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Prewar Factors in Combat-Related Posttraumatic Stress Disorder: Structural Equation Modeling With a National Sample of Female and Male Vietnam Veterans

Daniel W. King and Lynda A. King
Central Michigan University

David W. Foy
Pepperdine University

David M. Gudanowski
Central Michigan University

Structural equation modeling was used to examine relationships among prewar factors, dimensions of war-zone stress, and current posttraumatic stress disorder (PTSD) symptomatology using data from 1,632 female and male participants in the National Vietnam Veterans Readjustment Study. For men, previous trauma history (accidents, assaults, and natural disasters) directly predicted PTSD and also interacted with war-zone stressor level to exacerbate PTSD symptoms for high combat-exposed veterans. Male veterans who entered the war at a younger age displayed more symptoms. Family instability, childhood antisocial behavior, and age had indirect effects on PTSD for men. For women, indirect prewar effects emanated from family instability. More attention should be given to critical developmental conditions, especially family instability and earlier trauma exposure, in conceptualizing PTSD in adults.

Posttraumatic stress disorder (PTSD) is an anxiety disorder that may result when one is confronted with a highly stressful event that produces a response of fear, horror, or helplessness. It is characterized by three symptom clusters: reexperiencing, avoidance and numbing, and hyperarousal. The study of this disorder has moved from early work that focused predominantly on the role of the traumatic event toward more sophisticated multivariate explanations. One valuable line of research has been inquiry into personal characteristics and previous experiences that might mitigate or exacerbate the individual's response to an extreme stressor. In the present study, we addressed this issue by evaluating the relationships of an array of pretrauma demographic and psychosocial factors to PTSD within one trauma group, veterans of the Vietnam War.

The role of pretrauma variables in accounting for combat-related PTSD has been debated in the literature, initially in terms of the "stress evaporation" versus the "residual stress" hypotheses. According to the former, the negative impact of the precipitating event dissipates over time, and any persistent dysfunction is ascribed to preexisting conditions. This hypothesis has generally diminished in significance, given the accumulated evidence supporting the primacy of a war-zone effect (Kaylor, King, & King, 1987). In contrast, the residual stress proposition minimizes the influence of preexisting conditions, with posttrauma dysfunction being a consequence of the traumatic event itself. This position was supported by Foy, Sipprelle, Rueger, and Carroll (1984) with help-seeking veterans and by Foy and Card (1987) with community-based veterans.

Between these two opposing positions, however, is "stress vulnerability," which holds that pretrauma characteristics make one more susceptible to the deleterious effects of a traumatic experience. It is typically conceived as an interaction between the predisposing factor and the traumatic stressor, so that the relationship between the predisposing factor and PTSD depends on the level of trauma: Under high stress, individuals are prone to negative outcomes, regardless of their personal characteristics or previous experiences; under low stress, those with background vulnerability are more at risk. Foy, Resnick, Sipprelle, and Carroll (1987) and McCranie, Hyer, Boudewyns, and Woods (1992) demonstrated this form of interaction.

Helzer (1981) predicted a comparable vulnerability interaction for a veteran sample, albeit with depression as the dependent variable. He found interactions involving prewar drug use and education, but, interestingly, the form of the interactions was converse to that proposed. These variables were more powerful predictors for high-combat veterans than for low-combat veterans. Resnick, Kilpatrick, Kramer, and Best (1990) reported an analogous interaction for female crime victims, with preexisting depression as the vulnerability factor and PTSD as the outcome. Thus, there is some lack of consensus concerning precisely how stress vulnerability operates.

Yet another possibility may describe the relationship between pretrauma characteristics and PTSD. For veterans, prewar variables have been shown to independently relate to PTSD in the

Daniel W. King, Lynda A. King, and David M. Gudanowski, Department of Psychology, Central Michigan University; David W. Foy, Graduate School of Education and Psychology, Pepperdine University.

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Daniel W. King and Lynda A. King are now at the National Center for Posttraumatic Stress Disorder, Boston Department of Veterans Affairs Medical Center.

Correspondence concerning this article should be addressed to Daniel W. King, Department of Veterans Affairs Medical Center, 150 South Huntington Avenue, Boston, Massachusetts 02130.

presence of a significant war-zone exposure factor (e.g., Bremner, Southwick, Johnson, Yehuda, & Charney, 1993; Green, Grace, Lindy, Gleser, & Leonard, 1990). This outcome, which may be accompanied by a vulnerability-type interaction, suggests dual main effects in that PTSD is accounted for by a pretrauma characteristic as well as by the traumatic event, similar to Dohrenwend and Dohrenwend's "additive burden" (1981, p. 136) model.

Finally, pretrauma factors might relate to PTSD by means of "indirect association" (Resnick et al., 1990, p. 1). Here, the pretrauma characteristic acts as a selection factor (King & King, 1991) to increase the likelihood of being exposed to the traumatic event, which, in turn, leads to negative outcomes. Helzer, Robins, and McEvoy (1987) suggested that antisocial behavior increased the probability of combat service, which presumably increased the risk for PTSD. Similarly, Green et al. (1990) observed that younger, less educated soldiers were more likely to experience higher war-zone stressor levels, which could contribute to later problems.

In the present study, we evaluated these theoretical positions using structural equation modeling. This approach has several benefits. As Hoyle (1994) asserted, structural equation modeling is particularly valuable for uncovering complex relationships among a large number of variables. Because the procedure allows for the estimation of measurement error, influences among the latent variables can be estimated without concern for the bias that typically accompanies unreliable measures (Bollen, 1989b). Furthermore, the estimates are efficient, providing more stable values and more accurate representations of the relationships. Using this approach, we proposed an integrated network of prewar factors (along with war-zone stressor factors) and tested their direct, indirect or mediating, and interaction effects on PTSD. The prewar factors were as follows:

1. Family environment. This factor was intended to capture the psychosocial setting in which the veteran was raised, to include socioeconomic status, affiliation with parents, and family problems that may contribute to an unstable home life and transmit risk to offspring (see the works of Helzer, 1981; Foy et al., 1984, 1987; and McCranie et al., 1992).

2. Childhood antisocial behavior. Also considered was the extent to which the veteran exhibited early problem behaviors (e.g., excessive fighting, substance abuse, legal difficulties). Such tendencies have been repeatedly proposed as important prewar influences (e.g., Foy & Card, 1987; Foy et al., 1984; Green et al., 1990; Helzer, 1981; Helzer et al., 1987).

