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Distress Tolerance and Social Support in Adolescence: Predicting Risk for Internalizing and Externalizing Symptoms Following a Natural Disaster

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Abstract

The purpose of the multi-measure, multi-wave, longitudinal study was to examine the interactive relation between behavioral distress tolerance (DT) and perceived social support (PSS) in 352 tornado-exposed adolescents aged 12–17 years ($M=14.44$; $SD=1.74$). At baseline, adolescents completed a computer-based task for DT, and self-report measures of PSS, depressed mood, posttraumatic stress disorder (PTSD), substance use, and interpersonal conflict. Symptoms also were assessed 4 and 12 months after baseline. Findings showed that lower levels of DT together with lower levels of PSS conferred risk for elevated symptoms of prospective depression ($t(262)=-2.04$, $p=.04$; $r_{\text{effect size}}=0.13$) and PTSD ($t(195)=-2.08$, $p=.04$; $r_{\text{effect size}}=0.15$) following a tornado. However, only PSS was significant in substance use ($t(139)=2.20$, $p=.03$; $r_{\text{effect size}}=0.18$) and conflict ($t(138)=-4.05$, $p<.0001$; $r_{\text{effect size}}=0.33$) in our sample. Implications regarding adolescent DT, the transdiagnostic nature of PSS, and the clinical applications of our findings in the aftermath of a natural disaster are discussed.

Keywords

Distress Tolerance; Perceived Social Support; Natural Disasters; Adolescence

Distress tolerance (DT) is an important vulnerability for traumatic stress and various forms of psychopathology (Zvolensky, Leyro, Bernstein, & Vujanovic, 2011). Broadly, DT is one's ability to endure aversive, ambiguous, or uncertain states (Leyro, Zvolensky, & Bernstein, 2010). DT can be objectively measured in laboratory settings via behavioral tasks, reducing researchers' dependence on self-report measures (Lejeuz, Daughters, Danielson, &

Ruggiero, 2006). Most research concerning behavioral assessment of DT focuses on adults (Cummings et al., 2013); however, researchers have started focusing on DT in adolescence because it is a sensitive period for developing psychological distress (Abela & Hankin, 2008) and self-regulation strategies (Silvers et al., 2012).

DT develops early in life and stabilizes during adolescence (Cummings et al., 2013). As with adults (Leyro et al., 2010), low DT relates to emotional distress in both community (Daughters et al., 2009) and clinical adolescent samples (Nock & Mendes, 2008). Yet some findings indicate that DT does not relate to internalizing symptoms prospectively (Cummings et al., 2013), adding to a growing body of research that questions the predictive utility of DT for emotional distress (McHugh et al., 2011). As for externalizing symptoms, some research shows that low DT is related to alcohol use, shoplifting, and physical aggression (MacPherson et al., 2010), but other findings suggest that low DT does not confer risk for externalizing symptomatology (Cummings et al., 2013).

When relations between two variables are inconsistent, or when a construct prospectively relates to multiple outcomes (e.g., multifinality; Cicchetti & Rogosch, 1996), the inclusion of third variables may clarify findings. Past DT investigations focused on the moderating role of sex (Cummings et al., 2013; Danielson, Ruggiero, Daughters, & Lejuez, 2010) and race (Daughters et al., 2009; Daughters et al., 2013), but few consistent findings emerged. Discrepancies between these moderating variables are difficult to reconcile. One possible solution is to examine perceived social support (PSS), a construct that varies as a function of sex/race (Colarossi, 2001), in order to clarify DT's clinical impact.

Individual differences in PSS predict adolescent internalizing and externalizing symptoms (Brown & Bakken, 2011). Low PSS is linked to poor adolescent mental health through cognitive vulnerabilities (Flynn, Kecmanovic, & Alloy, 2010), interpersonal stressors (Auerbach, Bridga-Peyton, Eberhart, Webb, & Ho, 2011), and other relevant risk factors (Rudolph, Flynn, & Abaied, 2008). Historically, *intrapersonal* vulnerabilities such as DT, and *interpersonal* vulnerabilities such as PSS, are studied separately (Marroquin, 2011). However, risk factors do not exist in isolation, and testing the interaction between vulnerabilities assessed at multiple levels (e.g., self-report and behavioral observation) leads to richer explanatory models of psychopathology (Beauchaine & Gatzke-Kopp, 2012).

There are several explanations for why the interaction between DT and PSS might be especially deleterious. Individuals with low DT often have difficulty coping with negative emotions (Leyro et al., 2010; Rodman, Daughters, & Lejuez, 2009). Therefore, an adolescent with low DT *and* low PSS may be less able to cope with the elevated interpersonal stressors that accompany lower levels of perceived support (Auerbach et al., 2011; Rigby, 2000). Adolescents possessing low DT and inadequate PSS may also not have available models of appropriate coping behavior or someone to intervene with their maladaptive coping decisions. To date, only one study directly tested an association between adolescent PSS and DT. Ehrlich, Cassidy, Gorka, Lejuez, and Daughters (2013) found that harsh parental response style interacted with low DT to predict poorer friendship quality. We built on these findings by examining if DT and PSS interacted to forecast adolescent psychological distress following a traumatic event.

The present study involved a sample of adolescents from communities devastated by tornadoes (see Adams et al. 2014). Understanding mental health outcomes in adolescents following natural disasters is critical (Furr, Comer, Edmunds, & Kendall, 2010) as natural disasters are an increasing problem worldwide (Neumayer & Barthel, 2011). Although many adolescents are resilient following traumatic events (Bonanno, Brewin, Kaniasty, & La Greca, 2010), the psychological toll for others is profound (Furr et al., 2010), and can be more severe than in adults (La Greca, Silverman, Lai, & Jaccard, 2010). Research that investigates specific pathways to risk and resilience following natural disasters can identify which adolescents are at-risk for specific symptom outcomes, and guide tailored interventions for these youth.

