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The dynamics of persisting through distress: Development of a momentary distress intolerance
scale using ecological momentary assessment

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Abstract

Distress tolerance, or the ability to withstand uncomfortable states, is thought to be a transdiagnostic risk factor for psychopathology. Distress tolerance is typically measured using self-report questionnaires or behavioral tasks, both of which construe distress tolerance as a trait and downplay the potential variability in distress tolerance across time and situation. The aim of the current study was to provide a method for assessing momentary distress tolerance using ecological momentary assessment to capture both within- and between-individual information. Participants ($n = 86$) responded to random prompts on their cell phones seven times per day for one week, which included 10 momentary distress tolerance items as well as momentary emotion. After examining item distributions and interclass correlations, we conducted a multilevel exploratory factor analysis using both within-individual and between-individual data to arrive at a brief, 3-item measure we call the Momentary Distress Intolerance Scale (MDIS). Model fit and reliability indices were good for both within- and between-individual approaches. We found that distress tolerance varied significantly over time, and that average momentary distress intolerance and instability in momentary distress intolerance were associated with trait distress tolerance, emotion dysregulation and tendencies to use experiential avoidance. Neither average momentary distress intolerance nor instability in momentary distress intolerance correlated with behavioral distress tolerance tasks. We discuss the importance of construing distress tolerance from a dynamic perspective and provide recommendations toward future research.

Key Words: distress tolerance, distress persistence, ecological momentary assessment, scale development

Public Significance Statement

This study reports on the development of a brief 3-item measure assessing the degree to which people feel incapable of “sitting with” or tolerating their own distress (i.e., distress intolerance) in a given moment. We found evidence that momentary distress intolerance is related to but distinct from existing trait measures of distress tolerance, and that distress intolerance varies significantly over time.

Distress tolerance, or the ability to withstand uncomfortable physical or emotional states, has been construed as a transdiagnostic risk factor for psychopathology (Leyro, Zvolensky, & Bernstein, 2010; Zvolensky, Vujanovic, Bernstein, & Leyro, 2010). Specifically, problems with distress tolerance have been linked to cigarette smoking (Leventhal & Zvolensky, 2015), substance abuse (Bornovalova et al., 2008; Daughters, Lejuez, et al., 2005), personality pathology (Daughters, Sargeant, Bornovalova, Gratz, & Lejuez, 2005; Kiselica, Webber, & Bornovalova, 2014), anxiety (Bernstein, Marshall, & Zvolensky, 2011; Keough, Riccardi, Timpano, Mitchell, & Schmidt, 2010), and eating pathology (Corstorphine, Mountford, Tomlinson, Waller, & Meyer, 2007), as well as many other symptom sets (Leyro et al., 2010). Beyond specific diagnoses, low distress tolerance is also associated with greater affective distress (e.g., heightened anger, anxiety, depression), and less effective emotion regulation strategies (Iverson, Follette, Pistorello, & Fruzzetti, 2012), including over-reliance on avoidance or escape (Iverson et al., 2012; Schloss & Haaga, 2011).

Distress tolerance is measured via self-report or behavioral tasks (see Leyro et al., 2010 for review of existing measures). The self-report measures assess people's perceived capacity to withstand uncomfortable physical or emotional states, whereas the behavioral tasks assess persistence on distressing or uncomfortable tasks, essentially evaluating the length of time people are willing to endure distress (Leyro et al., 2010). There are typically small (and usually non-significant) relationships between self-report and behavioral distress tolerance measures (Ameral, Palm Reed, Cameron, & Armstrong, 2014; Bernstein et al., 2011; Cogle, Bernstein, Zvolensky, Vujanovic, & Macatee, 2013; Kiselica, Rojas, Bornovalova, & Dube, 2015), suggesting a discrepancy between people's self-reported perceptions and their actual behaviors (Veilleux, Pollert, Zielinski, Shaver, & Hill, 2017).

Despite these differences in assessment methods, distress tolerance is typically construed as an individual difference, or a relatively stable personality characteristic. Individual differences are amenable to self-report, where we would expect relative stability in responses across time and context, and the behavioral measures are also commonly used as indicators of a distress tolerance ability. For example, in the smoking literature, scores on behavioral measures of distress tolerance assessed in a laboratory are used to predict later difficulties with smoking cessation (Brown, Strong, et al., 2009; Cameron, Reed, & Ninnemann, 2013; Steinberg et al., 2012). The findings that people low in distress tolerance have more difficulty quitting smoking (Brown, Strong, et al., 2009; Cameron et al., 2013; Steinberg et al., 2012) suggest that the abilities are at the person level. However, others have suggested that because the laboratory behavioral measures are contextually situated, they may be more accurately measuring state distress tolerance (Veilleux et al., 2017).

There is little doubt that examination of distress tolerance as an individual difference is valuable, but the assumption that distress tolerance is *only* a trait is likely inaccurate (Leventhal & Zvolensky, 2015; Trafton & Gifford, 2011). Distress, broadly construed to include both negative emotions and physical discomfort, is certainly not static. It also follows that an individual person's ability to "sit with" or "withstand" distress could vary across time and situational contexts. For example, distress tolerance overlaps (or is the same as, depending on who you ask; Brandon, Vidrine, & Litvin, 2007) with the concept of *task persistence*. Persisting on a difficult or distressing task when the option to stop the task is available is a classic example of a self-control conflict, with the goal of persistence interfered by the more hedonic and proximal goal of distress relief. Goal persistence most certainly varies over time and by context (Muraven & Baumeister, 2000), and it follows that distress tolerance likely fluctuates

dynamically as well. Indeed, some work has found that distress tolerance changes based on situational factors (Bernstein, Trafton, Ilgen, & Zvolensky, 2008; Cosci, Aldi, & Nardi, 2015; Heckman, Ditre, & Brandon, 2012) and researchers have advocated for explicitly examining distress tolerance dynamically (Leventhal & Zvolensky, 2015; Trafton & Gifford, 2011; Veilleux et al., 2017).

