011). Studies have found that behavioral and self-report measures of DT tend not to be significantly associated with each other (Marshall-Berenz et al., 2010; McHugh et al., 2011). Although studies have compared self-report and behavioral measures to each other, few studies have compared behavioral and self-report DT in association with other clinically-relevant outcomes. Thus, the extent to which these measures account for unique and shared variance in psychiatric outcomes is unknown (Lejuez, Banducci, & Long, 2013). The current study aimed to evaluate a behavioral DT task, the computerized Mirror-Tracing Persistence Task (MTPT-C; Strong et al., 2003). The MTPT-C is a computerized version of the mirror-image tracing task that was originally developed as a measure of trial and error learning (Starch, 1910). It was subsequently utilized as a stress-induction task in biobehavioral research for its ability to

induce psychological and cardiovascular stress (Matthews & Stoney, 1988). Persistence on the mirror-tracing task was found to be significantly reduced in nicotine, alcohol, and substance users (Quinn, Brandon, & Copeland, 1996) leading to its use as a measure of distress tolerance, primarily within the substance use literature (Strong et al., 2003; Daughters et al., 2005). However, there is currently a lack of research on the construct validity of behavioral measures of DT in association with key trauma-related disorders, such as PTSD or depression. Given the theoretical relevance of the DT construct to the etiology of trauma-related disorders (i.e., high DT may lead to more natural extinction opportunities of trauma-relevant stimuli and therefore decrease risk for the disorder), careful extension of the literature is needed.

In their review of DT measurement, Leyro and colleagues (2010) highlighted the need to validate behavioral DT measures by distinguishing task persistence in response to distressing stimuli (e.g., sensitivity to negative reinforcement manifested by escape/avoidance) versus reward contingencies (e.g., sensitivity to positive reinforcement associated with risk taking). Thus, comparison to constructs such as negative urgency, a facet of impulsivity that captures the tendency to engage in rash behavior in the face of intense negative affect (Whiteside, & Lynam, 2001), or risk taking behaviors associated with reward contingencies may further clarify the construct underlying behavioral DT measurement.

For this study, we utilized a sample of veterans who served post-September 11, 2001. Veterans are an understudied, yet important, population with regard to DT given the documented high rates of trauma exposure and psychopathology in this population (Hoge, Auchterlonie, & Milliken, 2006; Jacobson et al., 2008). Studies have also found significant associations between negative urgency, traumatic stress, and risky behavior in veterans (Dutra & Sadeh, 2017; Hahn, Tirabassi, Simons, & Simons, 2015). The limited research available on DT in veteran samples has documented associations between lower self-reported DT, greater PTSD, depressive, and substance use symptoms (Banducci, Lejuez, Dougherty, & Macpherson, 2017; Hasan, Babson, Banducci, & Bonn-Miller, 2015; Holliday, Pedersen, & Leventhal, 2016). Behavioral DT has also demonstrated significant associations with executive functioning and behavioral regulation in veterans (Shura, Rowland, & Yoash-Gantz, 2015). However, no studies to date have examined the construct validity of the MTPT-C in veteran samples. Given evidence that traumatic stress in veterans is also associated with increased risk-taking and impulsivity (James, Strom, & Leskela, 2014), veteran samples may prove valuable in testing the distinction between negative and positive reinforcement motives of task persistence.

The overarching goal of this study was to bring the nomological network of the MTPT-C specifically, and of DT more generally, into greater focus by shedding light on the boundaries of the DT construct. This was accomplished by two aims. The first aim was to examine the convergent and discriminant validity of the MTPT-C from a multitrait-multimethod framework (Campbell & Fiske, 1959) using measures validated with veteran populations. Based on the existing literature, it was hypothesized that behavioral and self-report measures of DT would exhibit a method-effect such that correlations between behavioral and self-report methods of DT would be smaller than correlations between self-report measures of DT and self-report measures of theoretically similar constructs (i.e.,

negative urgency). We also hypothesized that behavioral and self-report measures of DT would still evidence discriminability such that they would not demonstrate significant correlations with other measures of conceptually independent constructs (e.g., behavioral risk-taking, self-reported sensation seeking). These analyses will help determine the extent to which behavioral DT shares significant variance with the facets of self-reported DT (e.g., tolerance, appraisal) versus measures of risk-taking (i.e., sensitivity to reward contingencies) or impulsivity (i.e., sensitivity to negative reinforcement).

