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An Etiological Model of Attempted Suicide Among Vietnam Theater Veterans

Prospective Generalization to a Treatment-Seeking Sample

ALAN FONTANA, PH.D.,[1,2] AND ROBERT ROSENHECK. M.D.[1,2]

The etiology of attempted suicide was investigated using both retrospective and prospective data from 402 Vietnam theater veterans who were receiving treatment in the Department of Veterans Affairs Posttraumatic Stress Disorder Clinical Teams Program. An etiological model that was developed previously for a community sample of Vietnam theater veterans was examined for its generalizability to this treatment-seeking sample. Structural equation modeling was used to first determine the similarity of significant paths in the treatment-seeking and community samples, and then to examine the applicability of the community-based model to the treatment-seeking sample. The community-based model achieved a very high fit with reasonably good parsimony with the treatment-seeking data. Causal paths in the treatment-seeking sample mirrored those in the community sample in that psychiatric symptoms (including posttraumatic stress disorder) were the sole factors contributing directly to attempted suicide. Traumatic military experiences played a substantial role, but only indirectly as they contributed to the development of psychiatric symptoms. The similarity of findings for previous and subsequent attempts eliminated a possible ambiguity in the direction of causation modeled for previous attempts.

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Initial reports of an extraordinarily high rate of suicide among Vietnam veterans have been found to overestimate the actual rate (Pollock et al., 1990). The suicide rate among those who served in Vietnam may still be greater, however, than the rate for a matched control population. In view of the personal tragedy represented by suicide and the high level of public concern for the welfare of Vietnam veterans, an examination of suicidal behavior and its etiology in this population is of pressing clinical and social significance.

Although war zone stress in general and posttraumatic stress disorder (PTSD) in particular would seem to be likely causes of suicide, recent studies have failed to find any military service factor or PTSD to be associated directly with completed or attempted suicide among Vietnam veterans (Farberow et al., 1990; Fontana and Rosenheck, in press). In one of these studies (Fontana and Rosenheck, in press), structural equation modeling was used to develop an etiological model of attempted suicide in the community sample of Vietnam veterans surveyed by the National Vietnam Veterans Readjustment Study (Kulka et al., 1990). General psychiatric disorders were the only factors found to contribute directly and significantly to making a suicide attempt. Traumatic exposure in the military played an indirect role through its contribution to the development of general psychiatric disorders.

Several nonmilitary elements have been reported in the literature to be associated consistently with attempted and/or completed suicide. Specifically, higher rates of suicide have been reported for people who, during their childhood or adolescence, were physically and/or sexually abused (Green, 1978), engaged in antisocial behavior (Shaffer, 1974), and were raised in an unstable family (Batchelor and Napier, 1953). In addition, higher rates of suicide have been reported for whites (Buda and Tsuang, 1990), for those lacking social support (Hart and Williams, 1987), for those psychiatrically distressed (Dorpat and Ripley, 1960), and for those abusing alcohol (Barraclough et al., 1974) and/or drugs (Ward and Shuckitt, 1980).

Multiple regression analysis has often been used as a statistical technique in an attempt to determine a predominant set of contributors. This technique has an inherent limitation, however, which precludes a clear resolution, namely, an inability to allocate shared variance with a dependent variable among the independent variables. Multiple regression analysis is less than an optimal analytical strategy for another reason as well.

[1] Northeast Program Evaluation Center (182), Evaluation Division of the National Center for Posttraumatic Stress Disorder, Veterans Administration Medical Center, 950 Campbell Avenue, West Haven, Connecticut 06516. Send reprint requests to Dr. Fontana.

[2] Department of Psychiatry, Yale University School of Medicine, New Haven, Connecticut.

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It does not provide a rationale for evaluating the associations among subsets of variables in terms of their causal possibilities.

Structural equation modeling is a statistical and conceptual extension of multiple regression analysis (James et al., 1982). Statistically, total effects can be partitioned into those that are direct or unmediated by any other variable, and those that are indirect or mediated by one or more variables. Conceptually, a model of causation can be specified that serves as a map to the theoretical selection of variables to be included in each equation. Although structural equation modeling is not designed to test actual causation experimentally, it is a powerful tool for evaluating the probability that causal propositions are valid within the limits of nonexperimental data.