Past research has suggested that post-disaster PSS is an especially important construct to assess following a natural disaster to understand adolescent mental health outcomes (even when compared to actual support received; Bonanno et al., 2010). For instance, in a sample of 384 hurricane-exposed adolescents, PSS assessed 9 months following the hurricane was related to PTSD symptoms 21 months following the hurricane. Similarly, a recent meta-analysis found that post-disaster PSS was an important indicator of depressive symptoms in youth following a natural disaster (Tang, Liu, Liu, Xue, & Zhang, 2014). As for externalizing symptoms, to our knowledge no study has prospectively examined whether poor social support relates to distinct patterns of externalizing symptoms following a natural disaster. The absence of these studies prevent us from knowing whether PSS represents a specific indicator for emotional distress post-disaster, or a global risk factor for both internalizing and externalizing distress. With regard to DT, one study to date has assessed the construct in a trauma-exposed community sample. Marshall-Berenz, Vujanovic, Bonn-Miller, Bernstein, and Zvolesky (2011) found that only self-reported DT and not behavioral DT related to PTSD symptoms in 81 (mostly) Caucasian adults. The authors stated that their findings were limited by the cross-sectional design, limited diversity of the sample with regard to age and race, and possibly inadequate assessment of behavioral DT (in the form of a breath-holding task). To the authors' knowledge, no study has ever used a behavioral assessment of DT in a trauma-exposed community sample of adolescents in a cross-sectional design, let alone, to assess prospective mental health symptoms. Testing the role of DT, within the context of a well-documented vulnerability (PSS) provides a unique opportunity to gain a nuanced understanding of adolescent post-disaster functioning across levels of analyses.

The present study sought to extend our understanding of mental health following a natural disaster by examining a) the role of PSS in tornado-exposed adolescents, an understudied population (Adams et al., 2014); b) how PSS relates to externalizing, in addition to internalizing, symptoms; and c) whether DT interacts with PSS to forecast psychological distress. We hypothesized that in the presence of low PSS, DT would prospectively relate to psychological distress, whereas in more supportive environments (e.g., moderate/high PSS) low DT would not relate to symptoms. Exploratory analyses assessed potential moderating roles of sex and/or race.

Method

Participants

This study was conducted in the context of a broader investigation of a self-help web-based intervention, Bounce Back Now (BBN; Ruggiero et al., 2012). BBN was designed to address mental health problems in adolescents and their families living in communities affected by the Spring 2011 tornadoes across the Southeast ($N=323$; April 25–28) and Joplin, Missouri ($N=29$; May, 22). Participants in the experimental condition completed brief 3–5 item screening questionnaires and then, based on their responses, were directed to complete certain treatment modules. Participants in the control group completed assessments but were not granted access to the BBN modules. The present study focused on fluctuations in adolescents' symptoms in both conditions. At baseline, 352 adolescents completed the DT behavioral task. The sample was balanced with regard to sex (55.4% female; $N=195$) and was 64.8% Caucasian ($N=228$), 21.6% African American ($N=76$), and 6.3% Other ($N=22$), with 7% ($N=26$) not identifying with a race. Adolescents were between 12 and 17 at baseline ($M=14.44$; $SD=1.74$).

Procedure

Selection criteria prioritized families directly impacted by a tornado. NOAA tornado track latitude/longitude coordinates were used to obtain surrounding radii of affected addresses based on where the tornadoes touched down (National Oceanic & Atmospheric Administration, 2011). Eligibility criteria included a parent who: 1) resided at their address during the tornado, 2) was the legal guardian of an adolescent, and 3) had reliable Internet access at home¹. Households returning the questionnaire received \$5 compensation regardless of study eligibility. Eligible households per the screening questionnaire were contacted via phone to confirm eligibility.

Eligible adolescents completed a structured telephone interview at baseline approximately 8 months after tornado exposure. Confidentiality was explained to all adolescents, and interviewers confirmed the adolescent had privacy before the interview began. Adolescents were asked about their perceived social support (PSS), depression symptoms, PTSD, substance use, and conflict in the family² over the prior four weeks. Following the phone call, participants accessed the intervention and the distress tolerance (DT) task on the computer via secure Internet login. Of the 352 adolescent subsample who completed the DT task (17.6% of the original sample contacted by phone)³, 50.4% of the participants completed the task the same day as the interview with an additional 28.7% (79.1% total) completing the task within a week of the interview ($M=7.6$ days, $SD=22.94$). Two more follow-up assessments were made at 4 and 12 months post-baseline (i.e., 12 and 20 months post-tornado). During these follow-ups, psychological symptoms were assessed.

¹Only 2.1% of all adolescents contacted were ruled out due to Internet access, suggesting that our inclusion criteria did not have an adverse impact on the generalizability of our results.

²Due to budgetary reasons, only 60% of the original sample was randomly selected to complete the Conflict Behavior Questionnaire (CBQ).

³Participants who completed the DT task were compared to those who did not across all study variables. No significant differences were found across constructs ($p > .20$).

Measures

The Behavioral Indicator of Resiliency to Distress (BIRD; Danielson et al., 2010; Lejuez et al., 2006)—The BIRD is a computerized task designed to assess DT. The BIRD challenges youth to click on a green dot displayed above a numbered box before the green dot appears above another number. If the green dot moves before the youth clicks on box or the wrong box is clicked, an unpleasant noise occurs and the adolescent does not earn a point. Participants are informed that prizes could be obtained based on points earned, but details about requirements for each prize are withheld. A running total for points earned is visible in the corner of the screen. Trials become faster, more challenging, and thus more aversive as the task progresses. During the final level of testing, adolescents can elect to stop at any time, but quitting hypothetically influences the magnitude of their prizes. For our study, DT was measured by persistence (i.e., total time in minutes to quit) on the final level ($M=2.51$; $SD=1.93$). Higher times indicate higher levels of DT (see Lejuez et al., 2006 for further detail).

Social Support for Adolescents Scale (SSAS; Seidman et al., 1995)—A modified version of the SSAS assessed the extent to which adolescents could turn to their mothers, fathers, siblings, close friends, and peers for 1) emotional social support (“talking about a personal problem”); 2) instrumental social support (“money and other things”); and 3) fun. Responses are made on a 3-point Likert scale ranging from “Not at all” to “A great deal.” Higher scores indicate higher levels of social support. Similar to other natural disaster studies (e.g., Feder et al., 2013; La Greca et al., 2010) and other studies that use the SSAS (e.g., Tandon, Dariotis, Tucker, & Sorenstein, 2013; Trickett & Birman, 2005), scores were summed across relationships and averaged across types of social support to form a global score. Total scores ranged between 1.67 and 10 in the present study. Reliability estimates for the 15-item measure were good ($\alpha=.80$) and consistent with past research (Birman, Trickett, & Vinokurov, 2002).