3. Maturity at entry to Vietnam. This factor was framed in terms of the age of the veteran on exposure to the war zone and premilitary education. Age has long been implicated as a salient demographic characteristic in veteran research (e.g., Green et al., 1990; Wilson, 1978), and prewar level of education has also been emphasized (e.g., Foy et al., 1984; Green et al., 1990; Helzer, 1981).

4. Previous trauma history. There has been relatively little empirical study of veterans' exposure to trauma before the war. One exception is Bremner et al.'s (1993) comparison of PTSD and non-PTSD Vietnam veterans on a number of childhood stressors. They found a significant difference for physical abuse. Zaidi and Foy (1994) likewise documented that 45% of a sample of PTSD-positive Vietnam veterans reported severe physical abuse during childhood. Also, Engel et al. (1993) found that prewar abuse history exerted both a main effect and an interaction with gender on PTSD symptomatology for Gulf War veterans. Perhaps many individuals entering the war zone carried the effects of previous exposure to extreme stressors. Indeed, documentations of the incidence of highly stressful experiences in everyday life (e.g., Norris, 1992; Resnick, Kilpatrick, & Lipovsky, 1991) would make this assertion quite viable. Moreover, veterans who experienced highly stressful events before Vietnam may present themselves quite differently than veterans without such a history. For some, it is possible that PTSD symptomatology predated war-zone exposure and was exacerbated by it, that the events in the war zone were perceived and responded to differently by those with previous trauma, or that war-zone exposure acted to reintroduce previously resolved difficulties related to the original event (or events). Surely, the presence or absence of significant prewar traumatic experiences may mandate different approaches to PTSD assessment and different treatment plans for those who suffer from it. The present study, therefore, included a previous trauma history factor in the model to be tested.

In addition, the model incorporated four war-zone stressor dimensions: (a) exposure to traditional combat events, (b) exposure to atrocities or episodes of extraordinarily abusive violence, (c) perceived threat, and (d) the general milieu of a harsh or malevolent environment. King, King, Gudanowski, and Vreven (1995) demonstrated that these representations could be reliably measured, had discriminant validity, and were differentially related to PTSD for both female and male Vietnam veterans.

Thus, the full model under investigation included both a complement of prewar demographic and psychosocial characteristics and a multifaceted war-zone stressor representation. In addition to a chronological basis for organizing and ordering the variables within each of these submodels, an overriding principal for model conceptualization was that broader ecological variables (e.g., socioeconomic status, exposure to a combat environment) would precede variables that might be characterized as more individually specific or idiosyncratic (e.g., childhood antisocial behavior, perceived threat). Although numerous possible relationships are necessarily implied within any complex model, in this study the following hypotheses were considered especially salient: (a) The prewar family environment factor was expected to conform to the stress vulnerability hypothesis, such that the relationship between family environment and PTSD depends on the level of war-zone stressor exposure. (b) Childhood antisocial behavior was expected to adhere to the indirect association hypothesis, suggesting that individuals high on this factor are simply more likely to have found themselves exposed to the war-zone stressors. (c) Maturity was expected to indirectly lead to PTSD by means of its linkage to war-zone stressors; that is, younger and less educated individuals were more likely to experience higher war-zone stressor levels. (d) The veteran's previous trauma history was expected to influence PTSD by way of two mechanisms: first, according to a vulnerability paradigm, wherein childhood traumatic experiences exacerbate the war-zone stressor effect, and, second, as a direct effect, with postwar symptomatology at least partially a consequence of previous trauma exposure.

Table 1
Descriptive Statistics and Reliability Estimates for All 21 Candidate Measures for the Full Sample

Measure	No. of items	*M*	*SD*	Coefficient α
Prewar factors				
Family environment				
Father's education	1	9.31	4.06	NA[a]
Mother's education	1	9.87	3.61	NA[a]
Perceived socioeconomic status	3	0.02[b]	2.60	.83
Presence of mother	1	2.83	0.54	NA[a]
Presence of father	1	2.57	0.90	NA[a]
Relationship with mother	6	0.01[b]	4.99	.91
Relationship with father	6	0.00[b]	5.03	.92
Family instability	9	10.64	2.49	.65
Childhood antisocial behavior[c]	15	0.00[b]	7.29	.77
Maturity at entry to Vietnam				
Age at entry to Vietnam	1	23.77	6.23	NA[a]
Education before military	1	2.22	0.84	NA[a]
Previous trauma history				
Inventory of traumatic events	5	0.34	0.72	NA[d]
Domestic violence	1	1.22	0.42	NA[a]
Severe punishment	2	0.00[b]	1.93	.92
War-zone stressors				
Traditional combat	36	0.00[b]	20.88	.94
Atrocities–abusive violence	9	0.00[b]	6.66	.89
Perceived threat	9	0.00[b]	5.94	.84
Malevolent environment	18	0.00[b]	11.16	.91
PTSD				
Mississippi Scale	35	72.58	21.91	.94
PTSD symptom count[c]	16	0.78	2.30	.92
Predicted probability of PTSD[e]	[e]	0.18	0.30	NA[a,e]

Note. PTSD = posttraumatic stress disorder; NA = not applicable.
[a] Measures consisted of a single item; estimates of internal consistency could not be computed. [b] Means were computed on sums of scores for items that had been transformed to standard or *z* scores. Thus, each item had a mean of 0 and a standard deviation of 1. Because of missing data, when a summative score across items was computed for all respondents, a scale mean of exactly 0 was not obtained for the measure. [c] Measures based on responses to the Diagnostic Interview Schedule (Robins, Helzer, Croughan, & Ratcliff, 1981). [d] Because there was no reason to expect reports of the separate incidents or circumstances to covary strongly with one another, an estimate of internal consistency was considered inappropriate. [e] This measure was a composite score derived from a logistic regression equation developed by the original researchers of the National Vietnam Veterans Readjustment Study for the purpose of estimating prevalence rates of PTSD in the Vietnam veteran population. Explanatory variables included ethnicity, geographic region, number of postwar readjustment problems, exposure to a traumatic event, number of PTSD symptoms experienced since return from the war, and continuous score on the Mississippi Scale for current PTSD. A thorough description of the methods used to compute predicted probabilities is provided in the Kulka et al. report (1990, Appendix E, pp. E2–E23).

Method

Data Source

Data were taken from the National Vietnam Veterans Readjustment Study (NVVRS; Kulka et al., 1990), in particular, the responses of the 1,632 (432 women and 1,200 men) Vietnam theater veteran participants. Extensive details about the sampling methodology and sample characteristics are given in the work by Kulka et al.

Measures

Table 1 presents information on the 21 candidate measures considered at the outset of the study. A detailed description of the variable definitions, item content, response scales, and scoring procedures are included in an extended version of this article, available from Daniel W. King.

