

Predictors of Posttraumatic Stress in Police and Other First Responders

CHARLES R. MARMAR,^{a,b} SHANNON E. McCASLIN,^{a,b}
THOMAS J. METZLER,^{a,b} SUZANNE BEST,^b DANIEL S. WEISS,^b
JEFFERY FAGAN,^c AKIVA LIBERMAN,^d NNAMDI POLE,^e
CHRISTIAN OTTE,^f RACHEL YEHUDA,^g DAVID MOHR,^{a,b}
AND THOMAS NEYLAN^{a,b}

^a*Veterans Affairs Medical Center, San Francisco, California 94121, USA*

^b*University of California, San Francisco, California 94121, USA*

^c*Columbia University, New York, New York 10027, USA*

^d*National Institute of Justice, Washington, D.C. 20531, USA*

^e*University of Michigan, Ann Arbor, Michigan 48109-1043, USA*

^f*University Hospital Hamburg-Eppendorf, Hamburg 20246, Germany*

^g*Division of Traumatic Stress Studies, Mount Sinai School of Medicine and Bronx Veterans Affairs Medical Center, Bronx, New York 10468, USA*

ABSTRACT: We provide an overview of previous research conducted by our group on risk and resilience factors for PTSD symptoms in police and other first responders. Based on our work, the findings of other investigators on individual differences in risk for PTSD, and drawing on preclinical studies fear conditioning and extinction, we propose a conceptual model for the development of PTSD symptoms emphasizing the role of vulnerability and resilience to peritraumatic panic reactions. We tested this conceptual model in a cross-sectional sample of police officers ($n = 715$). Utilizing an hierarchical linear regression model we were able to explain 39.7% of the variance in PTSD symptoms. Five variables remained significant in the final model; greater peritraumatic distress ($\beta = 0.240, P < .001$), greater peritraumatic dissociation ($\beta = 0.174, P < .001$), greater problem-solving coping ($\beta = 0.103, P < .01$), greater routine work environment stress ($\beta = 0.182, P < .001$), and lower levels of social support ($\beta = -0.246, P < .001$). These results were largely consistent with the proposed conceptual model. Next steps in this line of research will be to test this model prospectively in a sample of 400 police academy recruits assessed during training and currently being followed for the first 2 years of police service.

KEYWORDS: police; PTSD; risk; first responders; peritraumatic

Address for correspondence: Charles R. Marmar, M.D., San Francisco Veterans Affairs Medical Center, 4150 Clement St. (116 P), San Francisco, CA 94121. Voice: 415-221-4810 ext.: 2126; fax: 415-751-2297.

e-mail: Charles.marmar@med.va.gov

Ann. N.Y. Acad. Sci. 1071: 1–18 (2006). © 2006 New York Academy of Sciences.
doi: 10.1196/annals.1364.001

INTRODUCTION

Police service is widely recognized as one of the most dangerous and stressful occupations. Police and other first responders are repeatedly exposed to potentially traumatic situations (also known as “critical incidents”), such as armed confrontations, motor vehicle crashes, and witnessing violent deaths.¹⁻³ Such frequent exposure places first responders at risk for developing posttraumatic stress disorder (PTSD). Previous studies have found the incidence of current duty-related PTSD in police officers to vary between 7% and 19%.⁴⁻⁶ Moreover, many officers may experience symptoms that fail to meet full diagnostic criteria for PTSD but are nonetheless disturbing or debilitating.⁷ In a study of 262 Dutch police officers, PTSD symptoms were assessed at 2 weeks and again at both 3 and 12 months following a critical incident (CI). Seven percent of officers met full diagnostic criteria for current PTSD at some point during the study and an additional 34% suffered from clinically significant subsyndromal PTSD.⁴

Screening and early intervention are vital, given that the symptoms may contribute to adjustment problems in social, family, and work settings.⁷⁻⁹ First responders with PTSD present higher rates of absenteeism and early retirement.¹⁰ Given that nearly one million Americans serve in law enforcement, with increasing recruitment and responsibility in response to the threat of terrorist attacks, there is a public health imperative to identify with greater specificity individual and institutional factors that influence vulnerability and resilience to CI stressors.

MODELING INDIVIDUAL DIFFERENCES IN RISK AND RESILIENCE TO CI STRESSORS

A number of pretrauma, peritrauma, and posttrauma individual differences likely act together to impact one’s vulnerability or resilience to developing PTSD following traumatic exposure. Drawing on previous research, important pretrauma variables to consider include genetic susceptibility, demographic characteristics, such as female gender, prior trauma history including childhood trauma, family, and personal history of psychiatric illnesses, personal adjustment, intellectual functioning, and one’s style of coping with stressful events.

The characteristics of the traumatic event, such as degree of life threat, may influence responses to a CI. Even more important are the psychological and biological responses at the time of and shortly following exposure. Peritraumatic reactions, the reactions during or in the immediate aftermath of trauma exposure, as well as one’s perception of perceived threat at the time of the event have been shown to have strong associations with PTSD symptoms.¹¹⁻¹³

Indeed, in a meta-analysis of risk factors for PTSD, Ozer *et al.* (2003)¹⁴ found peritraumatic dissociation was found to be the strongest predictor of PTSD symptoms. Individual differences in genetic susceptibility, sensitization related to prior trauma exposure, and degree of perceived life threat at the time of exposure influence the level of adrenergic activation, a biomarker of peritraumatic panic and dissociation.

