Construct Validation of the

Posttraumatic Stress Disorder (PTSD) Concept

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Abstract

The goal of this study was to investigate the reliability and construct validity of the posttraumatic stress disorder (PTSD) concept. The reliability of PTSD was tested with a series of factor analyses while the construct validity of PTSD was tested with a series of regression analyses. The results of the confirmatory factor analyses provided evidence to support the internal consistency of the PTSD concept. The number of factors varied with the type of instrument used to measure PTSD, but within and between batteries the factor correlations were quite high. The DSM-III organization of PTSD criteria fit the data better than the DSM-III-R organization of PTSD. In addition, the factor structure of the PTSD items was invariant across subjects who had been exposed to combat stress and subjects who had not been exposed to combat stress.

The regression analyses provided evidence for the construct validation of the PTSD concept. PTSD was associated with pre-military measures of cognitive abilities and psychological functioning. Military measures of combat exposure and herbicide exposure also predicted PTSD. Finally post-military measures of psychological functioning and social support predicted measures of PTSD after controlling for both pre-military and military predictors.

The Keane-PTSD-R scale developed from the MMPI differentiated between 1) subjects with current PTSD and subjects with PTSD in remission and 2) subjects with delayed-onset PTSD and non-delayed-onset PTSD. The results are discussed in terms of current theoretical models used to describe the etiology of PTSD.

Table of Contents

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List of Tables

List of Appendices

List of Figures

Construct Validation of the Posttraumatic Stress Disorder (PTSD) Concept

Chapter I.

Posttraumatic stress disorder (PTSD) as a specific diagnostic category first appeared in the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III; American Psychiatric Association, 1980) and has evolved as a very loosely defined clinical category. The term PTSD has been used to describe symptoms related to a variety of stressful life events including combat (Atkinson, Sparr, Sheff, et al., 1984; Foy, Sipprelle, Rueger, & Carroll, 1984; Keane, Caddell, & Taylor, 1988), civilian shooting attacks (North, Smith, & Spitznagel, 1994), rape (Cohen & Roth, 1987), torture (Basoglu, Paker, Paker, et al., 1994), urban environments (Breslau, Davis, Andreski, & Peterson, 1991), floods (Erickson, 1979), fires (McFarlane, 1989), and nuclear disasters (Davidson, & Baum, 1986). Common developmental patterns associated with PTSD include symptoms of re-experiencing the traumatic life event and/or avoiding events that may remind the person of the traumatic event (Barlow, 1988).

DSM Criteria for PTSD

In DSM-III, PTSD was defined by four diagnostic criteria: (1) "Existence of a recognizable stressor that would evoke significant symptoms of distress in almost anyone." (2) "Re-experiencing of the trauma as evidenced by at least one" out of three symptoms, (3) "Numbing of responsiveness to or reduced involvement with the external world beginning some time after the trauma, as shown by at least one" out of three symptoms, and (4) "At least two of the following" six arousal type symptoms "that were not present before the trauma." (See Appendix 1).

In the Revised Diagnostic and Statistical Manual of Mental Disorders (DSM-III-R; American Psychiatric Association, 1987), the definition of PTSD includes five diagnostic criteria (1) "The person has experienced an event that is outside the range of usual human experience...," (2) "The traumatic event is persistently re-experienced in at least one" out of four symptoms. (3) "Persistent avoidance of stimuli associated with the trauma or numbing of general responsiveness, as indicated by at least three" out of seven symptoms, (4) "Persistent symptoms of increased arousal as indicated by at least two" out of six symptoms, and (5) "Duration of the disturbance of at least one month." (See Appendix 2).

The definition of PTSD in the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association, 1994) includes 6 diagnostic criteria: (1) The person has been exposed to a traumatic event that a) "involves actual threatened death or serious injury" and b) evokes "intense fear, hopelessness or horror.", (2) the traumatic event is persistently re-experienced, (3) persistent avoidance and associated numbing of responsiveness, (4) persistent increased arousal, (5) duration of symptoms is greater than one month, and (6) the disturbance results in "clinically significant distress or impairment of social or occupational" functioning.

In Table 1, the six conceptual changes that occurred between DSM-III to

Table 1

Revisions in the Criteria for PTSD between DSM-III and DSM-III-R

1. Survival Guilt was dropped.
2. Memory Impairment was split into two items.
   a) Inability to Recall Aspects Related to Trauma was moved from the Arousal symptom cluster to the Avoidance symptom cluster
   b) Memory Impairment remained under the Arousal symptom cluster.
3. Avoids Activities was split into two items.
   a) Avoids Thoughts/Feelings related to Trauma was moved from the Arousal symptom cluster to the Avoidance symptom cluster.
   b) Avoids Thoughts/Activities that Arouse Recollection of Trauma was moved from the Arousal symptom cluster to the Avoidance symptom cluster.
4. Certain Events Intensify Symptoms was moved from the Arousal symptom cluster to the Re-experience of Trauma symptom cluster.
5. Sense of Foreshortened Future was added to the Avoidance symptom cluster.
6. Three new items were added to the Arousal symptom cluster: Irritable or Outbursts of Anger, Hypervigilance, and Psychological Reactivity when exposed to Related Events.

DSM-III-R are presented. Although the changes appear relatively minor, they involve conceptual differences that ideally should be motivated by empirical findings. The DSM-III and DSM-III-R PTSD criteria can be organized as theoretical factor models and they can be tested as confirmatory factor models with the appropriate data. In Figure 1a, one potential factor structure for the DSM-III PTSD symptoms is presented. The three symptom clusters each form separate factors and the factors are allowed to correlate through their association with the second order factor, labeled PTSD. In Figure 1b, a factor structure for the DSM-III-R symptoms is presented. Although the first order factors are given the same general labels for both the DSM-III and DSM-III-R criteria, the items used to measure the constructs are rather different. To insure the reliable, and hence valid measurement of PTSD, more studies should examine the specific factor structures implied by the set of defining DSM criteria.

Measurement of Psychological Constructs

Crocker & Algina (1986) list five measurement problems common to most psychological constructs: (1) no single measurement scale has been accepted as the sole measurement tool for a construct by all researchers; (2) psychological measurements are often limited in their ability to sample behaviors from the domain they purport to measure; (3) error of measurement exists in most measurement scales; (4) the units of measurement are usually poorly defined and (5) most psychological constructs have not been adequately tested for construct validity. These general measurement issues have been visible throughout the PTSD literature. Keane, Wolfe,

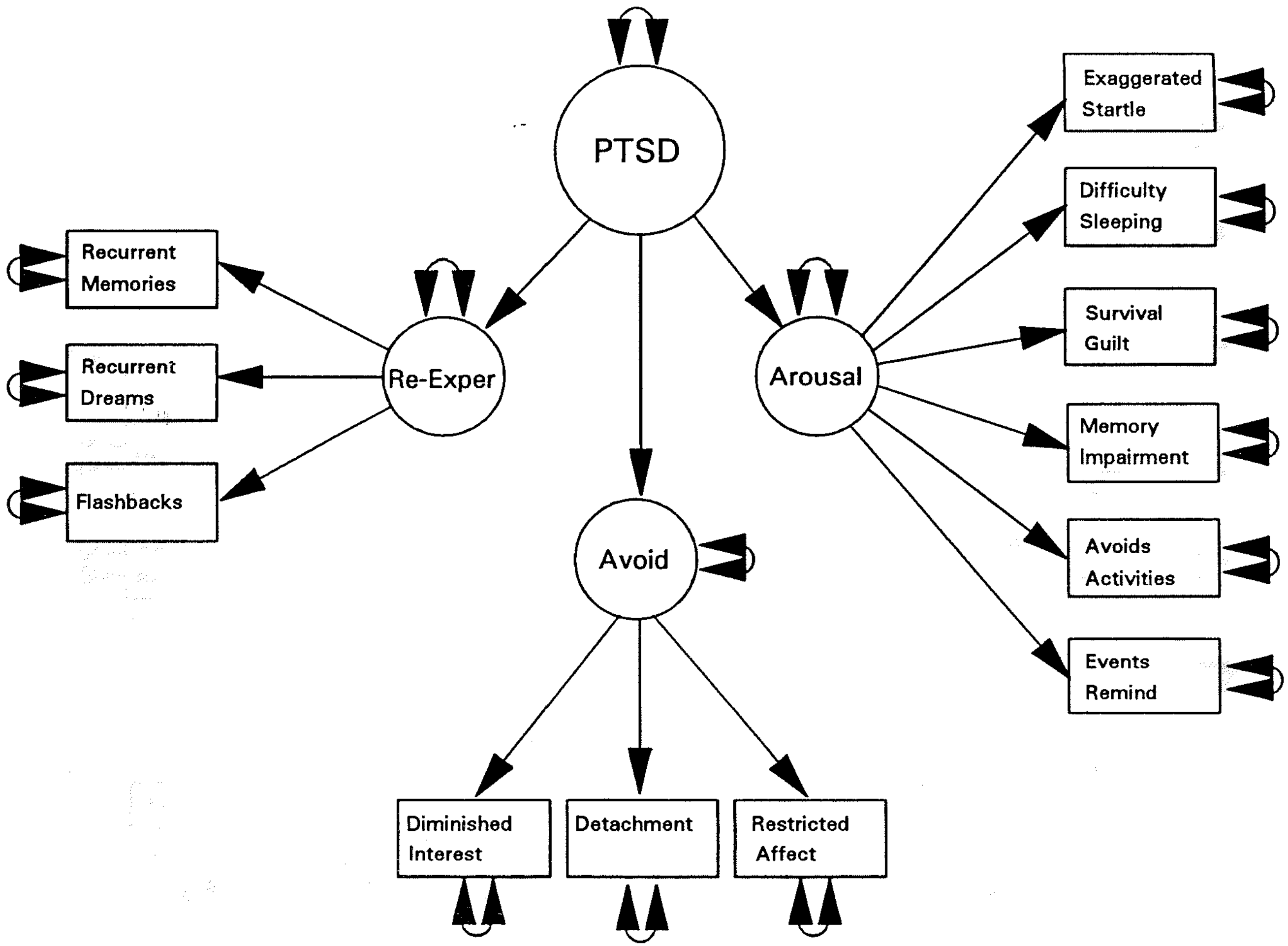


Figure 1a: A Path Model for DSM-III Criteria for PTSD

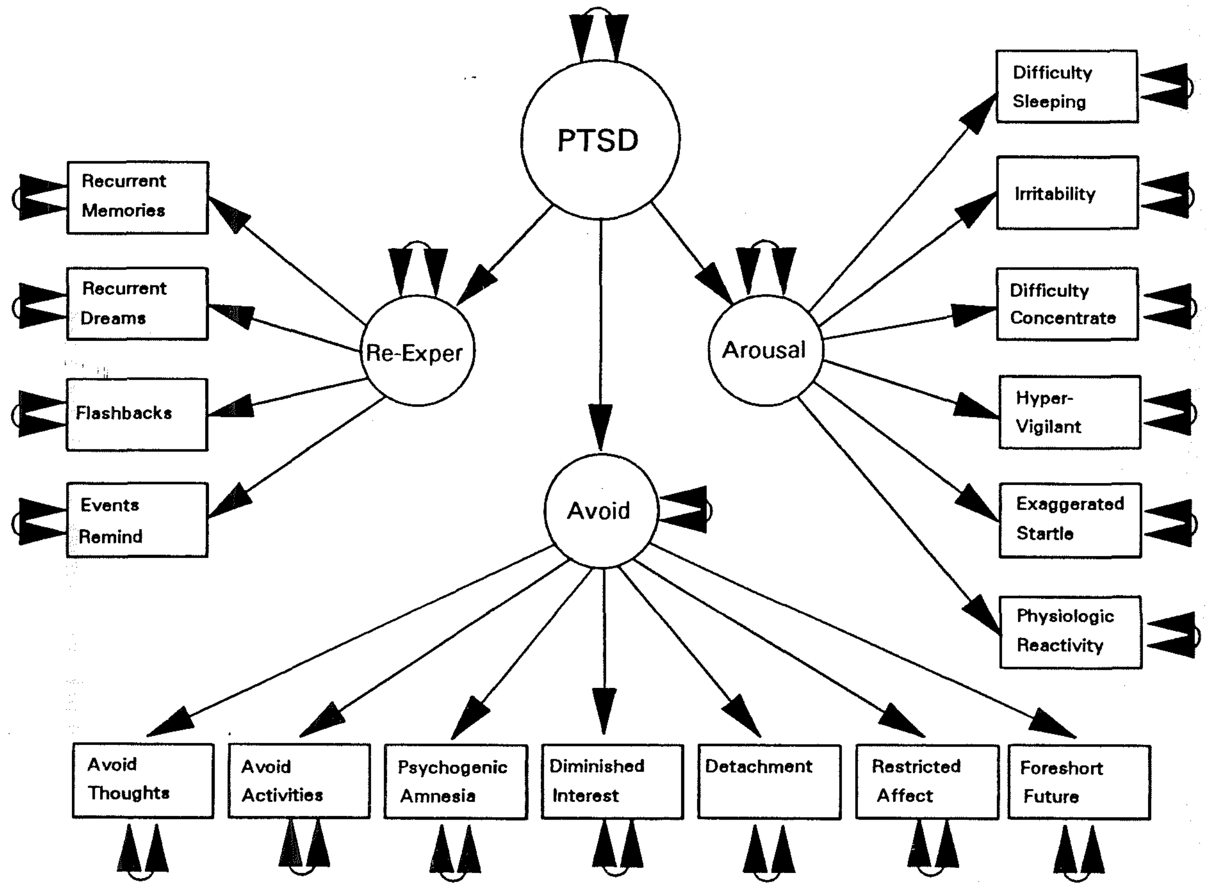


Figure 1b: A Path Model for DSM-III-R Criteria for PTSD

& Taylor (1987) recommended a multiaxial approach to the measurement of PTSD. Included in this approach is the use of (1) structured clinical interviews, (2) traditional psychometric measures, and (3) psychophysiological assessment. While there are numerous purported psychometric measures of PTSD, few of these measures have been adequately tested for internal consistency or external validity. The internal consistency of a battery of items purporting to measure a syndrome is frequently tested with factor analytic techniques (Cattell, 1964; Crocker & Algina, 1986). If a construct does not show adequate internal consistency (traditionally referred to as internal reliability, see Cronbach & Meehl, 1955), it is very difficult to study the construct in relation to other issues, such as etiological heterogeneity, that may confound the construct of interest.

Review of Factor Analytic Studies of PTSD Symptoms

Slater's Factor Analytic Study of "PTSD" (1943). Slater (1943) was the first individual to test theories regarding the internal consistency of "PTSD" with factor analytic methods. Slater wanted to determine what types of background characteristics best described the "neurotic constitution" associated with PTSD like symptoms. Using a principal components factor solution, he determined that positive family history for psychopathy, childhood neurosis, and abnormal personality had the highest loading on a neurotic constitution factor (see Table 2). Slater also hypothesized that higher levels of neuroticism were associated with lower levels of intellectual abilities but the results were not conclusive.

The Factor Structure of the Impact of Events Scale. The Impact of Events

Table 2

PCA for World War II veterans (Slater, 1941)

	Neurotic Constitution	Inadequate Intelligence
Positive Family History	.59	-.05
Childhood Neurosis	.66	.02
Poor Work Record	.43	.59
Previous Nervous Breakdown	.23	-.08
Abnormal Personality	.82	.11
Poor Intelligence	.13	.49

Note: Values presented in table are standardized factor loadings.

Scale (Horowitz, Wilner, & Alvarez, 1979) has frequently been used to measure PTSD. The IES is a 15 item scale that theoretically measures two constructs: intrusion and avoidance. The items that comprise the scale are based on four point Likert scales. Recently, Zilberg, Weiss, & Horowitz (1982) explored the factor structure of the IES with 72 subjects who had experienced the recent death of a close relative. A principal factor analysis was performed and a two factor solution was retained. The solution corresponded closely to the hypothesized IES constructs (see Table 3).

In an attempt to replicate the findings of Zilberg et al. (1982), Schwarzwald, Solomon, Weisenberg, & Mikulincer (1987) tested three samples of veterans in Israel: (1) a combat stress reaction group, (2) a combat control group, and (3) a noncombat control group. A principal factor analysis with a varimax rotation was fit. Although the solution resulted in three factors with eigenvalues greater than one, the IES has frequently been used to measure PTSD, it was not

originally developed for that purpose. As a result, there are DSM-PTSD criteria that are not represented in the IES scale. This may result in the identification of fewer factors for the PTSD construct if studies are based solely on the IES. Similarly, the lack of appropriate items may hinder the accurate measurement of PTSD.

Table 3

Two Factor PCA for PTSD-related symptoms (Zilberg et al., 1982)

PTSD Symptoms	F1	F2
Avoided getting upset about it	.39	
Stayed away from reminders	.62	
Felt as if it hadn't happened	.52	
Tried to not talk about it	.71	
Still had unresolved feelings about it	.75	
Tried not to think about it	.86	
Feelings were numb about it	.71	
Thought about it when I didn't want to		.58
Tried to remove it from memory		.65
Trouble falling asleep/asleep		.56
Strong feelings about it		.75
I had dreams about it		.59
Pictures popped into my mind		.73
Other things reminded me of it		.70
Reminder of it brought back feelings		.66

Table 4

Two factor PCA for PTSD-related symptoms (Schwarzwald et al., 1987)

PTSD Symptoms	F1	F2
Avoided getting upset about it	.50	
Stayed away from reminders		.59
Felt as if it hadn't happened		.25
Tried to not talk about it		.67
Still had unresolved feelings about it	.66	
Tried not to think about it		.74
Feelings were numb about it		.34
Thought about it when I didn't want to	.69	
Tried to remove it from memory		.62
Trouble falling asleep/asleep	.70	
Strong feelings about it	.79	
I had dreams about it	.69	
Pictures popped into my mind	.85	
Other things reminded me of it	.81	
Reminder of it brought back feelings	.70	

The Factor Structure of the Mississippi Scale for Combat-Related PTSD. The Mississippi Scale for Combat-Related PTSD (M-PTSD) was first developed to define PTSD on a continuous scale (Keane et al. 1987). The M-PTSD "... is a 35-item scale that samples the domain of PTSD symptoms as they are delineated in the Diagnostic and Statistical Manual of Mental Disorders and also includes items for some of the frequently observed associated features." (Keane et al. 1988, p. 86). Ratings for each symptom are made by the patient on a 5-point Likert scale.

Keane, et al, (1988), were the first to study the factor structure of the M-PTSD. The subjects in their study were 362 male Vietnam-era veterans seeking services from outreach centers. An exploratory principal components analysis with a varimax rotation resulted in a six factor solution: (1) intrusive memories and depressive symptomatology; (2) interpersonal adjustment problems; (3) lability of affect and memory difficulties; (4) ruminative features; (5) interpersonal difficulties and (6) sleep difficulties. Eleven of the 35 items did not load onto any one factor according to their criteria for standardized factor loading of .50 or greater. This suggests that some of the items in the M-PTSD may not be psychometrically efficient. The total score for the M-PTSD was associated with a combat exposure scale (r=.25) but did not correlate with either age or educational attainment.