Conflict Belief Questionnaire Short Form (CBQ; Robin & Foster, 1989)—Adolescents completed the CBQ Short Form, a 20-item true/false measure of parent-adolescent conflict (e.g., “At least once a day we get angry with each other,” “She/he says I have no consideration for her/him”). A total score is computed; higher scores indicate greater conflict. For the present study, total scores ranged between 0 and 20 across administrations. Similar to past research which used the CBQ (Kane & Garber, 2008), this scale had excellent internal consistency in our sample (α : 0.90 to 0.92 across administrations). The CBQ total score served as an indicator of externalizing behaviors in adolescents, given the high degree of conflict between externalizing adolescents and parents, and parents’ frustration with externalizing, as opposed to internalizing, adolescents (Hofer et al., 2013).

CRAFFT Substance Abuse Screening Test (Knight, Sheritt, Shrier, Harris, & Chang, 2002)—The CRAFFT is a brief measure of adolescent substance abuse. Respondents complete six dichotomous questions (yes=1, no=0) about engagement in risky substance use behaviors (e.g., “Did you ever use drugs or substance when you were by yourself?”) which are then summed, with higher scores indicating greater risk. Total scores

on the CRAFFT in our study ranged between 0 and 5. The CRAFFT had Cronbach alpha's ranging between 0.61 and 0.72, which is consistent with past research (see Dhalla, Zumbo, & Poole, 2011).

The National Survey of Adolescents-Replication PTSD and MDD modules (Resnick, Kilpatrick, Dansky, Saunders, & Best, 1993)—The NSA-R PTSD and MDD modules were used to assess the 17 *DSM-IV* symptom criteria for PTSD and 9 criteria for MDD in adolescents. Symptom criteria were scored dichotomously as present or absent over the past 4 weeks. Total scores in the present study reflected the full range for the measures (0–9 for depression; 0–17 for PTSD). Cronbach's alphas ranged between 0.82 and 0.88 for PTSD symptoms across the three assessments and 0.73 and 0.81 for MDD symptoms, and were similar to past research (Boscarino, Gacla, Ahern, Resnick, & Vlahov, 2002).

Data-Analytic Approach

All analyses were performed using restricted maximum likelihood models (REML) in the SAS (version 9.3) MIXED procedure. Outcomes were time varying, Level 1 symptom variables. Predictors for all dependent variables included DT (Level 2), PSS (Level 2), the interaction between DT and PSS, and a significant random intercept ($p < .0001$). Initial models included time (modeled as 0,1,2) as a fixed and random effect. Close inspection of the unconditional models suggested that limited variance in our outcomes prevented our ability to adequately assess growth curve model interactions across outcomes (e.g., DTxPSSxTime). These findings were consistent across alternative approaches for modeling time (e.g., quadratic approach). Assignment to the experimental condition was also included as a covariate in all analyses.

Because age positively related to substance use ($t(340)=2.84, p=.01; r_{\text{effect size}}=0.15$), and African-American adolescents, compared to Caucasian adolescents were more at-risk for depression ($t(311)=2.83, p<.01; r_{\text{effect size}}=0.16$) and PTSD ($t(313)=2.15, p=.03, r_{\text{effect size}}=0.12$), age was added as a covariate for substance use, and race was added as a covariate for depression and PTSD. Moderating effects for sex, age, race, and treatment condition were tested in initial models. Effect sizes using the r statistic ($r>.10$ =small; $r>.30$ =medium; Rice & Harris, 2005) were calculated for all results.

Results

Preliminary Analyses

Preliminary analyses indicated DT, PTSD, depression, substance use, and conflict had irregular kurtosis (see Tabachnick & Fidell, 2007) requiring data transformation. For PTSD, depression, and substance use, an inverse log transformation was necessary, for conflict a log transformation was utilized, and DT scores were raised to the 2.70 power (see Fink, 2009 for transformation details). Correlations for baseline measures can be found in Table 1. Means and standard deviations for measures prior to transformations can be found in Table 2.

Next, it was examined if participants differed systematically based on the number of assessments they completed. For the present study, 77.3% of the participants completed at

least two assessments (with 54% completing all three). As described by Hedeker and Gibbons (1997) we tested if the number of follow-ups completed by participants influenced any relations in our study. No significance was found for the number of follow-ups interacting with vulnerabilities (i.e., DT, PSS) to predict symptoms ($p>.10$). Furthermore, none of the study's measured variables correlated to the number of follow-ups completed suggesting that attrition did not occur in a systematic fashion and we concluded data were missing at random (MAR). Little's Missing Completely at Random (MCAR) test was statistically significant ($p<.05$), so no imputed data was used. However, we did retest our findings with imputed data using expectation maximization procedures (EM), and the pattern of results remained similar.

Outcomes for Internalizing Symptoms

For depression and PTSD, age, sex, race, and completing the intervention did not influence the relation between DT/PSS and symptoms ($p>.05$). Next, we examined whether DT interacted with PSS to predict depressive symptoms. This interaction was significant ($B=-0.0002$; $SE=0.0001$; $t(262)=-2.04$, $p=.04$; $r_{\text{effect size}}=0.13$). To examine this interaction, the predicted depressive scores for adolescents with low/high DT (± 2.0 SD above/below the group mean) and low/high PSS (± 2.0 SD) was calculated. Slopes for both high DT ($B=0.0567$; $SE=0.0083$; $t(303)=6.77$, $p<.0001$; $r_{\text{effect size}}=0.36$) and low DT ($B=0.0577$; $SE=0.0085$; $t(303)=6.82$, $p<.0001$; $r_{\text{effect size}}=0.36$) were significant. Planned contrasts demonstrated that those with low DT *and* low PSS were at greatest risk for elevated depressive symptoms.