Sustained fear-related adrenergic activation, triggered by terror at the time of the threat, results in greater fear conditioning and overconsolidation of traumatic memories, both implicated in the pathogenesis of PTSD.¹⁵ Variability in levels of immediate fear responses to a traumatic stressor may in part explain why only 25% of individuals exposed to a traumatic event will develop PTSD and the lack of a simple dose–response relationship between frequency and severity of stressor exposure and the risk for psychopathology.¹⁶

In this model, exposure is a necessary but not sufficient condition for the development of PTSD, with peritraumatic emotional distress mediating this relationship. Greater panic-like reactions during exposure (e.g., sweating, shaking, heart racing, fear of dying, fear of losing emotional control, depersonalization, and derealization) are associated with greater adrenergic activation, and as a result, greater fear conditioning, memory consolidation, and persistence of hyperarousal symptoms. Carlier *et al.*⁴ found that the presence of hyperarousal symptoms several weeks following a CI was predictive of continued posttraumatic stress symptoms 12 months later. Schell *et al.*¹⁷ examined the course of PTSD symptomatology and the relationships of three symptom clusters over time in adults exposed to community violence, measuring symptoms at three time points (baseline, 3 months, and 12 months). The authors demonstrated that level of hyperarousal symptoms at baseline was the best predictor of later PTSD symptom severity and the severity of symptoms in each cluster (intrusive, avoidant, and hyperarousal) over time. Furthermore, PTSD symptoms were much less likely to remit over time among participants with hyperarousal as their most prominent baseline symptom cluster (versus intrusive imagery or avoidance). The authors proposed that hyperarousal symptoms maintain the persistence of reexperiencing symptoms, leading to poorer recovery. Generalized hyperarousal symptoms have a biological basis in nonassociational fear conditioning, whereas intrusion and avoidance symptoms may be more related to associational fear conditioning.¹⁸

Finally, the model assumes that the balance of personal and environmental resources in the recovery environment play an important role in determining posttraumatic adjustment. Variables that favor greater chronicity and severity of PTSD symptoms, spreading comorbidities, and greater functional impairments include the use of maladaptive coping strategies, such as alcohol abuse and rigid avoidance of reminders, new stressful life events in the year after exposure, poorer social supports, and more negative work environments.

REACTIONS OF FIRST RESPONDERS TO THE 1989 LOMA PRIETA BAY AREA EARTHQUAKE

Our initial research on individual differences in vulnerability to posttraumatic stress in first responders was a three-group quasi-experimental and longitudinal cohort study that contrasted the responses of rescue workers to the 1989 Loma Prieta earthquake Interstate 880 freeway collapse ($n = 198$) with responses to exposure to a self-identified “worst” CI of Bay Area first responder controls ($n = 140$) and San Diego first responder controls ($n = 101$).¹⁹ The baseline evaluation for all three groups was, on average, 1 year after the earthquake. The groups were found to be strikingly similar with respect to demographics and years of emergency service. Nine percent of the total sample was characterized as having PTSD symptom levels typical of psychiatric outpatients. The three groups (I-880 responders, Bay Area controls, and San Diego controls) did not differ on current PTSD symptoms; however, rescue workers who responded to the I-880 freeway collapse reported higher exposure, greater immediate threat appraisal at the time of the CI, and more sick days. In the sample as a whole, those with PTSD symptom levels typical of psychiatric outpatients reported significantly greater CI exposure, greater peritraumatic emotional distress, greater peritraumatic dissociation, greater perceived threat, and less preparation for the CI.

Examining the total sample by type of emergency responder, it was found that EMT/paramedics reported higher peritraumatic dissociation, as assessed by the Peritraumatic Dissociative Experiences Questionnaire (PDEQ),¹³ at the time of their most distressing incident compared with police. Further, EMT/paramedics and the California Department of Transportation (Caltrans) road workers reported higher symptoms compared with police and fire personnel. The Caltrans workers differed from the other groups in that they had not been formally trained for rescue or recovery operations and may have had less preparation and subsequently more difficulty coping with traumatic incidents and their emotions. Differences in recruitment policies, organizational support, and the quality of rescue and recovery experiences may have accounted, at least in part, for the higher symptom levels observed in EMT/paramedics when compared to fire and police personnel. For example, it may be more difficult for EMT/paramedic personnel to maintain a detached attitude toward their work as they often have longer and more intimate contact with injured survivors during recovery operations.

Baseline results for the total sample also revealed that lower levels of social support, poorer adjustment—one of the big five dimensions of personality, as assessed by the Hogan Personality Inventory (HPI), related to reduced ability to remain calm under pressure.²⁰ Fewer years of experience, and external locus of control were related to both greater PTSD symptoms and general psychiatric distress. Separate hierarchical regression models were used to clarify the relative contributions of the variables in predicting both PTSD symptoms

and general psychiatric distress. Because our previous findings suggested that dissociation at the time of a CI may be uniquely important in the prediction of later symptomatology, we focused on whether the dissociative variables would account for a significant amount of variance after controlling for the other factors. Years of experience, exposure, adjustment, locus of control, and social support were entered in at the first step of the regression model, tendency to dissociate (trait dissociation) was entered at the second step, and dissociation at the time of the incident (PDEQ) was entered separately in the final step. We found that both trait dissociation and dissociation at the time of the incident accounted for significant increments in symptom variance (both general psychiatric distress and PTSD symptoms) after controlling for the other variables. Furthermore, the PDEQ contributed unique variance to the model over and above general dissociative tendencies.²¹

Because we found peritraumatic dissociation to be a robust predictor of PTSD symptoms, we explored characteristics in this same sample related to acute dissociative responses at the time of CI exposure.¹¹ For these analyses, the PDEQ was scored as the mean item response across all items with scores ranging from 1.0 to 5.0. These scores were then sorted into two categories to create a dichotomous variable; subjects with clinically salient levels of peritraumatic dissociation (a mean score of 1.50 or higher, $n = 91$) versus those who did not meet the threshold for clinically salient levels of peritraumatic dissociation (a mean score below 1.50, $n = 267$). In univariate analyses, clinically meaningful levels of peritraumatic dissociation were found to be significantly associated with age, greater exposure to CI stress, and the following individual difference variables: greater perceived threat, greater external locus of control, higher scores on measures of coping, specifically by means of escape-avoidance, self-control, and active problem solving, and lower scores on the adjustment, identity, ambition, and prudence scales of the HPI. Hierarchical logistic regression analyses were conducted to test the incremental contribution of the related variables to the classification of those who did or did not report clinically meaningful levels of peritraumatic dissociation. Age and exposure were entered in the first step of the model and the remaining individual difference variables were entered in the second. It was found that the individual difference variables as a set significantly improved classification, over and above classification rates on the basis of age and exposure. In the final model, greater perceived threat, coping by escape-avoidance means, and coping by means of self-control were the strongest predictors of being in the peritraumatic dissociation group.