In another factor analytic study of the M-PTSD, McFall, Smith, Mackay & Tarver (1990) administered the M-PTSD scale to both Vietnam combat veterans (n=101) and substance abusing patients without combat-related PTSD (n=102). An exploratory principal components analysis with a varimax rotation resulted in a three factor solution: 1) re-experiencing/numbing-avoidance, 2) anger/lability, and 3) social alienation. The re-experiencing factor accounted for 46.3% of the overall variance while the last two factors accounted for only 9.7% of the variance in the items. Nine of the 35 items did not load onto any of the three factors using a minimum standardized loading of .50. As a result, the nine items were not used in estimating the subsequent factor scores. Similar to the findings of Keane et al. (1988), there was a statistically significant correlation between the total M-PTSD score and a measure of combat exposure. When factor scores were estimated for each factor and only the M-PTSD re-experiencing factor was associated with a combat exposure measure (r=.43). In the same study, the IES was also administered to the subjects. The IES intrusion factor had a statistically significant positive correlation with the M-PTSD re-experiencing factor score but the IES avoidance factor did not correlate with any of the three M-PTSD factor scores.

In the first reported longitudinal factor analysis of the M-PTSD, Hyer, Davis, Boudewyns, & Woods (1991) studied two samples of Vietnam Veterans diagnosed with PTSD. One sample (n=52) was administered the M-PTSD on two occasions (test-retest reliability = .66), while the other sample (n=95) was given the test just once. All 35 items of the M-PTSD were factored but only 10 of the 35 items demonstrated adequate psychometric characteristics over time. A principal components analysis with a varimax rotation was performed using the short-form scale (see Table 5). The first factor was labeled "Guilt" and the second factor "Numbing/Anger". Two of the three items that comprised the first factor had

Table 5

Two Factor PCA using Short-form of the M-PTSD (Hyer et al., 1991)

PTSD Symptoms	F1	F2
Guilt	.56	
Survival Guilt	.58	
Can't go on	.57	
People afraid of me		.72
Can't laugh/cry		.66
Enjoy others		.57
Frightened by urges		.57
Can't enjoy		.55
Explode over things		.48
Concentration		.41

similarly large loadings on the first factor in the McFall et al. (1990) study and the items for the second factor corresponded closely to the second factor in McFall et al. (1990) study.

In the most recent factor analytic study of the M-PTSD, Keane (1993) examined the factor structure of the M-PTSD in 68 combat veterans. A principal components analysis with a varimax rotation resulted in four factors with eigen values greater than one (see Table 6). The first factor included items related to re-experiencing and intrusion. The second factor appeared to measure symptoms of numbing/avoidance. The third factor was associated with impulse control while the fourth factor appeared to measure problems in concentration.

In summary, the M-PTSD appears to have demonstrated a certain amount of internal consistency. The re-experiencing/intrusion factor appears to be the most reliable factor structure across studies. Furthermore, there appears to be some evidence for the identification of additional factors but the factors are not yet well defined.

The Internal Consistency of PTSD with Structured Interviews. Most structured interviews are developed to be administered by lay individuals with minimal clinical training and a number of structured interviews have been developed specifically to measure PTSD. For example, Davidson, Smith, and Kudler, (1989) investigated a sample of 116 military Veterans (WWII N=37, Korea N=11, Vietnam N=68) who were all diagnosed with PTSD. All subjects were administered the structured interview for posttraumatic stress disorder (SI-PTSD) and the IES. The

Table 6

Four Factor PCA using M-PTSD (Keane, 1993)

PTSD Symptoms	F1	F2	F3	F4
Distress from events that remind	X			
Nightmares	X			
Intrusive thoughts	X			
Survivor guilt	X			
Daydreams	X			
Alienation/detachment	X			
Numbing/Avoidance		X		
Restricted affect		X		
Irritability and anger		X		
Arousal, vigilance		X		
Expression of feelings difficult		X		
Violence and aggression			X	
Suicide			X	
Frightening urges			X	
Diminished interest in activities				X
Concentration impairment				X
Alienation/estrangement from others				X

Note: 'X' represents a variable with a standardized factor loadings greater than .50

SI-PTSD scale contains 13 items that closely correspond to the DSM-III PTSD criteria and each item score ranges from 0 to 4 with a total score ranging from 0 to 52. Using the SI-PTSD, a principal components factor analysis with a varimax rotation revealed three factors with eigen values greater than one (see Table 7). The first factor was related to intrusiveness and arousal. The second factor loaded onto items related to survival guilt, detachment, and avoidance of reminders, while the third factor was associated with decreased sleep, impaired memory, and low affect. The first factor correlated highly with the IES Intrusion scale ($r=.50$) while the second correlated highly with the IES Avoidance scale ($r=.45$). The three factor solution conformed better to the DSM-III criteria for PTSD than to the criteria specified by DSM-III-R. For example, Survival Guilt was the best marker of the second factor but Survival Guilt was not included in the DSM-III-R criteria for PTSD.

In another study, Keane (1993) examined 68 combat veterans with the SI-PTSD. A principal components analysis with a varimax rotation was fit. The results revealed four factors with eigen values greater than one. The first factor included items related to recurrent nightmares and perceptions that events were recurring. These symptoms are related to intrusive experiences. The second factor described reactivity symptoms and included items related to intense distress resulting from exposure to events that resemble the trauma and an exaggerated startle response. The third factor loaded onto items measuring irritability and concentration difficulties while the fourth factor loaded onto items related to feelings of detachment and

Table 7

Three Factor PCA for SI-PTSD (Davidson et al., 1989)

PTSD Symptoms	F1	F2	F3
Startle Reaction	.78		
Acting as if	.68		
Worse by reminders	.59		
Nightmares	.69		
Recurrent recollections	.48		
Behavioral guilt	.45	.45	
Avoidance of activities		.51	
Survival Guilt		.81	
Detachment/estrangement		.74	
Loss of interest			.62
Constricted affect			.65
Reduced sleep			.60
Impaired memory/concentration			.53

markedly diminished interest in activities (see Table 8).

Watson, Kucala, Juba, Manifold, Anderson, & Anderson (1991) administered the PTSD Interview (PTSD-I) to 131 Vietnam veterans The PTSD-I is a 17 item structured interview that closely resembles DSM-III criteria. An exploratory principal axes factor analysis with a varimax rotation was fit to the data. The results suggested a five factor solution: re-experience and intrusion, increased arousal, avoidance/numbing, guilt, and cognitive interference (see Table 9). The first factor included items such as intrusive memories and nightmares. The second factor included items such as hyperalertness, exaggerated startle and sleep difficulties. The third factor loaded onto numbed to intimacy and detachment. The fourth factor was associated with guilt while the fifth factor had just two items: memory problems and concentration difficulty.

<u>The Internal Consistency of Other Measures of PTSD</u>. There are a number of measurement scales that have been used to assess PTSD even though the scales were not developed specifically to measure PTSD. In one study, Silver and Iacono, (1984) attempted to determine the factor structure of symptoms associated with PTSD in a sample of 405 Vietnam Veterans who had accessed a Vietnam Veteran Outreach Program. All branches of the Armed Services were represented in the sample. A list of symptoms from clinical observations and research results was administered as a single test battery to all subjects using Likert-type scales ranging from 0 (mild) to 5 (severe). Factors were estimated by the principal axes method with a varimax rotation and the number of factors retained was determined by the Cattell Scree Test

Table 8

Four Factor PCA for SI-PTSD (Keane, 1993)

PTSD Symptoms	F1	F2	F3	F4
Recurrent nightmares	X			
Feeling as if recurring	X			
Restricted affect	X			
Hypervigilance	X			
Physiological reactivity		X		
Avoids activities that remind		X		
Exaggerated startle response		X		
Irritability/angry outbursts			X	
Concentration difficulties			X	
Diminished interest in activities				X
Detachment/estrangement				X

Table 9

Five Factor PA for DSM-III PTSD symptoms (Watson et al., 1991)

PTSD Symptoms	F1	F2	F3	F4	F5
Intrusive memories	.68				
Stimuli worsen symptoms	.60				
Diminished interest	.49				
Flashbacks	.34				
Avoiding trauma-like stimuli	.43		.40		
Nightmares	.46			.41	
Hyperalterness		.73			
Exaggerated startle		.69			
Sleep Difficulties		.47			
Detachment	.36		.50		
Numbed to intimacy			.75		
Constricted affect			.56		
Decreased sexual pleasure			.37		
Guilt over behaviors				.85	
Guilt over survival				.40	
Memory problems					.81
Concentration problems	.31				.71

(Cattell, 1966). In summarizing the data, only variables with standardized loadings greater than .50 were reported for the factor analysis. The orthogonal four factor solution is presented in Table 10. The first factor represents depressive symptoms while the second factor appears to be related to survival guilt. The third factor represents reexperiencing symptoms and the fourth factor includes numbing of responsiveness and detachment type items.

In another study, Pearce, Schauer, Garfield, Ohlde, & Patterson (1985) used a random sample of 90 Vietnam-era male veterans and administered the Problem Checklist. The test comprises 51 dichotomous items characteristic of the diagnostic criteria for PTSD. A principal components analysis with an orthogonal rotation was performed and resulted in nine factors. One major problem with these analyses is that the Problem Checklist appears to be a collection of dichotomous items and the standard principal components analysis is not the appropriate statistical analysis for such data (Parry & McArdle, 1991). The principal components analysis assumes that all items are continuous and normally distributed. Bias in the parameter estimates will increase as the endorsement of any item deviates from the 50% response rate, as it does with most measures of PTSD.

Schwarzwald, Weisenberg & Weisenberg (1991) investigated the factor structure associated with PTSD and combat stress reaction symptoms. In the study, 677 male soldiers from the Israel Defense Force who fought on the frontline during the 1982 Lebanon War were administered the Symptoms Checklist-90-Revised (SCL-90-R). The scale provides three global indices of distress related to the frequency and

Table 10

Four Factor PCA for PTSD related symptoms (Silver & Iacono, 1984)

PTSD Symptoms	F1	F2	F3	F4
Trouble concentrating	.64			
Low interest in job/activities	.63			
Feeling worthless/unsure	.60			
Difficulty keeping job	.57			
Depression	.55		.50	
Suicidal feelings or attempts	.53			
Problems with memory	.51			
Guilt about what I did in war		.61		
Guilt for surviving		.60		
Grief or sorrow		.59		
Nightmares			.66	
Violent dreams or fantasies			.63	
Flashback to Vietnam			.62	
Reacting when surprised			.56	

Table 10

Continued

PTSD Symptoms	F1	F2	F3	F4
Feeling angry/irritable				.70
Losing temper easily				.65
Difficulty with relationships				.65
Mistrust of others/government				.63
Jumpiness/Hyperalertness				.62
Emotionally distant from family				.56
Anxiety				.54
Difficulty feeling emotions				.54
Painful moods and emotions				.54
Feeling separated from others				.53
Fear of loss of control				.52
Having arguments				.50

intensity of individual symptoms. The factor structure of the SCL-90-R was evaluated for two groups: a combat stress reaction group (N=370) and non-combat stress reaction group (N=307). Fifty-nine percent of the combat stress reaction subjects were also suffering from PTSD. The ninety items of the SCL-90-R were tested with a principal factor analysis and a procrustes rotation based on the orthogonal nine factor solution defined by Derogatis and Cleary (1977). The factor solution for the CSR group was similar to the previously reported factor solution but the data did not fit as well for the non-CSR group.

<u>Summary of the Factor Analytic Studies of PTSD</u>. The principal components analysis with a varimax rotation is the most commonly used factor analytic technique for studying PTSD-related symptoms (see Table 11 for summary). The principal components analysis is considered an appropriate method for exploratory type investigations that have few a priori hypotheses (see McDonald, 1985). One major drawback to the principal components analysis is that under certain conditions, the method leads to biased parameter estimates (see McArdle, 1990). The varimax rotation has been the only rotation method used in factor analytic studies of PTSD to date. The varimax rotation is often considered unreasonable because it forces the factors of interest to be uncorrelated (Cattell, 1978).

In general, the findings in Table 11 suggest that there are well defined symptoms that describe a PTSD-related construct although agreement on the actual factor structure is varied (see Watson et al. 1991). The reported factor analytic results can be characterized in four ways: 1) most studies have been exploratory

Table 11

Factor Analytic Studies of PTSD-related Symptoms

Author & Date	Scale	N	S	M	R	F	Label
Slater (1943)	NR	1600	WW	PC	OR	2	AX,CI
Zilberg et al. (1982)	IES	72	BR	PC	OR	2	IN,AV
Schwarzwald et al. (1987)	IES	804	LW	PF	OR	2	IN,AV
Keane et al. (1988)	M-PTSD	362	VV	PC	OR	6	IN,AP,LA,CI ID,SP
McFall et al (1990)	M-PTSD	203	VV	PC	OR	3	IN,AN/LA,ID
Hyer et al. (1991)	M-PTSD-S	147	VV	PC	OR	2	GT,AN/NB
Keane (1993)	M-PTSD	68	VV	PC	OR	4	IN,NB/DP,AN,CI
Davidson et al. (1989)	SI-PTSD	116	MX	PC	OR	3	IN,GT,AX
Keane (1993)	SI-PTSD	68	VV	PC	OR	4	IN,RA,CI,DT
Watson et al. (1991)	PTSD-I	131	VV	PF	OR	5	IN,AX,ID,GT,CI
Silver & Iacono (1984)	33 items	405	VV	PF	OR	4	DP,GT,IN,AN
Pearce et al. (1985)	PC	90	VV	PC	OR	9	AN/DP,NB,GS,CI ID,RA,JP,DP,AS

Table 11

<u>Continued:</u>

Author & Date	Scale	N	S	M	R	F	Label
Schwarzwald et al. (1991)	SCL-90-R	677	LW	PC	OR	5-9	SO,OC,ID,DP,AX AN,PA,PI,PY
Green (1993)	SCL-90-R	NR	VV	NR	OR	7	GS,SD,AV,OC PI,SO,BL

Notes: 'N' = Sample Size; 'S' = Sample Type; 'M' = Factor Method; 'R' = Factor Rotation; 'F' = Number of Factors; 'Label' = Factor Labels; 'PC' = Principal Components Analysis; 'PF'= Principle Factor Analysis; 'OR' = Orthogonal Rotation; 'IES' = Impact of Event Scale; 'M-PTSD' = Mississippi Scale for Combat-Related Posttraumatic Stress Disorder; 'SI-PTSD' = Structured Interview for PTSD; 'SCL-90-R' = Symptoms Checklist 90-Revised; 'PTSD-I' = PTSD Interview; See Appendix 1 for Factor Label Abbreviations.

2) most studies have tested only one factor structure; 3) all studies have used orthogonal rotations; and 4) a limited number of factor analytic goodness-of-fit indices have been reported. Given the extensive number of exploratory analyses that have been presented in the literature, a confirmatory factor analytic approach for PTSD-related symptoms would be useful and informative.

Studies Using the MMPI to Measure PTSD

The Minnesota Multiphasic Personality Inventory (MMPI) is one of the most widely used standardized diagnostic instruments in the United States. Subjects diagnosed with PTSD were not included in the process of selecting items for the original scale construction of the MMPI, but more recently, considerable work has been conducted on the applicability of the MMPI in measuring PTSD. For example, Penk, Robinowitz, Roberts, Patterson, Dolan, & Atkins (1981) demonstrated that the MMPI could differentiate veterans exposed to high levels of combat from veterans exposed to low levels of combat. In a review of studies that evaluated the relationship between the MMPI and PTSD, the most common MMPI codetype for PTSD patients meeting all DSM-III PTSD criteria was an 8-2-7 profile (Penk, Keane, Robinowitz, Fowler, Bell, & Finkelstein, 1988). The 8-2-7 profile is common to many disorders but does not provide specificity in describing PTSD.

To improve the utility of the MMPI to diagnose PTSD, Keane, Malloy, & Fairbank (1984) developed a 49 item MMPI-PTSD scale based on comparing differential responses to 400 items of the MMPI for two groups of subjects: subjects diagnosed with PTSD (N=60) and a psychiatric control group (N=60). Validation studies of the MMPI-PTSD scale have demonstrated that the scale predicts PTSD symptoms independent of the actual traumatic history of the subjects (McFall, Smith, Roszell, Tarver, & Malas, 1990; Watson, Juba, Anderson, & Manifold, 1990). The overall hit rates for the MMPI-PTSD have averaged between 70% and 75% (Kulka & Schlenger, 1986; Penk et al. 1988; Watson, Kucala, & Manifold, 1986). Surprisingly, Kulka & Schlenger (1986) demonstrated that the MMPI-PTSD scale performed as well as the M-PTSD, the Diagnostic Interview Schedule PTSD scale (DIS-PTSD), and the IES in identifying subjects with PTSD. Conversely, some studies have cautioned against using the MMPI-PTSD scale due to the identification of an excessive number of false-positive cases (Hyer, Fallon, Harrison, & Boudewyns, 1987).

One major difficulty arising from the use of the MMPI-PTSD scale has been determining an appropriate cutting score. Keane et al. (1993) recommended the use of 30 as a cut score while others have recommended scores as low as 13 (Kulka, Schlenger, Fairbank, Jordan, Hough, Marmar, & Weiss, 1991; Watson et al. 1986). Unfortunately, the basis for the use of certain cut scores has often been determined in a post-hoc fashion based on the specific sample being evaluated. The use of both the continuous scale as well as the dichotomous scales based on specific cut-scores would provide useful information for comparing results across studies.

<u>Developmental Course of PTSD</u>

DSM-III describes an acute and chronic form of PTSD while DSM-III-R differentiates between a delayed onset and non-delayed onset PTSD. In DSM-IV, an acute stress reaction has been included for symptoms that occur within one month of the stressful event. Furthermore, both a delayed onset and non-delayed onset PTSD have been defined. Several studies have demonstrated that PTSD symptoms persist over time and can develop long after the trauma (Blank, 1993; McFarlane, 1988; Solomon & Mikulincer, 1988). This is especially true for long-term stressful life events such as wartime combat or incarceration as a prisoner of war. For example, Kulka et al (1990) found that 15% of the Vietnam veterans were still exhibiting symptoms of PTSD approximately 19 years after the war. Variations in the developmental patterns of PTSD symptoms have frequently been observed and the various subtypes have been characterized by adjectives such as acute, delayed, chronic, intermittent, residual, and reactive patterns (Blank, 1993; Garb, 1987). Most research has characterized the developmental pattern of PTSD symptoms based on two dimensions: an acute/chronic dimension and a delayed/non-delayed dimension (Garb, 1987; Peterson, Prout, & Schwarz, 1991). In one of the more interesting longitudinal studies of PTSD, McFarlane (1988) studied Australian subjects exposed to brush fires who were considered at risk for developing PTSD. McFarlane and colleagues were able to identify subjects with both acute and delayed onset PTSD that either remitted or persisted in a chronic form of PTSD. Interestingly, intrusion symptoms were more prominent than other PTSD symptoms in the early phase of the disorder suggesting a predictable developmental sequence in PTSD symptomatology. In another study, Solomon and colleagues (1988) studied a large sample of Israeli combat soldiers (N=382) and found that (1) combat soldiers may develop an acute combat stress reaction that is more extreme in symptomatology than PTSD, (2) the combat stress reaction may not be related to subsequent development of PTSD, and (3) delayed-onset PTSD occurred in both subjects who experienced an acute combat stress reaction and subjects who did not experience an acute combat stress reaction.