Ecological Momentary Assessment of Distress Tolerance

Ecological momentary assessment (EMA; Shiffman, Stone, & Hufford, 2008), also called experience sampling, is a method of data collection that allows for assessment of dynamic constructs. In EMA studies, participants go about their everyday lives and complete repeated assessments in naturalistic settings, typically via a mobile device. EMA has been touted as an ideal method for studying dynamic constructs (e.g., emotion) as well as low-frequency constructs (e.g., binge eating, substance use) because of the repeated assessments (Shiffman et al., 2008), and EMA also reduces retrospective report biases and issues with ecological validity because data collection occurs in given moments in participants' daily lives (Shiffman et al., 2008).

Thus far, work on distress tolerance in an EMA framework is limited, though a few studies have examined trait indices of distress tolerance (both self-report and behavioral) as predictive of EMA-assessed constructs. For example, one study of smokers planning to quit assessed distress tolerance via a mirror tracing task and used scores on the task to predict cigarette craving assessed via EMA (Volz et al., 2014). Another study found that those low in self-reported trait distress tolerance moderated the effect of positive affect on alcohol consumption (Simons & Gaher, 2005). To date, however, distress tolerance itself has not been assessed via EMA. Doing so would address recommendations in the field (Leventhal & Zvolensky, 2015; Trafton & Gifford, 2011; Veilleux et al., 2017) and allow for contextual

examination of the circumstances and situations in which issues with distress tolerance are most problematic.

The Current Study

The purpose of the current study was to develop a short, reliable self-report index of momentary distress intolerance via EMA, consistent with other work that has used EMA to develop momentary or state measures from traditionally trait constructs (i.e., impulsivity; Tomko et al., 2014). A psychometrically sound index of momentary distress intolerance, developed in a fashion that measures both inter- and intra-individual differences, that is brief enough to be completed quickly and easily, will facilitate the investigation of distress tolerance as a dynamic factor. In developing the measure, we used within- and between-person factor analyses, and used both within- and between-person indices of reliability to confirm the factor structure. Finally, to establish convergent validity of the measure, we examined the association of the newly developed brief measure along with trait measures of distress tolerance and associated difficulties (e.g., problems with emotion regulation, symptoms of anxiety and depression).

In the realm of convergent validity, we predicted that people with greater symptoms of anxiety and depression and greater problems with emotion regulation would report greater average momentary distress intolerance. In addition, individuals with low distress tolerance are thought to use experiential avoidance as an emotion regulation strategy. Experiential avoidance is the intentional escape or avoidance of thoughts, feelings and behaviors associated with distress (Chawla & Ostafin, 2007). Thus, we expected that higher levels of momentary distress intolerance should be associated with greater experiential avoidance tendencies. Additionally, we expected our momentary measure to correlate with traditional self-report measures of trait distress tolerance. In general, we expected that the momentary measure would correlate only

modestly with these individual difference measures due situational variability captured by our measure.

Method

Participants

Participants were 98 college students enrolled in introductory psychology who attended two laboratory sessions and completed one week of EMA in between, with the central inclusion criteria that they needed to have an iPhone or Android smartphone and were willing to download and use a phone application for one week. Participants were recruited in strata based on affect balance scores on the Scale of Positive and Negative Experiences (SPANE; Diener et al., 2010). This recruitment strategy was used to evaluate the role of affect balance in momentary emotion for a different study (citation removed for blind review) and to ensure that the sample included a spectrum of trait emotionality. All introductory psychology students across two semesters completed the SPANE as part of the subject pool screening process ($N = 2023$). After calculating affect balance (see measure information below), we grouped participants into low affect balance (0 and below), mildly positive affect balance (+1 to +9) and strongly positive affect balance (+10 or higher), with the groupings determined by norming data on the measure; most people have at least a mildly positive balance (Diener et al., 2010). Then, participants were invited to the lab study based on strata with the intention of recruiting approximately equal numbers of people from each strata, with a slight oversampling of the low affect balance group, as this was the group which likely experiences greater emotional turmoil. Of the 98 people who completed the study, 37 were in the low strata ($M = -3.65$, $SD = 3.11$), 28 were in the mild positive balance strata ($M = 5.86$, $SD = 2.37$), and 33 were in the strong positive balance strata ($M = 14.88$, $SD = 3.53$). We excluded 13 people who had response rates of lower than 50%,

which suggested inattentiveness to the EMA protocol, leaving a final sample of 86 people (Low group $n = 34$, Mild positive group $n = 25$, Strongly positive group $n = 26$).

The final sample was 76.8% female, 67.1% freshman, and 78.0% White, with an average age of 19.21 ($SD = 1.95$). There were no differences in proportion of males and females by affect balance strata, $\chi^2 = 2.59, p = .27$, and no age differences across affect balance strata, $F(2, 83) = 1.13, p = .33$. However, we did find differences in minority status by affect balance strata, $\chi^2 = 9.95, p = .01$, such that a higher percentage of the low affect balance group (39.4%) identified as an ethnic minority compared to the mild positive affect group (8%) or strongly positive group (12.5%). The final sample responded to 74.70% of the prompts ($SD = 11.39$) within five minutes of the notification.