We next reassessed this cohort 3.5 years after the earthquake.²² Of the original 367 participants, 322 (88%) completed measures of peritraumatic dissociation and emotional distress, current symptoms, and incident exposure (for responders to the I-880 freeway collapse, this was the index event at follow-up and for the control groups the index event was a self-identified “worst” CI). Despite modest improvement in intrusive and avoidant symptoms of PTSD and

improved work and interpersonal functioning at follow-up, many first responders continued to experience chronic symptomatic distress almost 4 years after the freeway collapse. Specifically, there was no change in hyperarousal symptoms of PTSD and marginally greater levels of general psychiatric distress. In a multiple linear regression model, peritraumatic dissociation accounted for significant increments in current PTSD symptoms at follow-up, over and above CI exposure and the following set of variables assessed at the time of the initial evaluation: adjustment as assessed by the HPI, years of experience, locus of control, social support, and trait dissociation as assessed at the time of the initial evaluation. In sum, those at greater risk for continuing symptomatic distress had more catastrophic initial exposure and who had been more prone to dissociate at the time of the CI. Findings from both the cross-sectional as well as the follow-up portions of this study of emergency responders highlighted the importance of peritraumatic responses as a risk factor for subsequent post-traumatic stress.

CROSS-SECTIONAL SURVEY OF NEW YORK AND BAY AREA POLICE OFFICERS

Our second study is a cross-sectional evaluation of 747 police officers from New York and Bay Area departments and 301 peer-matched controls not working in law enforcement or first responder professions. We focused on self-report measures of exposure to duty-related CIs, peritraumatic dissociation, PTSD symptoms, and general psychiatric symptoms. Additional demographic variables and response bias on account of social desirability were also assessed. Data from this study were also used to develop three new self-report measures, a measure of emotional reactions at the time of a traumatic or stressful event, a measure of work environment stress for police officers, and a measure of cumulative exposure to CIs for police officers.

Drawing on this sample, we developed a 13-item self-report measure, the Peritraumatic Distress Inventory (PDI), as a way of obtaining a quantitative measure of distress experienced during and immediately after a traumatic event.¹² Our main goal was to develop a valid and reliable measure of DSM-IV criterion A2; that is, to characterize levels of terror, horror, and helplessness at the time of CI exposure. Seven hundred and two of the 747 officers and 301 matched controls including both genders completed the PDI. The sample of officers was diverse, comprising nearly 20% female and 50% Hispanic, African American, or other ethnic minority group, all of whom were exposed to a wide range of CIs. The PDI was found to be internally consistent, have good test-retest reliability, and strong convergent and divergent validity.¹² Even after controlling for peritraumatic dissociation or for general psychopathology, total PDI score remained strongly correlated with two measures of PTSD symptoms, demonstrating its promise as a measure of PTSD criterion A2. We are presently

examining the role of the PDI in predicting PTSD in a prospective study of police academy recruits, including the relationship of peritraumatic distress to biological and cognitive variables.

The second measure we developed, The Work Environment Inventory (WEI), assesses routine (i.e., nontraumatic) work environment stress in law enforcement.²³ Using this new measure, we found that routine occupational stress exposure appears to be a significant predictor of both general psychological distress and posttraumatic stress symptoms among police officers. Specifically, exposure to routine work stressors predicted general psychological distress ($r = 0.46$), as well as the three posttraumatic stress symptom cluster scores following an officer's self-identified most traumatic career incident (r s = 0.26 to 0.39). Controlling for time since the officer's most traumatic event, social support, and social desirability effects, multivariate analyses found that the effects of routine work stressors were independent of, and greater than, the effects of cumulative CI exposure. These findings support the role of occupational stressors as a strong predictor or marker for psychological distress, perhaps somewhat surprisingly, even more so than CI exposure. However, because of the cross-sectional nature of the data, it is not possible to know with certainty whether those with increased PTSD symptoms perceive more work stressors, or if greater work stress is actually a causal factor for PTSD.

We aimed to develop the third measure to assess the amount of exposure to CIs accumulated over the course of a career in law enforcement. The Critical Incident History Questionnaire (CIHQ) comprises a set of 34 items weighted for their varying level of severity.^{2,3} Scores on the CIHQ correlated $r = 0.37$ with years of service, $r = 0.28$ with age, and were stable over time. Correlations of the CIHQ with peritraumatic dissociation, and symptom measures were of lesser magnitude, and were in the same range as the correlations between cumulative exposure and routine work stress ($r = 0.11$).

In this cross-sectional study of New York and Bay Area police officers, we also assessed ethnic and gender differences in duty-related PTSD symptoms.²⁴ As mentioned previously, the sample was quite diverse, 21% of the officers were female, 48% were Caucasian, 24% were African American, and 28% were Hispanic. We found that self-identified Hispanic American officers reported greater PTSD symptoms than both self-identified European American and African American officers. Although small in size, these effects persisted even after accounting for differences in other relevant variables and replicate earlier findings of greater PTSD symptoms among Hispanic American military personnel.²⁵⁻²⁷ Contrary to typical findings of greater rates of PTSD symptoms among women in the community, we found no gender differences in PTSD symptoms among these officers. In secondary analyses from this study, we attempted to explain our findings of higher levels of PTSD symptoms in Hispanic officers.²⁸ We identified and modeled predictors of PTSD symptom severity that distinguished Hispanic police officers ($n = 189$) from

their non-Hispanic Caucasian ($n = 317$) and African American ($n = 162$) counterparts. The predictors that were found to be significant in explaining the elevated risk for PTSD among this group were greater peritraumatic dissociation, greater wishful thinking and self-blame coping, lower social support, and greater perceived racism.