Next, we examined whether the interaction between DT and PSS predicted prospective PTSD symptoms. As with depression, this interaction was significant ($B=-0.0002$; $SE=0.0001$; $t(195)=-2.08$, $p=.04$; $r_{\text{effect size}}=0.15$). Post-hoc analyses, identical to the ones described above, were conducted to understand the interaction. The slopes for high DT ($B=0.0587$; $SE=0.0097$; $t(303)=6.01$, $p<.0001$; $r_{\text{effect size}}=0.33$) and low DT ($B=0.0600$; $SE=0.0099$; $t(303)=6.08$, $p<.0001$; $r_{\text{effect size}}=0.33$) were both significant. Planned contrasts demonstrated that those with low DT *and* low PSS were at greatest risk for elevated PTSD symptoms.

Outcomes for Externalizing Symptoms

With regard to externalizing symptoms, no higher-ordered interactions with demographic variables or experimental condition were significant ($p>.10$). The interaction between PSS and DT also did not predict parent-adolescent conflict ($B=0.0003$; $SE=0.0003$; $t(130)=1.12$, $p=.26$; $r_{\text{effect size}}=0.09$) or substance use ($B=0.0000$; $SE=0.0000$; $t(175)=-1.02$, $p=.31$; $r_{\text{effect size}}=0.08$). We next tested DT or PSS as main effects. For conflict, PSS ($B=-0.0648$; $SE=0.0159$; $t(138)=-4.05$, $p<.0001$; $r_{\text{effect size}}=0.33$) was a significant predictor whereby lower levels of PSS predicted higher levels of conflict, but DT ($B=-0.0005$; $SE=0.0007$; $t(155)=-0.68$, $p=.50$; $r_{\text{effect size}}=0.05$) was not significant. Finally, PSS ($B=0.0039$; $SE=0.0018$; $t(139)=-2.20$, $p=.03$; $r_{\text{effect size}}=0.18$), but not DT ($B=-0.0001$; $SE=0.0001$; $t(130)=-0.79$, $p=.43$; $r_{\text{effect size}}=0.07$), predicted substance use, such that lower levels of PSS predicted elevated levels of substance use.⁴

Post-Hoc Analyses

The sample utilized an unconventional approach by including both the treatment and control group to test our hypotheses. In light of this fact, we tested additional analyses to ensure that our results were not influenced by the intervention itself. We first tested whether including 1) accessing the intervention or 2) completing the intervention within interaction terms altered our hypotheses. Across both conditions (accessing and completing), and across all four outcomes, all three-way and two-way interactions were insignificant. Next, we tested whether our findings were consistent when we only included those youth assigned to the control condition ($N = 249$). Findings across all four outcomes remained identical for the interaction between DT and PSS, and for the findings for DT and PSS as main effects.⁵

Discussion

The present study advances our understanding of post-disaster distress by testing the impact of distress tolerance (DT) across levels of perceived social support (PSS) in a sample of tornado-exposed adolescents. Findings demonstrated that low levels of DT were associated with elevated symptoms of depression and PTSD in the presence of low PSS. DT did not interact with PSS to predict symptoms of substance use or family conflict, and only PSS, as a main effect, predicted these symptoms.

This study sheds light on the adolescent DT and internalizing symptoms literature. Past research is mixed, with some studies suggesting a significant, prospective inverse relation between low DT and emotional distress (Danielson et al., 2010; Daughters et al., 2013), and others finding no such relation (Cummings et al., 2013). Our findings offer an explanation for these inconsistencies by suggesting that DT is associated with prospective symptoms of PTSD and depression, but only in the presence of low social support. Positive findings for our moderation hypothesis highlight the need to integrate multiple vulnerabilities into models of psychopathology to properly contextualize the impact of specific risk factors (Beauchaine & Gatzke-Kopp, 2012).

Findings regarding internalizing symptoms are congruent with Ehrlich and colleagues' (2013) study, in which low DT only predicted friendship quality in the presence of low parental support. Integrating our findings with Ehrlich and colleagues' (2013) study, it may be the interaction between parental support and DT relates to psychosocial impairment more broadly during adolescence, including negative perceptions of friendships. Likewise, it may be that friendship quality explains the resulting symptoms of depression and PTSD (an example of moderated mediation; Bauer, Preacher, & Gil, 2006). Collectively, these findings suggest that low DT is only problematic in specific interpersonal contexts, where PSS is low. As PSS plays a key role in coping with the aftermath of natural disasters (La Greca, Taylor, & Herge, 2012), these findings warrant further investigation.

⁴To provide a more stringent test of our findings, all prospective analyses were rerun with the intercept recentered to 0 at Time 2 and subsequently Time 3. Our pattern of findings remained identical across analyses providing further support that significance was maintained across the duration of the study.

⁵Contact the first author for specific estimates for these analyses.

Given the increase of natural disasters worldwide (Neumayer & Barthel, 2011), the experience of living through these traumatic events is becoming increasingly common. With regard to emotional distress the interaction between PSS and DT may play out in several ways following a tornado. For instance, major life events (e.g., loss of a family member, property destruction) and daily hassles (e.g., closed roads, power outages) are endemic to living through a natural disaster (Furr et al., 2010). Having low levels of DT may leave one emotionally overwhelmed coping with these events and lead to withdrawal from loved ones (Leyro et al., 2010). Although it may not be possible to simply withdraw within the context of normative PSS, individuals who do not perceive their family and friends as supportive may either resist efforts by others to reengage or not have people reaching out to them. Withdrawing from these networks, and feeling overwhelmed emotionally, may set the stage for negative cognitions to persist about one's ability to survive after a storm, and internalizing symptoms may emerge.

