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Duration of Exposure and the Dose-Response Model of PTSD

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A dose-response model underlies posttraumatic stress disorder (PTSD) and posits a relationship between event magnitude and clinical outcome. The present study examines whether one index of event magnitude—duration of exposure—contributes to risk of PTSD among female victims of sexual assault. Findings support a small but significant contribution of event duration to clinical status in the immediate aftermath of trauma but not at 3-month follow-up. The opposite pattern is obtained for subjective appraisals of threat. These findings add to a growing literature that suggests that a simple application of the dose-response model to objective event characteristics may be insufficient to explain the risk of PTSD.

Keywords: *sexual assault; victimization; posttraumatic stress disorder; crime victims; rape; injuries*

The field of stress studies posits an adversity–stress relationship, as reflected in Cannon's (1935) notion of critical stress and Selye's (1946) concept of the General Adaptation Syndrome. Underlying this framework is the

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original biological dose-response model and the assumption that an individual's risk of illness varies with the magnitude of a stressor (Dohrenwend & Dohrenwend, 1974; Wyler, Masuda, & Holmes, 1971). These assumptions contributed to the conceptual origins of posttraumatic stress disorder (PTSD) and the belief that a distinct class of traumatic events (Criterion A) put people at risk for developing the clinical syndrome (American Psychiatric Association, 1980). Studies on PTSD-diagnosed individuals have in turn provided some support for the dose-response model. For example, studies report higher rates of PTSD for directly experienced events as compared to witnessed events (Hoge et al., 2004) and for events experienced at close proximity as compared to those at a distance (e.g., Goenjian, Walling, Steinberg, Karayan, Najarian, Pynoos, 2005). At the same time, a large literature challenges the dose-response model, finding that preincident, peritraumatic, and postincident factors contribute more to clinical outcome than specific etiologic events do (e.g., Bowman & Yehuda, 2004; Brewin, Andrews, & Valentine, 2000; Ozer, Best, Lipsey, & Weiss, 2003).

With the publication of the Diagnostic and Statistical Manual of Mental Disorders (4th ed.; American Psychiatric Association, 1994), the magnitude of traumatic events was defined along two dimensions: (a) the objective characteristics involving actual threat of death or serious injury (Criterion A1); and (b) the subjective characteristics involving emotional responses of intense fear, helplessness, or horror (Criterion A2). Within this definition, and in accord with the dose-response model, duration of exposure is an objective event characteristic that has been shown to influence posttraumatic morbidity. Buydens-Branchey, Noumair, and Branchey (1990) defined *duration of exposure* as the number of months in combat and found that this measure related to severity of PTSD symptoms among Vietnam veterans. Similarly, in a study on the effects of childhood sexual abuse, duration of abuse was predictive of PTSD (Wolfe et al., 1994). Unfortunately, defining exposure in this manner confounds the independent variable of duration with the number of independent events that may occur during time periods of variable length (Kaysen, Resick, & Wise, 2003).

It is surprising that a search of the literature did not yield any data on duration of exposure for a single incident traumatic event. Nor has research examined the relationship between duration and perceived threat in the prediction of PTSD. We therefore looked at previously unanalyzed data from a large-scale study of sexual assault victims in which participants had reported on the duration of a crime victimization experience and their appraisals of threat. The question of interest was whether duration of exposure as an index of event magnitude contributes to the risk of PTSD.

Method

Participants

Female participants (n = 142) were recruited through police, hospital, and victim service agencies. Participants were assessed at two time periods: at 2 to 4 weeks after assault (Time 1) and again at 3 months after assault (Time 2). Assaults consisted of sexual assaults defined as completed vaginal, oral, or anal penetrative assault. Eleven women were excluded for various reasons (e.g., illiterate, did not meet assault criteria).

Measures

Clinician-Administered PTSD Scale (CAPS; Blake et al., 1995). This clinician-administered diagnostic interview provides severity scores for each of the PTSD symptom clusters, including intrusive, avoidance, and hyperarousal symptoms. For the purposes of this study, only total scores are reported. Interrater reliability on CAPS was established with new diagnostic interviewers by using training tapes and by having more experienced faculty interviewers supervise and rate initial live interviews. After reliability was established (100% diagnostic reliability), all diagnostic interviewers had the audiotapes reviewed by senior project staff on a random, ongoing basis to reduce drift in diagnostic decisions. The CAPS was administered at Times 1 and 2.