As a large percentage of police officers report disturbances in subjective sleep quality, we examined the impact of CI exposure and routine work environment stressors on sleep quality, controlling for the effects of work shift schedule.²⁹ Subjective sleep quality, assessed by the Pittsburgh Sleep Quality Index, in police officers (variable shift workers, $n = 551$; stable day shift workers, $n = 182$) was compared with that of control subjects not involved in police or emergency services (variable shift workers, $n = 98$; stable day shift workers, $n = 232$). Police officers on both variable and stable day shifts reported significantly worse sleep quality and less average sleep time than the two corresponding control groups. Sleep disturbances were strongly associated with PTSD symptoms and general psychopathology. Among police officers, cumulative CI exposure measured by the CIHQ was associated with nightmares but only weakly associated with poor global sleep quality. In contrast, the stress from officers' general work environment was strongly associated with poor global sleep quality. In other words, although the life-threatening aspects of police work were related to nightmares, the routine stressors of police service seemed to most affect global sleep quality in these officers.

Both posttraumatic stress symptoms and sleep disturbance have been linked to increased health problems in previous research. We tested the hypothesis that the relationship between posttraumatic stress symptoms and adverse health complaints is mediated by sleep disturbance.³⁰ We found that posttraumatic stress symptoms were significantly related to self-reported somatic symptoms, including headache, faintness/dizziness, pains in the heart or chest, and muscle soreness ($R^2 = 0.18$, $P = 0.001$). Sleep disturbances partially mediated the relationship between posttraumatic stress symptoms and somatic symptoms ($P = 0.001$). These findings suggest that sleep quality may serve as an important mediator in the relationship of traumatic stress symptoms to somatic symptoms.

We were also interested in predictors of alcohol use in this sample and determined patterns and predictors of alcohol use in 687 of these 747 police officers.³¹ We found that: (a) 7.8% of the entire sample met criteria for lifetime alcohol abuse or dependence, (b) 18.1% of males and 15.9% of females endorsed experiencing adverse lifetime consequences from alcohol use, and (c) 11.0% of males and 16.3% of females reported excessive drinking in the past week. Patterns of alcohol use were similar for female and male officers, although women officers had patterns of alcohol use that were substantially greater than women in the general population. Compared to the males in the general population male officers had similar rates of current heavy drinking but female officers were 1.6 times more likely than women in the general

population to have had greater than 14 drinks in the past week. Unexpectedly, greater CI exposure and current PTSD symptoms were not associated with greater current alcohol use. For the entire sample, lower education, greater routine work stress, and greater current psychiatric symptoms were related to greater lifetime adverse consequences from alcohol use. There were noteworthy interactions with gender; lower education was associated with greater alcohol use in male but not female officers, and greater routine work stress was related to lower current alcohol use in female (but not male) officers. The relationship of lower routine work stress and increased alcohol use among female officers is somewhat contrary to what one might expect. Among the officers, social drinking is often an accepted part of the culture.³² In a male-dominated profession, it is possible that female officers rating their work environment as less stressful may be those who have acculturated to male officer norms, such as alcohol use. However, prospective studies are necessary to clarify the relationship between these variables in groups of female and male officers.

The relationship between type of CI stressor and peritraumatic responses and PTSD symptoms was also examined in this cross-sectional sample of the New York and Bay Area police.¹ Officers ($n = 662$) provided narratives of the most distressing CI they had experienced during police service and completed measures of peritraumatic responses and PTSD symptoms anchored to this incident. Narratives were reliably rated ($Kappa = 0.80-1.0$) on seven categories emerging from a series of factor analyses of the CIHQ.^{2,3} When analyzed by collapsing categories into high versus low personal threat, officers whose worst CI contained high personal threat reported greater peritraumatic dissociation and emotional distress, and had greater current PTSD hyperarousal symptoms. By contrast, there were no differences in intrusion, avoidance, or total PTSD symptoms in the high versus low personal threat groups. Results suggest that greater personal threat during a CI may place an officer at increased risk for greater peritraumatic dissociation and distress and the development and maintenance of hyperarousal symptoms, consistent with longitudinal findings that hyperarousal symptoms are an especially salient aspect of PTSD.¹⁶

MULTIVARIATE PREDICTORS OF PTSD SYMPTOMS IN THE CROSS-SECTIONAL SURVEY

Building on the above studies we developed a multivariate model for determining predictors of PTSD symptoms in our cross-sectional sample of the New York and Bay Area officers. Because of scattered missing data for the predictors, the sample size for the multivariate model would be limited to 635 of 747 using list-wise case deletion. We examined the demographic characteristics of the included cases compared to the deleted cases, and found that the only significant difference was in the proportion of Hispanics in the two subsamples. Hispanics were over twice as likely as non-Hispanics to be

dropped because of missing data (22.9% versus 9.7%, $\chi^2(1, N = 737) = 22.13, P < 0.001$). To avoid biasing the analysis, we imputed missing data using the Expectation–Maximization method implemented in SPSS Missing Values Analysis software. Neither missing outcomes nor categorical predictors (gender, ethnicity) were imputed, yielding a sample of 723 for the final regression model. This sample was 21.4% female ($n = 157$), mean age 37.0 (SD = 6.8), education (3.7% <HS, 28.1% HS/GED, 33.0% some college, 31.7% college grad, and 3.5% postgrad), and ethnicity (26.3% Hispanic, 22.3% African American, 44.0% Caucasian, and 7.4% Other/Multiple ethnicities).