Overview of Analyses

From the total of 1,632 veterans, four subsamples were formed: (a) a 25%-stratified (by gender) random selection of 408 persons, 108 women and 300 men; (b) the remaining 324 women; (c) a 50% random sample of the remaining 900 men, or 450 men; and (d) the other 450 men. A two-step modeling process was followed, with the measurement model specified on one data set and the structural model specified on another data set (Anderson & Gerbing, 1988). Moreover, the availability of multiple subsamples allowed for some replication and cross-validation of findings.

The mixed-gender subsample (n = 408) was used solely for measurement purposes. The resulting measurement model was then replicated on the subsample of 324 women and on the first of the two subsamples of 450 men. The structural model was next addressed, using the subsample of 324 women and the first subsample of 450 men. The following stage focused on tests of interactions. Because the requirement for mul-

tivariate normality was not met (Kenny & Judd, 1984), a subgroup analysis approach was used. The same female (n = 324) and male (n = 450) subsamples used in the preceding analyses were each divided into two groups by means of a median split on the traditional combat variable. Then, a multisample modeling procedure was applied. The aim was to determine the equivalence of relationships between the prewar factors and the remaining war-zone stressors and PTSD for the separate high versus low combat-exposed groups. Finally, cross-validation of the final model for men was conducted using the last subsample of 450 men. Cudeck and Browne's (1983) double cross-validation procedure was used. The number of women in the full sample precluded withholding women for cross-validation. For women, only the expected cross-validation indices (Browne & Cudeck, 1989) were computed.

For all analyses, matrices of covariances were submitted to the LISREL 8 program (Jöreskog & Sörbom, 1993). Generalized least squares estimation was used; when latent variables and residuals are independent and sample sizes are less than 500, this approach is preferable (Hu, Bentler, & Kano, 1992). Covariances among residuals were always fixed at 0. Additional rationale and details on analytic strategies are integrated within the Results section.

Results

Specification and Replication of the Measurement Model

The beginning point was nine latent variables (four prewar factors, four war-zone stressors, and PTSD) together with their 21 inclusive measures. Manifest indicators derived from the measures were specified to load on designated latent variables, and the model was fit to the data from the first subsample. Resulting goodness-of-fit indices suggested the need for respecification. Attention was given to the content of manifest indicators in light of the intended meaning of the latent variables. In the end, four of the original measures were deleted: presence of mother, presence of father, relationship with mother, and premilitary education. In addition, there was an increase in the number of latent variables: The family environment composite disaggregated into socioeconomic status, relationship with father, and family instability. Last, two indicators initially expected to load with the previous trauma history latent variable were moved to family instability: domestic violence and severe punishment.

Table 2 summarizes the resulting measurement solution, the one that defined the latent variables for the remainder of the study. The manifest indicators for three latent variables—previous trauma history, traditional combat, and atrocities–abusive violence—were treated as causal indicators. Exposure to these stressors likely "causes" the experiencing of trauma, rather than the more typical reverse direction, where latent variables "cause" observed or manifest indicators (Loehlin, 1992; MacCallum & Browne, 1993). Additionally, age of the veteran at entry to Vietnam was considered a perfectly reliable indicator of its respective construct. Items on a number of the multi-item measures of the remaining latent variables were grouped into clusters, to yield several "miniscales" or item "parcels" (Bagozzi & Heatherton, 1994; MacCallum, Roznowski, & Necowitz, 1992). For the relationship with father, childhood antisocial behavior, perceived threat, and malevolent environment measures, scores on randomly grouped triplets of scale items were derived. For one PTSD measure, the Mississippi Scale (Keane, Caddell, & Taylor, 1988), four parcels were formed according to symptom content previously confirmed in a series of factor analyses (King & King, 1994).

Muthen's (1989) heterogeneous population model, treating gender as a fixed exogenous variable, allowed for both a pooled within-groups factor solution and gender-based between-groups test statistics. The last column in Table 2 presents the resulting t values for female–male differences on the latent variables.

For the respecified measurement model on the first, mixed-gender subsample, the discrepancy statistic was significant, $\chi^2(434, N = 384) = 804.73, p < .001$, but its ratio to the degrees of freedom was less than 2.00, thus meeting a standard of acceptable fit suggested by Newcomb (1994). When the same measurement model was specified for the second, all-female subsample, with freely estimated factor loadings, factor variances and covariances, and residuals, it appeared to fit the data quite well: $\chi^2(413, N = 317) = 564.44, p < .001$; the root-mean-square error of approximation (RMSEA; Steiger, 1990) was .034; the parsimony normed fit index (PNFI; James, Mulaik, & Brett, 1982) was .81; the LISREL goodness-of-fit index (GFI; Jöreskog & Sörbom, 1993) was .89; the normed fit index (NFI; Bentler & Bonett, 1980) was .98; the comparative fit index (CFI; Bentler, 1990) was .99; and the incremental fit index (IFI; Bollen, 1989a) was .99. A similarly sound fit was obtained for the third, all-male subsample: $\chi^2(413, N = 427) = 614.95$, $p < .001$; RMSEA = .034; PNFI = .83; GFI = .91; NFI = .98; CFI = .99; and IFI = .99.

Evaluation of Direct and Indirect Effects: Structural Models

Having an acceptable measurement model, we turned our attention to examining relationships among the 11 latent variables (Table 2), using the fit associated with the measurement model as the base for judging more parsimonious models. The designation of paths was guided by the hypotheses involving the direct and indirect influences of prewar factors. A prerequisite to evaluating the structural component was to determine whether female and male models should be considered simultaneously or separately by testing the equivalence of factor solutions. The multisample measurement model having similar patterns of factor loadings, factor variances and covariances, and residuals for both genders yielded a significant discrepancy statistic, $\chi^2(826, N = 744) = 1{,}179.39, p < .001$. All other fit indices were nearly the same as those produced when the women and men were treated separately. Thus, the number of factors and the pattern of loadings were comparable for the two groups. However, a model with equivalent factor loadings across genders provided a worse fit, $\chi^2(847, N = 744) = 1{,}237.79, p < .001$. The significant difference, $\chi^2(21, N = 744) = 58.40, p < .001$, between this more constrained model and its predecessor model prescribed that the ensuing examination of structural models be conducted separately for women and men.