Procedure and Measures

The current study received Institutional Review Board approval from [name omitted for blind review]. Participants completed 7 days of EMA on their phone cell phones using an application called LifeData (<http://lifedatacorp.com>), where they were prompted randomly about 7 times per day from 9:30am to 9:30pm, with at least 45 minutes between prompts. A full description of the entire EMA protocol is not within the scope of this manuscript, but the authors can be contacted for details. Participants completed behavioral distress tolerance tasks and individual difference measures at an orientation session, where they were also guided to download the LifeData app and walked through a typical EMA prompt. At each prompt, participants were first asked about current mood and then momentary distress intolerance items (see below). During each EMA session, participants were also asked if they had experienced (a) a significant positive event since the previous prompt and (b) a significant negative event since the previous prompt. If they said yes to either, they were asked to provide a brief text account of

the situation. For stressful events only, participants were asked the degree to which they engaged in several emotion regulation strategies to manage their feelings (see below).

Individual Difference Self-Report Measures.

Affect balance. The Scale of Positive and Negative Experiences (SPANE; Diener et al. 2010) is a 12-item scale that assesses recent affective experience using Likert-type scale responses from 0 (*Absent*) to 4 (*Very Strong*). Six of the items assess positive affect (positive, good, pleasant, happy, sad, joyful, and contented) and six assess negative affect (negative, bad, unpleasant, sad, afraid, angry). A positive score is calculated by adding the six positive items, and a negative score is calculated by adding the six negative items. Affect balance is then calculated by subtracting negative from positive scores. The affect balance score can range from -24 to +24, where more positive scores indicate a greater ratio of positive to negative affect, and more negative scores indicate a greater ratio of negative to positive affect.

Discomfort intolerance. The Discomfort Intolerance Scale (DIS; Schmidt, Richey, & Fitzpatrick, 2006) is a 5-item measure assessing an individual's tolerance of uncomfortable physical sensations. Items are given on a 7-point Likert type scale from 1 (*not at all like me*) to 6 (*very much like me*), and higher scores indicate a greater intolerance of physical discomfort ($\alpha = .86$).

Distress tolerance. The Distress Tolerance Scale (DTS; Simons & Gaher, 2005) is a 14-item scale assessing tolerance of negative emotional states. Items are given on a 1 (*strongly agree*) to 5 (*strongly disagree*) Likert-type scale, and higher scores indicate a better ability to handle distressing emotional states ($\alpha = .93$).

Experiential avoidance. The Brief Experiential Avoidance Questionnaire (BEAQ; Gámez et al., 2013) a 15-item version of the longer Multidimensional Experiential Avoidance

Questionnaire (Gámez, Chmielewski, Kotov, Ruggero, & Watson, 2011), the intentional avoidance of thoughts, feelings and experiences associated with distress. Items are given on a 1 (*strongly disagree*) to 6 (*strongly agree*) Likert-type scale, and higher scores indicate stronger experiential avoidance tendencies ($\alpha = .87$).

Emotion dysregulation. To measure emotion dysregulation, participants completed the Difficulties with Emotion Regulation Scale (DERS; Gratz & Roemer, 2004), a 36-item scale assessing difficulties with engaging in effective emotion regulation strategies, acting impulsively when upset, lacking acceptance of negative emotions, lack of awareness of emotion, difficulty clearly identifying emotions, and problems engaging in goal-directed behavior when upset. Items are given on a 5-point Likert-type scale from 1 (*almost never*) to 5 (*almost always*). For the current study, a total score was used, where higher scores are indicative of greater emotion dysregulation ($\alpha = .95$).

Psychological distress. To generally assess symptoms of psychological distress, participants completed the 21-item Depression Anxiety Stress Scales (DASS-21; Henry & Crawford, 2005), which assesses symptoms of depression, anxiety and panic. The items are measured on a 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*) scale. In the current study, a total score was used which indicates heightened general psychological distress ($\alpha = .94$).

Behavioral Tasks.

Breath holding. Participants were asked to take a deep breath and hold it as long as they could (Brown, Lejuez, et al., 2009). The length of time was assessed via stopwatch by an experimenter. After a 60 second break, participants completed a second breath holding trial. The average was calculated as an index of breath holding capacity (Bernstein et al., 2011; Glassman

et al., 2016; Zvolensky, Feldner, Eifert, & Brown, 2001). As an index of physical tolerance, the breath holding task correlates with other physical tolerance tasks (MacPherson et al., 2008; McHugh & Otto, 2011) as well as with frustration tolerance tasks (i.e., the mirror tracing task; Bernstein et al., 2011; McHugh & Otto, 2011). Moreover, lower breath holding prospectively predicts smoking cessation lapse (Abrantes et al., 2008; Brown et al., 2009).

Emotional image tolerance. To assess emotional distress tolerance, participants completed the Emotional Image Tolerance task (Veilleux et al., 2017). This is a computerized task in EPrime where participants view 45 negatively valenced images from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008) and press “q” when they begin to feel distress and “p” when the distress is too great and they want to move on to the next slide. Each image can be viewed for up to 30 seconds before the program moves on to the next slide. The measure results in four outcome variables, (1) image persistence, or the average total image viewing time; (2) count of distress, or the number of images (out of 45) the client indicated distress on (e.g., on how many slides the client pressed “q”), (3) distress threshold, or the average time into the slides the participant pressed began to feel distress and (4) distress tolerance, or the average time *after* acknowledging distress the participant continued to view the slide (i.e., the time between pressing “q” and “p”).