Other researchers have argued that there are few practical reasons to differentiate between acute, chronic, and delayed onset PTSD (Rothbaum & Foa, 1993; Watson, Kucala, Manifold, Vassar, & Juba, M.P., 1988). For example, Watson et al. (1988) studied 32 Vietnam veterans with acute PTSD and 31 Vietnam veterans with delayed onset PTSD and found no differences in severity of PTSD symptoms between the two groups. In general, few studies have focused on differentiating between different developmental patterns of PTSD and the available data has produced inconclusive results.

Etiological Models for Describing PTSD

The etiology of PTSD is related to the validity of PTSD as a diagnostic construct/syndrome. Failure to understand the etiological precursors of a construct jeopardizes its construct validation. Slater (1943) was a pioneer in systematically examining the etiology of what is now called PTSD (McFarlane, 1990; Trimble, 1981). In an extensive study of British soldiers exposed to different levels of combat stress ranging from "trifling" to "severe" and admitted to a neuropsychiatric Emergency Hospital in England during World War II, Slater described two unique types of reaction to combat exposure. The first reaction occurred with the large majority of military casualties who had been exposed to extreme levels of combat.

Slater described this reaction as retrospective amnesia -- a simple protective mechanism which involves avoiding the recollection of painful life events, currently referred to as "numbing". Retrospective amnesia is most closely associated with combat stress reaction (see Grinker & Speigel, 1945 or Solomon, Mikulincer, & Avitzur, 1988). Slater referred to a second type of stress reaction which occurred with a smaller number of military casualties, as fugues (possibly PTSD or dissociative disorders). He suggested that fugues may be an escape from events of the present and are often found in severely "psychopathic personalities" in the Schneiderian (1950) sense (i.e., not exclusively sociopathic).

Barlow (1988) described a slightly different model for the etiological development of PTSD symptoms (See Figure 2). The model assumes that individual differences exist with respect to biological vulnerability to traumatic events. When an individual experiences a traumatic event, there is an intense emotional response that most individuals experience regardless of their biological vulnerability. Many individuals learn to respond to the circumstances surrounding the traumatic event with anxious apprehension. Based on the biological vulnerability and the moderating effects of the social support and coping resources, an individual may or may not develop the full blown PTSD syndrome.

The Diathesis-Stressor Model

The diathesis-stressor model is a good framework for describing the etiological development of the PTSD syndrome (Gottesman & Shields, 1972; Slater 1943 [1971]; Slater & Slater, 1944 [1971]). The model assumes that pre-military adjustment is

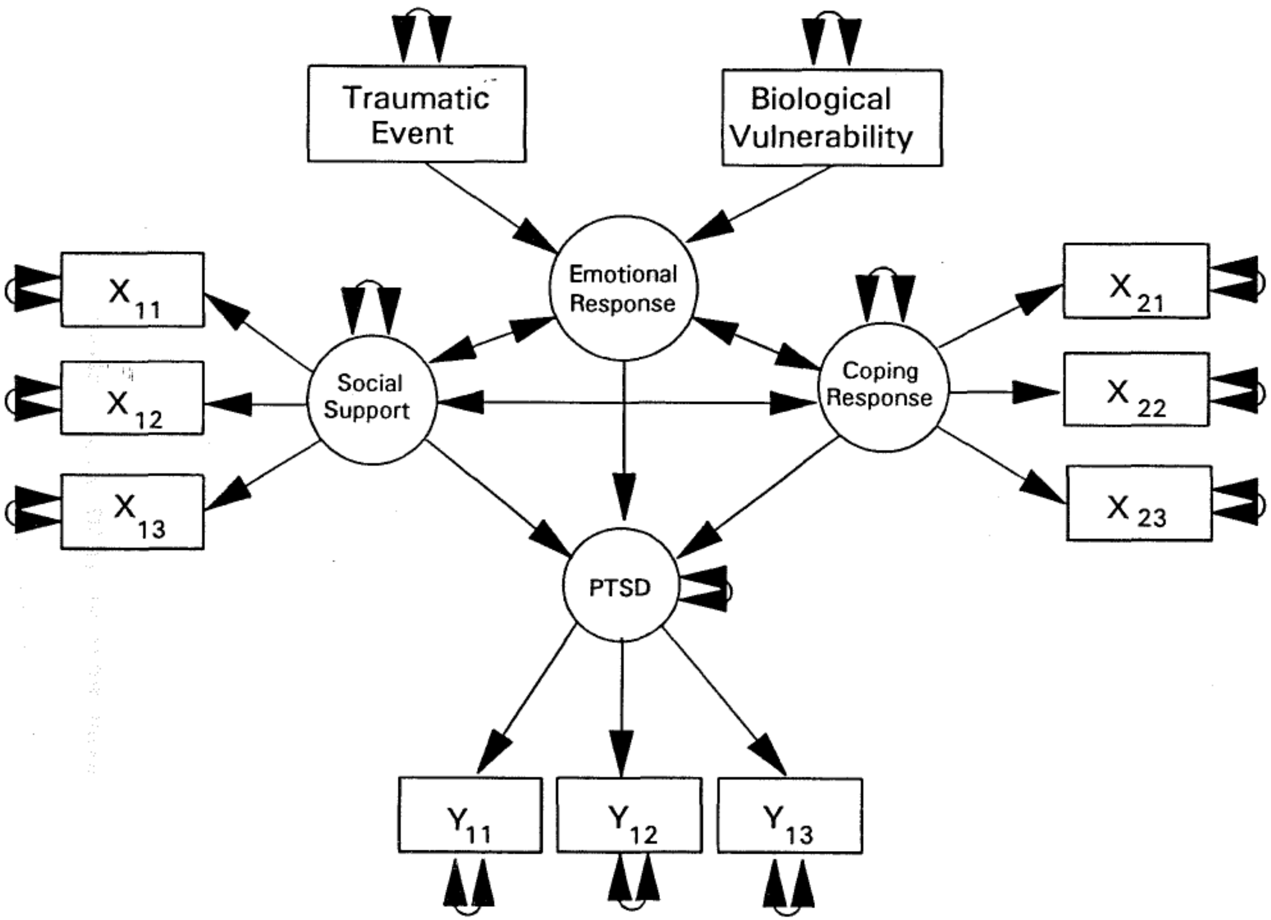


Figure 2: Etiological Model for PTSD Developed by Barlow (1988)

predictive of which individuals will be most vulnerable to developing symptoms related to PTSD when exposed to a severe stressor. Figure 3a is a diagrammatic representation of the Gottesman & Shields (1972) diathesis-stressor model developed for schizophrenia but adapted here for the PTSD framework. At the first occasion of measurement, a pre-military construct and PTSD related symptoms are measured. At occasion two, combat exposure and PTSD related symptoms are measured. At occasion three, a post-military construct and PTSD related symptoms are measured. The pre-military construct is a latent variable or factor measured by three manifest variables (X_{11}-X_{13}). Combat exposure and the post-military construct are two additional latent variables measured by three manifest variables each (X_{21}-X_{23}, X_{31}-X_{33} respectively). PTSD is a latent variable measured by three manifest variables (Y_{11}-Y_{13}) at three different occasions. The hypothesized model allows for causal relationships between the pre-military construct and PTSD related symptoms at occasions one, two, and three while a causal relationship between combat exposure and PTSD related symptoms is estimated at only the second and third occasion of measurement. Finally, the model predicts a causal relationship between the post-military construct and PTSD related symptoms at occasion three only.

In Figure 3b, a model is specified for individuals who have not been exposed to a severe stressor. The model is essentially the same model as Figure 3a but the combat exposure factor is not included. The reason the model is specified separately for the non-combat group is because the DSM criteria for PTSD requires exposure to a traumatic event. For those individuals who have not been exposed to a severe

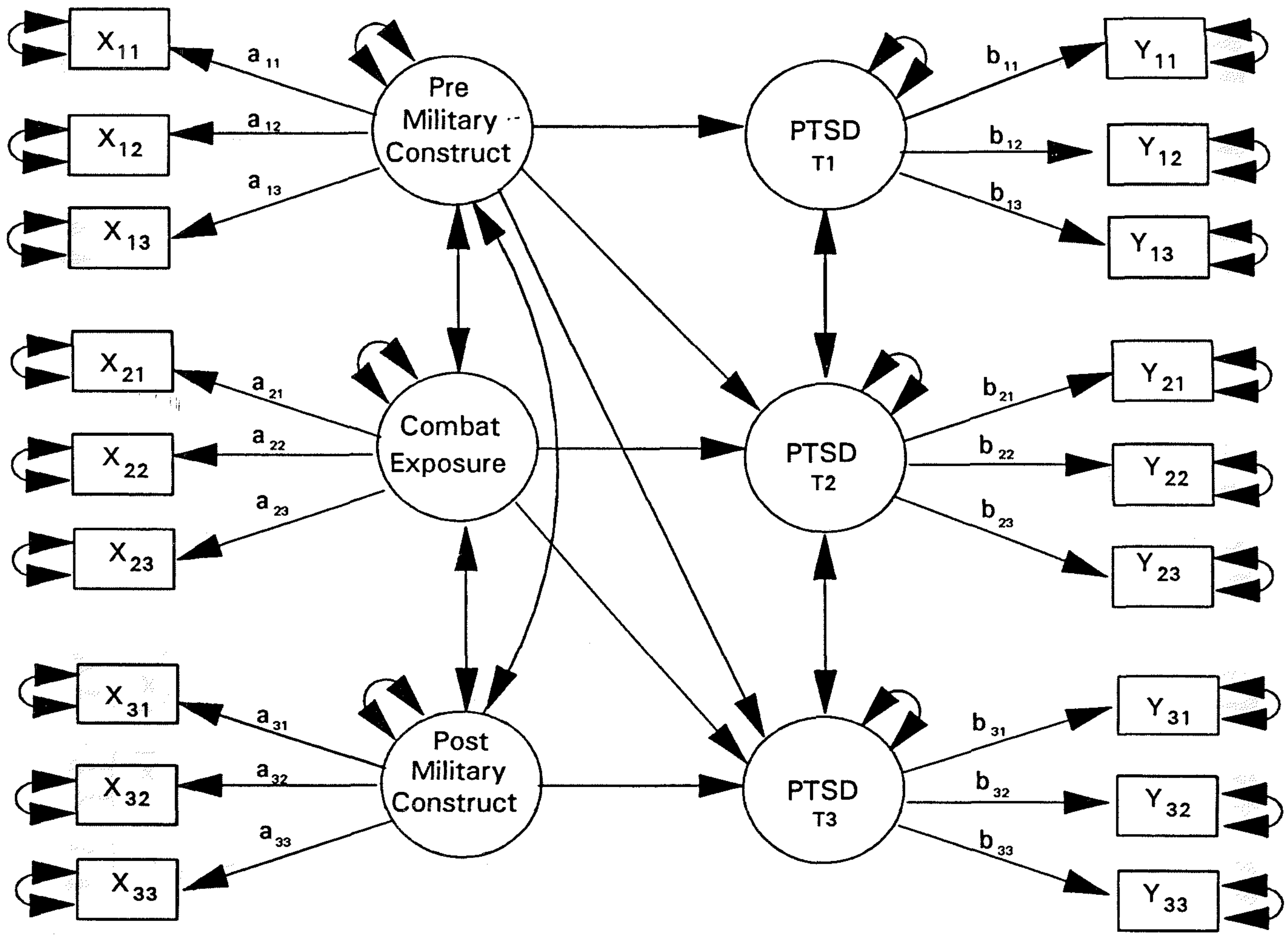


Figure 3a: Diathesis-Stressor Model for Combat Group

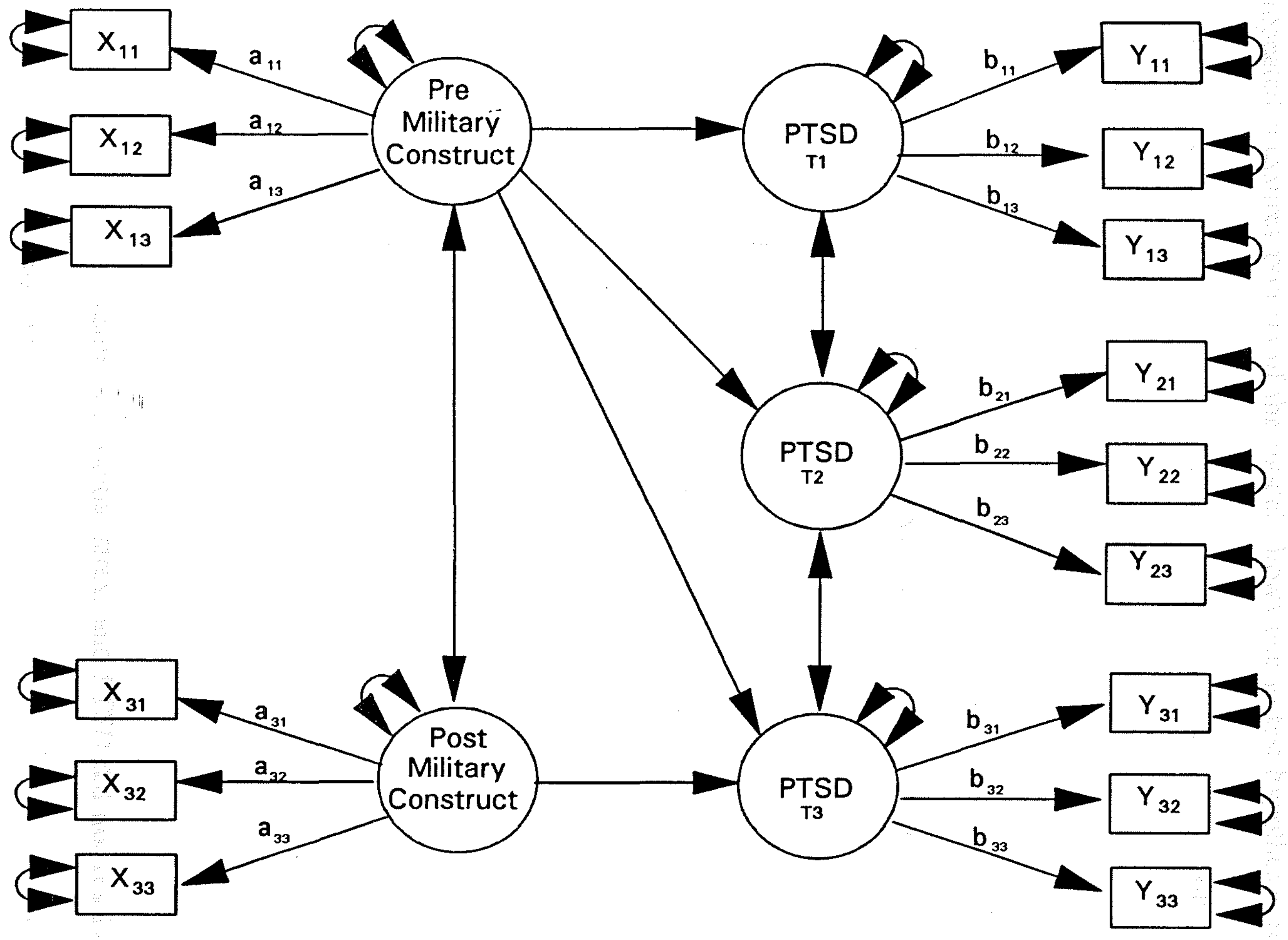


Figure 3b: Diathesis-Stressor Model for Non-Combat Group

stressor, the etiological development of PTSD-like symptoms may be quite different.

Figures 3a and 3b include a testable measurement model for PTSD. The repeated measures portion of the model allows one to test hypotheses regarding factor invariance across time while the multiple groups portion of the model allows one to test hypotheses regarding factorial invariance across groups. Factorial invariance is a necessary condition when comparing factor scores across occasion or when comparing factor scores between groups within the same occasion (Horn, McArdle, & Mason, 1983; Meredith, 1964a; 1964b). For example, to establish factorial invariance for the PTSD construct across the first two occasions of measurement, it would be necessary to demonstrate that the loadings b_{11}-b_{13} were equivalent to the loadings b_{21}-b_{23}, respectively. To establish factorial invariance across groups for the first occasion of measurement, it would be necessary to demonstrate that the loadings b_{11}-b_{13} were equivalent across combat exposure groups.

Etiological Predictors of PTSD

Currently, DSM-III-R treats all stressors as equal and all victims as if they were equally predisposed. Interestingly, not all subjects who have been exposed to extreme stressors develop PTSD symptoms. Yager, Laufer, & Gallops (1984) found large individual differences in response to atrocities and concluded that the strong association between measures of combat stress and PTSD did not resolve the issue about the possible etiological role of pre-combat factors such as pre-morbid personality characteristics. One of the major goals in the stress literature has been to identify why individuals are selectively vulnerable to acute and chronic stress (Baum, Cohen, & Hall, 1993). In the following sections, the literature on the etiology of PTSD will be discussed in relation to the timing of the stressful event. Therefore, emphasis will be placed on pre-military, military, and post-military predictors of PTSD.

Pre-Military Risk Factors Associated with the Development of PTSD. A number of studies have demonstrated that pre-morbid functioning is predictive of the levels of PTSD symptoms experienced following the occurrence of a traumatic event. For example, Schnurr, Friedman, & Rosenberg (1993) found that pre-military MMPI scores predicted lifetime PTSD symptoms in Vietnam combat veterans. Even after controlling for combat exposure, the MMPI scales demonstrated statistically significant relationships with PTSD symptoms. Psychopathic deviate and masculinity scores were the best predictors of lifetime symptoms. Similarly, Nolen-Hoeksema & Morrow (1991) measured PTSD symptoms in 137 college students before and after the 1989 Loma Prieta earthquake in the San Francisco Bay area. The results demonstrated that PTSD symptoms increased after the earthquake but that the post-quake PTSD symptoms were associated with pre-quake measures of PTSD, self-reported stress, and ruminative responses. The three measures accounted for 47% of the variance in the post-quake PTSD symptoms 10 days after the quake. In addition, the pre-quake measure of PTSD continued to predict PTSD symptoms measured 7 weeks after the quake.

In another well designed prospective study, Green, Grace, Lind, Glesser, & Leonard (1990) collected pre-military, military, and post-military measures on 200 male Vietnam veterans. Age of entry into the military and pre-military education both predicted the level of combat that soldiers experienced with younger, less well educated veterans were more likely to experience higher levels of combat. A measure of anti-social personality also predicted combat exposure. Interestingly, pre-military psychological functioning and education level were statistically significant predictors of a post-military measure of PTSD. As a whole, the pre-military factors accounted for 9% of the variance in the post-military measure of PTSD.

With a sample of 469 firefighters, McFarlane (1989) found that severity of exposure to an extreme event predicted acute PTSD symptoms but that the pre-trauma psychological status of the subjects was the best predictor of long-term psychological functioning. Pre-morbid neuroticism appeared to be the most salient etiological factor related to PTSD symptoms in the study. Similarly, Slater (1943) found that childhood neurosis was associated with neurotic symptoms experienced after exposure to severe combat.