Contrary to hypotheses, DT did not interact with PSS to predict substance use. One explanation for this discrepancy from past studies (Daughters et al., 2013) could be lower base rates of substance use in our study compared to past research (Danielson et al., 2014). Low base rates for substance use may be due to several reasons, including lower substance use rates in Missouri (Missouri Department of Public Safety and Statistical Analysis, 2012) and southeastern United States (CDC, 2011) compared to other regions of the country. These low base rates may have precluded detection of interactions between PSS and DT. Past research shows that low DT plays an important role in other types of externalizing symptoms, including physical altercations/conflict (Cummings et al., 2013; Daughters et al., 2009; Daughters et al., 2013). We did not observe this finding in our sample. Cummings and colleagues (2013) found that low levels of DT predicted increased prospective symptoms of Attention Deficit Hyperactivity Disorder (ADHD), decreased levels of Oppositional Defiant Disorder (ODD), and was not related to Conduct Disorder (CD). Therefore, as increased conflict may be expected across these three diagnostic classes, simply measuring conflict may not adequately identify the different associations between DT and specific externalizing symptoms.

Alternatively, the insignificant interaction between DT and PSS in the context of externalizing symptoms, suggests it is best to focus on PSS alone to understand behavioral disturbances post-disaster. Even compared to other forms of social support (e.g., received support), post-disaster PSS is among the strongest predictors of functioning following natural disasters (Bonnano et al., 2010). Although past research focused on symptoms of PTSD, and to a lesser extent depression (Lai, La Greca, Auslander, & Short, 2013), low PSS also seems to be a risk factor for maladjustment broadly defined. Because limited resources exist for adolescents coping with natural disaster consequences (Jaycox et al., 2010), it is important to identify adolescents most at-risk for symptoms to prioritize access to services. Combined with other research (e.g., La Greca et al., 2010; Lai et al., 2013), our findings support targeting post-disaster PSS as a transdiagnostic vulnerability following a natural disaster.

Null results for exploratory analyses concerning gender, race, and age were noteworthy. Our findings were consistent with Cummings and colleagues' (2013) observation that these

demographic factors did not influence the DT-psychopathology relation. These findings deviate from Daughters and colleagues' (2009 (2013) research that found demographic differences. One reason for our null findings may be that coping mechanisms become more homogeneous across demographic factors following a natural disaster due to the significant impact on community and family resources (Bonanno et al., 2010). However, another possibility is that the relation between demographic differences and DT is unstable, as even the influence of race on externalizing symptoms between the Daughters and colleagues (2009, 2013) studies varied. Thus, focusing on psychological processes, such as PSS, seems to provide a clearer context for the relation between DT and emotional distress. Furthermore, by focusing on malleable processes such as DT and PSS, we identified constructs that can be targeted via clinical intervention.

The present study had several strengths, including its longitudinal design, large sample, and multi-method approach, but there also are noteworthy limitations. First, assessments of baseline vulnerabilities only occurred once, and 8-months following the tornado. This methodology prevents us from understanding any psychosocial functioning prior to the natural disaster. Although the broader developmental literature shows DT to be fairly stable during adolescence (Cummings et al., 2013), research concerning PSS shows that important changes (i.e., decreases; Bonanno et al., 2010) can occur post-disaster. However, despite not having pre-tornado levels, the present study provides critical vulnerability data that can be easily translated to inform current prevention efforts. A majority of research has demonstrated that interpersonal interventions and restoring social networks is a key effort in stabilizing mental health following a natural disaster (Bonanno et al., 2010). In practice, it would be rare that these programs have access to pre-trauma social support levels. However, from our research, these programs may want to direct interpersonal intervention efforts to protect against a wide array of mental health issues, and also integrate additional constructs, such as DT, to make prevention program referrals more targeted (e.g., for internalizing distress as opposed to psychological distress). Therefore, our study provides novel and useful clinical data concerning post-disaster indicators that may signal the trajectory of symptoms following the natural disaster.

Having our baseline assessment occur 8 months post-disaster probably also contributed to lower than expected adolescent symptom levels as declines usually takes place between 7 and 10 months post-disaster (La Greca, Silverman, Vernberg, E. M., & Prinstein, 1996). Our delayed assessment also probably accounted for the lack of variability in our symptom outcomes overtime as youths' symptoms tend to stabilize approximately 8 months post-disaster (La Greca et al., 2010). Given the low levels of symptoms and stable pattern over time, it may not be surprising that similar to most community studies (McClelland & Judd, 1993) our effect sizes were in the small range and need to be interpreted cautiously (see Adams et al., 2014 for an explanation of symptom patterns across the larger study). Conducting future studies temporally closer to natural disasters may result in higher variability in symptoms across assessment intervals and allow for the examination of increasing/decreasing trajectories through growth curve models.

In spite of these related limitations (assessment of vulnerability factors post-disaster and baseline occurring 8-months post-disaster), it is important to recognize that there is a

tradition of research that examines post-disaster indicators of functioning (e.g., post-disaster PSS) to test how long-term mental health patterns form following a trauma (see Bonanno et al., 2010). As acute stress would be a normal reaction to a disaster, this methodology can provide insight into post-disaster indicators for chronic or delayed trauma responses. This body of research is important to distinguish from other studies that examine functioning in the immediate aftermath of a natural disaster as short-term and long-term responses to community traumas may have unique vulnerability patterns (Adams & Boscarino, 2006; La Greca, Silverman, & Wasserstein, 1998). Therefore, our study should be contextualized with other research that examined indicators of long-term adjustment following a disaster as opposed to models which discuss responses in the days or weeks following a community trauma.

A final limitation that is important to note was that the present study was unable to assess prospective stressors following the natural disaster. Within our theoretical model, we hypothesize that the inability to deal with stressors following a disaster is what makes low DT and low PSS a dangerous combination. However, by not including any post-disaster stressor assessment, we were unable to empirically assess this hypothesis. Future studies may want to include a comprehensive examination of post-disaster stressors so that this mediational pathway can be formally tested.

Novel findings presented here advance our understanding of adolescent development in two important domains. First, the impact of having low DT is best understood in combination with other vulnerabilities. We identified PSS as one such vulnerability, but future research should focus on other risk factors (e.g., cognitive; Flynn et al., 2010 or genetic; Amstadter et al., 2012), to which adolescents with low DT may be especially reactive. Second, our findings showed the importance of PSS within a tornado-exposed adolescent sample. In addition to examining which aspects of PSS are most important in preventing emotional distress following a storm (e.g., instrumental, emotional support; La Greca et al., 2010), future research should test how different patterns of inadequate PSS differentially relate to internalizing and externalizing distress as our methodology was not ideal for assessing these complex and interconnected adolescent relationships. Given the substantial consequences of experiencing a natural disaster in adolescence (La Greca et al., 2012), understanding the relations between specific vulnerability profiles and unique symptom outcomes is an important goal for the field.