Model for women. For female veterans, an initial model with 33 structural coefficients was specified. The rather large number of coefficients allowed for evaluation of the working hypotheses concerning direct and indirect effects, and it also was intended to aid in the later examination of hypothesized interaction effects. Furthermore, as explained by Newcomb (1994), it was important to overfit the model to be able to eval-

Table 2
Measurement Model

Latent variable	No. of indicators	Description of indicators	*t* for women vs. men[a]
Prewar factors			
Socioeconomic status	3	Father's education in years	3.38[b]
		Mother's education in years	
		Average score of three items assessing the veteran's perception of family financial well-being	
Relationship with father	2	Average scores on each of two randomly grouped item triplets measuring relationship quality (e.g., closeness, affection)	0.37
Family instability	3	Average of the nine family instability items (e.g., substance abuse in the home, arrest of family member)	−1.94
		Domestic violence item reflecting interparental physical abuse	
		Severe punishment score computed as average of two items assessing whether the veteran was hit as a child	
Childhood antisocial behavior	5	Average scores on each of five randomly grouped item triplets measuring disciplinary problems before age 15	−6.10[b]
Age at entry to Vietnam	1	Veteran's age in years	4.43[b]
Previous trauma history	1	Score on the inventory of traumatic events assessing categories of highly stressful experiences (e.g., natural disasters, accidents)	−2.70[b]
War-zone stressors			
Traditional combat	1	Average of the 36 items assessing stereotypical war-zone events (e.g., firing a weapon, receiving fire)	−5.75[b]
Atrocities–abusive violence	1	Average of the nine items assessing war-zone events considered deviant (e.g., mutilation, killing civilians)	−3.28[b]
Perceived threat	3	Average scores on each of three randomly grouped item triplets measuring subjective judgments of fear	−3.89[b]
Malevolent environment	6	Average scores on each of six randomly grouped item triplets measuring day-to-day discomforts (e.g., the heat, poor living facilities)	−4.76[b]
PTSD	6	Average score on 11 Mississippi Scale Reexperiencing and Situational Avoidance items	−3.24[b]
		Average score on 11 Mississippi Scale Withdrawal and Numbing items	
		Average score on eight Mississippi Scale Arousal and Lack of Control items	
		Average score on five Mississippi Scale Guilt and Suicidality items	
		PTSD symptom count	
		Predicted probability of PTSD	

Note. PTSD = posttraumatic stress disorder.
[a] Positive values of the statistic indicate that women have higher average scores on the latent variable; negative values indicate that men have higher average scores. [b] *t* statistic exceeds 2.00.

uate various plausible associations, whether hypothesized or not.

Beginning with the trio of family environment influences, socioeconomic status was proposed to predict both relationship with father and family instability, whereas relationship with father was proposed to predict family instability. Each of these three latent variables, in turn, had paths to previous trauma history, childhood antisocial behavior, age at entry to Vietnam, and traditional combat. Next, paths were postulated from previous trauma history to childhood antisocial behavior and from previous trauma history directly to PTSD. Childhood antisocial behavior had paths to the latent variables of age, traditional combat, and atrocities–abusive violence, and age had a single path to traditional combat. Looking strictly within the set of prewar factors, as noted earlier, it was expected that the more general ecological or "setting" variables would precede variables considered more individual or specific. Hence, socioeconomic status predicted relationship with father and family instability. At a higher level and along the same lines, the family environment cluster and the previous trauma variable were antecedent to childhood antisocial behavior and age at entry to Vietnam within the prewar factors submodel.

Eight additional paths involved the war-zone stressors: three from traditional combat to each of the other stressors (atrocities–abusive violence, perceived threat, and malevolent environment); one from each of these three to PTSD; one from atrocities–abusive violence to malevolent environment; and one from malevolent environment to perceived threat. The proposed pattern of direct and indirect relationships among these elements was founded in the earlier King et al. (1995) modeling study. In general, the paths among the war-zone stressors were intended to suggest that the broader combat environment "produces" instances amenable to the commission of atrocities, as well as the internalization of threat and increased sensitivity to the noisome or uncomfortable aspects of daily war-zone living conditions. The link between malevolent environment and perceived threat was found by King et al. and suggests that annoying features of the general war-zone milieu may exacerbate the perception of threat of bodily harm.

Finally, four paths were included to represent the possible re-

Table 3
Sequential Chi-Square Difference Tests for Structural Models

Model	χ^2	*df*	*p*	Δ from base χ^2	Δ from base *df*	Δ from base *p*	Δ from previous model χ^2	Δ from previous model *df*	Δ from previous model *p*	Cross-validation indices
Women										
Base (measurement model)	564.44	413	.00							
Initial structural model (33 paths)	595.10	435	.00	30.66	22	.10				2.47[a]
Delete 4 paths from relationship with father (29 paths)	598.30	439	.00	33.86	26	.14	3.20	4	.52	2.46[a]
Delete 3 paths from childhood antisocial behavior (26 paths)	600.58	442	.00	36.14	29	.17	2.28	3	.52	2.44[a]
Delete 3 paths from family instability and previous trauma history (23 paths)	601.81	445	.00	37.37	32	.24	1.23	3	.75	2.44[a]
Delete 1 path from age; final accepted model (22 paths)	601.88	446	.00	37.44	33	.27	0.07	1	.79	2.42[a]
Delete 4 remaining paths from prewar factors (18 paths)	614.98	450	.00	50.54	37	.07	13.10	4	.01	2.44[a]
Men										
Base (measurement model)	614.95	413	.00							
Initial structural model (33 paths)	650.35	435	.00	35.40	22	.04				
Add 2 paths (35 paths)	639.33	433	.00	24.38	20	.23				2.49/2.05[b]
Delete 4 paths from socioeconomic status (31 paths)	642.33	437	.00	27.38	24	.29	3.00	4	.56	2.46/2.06[b]
Delete 4 paths from relationship with father (27 paths)	649.79	441	.00	34.84	28	.17	7.46	4	.11	2.47/2.06[b]
Delete 4 paths from family instability and previous trauma history; final accepted model (23 paths)	655.48	445	.00	40.53	32	.14	5.69	4	.22	2.44/2.04[b]
Delete 7 remaining paths from prewar factors (16 paths)	702.77	552	.00	87.82	39	.00	47.29	7	.00	2.50/2.15[b]

Note. For all tests of models, $n = 317$ for women and 427 for men.
[a] Values for women are expected cross-validation indices from the single all-female subsample. [b] The first value represents the cross-validation of the model from the first all-male subsample to the second all-male subsample; the second value represents the cross-validation of the second to the first.

lationships between earlier childhood experiences and later appraisals of war-zone circumstances. Specifically, paths were introduced from both family instability and previous trauma history to both perceived threat and malevolent environment, the latter being the two war-zone stressor dimensions considered more "subjective" (King et al., 1995). The rationale here was that earlier incidents or life circumstances might predispose the veteran to have stronger reactions to a highly stressful environment.