In this article, we use structural equation modeling to examine the generalizability to a treatment-seeking sample of an etiological model of attempted suicide that was derived from a community sample. Of particular interest in this examination is whether the etiological role of traumatic military exposure would again be found to be mediated by psychiatric symptomatology. The data from the treatment-seeking sample have another advantage as well. In addition to attempted suicide in the past, data are available on attempted suicide in the year following initial data collection. It is possible, therefore, to determine whether the modeling of attempted suicide when it was measured prospectively would confirm the results when it was measured retrospectively.

Methods

Sample

A total of 476 Vietnam theater veterans who sought outpatient treatment from the Department of Veterans Affairs' PTSD Clinical Teams Program during 1990 and 1991 were surveyed extensively as one component of a comprehensive, nationwide program evaluation (*cf.*, Fontana et al., 1990). Vietnam theater veterans are those who served in Vietnam or its surrounding waters or airspace for some period of time from 1964 to 1975. All eligible veterans were entered into the evaluation consecutively during this period. These data were collected at subset of six sites in the program: Boston, MA, Jackson, MI, Kansas City, MO, New Orleans, LA, Providence, RI, and San Francisco, CA.

The 402 veterans who provided complete data were selected for data analysis (see below for a comparison with dropped veterans). Due to the extremely small number of women applying for treatment, only men are represented in the sample. They averaged 42.8 (SD = 2.9) years of age and 13.0 (SD = 2.3) years of education. Forty-seven percent were currently married, 31% were divorced, 9% were separated, and 12% were never married. Ethnically, 71% were white, 25% were black, 1% were Hispanic, and 3% were other minorities. Diagnostically, 77.5% met DSM-III-R criteria for current PTSD (American Psychiatric Association, 1987). Veterans from these six sites were comparable to those from the other 38 sites in the program at the time with respect to age, years of education, marital status, PTSD diagnosis, exposure to combat, and participation in abusive violence. Although there was no difference in the percentages of white and minority veterans taken as a whole, the six sites had proportionally more black veterans (25% *vs.* 16%) and proportionally fewer Hispanic veterans (1% *vs.* 11%).

Within the study sample, veterans with complete data were compared with those with missing data on the demographic variables that are described above and on the 18 variables included in the models examined in the study. Demographically, the groups differed significantly only in marital status, with more of the included veterans being married and fewer separated and divorced ($\chi^2 = 9.98$, $df = 4$, $p < .05$). Of the model variables, the included veterans came from less unstable families ($t = 2.06$, $df = 469$, $p < .05$) and were less abusing of alcohol ($t = 3.19$, $df = 473$, $p < .01$). Included and omitted veterans did not differ significantly on any of the other demographic or model variables.

Measures

The data were obtained by means of the War Stress Interview, a three-section battery of standardized instruments and specially constructed items which consists of two structured interview sections and one questionnaire section (Fontana et al., 1990). One interview section was administered by clinicians at intake, and the other two sections were administered by specially trained evaluation assistants shortly after intake. Evaluation assistants followed up veterans' adjustment for 1 year after they began treatment.

Premilitary Risk Factors and Traumas. BLACK ethnicity (mean ± SD) (.26 ± .44) and childhood physical or sexual abuse (ABUSE; .15 ± .36) were dichotomous items. Family instability (FAM INST) was measured by the Family Stability Scale (Kadushin et al., 1981), the sum of 11 dichotomous items covering experiences before the age of 18 (2.97 ± 2.10). Eleven behaviors indicative of a conduct disorder before the age of 15 (COND DIS) were taken from the list compiled by Helzer et al. (1987) (1.44 ± 1.92).

War-Related Traumatic Exposure and Adjustment to the Military. Combat was measured by two scales: the Revised Combat Scale (Laufer et al., 1981; REV COM; 10.69 ± 2.88) and the Combat Exposure Scale (Keane et al., 1989; EXP COM; 28.16 ± 9.24). They correlated .69 with each other in the present study.