The second aim was to examine the concurrent validity of the behavioral and self-report measures of DT in association with trauma-related internalizing psychiatric symptoms (i.e., PTSD and depressive symptoms). First, we examined the extent to which PTSD and depression are associated with *distress-sensitivity*. We hypothesized that participants with greater depressive symptoms and/or PTSD would exhibit greater distress-sensitivity as indicated by increases in negative affect in response to the MTPT-C task. Second, we examined the extent to which tolerance of distress (e.g., higher self-report DTS and task persistence on the MTPT-C) predicts meaningful variance in PTSD symptom severity and depressive symptoms and the degree to which it accounts for shared and unique variance in these outcomes. Taken together, these analyses provide an empirical evaluation of the validity of the DT construct.

Method

Participants

The [edited out for blind review] University and Veterans Administration (VA) Medical Center Institutional Review Boards approved all study procedures and informed consent was obtained from all study participants. Participants were recruited primarily through the local VA medical center by direct mail and phone calls to registered patients within the qualifying age range (21–40). Veterans who may not be registered with the local VA were recruited from the university and surrounding community through flyers posted in public areas. Inclusion/exclusion criteria were set by the parent study examining genetic influences of the association between combat trauma, biological markers of stress reactivity, and alcohol use. Interested participants were prescreened over the telephone following verbal consent for eligibility. Participants had to have served in the armed forces post-September 11, 2001, drink at least 4 drinks/month, and could not be seeking treatment for alcohol dependence. Exclusion criteria included: history of a moderate or severe traumatic brain injury; presence of a medical condition or medication affecting hypothalamic-pituitary-adrenal axis functioning, severe obesity, and women who were currently pregnant/nursing.

Procedure

Following initial screening for inclusion and exclusion criteria by telephone or online via REDCap (Research Electronic Data Capture; Harris et al., 2009). All participants were asked to provide verbal consent or indicate agreement with a consent statement online before responding to screening questions. Eligible participants were scheduled for an on-campus visit, completed in-person informed consent, and completed the self-report

questionnaires, clinical interview, and computerized behavioral tasks, and were compensated \$20.

Measures

Computerized Mirror-Tracing Persistence Task (Strong et al., 2003).—The MTPT-C is a computerized version of the mirror-tracing persistence task (MTPT; Quinn, Brandon, & Copeland, 1996) and served as our measure of behavioral DT. Participants traced a red dot along the lines of three shapes using the computer's mouse. To make the task similar to the original mirror-tracing task, the mouse is programmed to move the red dot in the reverse direction (i.e., if a participant moved the mouse to the left, the red dot would move to the right). To increase difficulty level and frustration, if a participant moved the red dot outside of the lines of the shape or stalled for more than two seconds, a loud buzz would sound and the red dot would return to the starting position. Participants completed two required trails of increasing difficulty (i.e. straight line and right angle) before completing the final test trial in which they were asked to trace a 5-pointed star until they chose to terminate the task. The two required trials oriented participants to the task and served as a minimum engagement period. To match the level of difficulty to the participant's ability, the shapes following the first trial were adjusted depending upon the participant's performance on the first trial. Behavioral distress tolerance was measured as latency in seconds to task termination (MTPT-C Time) and was used as the primary outcome measure for the current study. Before and after completing the MTPT-C, participants were prompted on the computer to rate the extent to which they were currently experiencing each of six emotions (i.e., irritability, frustration, anxiety, difficulty concentrating, urge to smoke, and bodily discomfort) about their current mood state on a 100-point sliding scale (1 = *none*, 100 = *extreme*). Internal consistency of these items were $\alpha = .78$ pre-task and $\alpha = .79$ post-task. The difference between pre- and post-task scores were used as a manipulation check of the ability of the MTPT-C to illicit emotional distress.