Mirror tracing. The computerized mirror tracing test used in this study was an updated version of the original task (Strong et al., 2003) that includes titrating difficulty (downloaded from <https://psyc.umd.edu/research/caper-task-downloads>). In all rounds, participants trace the star backwards with computer mouse and when the cursor moves outside the boundaries of the star, the program emits a loud beep and returns the cursor to the start. There are two initial rounds where the boundaries around the star become thinner (e.g., the task becomes more

difficulty) based on the participants skill at the task. In the final round, participants are given the option to escape the task. Two outcome variables are recorded: whether or not the participant completes the final star, and for those who quit the task, the time until the participant escapes or quits the task is the primary index of distress tolerance. The mirror tracing task is task of frustration tolerance, and has demonstrated construct validity via significant correlations with other frustration tolerance measures (Bernstein et al., 2011; Daughters et al., 2005; Kiselica et al, 2015). Additional validity evidence shows that lower persistence on mirror tracing predicts early treatment dropout for substance abusers (Daughters et al., 2005), and that mirror tracing persistence increases after a distress tolerance intervention (Macatee & Coughle, 2015).

EMA Measures.

Momentary distress intolerance. Items from existing distress tolerance measures including the DTS (Simons & Gaher, 2005) and the Frustration Discomfort Scale (FDS; Harrington, 2005) were examined and adapted to reflect momentary distress tolerance. We intentionally included items worded to reflect poor distress tolerance and items that reflected successful distress tolerance (see Table 1 for all items). Although measure development experts typically recommend an overinclusive item set (Clark & Watson, 1995), minimizing participant burden is essential for EMA studies and thus we selected 10 candidate items with the intention of reducing to a final item set of around 3 or 4 items. Participants responded on a 1 (*strongly disagree*) to 7 (*strongly agree*) Likert-type scale and items were constructed to reflect the participant's perception of their ability to tolerate their feelings right now in this moment.

Momentary emotion. At the start of each prompt, participants were asked the degree to which they were experiencing ten emotions (positive: joyful, relaxed, excited, calm; negative: lonely, scared, angry, nervous, sad and irritable) given on a 0 (*not at all*) to 6 (*extremely*) Likert-

type scale. For purposes of analyses, average scores on the four positive items across all eligible sessions and average scores on the six negative items across all eligible sessions were calculated for each person to establish the relationship between average emotional experience and average momentary distress intolerance.

Emotion regulation strategies. When participants acknowledged experiencing a stressful event in the time period between prompts, they were asked to rate the degree to which they engaged in each of the following emotion regulation strategies, rated from 0 (*not at all*) to 6 (*extremely*): escaping the situation, suppressing expression of emotion, viewing the situation as if it were happening to someone else, avoid thinking about the situation, “sit with” or accept the feelings, try to figure out “why” the situation occurred, or trying to problem solve. Negative events were not particularly common across the EMA period, though did occur occasionally (participants reported an average of 2.28 events, $SD = 2.17$). Average ratings for each regulation strategy were calculated for reported stressful events for each person.

Data Analysis

Following prior work using EMA to develop momentary measures of constructs typically construed as individual differences (Tomko et al., 2014), and measures developed in a multilevel framework (Lindqvist et al., 2016), we conducted a multilevel factor analysis (Kim, Dedrick, Cao, & Ferron, 2016; Reise, Ventura, Nuechterlein, & Kim, 2005; van de Vijver & Poortinga, 2002).

We first conducted item analysis of descriptive statistics, inter-item correlations at both the within-individual and between-individual levels, and looked for items that could be removed for redundancy, considering the goal of this study was to create a brief (3-4 items) well performing measure of momentary distress tolerance. We evaluated the applicability of these

data to multilevel analysis by examining interclass correlations (ICCs) of the items (Reise et al., 2005), which are typically between .2 and .4 for intensive longitudinal data (Bolger & Laurenceau, 2013) and will be above 0 if the items demonstrate between-individual differences. To calculate ICCs, we ran a null (i.e., random intercept only) two level model with prompts (repeated measurements) as Level 1 and participants as Level 2. All ICCs were above zero (they ranged between .27 and .66), and were all also above .10, the threshold suggested by Muthén (1997) for using multilevel modeling.

We then conducted a multilevel exploratory factor analysis in Mplus version 8.0 (Muthén & Muthén, 2017). We used a two-level model with Level 1 representing the repeated measurements over time, and Level 2 representing the person. Factors were rotated using Geomin rotation, and both the between-individual and within-individual factor structures were evaluated. Model fit was tested with the chi-square test of exact fit, the comparative fit index (CFI) and the root mean square error of approximation (RMSEA). We evaluated model fit based on published norms, where CFI values of .95 and higher and RMSEA values of .06 and less are considered adequate (Hu & Bentler, 1999), and evaluated the factor loadings in both the between-individual and within-individual results.

After finalizing the measure, we calculated basic descriptives of the scale. This included the average score across all eligible time points for each person, as well as mean squared successive difference (MSSD) to capture variability and instability. The MSSD is the average of the squared difference between successive observations and accounts for variability over time as well as temporal dependency (Jahng et al., 2008). We first calculated a daily MSSD for each person per study day, adjusting for unequal time intervals due to the random prompt schedule

(Jahng, Wood, & Trull, 2008), and then averaged daily MSSD scores to arrive at an overall study MSSD for each person.