Results of a hierarchical linear multiple regression model are presented in TABLE 1. The dependent variable for this model is the total PTSD symptom score on the Mississippi Combat Scale-Civilian Version (MCS-CV).³³ At the first step, demographics accounted for 1.5% of the variance, with greater PTSD symptoms associated with Hispanic ethnicity. At the second step we entered two exposure variables, the Trauma History Questionnaire (THQ)³⁴ to assess lifetime exposure to traumatic events occurring outside of police service and the CIHQ to assess cumulative frequency and severity of CI stress exposures across the officer's entire career in police service. The exposure variables accounted for an additional 4.2% of the variance of current PTSD symptom scores with greater THQ and CIHQ scores respectively associated with greater symptoms.

At the third step we entered peritraumatic reactions to the officer's self-identified worst CI during their entire police service. Two peritraumatic variables were entered at this step, the PDI capturing terror, horror, and related emotional distress at the time of the worst incident and the Peritraumatic Dissociative Experiences Questionnaire (PDEQ) capturing derealization, depersonalization, altered time sense, and related dissociation of the time of the worst incident. Peritraumatic reactions accounted for an additional 21.5% of the variance of current PTSD symptoms.

At the final step we entered variables reflecting the officers' current resources and environment including escape-avoidant and planful problem-solving coping from the Ways of Coping Scale,¹⁸ social support assessed by the Sources of Support Scale,²⁶ and routine non-CI stress in police service (WEI). Coping, social support, and work environment stress accounted for an additional 12.5% of the variance of current PTSD symptoms. The full model accounted for 39.7% of variance of current PTSD symptoms. Five variables had significant beta weights in the final model; greater peritraumatic distress, greater peritraumatic dissociation, greater problem-solving coping, greater routine work environment stress, and lower levels of social support accounted for greater PTSD symptoms. Hispanic ethnicity, duty, and nonduty-related traumatic exposure, and escape-avoidant coping were not significant predictors in the final model.

The finding that greater use of planful problem-solving coping strategies was associated with greater current PTSD symptoms runs counter to the prevalent

TABLE 1. Hierarchical linear regression model predicting PTSD symptoms in the total cross-sectional sample of police officers ($n = 715$)

Predictors	R^2	ΔR	F change (P)	β (Step 1)	β (Step 2)	β (Step 3)	β (Final model)
1. Demographics	0.015	0.015	2.658 (0.032)				
Age				0.030	-0.032	-0.011	-0.040
Gender				-0.017	-0.026	-0.011	0.012
Hispanic ethnicity				0.110**	0.103**	0.069*	0.047
Education level				-0.017	-0.017	-0.037	-0.026
2. Exposure	0.057	0.042	15.821 (0.000)				
THQ					0.151***	0.071*	0.048
CIHQ					0.121**	0.055	0.056
3. Peritraumatic reactions	0.272	0.215	104.515 (0.000)				
PDI						0.303***	0.240***
PDEQ						0.233***	0.174***
4. Resources and environment	0.397	0.125	36.328 (0.000)				
EA Coping							-0.021
PPS Coping							0.103**
SOS							-0.246***
WEI							0.182***

NOTE: * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$; THQ = trauma history questionnaire; CIHQ = critical incident history questionnaire; PDI = peritraumatic distress inventory; PDEQ = peritraumatic dissociative experiences questionnaire; EA coping = escape-avoidant coping; PPS coping = planful problem-solving coping; SOS = sources of support; WEI = work environment inventory.

view that active coping is protective against CI-related PTSD symptoms. Of interest, this counterintuitive finding replicates our earlier work with 437 first responders to the 1989 Bay Area freeway collapse and control CIs. It appears that police and some other first responders struggling with CI-related posttraumatic stress make greater use of a variety of coping strategies, including those traditionally regarded as adaptive. This may reflect a nonspecific increase in demand for coping to deal with persistent symptoms in the face of continued CI exposure. Studied prospectively, it may be possible to see whether this style of coping (i.e., making use of a variety of coping strategies) is a characteristic that is present prior to engaging in emergency service work or whether this is a style of coping that develops over time when engaged in this area of work.

The results of the multivariate analyses are largely consistent with our conceptual model, which emphasizes the role of peritraumatic reactivity as the lynchpin in the development of PTSD symptoms. Demographics and both civilian and CI traumatic stressors are significant predictors at the first steps but drop out of the full model that takes account of peritraumatic emotional distress and peritraumatic dissociation. Also consistent with our model, the postincident recovery environment plays an important role with lower social support and greater routine work environment stress associated with greater PTSD symptoms. Two additional findings are noteworthy; female gender is not a predictor reflecting selection and training effects that may differentiate women in law enforcement from women in the general population, and greater positive planful coping is positively rather than negatively related to PTSD symptoms, likely reflecting the efforts of an active and resilient group to manage PTSD symptoms.

BIOLOGICAL PREDICTORS OF POSTTRAUMATIC STRESS IN POLICE OFFICERS

Patients suffering from PTSD frequently complain about overreacting to sudden, loud noises.³⁵ Exaggerated startle distinguishes PTSD from all other disorders listed in the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition.³⁶ Like most psychiatric symptoms, this important feature of PTSD is typically assessed by relying upon subjective reports of distressed patients. Compared with controls adults with PTSD have larger eyeblink, heart rate (HR), and skin conductance responses to standard³⁷⁻³⁹ and threat-enhanced acoustic startle.⁴⁰

In our first psychophysiology study of posttraumatic stress in police we evaluated emotional (perceived safety and danger) and physiologic [eyeblink electromyogram (EMG) and skin conductance (SC)] responses to startling sounds under low, medium, and high threat conditions in 55 Bay Area police officers with a wide range of PTSD symptoms, drawn from the survey sample

of 747 officers.⁴¹ We found that contextual threat affected both physiologic and emotional responses in complex ways. Greater PTSD symptom severity was related to greater physiologic responses under the low and medium but not the high threat condition. Self-report measures of emotional response or feelings of exaggerated startle were not found to explain the relationship between PTSD symptoms and physiologic responses. Our results from this preliminary study suggested that laboratory measures of startle improve upon self-reported feelings of exaggerated startle alone in indexing PTSD symptom severity in this sample.