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References

- Abela, JRZ., Hankin, BL. Cognitive vulnerability to depression in children and adolescents. In: Abela, JRZ., Hankin, BL., editors. Handbook of depression in children and adolescents. New York: Guilford; 2008. p. 35-78.

- Adams RE, Boscarino JA. Predictors of PTSD and delayed PTSD after disaster: The impact of exposure and psychosocial resources. *The Journal of nervous and mental disease*. 2006; 194:485–504. [PubMed: 16840844]
- Adams ZW, Sumner JA, Danielson CK, McCauley JL, Resnick HS, Grös K, ... Ruggiero KJ. Prevalence and predictors of PTSD and depression among adolescent victims of the Spring 2011 tornado outbreak. *Journal of child psychology and psychiatry*. 2014; doi: 10.1111/jcpp.12220
- Amstadter AB, Daughters SB, MacPherson L, Reynolds EK, Danielson CK, Wang F, ... Lejuez CW. Genetic associations with performance on a behavioral measure of distress intolerance. *Journal of psychiatric research*. 2012; 46:87–94. DOI: 10.1016/j.jpsychires.2011.09.017 [PubMed: 22024485]
- Auerbach RP, Bigda-Peyton JS, Eberhart NK, Webb CA, Ho MHR. Conceptualizing the prospective relationship between social support, stress, and depressive symptoms among adolescents. *Journal of abnormal child psychology*. 2011; 39:475–487. DOI: 10.1007/s10802-010-9479-x [PubMed: 21188628]
- Bauer DJ, Preacher KJ, Gil KM. Conceptualizing and testing random indirect effects and moderated mediation in multilevel models: new procedures and recommendations. *Psychological methods*. 2006; 11:142–163. DOI: 10.1037/1082-989X.11.2.142 [PubMed: 16784335]
- Beauchaine TP, Gatzke-Kopp LM. Instantiating the multiple levels of analysis perspective in a program of study on externalizing behavior. *Development and psychopathology*. 2012; 24:1003–1018. <http://dx.doi.org/10.1017/S0954579412000508>. [PubMed: 22781868]
- Bernstein A, Marshall EC, Zvolensky MJ. Multi-method evaluation of distress tolerance measures and construct(s): Concurrent relations to mood and anxiety psychopathology and quality of life. *Journal of Experimental Psychopathology*. 2011; 2:386–399. <http://dx.doi.org/10.5127/jep.006610>.
- Birman D, Trickett EJ, Vinokurov A. Acculturation and adaptation of Soviet Jewish refugee adolescents: Predictors of adjustment across life domains. *American journal of community psychology*. 2002; 30:585–607. DOI: 10.1023/A:1016323213871 [PubMed: 12188052]
- Bonanno GA, Brewin CR, Kaniasty K, La Greca AM. Weighing the costs of disaster consequences, risks, and resilience in individuals, families, and communities. *Psychological Science in the Public Interest*. 2010; 11:1–49. DOI: 10.1177/1529100610387086 [PubMed: 26168411]
- Boscarino JA, Galea S, Ahern J, Resnick HS, Vlahov D. Utilization of mental health services following the September 11th terrorist attacks in Manhattan, New York City. *International Journal of Emergency Mental Health*. 2002; 4:143–155. DOI: 10.1176/appi.ps.55.3.274 [PubMed: 12387188]
- Brown BB, Bakken JP. Parenting and peer relationships: Reinvigorating research on family–peer linkages in adolescence. *Journal of research on adolescence*. 2011; 21:153–165. DOI: 10.1111/j.1532-7795.2010.00720.x
- CDC. Centers for Disease Control and Prevention. Youth Risk Behavior Survey (YRBS). U.S. Department of Health and Human Services; 2011.
- Cicchetti D, Rogosch FA. Equifinality and multifinality in developmental psychopathology. *Development and Psychopathology*. 1996; 8:597–600. <http://dx.doi.org/10.1017/S0954579400007318>.
- Colarossi LG. Adolescent gender differences in social support: Structure, function, and provider type. *Social Work Research*. 2001; 25:233–241. DOI: 10.1093/swr/25.4.233
- Cummings JR, Bornovalova MA, Ojanen T, Hunt E, MacPherson L, Lejuez C. Time doesn't change everything: The longitudinal course of distress tolerance and its relationship with externalizing and internalizing symptoms during early adolescence. *Journal of abnormal child psychology*. 2013; 41:735–748. DOI: 10.1007/s10802-012-9704-x [PubMed: 23329354]
- Danielson CK, Sumner J, Adams Z, McCauley J, Carpenter M, Amstadter AB, Ruggiero K. Substance use patterns and problems among disaster-exposed adolescents: Findings from the Alabama/Missouri Tornadoes of Spring of 2011. 2014 Manuscript submitted for publication.
- Danielson CK, Ruggiero KJ, Daughters SB, Lejuez CW. Distress tolerance, risk-taking propensity, and PTSD symptoms in trauma-exposed youth: Pilot study. *The Behavior Therapist*. 2010; 33:28–34.
- Daughters SB, Gorka SM, Magidson JF, MacPherson L, Seitz-Brown CJ. The role of gender and race in the relation between adolescent distress tolerance and externalizing and internalizing

psychopathology. *Journal of adolescence*. 2013; 36:1053–1065. DOI: 10.1016/j.adolescence.2013.08.008 [PubMed: 24215952]

Daughters SB, Reynolds EK, MacPherson L, Kahler CW, Danielson CK, Zvolensky M, Lejuez CW. Distress tolerance and early adolescent externalizing and internalizing symptoms: The moderating role of gender and ethnicity. *Behaviour Research and Therapy*. 2009; 47:198–205. DOI: 10.1016/j.brat.2008.12.001 [PubMed: 19135649]

Dhalla S, Zumbo BD, Poole G. A review of the psychometric properties of the CRAFFT instrument: 1999–2010. *Current drug abuse reviews*. 2011; 4:57–64. [PubMed: 21466499]