To calculate reliability, we followed published guidelines for calculating both within- and between-individual reliability for the scale items (Shrout & Lane, 2012). Variance component estimates were obtained using an analysis of variance approach. Then, the variance components were used to construct reliability estimates based on generalizability theory (Cronbach, Gleser, Nanda, & Rajaratnam, 1972). The reliability coefficients are defined to describe the reliability of between-person differences (averaged over items and time) and the reliability of within-person variation (averaged over items); thus, high within-person reliability is indicative of high consistency between items within-persons, whereas high between-person reliability is indicative of high consistency of items over time and across all persons (Tomko et al., 2014).

To establish convergent validity, we examined how the average scores on the newly developed measure and the MSSD of the average scores correlated with momentary emotions and momentary emotion regulation strategies reported via EMA. We also examined whether momentary distress intolerance and MSSD of momentary distress intolerance was associated with the behavioral distress tolerance tasks, as well as self-reported trait indices of distress tolerance and related constructs (e.g., experiential avoidance, symptoms of affective distress, and emotion dysregulation). Finally, we used multilevel modeling to examine the extent to which people's reports of how they generally tolerate distress predict the variability in their momentary reports of distress intolerance.

Results

We initially examined distributions, inter-item correlations (using both between-individual and within-individual models) and interclass correlations (ICCs) of the items to

identify items with significant skew or redundancy. The latter is particularly important in the development of a momentary measure for use in EMA, as a short scale with lower redundancy will be more practical (less participant burden) than a longer scale with greater redundancy. We dropped 4 items using these methods. Specifically, Items 3 and 4 (see Table 1) were dropped for low endorsement (positively skewed) and Items 7 and 9 were dropped for extremely high correlations with Item 10 ($r > .95$).

An initial multilevel exploratory factor analysis evaluated both 1 and 2 factor solutions at both the within-individual and between-individual levels using the remaining 6 items. Initial examination of both within-individual and between-individual EFA and modification indices suggested that a two-factor solution at the within-individual level and a one-factor solution at the between-individual level was an acceptable fit ($\chi^2 = 198.39$, CFI = .97, RMSEA = .07). However, this solution was not advantageous because we ultimately wanted a shorter (e.g., 3 or 4 item) measure. Thus, we examined the factor loadings and modification indices, and we dropped Item 6 (which loaded on both within-individual factors) and Items 2 and 8 which were indicated as a candidate to drop based on modification indices.

We then re-ran the analysis using Items 1, 5 and 10 where the single factor solution provided an excellent fit to the data ($\chi^2 = 18.03$, CFI = 1.0, RMSEA < .01). Eigenvalues of the between-individual correlation matrix was 2.21, .61 and .19, and for the within individual was 1.80, .64 and .48. Standardized item factor loadings are located in Table 2, along with correlations, which are approximately the same at the within- and between-individual levels.

We named the final measure the Momentary Distress Intolerance Scale (MDIS). MDIS scores were then calculated by first creating an average MDIS score for each instance (the mean of Item 1, Item 5 and the reverse of Item 10 because that was initially coded to reflect higher

distress tolerance). We then calculated an average score for each person across all item periods to get a person-level MDIS score, and found the average MDIS score was 2.04 ($SD = .74$; Range .40 to 3.75), reflecting relatively low momentary distress intolerance on average but with variability across people. Note that the average person-level score on the MDIS was highly correlated with the average person-level score on all 10 items ($r = .98$) suggesting this 3-item version is a good approximation of the longer measure. There also was variability in MDIS, reflected by an average MSSD of MDIS scores of 1.35 ($SD = 1.65$; Range .01 to 11.66), and higher average MDIS scores were also associated with greater instability of MDIS, $r = .25$, $p = .02$. An additional test of variability of the MDIS included an unconditional multilevel model via a simple random effect linear model, which assesses how much individuals vary in their momentary distress intolerance. Variance components estimates indicated that individuals vary 49.48% in their momentary distress intolerance ($SE = .08$, Wald $Z = 6.20$, $p < .001$).

Between- and within-person reliability were computed for the three-item MDIS scores, using equations described in previous work (Nezlek & Gable, 2001; Shrout & Lane, 2012). Results indicated that between-person reliability was high ($R_{CN} = .91$) and within-person reliability was moderate ($R_{KRN} = .70$). This suggests there was high consistency of item responses over time and across all individuals, and greater variability between items within individuals, which is expected for a momentary measure of experience.

Convergent Validity

To establish convergent validity, we first examined the correlations between the MDIS and momentary positive and negative affect, using within-person correlations at the momentary level. Greater momentary distress tolerance was associated with lower momentary positive emotion, $r = -.45$, and greater momentary negative emotion, $r = .59$. We also evaluated the

correlations between average MDIS scores and the MSSD of the MDIS scale at the person level along with other averaged momentary variables, namely the average momentary positive and negative emotion and emotion regulation strategies utilized during stressful events (see Table 3). We found that greater momentary distress intolerance and instability of momentary distress intolerance was associated with lower average momentary positive emotion and greater negative emotion. In addition, greater momentary distress intolerance and greater instability in distress intolerance were associated with greater reports of trying to escape or avoid distressing situations and greater use of thought suppression; both of these are experiential avoidance factors. Greater average momentary distress intolerance, but not instability, was associated with greater use of expressive suppression, asking why, and distancing, but not the classically “adaptive” regulation strategies of reappraisal, acceptance, and problem solving.

Correlations between the behavioral distress tolerance tasks and both the MDIS and the MSSD of the MDIS scale are reported in Table 4. None were statistically significant, though there were a few marginal ($p < .10$) correlations. Specifically, greater MDIS scores were marginally associated with lower breath holding, quitting the mirror tracing task prior to completion, finding more images distressing and noting distress earlier into the image on the emotional image task. These small and non-significant correlations are consistent with the size of correlations typically found between behavioral tasks and self-report measures of distress tolerance (Ameral et al., 2014; Bernstein et al., 2011; Cogle et al., 2013; Kiselica et al., 2015; Veilleux et al., 2017).