Therefore, a latent variable of COMBAT was generated in the model to represent this category of traumatic exposure. Participation in abusive violence (PARTICIP) was measured by structured interview to the item: "During wartime, soldiers are sometimes given orders or pressured into doing things that they thought were morally wrong. Some vets have reported that they either saw or did things that other people would consider to be *excessively* violent or brutal, even in wartime. Did you ever observe or participate yourself in doing any of these kinds of things (*e.g.*, atrocities: torturing prisoners, mutilating enemy bodies, harming civilians)?" Participation was coded dichotomously (.33 ± .47). Receipt of a disciplinary action (DISCIP) was measured dichotomously by structured interview to the item, "Did you ever receive any disciplinary actions while you were serving in a war zone, such as a demotion, an Article 15 (punishment from the company commander), or a court martial" (.53 ± .50). Non-war-related traumatic exposure during the military was coded dichotomously (NONMIL; .53 ± .50).

Postmilitary Disorders and Traumatic Exposure. Psychiatric symptoms (PSYCH) were measured by two instruments: the Mississippi Scale for Combat-Related PTSD (125.13 ± 21.13; Keane et al., 1988) and the Global Severity Index (2.17 ± .81) of the Brief Symptom Inventory (Derogatis and Melisaratos, 1983). These two scales correlated .82 with each other in the present study. Therefore, a latent variable of PSYCH was generated in the model to represent severity of psychiatric symptoms. Substance abuse (SUB ABUSE) was measured by two instruments: the CAGE index for alcohol abuse (ALCOHOL; 1.04 ± 1.46; Ewing, 1984) and the Diagnostic Interview Schedule screener for drug abuse (DRUG; .50 ± .92; Vernez et al., 1988). The two instruments correlated .36 with each other and were modeled as a latent variable of SUB ABUSE.

Lack of support was measured by three items which were coded in the direction of low support. These were the availability of someone from whom to get a loan (LOAN; 7.92 ± 1.53), someone from whom to get a ride (RIDE; 7.85 ± 1.66), and someone with whom to discuss the war (WAR; 8.00 ± 1.52). These items were modeled as manifest indicators of a latent variable of lack of support (LOW SUPP). Postmilitary traumatic exposure (POSTMIL) was measured dichotomously from the same list of traumas as those that comprised the non-war-related traumas during the military (.94 ± .24).

Attempted Suicide. Previous suicide attempt (PREV SUICATT) was a dichotomous variable that was coded positively if the veteran reported making an attempt prior to beginning treatment (.33 ± .47). Subsequent suicide attempt (SUBSEQ SUICATT) was a dichotomous variable that was coded positively if the veteran or his clinician reported that he made an attempt during the year following entry into treatment (.11 ± .31). Two of these attempts resulted in completed suicides.

Specification of the Model

The model was specified and estimated in three stages. In the first stage, the initial model from the community-based sample was applied to previous suicide attempts in the treatment-seeking sample. This was done to determine the similarity of significant paths across the two samples using the same outcome measure. In the initial model, causation among sets of variables was specified according to the period in which each set occurred historically. Of particular interest was whether there was a significant direct path between psychiatric symptoms and suicide attempts and an absence of significant direct paths between both substance abuse and social support and suicide attempts. Also of particular interest was the presence of an indirect effect for traumatic war exposure that was mediated through psychiatric symptoms.

The second stage involved applying the reduced model from the community sample to previous suicide attempts in the treatment-seeking sample. The initial model in the community sample had been reduced by specifying only the significant paths in both a development sample and a cross-validation sample (Fontana and Rosenheck, in press). The purpose of this stage was to determine whether there was any improvement in parsimony (without a major erosion of fit) that would be achieved by applying the most preferable model of etiology in the community sample. The reduced community model specifies causal paths between black ethnicity and both disciplinary action and traumatic exposure postmilitary; between family instability and both disciplinary action and lack of support; between childhood abuse and lack of support; between antisocial behavior and both disciplinary action and substance abuse; between combat exposure and participation in abusive violence, lack of support, and psychiatric symptoms; between participation in abusive violence and psychiatric symptoms; between nonmilitary traumatic exposure while in the military and psychiatric symptoms; between disciplinary action and substance abuse; and between psychiatric symptoms and attempted suicide.