Ehrlich KB, Cassidy J, Gorka SM, Lejuez CW, Daughters SB. Adolescent friendships in the context of dual risk: The roles of low adolescent distress tolerance and harsh parental response to adolescent distress. *Emotion*. 2013; 13:843–851. DOI: 10.1037/a0032587 [PubMed: 23795594]

Feder A, Ahmad S, Lee EJ, Morgan JE, Singh R, Smith BW, ... Charney DS. Coping and PTSD symptoms in Pakistani earthquake survivors: Purpose in life, religious coping and social support. *Journal of affective disorders*. 2013; 147(1):156–163. [PubMed: 23196198]

Fink EL. The FAQs on data transformation. *Communication Monographs*. 2009; 76:379–397. DOI: 10.1080/03637750903310352

Flynn M, Kecmanovic J, Alloy LB. An examination of integrated cognitive-interpersonal vulnerability to depression: The role of rumination, perceived social support, and interpersonal stress generation. *Cognitive Therapy and Research*. 2010; 34:456–466. DOI: 10.1007/s10608-010-9300-8 [PubMed: 25429169]

Furr JM, Comer JS, Edmunds JM, Kendall PC. Disasters and youth: A meta-analytic examination of posttraumatic stress. *Journal of consulting and clinical psychology*. 2010; 78:765–780. DOI: 10.1037/a0021482 [PubMed: 21114340]

Hedeker, D., Gibbons, RD. *Longitudinal Data Analysis*. Hoboken, NJ: John Wiley & Sons, Inc; 1997.

Hofer C, Eisenberg N, Spinrad TL, Morris AS, Gershoff E, Valiente C, ... Eggum ND. Mother–adolescent conflict: Stability, change, and relations with externalizing and internalizing behavior problems. *Social Development*. 2013; 22:259–279. DOI: 10.1111/sode.12012 [PubMed: 23729993]

Jaycox LH, Cohen JA, Mannarino AP, Walker DW, Langley AK, Gegenheimer K, ... Schonlau M. Children's mental health care following Hurricane Katrina: A field trial of trauma-focused psychotherapies. *Journal of Traumatic Stress*. 2010; 23:223–231. DOI: 10.1002/jts.20518 [PubMed: 20419730]

Kane P, Garber J. Parental depression and child externalizing and internalizing symptoms: Unique effects of fathers' symptoms and perceived conflict as a mediator. *Journal of Child and Family Studies*. 2009; 18(4):465–472. DOI: 10.1007/s10826-008-9250-x

Knight JR, Sherritt L, Shrier LA, Harris SK, Chang G. Validity of the CRAFFT substance abuse screening test among adolescent clinic patients. *Archives of Pediatrics & Adolescent Medicine*. 2002; 156:607–614. DOI: 10.1001/archpedi.156.6.607 [PubMed: 12038895]

La Greca AM, Silverman WK, Lai B, Jaccard J. Hurricane-related exposure experiences and stressors, other life events, and social support: Concurrent and prospective impact on children's persistent posttraumatic stress symptoms. *Journal of consulting and clinical psychology*. 2010; 78:794–805. DOI: 10.1037/a0020775 [PubMed: 20939624]

La Greca AM, Silverman WK, Vernberg EM, Prinstein MJ. Symptoms of posttraumatic stress in children after Hurricane Andrew: a prospective study. *Journal of consulting and clinical psychology*. 1996; 64(4):712. [PubMed: 8803361]

La Greca AM, Silverman WK, Wasserstein SB. Children's predisaster functioning as a predictor of posttraumatic stress following Hurricane Andrew. *Journal of consulting and clinical psychology*. 1998; 66:883–892. [PubMed: 9874901]

La Greca AM, Taylor CJ, Herge WM. Traumatic stress disorders in children and adolescents. *The Oxford handbook of traumatic stress disorders*. 2012:98–118.

Lai BS, La Greca AM, Auslander BA, Short MB. Children's symptoms of posttraumatic stress and depression after a natural disaster: Comorbidity and risk factors. *Journal of affective disorders*. 2013; 146:71–78. DOI: 10.1016/j.jad.2012.08.041 [PubMed: 22974469]