In our first neuroendocrine study with police officers we examined whether pre- and postdexamethasone salivary cortisol was related to cumulative CI exposure, peritraumatic responses, or PTSD symptoms.⁴² In another subsample of 30 active duty police officers from the Bay Area who had participated in the survey of 747 officers, we measured peritraumatic distress, peritraumatic dissociation, duty-related CI exposure, and PTSD symptoms. Salivary cortisol was consolidated into three outcome variables: (a) predexamethasone free cortisol levels (at 1, 30, 45, and 60 min after awakening), (b) postdexamethasone cortisol levels (at the identical wake time), and (c) percentage of cortisol suppression. Age, gender, night shift work, routine work environment stressors, and salivary dexamethasone levels were controlled for in the analyses. Zero order correlations of the three cortisol measures showed that the predexamethasone cortisol response to awakening was significantly inversely related to PTSD symptom severity ($r = -0.57, P < 0.01$), peritraumatic distress ($r = -0.49, P < 0.05$), and peritraumatic dissociation ($r = -0.41, P < 0.05$), with a trend for an inverse relationship for age. When these four predictor variables were entered simultaneously in a regression analysis, only PTSD symptom severity and age significantly predicted basal cortisol levels. Our findings that greater PTSD symptoms were related to lower levels of basal cortisol replicated previous research,⁴³⁻⁴⁵ extending this finding to a previously unstudied population of urban police.

PROSPECTIVE STUDY OF VULNERABILITY AND RESILIENCE TO POSTTRAUMATIC STRESS IN POLICE

Building on these cross-sectional and longitudinal studies of police and other first responders, we initiated a prospective study of police academy recruits in New York and Bay Area departments. The aim is to disentangle cause and effect relations in predictors of vulnerability and resilience to PTSD symptoms in police officers by evaluating academy recruits prior to actual CI exposure and following them for the first 3 years of police service.

In related work, Guthrie and Bryant found initial support for elevated startle being a vulnerability factor for PTSD symptoms in a prospective psychophysiological study.⁴⁶ Auditory startle response in 84 firefighters was measured

using eyeblink EMG, SC, and HR responses to 15 100-dB acoustic startle stimuli during their initial firefighter training (baseline). After entering active duty, 35 firefighters were reassessed within 4 weeks of exposure to a traumatic event, and 36 firefighters were reassessed as a nontrauma-exposed control group. In the trauma-exposed group greater baseline acoustic startle responses (SC and eyeblink EMG) were predictive of greater posttrauma startle responses and greater severity of posttraumatic stress symptoms.

In another prospective study, psychological but not biological characteristics were predictive of PTSD symptoms in 43 firefighters assessed immediately after training and at 6, 9, 12, and 24 months after entry into firefighter service.⁴⁷ Heinrichs and colleagues assessed neuroendocrine activity using awakening and diurnal salivary cortisol profiles and 24-h urinary catecholamines. At 24-month follow-up, they found that higher levels of hostility and lower levels of self-efficacy at baseline accounted for 42% of the variance in PTSD symptoms. However, biological variables were not predictive of symptoms. Additionally, firefighters who had both higher levels of hostility and lower levels of self-efficacy at baseline showed a significant increase in measures of PTSD symptoms, depression, anxiety, and alexithymia during the 2-year period.

In a first report from our prospective study of police academy recruits we predicted that academy recruits with histories of childhood abuse would show increased neuroendocrine and sympathetic nervous system responses to stress challenge testing.⁴⁸ Seventy-six police academy recruits who screened negative on the Structured Clinical Interview for DSM-IV, Non-Patient Version (SCID-NP)⁴⁸ for current Axis I disorders were exposed to a 20-min video depicting real-life officers exposed to highly stressful duty-related incidents. Salivary cortisol and the major metabolite of norepinephrine (MHPG) were collected at baseline, immediately after the video, and 20 min after the video. Childhood trauma prior to age of 14 years was assessed with the life stressor checklist. Exposure to the video elicited a significant MHPG and cortisol response in both groups (childhood trauma positive, $n = 16$; childhood trauma negative, $n = 61$). Although the cortisol response did not differ between groups, recruits with childhood trauma histories had a significantly greater MHPG response as evidenced by a group effect ($F = 8.0, P < 0.01$), and a group \times time interaction ($F = 4.1, P < 0.05$). Moreover, rates of lifetime depression were found to be higher among academy recruits with a history of child trauma. Specifically, lifetime depression was present in 4 of 16 participants with childhood trauma compared to 1 of 61 subjects without childhood trauma ($P < 0.01$). In sum, academy recruits with childhood trauma histories had a higher rate of lifetime depression and increased catecholamine response to psychological stress.

In the next year we will complete enrollment on 500 academy recruits with 250 projected to participate in a first-year follow-up. This will provide sufficient power to determine comprehensively the role of *psychosocial variables* including gender, ethnicity, trait anger, trait dissociation, neuroticism,

alexithymia, peritraumatic distress, peritraumatic dissociation, social support, routine work environment stress, and sleep quality; *cognitive variables*, such as intellectual and executive functioning and psychomotor vigilance; and *biological and psychophysiological variables* including family history of mental disorders, catecholamine response to stress testing, standard- and threat-enhanced acoustic startle, awakening and postdexamethasone salivary cortisol, in predicting resilience and vulnerability to PTSD symptoms. This large study of young, psychologically healthy, and physically fit academy recruits followed in high-risk urban policing provides an opportunity to disentangle cause and effect relations that limit postexposure cross-sectional and longitudinal studies of trauma victims.