Distress Tolerance Scale (DTS; Simons & Gaher, 2005).—The DTS is a 15-item self-report measure of DT, in which respondents indicated, on a five-point Likert-type scale (1 = *strongly agree* to 5 = *strongly disagree*), the extent to which they believed they could experience and withstand distressing emotional states. The distress tolerance scale included a composite score from the mean of all items (Cronbach's α for this sample = .89) as well as 4 subscales: tolerance ($\alpha = .70$), appraisal ($\alpha = .79$), absorption ($\alpha = .79$), and regulation ($\alpha = .74$). Items are scored such that higher scores reflect greater ability to withstand distress. The DTS has been shown to be stable over a 6-month interval (Simons & Gaher, 2005).

Balloon Analogue Risk Task—(BART; Lejuez et al., 2002) is a computerized, laboratory-based behavioral measure of risk-taking in which riskiness is rewarded up until a point at which further riskiness results in poorer outcomes. Participants were presented with a series of computerized balloons and clicked a button to incrementally inflate the balloon and earned money with each click. Participants were instructed that they must “cash-out” before the balloon explodes, which would occur after unknown pre-determined clicks, causing them to lose the accumulated earnings for that trial. Thus participants had to weigh the potential for reward with each additional click against the risk of the balloon exploding.

Previous research showed that risky behavior on the BART (adjusted average pumps) showed acceptable test-retest reliability across days ($r = .77$, $p < .001$; White, Lejuez, & de Wit, 2008).

Impulsive Behavior Scale (UPPS-P; Cyders, Smith, Spillane, Fischer, Annus, & Peterson, 2007; Whiteside, et al., 2005).—The UPPS-P is a well-validated measure of trait-like impulsivity. Participants rated 59 items on a four-point scale (1 = *agree strongly* to 4 = *disagree strongly*). Many items are reverse coded such that higher scores represent greater impulsivity. The UPPS-P assessed Negative Urgency (tendency to engage in rash behavior in the face of negative emotion), Positive Urgency (tendency to engage in rash behavior in the face of positive emotion), (lack of) Premeditation (tendency to act before thinking or to not plan), (lack of) Perseverance (difficulty sustaining attention or motivation for goal-directed behavior), and Sensation Seeking (tendency to seek out novel experiences) as distinct personality pathways to impulsive behavior. Internal consistency for the scales of the UPPS in this sample ranged from $\alpha = .80$ to $.89$.

Clinician Administered PTSD Scale for DSM-IV (CAPS; Blake et al., 1995).—The CAPS is a diagnostic interview for current and lifetime PTSD. Participants first completed a life events checklist, indicating if they ever experienced, witnessed, or learned about 17 types of potentially traumatic events. Given the focus on combat-related PTSD of the larger study, combat events meeting DSM-IV A criteria were assessed first. If the participant endorsed a qualifying combat event, they were interviewed about past month PTSD symptoms. If they did not meet current PTSD symptoms they were asked if they ever experienced the symptoms discussed and were interviewed for the most severe lifetime symptoms (whether combat related or not). If participants did not endorse a qualifying combat event, they were asked to identify their “worst” event and, if meeting DSM-IV A criteria, were assessed for lifetime and current symptoms. The inter-rater reliability for this sample was high (i.e., $\kappa = .92$) for the CAPS diagnostic algorithm and internal consistency was acceptable for the total severity score ($\alpha = .89$) and each of the three PTSD symptom cluster severity scores (ranging from $.67$ to $.82$) in this sample. Total past month severity score and diagnostic status (combat or noncombat) were used in the current analyses.

Beck Depression Inventory II (BDI-II; Beck, Steer, & Brown, 1996).—The BDI-II is a 21-item self-report measure of depressive symptoms experienced in the past two weeks. Each item presents an array of four statements reflecting increasing degrees of symptom severity, scored from 0 (not present) to 3 (severe), and participants were asked to select the sentence that best describes how they had been feeling over the past two weeks. The BDI-II has been shown to discriminate between depressed and non-depressed individuals, had high internal consistency and convergent validity (Beck et al., 1996) and is the most commonly used measure of depressive symptoms. Internal consistency of the BDI-II total score for this sample was $\alpha = .91$.