The upper portion of Table 3 presents the chi-square difference testing sequence used to systematically simplify this initial structural model for female veterans. Guided by statistical and substantive considerations, paths were deleted at several steps. Consistent with the recommendation of Jöreskog and Sörbom (1993), a path was removed if its associated *t* statistic was less than an absolute value of 2.00 and if there was no compelling rationale for its retention. No paths with *t* statistics greater than 2.00 were deleted, although some with *t* statistics less than 2.00 were retained, when substantive theory appeared to deem their retention. Overall, the guiding principle was whether the deletion of paths produced a significantly worse model–data fit, the emphasis thus on fitting model-based covariance matrices (Bollen, 1989b). A total of 11 paths were deleted, with nonsignificant differences between all constrained models and the base model and when each successive model was compared with its predecessor. The last entry for women in Table 3 is a model in which the four remaining path coefficients from prewar factors to war-zone stressors and PTSD are constrained to 0. The significant chi-square difference between this more constrained model and the previous (final accepted) model means that deleting these connections significantly damages model–data fit. Thus, the previous model is the more parsimonious representation of the data. Furthermore, PTSD is predicted by the prewar factors beyond what can be attributed to the war-zone stressors.

The final structural model for female veterans is depicted in Figure 1; total, direct, and indirect effects of all prewar factors and war-zone stressors on PTSD are presented in Table 4. In addition to the chi-square statistic listed in Table 3, the final accepted model for women produced the following fit indices: RMSEA = .033; PNFI = .88; GFI = .88; NFI = .98; CFI = .99; and IFI = .99.

Model for men. Table 3 also contains the results of model fitting for male veterans. All procedures paralleled those for the women. In this case, however, the initial model differed significantly from the base model. Examination of the LISREL modification indices suggested a respecification, with the addition of two conceptually tenable structural coefficients, paths from age to PTSD and from childhood antisocial behavior to perceived threat. When these paths were added, the chi-square difference from base was no longer significant. Simplification proceeded from this more saturated model, with 35 structural coefficients. As with the women's model, the final accepted model for men differed significantly from one in which all connections between prewar factors and war-zone stressors and PTSD were deleted (last line of Table 3). Hence, the results for men also suggest that prewar factors may be implicated in PTSD.

Figure 2 displays the final model for male veterans, and the lower part of Table 4 presents the corresponding effects. For the men, the total effects of prewar factors on PTSD are generally stronger than those for the women, and there are more links

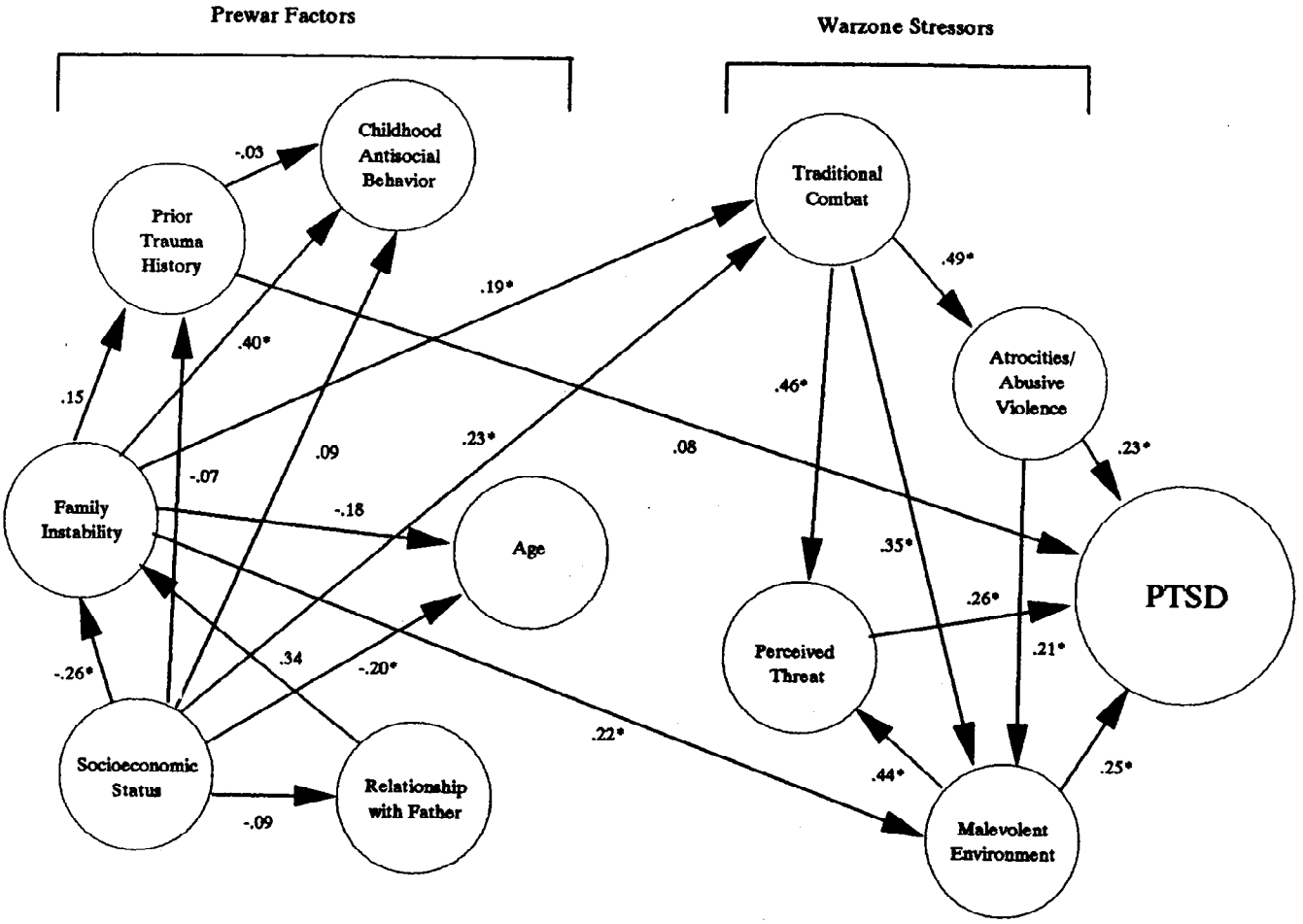

Figure 1. Final structural model of the associations among prewar factors, war-zone stressors, and post-traumatic stress disorder (PTSD) for female veterans.

between prewar factors and war-zone stressors and PTSD. Fit indices for the final accepted model for men were as follows: RMSEA = .033; PNFI = .88; GFI = .90; NFI = .98; CFI = .99; and IFI = .99.