In the Epidemiological Catchment Area Study (ECA), Helzer, Robins, & McEvoy (1987) found a significant relationship between behavioral problems before the age of 15 and a PTSD diagnosis. Among the subjects who reported less than four behavioral problems before the age of 15, only one percent of the subjects met the DSM-III criteria for PTSD. Of the subjects who reported four or more behavior problems before the age of 15, six percent of the subjects currently met the DSM-III criteria for PTSD. Helzer and colleagues suggested that individuals with childhood behavior problems may be predisposed to experiencing traumatic events and/or experiencing symptoms related to traumatic events. The results highlight the possible effects of self-selection for stressful life events.

Solkoff, Gray, & Keill (1986) compared 50 Vietnam veteran with PTSD to 50 control combat veterans and found that the two groups differed on three pre-military measures: enlistment status (volunteered versus drafted), attitudes toward school, and religious upbringing. The subjects who were PTSD positive were more likely to have volunteered, had poorer attitudes about school and had less rigid religious upbringing than the non-PTSD control group.

Numerous studies have suggested genetic influences contribute to the vulnerability to developing PTSD symptoms (Davidson, Swartz, Storck et al. 1985; McFarlane, 1990; Slater, 1943; True, Rice, Eisen, Heath, Goldberg, Lyons, & Nowak, 1993). In the largest twin study to date, True et al. (1993) studied 15 PTSD symptoms in a sample of 4042 Vietnam Era monozygotic and dizygotic twins. Nearly all the PTSD symptoms demonstrated statistically significant heritability estimates even when controlling for level of combat exposure. Heritability estimates ranged from .32 to .45 for the 15 items.

Although a number of other studies have demonstrated a variety of pre-morbid predictors of PTSD symptoms, the literature is dominated by studies that suggest pre-military factors <u>do not</u> play a significant role in the development of PTSD symptoms (Green & Berlin, 1987; Resnick, Foy, Donohoe, & Miller, 1989). For example, Card (1987) examined pre-military, military, and post-military predictors of PTSD in a sample of 1500 vietnam and non-vietnam veterans. Fifty-one pre-military characteristics collected when the subjects were in the ninth grade were examined approximately 20 years later. The only pre-military characteristic associated with PTSD was low self-confidence. Pre-military academic ability, socioeconomic status, and race were not associated with PTSD.

Foy et al. (1984) are cited extensively for having shown that pre-military variables do not predict outcomes for subjects exposed to extraordinary stressors such as combat. Their study utilized 43 Vietnam-era veterans who had applied for psychiatric services at a Los Angeles Veterans Administration medical center. The best predictor of the PTSD Summary score was the combat exposure score. These same analyses have been replicated (Carroll, Rueger, Foy, and Donahoe, 1985). The sample consisted of 21 help-seeking Vietnam combat veterans with a PTSD diagnoses, 18 help-seeking combat veterans without evidence of PTSD, and 21 help-seeking veterans with minimal combat experience. The three groups did not differ on pre-military adjustment scores but did differ on post-military social adjustment scales. In general, the PTSD positive group experienced more post-military interpersonal difficulties. One methodological problem associated with both of these studies was that the pre-military variables were entered into the hierarchical regression analyses last.

Military Predictors of PTSD. Most studies of PTSD have tended to focus on the effects of the stressor on the development of PTSD symptoms. Helzer et al. (1987) found prevalence estimates for PTSD to be 1% in the general population, 3.5% in Vietnam veterans who had never been wounded during the war and in civilians who had suffered physical attacks, and 20% in Vietnam veterans who had been wounded. Similar results were found by Goldberg, True, Eisen, & Henderson (1990) who studied a large sample of monozygotic twins discordant for military service in Southeast Asia (SEA). The prevalence of PTSD in twins who served in SEA was 16.8% while only 5% for the cotwins who did not serve in SEA. In addition, there was a nine fold increase in the prevalence of PTSD, comparing twins who experienced high levels of combat and cotwins who did not serve in SEA.

In the congressionally mandated National Vietnam Veterans Readjustment Study (NVVRS: Kulka, Schlenger, & Fairbank, 1990), the prevalence rates for PTSD were 15.2% for Vietnam theater veterans, 2.5% for Vietnam era veterans, and 1.2% for civilians. Vietnam theater veterans in high combat zone areas were also more likely to be diagnosed with a variety of other clinical diagnoses than veterans who had experienced low levels of combat. The diagnoses included major depression, dysthymia, obsessive-compulsive disorder, generalized anxiety, and drug and alcohol abuse/dependence.

In another study, Buydens-Branchey, Noumar, & Branchey (1990) demonstrated that a PTSD diagnosis was related to both the duration of exposure to combat and the intensity of combat. Veterans who were currently diagnosed with PTSD had experienced greater durations of combat and more extreme types of combat than veterans who were in remission for a PTSD diagnosis. In general, most studies have demonstrated that levels of combat exposure predict severity of PTSD symptomatology (Breslau & Davis, 1987; Card, 1987; Foy et al. 1984; Green et al.

1990; Solkoff et al., 1986).

Post-Military Predictors of PTSD. The most commonly reported post-military mediator of PTSD symptoms is social support (Barlow, 1988; Foy et al. 1984; Slater, 1943). For example, Keane, Scott, Chavoya, Lamparski, & Fairbank (1985) reported smaller social networks for individuals with PTSD subsequent to serving in the military when compared to well-adjusted Vietnam veterans. Furthermore, pre-military differences in social networks were not apparent between the PTSD positive and PTSD negative subjects. Frye & Stockton (1982) also suggested that individuals who experienced PTSD symptoms were more likely to perceive their families as less helpful upon return from military duty.

The main effects model for social support suggests that social support exerts beneficial effects on psychological well-being regardless of the individuals level of stress (Quittner, Glueckauf, & Jackson, 1990; Kessler & Essex, 1982; Kessler & McLeod, 1985). A number of studies have supported this model. Card (1987) found that post-military marital status was associated with PTSD. Married men tended to experience lower levels of PTSD than men who were single or divorced. Other measures of post-military functioning, such as educational status and socioeconomic status, were not associated with PTSD. Similarly, Solkoff et al. (1986) found that PTSD positive Vietnam veterans were less likely to have had parental or spousal support upon returning from the war than non-PTSD controls.

As part of the NVVRS, Kulka, et al. (1990) examined family problems in 967 Vietnam veterans. Subjects with PTSD were more likely to report marital problems, parental problems, and family adjustment problems. Subjects without PTSD were more likely to be married, working, and better educated than PTSD subjects. In addition, subjects without PTSD were more likely to be married longer. Finally, the children of subjects with PTSD reported more behavior problems than the children of parents without PTSD.

Solomon et al. (1988) measured PTSD in 262 Israeli soldiers 24 and 36 months after exposure to combat in the Lebanon war. The results suggested that PTSD symptoms were experienced more by individuals with low social support, high external locus of control, and low emotion focused coping. In addition, the changes in reported PTSD symptoms between the 24 and 36 month measurement period were also related to social support and emotion-focused coping styles.

Green et al. (1990) found that post-military experience accounted for 12% of the variance in a measure of PTSD after pre-military and military variables had been accounted for. The largest contributors to the post-military measures of PTSD were support at the homecoming and current social support. Both types of support decreased the experience of PTSD symptoms.

Finally, some studies have reported lower cognitive functioning in subjects exposed to combat when compared to non-combat subjects (Sutker, Allain, & Johnson, 1993; Sutker, Winstead, Galina, & Allain, 1991). An important characteristic to consider in studies of post-military predictors of PTSD symptoms is that the direction of the causal relationship is difficult to determine because the measures have been collected after the occurrence of the stressful life event.

Methodological Issues

Goodness-of-Fit Indices. There has been considerable debate regarding what types of goodness-of-fit indices are most appropriate to use in the context of fitting structural equation models (Anderson & Gerbing, 1988; Bentler, 1990; Bollen, 1990; Browne & Cudeck, 1992; Marsh, Balla, & McDonald, 1988; McDonald & Marsh, 1990; Mulaik, James, Van Alstine, Bennett, Lind, & Stillwell, 1989). More commonly reported measures of goodness-of-fit include LISREL's goodness-of-fit index (GFI), LISREL's root-mean-square residual (RMS) and Akaike's information criterion (AIC). McDonald & Marsh (1990) suggest that the AIC behaves appropriately with large sample simulations but that its practical use with smaller samples is rather limited. McDonald developed what he called a measure of centrality (m_k) that can be written in the following form.

(1.4)
$$m_k = e^{-.5\frac{(\chi^2_k - df_k)}{n}}$$

This m_k index is a measure of absolute fit. Developing indices of relative fit have been more problematic (See Marsh, Balla, & McDonald for review). One of the more commonly used relative fit indices is the Normed Fit Index (Δ_1) developed by Bentler & Bonett (1980). The index can be can written as,

(1.5)
$$\Delta_1 = \frac{(\chi^2_0 - \chi^2_k)}{\chi^2_0}$$

The Δ_1 compares the fit of a target model to some defined null model. The Δ_1 is equivalent to the Likelihood Improvement Percentage (LIP) used by McArdle and Prescott (1992). Marsh, Balla, & McDonald (1988) describe these type of indices as a Type I incremental fit Index. The major advantage of using an index such as the Δ_1 is that it is bounded between 0 and 1 and is conceptually easy to understand. The major disadvantage of using the Δ_1 is that the value is dependent on the sample size. For sample sizes under 200 the Δ_1 underestimates the true population value (Bentler, 1990; Marsh, Balla, & McDonald, 1988). James, Mulaik, & Brett (1982) have suggested that multiplying the Type I incremental indices by a parsimony ratio, d_k/d_0 improves the behavior of the fit index. This is an attempt to weight parsimony and goodness-of-fit equally (McDonald & Marsh, 1990). Bollen (1988) developed an alternative to Δ_1 that seems to be less dependent on sample size.

$$\Delta_2 = \frac{\chi^2_0 - \chi^2_1}{\chi^2_0 - \frac{df_m}{(N-1)}} \tag{1.6}$$

Bollen (1990) showed that as the sample size increases, the differences between Δ_1 and Δ_2 decreases to zero. Bollen (1990) recommended reporting both Δ_1 and Δ_2 in studies comparing the fit of alternative structural equation models.

The Incremental Normed Fit Index (Δ_{jk}) was developed by Bentler & Bonett (1980) as a more general form of Δ_1 and allows comparisons of nested submodels. The equation is written as

$$\Delta_{jm}=\frac{(\chi^2{}_j-\chi^2{}_m)}{\chi^2{}_0}$$

(1.7)

The Tucker Lewis Index (TLI, Tucker & Lewis, 1973) which is identical to the Non-Normed Fit Index (NNFI: Bentler & Bonett, 1980) is another goodness-of-fit index that was developed to be independent sample size (Bentler, 1990; Marsh, Balla, & McDonald, 1988; McDonald & Marsh, 1990) and is written as

$$TLI=\frac{(\frac{\chi^2{}_0}{df_0})-(\frac{\chi^2{}_k}{df_k})}{(\frac{\chi^2{}_0}{df_0})-1}$$

(1.8)

Marsh, Balla, & McDonald (1988) refer to the TLI and NNFI as Type II incremental fit-indices and demonstrated that the Type II fit indices are less biased estimators than Type I incremental fit indices. The TLI and NNFI can be used to compare nested submodels similar to the way in which the INFI was derived from Δ_1. In a recent comparison of fit indices, Williams & Holohan (1992) simulated various data structures and found that the TLI, AIC, and a variation of the m_k index were most effective in identifying the true model.

Factor Analysis of Dichotomous or Ordinal Items. A low frequency response rate for dichotomous items suggests that the standard statistical assumptions for confirmatory factor analysis will be violated (McDonald, 1985; Muthen, 1993; Parry & McArdle, 1991; Waller, 1993). Factor analysis of binary variables requires the use of non-linear regressions of variables on the continuous, unobserved factors (McDonald, 1985). This is similar to logistic regression of a binary dependent variable on a continuous, observed predictor. The regression curve of a binary variable on a common factor is usually referred to as an item characteristic curve (ICC).

Using the notation of Christoffersson (1975), we specify the standard factor model as:

(1.9) $$y=\mu+\Lambda\varphi+\delta$$

Where Λ = M * K matrix of factor loadings,

φ = vector of factor scores,

δ = M dimensional residual vector.

The expected value for φ and δ is zero and y is multivariate normal. The covariance matrix of y is:

(1.10) $$E[(y-u)(y-u)'] = \Sigma = \lambda\phi\lambda' + \psi$$

Where Φ = covariance matrix of the factors,

ψ = residual covariance matrix of δ.

Now suppose that if y is greater than some threshold, τ, then y^* equals 1, otherwise y^* = 0.

Bock & Lieberman (1970) described the response strength on any item in the latent trait space in a similar fashion but they write the equation using standardized variables.

(1.11) $$y_i=\alpha_i\theta+\sqrt{(1-\alpha^2)}\,\epsilon$$

Where θ = latent ability with $\mu = 0$ and $\sigma = 1$,

ϵ = specific component of response strength that is distributed with $\mu = 0$ and $\sigma = 1$,

θ and ϵ are considered to be independent.

Both Bock & Lieberman (1970) and Christoffersson (1975) developed their model based on a two parameter latent trait model. Using Lord's (1975) notation, the latent trait model can also be expressed as

(1.12) $$P\{y_j=1 \mid \theta\} = (1-c_j)N[a_j(\theta-b_j)]$$

Where θ = the latent trait variable,

a_j = discrimination parameter,

b_j = difficulty parameter,

c_j = guessing parameter,

N[.] = the normal distribution function.

Lord's notation is referred to as a three parameter latent trait model. The three parameter model includes the discrimination parameter, the item difficulty parameter, and a guessing parameter. The discrimination parameter is related to the factor loading of the item while the difficulty parameter is related to the number of subjects who endorse that particular item. Finally, the guessing parameter is included to adjust for guessing correct answers. The guessing parameter adjusts the height of lower asymptote of the item characteristic curve. A more general form of the three parameter latent trait model can be written in the following manner.

$$P_j(\theta) = c_j + \frac{(1-c_j)\, e^{Da_j(\theta-b_j)}}{1+e^{Da_j(\theta-b_j)}} \tag{1.13}$$

Where D = a constant that can be arbitrarily set,

a_j = discrimination parameter,

b_j = difficulty parameter,

c_j = guessing parameter.

If D is fixed at 1.7 then the model closely resembles the logistic ogive. The two parameter latent trait model assumes that there is no guessing involved in answering the items and therefore includes only a discrimination parameter and a difficulty parameter. Using Lord's notation, the two parameter model can be written in the following manner,

$$P_j(\theta) = \frac{e^{Da_j(\theta-b_j)}}{1+e^{Da_j(\theta-b_j)}} \tag{1.14}$$

A special case of the latent trait model where all items have the same discrimination parameter is called the Rasch Model. The Rasch model is a nonlinear transformation of a special case of the Spearman single factor model in which the factor loadings are required to be the same (McDonald, 1985). The Rasch model assumes that the discrimination parameters, a_j, are equal for all items on the test while the difficulty parameters for the items are allowed to vary. The Rasch model is useful for initial test construction and the opportunity to throw out items is available if the discrimination parameters are too low or too high. The Rasch model is sometimes recommended over other latent trait models because (1) the total sum of items for each subject contains all the information from the data needed to estimate the subjects ability level (2) the estimates of the abilities are independent of the difficulties of the items chosen to measure the ability in question (McDonald, 1985).

Goals of the Current Study

A large number studies have examined the internal consistency of PTSD but most of the studies have tested a rather limited set of alternative hypotheses. For example, in every factor analytic study to date, there has always been just one exploratory factor model fit to the data. The present study will examine alternative factor models that could be fit to sets of items that measure PTSD-related symptoms. Both confirmatory and exploratory factor models will be tested.

In addition to testing measurement hypotheses, etiological predictors of PTSD will be examined. Relationships between measures of pre-military, military and post-military functioning and measures of post-military PTSD will be tested. Pre-military adjustment will be represented by a number of factors including cognitive functioning and reported childhood behavior problems. Military predictors will include measures of combat exposure and whether the soldier was wounded in action. Lastly, post-military adjustment will be determined by marital status, income level and the Keane-MMPI scale.

<u>Primary Hypotheses</u>

Eight primary hypotheses were developed for this study:

1) The factor structure for PTSD-related symptoms will conform best to the DSM-III-R conceptualization of PTSD (DSM-IV was not available before the conclusion of this study). Specifically, the null hypothesis (H_{n1}) states that the oblique DSM-III-R three factor model for PTSD will not fit the covariance structure for the PTSD-related items as well as other one, two, and three factor models. The alternative hypothesis (H_{a1}) states that the oblique three factor model using DSM-III-R criteria will fit the PTSD items better than the alternative one, two, and three factor models (see Figure 1b for hypothesized path model).

2) There will be similarities between the factor structures represented by two alternative measures of PTSD-related symptoms and there will be statistically significant positive correlations across time for the PTSD factors that measure similar constructs. The null hypothesis (H_{n2}) states that the intercorrelation matrix of the between battery PTSD factors will be zero. The alternative hypothesis (H_{a2}) states that the between battery intercorrelation matrix for PTSD factors will be nonzero and positive.

3) The factor structure for PTSD-related symptoms will differ across groups. Specifically, the factor structure for subjects who were exposed to combat will be

unique relative to the factor structure for subjects who were not exposed to combat. The null hypothesis (H_{3n}) states that the factor loadings and factor pattern will be invariant across combat exposure groups. The alternative hypothesis (H_{3a}) states that the factor loadings and factor pattern will not be equal across combat exposure groups.

4) Measures of pre-military cognitive functioning will be associated with higher levels of PTSD symptomatology. Specifically, higher pre-military cognitive functioning will be associated with lower levels of post-military PTSD symptoms. The null hypothesis (H_{4n}) states that the regression coefficient for pre-military cognitive functioning will be zero when predicting PTSD symptoms after discharge from the military. The alternative hypothesis (H_{4a}) states that the pre-military cognitive functioning regression coefficient will be non-zero and negative.

5) Measures of pre-military psychological functioning will be associated with measures of PTSD. Specifically, higher levels of conduct disorder (i.e. more aggressive traits) will be associated with lower post-military PTSD scores. The null hypothesis (H_{5n}) states that the regression coefficient for pre-military psychological functioning will be zero for predicting PTSD symptoms following the war. The alternative hypothesis (H_{5a}) states that the regression coefficient for pre-military psychological functioning will be non-zero and negative for predicting post-military PTSD symptoms.

6) Measures of combat exposure will be associated with PTSD. Specifically, higher levels of combat exposure will be associated with higher levels of PTSD,

independent of pre-military functioning. The null hypothesis (H_{6n}) states that the regression coefficients for the measures of combat exposure will be zero after controlling for pre-military effects. The alternative hypothesis (H_{6a}) states that the combat exposure regression coefficients will be non-zero and positive after controlling for pre-military effects.

7) Self-reported levels of current social support will mediate levels of reported PTSD symptoms. Specifically, higher levels of social support, measured by marital status, will be associated with lower levels of PTSD, independent of the pre-military and military predictors of PTSD. The null hypothesis (H_{7n}) states that the regression coefficients for the measure of current social support will be zero after controlling for pre-military and military effects. The alternative hypothesis (H_{7a}) states that the current measure of social support will be non-zero and negative after controlling for pre-military and military effects.