Data Analysis

A manipulation check of the MTPT-C was performed to examine the extent to which a) the MTPT-C elicits distress in the form of negative affect change (i.e. irritability, frustration, anxiety, difficulty concentrating, urge to smoke, and discomfort) using repeated measures ANOVA, and b) whether affect change predicts MTPT-C Time (i.e. whether MTPT-C Time operates as a stress task versus distress-tolerance task) using linear regression. We used a multitrait-multimethod approach to address aim one, which was to examine the convergent, discriminant, and concurrent validity of DT measures, with a focus on the validity of the MTPT-C. Evidence of convergent validity is shown by high monotrait-heteromethod correlations and low heterotrait-monomethod correlations. Evidence of discriminant validity is further demonstrated by relatively low heterotrait correlations regardless of method (for a complete description of the MTMM method, see Campbell & Fiske, 1959). To address aim two, we conducted repeated measures GLM (Time X PTSD/depressive symptoms) to examine whether participants with PTSD or higher depressive symptoms reported greater distress sensitivity as indexed by increases in negative affect as a result of the MTPT-C. Then, we examined whether MTPT-C Time (i.e. tolerance of negative affect) and the DTS predicted unique or shared variance in 1) current PTSD symptom severity among trauma-exposed veterans (e.g., only those endorsing DSM-IV Criterion A trauma-exposure), and 2) depressive symptom severity using hierarchical linear regression. All analyses were conducted using SPSS, version 24.

Results

A total of 345 participants were eligible for inclusion in this study. Only individuals with available behavioral and self-report DT data were included in the present analyses ($n = 306$). Data were missing due to tablet/computer failure (MTPT-C = 19; DTS = 26, BDI = 16; PTSD = 0; BART = 13; UPPS-P = 18) and Little's MCAR test confirmed that data were missing completely at random ($X^2(247) = 258.01, p = .302$). The final sample included 306 veterans who served post-September 11, 2001, 89.9% male, aged 21–40 ($M = 30.2, SD = 4.5$), and approximately 69.6% White (Table 1), providing a representative sample comparable to overall active-duty US Military personnel demographics (Department of Defense, 2015). All but one (99.7%) reported experiencing or witnessing at least one potentially traumatic event on the life events checklist ($Mdn = 10$). Ninety-five percent reported experiencing or witnessing combat, 86% percent endorsed DSM-IV-TR PTSD Criterion A (i.e., threat to life, injury, or physical integrity, and feelings of fear, helplessness, or horror), and 23.3% of the total sample met criteria for current PTSD.

MTPT-C Performance and Psychometrics

Average persistence time on the MTPT-C was mean = 221.14 seconds ($SD = 264.46$). The distribution was nonnormal, skew = 2.85 ($SE = .14$), kurtosis = 9.193 ($SE = 2.69$) and so values were natural log transformed resulting in mean = 4.91 ($SD = .94$). Transformed values were used in all analyses. As a manipulation check, we examined whether the task elicited negative affect. Results of a repeated measures ANOVA of pre- and post-task negative affect scores were significant: $F(6, 298) = 38.51, p < .001$. Follow-up analyses revealed that there was significant increase in frustration ($F(1, 303) = 219.27, p < .001$),

irritability ($F(1, 303) = 115.15, p < .001$), and urge to smoke ($F(1, 303) = 5.95, p = .015$). There was no significant change in anxiety ($p = .051$), difficulty concentrating ($p = .846$), or discomfort ($p = .123$). Next, we examined whether affective change influenced MTPT-C Time. Linear regression predicting the MTPT-C Time from affect change scores was not significant $F(6, 303) = .87, p = .515$. This provides evidence that MTPT-C Time is not a function of distress-sensitivity. Finally, we examined whether skill (e.g., hand-eye coordination) affected persistence on the MTPT-C. Errors per second (EPS; $M = 1.25, SD = 1.06$), was calculated by dividing total count of errors by total task time and then natural log transformed to correct for violations of normality (skew = 2.5, kurtosis = 10.87). EPS had a small, but significant, association with persistence time, $r = .12, p = .038$. EPS was used to control for the effects of participant tracing skill in regression analyses.