Correlations between the MDIS and the MSSD of the MDIS scale along with the self-reported individual difference measures are reported in Table 5. MDIS and MSSD of the MDIS scores were associated with all of the individual differences except for physical discomfort

intolerance, in predicted directions. Greater momentary distress intolerance and greater instability in momentary intolerance were associated with lower affect balance (more negative-to-positive affect ratio), lower self-reported trait distress tolerance, higher experiential avoidance, greater emotion dysregulation, and greater symptoms of affective distress.

We also evaluated the unique predictive power of both the MDIS and the MSSD of the MDIS scores by regressing each individual difference on the two momentary scores (see Table 5). We found that greater instability of momentary distress intolerance was uniquely associated with affect balance and symptoms of affective distress, whereas average momentary distress tolerance was uniquely associated with trait distress tolerance. Both momentary distress tolerance measures uniquely and significantly predicted experiential avoidance and emotion dysregulation.

As one final test of convergent validity, we also conducted a multilevel analysis with the DTS (Level 2) predicting momentary distress intolerance (Level 1). This analysis found that those with lower self-reported distress tolerance at baseline reported significantly higher momentary reports of distress intolerance during the EMA period, $B = -.28$, $SE = .08$, $t(80) = -3.30$, $p = .001$. We found that the variance component decreased to 42.32 ($SE = .06$, Wald $Z = 5.99$, $p < .001$) compared to the unconditional model (49.48, reported above), where the proportion of variance in momentary distress tolerance is explained by trait distress tolerance is 14.48% ($.4948 - .4232 / .4948$). This suggests that distress intolerance varies within person over time, and although predicted by individual differences, significant situational variability remains.

Discussion

The goal of the current study was to develop and validate a brief measure of momentary distress tolerance to be used in experience sampling (i.e., EMA) studies, and in doing so

demonstrate that distress tolerance varies over time. The final measure, the Momentary Distress Intolerance Scale (MDIS), is a well-performing 3-item measure with reliable scores at both the between-subject and within-subject levels of analysis and that demonstrated significant relationships with trait measures of emotion distress tolerance and emotion dysregulation. In addition, the MDIS captures variability over time, and is associated with greater momentary negative emotion and use of maladaptive emotion regulation strategies during stressful events.

This is the first study we are aware of which explicitly evaluates distress tolerance dynamically, which has been suggested as an important future direction in several distress tolerance papers (Leventhal & Zvolensky, 2015; Trafton & Gifford, 2011; Veilleux et al., 2017). Considering that emotions vary over time and situation, and self-control also fluctuates based on context, distress tolerance—which is a special type of self-control process requiring inhibition of the impulse to alleviate discomfort (Trafton & Gifford, 2011)—should also vary over time and across situations. We found that to be the case. Yes, even momentary distress tolerance has an individual difference component such that some people seem to exhibit lower tolerance for distress compared to others, but there also was significant variability across time. This represents an important step in research on distress tolerance, and we hope that the MDIS will be valuable in future studies examining distress tolerance dynamically, such as via EMA.

Convergent Validity

The MDIS intentionally tried to capture self-reported persistence through distress. Conceptually, the three items retained on the MDIS come closer to what is assessed by behavioral distress tolerance tasks than typical self-report trait measures such as the Distress Tolerance Scale (DTS; Simons & Gaher, 2005) which assesses judgments and dislike of distress more than willingness to persist through distress. Despite the emphasis on persistence within the

MDIS, we still found small and only marginally significant correlations between the MDIS and behavioral distress tolerance tasks, similar to the kind of correlations found between traditional distress tolerance self-report measures and the behavioral tasks (Ameral et al., 2014; Bernstein et al., 2011; Cogle et al., 2013, Kiselica et al., 2015; Veilleux et al., 2017). There are several potential explanations for these findings. First, this could be similar to classic examples of low correlations of behaviors purportedly measuring the same underlying construct (Mischel, 1968), which are rampant in psychology and sometimes attributed to measurement error (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Others suggest that because these behaviors *do* change over time, situational or contextual factors likely contribute to the low correlations (Mischel, 1968). Alternately, accuracy of respondent self-assessment could be responsible for low correlations; some people may be accurate self-reporters (e.g., where self-reported perceptions match behaviors), but others are almost certainly lacking either self-awareness or honesty in their self-report. Some people likely believe they are better at persisting through distress than they actually demonstrate via behavioral tasks, and others likely believe they are worse at persisting through distress than scores on behavioral tasks would convey. These three explanations are also not mutually exclusive, as all of them could be (and likely are) operating simultaneously in studies that assess both self-report and behavioral distress tolerance. Ultimately, the data in this study suggest that differences between subdomains or subfoci within the overall distress tolerance construct (tolerance of physical sensations, tolerance of frustration, etc.; Zvolensky et al., 2010) are not the most likely explanation for low correlations between self-report and behavioral indices.