8) The Keane-PTSD measure developed from the MMPI will be associated with measures of PTSD. Specifically, higher scores on the Keane-PTSD scale will be associated with higher PTSD scores, independent of pre-military functioning or combat exposure. The null hypothesis (H_{8n}) states that the Keane-PTSD regression coefficient will be zero after controlling for pre-military and military effects on PTSD symptoms. The alternative hypothesis (H_{8a}) states that the Keane-PTSD regression coefficient will be non-zero and positive after controlling for the effects of pre-military and military predictors of PTSD.

Chapter II.

Method

Subjects

The Vietnam Experience Study (VES) study was carried out by the Center for Disease Control at the request of Congress (Center for Disease Control: CDC, 1988). The original purpose for designing the VES was to determine negative health effects associated with active military service in the Vietnam War, including any effects of exposure to the defoliant "Agent Orange". Initially, a large sample of subjects (N=48,513) was randomly selected from 4.9 million Vietnam-Era US Army personnel records. Of those records, (n=18,581) subjects qualified for the study by satisfying the following five conditions: (1) entered the Army between January, 1956 and December, 1971, (2) served in the Army for only one term of enlistment, (3) had at least 16 weeks of active service, (4) earned a military occupational specialty other than trainee or duty soldier, and (5) had attained a pay grade no higher than sergeant when discharged from active duty (CDC, 1988).

Of the subjects who qualified for the VES study (n=18,581), most of the Vietnam veterans (87%) and non-Vietnam veterans (84%) were contacted for a comprehensive telephone interview. Approximately half of the n=15,288 subjects interviewed by telephone were also invited by random assignment for an extensive medical and psychological exam one year later. Approximately two thirds of the subjects invited for the exam accepted the invitation (n=4,462). During the examination period, n=2,490 Vietnam veterans and n=1,972 non-Vietnam veterans controls were tested on a wide variety of medical and psychological batteries (see Figure 4 for details of the selection process).

Procedure

Preliminary Data Collection. Records were obtained regarding characteristics at the time of entry into the military for all subjects who qualified for the study. A certain amount of standard background information is recorded by the Army at the time of entry into the service for all individuals. During the Vietnam War, standard military procedures required that all subjects take both the Armed Forces Qualification Test (AFQT) and the Army Classification Battery (ACB) at time of entry into the military. It is relatively easy to obtain the ACB and AFQT test scores for enlisted men because the scores are recorded on form 20, a form that accompanies the enlisted men throughout their career in the Army.

Phone Interview. Some attrition due to death occurred between time of enlistment and the post-war examination. The remaining veterans were all eligible for a comprehensive structured telephone interview. A contract with the Research Triangle Institute provided the necessary manpower to trace, contact and interview eligible veterans. The tracing was accomplished through mailings, telephone directory assistance, credit bureau searches, and motor vehicle registration records. Once a veteran was located, a letter was sent requesting their participating in the initial telephone interview (See Appendix 4). Tracing and interviewing for the study began in February 1985 and ended in July 1986.

The primary purpose of the telephone interview was to obtain information on

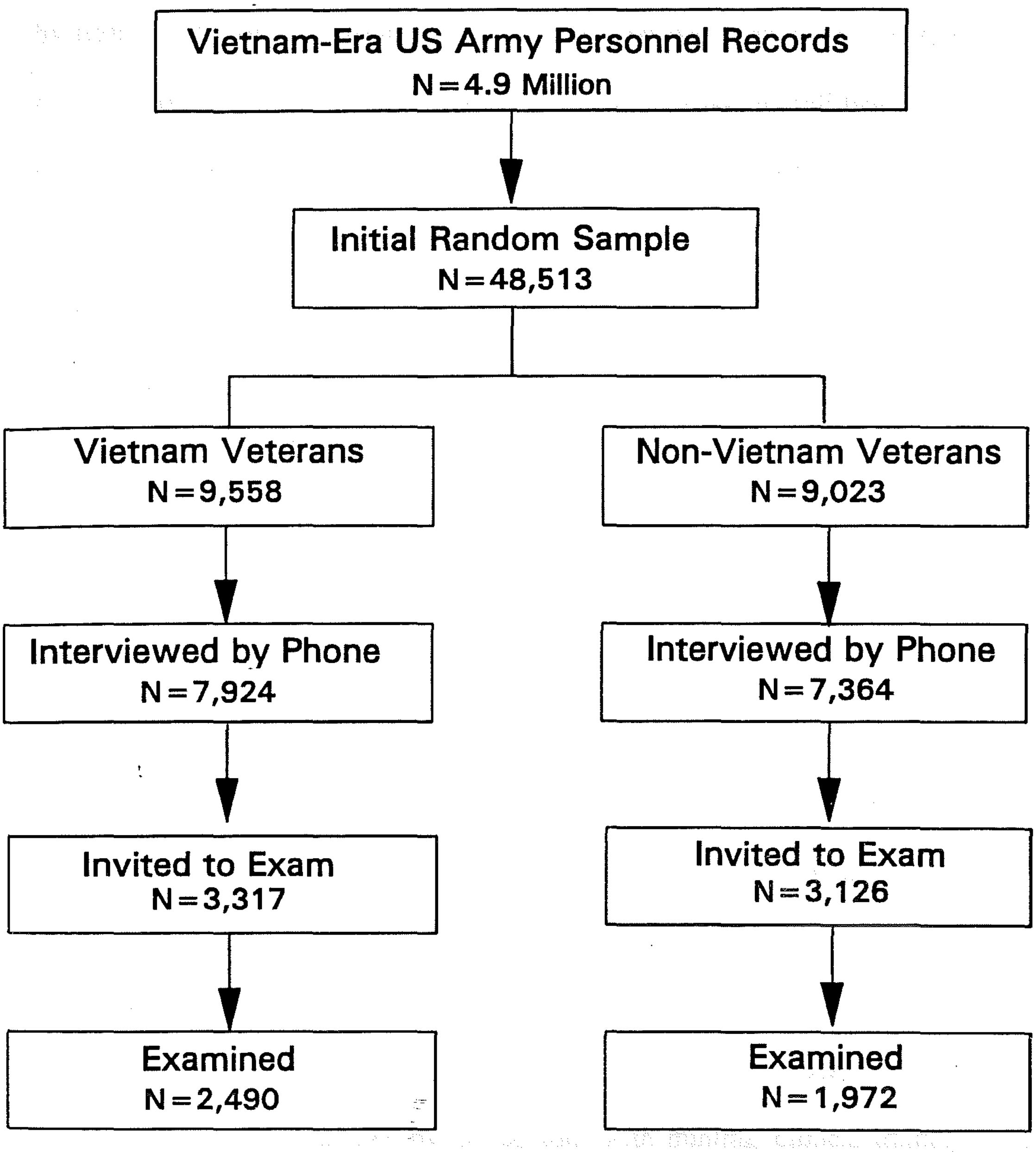


Figure 4: Selection of Sample for VES Study

the past and present health status of Vietnam and Non-Vietnam veterans in terms of self-reported health outcomes. The structured telephone interview was administered by trained interviewers using a computer-assisted telephone interview system. During the telephone interview, subjects were given assurances of confidentiality regarding the information they provided due to the sensitive nature of many of the questions. Information was collected regarding family background, tour of duty, medical history, current and past psychological status, and the status of the subjects' offspring.

Medical and Psychological Exams. Extensive medical and psychological batteries were administered to a subset of the telephone interviewed subjects approximately one year after the telephone interview. Individuals were brought into test centers for three days of testing. On the first day, subjects were given a thorough medical examination. During the second day of the study, subjects were administered a full day of psychological and neuropsychological tests. On the third day, subjects were provided feedback on both the medical and psychological exams.

Psychological health was assessed with the Diagnostic Interview Schedule: Version III-A (DIS-III-A; Robins, Helzer, Croughan, & Ratcliff, 1981), a modification of the diagnostic instrument used in the Epidemiological Catchment Area Study (Robins & Rogier, 1991). The DIS is a structured clinical interview that was developed to be administered by lay persons with minimal clinical training. The DIS-III-A was used to assess the prevalence of clinical disorders according to DSM-III criteria. Reliability and quality control of the technicians administering the DIS-III-A was ensured by providing intensive eight day training sessions and audiotaping every tenth interview that the technician administered. Feedback from the audiotaped interviews was provided to the technicians on a regular basis from independent reviewers.

Variables

Entry into Military. For the VES study, the United States Army provided scores on four of the subtests from the ACB: (1) ACB-Verbal, (2) ACB-Arithmetic, (3) ACB-Pattern Analysis, and (4) ACB-General Information. The Army also provided scores for the AFQT. The AFQT consists largely of verbal and arithmetic items that are similar to the items of ACB-Verbal and ACB-Arithmetic subtests.

Additional demographic variables were made available regarding the subjects' status during their tour of duty such as date of entry into military, date of separation from military, type of enlistment status, marital status at time of discharge, race, total active service time, primary duty, and combat versus noncombat assignments.

Phone Interview. The telephone interview covered questions regarding both the medical and psychological health status of the veterans. As part of the psychological status questions, a series of questions was asked regarding the experience of PTSD-related symptoms in the previous 6-months. The items closely corresponded to DSM-III PTSD criteria. Some of the questions explicitly asked about symptoms related to the subjects' experience in the military while other questions were more general questions regarding problems with sleep and concentration (See Appendix 5 for list of questions). The scales for the psychological status questions ranged from 0 to 3. A response of 0 was associated with "never" experiencing the symptom while a response of 3 represented experiencing the symptom "very often."

Subjects were also questioned about their experience with military combat during the telephone interview. Questions were asked about the frequency of occurrence of five different types of combat that the individuals may have encountered during the war: (1) incoming fire, (2) sniper fire, (3) firefights, (4) mines and booby traps, and (5) ambushing (See Appendix 6 for list of questions).

Medical and Psychological Exams. The DIS-III-A was used to assess a number of psychological diagnoses including PTSD and Conduct Disorder. For both PTSD and Conduct Disorder, the DIS-III-A items are a series of dichotomous yes/no questions regarding symptoms associated with each disorder. For PTSD, the items inquired into current and past experiences with specific PTSD symptoms. For Conduct Disorder, the items retrospectively inquired into the occurrence of certain problem behaviors during childhood and adolescence.

In addition to the DIS-III-A, individuals were administered the Minnesota Multiphasic Personality Inventory (MMPI). The MMPI is a self-administered 566 item test of true/false questions that measures 10 broad personality and emotional constructs and four validity indicators. A large number of published subscales have been derived from the MMPI including the 49 item Keane-PTSD scale.

As part of the psychological exam, subjects were also administered the Combat Exposure Index (CEI: see Appendix 7). The CEI measures self-report frequencies of twelve combat related events including incoming fire, sniper and sapper fire, firefights, mines and booby traps, and ambushes. The items are rated on a scale from zero to four and the items are totaled into a single composite score.

Analyses

Selection Effects. It was helpful to characterized the VES study according to the different selection processes that occurred as part of the study design. The sample can be described as a single random sample of veterans or as three subsamples based on the design of the study. The three primary subsamples were (1) subjects who did not receive either the telephone interview or the extensive follow-up exam (Non-Participants: NONP), (2) subjects who received only the telephone interview (Phone Interview Only Participants: PIOP), and (3) subjects who were administered both the telephone interview and the extensive medical and psychological follow-up exams (Phone Interview and Exam Participants: PIEP).

The NONP largely consisted of subjects who died during or after the war or subjects who could not be located for the telephone interview. The NONP were more likely to include destitute and homeless individuals who did not have a permanent residence or personal telephone listing. Differences between the NONP and the other two subsamples were examined for selection effects using multiple regression, logistic regression, and multivariate analysis of variance (MANOVA). Two dummy coded variables were created that contrasted 1) the PIOP and the NONP and 2) the PIEP and the NONP. The independent variables for the analyses were the two dummy coded group effects. The dependent variables for the analyses were race, marital status at time of discharge, enlistment status (volunteered versus drafted), age of entry into the military, and the five cognitive scales from the ACB and AFQT.

Selection effects were also examined with regard to military assignment into combat zones. Previous research has examined the effects of combat on numerous health status outcomes but no studies to date have examined the process in which soldiers were assigned (or selected) into combat. Logistic regression was used to predict combat status from a number of pre-military characteristics. The dependent variable was a dummy code based on whether or not the subject had been in combat (non-combat=0, combat=1). The independent variables were race (black versus other), marital status at time of discharge (never married versus ever married), enlistment status (volunteered versus drafted), age of entry into the military, and the five cognitive scales from the ACB and AFQT. In addition, a separate analysis was run with only subjects who were assigned into combat. For these analyses, a multiple regression model was used to assess which pre-military characteristics predicted self-reported levels of combat exposure.

Finally, selection effects were tested to examine differences between the PIOP and the PIEP based on the psychological status variables collected during the phone interview. The analyses tested whether certain types of individuals were more likely to accept an invitation to the follow-up examination. MANOVA was used to test group differences on the twelve PTSD-related items. The independent variable was a single dummy variable coded zero for the PIOP and one for the PIEP. The dependent variables were the twelve PTSD-related phone interview items.

Simulating Latent Trait Factor Models. Different structural equation modeling programs were examined to test both the power and efficiency of each program in reproducing population parameters from known factor models generated in SAS. The SAS program listed in Appendix 8 was used to generate the simulated data. The program created two standardized normally distributed factor scores with a correlation of .60 between the two factors. Four continuous normally distributed standardized variables were generated from each of the factor scores based on equation (1.11), using loadings equal to .80 for each item. Next, sets of eight dichotomous items were generated from the eight continuous items based on varying item difficulties (i.e., z-score cut points). The five item difficulties selected for the simulation were based on normal z-scores of 0.0, 1.0, 1.5, 1.75, and 2.0. In Table 12, the population parameters for alternative latent trait factor models are presented.

The four programs that were evaluated were SAS, LISREL (Joreskog & Sorbom, 1989), LISCOMP, and NOHARM. For SAS, the tetrachoric correlation matrix generated from PRELIS was used as an estimate of the true correlation matrix. For the other three programs, routines are available for fitting latent trait factor models. PRELIS (Joreskog & Sorbom, 1989) was used to compute the tetrachoric correlation matrices for testing the latent trait factor models in LISREL 7 (Joreskog & Sorbom, 1989). For both LISREL and LISCOMP, a weighted least-squares analysis was used to estimate the factor structure.

Generating Power Curves for Latent Trait Factor Models. The power of a statistical test can be determined by first specifying a null hypothesis and an alternative hypothesis. In this study, the null hypothesis for the power analysis was a one factor model with eight indicators while the alternative hypothesis was a two

Table 12

Parameters used to Generate Alternative Latent Factor Models

	Model 1	Model 2	Model 3	Model 4	Model 5
a_{11}	.80	.80	.80	.80	.80
a_{12}	.80	.80	.80	.80	.80
a_{13}	.80	.80	.80	.80	.80
a_{14}	.80	.80	.80	.80	.80
a_{21}	.80	.80	.80	.80	.80
a_{22}	.80	.80	.80	.80	.80
a_{23}	.80	.80	.80	.80	.80
a_{24}	.80	.80	.80	.80	.80
b_{11}	0.0	1.0	1.5	1.75	2.0
b_{12}	0.0	1.0	1.5	1.75	2.0
b_{13}	0.0	1.0	1.5	1.75	2.0
b_{14}	0.0	1.0	1.5	1.75	2.0
b_{21}	0.0	1.0	1.5	1.75	2.0
b_{22}	0.0	1.0	1.5	1.75	2.0
b_{23}	0.0	1.0	1.5	1.75	2.0
b_{24}	0.0	1.0	1.5	1.75	2.0
R_{12}	.60	.60	.60	.60	.60

Note: a's represents standardized factor loadings while b's represent z-score cut-points.

factor model with four indicators each. These two factor structures were considered to be important models to differentiate between in this study. It was assumed that if the two factor model could be differentiated from the one factor model, then the power to detect other factor models would be adequate. To determine the power to reject a one factor model, a one factor latent trait model was fit to the data generated from a two factor latent trait population structure. The χ^2 obtained from fitting the one factor model to the two factor structure was used to generate the power curves.

Latent Trait Factor Models using PTSD Symptoms. The latent trait factor structure for two sets of PTSD-related symptom items were tested. The first set of PTSD-related items were administered to subjects during the telephone interview. The second set of PTSD-related items were administered as part of the structured clinical interview using the DIS-III-A. The alternative models were designated by a four digit code. The first digit represented the number of factors. The second digit represented a two factor combination of the three DSM PTSD symptom clusters. For a value of 1, items from DSM cluster one and two were combined under a single factor. For a value of 2, items from DSM cluster two and three were combined under a single factor. For a value of 3, items from DSM cluster one and three were combined under a single factor. The third digit in the model code defined whether the DSM-III or DSM-III-R criteria was used to define the factor structure. The DSM-III and DSM-III-R aggregate symptoms in a slightly different manner and the differences between the alternative diagnostic criteria were tested. Finally, the fourth digit represented the type of factor rotation (1=orthogonal rotation; 2=oblique rotation).

A number of alternative factor models were fit to both sets of items. The baseline model, or null model (M_{0000}), was defined to make relative comparisons to other model fits. In accordance with the recommendations of Anderson and Gerbing (1988), M_{0000} allowed for no intercorrelations between items in the model and by definition was considered to be the worst fitting model. M_{1000} was defined as a one factor model. The one factor model is the most straightforward factor model because it cannot be rotated. M_{1000} is the same model regardless of whether DSM-III or DSM-III-R criteria were being tested.

A two factor model proposed by Horowitz (1976) organized PTSD-related symptoms into two categories (factors) that were called intrusion and avoidance. Items related to an exaggerated arousal response were included under the intrusion factor while items related to inattention and amnesia were included under the avoidance factor. The two factor models can be rotated to either an orthogonal or an oblique solution. If an oblique solution is specified, then a covariance structure is estimated between the factors. M_{2111}, M_{2211}, M_{2311} were designated the two factor orthogonal models using the DSM-III criteria while M_{2112}, M_{2212}, M_{2312} were designated the two factor oblique models using DSM-III criteria. Similarly, M_{2121}, M_{2221}, M_{2321} were designated the two factor orthogonal models using the DSM-III-R criteria while M_{2122}, M_{2222}, M_{2322} were designated the two factor oblique models using DSM-III-R criteria.

The most commonly hypothesized model regarding PTSD-related symptoms is the three factor model proposed in DSM-III-R; the three factors specified are: 1) re-experiencing of the trauma, 2) persistent avoidance, and 3) increased arousal (see Figure 1b). Again, the factor model can be rotated to either an orthogonal or an oblique solution. M_{3011} and M_{3012} represents the three factor orthogonal and oblique solutions for DSM-III criteria while M_{3021} and M_{3022} represent the three factor orthogonal oblique solutions for DSM-III-R criteria.