A cautionary note for both the model for women and the model for men: Evidence in support of a model does not confirm the model. It merely suggests that there is no available disconfirmatory evidence. Therefore, one must always recognize that other equally satisfactory and plausible models may explain the observed data (Loehlin, 1992).

Evaluation of the Stress Vulnerability Perspective: Subgroup Analyses

One hypothesis concerned whether the relationship of family environment risk factors to PTSD depends on war-zone stressor exposure. A similar hypothesis concerned the relationship of previous trauma history to PTSD. Two reasons seemed to point to using traditional combat as the basis for creating high and low stressor-exposed subgroups. First, because it was treated as a single causal indicator, observed scores on traditional combat were equivalent to scores on the latent variable. Second, we felt that this variable provided the best representation of the veteran's objective war-zone experiences.

Subgroup analyses for women. It was necessary to have an initial model for both high and low combat-exposed women that included all possible structural paths from the three family environment latent variables (socioeconomic status, relationship with father, and family instability) to the three remaining war-zone stressor latent variables (atrocities–abusive violence, perceived threat, and malevolent environment), which, in turn, are linked to PTSD. It was also necessary to include paths from previous trauma history to the three other war-zone stressors. Vulnerability was evaluated by constraining all of the paths to be either equal to 0 or to be equivalent across high and low combat-exposed female veterans. In addition, for this and all subsequent models, all other paths from the previously specified final model for direct and indirect effects were included, factor loadings were specified as invariant across subgroups, and covariances among residuals were fixed at 0.

Scrutiny of the path coefficients in the initial model revealed six paths not previously included in the direct and indirect effects model that failed to achieve the conventional t value of 2.00 for either of the two subgroups of female veterans. Hence, the involved

Table 4
Effects of Prewar Factors and War-Zone Stressors on PTSD

Latent variable	Total effect	Direct effect	Indirect effect
Women			
Prewar factors			
Socioeconomic status	.04		.04
Relationship with father	.06[a]		.06[a]
Family instability	.17[a]		.17[a]
Childhood antisocial behavior			
Age at entry to Vietnam			
Previous trauma history	.08	.08	
War-zone stressors			
Traditional combat	.39[a]		.39[a]
Atrocities–abusive violence	.30[a]	.22[a]	.08[a]
Perceived threat	.26[a]	.26[a]	
Malevolent environment	.36[a]	.25[a]	.11[a]
Men			
Prewar factors			
Socioeconomic status	−.01		−.01
Relationship with father	.10[a]		.10[a]
Family instability	.21[a]		.21[a]
Childhood antisocial behavior	.17[a]		.17[a]
Age at entry to Vietnam	−.21[a]	−.11[a]	−.10[a]
Previous trauma History	.11[a]	.11[a]	.00
War-zone stressors			
Traditional combat	.62[a]		.62[a]
Atrocities–abusive violence	.18[a]	.14[a]	.04
Perceived threat	.29[a]	.29[a]	
Malevolent environment	.44[a]	.32[a]	.12[a]

Note. All effects are computed from the LISREL 8 standardized solution. PTSD = posttraumatic stress disorder.
[a] *t* statistic exceeds 2.00.

antecedent prewar variables appear to neither exert direct effects for the group as a whole nor exert differential effects as a function of combat exposure. Accordingly, the paths representing their influence were deleted from the model, with no degradation of fit.

In the direct and indirect effects model, socioeconomic status was associated with traditional combat for women. To evaluate whether its influence also depended on level of combat exposure, a model was next specified equating its influence across subgroups. The change in chi-square was nonsignificant. A similar strategy followed for the family instability latent variable and then for the previous trauma history latent variable. In both cases, nonsignificant chi-square differences also resulted. Thus, the sequence of tests for interactions provided no evidence for stress vulnerability for women, using the prewar factors as operationalized in this study.

Subgroup analyses for men. The logic and procedures for the initial structural model testing interactions for men were the same as for women. For both high and low combat-exposed male subgroups, 12 paths not previously included in the direct and indirect effects model had *t* statistics with values less than 2.00 in this model. Again, this outcome suggests that the antecedent variables neither exert direct effects for the group as a whole nor differential effects as a function of exposure to combat. When the paths associated with their influence were deleted from the model, the fit was not significantly altered.

When the direct path from previous trauma history to PTSD was constrained to be equivalent for both male subgroups, the chi-square difference between this model and the preceding, less constrained model was significant, $\chi^2(1, N = 427) = 5.35, p < .05$. Therefore, the path coefficients for the high and low combat-exposed male veterans are not equivalent, and the relationship between previous trauma history and PTSD appears to differ as a function of exposure to traditional combat. Inspection of the completely standardized (to a common metric) path coefficients and associated *t* statistics reveals that the relationship is positive and stronger, $\beta = .29$, $t = 3.48$, for male veterans scoring higher on the traditional combat variable, whereas it is quite negligible, $\beta = .00$, with rounding, $t = .05$, for those male veterans scoring lower on the traditional combat variable.

Cross-Validation

The cross-validation results are displayed in the last column of Table 3. According to Cudeck and Browne (1983), in evaluating a series of nested models, the researcher should select models with smaller cross-validation values. Table 3 shows that the trend for the women reinforces the model that we previously settled on using chi-square difference tests. Likewise, for the men, the first cross-validation obviously concurred with the earlier modeling results. The second cross-validation was not so definitive, however, with solutions between the initial model and the accepted model having slightly higher values. Nonetheless, the lowest index corresponds to the accepted model. Therefore, the findings generally suggest that the final accepted models for both women and men are the preferred ones.