ACKNOWLEDGMENTS

This research was supported by grants R01-MH56350 from the National Institute of Mental Health.

CONFLICT OF INTEREST

Views expressed here are solely those of the authors and do not represent official positions or policies of the National Institute of Justice or the Department of Justice.

REFERENCES

1. MCCASLIN, S.E., C. ROGERS, T.J. METZLER, *et al.* The impact of personal threat on police officers' responses to critical incident stressors. *J. Nerv. Ment. Dis.* Submitted.
2. WEISS, D.S., A. BRUNET, N. POLE, *et al.* 2005. The critical incident history questionnaire: a method for measuring total cumulative exposure to critical incidents in police officers. Submitted.
3. WEISS, D.S., A. BRUNET, T.J. METZLER, *et al.* 1999. Critical incident exposure in police officers: frequency, impact, and correlates. [Abstract] 1999 International Society of Traumatic Stress Studies Conference Miami, FL, p 52.
4. CARLIER, I.V.E., R.D. LAMBERTS & B.P.R. GERSONS. 1997. Risk factors for post-traumatic stress symptomatology in police officers: a prospective analysis. *J. Nerv. Ment. Dis.* **185**: 498–506.
5. GERSONS, B.P. 1989. Patterns of PTSD among police officers following shooting incidents: a two-dimensional model and treatment implications. *J. Trauma. Stress* **2**: 247–257.
6. ROBINSON, H.M., M.R. SIGMAN & J.P. WILSON. 1997. Duty-related stressors and PTSD symptoms in suburban police officers. *Psychol. Rep.* **81**: 835–845.

7. STEIN, M., J. WALKER, A. HAZEN & D. FORDE. 1997. Full and partial posttraumatic stress disorder: findings from a community survey. *Am. J. Psychiatry* **154**: 1114–1119.
8. ZATZICK, D.F., D.S. WEISS, C.R. MARMAR, *et al.* 1997. Post-traumatic stress disorder and functioning and quality of life outcomes in female Vietnam veterans. *Mil. Med.* **162**: 661–665.
9. ZATZICK, D.F., C.R. MARMAR, D.S. WEISS, *et al.* 1997. Posttraumatic stress disorder and functioning and quality of life outcomes in a nationally representative sample of male Vietnam veterans. *Am. J. Psychiatry* **154**: 1690–1695.
10. EMSLEY, R.A., S. SEEDAT & D.J. STEIN. 2003. Posttraumatic stress disorder and occupational disability in South African Security Force members. *J. Nerv. Ment. Dis.* **191**: 237–241.
11. MARMAR, C.R., D.S. WEISS, T.J. METZLER & K. DELUCCHI. 1996. Characteristics of emergency services personnel related to peritraumatic dissociation during critical incident exposure. *Am. J. Psychiatry* **153**: 94–102.
12. BRUNET, A., D.S. WEISS, T.J. METZLER, *et al.* 2001. The peritraumatic distress inventory: a proposed measure of PTSD criterion A2. *Am. J. Psychiatry* **158**: 1480–1485.
13. MARMAR, C.R., T.J. METZLER & C. OTTE. 2004. The peritraumatic dissociative experiences questionnaire. *In Assessing Psychological Trauma and PTSD*. J. Wilson & T. Keane, Eds.: 144–167. Guilford Press. New York.
14. OZER, E.J., S.R. BEST, T.L. LIPSEY, *et al.* 2003. Predictors of posttraumatic stress disorder and symptoms in adults: a meta-analysis. *Psychol. Bull.* **129**(1): 52–73.
15. PITMAN, R.K., A.Y. SHALEV & S.P. ORR. 2000. Posttraumatic stress disorder: emotion, conditioning, and memory. *In The New Cognitive Neurosciences*. M.D. Corbetta & M. S. Gazzaniga, Eds.: 687–700. Plenum Press. New York.
16. KESSLER, R.C., A. SONNEGA, E. BROMET, *et al.* 1995. Posttraumatic stress disorder in the National Comorbidity Survey. *Arch. Gen. Psychiatry* **52**: 1048–1060.
17. SCHELL, T., G. MARSHALL & L. JAYCOX. 2004. All symptoms are not created equal: the prominent role of hyperarousal in the natural course of posttraumatic psychological distress. *J. Abnorm. Psychol.* **113**: 1115–1119.
18. SIEGMUND, A. & C.T. WOTJAK. 2005. Towards an animal model of PTSD. *Ann. N. Y. Acad. Sci.* This volume.
19. MARMAR, C.R., D.S. WEISS, T.J. METZLER, *et al.* 1996. Stress responses of emergency services personnel to the Loma Prieta earthquake Interstate 880 freeway collapse and control traumatic incidents. *J. Trauma. Stress* **9**: 63–85.
20. HOGAN, R. & J. HOGAN. 1992. Hogan Personality Inventory Manual. Hogan Assessment Systems. Tulsa, OK.
21. WEISS, D.S., C.R. MARMAR, T.J. METZLER & H.M. RONFELDT. 1995. Predicting symptomatic distress in emergency services personnel. *J. Consult. Clin. Psychol.* **63**: 361–368.
22. MARMAR, C.R., D.S. WEISS, T.J. METZLER, *et al.* 1999. Longitudinal course and predictors of continuing distress following critical incident exposure in emergency services personnel. *J. Nerv. Ment. Dis.* **187**: 15–22.
23. LIBERMAN, A., S.R. BEST, T.J. METZLER, *et al.* 2002. Routine occupational stress and psychological distress in police. *Policing. Intl. J. Police Strat. Mngt.* **25**: 421–439.
24. POLE, N., S.R. BEST, D.S. WEISS, *et al.* 2001. Effects of gender and ethnicity on duty-related posttraumatic stress symptoms among urban police officers. *J. Nerv. Ment. Dis.* **189**: 442–448.