Finally, Laufer, Brett & Gallops (1985) proposed a four factor model for PTSD-related symptoms. The scales they developed were Intrusive Imagery, Numbing, Hyperarousal, and Cognitive Disruptions. This model is very similar to DSM-III-R with the addition of a cognitive impairment factor. This model was considered to fall within the definition of an exploratory model. A summary of the alternative factor models is presented in Table 13.

Multiple Group Latent Trait Factor Models. For the diagnosis of PTSD, the DSM requires that a person has "experienced an event that is outside the range of usual human experience...." Combat is considered one of the events that falls outside the range of usual human experience. Multiple group latent trait factor models were fit to test for factor invariance between subjects who had been exposed to a combat and subjects who had not been exposed to combat. If it could be determined that the factor structure was invariant across groups that differed in their exposure to combat, the result would suggest that combat itself is not responsible for producing a unique set of PTSD symptoms.

Table 13

Alternative Confirmatory Factor Models

M_{0000}	A null factor model that allows no intercorrelations between PTSD-related symptoms. All models will be evaluated relative to this baseline.
M_{1000}	A one factor model with estimated loadings for all PTSD-related symptoms.
M_{2111}	An orthogonal two factor model. Loadings will be estimated on the first factor for DSM-III-R Cluster 1 symptoms. Loadings will be estimated on the second factor for Cluster 2 and Cluster 3 symptoms.
M_{2211}	An orthogonal two factor model. Loadings will be estimated on the first factor for DSM-III-R Cluster 2 symptoms. Loadings will be estimated on the second factor for Cluster 1 and Cluster 3 symptoms.
M_{2311}	An orthogonal two factor model. Loadings will be estimated on the first factor for DSM-III-R Cluster 3 symptoms. Loadings will be estimated on the second factor for Cluster 1 and Cluster 2 symptoms.
M_{2112}	An oblique two factor model. Loadings will be estimated on the first factor for DSM-III-R Cluster 1 symptoms. Loadings will be estimated on the second factor for Cluster 2 and Cluster 3 symptoms.
M_{2212}	An oblique two factor model. Loadings will be estimated on the first factor for DSM-III-R Cluster 2 symptoms. Loadings will be estimated on the second factor for Cluster 1 and Cluster 3 symptoms.

Table 13

Continued:

M_{2312}	An oblique two factor model. Loadings will be estimated on the first factor for DSM-III-R Cluster 3 symptoms. Loadings will be estimated on the second factor for Cluster 1 and Cluster 2 symptoms.
M_{3011}	An orthogonal three factor model. Loadings will be estimated for each factor according to the 3 symptom clusters in DSM-III-R.
M_{3012}	An oblique three factor model. Loadings will be estimated for each factor according to the 3 symptom clusters in DSM-III-R.
M_{EXPL}	Exploratory Model

Latent Trait Factor Model using the PTSD-MMPI items. The Keane-PTSD scale developed by Keane et al. (1984) was examined with regard to its psychometric properties. The limited number of studies on the reliability and construct validation of the Keane-PTSD scale suggested that further test development would be useful. In previous studies, it was assumed that the Keane-PTSD scale measured just one factor (Keane, 1993). Fitting a latent trait factor model to 49 items is problematic. Neither LISREL nor LISCOMP were capable of running a 49 item model so an exploratory factor analysis was fit using the NOHARM (McDonald, 1985). The four items that did not load onto the one factor model or had a low correlation with the total score were dropped from the Keane-PTSD measure, yielding a 45 item Keane-PTSD-R scale.

Regression Models. Only post-combat measures of PTSD were collected in this study, therefore, for practical reasons, the diathesis-stress model was fit as a series of hierarchical regression models. During the phone interview, the PTSD scale measured symptoms experienced in the last 6 months. During the follow-up exam, the DIS-PTSD scale measured both current (last month) and lifetime experience of PTSD symptoms. Subjects who were diagnosed with DIS-PTSD at some point in the past and were not currently experiencing symptoms were referred to as "in remission." Subjects who were diagnosed with DIS-PTSD and were currently experiencing symptoms were identified as "current." The DIS-PTSD scale also measured PTSD based on a delayed-onset/non-delayed-onset dimension. The dependent measures for the hierarchical regression analyses were the following:

1) Phone Interview PTSD Total (PHONE-PTSD): The measure was the sum total of 12 items that comprised the Phone Interview PTSD scale. The raw score total was positively skewed, therefore, both the raw score total and the logarithm of the raw score total were analyzed. Linear regression models were used to estimate parameter estimates.

2) Lifetime diagnosis of PTSD assessed by the DIS (LDX-PTSD): The measure was a dichotomous item created from the DSM criteria. Both the DSM-III and the DSM-III-R criteria were tested. Logistic regression models were used to estimate parameter estimates.

3) Current diagnosis of PTSD assessed by the DIS (CDX-PTSD): The measure was a dichotomous item created from the DSM criteria. Both the DSM-III and the DSM-III-R criteria were tested. Only subjects who were positive for a lifetime DIS-PTSD diagnosis were included in the analyses. Logistic regression models were used to estimate parameter estimates.

4) Delayed onset PTSD assessed by the DIS (DDX-PTSD): The measure was a dichotomous item created from the DSM criteria. Both the DSM-III and the DSM-III-R criteria were tested. Only subjects who were positive for a lifetime DIS-PTSD diagnosis were included in the analyses. Logistic regression models were used to estimate parameter estimates.

For each dependent variable, univariate regression models were run for every independent variable. Next, each of the four PTSD measures were regressed onto pre-military, military, and post-military predictors in an incremental fashion. Pre-military variables were entered into the model first, then military predictors, and lastly, post-military predictors. In addition to these three models, there was one interaction model tested. All two-way interactions with combat exposure were entered into a model following the addition of the pre-military, military, and post-military variables.

The independent variables used in the regression analyses varied depending on the sample that was being tested. For the Phone Interview sample, there were a limited number of variables that were available. In Table 14, the independent variables are listed according to the step in which they were entered into the regression model. Some of the independent variables, such as conduct disorder, were only available for the follow-up exam sample.

MMPI Subscales. Group differences on the thirteen MMPI subscales were tested using the delayed-onset PTSD diagnosis and the current PTSD diagnosis. First, a series of ANOVAs based on the delayed-onset PTSD diagnosis was tested. Next, a series of ANOVAs based on the current PTSD diagnosis was tested. All the MMPI subscales could not be tested simultaneously because of the overlapping items between scales. In addition, the individual ANOVAs were not independent tests and therefore were considered to be exploratory analyses.

Table 14

Independent Variables used in Regression Analyses

Measures	Description of Variable
A) Pre-Military	
1) Age of Entry	Age of entry into the military.
2) Ability	First principal component of ACB and AFQT.
3) Enlisted	Volunteer=1; Drafted=0.
4) Race	Black=1; Other=0.
5) Single	Single when entered into military=1; Other=0.
6) Conduct	Conduct Disorder=1; Negative=0.
B) Military	
1) Combat	Continuous measure of combat exposure.
2) Wounded	Wounded in action=1; Not wounded=0.
3) Herbicide	Ordinal scale describing Agent Orange exposure.
C) Post-Military	
1) Post-Test	Tested at Follow-up Exam=1; Not Tested=0;
2) Income	Ordinal measure of current annual income.
3) Married	Currently married=1; other=0.
4) Keane-PTSD-R	Sum score of the revised Keane-PTSD scale.

Chapter III.

Results

Descriptive Statistics

The descriptive statistics obtained at the time of entry into the military for the total sample with complete data (N=18,131) are presented in Table 15. The average age of entry into the military for the entire sample was 20.4 years. The youngest person to enlist in the sample was 15 years (sic) of age and the oldest person to enlist was 35 years of age. Twelve percent of the men were black and 70.6% were single when they entered the military. Thirty-five percent of the men enlisted into the Army while the rest of the men (64.7%) were drafted. The means and standard deviations for the ACB subscales and the AFQT were relatively similar to previously reported Army norms.

The descriptive statistics for the twelve Phone Interview PTSD Symptoms are presented in Table 16 (See Appendix 9 for reliabilities). The items represent symptoms experienced by the subject in the last 6 months prior to being administered the Phone Interview. The item scores ranged from 0 to 3. The highest mean values for the 12 symptoms were for Hypervigilance and Trouble with Sleep. The lowest mean values were obtained for Deja Vu Experiences about the Army and Shame/Guilt about the Army. In general, items that specifically referenced the Army had lower means than the items that referenced more general symptoms.

The descriptive statistics for the frequency of occurrence of certain combat related activities are presented in Table 17. The data were collected only on subjects

Table 15

Entering Characteristics of VES Sample (N=18,131)

	Mean	(Std)	Min	Max
Age Entry	20.4	(1.74)	15	35
Black %	12.3	(32.9)	0	1
Enlisted %	35.3	(47.8)	0	1
Single %	70.7	(45.5)	0	1
AFQT	51.4	(25.8)	1	112
ACB-VERB	105.6	(22.0)	9	176
ACB-ARIT	102.7	(21.8)	12	179
ACB-PA	102.6	(22.4)	7	179
ACB-GI	100.6	(18.4)	1	178

Table 16

Phone Interview PTSD Symptoms in the Last 6-Months (N=15,120)

PTSD Symptoms	Mean	(Std)	Min	Max
Nightmares about army	.37	(.67)	0	3
Painful memories of army	.45	(.71)	0	3
Deja vu experience about army	.23	(.53)	0	3
Lost interest	.83	(.81)	0	3
Felt distant others	.78	(.87)	0	3
Life not meaningful	.45	(.75)	0	3
Hypervigilance	1.35	(.88)	0	3
Trouble with Sleep	1.00	(1.0)	0	3
Shame/guilt about army	.24	(.60)	0	3
Trouble Memory/Concentrating	.90	(.88)	0	3
Anxious about reminders of army	.35	(.64)	0	3
Avoid reminders of army	.40	(.78)	0	3

Table 17

Phone Interview Combat Exposure Items (N=7,235)

Combat Items	Perc Freq	(Std)	Mean Freq	(Std)
Received Incoming fire	94.6	(22.6)	51.2	(95.3)
Received sniper or sapper fire	80.2	(39.8)	27.3	(68.1)
Involved in firefights	58.1	(49.3)	15.4	(49.6)
Mines/booby traps	43.5	(49.6)	15.4	(53.3)
Ambushed	37.8	(48.5)	4.1	(23.4)

who had experienced combat (n=7,235). The percent frequency column represents the percent of the subjects who experienced the specific combat event. The mean frequency column represents the group average of the number of times that a subject reported experiencing a certain combat activity. Receiving incoming fire occurred to 94.6% of the subjects who reported experiencing combat. On average, subjects who experience combat experienced incoming fire 51.2 times during their tour of duty. Fewer subjects reported experiencing events such as firefights or booby traps (58.1%, 43.5% respectively). The least frequent combat event that occurred in this sample was being ambushed (37.8%). On average, ambushes occurred 4.1 times during the subjects' tour of duty.

In Table 18 the descriptive statistics for the DIS-PTSD symptoms experienced in the last month and over the lifetime are reported (See Appendix 10 and 11 for reliabilities). The most frequently occurring symptom in the last month and over the lifetime was being jumpy or easily startled. Slightly more than seven percent of the subjects experienced the symptom in the last month while thirty-one percent of the subjects experienced the symptom over the lifetime. The least frequently experienced symptom was shame and guilt associated with surviving a traumatic event. The symptom was experienced by 1.4 percent of the subjects in the last month and 5.9 percent of the subject over the lifetime. The relative frequency of the DIS-PTSD symptoms was similar to the relative frequency of the Phone Interview PTSD symptoms that were collected one year earlier (compare Table 16 and Table 18). For example, the same symptoms that were reported most frequently in the Phone

Table 18

Current and Lifetime DIS-PTSD Symptoms (N=4,462)

DIS-PTSD Symptoms	Last Month Mean	(Std)	Lifetime Mean	(Std)
Recurrent thoughts/dreams	5.8	(23.3)	27.1	(44.4)
Felt as if event was recurring	1.8	(13.5)	6.5	(24.6)
Numbing experience	4.1	(19.8)	12.4	(33.0)
Jumpy or easily startled	7.4	(26.2)	31.0	(46.3)
Trouble sleeping	5.2	(22.3)	27.7	(44.7)
Ashamed of being alive	1.4	(11.8)	5.9	(23.5)
Forgetful or trouble concentrating	3.9	(19.3)	10.9	(31.1)
Symptoms worsen in situations	2.7	(16.2)	12.6	(33.2)
Avoids situations that remind	6.1	(23.9)	22.6	(41.8)

Interview were the same symptoms that were reported most frequently during the DIS interview.

Descriptive statistics for DIS-Conduct Disorder items are presented in Table 19. The most frequently reported childhood event was stealing (44.4%). Other frequently reported childhood events include playing hooky, fighting in school, and damaging property. The least frequently reported childhood event was gambling with only 0.6% reporting some type of serious gambling before the age of 15. In Table 20 the frequency distribution for the sum score of the DIS-Conduct Disorder items is presented (See Appendix 13 for reliabilities). Thirty-one percent of the subjects reported never having engaged in any of the twelve activities while thirteen percent of the subjects reported engaging in four or more of the twelve activities before the age of 15.

In Table 21, the means and standard deviations for the K-corrected MMPI subscales are presented. The MMPI subscales are normed to a mean of 50 and a standard deviation of 10. MMPI subscale scores that were five standard deviations above the mean were considered to be outliers and were deleted from the sample. In general, the means for the MMPI subscales fall within normal limits. Descriptive statistics for the Keane-PTSD and Keane-PTSD-R scale are also presented. The reliabilities for the Keane-PTSD scale are presented in Appendix 14. The Keane-PTSD-R scale was created by examining both the factor loadings from an exploratory one factor model and the reliabilities of the items. Any item that had a standardized factor loadings below .50 or a total item correlation that was less than .30 was

Table 19

Lifetime DIS-Conduct Disorder Scale (N=4,462)

Items	Mean	(Std)	Min	Max
Expelled/Suspended	12.1	(32.7)	0	1
Played Hooky	28.2	(45.0)	0	1
Fighting in School	15.5	(36.2)	0	1
Fighting out of School	5.2	(22.3)	0	1
Ran away from home	8.3	(27.6)	0	1
Told many lies as a child	12.4	(33.0)	0	1
Stealing	44.4	(49.7)	0	1
Damaged Property	13.2	(33.8)	0	1
Arrested	9.1	(28.8)	0	1
Alcohol Use	10.9	(31.1)	0	1
Drug Use	0.7	(8.4)	0	1
Gambling	0.6	(7.6)	0	1

Table 20

Frequency Distribution for Lifetime DIS-Conduct Disorder Items

Conduct	Freq	Perc	Cum Freq	Cum Perc
0	1387	31.1	1387	31.1
1	1276	28.6	2663	59.7
2	764	17.1	3427	76.8
3	457	10.2	3884	87.0
4	251	5.6	4135	92.7
5	150	3.4	4285	96.0
6	78	1.7	4363	97.8
7	53	1.2	4416	99.0
8	25	0.6	4441	99.5
9	14	0.3	4455	99.8
10	5	0.1	4460	100.0
11	2	0.0	4462	100.0

Table 21

Descriptive Statistics for MMPI Profiles (N=4,123)

Scale	Mean	(Std)	Min	Max
L	50.7	(7.4)	36	80
F	55.6	(8.5)	44	96
K	54.5	(9.4)	29	79
Hypochondriasis	57.0	(8.8)	35	93
Depression	60.0	(12.4)	29	99
Hysteria	57.0	(8.8)	35	93
Psychopathic Deviate	59.9	(10.8)	32	97
Masculinity-Femininity	58.6	(9.3)	30	90
Paranoia	56.0	(9.5)	30	99
Psychasthenia	57.9	(11.1)	30	99
Schizophrenia	57.0	(12.3)	23	99
Hypomania	57.3	(10.7)	28	96
Social Introversion	53.9	(10.5)	29	87
Keane-PTSD	10.2	(7.4)	0	41
Keane-PTSD-R	8.4	(7.3)	0	38

Note. MMPI profiles with subscales that were five standard deviations above the populations norms were deleted from sample.

dropped from the revised scale. Based on this inclusion criteria, four items were dropped from the revised scale.

In Table 22, the base rates for PTSD based on alternative DSM criteria and levels of combat exposure are presented. When DSM-III-R criteria were used to diagnosis PTSD, more individuals were diagnosed with PTSD relative to the DSM-III criteria. In addition, subjects who were exposed to combat were more likely to experience PTSD related symptoms. In Table 23 the base rates for diagnosing PTSD using DSM-III and DSM-III-R criteria are presented for only Vietnam Veterans. The table includes only Vietnam veterans so that relative comparisons could be made with previously reported data from the NVVSR study. Within the VES study, if DSM-III criteria were used to diagnosis PTSD, 2.5% of the subjects were given a current diagnosis of PTSD. Current was defined in the VES study as symptoms that occurred in the last month. When assessing a lifetime PTSD diagnosis using the DSM-III, 15.4% of the subjects met the diagnostic criteria. In most published reports of the VES study, only the DSM-III base rates were reported. When DSM-III-R criteria were used to diagnose PTSD, 3.3% of the subjects were assigned a current diagnosis of PTSD while 25.2% of the subjects were given a lifetime diagnosis of PTSD. The DSM-III-R estimates of PTSD more closely resemble the NVVSR study and may explain the differences that were reported between the two studies.

Selection Effects

Selection Into the Study. In Table 24, the results for the univariate linear regressions and logistic regressions in predicting entering characteristics of the

Table 22

Baserate Differences between DSM-III and DSM-III-R Criteria

		Non-Combat (N=2,131) Perc	(STD)	Combat (N=2,265) Perc	(STD)
DIS-III	Current	0.0	(2.1)	2.5	(15.5)
	Lifetime	0.7	(8.7)	15.4	(36.2)
DSM-III-R	Current	0.1	(3.1)	3.3	(17.8)
	Lifetime	1.0	(10.0)	25.2	(43.5)

Table 23

Comparison between VES and NVVSR for PTSD Baserates

	VES DSM-III 1-M	Life	VES DSM-III-R 1-M	Life	NVVSR DSM-III-R 6-M
Theater Veterans	2.5	15.4	3.3	25.2	15.2
High Combat	3.6	21.8	4.9	34.1	38.5
Low Combat	0.5	4.8	0.5	10.1	8.5

Table 24

Mean Differences in Entering Characteristics for Three Subsamples

	NONP (N=3,210) Mean	PIOP (N=10,572) Mean	PIEP (N=4,349) Mean	R^2
Age Entry	20.1	20.5	20.4	.006*
Black %	19.4	10.5	12.2	.012*
Enlisted %	40.9	33.1	36.9	.002*
Single %	74.1	69.9	70.1	.001*
AFQT	46.0	52.1	53.8	.010*
ACB-VERB	102.0	106.0	107.2	.006*
ACB-ARIT	97.5	103.5	104.5	.012*
ACB-PA	99.0	103.0	104.4	.006*
ACB-GI	97.0	101.1	102.1	.011*

Note. * represents $p<.01$,

$F_1(5,18125) = 43.3$, $\Lambda = .988$, $p<.01$

subjects from group characteristics of the study are presented. The NONP group was younger when they entered the military (R^2=.006), were more likely to be black (R^2=.012), volunteered more often for the service (R^2=.002), and were more likely to be single when they entered the military (R^2=.001) compared to the PIOP and PIEP groups. The effect sizes were relatively small with the largest effect size for minority status. A MANOVA using the five military entrance tests as dependent variables revealed relatively small but statistically significant differences between the three subsamples on the five ability scores ($F_1(5,18124)=43.3$, $\Lambda=.988$). The NONP scored lower than the other two groups on all five ability scores with the R^2 ranging from .006 to .012.