In the third stage, the reduced model from the community sample was applied to subsequent suicide attempts in the treatment-seeking sample. The purpose of this stage was to determine whether results similar to those obtained in stage 2 would be obtained when attempted suicide was measured prospectively and when it was measured retrospectively.

Data Analyses

Statistically, the adequacy of a model can be judged from its fit and its parsimony. Fit signifies the extent to which the values estimated by the model correspond to the actual values in the data set. In the extreme, where the maximum number of parameters are estimated (that is, where the degrees of freedom are zero), fit is necessarily perfect and is therefore meaningless. What is desirable, therefore, is to achieve a high degree of fit with the estimation of as few parameters as possible. In this way, the parsimony of the model is optimized. Parsimony indices essentially adjust the goodness of fit achieved for the degrees of freedom that were used to achieve it.

For fit, we have selected the root mean square residual (RMR) and Bentler's (1990) comparative fit index (CFI). The RMR provides an indication of how well competing models within a nested set estimate the parameters relative to the actual parameters. The limitation to the RMR is that its values have meaning only within the particular set of models under consideration. The CFI ranges between 0 and 1.00, with higher values signifying better fit. Values of the CFI are generalizable across different models.

For parsimony, we have selected the consistent information criterion (CIC) (Bozdogan, 1987) and the parsimonious fit index (PFI; James et al., 1982). The CIC represents the amount of information accounted for by the model relative to the degrees of freedom needed to account for it. The larger the negative value of the CIC, the more parsimoniously the model captures information. The PFI is essentially an adjustment of the fit index for the degrees of freedom used to attain the fit. It ranges from 0 to 1.00, with higher values indicating greater parsimony.

Each overall model is composed of a measurement model and a structural equation model. The measurement model generates latent variables that are assumed to underlie and to give rise to specific observable indicators that can be measured. In the present model, REV COM and EXP COM are specified to be observable indicators of an underlying dimension of COMBAT exposure, Mississippi Scale for Combat-Related PTSD and Brief Symptom Inventory scores are specified to be observable indicators of an underlying dimension of PSYCH symptoms, ALCOHOL and DRUG are specified to be observable indicators of SUB ABUSE, and LOAN, RIDE and WAR are specified to be observable indicators of an underlying dimension of LOW SUPP.

The structural equation model specifies the causal paths that are posited to exist between exogenous and endogenous variables and among the endogenous variables themselves. In the present model, the four premilitary variables are exogenous variables whose causation lies outside the scope of the model. These variables are posited to affect war-related and nonmilitary war zone experiences, psychiatric disorders, lack of support, postmilitary traumatic exposure, and attempted suicide. Noncausal associations among the exogenous variables were included in the statistical evaluation of the model, but, in the interests of clarity of exposition, these associations are not diagrammed in Figure 1. War zone experiences, psychiatric disorders, lack of support, postmilitary traumas, and attempted suicide are endogenous variables that are posited to have been caused by the exogenous variables and the antecedent endogenous variables.[3]

Prior to estimating the model's parameters, the data were checked for outliers. No extreme values were detected that necessitated deletion from the sample. The kurtosis was also examined for each variable. Kurtosis refers to the peakedness or flatness of a distribution relative to the shape of a normal distribution. None of the variables' distributions could be made to approximate this more closely by a logarithmic transformation. Examination of the multivariate kurtosis (Mardia, 1970) revealed that the distribution was substantially more peaked than normal, thereby making an assumption of multivariate normality unjustifiable for analytic purposes. Therefore, we selected generalized least squares for the method of model parameter estimation, because it does not depend upon such an assumption. For model parameter estimation, we used the CALIS procedure of the SAS software package (SAS Institute, 1990).