Convergent and Discriminant Validity of the MTPT-C

The results of the multitrait-multimethod matrix can be found in Table 2. Evidence of convergent validity of the behavioral and a self-report measure of DT is indicated by the monotrait-heteromethod correlations between the MTPT-C and the DTS, which were small but significant ($r_s = .16 - .18, p_s = .002 - .008$), with the exception of the DTS regulation subscale ($r = .11, p = .054$). By contrast, the correlations between the DTS subscales were strong and significant, expected of a scale assessing a single higher-order factor, and the correlations of the UPPS-P (rows and columns 8 – 12) were less consistent across the scales, consistent with the theories of trait impulsivity as a multi-faceted construct, (Whiteside & Lyman, 2001).

The heterotrait-monomethod correlations resulted in low evidence of method effect among the two behavioral tasks (MTPTC-C and BART; $r = .08, p = .183$). There was moderate evidence of a method effect for the self-report measures. In particular, the DTS was significantly correlated with positive urgency ($r_s = -.22$ to $-.32, p_s < .001$) and negative urgency (r_s ranging from $-.19$ to $-.48, p_s = .001$) scales, each associated with rash action in face of strong emotion. The DTS subscales were also associated, to a lesser extent, with the lack of perseverance scale ($r_s = -.15$ to $-.29, p_s = .009$) with the exception of the DTS regulation subscale ($r = .04, p = .487$). Lack of premeditation and sensation seeking had nonsignificant or small nominally significant correlations with the DTS subscales ($r_s = -.03$ to $.12; p_s = .041 - .996$).

Heterotrait-heteromethod correlations between the MTPT-C and the UPPS-P were not significant (r_s ranging from $-.02$ to $.06, p_s = .199 - .889$), with the exception of the sensation seeking subscale ($r = .13, p = .027$). The correlation between the MTPT-C and negative urgency subscale was not significant ($r = -.08, p = .119$), despite the expectation that negative urgency would be more closely associated with DT than the other UPPS-P subscales.

Concurrent Validity of the MTPT-C

Associations between MTPT-C and PTSD.—The repeated measures GLM (Time X Current PTSD diagnosis) to examine distress sensitivity associated with PTSD resulted in a significant main effect, such that participants with PTSD reported significantly higher

negative affect across all measures, collapsing across time, $F(6,288) = 38.39, p < .001$. The within-subjects interaction effect of the MTPT-C task on change in negative affect was significant such that participants with PTSD reported steeper increases in frustration ($F(1) = 7.478, p = .007$) and irritability ($F(1) = 5.060, p = .025$), compared to participants without PTSD. All other interactions were non-significant.

Results of the hierarchical linear regression of MTPT-C Time on current PTSD symptom severity, controlling for errors per second, (Table 3) was significant, $\beta = -.013, p = .036$, accounting for approximately 1% variance in PTSD severity ($r^2 = .01$). When DTS was entered in the third step, only DTS was a significant predictor of PTSD, $\beta = -.35, p < .001$, and accounted for approximately 12% unique variance in PTSD severity ($r^2 = .12$).

Associations between MTPT-C and Depressive Symptoms.—The repeated measures GLM (Time X depression symptoms) to examine distress sensitivity associated with depression symptoms resulted in a significant main effect, $F(6, 273) = 7.695, p < .001$, such that participants with higher depressive symptoms reported significantly higher negative affect across all emotions, except urge to smoke, collapsing across time. The within-subjects interaction of the effect of the MTPT-C task on change in negative affect was significant such that participants with higher depression scores reported greater increases in frustration $F(1, 278) = 12.827, p < .001$, irritability $F(1, 278) = 8.108, p < .001$, and difficulty concentrating $F(1, 278) = 5.372, p = .021$, compared to those with lower depression scores.