Trauma Interview (Resick, Jordan, Girelli, Hutter, & Marhoefer-Dvorak, 1988). This structured interview, administered only at Time 1, yielded descriptive information on the current trauma, including victim perceptions of risk of death or injury, along with objective information about the event (Kaysen, Morris, Rizvi, & Resick, 2005). Two questions contained in the interview and relevant to this article assessed the subjective experience of the victim's perception of threat. The first question asked, "During the incident, did you think about being killed or seriously injured?" Possible responses ranged from 0 (*not at all*) to 4 (*thought about it all the time*). The second question asked, "During the incident, how certain were you that you were going to be killed?" Possible responses ranged from 0 (*completely certain that I would not be killed*) to 4 (*completely certain that I would be killed*). Scores on these two items were summed to generate a perceived threat score for each participant such that the range of possible scores was 0 to 8 (Kaysen et al., 2005). The interview also included a quantitative

assessment of duration of the sexual assault, ranging from 1 (*30 minutes or less*) to 5 (*more than 4 hours*).

Procedures

Prior to data collection, participants signed informed consent statements. Master's-level psychology graduate students conducted the interviews as part of a larger assessment battery. The CAPS was administered first, followed by the trauma interview. All participants were paid $50.00 for completion of Time 1 interviews and $75.00 for completion of Time 2 interviews. There was no contact with research staff between the two interviews, other than to schedule the second assessment meeting.

Results

Overview of Participants and Data Analyses

Of participants assessed at Time 1 (n = 131), 63% returned for Time 2 (n = 83). Of those, 66 had complete data at both time points on measures of interest for this study. There were no differences between completers and noncompleters on trauma or symptom severity measures or on demographic variables. Analyses were therefore conducted on the complete longitudinal sample.

The mean age was 31.48 years (SD = 8.60, range = 18 to 55). Average education was 12.45 years (SD = 2.28, range = 8 to 20). Fifty-seven percent of participants were single; 23% were married or cohabiting; and the remainder were separated, widowed, or divorced. Fifty-four percent earned less than $5,000 annually. Seventy one percent were African American, 23% Caucasian, and 2% Hispanic. Seventy-seven percent of participants (n = 50) met criteria for PTSD at Time 1 (excluding the requirement that symptoms persist beyond 1 month), as compared to 55% of participants (n = 36) at Time 2.

Scale Distributions and Correlations

The data were examined for compliance with the assumptions of multiple regression according to guidelines provided by Tabachnick and Fidell (2001). No univariate outliers were identified based on the criteria of standardized scores more than 3.29 standard deviations from the mean of the

Table 1
Means, Standard Deviations, and Intercorrelations for Posttraumatic Stress Disorder (PTSD) and Trauma Severity (n = 66)

Measure	*M*	*SD*	1	2	3	4
1. CAPS-T1	71.01	24.40	—			
2. CAPS-T2	46.86	25.90	.65*	—		
3. Duration	2.78	1.53	.25*	.18	—	
4. Threat	5.58	2.42	–.04	.19	–.001	—

Note: CAPS = Clinician-Administered PTSD Scale.
*p < .05.

Table 2
Duration of Trauma Exposure and Posttraumatic Stress Disorder (PTSD) Symptom Severity (n = 66)

		CAPS-T1		CAPS-T2	
Duration	*n*	*M*	*SD*	*M*	*SD*
1. 30 minutes or fewer	18	66.28	25.76	43.78	26.63
2. 31 minutes to 1 hour	15	64.13	22.05	37.00	29.06
3. 1 to 2 hours	10	72.50	26.73	57.10	24.50
4. 2 to 4 hours	9	73.89	22.61	49.22	22.92
5. 4 hours or more	14	81.29	24.22	53.07	21.88

Note: CAPS = Clinician-Administered PTSD Scale.

scale. The data were examined for multicollinearity using both the tolerance value and the variance inflation factor. Based on these parameters, there were no problems with multicollinearity. Means and standard deviations of each variable used in these analyses and their intercorrelations are presented in Table 1. CAPS scores based on duration are presented in Table 2.

Missing Data Analyses

Of the original sample of 131 participants, 65 were missing one or more measures. There were no significant differences between participants with missing data and those with complete data (n = 66) with regard to education, income, race, marital status, Time 1 PTSD symptom severity, duration, or perceived threat. Correlations between missing status and all variables of interest were not significant, indicating that missing data occurred at random.