Results

Generalized least squares estimation was performed on the variance-covariance matrices of the model variables. The first stage was to determine the adequacy of the initial model for previous suicide attempts (χ^2 = 125.24, 78 *df*, $p < .0006$). The RMR of .058 and the CFI of .995 indicate that the initial model achieved a very high degree of fit. Concomitantly, the CIC of −420 and the PFI of .503 reveal that the parsimony of the fit was moderately good.

The second stage was to compare the adequacy of the reduced model (χ^2 = 191.47, 121 *df*, $p < .0001$) to the initial model for previous suicide attempts. The RMR increased slightly to .076, but there was virtually no erosion of the CFI at .992. There was a major improvement in the parsimony with which this same level of fit was attained, however, with a CIC of −655 and a PFI of .775.

The third stage was to compare the adequacy of the reduced model for subsequent suicide attempts (χ^2 = 184.87, 121 *df*, $p < .0001$) to the reduced model for

[3] Bivariate correlations among the variables in the model are available from the authors.

previous suicide attempts. All indices of fit (RMR = .74 and CFI = .993) and parsimony (CIC = −662 and PFI = .775) were virtually identical for subsequent and previous suicide attempts.

In addition to fit and parsimony of the model as a whole, the significant direct paths among variables were of crucial relevance to the generalizability of the community-based model. The initial model had nine significant paths in common between the community and treatment-seeking samples for previous suicide. Especially important was the fact that there was a significant path from psychiatric symptoms to suicide attempts, and no significant paths from substance abuse or social support to suicide attempts. Important also was the fact that there were significant paths from combat exposure and participation in abusive violence to psychiatric symptoms, but no significant direct paths from these trauma variables to suicide attempts. Thus, the same general pattern of significant causation, including the most critical paths, was found in the treatment-seeking sample as in the community sample.

The reduced model has seven significant direct paths in common between the community and treatment-seeking samples for both previous and subsequent suicide attempts. Again, psychiatric symptomatology was the only factor to contribute significantly to suicide attempts directly. In turn, psychiatric symptoms were affected by combat exposure and participation in abusive violence. Combat exposure also contributed to participation in abusive violence and to low social support after the military. Childhood conduct disorder led to disciplinary problems in the military, which in turn contributed to substance abuse after the military.

The reduced model with its path (standardized regression) coefficients is diagrammed for subsequent suicide attempts in Figure 1. Nonsignificant path coefficients are signified by parentheses. The small arrows that are attached to each variable but do not proceed from another variable indicate the disturbance (that is, the proportion of variance unaccounted for by the model) associated with each variable. In the interests of economy of space, this is the only version diagrammed. It was selected because it represents the most generalizable representation of the etiology of attempted suicide among Vietnam theater veterans and the endpoint of our study.

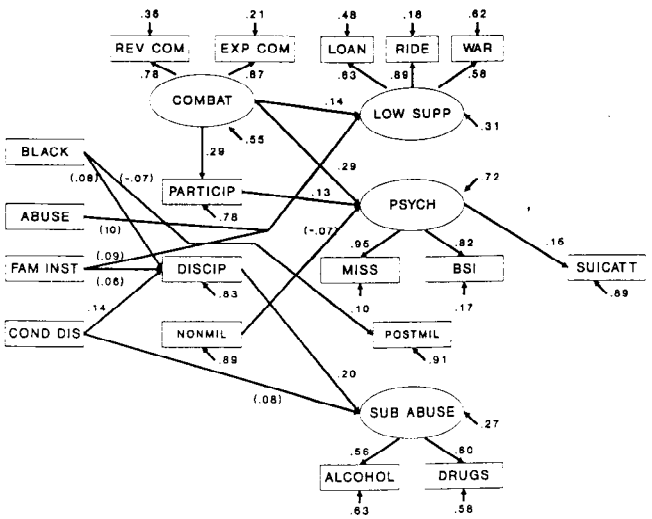

FIG. 1. Community-based model of the etiology of subsequent suicide attempts among treatment-seeking veterans. Nonsignificant path coefficients are in parentheses.