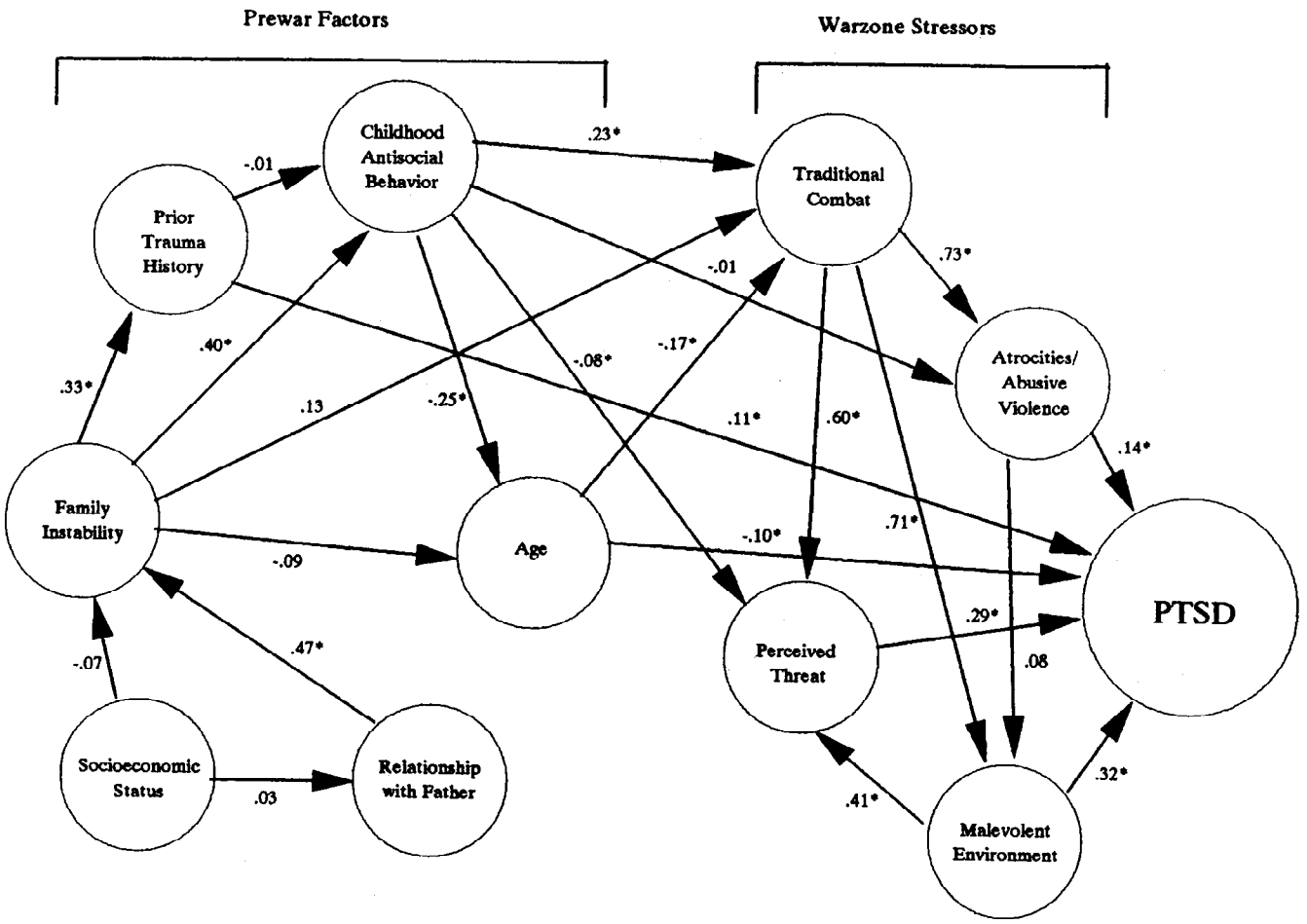

Figure 2. Final structural model of the associations among prewar actors, war-zone stressors, and post-traumatic stress disorder (PTSD) for male veterans.

Discussion

Summary and Interpretation of the Findings

The data produced in the NVVRS, on which the present study relied, have much to recommend them. Still, one must exercise caution in any study relying on cross-sectional, retrospective data, as is the case here. Please see King et al. (1995) for discussion of particular problems along these lines and King and King (1991) for comment on validity threats in Vietnam veteran research.

In this study, we evaluated the relationships of retrospectively reported prewar demographic and psychosocial characteristics, together with war-zone stressors, to current PTSD symptomatology among a national sample of Vietnam veterans. A measurement model comprising 11 latent variables was robust across several subsamples of the data. Average scores of women and men appeared to differ on 9 of the 11 latent variables. The pattern of loadings of the manifest indicators was consistent across genders, but the values of the loadings differed. Consequently, structural models were specified separately for women and men. For both genders, the set of war-zone stressors was potent, but prewar factors played a role, more so for men than for women. The viability of the resulting model for men was strengthened through cross-validation with a separate subsample.

The first of four general hypotheses governing the study proposed that aspects of the prewar family environment (socioeconomic status, relationship with father, and family instability) would interact with level of war-zone stressor exposure. We found no evidence to support this stress vulnerability hypothesis. For both women and men, there was no tendency for high versus low combat-exposed individuals to be more or less susceptible to PTSD as a function of the prewar family environment.

The absence of an interaction between family environment variables and combat exposure, however, did not preclude features of the prewar family environment from exerting indirect effects on PTSD. For both genders, family instability and, to a lesser extent, relationship with father (through its influence on family instability) were implicated. For women, an unstable family background seemed primarily to relate to PTSD through traditional combat and malevolent environment (Figure 1); those from more unstable families tended to report greater exposure to combat and to view the war zone as more

harsh or malevolent. For men, family instability had strong associations with PTSD through links with childhood antisocial behavior, age, previous trauma history, and traditional combat (Figure 2), all of which were important in their own right (Table 4).

Two of the three manifest indicators of family instability involved some degree of violence in the home. The domestic violence measure assessed whether the veteran had observed parents hit one another, and the severe punishment measure assessed the extent to which the veteran had been excessively hit as a child. Thus, the study suggests that violence in the home environment is implicated in the network of relationships. These results encourage future PTSD researchers to incorporate a variable reflecting instability within the family of origin, particularly one involving parental discord or corporal punishment. In addition, the "relationship with father" variable deserves more research attention.

For women, socioeconomic status was related to exposure to traditional combat (Figure 1), and weakly related to PTSD (Table 4). The nature of the association was such that those reporting higher socioeconomic status for their families of origin also reported greater exposure to combat. This modest relationship could reflect a generational phenomenon, with younger, junior military women reared in the relatively affluent 1950s and 1960s likely to be closer to combat and its aftermath. Older, senior military women, on the other hand, were more likely to serve in managerial positions, perhaps further from action, and these women would have grown up in times of economic depression and lower levels of parental education.

The second hypothesis, concerning childhood antisocial behavior's indirect effect on PTSD, was not supported for women. This outcome may be for one or both of two reasons. First, the NVVRS's childhood antisocial behavior items largely addressed aggressive acting-out behaviors that were more typical of problems exhibited by young men; thus, the measurement of the construct for women may have been lacking. Second, the prevalence of childhood antisocial behavior among the population of female Vietnam veterans was probably quite low, as these women were primarily registered nurses who had been professionally screened for entry and progression through their higher education and career. Thus, there could have been a mismatch between the variable operationalization and the population under investigation.