Listwise deletion of missing data has been criticized as having the risk of biasing results and reducing statistical power (Little, 1995; Schafer & Graham, 2002). Multiple imputation has been recommended as an alternative strategy for handling missing data, because it appears to produce unbiased parameter estimates, is robust to departures from normality assumptions, and provides adequate results despite low sample sizes or high rates of missing data (Sinharay, Stern, & Russell, 2001). Imputation was done using the SOLAS software program (Schafer, 1999). The results were essentially the same as those found with the sample size of 66. For ease of interpretation, results are reported for completers, although parameter estimates for imputed data are available from the first author.

Perceived Threat and Within-Crime Variables

Four hierarchical multiple regression analyses were performed to examine the contribution of both objective and subjective features of the assault experience (length of exposure and perception of threat) in the prediction of PTSD symptom severity. Two sets of analyses at each time period were conducted: one with the objective index of trauma severity entered first, followed by subjective severity; the other with entries in reverse order. Analyses were conducted in this manner to ensure that results were not due to the order in which variables were entered into the regression equation.

PTSD symptoms following the incident. In the first analysis for this time period, duration of the assault was entered and found to be significantly associated with PTSD symptoms, $R^2 = .06$, $F(1, 65) = 4.12$. In the second step of this analysis, perceived threat did not significantly add to the prediction of PTSD symptoms, $\Delta R^2 = .001$, $\Delta F(1, 64) = .10$. The full model was not significant, $R^2 = .06$, $F(2, 66) = 2.08$, although duration of the assault remained as a significant individual predictor of PTSD at Time 1 ($\beta = .25$, $p < .05$).

Second, the contribution of duration, once perceived threat was included, was examined. In the first step, perceived threat was not significantly associated with PTSD symptoms, $R^2 = .001$, $F(1, 65) = .09$. The second step significantly added to the prediction of PTSD symptoms, $\Delta R^2 = .06$, $\Delta F(1, 64) = 4.06$. The full model was not significant, $R^2 = .06$, $F(2, 66) = 2.08$, although duration of the assault remained as a significant individual predictor of Time 1 PTSD ($\beta = .25$, $p < .05$).

PTSD symptoms at 3 months. In the first analysis for Time 2, the first block consisted of initial PTSD symptoms, the second block was the duration variable, and the third block consisted of perceived threat once initial PTSD and duration were included. In the first step, initial PTSD severity was significantly associated with later PTSD symptoms, $R^2 = .43$, $F(1, 66) = 47.67$, $p < .001$. In the second step, duration did not significantly add to the prediction of PTSD symptoms, $\Delta R^2 = .00$, $\Delta F(1, 64) = .04$. In step 3, perceived threat did significantly add to the prediction of PTSD symptoms once initial PTSD symptoms and duration were included in the model, $\Delta R^2 = .05$, $\Delta F(1, 62) = 5.28$. The full model was significant, $R^2 = .47$, $F(3, 66) = 18.49$, $p < .001$, with both initial PTSD symptoms ($\beta = .66$, $p < .001$) and perceived threat ($\beta = .21$, $p < .05$) serving as significant individual predictors of 3-month PTSD symptoms.

The contribution of duration in predicting 3-month PTSD symptoms, once perceived threat was included, was examined. The first block consisted of initial PTSD symptoms, the second block perceived threat, and the third block duration once initial PTSD and perceived threat were included. In the first step, initial PTSD severity was significantly associated with later PTSD symptoms, $R^2 = .43$, $F(1, 66) = 47.67$, $p < .001$. In the second step, perceived threat significantly added to the prediction of PTSD symptoms, $\Delta R^2 = .05$, $\Delta F(1, 64) = 5.37$, $p < .05$. Duration (step 3) did not significantly add to the prediction of PTSD symptoms, $\Delta R^2 = .00$, $\Delta F(2, 63) = .04$. The full model was significant, $R^2 = .47$, $F(3, 66) = 18.49$, $p < .001$. In the full model, both initial PTSD symptoms ($\beta = .66$, $p < .001$) and perceived threat ($\beta = .21$, $p < .05$) were significant individual predictors of 3-month PTSD symptoms, whereas duration, the only objective indicator relating to the event, was not.