In the current study, we found significant relationships between momentary distress tolerance as measured by the MDIS and self-report trait measures of distress tolerance and

associated constructs. Specifically, higher average MDIS scores correlated with higher emotional distress tolerance, and emotional distress tolerance assessed at baseline via the DTS predicted variability in momentary distress intolerance. Higher average MDIS scores also correlated with greater experiential avoidance, greater problems with emotion dysregulation and greater affective distress (both aggregated and at momentary levels). These results are important because aggregation of momentary measures across time and situation should reflect average tendencies and thus approximate trait characteristics (Epstein, 1983) and should also be associated/predictive of issues like emotion dysregulation and symptoms of anxiety and depression, which are known correlates of distress intolerance (Leventhal & Zvolensky, 2015; Leyro et al., 2010). In addition, the significant relationships between the MDIS and emotional distress tolerance versus the non-significant relationship between the MDIS and physical distress tolerance suggests that the MDIS is specifically addressing emotional tolerance. However, considering this was an undergraduate sample who may not regularly experience physical discomfort in combination with emotional discomfort in the same fashion as other populations (e.g., smokers, people with chronic pain), the relationship between MDIS and trait distress tolerance measures should continue to be explored in other groups of people.

Our results suggest that average momentary distress intolerance and instability of distress intolerance are both related to emotional characteristics, but not in identical ways. For example, instability of MDIS, operationalized as the average daily mean squared successive difference in MDIS scores, was uniquely predictive of both lower affect balance, or a lower ratio of positive to negative affect, and symptoms of emotional pathology. This suggests that greater variability in momentary distress tolerance, above and beyond the average level of momentary distress tolerance, tends to be associated with greater levels of affective symptoms. Perhaps both low

affect balance and symptoms of anxiety and depression are associated with emotional uncertainty and unpredictability, such that people with these symptoms are never sure when they will feel capable of handling their situations and when they will not.

In contrast, average MDIS scores were uniquely associated with trait distress tolerance above and beyond instability of MDIS; this result provides additional evidence for discriminant validity of MDIS scores. In addition, average MDIS scores exhibited stronger associations with average momentary responses to stressful situations suggestive of suppression and maladaptive regulation strategies, including thought suppression, expressive suppression, asking “why” and distancing. It should be noted that of these emotion regulation strategies, neither asking “why” nor distancing are inherently problematic, though asking “why” tends to be associated with rumination (Nolen-Hoeksema, 2000) and distancing could be interpreted as distraction or avoidance rather than psychological distancing advocated by acceptance-based treatments (Kross & Ayduk, 2011).

Finally, both MDIS and instability of MDIS were uniquely predictive of greater trait experiential avoidance and greater trait emotion dysregulation. Both were also significantly correlated with lower positive affect, greater negative affect, and with the emotion regulation strategies of escaping the situation and thought suppression in response to stress, which are essentially instances of experiential avoidance. The momentary correlations converge with the individual difference information—in given moments, a greater sense that emotions are getting in the way and can’t be tolerated is associated with not only greater acknowledgment of using experiential avoidance as a regulation strategy at the trait level, but also greater acknowledgement of using these strategies when experiencing stressors in daily life.

Limitations

We recognize that the sample used in the current study—a college student sample—results in limits to generalizability. The sample was not a clinical sample, although we intentionally recruited people who differ in affect balance, where the “low” group tends to have greater distress than people who have a higher positivity ratio and may approximate a clinical sample. Still, this sample did report relatively few acute stressful events over the EMA time frame, and it is possible that the factor structure of the MDIS may not generalize to clinical populations who are thought to struggle with distress tolerance (e.g., those with borderline personality disorder, smokers, etc.), or to people experiencing significant life stressors. Future research is certainly needed to confirm the factor structure in additional samples at both within and between-subjects levels of analysis, and examining momentary distress tolerance over longer periods of time.

Clinical Implications and Future Directions

We believe that there is significant clinical utility to this measure. First, if problems with distress tolerance truly are contextual, as we propose here, then people with noted problems in distress tolerance should reflect greater *momentary* problems with distress tolerance compared to people without psychopathology. Indeed, because distress tolerance is thought to be a transdiagnostic risk factor for psychopathology, it may be that levels of momentary distress intolerance are higher for people experiencing current psychopathology compared to people who do not meet criteria for disorder or who are in remission.

Because this is a momentary measure, the MDIS can also be used to examine momentary hypotheses, whether in laboratory based studies or in future studies using EMA. For example, as behavioral distress tolerance tasks have been used as outcomes of lowered self-control in studies of ego-depletion (Hagger, Wood, Stiff, & Chatzisarantis, 2010), the MDIS could likewise reflect

if people can report lowered distress tolerance after prior self-control depletion. Relatedly, it should be that the ability to tolerate distress is lower when physical energy is lower; perhaps momentary distress intolerance is heightened when people are sleep deprived or hungry. These are not inherently clinical implications, but all of these questions could also be examined in clinical populations, as these resource deficits may also contribute to avoidance or other behavioral problems that can occur when distress is heightened.

Future research will also benefit from teasing apart contextual shifts in distress tolerance from shifts in emotional level. Our study found that when examining averages of momentary distress intolerance and momentary emotion, heightened negative affect was associated with heightened distress intolerance. Yet, it will be essential to evaluate contextual factors (including those highlighted above like hunger, tiredness, and prior use of self-control) that contribute to distress tolerance shifts even when the emotional level is the same. That is, consider a person who experiences negative emotions at two different time points, and at both time points rates their distress as a 5 out of 7. Is distress intolerance the same in both of these situations, or are there times and contexts in which distress is high, but distress *intolerance* is actually low. These would indicate times when the distress is manageable or tolerable. EMA is particularly well suited for these types of analyses because an individual person can be measured across time and situation. Perhaps for some people, distress and distress intolerance are always tightly coupled, whereas for other people they are less consistently related. These differences may reflect important information about emotion regulation flexibility (Aldao, Sheppes, & Gross, 2015) and are ripe for future research.