In contrast, the hypothesis of an indirect effect of childhood antisocial behavior was strongly endorsed for men, with multiple paths leading to PTSD (Figure 2). Those scoring high on childhood antisocial behavior tended to report less perceived threat in the war zone, an unforeseen relationship at the outset of this study. Another finding of some interest concerns how childhood antisocial behavior is linked to the atrocities–abusive violence variable for men. The direct effect of the former on the latter is negligible and, in fact, negative. The indirect effect through age and traditional combat, however, is quite strong and positive. This pattern suggests that veterans with prewar behavioral problems were not directly predisposed to atrocious acts; rather, any observed relationship between these two variables is mediated by age and amount of combat experienced.

The third hypothesis involved the indirect effect of maturity on PTSD. This hypothesis was not upheld for female veterans, inasmuch as the link between age and traditional combat was not a part of their final model (Figure 1). Perhaps the aforementioned potential for a generation effect and accompanying covariation between socioeconomic status and age rendered inconsequential the path between age and combat exposure. For men, however, age at entry to Vietnam was indeed indirectly associated with PTSD through traditional combat (Figure 2). The model supported Green et al.'s (1990) notion that younger men were subjected to higher levels of combat, which, in turn, predicted more current symptoms.

In addition, for men, there was a direct effect of age on PTSD, not anticipated in the initial model but appearing equally as potent as the hypothesized indirect effect (Table 4). Regardless of their degree of exposure to war-zone stressors, men who were younger when they went to war were more likely to display postwar PTSD symptoms. This finding is consistent with Wilson's (1978) assertion of an important developmental component to Vietnam veterans' reactions to their experiences and subsequent reintegration into society. Wilson pointed out that many men who fought the Vietnam War were simply too young to have achieved a sufficient degree of ego development to withstand the pressures of the war zone.

According to the fourth hypothesis, previous trauma history was proposed to have a direct effect on PTSD but differentially as a function of war-zone stressor exposure. For women, the direct effect was negligible (Figure 1 and Table 4), and there was no discernible interaction. The failure to find a stronger effect for female veterans might be attributed to the content of the measure of previous trauma. Like the childhood antisocial behavior items, some of the previous trauma history items may have been unsuitable for eliciting information about women's experiences. For example, two traumatic-events questions, about vehicular accidents and farm or industrial accidents, were probably more germane to assessing the experiences of young men. More important, the item that might be most relevant to earlier trauma for women included rape and abuse as only two in a more general list of assaultive events. We clearly recognize that there is evidence in the rape and assault literature (e.g., Astin, Ogland-Hand, Coleman, & Foy, in press; Resnick et al., 1991) showing that earlier highly stressful or traumatic experiences, including previous assaults, can exacerbate PTSD symptomatology.

For men, the fourth hypothesis was supported. The direct effect of previous trauma history did obtain and was qualified by level of exposure to traditional combat. The form of the interaction mirrored that found by Helzer (1981) and Resnick et al. (1990), with a relationship between previous trauma history and PTSD primarily for those exposed to higher war-zone stressor levels. The direct effect (Figure 2 and Table 4) indicates that, across all veterans, previous trauma is associated with PTSD symptomatology. However, the interaction suggests that those veterans who experienced higher war-zone stressor levels are more predisposed to this relationship. Hence, the findings offer compelling evidence for the importance of the previous trauma history variable and reinforce a multiple-traumatic-events perspective for future PTSD investigations.

The structural models for both women and men also predicted that traditional combat would have indirect effects on PTSD through the other three war-zone stressors, each of which

would have a direct effect on PTSD. This pattern was found. The most powerful war-zone stressor was traditional combat. This finding differs from that reported by King et al. (1995), but it can be understood in terms of model specification. In that study, atrocities–abusive violence and malevolent environment were exogenous variables covarying with traditional combat. In the present study, they had paths from traditional combat. Hence, the indirect effect for traditional combat was a composite that incorporated its powerful direct influences on atrocities–abusive violence and malevolent environment. As with the King et al. study, malevolent environment was also quite influential. Additional investigation of combat-related PTSD using multifaceted conceptualizations of war-zone stressors seems fitting, and multiple stressor dimensions might prove beneficial to PTSD research with other populations.

Implications for Clinical Practice

The findings of the study underscore the enduring potency of highly stressful war-zone experiences in the diagnosis and treatment of combat-related PTSD. They also indicate that prewar factors cannot be discounted in attempting to understand and confront the symptomatology exhibited by Vietnam veterans.

One specific implication of the findings to clinical practice involves the link between childhood antisocial behavior and atrocities–abusive violence in the model for men. The direct path from the former to the latter was quite negligible, and the effect was negative. Therefore, contrary to the hypothesis that veterans involved in atrocious acts in the war zone did so as an extension of adolescent behavior problems, the connection appears more complicated. Instead, the impact of childhood antisocial behavior was apparently mediated by exposure to traditional combat. Thus, the clinician must guard against attributions about previous personality determining involvement in atrocities or episodes of abusive violence.

Family instability was noteworthy in the model for both genders, and previous trauma history seemed quite important in the model for men. Actually, both of these variables reflect a common theme of early exposure to stressful conditions, and both bear examination in clinical practice with PTSD clients. Because family instability included indicators of domestic violence and severe corporal punishment, careful attention should be directed toward possible abusive conditions within the veteran's family of origin. The salience of previous trauma history likewise calls for consideration of extrafamilial traumatic experiences, such as serious accidents, natural disasters, or victimization. An assessment or inventory of traumatic events over the course of the individual's early life should be administered and developmental ramifications examined. Treatment needs to incorporate the recognition of possible multiple traumas, and clinicians should be aware that events in the war zone may have had different meanings for those with and without previous exposure to highly stressful life events.

Finally, a comprehensive evaluation of war-zone experiences seems necessary. The assessment needs to include not only the more objective circumstances or events that the veteran may have faced (traditional combat activities or exposure to atrocious situations considered beyond "normal" combat) but also an assessment of if and to what extent the veteran perceived the experiences as threatening to well-being or survival. Also, it may be important to explore the manner in which the veteran addressed generally harsh or malevolent war-zone surroundings; it may be that lower magnitude circumstances created day-to-day pressures or irritations that cumulatively contributed to stress reactions in the war zone or later dysfunction. Furthermore, the study's findings suggest that the effects of the more objective, verifiable war-zone experiences may be filtered through the more subjective dimensions of perceived threat and malevolent environment. Hence, the clinician may wish to probe these connections to gain a better grasp of the veteran's construal of the overall Vietnam milieu.

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