- Lejuez CW, Daughters SB, Danielson CW, Ruggiero K. The behavioral indicator of resiliency to distress (BIRD). 2006 Unpublished manual.
- Leyro TM, Zvolensky MJ, Bernstein A. Distress tolerance and psychopathological symptoms and disorders: a review of the empirical literature among adults. *Psychological bulletin*. 2010; 136:576–600. DOI: 10.1037/a0019712 [PubMed: 20565169]
- MacPherson L, Reynolds EK, Daughters SB, Wang F, Cassidy J, Mayes LC, Lejuez CW. Positive and negative reinforcement underlying risk behavior in early adolescents. *Prevention Science*. 2010; 11:331–342. DOI: 10.1007/s11121-010-0172-7 [PubMed: 20309633]
- Marroquín B. Interpersonal emotion regulation as a mechanism of social support in depression. *Clinical psychology review*. 2011; 31:1276–1290. DOI: 10.1016/j.cpr.2011.09.005 [PubMed: 21983267]
- Marshall-Berenz EC, Vujanovic AA, Bonn-Miller MO, Bernstein A, Zvolensky MJ. Multimethod study of distress tolerance and PTSD symptom severity in a trauma-exposed community sample. *Journal of Traumatic Stress*. 2010; 23:623–630. [PubMed: 20848616]
- McClelland GH, Judd CM. Statistical difficulties of detecting interactions and moderator effects. *Psychological Bulletin*. 1993; 114:376–390. [PubMed: 8416037]
- McHugh RK, Daughters SB, Lejuez CW, Murray HW, Hearon BA, Gorka SM, Otto MW. Shared variance among self-report and behavioral measures of distress intolerance. *Cognitive therapy and research*. 2011; 35:266–275. DOI: 10.1007/s10608-010-9295-1 [PubMed: 23894216]
- Missouri Department of Public Safety and Statistical Analysis. Nature and extent of the illicit drug problem in Missouri Report. 2012
- Neumayer E, Barthel F. Normalizing economic loss from natural disasters: a global analysis. *Global Environmental Change*. 2011; 21:13–24. DOI: 10.1016/j.gloenvcha.2010.10.004
- Nock MK, Mendes WB. Physiological arousal, distress tolerance, and social problem-solving deficits among adolescent self-injurers. *Journal of Consulting and Clinical Psychology*. 2008; 76:28.doi: 10.1037/0022-006X.76.1.28 [PubMed: 18229980]
- Resnick HS, Kilpatrick DG, Dansky BS, Saunders BE, Best CL. Prevalence of civilian trauma and posttraumatic stress disorder in a representative national sample of women. *Journal of Consulting and Clinical Psychology*. 1993; 61:984–991. DOI: 10.1037/0022-006X.61.6.984 [PubMed: 8113499]
- Rigby K. Effects of peer victimization in schools and perceived social support on adolescent well-being. *Journal of Adolescence*. 2000; 23:57–68. DOI: 10.1006/jado.1999.0289 [PubMed: 10700372]
- Robin, AL., Foster, SL. Negotiating parent-adolescent conflict: A behavioral-family systems approach. New York: Guilford Press; 1989.
- Rodman SA, Daughters SB, Lejuez CW. Distress tolerance and rational-emotive behavior therapy: A new role for behavioral analogue tasks. *Journal of Rational-Emotive & Cognitive-Behavior Therapy*. 2009; 27:97–120. DOI: 10.1007/s10942-009-0090-4
- Rice ME, Harris GT. Comparing effect sizes in follow-up studies: ROC Area, Cohen's d, and r. *Law and Human Behavior*. 2005; 29:615–620. DOI: 10.1007/s10979-005-6832-7 [PubMed: 16254746]
- Rudolph, KD., Flynn, M., Abaied, JL. A developmental perspective on interpersonal theories of youth depression. 79–102. In: Abela, JRZ., Hankin, BL., editors. *Handbook of depression in children and adolescents*. New York: Guilford; 2008. p. 79–102.
- Ruggiero KJ, Resnick HS, Paul LA, Gros K, McCauley JL, ... Galea S. Randomized controlled trial of an internet-based intervention using random-digit-dial recruitment: the *Disaster Recovery Web* project. *Contemporary Clinical Trials*. 2012; 33:237–246. DOI: 10.1016/j.cct.2011.10.001 [PubMed: 22008248]
- Seidman E, Allen L, Aber JL, Mitchell C, Feinman J, Yoshikawa H, ... Roper GC. Development and validation of adolescent-perceived microsystem scales: Social support, daily hassles, and involvement. *American Journal of Community Psychology*. 1995; 23:355–388. [PubMed: 7572836]
- Silvers JA, McRae K, Gabrieli JD, Gross JJ, Remy KA, Ochsner KN. Age-related differences in emotional reactivity, regulation, and rejection sensitivity in adolescence. *Emotion*. 2012; 12:1235–1247. DOI: 10.1037/a0028297 [PubMed: 22642356]

- Smyth, JM., Heron, KE. Ecological Momentary Assessment (EMA) in family research. In: McHale, SM. Amato, P., Booth, P's, editors. *Emerging Methods in Family Research*. Springer International Publishing; 2014. p. 145-161.
- Tabachnick, BG., Fidell, LS. *Using multivariate statistics*. 5. Boston: Allyn and Bacon; 2007.
- Tandon SD, Dariotis JK, Tucker MG, Sonenstein FL. Coping, stress, and social support associations with internalizing and externalizing behavior among urban adolescents and young adults: revelations from a cluster analysis. *Journal of Adolescent Health*. 2013; 52:627–633. [PubMed: 23298992]
- Tang B, Liu X, Liu Y, Xue C, Zhang L. A meta-analysis of risk factors for depression in adults and children after natural disasters. *BMC public health*. 2014; 14:623–635. [PubMed: 24941890]
- Trickett EJ, Birman D. Acculturation, school context, and school outcomes: Adaptation of refugee adolescents from the former Soviet Union. *Psychology in the Schools*. 2005; 42(1):27–38.
- Zvolensky, MJ., Leyro, TM., Bernstein, A., Vujanovic, AA. Historical perspectives, theory, and measurement of distress tolerance. In: Zvolensky, MJ. Bernstein, A., Vujanovic, AA., editors. *Distress tolerance: theory, research, and clinical applications*. New York: Guilford; 2011. p. 3-27.

Table 1

Correlations between baseline measures

	1	2	3	4	5
1. Distress tolerance (DT)					
2. Perceived social support	.02				
3. Depressive symptoms	.02	-.33**			
4. PTSD symptoms	.04	-.31**	.59**		
5. Conflict	.06	-.38**	.28**	.19**	
6. Substance use	.06	-.18**	.17**	.24**	.17**

Note: Distress tolerance (DT)=Time on the BIRD; Perceived social support=Social Support for Adolescents Scale (SSAS) scores; Depressive symptoms=National Survey for Adolescents-Replication (NSA-R) baseline scores, MDD module; PTSD symptoms=NSA-R baseline scores, PTSD module; Conflict=Conflict Belief Questionnaire Short Form (CBQ) scores; Substance use=Substance Abuse Screening Test (CRAFT) scores.

**
p<.01

Table 2

Means and Standard Deviations for all Measures

Measure	Baseline			4-month follow-up			12-month follow-up		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
DT	352	2.51	1.93	***	***	***	***	***	***
PSS	307	6.97	1.66	***	***	***	***	***	***
Depression	351	.63	1.28	249	.61	1.27	214	.63	1.39
PTSD	352	1.17	2.20	249	1.13	2.47	214	1.13	2.55
Conflict	230	2.44	3.44	167	2.47	4.04	143	2.16	3.53
Substance use	351	.09	.47	249	.05	.41	214	.08	.39

Note: DT=Distress tolerance as measured by time on the BIRD; PSS=Perceived social support as measured by SSAS scores; Depression=NSA-R-MDD module (number of symptoms); PTSD=NSA-R scores; PTSD module (number of symptoms); Conflict=Scores on the CBQ; Substance Use=CRAFT scores.