Conclusion

In conclusion, the current study reports on the development and validation of a brief measure of momentary distress tolerance using ecological momentary assessment. The resulting measure, the MDIS, developed using both within- and between-person analyses, appears reliable and applicable for assessing momentary fluctuations in distress tolerance. Indeed, one of the major strengths of this study is that we established, consistent with predictions from experts, (Leventhal & Zvolensky, 2015; Trafton & Gifford, 2010), that distress tolerance does change over time and context. The brief 3-item MDIS scale can thus assess fluctuations in distress tolerance, and expands the conceptualization of distress tolerance away from a trait or ability-based model to a more nuanced approach that can hopefully help future researchers continue exploration of the transdiagnostic implications of tolerating distress.

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Table 1. *Initial items for momentary distress tolerance measure*

| Item # | |
|-----------------|---|
| 1 ^a | I want to stop what I'm doing right now so I can feel better |
| 2 | I can't stand the hassle of having to do things right now. [FDS #17] |
| 3 | I don't think I can handle what I'm feeling right now. |
| 4 | I'll do anything to stop feeling how I am feeling right now |
| 5 ^a | Right now, my emotions are getting in my way. |
| 6 | Right now, I do not want to feel the way I'm feeling. |
| 7 | My current feelings won't stop me from doing what I want to do right now. [R] |
| 8 | Right now, I am willing to sit with my feelings [R] |
| 9 | I can tolerate the emotions I'm feeling right now [R] |
| 10 ^a | I can keep doing what I'm doing right now, regardless of how I feel [R] |

^aItem was retained in the final scale.

Table 2. *Factor loadings and inter-tem correlations on final three-item measure, the Momentary Distress Intolerance Scale (MDIS).*

| Item # | Factor loadings | | Inter-item correlations | | |
|--------|-----------------|---------|-------------------------|------|------|
| | Within | Between | 1. | 5. | 10. |
| 1. | .63 | .83 | -- | .73 | -.46 |
| 5. | .79 | .97 | .81 | -- | -.55 |
| 10. | -.58 | -.54 | -.45 | -.53 | -- |

Note. Within-individual correlations above the diagonal; between-individual correlations appear below the diagonal.

Table 3. *Bivariate correlations of Momentary Distress Intolerance Scale (MDIS) scores (averaged across the study) and instability in MDIS scores (MSSD) with averaged momentary emotion and regulation strategies.*

| Momentary Emotion Variables | Zero-order Bivariate Correlations | |
|------------------------------------|-----------------------------------|--------------|
| | MDIS | MSSD of MDIS |
| Average Positive Emotion | -.29** | -.25* |
| Average Negative Emotion | .67** | .27* |
| Regulation: Escaping the situation | .41** | .48** |
| Regulation: Expressive suppression | .41** | .20 |
| Regulation: Thought suppression | .34** | .27* |
| Regulation: Asking why | .24* | -.03 |
| Regulation: Distancing | .31** | -.06 |
| Regulation: Reappraisal | .21 | .10 |
| Regulation: Acceptance | -.11 | .02 |
| Regulation: Fixing the problem | .29 | .17 |

* $p < .05$, ** $p < .01$

Table 4. *Bivariate correlations of Momentary Distress Intolerance Scale (MDIS) scores (averaged across the study) and instability in MDIS scores (MSSD) with behavioral distress tolerance tasks*

| Behavioral Tasks | Zero-order Bivariate Correlations | |
|---|-----------------------------------|--------------|
| | MDIS | MSSD of MDIS |
| Breath holding | -.18 | -.16 |
| Mirror Tracing Complete Final Star (0 = quit; 1 = completed) | -.19+ | -.16 |
| Mirror Tracing Time to Quit ($n = 66$) | -.04 | -.05 |
| EIT Image Persistence | -.07 | -.09 |
| EIT Count Distress | .19+ | .13 |
| EIT Distress Threshold | -.19+ | -.11 |
| EIT Distress Tolerance | .03 | -.07 |

Note. EIT = Emotional Image Tolerance

+ $p < .10$, * $p < .05$

Table 5. *Bivariate correlations and simultaneous regressions predicting individual differences from Momentary Distress Intolerance (MDI) scores (averaged across the study) and instability in MDI scores (MSSD).*

| Individual Difference | Zero-order Bivariate Correlations | | Simultaneous Regression | | |
|--------------------------------|-----------------------------------|--------------|-------------------------|---------|--------------|
| | MDIS | MSSD of MDIS | Full Model R^2 | β | |
| | | | | MDIS | MSSD of MDIS |
| Affect Balance (SPANE) | -.25* | -.38** | .17** | -.16 | -.34** |
| Trait Distress Tolerance (DTS) | -.36** | -.27* | .17** | -.32** | -.19 |
| Discomfort Intolerance (DIS) | .20 | -.02 | .05 | .22 | -.07 |
| Experiential Avoidance (BEAQ) | .46** | .42** | .31** | .38** | .32** |
| Emotion Dysregulation (DERS) | .43** | .39** | .27** | .35** | .31** |
| Affective Distress (DASS-21) | .30** | .49** | .27** | .19 | .44** |

Note. MSSD = mean squared successive difference; SPANE = Scale of Positive and Negative Experiences; DTS = Distress Tolerance Scale; DIS = Discomfort Intolerance Scale; BEAQ = Brief Experiential Avoidance Questionnaire; DERS = Difficulties with Emotion Regulation Scale; DASS = Depression, Anxiety and Stress Scales

* $p < .05$, ** $p < .01$.