25. GALEA, S., J. AHERN, H. RESNICK, *et al.* 2002. Psychological sequelae of the September 11 terrorist attacks in New York City. *N. Engl. J. Med.* **346**: 982–987.
26. PERILLA, J.L., F.H. NORRIS & E.A. LAVIZZO. 2002. Ethnicity, culture, and disaster response: identifying and explaining ethnic differences in PTSD six months after Hurricane Andrew. *J. Soc. Clin. Psychol.* **21**: 20–45.
27. KULKA, R., W. SCHLESINGER, J. FAIRBANK, *et al.* 1990. Trauma and the Vietnam war generation : reports of Findings from the National Vietnam Veterans Readjustment Study. Brunner/Mazel. New York. NY.
28. POLE, N., S.R. BEST, T.J. METZLER, C.R. MARMAR. 2005. Why are hispanics at greater risk for PTSD? *Cultural Divers. Ethni. Minor. Psychol.* **11**: 144–161.
29. NEYLAN, T.C., T.J. METZLER, S.R. BEST, *et al.* 2002. Critical incident exposure and sleep quality in police officers. *Psychosom. Med.* **64**: 345–352.
30. MOHR, D.C., K. VEDANTHAM, T.C. NEYLAN, *et al.* 2003. The mediating effects of sleep in the relationship between traumatic stress and health symptoms in urban police officers. *Psychosom. Med.* **65**: 485–489.
31. BALLENGER, J., S.R. BEST, T.J. METZLER, *et al.* 2006. Patterns and predictors of alcohol use in urban police officers. *J. Addict. Behav.* In press.
32. KIRSCHMAN, E. 1997. *I Love a Cop: what Police Families Need to Know.* Guilford Press. New York.
33. KEANE, T., J. CADDELL & K. TAYLOR. 1988. Mississippi scale for combat-related posttraumatic stress disorder: three studies in reliability and validity. *J. Consult. Clin. Psychol.* **56**: 85–90.
34. GREEN, B. 1996. Trauma history questionnaire. *In* Measurement of Stress, Trauma, and Adaptation. S.B. Lutherville, Ed.: 366–369. Sidran Press. Towson, MD.
35. SOUTHWICK, S.M., C.A. MORGAN, III, A. DARNELL, *et al.* 1995. Trauma-related symptoms in veterans of operation desert storm: a 2-year follow-up. *Am. J. Psychiatry* **152**: 1150–1155.
36. AMERICAN PSYCHIATRIC ASSOCIATION. DIAGNOSTIC AND STATISTICAL MANUAL OF MENTAL DISORDERS (DSM-IV). 1994. American Psychiatric Association. Washington DC.
37. MORGAN, C.A., C. GRILLON, S.M. SOUTHWICK, *et al.* 1996. Exaggerated acoustic startle reflex in Gulf War veterans with posttraumatic stress disorder. *Am. J. Psychiatry* **153**: 64–68.
38. ORR, S.P., N.B. LASKO, A.Y. SHALEV & R.K. PITMAN. 1995. Physiologic responses to loud tones in Vietnam veterans with posttraumatic stress disorder. *J. Abnorm. Psychol.* **104**: 75–82.
39. SHALEV, A.Y., T. PERI, S.P. ORR, *et al.* 1997. Auditory startle responses in help-seeking trauma survivors. *Psychiatry Res.* **69**: 1–7.
40. GRILLON, C., C.A. MORGAN III, M. DAVIS & S.M. SOUTHWICK. 1998. Effect of darkness on acoustic startle in Vietnam veterans with PTSD. *Am. J. Psychiatry* **155**: 812–817.
41. POLE, N., T. NEYLAN, S.R. BEST, *et al.* 2003. Fear-potentiated startle and posttraumatic stress symptoms in urban police officers. *J. Trauma. Stress* **16**: 471–479.
42. NEYLAN, T., A. BRUNET, N. POLE, *et al.* 2005. PTSD symptoms predict cortisol levels in active duty police officers. *Psychoneuroendocrinology* **30**: 373–381.
43. YEHUDA, R., L.M. BIERER, J. SCHMEIDLER, *et al.* 2000. Low cortisol and risk for PTSD in adult offspring of holocaust survivors. *Am. J. Psychiatry* **157**: 1252–1259.
44. YEHUDA, R. 2002. Posttraumatic stress disorder. *N. Engl. J. Med.* **346**: 108–114.

45. YEHUDA, R. 2002. Current status of cortisol findings in post-traumatic stress disorder. *Psychiatr. Clin. North Am.* **25**: 341–368.
46. GUTHRIE, R. & R. BRYANT. 2005. Auditory startle response in firefighters before and after trauma exposure. *Am. J. Psychiatry* **162**: 283–290.
47. HEINRICHS, M., D. WAGNER, W. SCHOCH, *et al.* 2005. Predicting posttraumatic stress symptoms from pretraumatic risk factors: a 2-year prospective follow-up study in firefighters. *Am. J. Psychiatry* **162**: 2276–2286.
48. OTTE, C., T. NEYLAN, N. POLE, *et al.* 2005. Association between childhood trauma and catecholamine response to psychological stress in police academy recruits. *Biol. Psychiatry* **57**: 27–32.
49. SPITZER, R.L., J.B. WILLIAMS, M. GIBBON & M.B. FIRST. 1992. The Structured Clinical Interview for DSM III-R (SCID): I. History, rationale, and description. *Arch. Gen. Psychiatry* **49**: 624–629.