The reduced model accounted for 18% of the variance in previous suicide attempts and 11% of the variance in subsequent suicide attempts. These have been classified by Cohen (1988) as small to medium-size effects. The total effects accounted for by the model can be partitioned among the individual variables to determine their relative contributions. The total effects for each variable are presented in Table 1 for each of the three versions of the model. Combat exposure and participation in abusive violence together account for 20% of the total effects in the initial model for previous suicide attempts, and 36% of the total effects in each of the reduced models for previous and subsequent attempts.

The measurement model within the reduced model indicates that the latent variable, COMBAT, is highly saturated with variance from both combat scales, with loadings of .78 and .87. LOW SUPP is moderately saturated with variance from its manifest indicators, with

TABLE 1
Total Effects on Previous and Subsequent Attempted Suicide According to Initial and Reduced Models

	Model		
	Initial previous attempt	Reduced previous attempt	Reduced subsequent attempt
Premilitary			
Black ethnicity	−.06	.00	.00
Childhood abuse	.16	.00	.00
Conduct disorder	−.02	.00	.00
Family instability	.01	.00	.00
Sum	.09	.00	.00
Military			
Combat exposure	.02	.11	.06
Participation in abusive violence	.11	.03	.02
Nonmilitary trauma	.00	−.02	−.01
Disciplinary action	.08	.00	.00
Sum	.21	.12	.07
Postmilitary			
Psychiatric symptoms	.28	.27	.15
Substance abuse	.06	.00	.00
Low support	.05	.00	.00
Postmilitary trauma	−.04	.00	.00
Sum	.35	.27	.15
Total Sum	.65	.39	.22

loadings of .63, .89, and .58. PSYCH is highly saturated with variance from its indicators, with loadings of .95 and .82. Finally, SUB ABUSE is moderately saturated with variance from its indicators, with loadings of .63 and .58.

Discussion

Results from the treatment-seeking sample replicate those from the community-based sample in identifying psychiatric symptoms as the direct contributor of predominant importance to making a previous suicide attempt. This replication was obtained when all factors were specified as possible contributors in an initial, relatively unrestricted model, and when only the significant factors from the community-based model were specified as contributors in a reduced model. Further, the possibility that the direction of causation between psychiatric symptoms and making a previous suicide attempt might be the reverse of that modeled was addressed by the replication of results for making a subsequent suicide attempt. The community-based model suggests, further, that *among* psychiatric symptoms, those associated with general psychiatric disorders are more influential than PTSD symptoms (Fontana and Rosenheck, in press).

The community-based model achieved a very good fit to the treatment-seeking sample and with very respectable parsimony. As such, it represents a robust and generalizable picture of the etiology of attempted suicide among Vietnam theater veterans. Combat exposure and participation in abusive violence contribute to making a suicide attempt, but only indirectly as each contributes to the development of psychiatric symptoms. Combat exposure and participation in abusive violence accounted for 36% of the total effects for both previous and subsequent suicide attempts. Thus, although the influence of military trauma was indirect, it was of substantial magnitude.

While the actuarial prediction of suicide attempts was not the goal of this study, the applicability of the results to prediction is of relevance to the pressing demands of clinical practice. Although the amount of variance accounted for in attempted suicide is modest indeed, the model suggests that clinicians should focus on and give most weight to the severity of psychiatric symptoms in their decisions regarding risk of suicide. In supplemental analyses, we included thoughts of suicide during the 30 days prior to beginning treatment in our model of subsequent suicide attempts. Those analyses indicated that thoughts of suicide superseded psychiatric symptoms in importance, but the former only accounted for an additional 2% of the variance. Addition of a specific question regarding suicidal thoughts, therefore, aids prediction, but the overall power of predicting suicide attempts prospectively is still quite low.

To a great extent, the modest amount of variance in attempted suicide that is accounted for by our model reflects the rudimentary nature of the extent of knowledge concerning the causes of suicide. The identification of more powerful predictors still awaits this field of study. We believe that our model has value, however, both as an indication of the indirect nature of the etiological role of traumatic wartime experiences and as a heuristic framework for progressively filling in the missing pieces as more research findings and more inclusive data become available.

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