Results of the hierarchical linear regression (Table 3) of MTPT-C Time on depressive symptom, controlling for errors per second was not significant, $\beta = -.08, p = .168$. The effect of DTS was a significant predictor of depressive symptoms in the final step, $\beta = -.48, p < .001$, and accounted for approximately 22% unique variance in BDI-II scores ($r^2 = .22$).

Discussion

The overarching goal of this study was to examine the boundaries of the nomological network of the underlying construct of DT and how different methods (e.g., behavioral vs self-report) may tap into overlapping or distinct facets of DT in a sample of veterans. To do so, the present study utilized the multitrait-multimethod approach to examine the convergent, discriminant, and concurrent validity of a behavioral measure of DT, the MTPT-C.

Convergent Validity of Behavioral and Self-report DT measures

Contrary to the hypothesis, a primary finding of note was the significant association, albeit small, between the behavioral and self-report DT measures. While this association is expected from a theoretical perspective, previous research has failed to find significant multimethod correlations (Anestis et al., 2012; Marshall-Berenz et al., 2010; McHugh et al., 2011). There are a few possible explanations for this association in the present study. First, our veteran sample reported significantly higher trauma exposure and PTSD symptoms compared to prior studies of DT (Marshall-Berenz et al., 2010). Further, many, but not all, of the participants completed the MTPT-C following the diagnostic interview for PTSD, which

may have elicited greater sensitivity to distress and may have impacted DT in the moment, especially for those with significant trauma histories. However, we did not collect data on order of administration to be able to test for order effects. Future research should examine whether performance on behavioral DT tasks is moderated by tasks that involve trauma-relevant cues. If so, this may enhance our ability to test clinically relevant behavioral indicators of DT during times of distress.

Discriminant Validity of the Behavioral DT Measure

As hypothesized, the MTPT-C and the behavioral measure of risk taking (BART) were not correlated which suggests that task persistence on MTPT-C is not indexing other, behaviorally measured traits (e.g., sensitivity to reward contingencies; Leyro et al., 2010). Further, the correlations between the MTPT-C and the self-report measure of impulsivity were not significant, suggesting little evidence that the MTPT-C indexes impulsive escape/avoidance tendencies (with the exception of the sensation seeking subscale, contrary to hypotheses, which may warrant further investigation).

While existing literature has suggested self-report and behavioral measures of DT are both associated with impulsivity (Anestis et al., 2012; Shaw & Timpano, 2016), the present findings that the MTPT-C was not inversely associated with lack of perseverance and positive and negative urgency suggest this measure of behavioral DT is not indexing these aspects of impulsivity.

Concurrent Validity of DT, PTSD, and Depressive Symptoms

Participants with higher depressive symptom scores or with PTSD were more likely to report greater increases in negative affect after completing the MTPT-C, suggesting that the MTPT-C may be more useful as an indicator of stress-reactivity and risk for depressive symptoms and PTSD. Given that negative affect in general, and irritability in particular, are common features of both PTSD (Castillo, Baca, Conforti, Qualls, & Fallon, 2002) and depression (Perlis et al., 2005), a behavioral measure of irritability and stress reactivity may prove to be useful in research aimed at understanding the role stress-reactivity, particularly for trauma-exposed populations.

Examination of the predictive validity of DT measures on PTSD and depressive symptoms suggested that behavioral DT was less predictive of psychiatric outcomes than perceived DT. MTPT-C persistence time was significantly associated with PTSD symptom severity, in support of its construct validity, but this association was diminished when self-report DT was entered into the model. MTPT-C persistence time was not associated with depressive symptoms, suggesting that the MTPT-C may index something that is not shared between these two outcomes and warrants further research given the theoretical interest in DT as a transdiagnostic construct. The stronger association between self-report DT and PTSD severity and depressive symptoms may be due to the fact that the scores of these measures, either self-report or clinician interview derived, may be influenced by a participants' perception. Associations between behavioral measures of DT, such as the MTPT-C, and behavioral indices of pathology (e.g., substance use, startle reflex) may yield stronger associations. Future research would benefit from examination of whether the MTPT-C may

be more highly correlated with behavioral manifestations of PTSD than self-reported symptom severity.