Selection Effects Based on Death Prior To Study. Another selection process that may have contributed to difference between the three subsamples was the death of the subjects in the NONP group. In Table 25, the results for the logistic regression predicting death from initial status measures are presented for the entire sample (N=18,130). The overall χ^2 difference was statistically significant (χ^2=29 with 5 df, $p<.01$) but the effect size was small (R^2=.01). There were statistically significant independent effects for age of entry into the military, single status, and ability score. Subjects who entered the military at a younger age were more likely to have died prior to the beginning of the study (β=-.09) as well as individuals who were single when they entered the military (β=.09). In addition, individuals who scored lower on the ability measures (β=-.07) were more likely to have died prior to the beginning of the study. There were no statistically significant differences in the

Table 25

Predicting Death from Pre-Military Characteristics (N=18,130)

Variables	B	(se)	β	
Intercept	-2.33	(.83)	.00	*
Age of Entry	-.10	(.04)	-.09	*
Black %	.06	(.17)	.01	
Enlisted %	.05	(.12)	.01	
Single %	.36	(.14)	.09	*
Ability	-.13	(.06)	-.07	*

Note: χ^2=29.0 with 5 Df; Pseudo R^2=.01

death rate by racial group. Again, the effect size for the overall result was relatively small but statistically significant.

Selection into Combat. An important selection process to understand was how subjects were selected (or assigned) into combat duty. In Table 26, the results of the logistic regressions in predicting whether an individual was assigned into a combat or a non-combat position are presented. The χ^2 difference was statistically significant (χ^2=122 with 5 df, p<.01). The tests of significance for the individual parameter estimates showed statistically significant effects for age of entry, race, and ability score. Individuals who entered the military at a younger age were more likely to be assigned a combat duty (B=-.07, β=-.07, p<.01) while blacks were less likely to be assigned a combat duty (B=-.16, β=-.03, p<.01). Finally, soldiers who scored lower on the ability measures were more likely to be assigned combat duty than soldiers who scored higher on the ability measures (B=-.11, β=-.06, p<.01). The effects were relatively small with the overall pseudo R^2 equal to .01.

An alternative way to view the assignment into combat was to study only those individuals who were assigned into combat. The self-reported combat exposure items administered during the Phone Interview (see Table 17) were summed into a composite score that was relatively normally distributed. A multiple regression analysis was performed using the same predictors from the previous logistic regression analysis. The dependent variable for the analysis was the composite combat score and the analysis included only those subjects who were assigned to combat. The overall F test was statistically significant (F[5,7145]=30.6, p<.01)

Table 26

Predicting Combat from Pre-Military Characteristics (N=14,937)

Variables	B	(se)	β	
Intercept	1.39	(.23)	.00	*
Age of Entry	-.07	(.01)	-.07	*
Black %	-.16	(.06)	-.03	*
Enlisted %	.06	(.04)	.02	
Single %	.01	(.04)	.00	
Ability	-.11	(.02)	-.06	*

Note: χ^2=122 with 5 Df; Pseudo R^2=.01

with an $\underline{R}^2$ equal to .02 (See Table 27). The test of the individual b-weights revealed statistically significant effects for type of enlistment (B=-.32, $\underline{\beta}$=.02, p<.01), single status (B=-.12, $\underline{\beta}$=-.04, p<.01), age of entry into the military (B=-.11, $\underline{\beta}$=-.07, p<.01) and ability score (B=-.07, $\underline{\beta}$=-.06, p<.01). There was not a statistically significant effect for race. Volunteers and single men were less likely to be exposed to heavy combat than drafted and married men. In addition, younger, less intelligent men were more likely to see heavy combat than older, more intelligent men.

Selection into the Extensive Follow-Up Exam. In Table 28, the descriptive statistics for the Phone Interview PTSD symptoms are presented by participation in the study. The NONP group did not have data collected on them so only the two participating groups can be compared. A MANOVA revealed a statistically significant overall effect between groups (F[12,15107]=4.17, $\underline{\Lambda}$=.997). The mean differences between the PIOP and the PIEP on the twelve PTSD symptoms were all statistically significant except for nightmares and life not meaningful. Again, the effects sizes were relatively small with the $\underline{R}^2$ ranging from .000 to .002. The results suggest that subjects who reported experiencing more PTSD like symptoms were more likely to attend the follow-up exam. The selection effects were important to characterize because of their potential effects on the subsequent factor analyses and multiple regressions.

Estimates for Alternative Structural Equation Model Programs

The results for the estimation of known population parameter from simulated models for the alternative structural equation modeling programs are presented in

Table 27

Predicting Combat Levels for Combat Veterans (N=7,151)

Variables	B	(se)	β	
Intercept	5.48	(.23)	.00	*
Age of Entry	-.11	(.01)	-.12	*
Black %	-.01	(.06)	-.01	
Enlisted %	-.32	(.04)	-.11	*
Single %	-.12	(.04)	-.04	*
Ability	-.07	(.02)	-.05	*

Note: $F[5,7145]=30.6$, $p<.01$, $R^2=.02$

Table 28

Mean Differences between PIP and PIEP for Phone PTSD Symptoms

PTSD Symptoms	PIOP (N=10,717) Mean	(Se)	PIEP (N=4,403) Mean	(Se)	R^2
Nightmares about army	.36	(.67)	.39	(.68)	.001
Painful memories of army	.44	(.70)	.48	(.72)	.001 *
Deja vu experience about army	.23	(.53)	.24	(.53)	.001 *
Lost interest	.81	(.81)	.87	(.81)	.001 *
Felt distant others	.76	(.86)	.82	(.87)	.001 *
Life not meaningful	.44	(.75)	.47	(.77)	.000
Hypervigilance	1.34	(.88)	1.39	(.87)	.001 *
Trouble with Sleep	.97	(1.0)	1.06	(1.0)	.002 *
Shame/guilt about army	.22	(.58)	.26	(.62)	.001 *
Trouble Memory/Concentrating	.87	(.87)	.97	(.90)	.002 *
Anxious about reminders of army	.34	(.63)	.38	(.65)	.001 *
Avoid reminders of army	.39	(.77)	.44	(.81)	.001 *

Note. * represents $p<.01$,

$F_1(15,107) = 4.17$, $\Lambda = .997$, $p<.01$

Table 29a through Table 29e. The tetrachoric correlation matrices were generated in PRELIS and were used to estimate the exploratory factor structure in SAS. In a broad exploratory sense, SAS adequately reproduced the population factor loadings for all five z-score cut points. With LISREL, the correct factor pattern was specified, and the program reproduced the population factor loadings for all five z-score cut points quite well. The exploratory factor analysis procedure of LISCOMP adequately reproduced the population factor loading for four of the five different z-score cut-points. For a z-score cut-point of 2.00, LISCOMP tended to overestimate a number of factor loadings. Finally, NOHARM adequately reproduced the population factor loadings for all five different z-score cut-points.

For z-score cut-points that were closer to zero, LISREL, LISCOMP, and NOHARM were better at providing estimates of the population factor correlation matrix. For z-score cut-points that were extreme, SAS was better at reproducing the factor correlation matrix than any other program. Given that LISREL adequately reproduced the population factor loadings for the different models, LISREL was used in this study to estimate population parameters for single group structural equation models.

Power Analysis

In Figure 5, the power curves are plotted for five alternative sets of dichotomous items based on differing z-score cut points. The null hypothesis was a one factor model and the alternative factor model was a two factor model with four items on each factor. For the dichotomous items that were generated based on a

Table 29a

Results from simulated models for Z-Score Cut-Point = 0.00

	SAS		LISREL		LISCOMP		NOHARM	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
X_1	.81	.00	.80	.00	.82	.02	.84	.00
X_2	.78	.03	.79	.00	.79	.04	.80	.03
X_3	.76	.04	.80	.00	.78	.08	.80	.05
X_4	.78	.03	.79	.00	.84	-.01	.86	-.05
X_5	.04	.78	.00	.80	.01	.84	-.02	.86
X_6	.04	.76	.00	.81	.10	.72	.08	.73
X_7	.02	.79	.00	.81	.08	.71	.06	.70
X_8	.02	.77	.00	.79	-.03	.82	-.06	.84
R_{12}	.55		.60		.58		.61	

Table 29b

Results from simulated models for Z-Score Cut-Point = 1.00

	SAS		LISREL		LISCOMP		NOHARM	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
X_1	.75	.04	.75	.00	.76	.02	.78	.01
X_2	.81	.03	.84	.00	.74	.13	.75	.12
X_3	.78	.04	.74	.00	.82	−.03	.81	−.06
X_4	.78	.01	.81	.00	.82	.02	.88	−.04
X_5	.01	.78	.00	.78	.07	.73	.06	.74
X_6	.04	.77	.00	.82	.03	.81	.00	.84
X_7	.04	.78	.00	.74	.10	.68	.08	.67
X_8	.03	.80	.00	.80	−.04	.89	−.08	.90
R_{12}	.56		.57		.57		.59	

Table 29c

Results from simulated models for Z-Score Cut-Point = 1.50

	SAS		LISREL		LISCOMP		NOHARM	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
X_1	.81	.01	.83	.00	.77	.10	.74	.12
X_2	.81	.03	.76	.00	.76	.03	.79	-.03
X_3	.78	.05	.79	.00	.83	-.01	.84	-.05
X_4	.77	.03	.81	.00	.85	-.03	.84	-.02
X_5	.04	.79	.00	.82	.04	.81	.02	.82
X_6	.02	.78	.00	.76	.05	.73	.07	.72
X_7	.03	.78	.00	.77	-.02	.81	-.05	.81
X_8	.04	.78	.00	.82	-.01	.83	-.03	.86
R_{12}	.55		.53		.50		.49	

Table 29d

Results from simulated models for Z-Score Cut-Point = 1.75

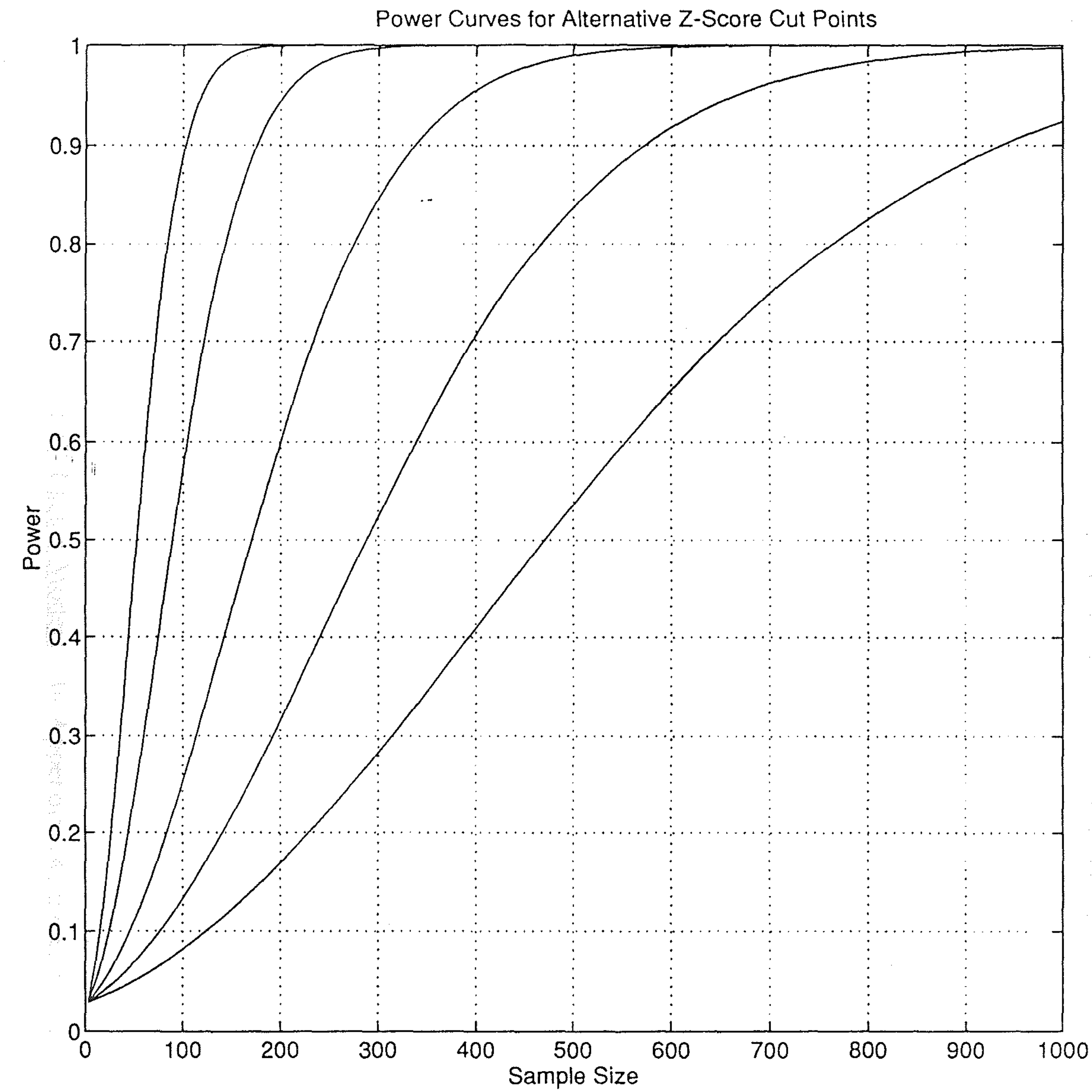
	SAS		LISREL		LISCOMP		NOHARM	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
X_1	.77	.04	.76	.00	.73	.03	.82	.07
X_2	.80	.03	.69	.00	.65	.08	.65	.01
X_3	.80	.04	.75	.00	1.03	-.24	.87	-.18
X_4	.78	.01	.81	.00	.53	.40	.63	.18
X_5	.03	.80	.00	.85	.07	.77	.09	.79
X_6	.01	.81	.00	.70	.01	.69	.04	.69
X_7	.05	.77	.00	.76	-.24	1.06	-.15	.87
X_8	.03	.76	.00	.81	.18	.62	.02	.81
R_{12}	.56		.55		.51		.51	

Table 29e

Results from simulated models for Z-Score Cut-Point = 2.00

	SAS		LISREL		LISCOMP		NOHARM	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
X_1	.74	.09	.71	.00	.62	.18	.74	-.04
X_2	.84	.02	.68	.00	.18	.31	.65	.12
X_3	.80	.01	.73	.00	1.36	-.51	.83	-.13
X_4	.78	.04	.91	.00	.59	.47	.80	-.16
X_5	.04	.76	.00	.80	-.04	.79	.08	.76
X_6	.03	.78	.00	.80	-.43	1.19	.04	.82
X_7	.03	.79	.00	.80	.40	.62	.01	.83
X_8	.01	.76	.00	.65	.29	.23	-.13	.64
R_{12}	.55		.49		.48		.34	

Figure 5.


Power Curves for Alternative Z-Score Cut Points
Power
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
100
200
300
400
500
600
700
800
900
1000
Sample Size

z-score cut-point of 0.0, approximately 50% of the subjects were assigned a value of 1 for each item. For items that approximate a 50-50 ratio, the assumptions of the continuous variable factor analysis are not violated. Thus items that approximate a 50-50 ratio tend to have the greatest power to detect alternative hypotheses when testing latent trait models. To achieve power greater than .90 for a 50-50 ratio type item, only 100 subjects would be necessary. As the item difficulty (z-score cut-point) increased for the items, the power to detect the alternative hypothesis decreased. For a z-score of 1.0, approximately 170 subjects are needed to achieve a power of .90. For a z-score of 1.5, or when an average of 6.7% the subjects endorsed an item, it is necessary to measure 340 subjects to achieve a power greater than 90. For a z-score of 1.75, or on average 4% of the subjects endorsed an item, 570 subjects would be necessary to achieve a power greater than .90. Finally, for a score of 2.0, approximately 950 subjects would be needed to achieve power = .90. In summary, as the item difficulty deviates from a 50-50 ratio, the power to detect a two factor latent trait model decreases rather quickly. For this study, it was concluded that adequate power was available to detect the difference between a one factor and two factor model.

Confirmatory Factor Analysis of Phone Interview PTSD Symptoms

Confirmatory DSM-III Factor Models. In Appendix 14, the tetrachoric correlations for the twelve PTSD symptoms collected during the Phone Interview are presented. The symptoms were all positively correlated. The results of fitting the alternative DSM-III factor models using the twelve PTSD symptoms are presented in

Table 30. The null model, M_{0000}, resulted in a very large χ^2 value for 66 degrees of freedom (χ^2=119,925). The probability of the χ^2 value is statistically significant with an approximate z-score value of 192.6. The LISREL goodness-of-fit index was .433 while the RMSR was .546. The one factor model, M_{1000}, resulted in a large decrease in the χ^2 value for a relatively small decrease in the degrees of freedom (χ^2=7,747, df=54). The z-score approximation of the χ^2 was 65.9. The LISREL goodness-of-fit index was .963 while the RMSR was .084. The alternative orthogonal two factor models (M_{2111}, M_{2211}, M_{2311}) all resulted in relatively large χ^2 values (99,290, 72,153, and 59,401 respectively). The three factor orthogonal model, M_{3011}, also resulted in a large χ^2 value (χ^2=94,344, df=54, $p<.01$). Interestingly, the χ^2 for M_{3011} was larger than the two χ^2 values for the orthogonal two factor models. In absolute terms, all of the two factor oblique models fit the data better than their respective two factor orthogonal models. The χ^2 for the three oblique two factor models were similar in size to M_{1000}. Finally, in terms of the absolute fit, the three factor oblique model fit the data best (χ^2=4,522, df=51, Z=52.4, $p<.01$).