Discussion

In the present study, duration of exposure made a small, significant contribution to clinical status in the immediate aftermath of trauma among women who had experienced violent sexual assault. Longer term adjustment, however, was not influenced by this objective index of stressor magnitude. In contrast to these findings, subjective appraisals of threat reported shortly after an assault did not contribute to clinical status in the aftermath of trauma but did significantly contribute to longer term outcome once initial symptoms were included in the model. These findings add to a growing body of literature that suggests that a simple dose-response model may not sufficiently explain PTSD status (e.g., Bowman & Yehuda, 2004; Rosen & Lilienfeld, 2008). Findings also are consistent with a growing literature that

emphasizes the role of subjective appraisals in mediating posttraumatic morbidity (e.g., Basoglu et al., 1997; Brewin, Andrews, & Rose, 2000; Creamer, McFarlane, & Burgess, 2005).

When considering current findings, it is important to observe that participant retention from Time 1 to Time 2 was an issue. Although rates of retention were respectable and analyses suggested that missing data occurred at random, the loss of such data may have affected results and/or reduced our power to detect an effect for duration at Time 2. Replication of the results using multiple imputation suggests that this was not the case, but this does not entirely rule out the concern. In addition, this study included only two time points. This prevents the modeling of potential nonlinear relationships of the variables of interest over time. It also precludes any analysis of how these relationships may change following the 3-month assessment period.

Also of concern when considering the implications of current findings is that various relationships between variables are likely to be more complex than suggested by current analyses. This results from several concerns. First, there are many more objective and subjective dimensions for determining event magnitude than those included in the present study. Although this study's selected focus was by design, it is a limiting issue when developing models to account for posttraumatic risk and morbidity. Second, participants' ratings of perceived threat and duration of an assault are confounded by subjective and objective considerations. Thus, a participant's perception of the threat may have been influenced by objective factors (e.g., presence of a weapon). The present study also used as a measure of duration the participants' subjective estimates, which could have themselves been influenced by perceived threat and levels of symptomatology. In that regard, an objective measure of event duration is preferred, though not necessarily feasible.

There are several issues regarding the sample included in the study that may affect the generalizability of findings to other populations. First, the study focused exclusively on sexual assault rather than including a broad or general trauma population. Although including a measure of duration of exposure to a traumatic event across trauma types would be of interest in examining the core questions of the present study, it also highlights the difficulties inherent in measuring the dose of trauma exposure across traumatic events. We chose to focus on one specific and relatively homogeneous type of traumatic event to better delineate the relationships between duration of exposure and PTSD. This study does not address the issue of repeated exposure to traumatic events like what is often seen in domestic violence, child maltreatment, or combat exposure (Kaysen et al., 2003). This highlights the importance of and complexities of examining whether relationships obtained in the present study can be replicated across types of trauma. In addition, this sample overrepresented African American respondents and individuals who were economically disadvantaged. Studies have found differences in rates of PTSD in African Americans, differences in coping strategies, and differences in level of dissociation following a traumatic event (Pole, Gone, & Kulkarni, 2008). Poverty has been associated with elevated risk of assault (Bassuk, Buckner, Perloff, & Bassuk, 1998). It is likely that women in the present study faced severe daily stresses that may have elevated rates of PTSD, thereby affecting results. On the other hand, results can be viewed as representing especially pertinent information for a group more likely to experience victimization.

Despite these concerns, the relevance and import of current findings are not erased. This is particularly the case when one considers that subjective estimates of duration, if affected by perceived threat and posttraumatic morbidity, should have served to increase any relationship between estimates of event magnitude and PTSD symptom level. The absence of such a long-term relationship between event duration and clinical status cannot solely be explained by a biasing effect that would be expected to produce this very relationship.

Findings in the present study are consistent with the emerging viewpoint that severe and persistent posttrauma problems represent a failure to recover from common and often transient reactions (McHugh & Treisman, 2007). Within this framework, an early temporal relationship between objective indexes of event magnitude and initial posttraumatic reactions may be observed. Longer term outcomes, on the other hand, may not be explained solely by a simple dose-response model. Instead, a variety of factors influence an individual's ability to adjust in the aftermath of trauma: preincident psychiatric vulnerability, subjective appraisals, alterations in cognitive schema, and postincident social and situational concerns. This study also highlights the importance of further long-term studies to model the process of recovery from traumatic events over time.

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