Limitations and Future Directions

While the present study extends the literature on the MTPC-C as well as the broader behavioral DT literature, it is not without limitations. We examined only two measures of DT, yet several measures of both self-report and behavioral DT exist. Similarly, other measures of the comparison constructs also exist, such as other behavioral measures of risk taking (e.g., Iowa Gambling Task; Bechara, Damasio, Damasio, & Anderson, 1994). Examination of alternative measures of behavioral and self-report DT, as well as additional comparisons to other constructs (e.g., emotion regulation, behavioral dyscontrol), are needed for greater understanding of DT as a construct as well as the utility of these measures attempting to capture DT and related constructs.

This study began before the release of the DSM-5 (American Psychiatric Association, 2013), and so PTSD diagnosis was based on DSM-IV-TR criteria. Results may or may not differ if DSM-5 criteria were used. Given the high rates of trauma exposure in the sample and the desire to minimize participant burden, we were unable to conduct a complete assessment of current and lifetime symptoms for all traumas; thus, multiple traumas and previous/lifetime PTSD were not examined, both of which may have had an impact on study findings. Additionally, as mentioned previously, the behavioral tasks were completed following a structured clinical interview, which may have impacted findings; however, potential order effects could not be tested for in this study. Another limitation is the cross-sectional nature of the study; while this is common in the DT literature, longitudinal designs are needed to truly determine the predictive ability of DT.

Finally, the selective nature of the sample, due to the parent study protocol, may limit generalizability to other veteran or community-based populations. Although direct comparisons cannot be made to the broader veteran population receiving healthcare at the VA from which participants were recruited, this sample is largely comparable to the wider treatment-seeking VA healthcare population of veterans who have served in Iraq, Afghanistan, and related military operations based on existing literature (e.g., rates and comorbidity of psychiatric conditions, most veterans are not prescribed psychotropic medications; Wiechers, Kirwin, & Rosenheck, 2014). Further work is needed to determine whether other relevant conditions (e.g., psychotropic medication use, drug dependence) influence distress tolerance.

Conclusion

Despite these limitations, the present study is the first, to our knowledge, to examine the convergent and discriminant validity of behavioral and self-report DT measures in veterans. The results of this study suggest that DT, like impulsivity (Whiteside & Lynam, 2001) and coping (Carver & Connor-Smith, 2010), is a multi-faceted construct in which a person's tendency to experience strong emotions, ability to tolerate internal states, and their ability to engage in adaptive goal-directed behavior in the face of negative internal states represent distinct pathways that cannot be simply characterized under a single term. The MTPT-C was

associated with significant changes in irritability and frustration, and thus may be most appropriately described as a “frustration tolerance task” rather than a “distress tolerance” task. The lack of robust associations between this behavioral DT measure and internalizing mental health outcomes suggests that at this time, the measure may be more useful in research than clinical settings, and may be more relevant to the study of externalizing and substance use outcomes. At this time, self-report measures are time and cost effective and may be more useful for identifying individuals at greater risk for internalizing outcomes compared to behavioral DT measures. However, efforts to understand similarities and differences between behavioral and self-report measures of DT, and their relationship with clinically-relevant outcomes are relatively young, and many questions remain (Leyro et al., 2010).

Acknowledgments

This study is funded by R01AA020179 and K02AA023239. The authors would like to thank Katherine Taylor, Emily Brown, Nadia Chowdhury, and Sage McNett for their significant contributions to data collection.

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Table 1.

Descriptive Statistics

	%
Age	$M = 30.2$ $SD = 4.5$
Sex, % male	89.9%
Race	
White	69.6%
Black	22.2%
Other	8.2%
Branch	
Army	55.9%
Marines	18.6%
Navy	10.5%
Air Force	4.2%
Other ^a	10.8%
Education	
High school/GED	6.5%
Some college	45.8%
College	29.1%
Graduate degree	10.1%
Annual Income	
< \$20K	22.9%
\$20–50K	45.8%
\$50–80K	20.9%
> \$80K	10.5%
Deployed to Combat Zone	95%
Trauma Exposed ^b	85.6%
Past Month PTSD	23.3%
Current Major Depressive Episode	3.9%
PTSD and Major Depressive Episode	2.0%

N = 306.

^aIncluding National Guard, Coast Guard, and Reserves^bAccording to DSM-IV-TR Criterion A

Multitrait-Multimethod Matrix of Bivariate Correlations between Behavioral and Self-Report Measures of Distress Tolerance and Impulsivity

Table 2.

	Distress Tolerance Scale						Impulsive Behavior Scale					
	MTPT-C	BART	Com	Tol	App	Abs	Reg	NU	Pre	Per	SS	PU
1. MTPT-C	-	.08	.18**	.17**	.16**	.15**	.11	-.08	.07	-.06	.13*	-.01
2. BART		-	.06	.00	.10	-.07	.11	.04	.03	.06	.09	-.02
3. DTS-Com				.79**	.89**	.82**	.68**	-.46**	.01	-.20**	.11	-.32**
4. DTS-Tol				-	.58**	.71**	.35**	-.33**	-.03	-.26**	.12*	-.24**
5. DTS-App					-	.61**	.51**	-.44**	.00	-.15**	.12*	-.28**
6. DTS-Abs						-	.39**	-.48**	-.01	-.29**	.09	-.28**
7. DTS-Reg							-	-.19**	.08	.04	.02	-.22**
8. UPPS-NU									.37**	.44**	-.03	.67**
9. UPPS-Pre									-	.42**	.16**	.41**
10. UPPS-Per										-	-.15**	.41**
11. UPPS-SS											-	.06
12. UPPS-PU												-
<i>M</i>	221.14 ^a	30.74	3.63	3.76	3.74	3.73	3.19	2.08	1.81	1.74	3.12	1.74
<i>SD</i>	264.46	13.76	0.73	0.92	0.83	0.96	0.98	0.59	0.45	0.43	0.51	0.57

Note. *n* = 290, listwise deletion used for missing data. MTPT-C = Computerized Mirror Tracing Persistence Task; BART = Balloon Analogue Risk Task; Distress Tolerance Scale abbreviations: Com = Composite, Tol = Tolerance, App = Appraisal, Abs = Abs; Reg = Regulation; Impulsive Behavior Scale abbreviations: NU = Negative Urgency; Pre = (lack of) Premeditation; Per = (lack of) Perseverance; SS = Sensation Seeking; PU = Positive Urgency.

^aUnadjusted Mean and SD of MTPT-C is presented; natural log transformation used for analyses.

* $p < .05$ level (2-tailed).

** $p < .01$ level (2-tailed).

Table 3.
Multiple Regression of Behavioral and Self-Report Distress Tolerance on PTSD Severity and Depressive Symptoms

Step/Predictor	PTSD Severity ^a			Depressive Symptoms ^b		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
1. MTPT-C errors	-.09	-.07	-.06	-.02	-.01	.01
2. MTPT-C time		-.13 *	-.06		-.08	.01
3. DTS Composite			-.35 **			-.48 **
<i>R</i> ²	.09	.16	.37	.02	.08	.48
<i>R</i> ²	.01	.02 *	.12 **	.00	.01	.23 **

Standardized regression coefficients presented in columns. MTPT-C Errors = Computerized Mirror Tracing Performance Task – Errors Per Second, natural log transformed. MTPT-C Time = MTPT-C persistence time, natural log transformed. DTS = Distress Tolerance Scale – composite score.

^a *n* = 278, trauma-exposed sample only.

^b *n* = 300 with BDI-II scores.

* *p* < .05 level (2-tailed).

** *p* < .001 level (2-tailed).