In Table 31, the incremental improvement in fit relative to the null model, M_{0000}, is presented for each alternative model. The table presents the Bentler & Bonett normed fit index (BBI) and the Tucker Lewis Index (TLI) as relative fit indices to describe improvement in fit. Every model was a statistically significant improvement over the baseline model and the more important task was to compare effect sizes based on the relative fit indices. For the one factor model, the change in

Table 30

Fit Indices for DSM-III Models using Phone-PTSD Items

MODEL	χ^2	Df	Z	p	GFI	RMSR
M_{0000}	119,925	66	192.6	.00	.433	.546
M_{1000}	7,747	54	65.9	.00	.963	.084
M_{2111}	99,290	54	175.0	.00	.531	.465
M_{2211}	72,153	54	155.8	.00	.659	.411
M_{2311}	59,401	54	145.0	.00	.719	.364
M_{3011}	94,344	54	171.8	.00	.554	.483
M_{2112}	7,721	53	65.7	.00	.964	.084
M_{2212}	6,954	53	63.0	.00	.967	.078
M_{2312}	5,646	53	57.7	.00	.973	.071
M_{3012}	4,522	51	52.4	.00	.979	.063

Table 31

Incremental Fit Indices for DSM-III Models using Phone-PTSD Items

MODEL	$d\chi^2$	dDf	dZ	p	BBI	TLI
M_{0000}	0	0	---	---	---	---
M_{1000}	112,178	12	147.1	.00	.935	.922
M_{2111}	20,635	12	80.6	.00	.172	-.012
M_{2211}	47,772	12	108.9	.00	.398	.265
M_{2311}	60,524	12	118.5	.00	.505	.395
M_{3011}	25,581	12	87.1	.00	.213	.039
M_{2112}	112,204	13	148.9	.00	.936	.920
M_{2212}	112,971	13	149.3	.00	.942	.928
M_{2312}	114,279	13	149.9	.00	.953	.942
M_{3012}	115,403	15	153.6	.00	.962	.952

the χ^2 value was 112,178 with a difference of 12 degrees of freedom. The improvement in fit was statistically significant (χ^2=112,178, $\underline{df}$=12, $\underline{Z}$=147.1, $\underline{p}$<.01). The BBI=.935 and this indicates a 93.5% improvement in the χ^2 value over the baseline model M_{0000}. The TLI, an adjusted improvement in fit index, was quite large for M_{1000} (TLI=.922). The TLI can be interpreted in the same way as the BBI. For M_{2111}, the improvement in fit was not large relative to the baseline model (BBI=.172, TLI=-.012). In theory the TLI is bounded by 0 and 1 but for very poor fitting models, such as M_{2111} the value can fall below zero. M_{2211} and M_{2311} were better fitting models than M_{2111} when compared to the baseline model (BBI=.398, BBI=.505 respectively). No two factor orthogonal model fit the data as well as the one factor model.

The two factor oblique models fit the data well relative to the baseline, M_{0000}. The decrease in the χ^2 for M_{2112}, M_{2212}, and M_{2312} was 112,204, 112,971, and 114,279 respectively. The BBI and TLI were all above .920 for the three models suggesting a relatively good fit for the models compared to the baseline model. M_{2312} was the best fitting model of the two factor oblique models (BBI=.953, TLI=.942). The model combines DSM-III items from clusters one and three under a single factor. In absolute terms, the oblique three factor, M_{3012}, was the best fitting overall model largely because it had the fewest degrees of freedom (BBI=.962, TLI=.952). The improvement in the χ^2 value was large and statistically significant (χ^2=115,403, $\underline{df}$=15, $\underline{Z}$=153.6, $\underline{p}$<.01). The TLI, a goodness-of-fit index that was adjusted by the degrees of freedom, did not have to be larger for the oblique three factor model relative to the other models. Conversely, the TLI index for M_{3012} was only a 1% improvement over the best fitting oblique two factor model M_{2312}.

In Table 32, the factor loadings for the best fitting models are presented. The best fitting models were assessed according to the BBI and TLI. Any model that had a BBI and TLI greater than .90 was included in the table. For all models, every estimated factor loading was positive and statistically significant. For M_{1000}, the factor loadings ranged from .65 to .88 while for M_{2112}, the factor loadings ranged from .66 to .89. For M_{2212}, the factor loadings ranged from .66 to .91 and for M_{2312}, a similar result was found with factor loadings ranging from .66 to .89. Finally, M_{3112} had all positive loadings ranging from .66 to .90. Based on the factor loadings alone, all the models appear to fit the data well with relatively small differences in the factor loadings across different models.

In Table 33 the correlations and squared correlations between the factors for the alternative best fitting models are presented. For M_{2112}, the correlation between the two factors was .99 with an extremely large shared variance (r^2=.98). The result suggests that the two factors represent a similar construct. The combination of the symptoms under a single factor (M_{1000}) resulted in relatively small loss in fit and an increase in model parsimony relative to M_{2112}. For M_{2212} there was also a very large positive correlation (r=.91) between the two factors with a large shared variance (r^2=.83). For M_{2312}, the correlation was somewhat smaller (r=.84) with r^2=.70. Finally, for the oblique three factor model, M_{3012}, the first and second factor share the

Table 32

Factor Loadings for DSM-III Models using Phone-PTSD

	M_{1000}	M_{2112}		M_{2212}	
	F_1	F_1	F_2	F_1	F_2
Nightmares about Army	83	83		86	
Painful memories about Army	87	87		91	
Deja vu experience about Army	88	88		91	
Lost interest in	71	71			72
Felt Distant from others	82	82			82
Life is not Meaningful	78	78			79
Hyperarousal	80		80		80
Trouble Sleeping	72		72		73
Shame/Guilt about Army	83		84		84
Trouble Concentrating/Memory	88		89		89
Anxious about reminders of Army	75		76		76
Avoid Reminders about Army	65		66		66

Note: The reported factor loadings are unstandardized and multiplied by 100. Standard errors for the factor loadings did not exceed .02 for any model.

Table 32

Continued:

	M_{2312}		M_{3012}		
	F_1	F_2	F_1	F_2	F_3
Nightmares about Army	83		86		
Painful memories about Army	87		90		
Deja vu experience about Army	88		90		
Lost interest in		77		77	
Felt Distant from others		88		89	
Life is not Meaningful		84		84	
Hyperarousal	80				79
Trouble Sleeping	73				72
Shame/Guilt about Army	84				83
Trouble Concentrating/Memory	89				88
Anxious about reminders of Army	76				75
Avoid Reminders about Army	66				66

Note: The reported factor loadings are unstandardized and multiplied by 100. Standard errors for the factor loadings did not exceed .02 for any model.

Table 33

Correlation Matrices for DSM-III Models using Phone-PTSD Items

Model		F_1		F_2		F_3	
		r	(r^2)	r	(r_2)	r	(r_2)
M_{2112}							
	F_1	1.00					
	F_2	.99	(.98)	1.00			
M_{2212}							
	F_1	1.00					
	F_2	.91	(.83)	1.00			
M_{2312}							
	F_1	1.00					
	F_2	.84	(.70)	1.00			
M_{3012}							
	F_1	1.00					
	F_2	.72	(.51)	1.00			
	F_3	.96	(.92)	.89	(.79)	1.00	

Note: The standard error for the correlation estimates did not exceed .01 for any model.

smallest amount of common variance ($\underline{r}^2$=.51) while the first and third factor share the greatest proportion of common variance ($\underline{r}^2$=.92). For the factors that shared more variance in common, the factors could be collapsed under a single factor with a relatively small loss in fit. Therefore, the best fitting two factor model (M_{2312}) combined the factors with the highest correlation.

Confirmatory DSM-III-R Factor Models. The same set of models that were fit using the DSM-III factor structure were also tested using the DSM-III-R factor structure. In Table 34 the goodness-of-fit indices are presented for the alternative models. M_{0000} and M_{1000} are the exact same models as M_{0000} and M_{1000} in Table 30 and are included in this table to make relative comparisons. Similar to the DSM-III models, the DSM-III-R orthogonal models did not fit the data well. M_{2121}, M_{2221}, M_{2321} all resulted in large χ^2 values (77,197, 67,480, and 81,610 respectively) with a relatively large number of degrees of freedom ($\underline{df}$=54). The three factor orthogonal model also resulted in a large χ^2 value (χ^2=87,433; $\underline{df}$=54, $\underline{p}$<.01). In this set of models, all the two factor orthogonal models fit the data better than the three factor orthogonal model. Similar to the DSM-III models, all the two factor oblique models fit the data better than their respective two factor orthogonal models. Finally, in terms of the absolute fit, the three factor oblique model fit the data best (χ^2=6,028, $\underline{df}$=51, Z=59.1, $\underline{p}$<.01).

In Table 35, the incremental improvement in fit indices for the alternative DSM-III-R models are presented. Again, every model was a statistically significant improvement over the baseline model, M_{0000}. For M_{2121} through M_{2321}, the

Table 34

Fit Indices for DSM-III-R Models using Phone-PTSD Items

MODEL	χ^2	Df	Z	p	GFI	RMSR
M_{0000}	119,925	66	192.6	.00	.433	.546
M_{1000}	7,747	54	65.9	.00	.963	.084
M_{2121}	77,197	54	159.7	.00	.635	.414
M_{2221}	67,480	54	152.0	.00	.681	.427
M_{2321}	81,610	54	162.9	.00	.614	.430
M_{3021}	87,433	54	167.1	.00	.587	.403
M_{2122}	7,515	53	65.0	.00	.964	.083
M_{2222}	6,139	53	59.8	.00	.971	.073
M_{2322}	7,284	53	64.2	.00	.966	.082
M_{3022}	6,028	51	59.1	.00	.972	.073

Table 35

Incremental Fit Indices for DSM-III-R Models using Phone-PTSD Items

MODEL	$d\chi^2$	dDf	dZ	p	BBI	TLI
M_{0000}	0	0	---	---	---	---
M_{1000}	112,178	12	147.1	.00	.935	.922
M_{2121}	42,728	12	104.7	.00	.356	.213
M_{2221}	52,445	12	112.6	.00	.437	.312
M_{2321}	38,315	12	100.7	.00	.319	.168
M_{3021}	32,492	12	94.9	.00	.271	.109
M_{2122}	112,410	13	149.0	.00	.937	.922
M_{2222}	113,786	13	149.6	.00	.949	.937
M_{2322}	112,641	13	149.1	.00	.939	.925
M_{3022}	113,897	15	152.9	.00	.950	.935

improvement in fit using the BBI was not large relative to the baseline model (.356, .437, .319). The two factor oblique models fit the data well relative to M_{0000}. The decrease in the χ^2 value for M_{2122}, M_{2222}, and M_{2322} was 112,410, 113,786, and 112,641 respectively. The BBI and TLI were all above .920 for the three oblique two factor models suggesting a relatively good fit for the models compared to the M_{0000}. M_{2222} was the best fitting of the DSM-III-R two factor oblique models (BBI=.949; TLI=.937). M_{2222} combines the DSM-III-R clusters two and three under a single factor. For M_{3022}, the oblique three factor model, the improvement in the χ^2 was large and statistically significant ($d\chi^2$=113,897, dDf=13, $p<.01$). The model fit the data better than the other alternative models in an absolute sense largely because the model had the fewest degrees of freedom. M_{3022} had the largest BBI (BBI=.950) while M_{2222} had the largest TLI. Again, the TLI adjusts for the degrees of freedom in the model. Therefore, of the DSM-III-R models, M_{2222} was the best fitting most parsimonious model.

In Table 36, the factor loadings for the best fitting models are presented. The best fitting models were assessed in the same manner that the DSM-III models were assessed. Any model that had a BBI and TLI greater than .90 was included in the table. For every model, none of the factor loadings fell below a value of .65. The loadings themselves, in this case, did not provide useful information for differentiating between the best fitting models.

In Table 37 the correlations and squared correlations between the factors for the alternative best fitting models are presented. For M_{2122}, the correlations between

Table 36

Factor Loadings for DSM-III-R Models using Phone-PTSD Items

	M_{1000}	M_{2122}		M_{2222}	
	F_1	F_1	F_2	F_1	F_2
Nightmares about Army	83	83		85	
Painful memories about Army	87	87		89	
Deja vu experience about Army	88	88		89	
Anxious about reminders of Army	75	88		90	
Lost interest in	71	71			72
Felt Distant from others	82	82			83
Life is not Meaningful	78	78			79
Avoid Reminders about Army	65	83			86
Hyperarousal	80		80		77
Trouble Sleeping	72		68		67
Shame/Guilt about Army	83		83		81
Trouble Concentrating/Memory	88		74		73

Note: The reported factor loadings are unstandardized and multiplied by 100. Standard errors for the factor loadings did not exceed .02 for any model.

Table 36

<u>Continued:</u>

	M_{2322}		M_{3022}		
	F_1	F_2	F_1	F_2	F_3
Nightmares about Army	83		85		
Painful memories about Army	87		89		
Deja vu experience about Army	88		89		
Anxious about reminders of Army	89		90		
Lost interest in		74		73	
Felt Distant from others		84		84	
Life is not Meaningful		80		80	
Avoid Reminders about Army		86		87	
Hyperarousal	76				77
Trouble Sleeping	66				68
Shame/Guilt about Army	80				82
Trouble Concentrating/Memory	73				74

Note: The reported factor loadings are unstandardized and multiplied by 100. Standard errors for the factor loadings did not exceed .02 for any model.

Table 37

Correlation Matrices for DSM-III-R Models using Phone-PTSD Items

Model		F_1		F_2		F_3	
		r	(r^2)	r	(r_2)	r	(r_2)
M_{2122}							
	F_1	1.00					
	F_2	.94	(.88)	1.00			
M_{2222}							
	F_1	1.00					
	F_2	.89	(.79)	1.00			
M_{2322}							
	F_1	1.00					
	F_2	.93	(.86)	1.00			
M_{3022}							
	F_1	1.00					
	F_2	.87	(.76)	1.00			
	F_3	.88	(.77)	.95	(.90)	1.00	

Note: The standard error for the correlation estimates did not exceed .01 for any model.

the two factors was .94 and the r^2 was equal to .88. The high correlation and shared variance suggest that the factors represent similar constructs. For M_{2222}, there was also a very large positive correlation of .89 and with a large shared variance (r^2=.79). For M_{2322}, the correlation was also large (r=.93) with r^2=.86. Finally, for the three factor model, M_{3022} showed that the first and second factor had the smallest amount of variance in common (r^2=.76) while the first and third factor shared the greatest proportion of variance (r^2=.90).

In Table 38, a further refinement of the goodness-of-fit indices are presented for both the DSM-III and the DSM-III-R factor models. Since M_{1000} fit the data relatively well, differences in fit relative to the one factor model were assessed. Only models that fit better than M_{1000} were included in the table. In absolute terms, the best fitting model was M_{3012} ($d\chi^2$=3,225, dDf=3, dZ=34.1, $p<.01$). M_{3012} was the DSM-III oblique three factor model. The change in fit assessed by BBI_0 between M_{3012} and M_{1000} was .027. The value represents a 2.7% increase in explained covariance when selecting M_{3012} over M_{1000} relative to the baseline model M_{0000}. The model was also evaluated relative to M_{1000} using BBI_1. In that case, there was a 41.6% improvement in fit (BBI_1=.416) relative to the one factor model. BBI_0 for M_{2312} was .018 or a 1.8% improvement over M_{1000}. The difference between M_{3012} and M_{2312} was less than 1% relative to M_{0000} while the difference was larger (14.5%) when using M_{1000} as the relative baseline. Two other models fit relatively well when compared to the one factor model: M_{2222} and M_{3022}. Both models were based on the DSM-III-R factor structure but neither model fit the data as well as the two DSM-III

Table 38

Incremental Fit Indices for Models using Phone-PTSD Items with M_{1000}

MODEL	$d\chi^2$	dDf	dZ	p	BBI_1	TLI_1	BBI_0	TLI_0
M_{2112}	26	1	4.6	.00	.003	-.016	.000	-.001
M_{2212}	793	1	17.9	.00	.102	.086	.007	.007
M_{2312}	2,101	1	25.5	.00	.271	.259	.018	.020
M_{3012}	3,225	3	34.1	.00	.416	.385	.027	.030
M_{2122}	232	1	11.4	.00	.030	.012	.002	.001
M_{2222}	1,608	1	23.1	.00	.208	.194	.013	.015
M_{2322}	463	1	14.7	.00	.060	.042	.004	.003
M_{3022}	1,719	3	27.1	.00	.222	.177	.014	.014

models: M_{2312} and M_{3012}.

Exploratory Factor Analysis of Phone Interview PTSD Symptoms

Following the confirmatory factor analysis of the PTSD symptoms measured during the Phone Interview an exploratory factor analysis of the tetrachoric correlation matrix was performed in SAS. The exploratory solution was then used to fit a more constrained LISREL model and compared to the fit statistics of the previously described models. In Table 39, the exploratory factor model is presented. The first factor included all the DSM-III-R re-experiencing symptoms and two additional symptoms that have not typically been included under the first symptom cluster. The most noteworthy characteristic for the two factors was that the first factor included all the questions that referred to experiences and symptoms specifically associated with the Army while the items that fell under the other factor did not explicitly mention the Army in the questions. As with the other previously tested factor models, there was a large statistically significant correlation between the two factors ($r=.77$). The fit indices for the model represent statistically significant improvements over any of the previously tested models ($\chi^2=852$, $df=53$, $Z=23.6$, $p<.01$).

Confirmatory Factor Analysis of DIS PTSD Symptoms

In Appendix 15 and 16 the tetrachoric correlations for the nine DIS PTSD symptoms reported over the last month and over the lifetime are presented. One obvious characteristic of the reported PTSD symptoms was that they were all positively correlated. In Table 40 the results of the confirmatory factor analyses

Table 39

Exploratory Factor Model For Phone-PTSD Items

	F_1	F_2
Nightmares about Army	85	
Painful memories about Army	89	
Deja vu experience about Army	88	
Anxious about reminders of Army	90	
Lost interest in		75
Felt Distant from others		86
Life is not Meaningful		82
Avoid Reminders about Army	85	
Hyperarousal		80
Trouble Sleeping		69
Shame/Guilt about Army	81	
Trouble Concentrating/Memory		76

Note: χ^2=852; Df=53; Z=23.6; p<.01; GFI=.996; RMSR=.024; r_{12}=.77

The tetrachoric correlation matrix was fit in SAS and the results were subsequently fit to a more constrained factor structure in LISREL. The reported factor loadings are unstandardized and multiplied by 100.

Table 40

Fit Indices for the Current DIS-PTSD Items

MODEL	χ^2	Df	Z	p	GFI	RMSR
M_{0000}	10,855	36	72.5	.00	.649	.632
M_{1000}	36	27	1.2	.11	.999	.034
M_{2111}	6,305	27	56.8	.00	.796	.454
M_{2112}	35	26	1.2	.12	.999	.034
M_{2212}	31	25	0.9	.20	.999	.032
M_{2121}	7,208	27	59.9	.00	.767	.481
M_{2221}	6,276	27	56.7	.00	.797	.454
M_{2321}	4,431	26	49.1	.00	.857	.374
M_{2122}	35	26	1.2	.12	.999	.034
M_{2222}	34	26	1.1	.15	.999	.033

using the current DIS PTSD symptoms are presented. In general, very few of the alternative models could be fit because the items were so highly intercorrelated. The one factor model fit the data well relative to the baseline model (χ^2=36, df=27, Z=1.2, p<.11). As with the previously described models, none of the orthogonal rotations fit the data well. The other more complex two factor models resulted in very small improvements over the one factor model. For example, the best fitting model, M_{2212}, resulted in a χ^2 value of 31 for 25 degrees of freedom. The difference in fit between the two models was a χ^2 value of 4 with 2 df. The test was not statistically significant. In Table 41, the incremental goodness-of-fit indices are presented. The BBI value of .997 and TLI value of .999 for M_{1000} further confirmed that the model fit the data very well. The orthogonal models did not fit the data well and the two factor models did not fit the data any better than the one factor model. In Table 42, the one factor model is presented along with the exploratory factor model. The exploratory factor model resulted in two factors that were highly correlated. The loss in fit by forcing a one factor model to the data was minimal.

In Table 43, the results of the confirmatory factor analyses using the lifetime DIS PTSD symptoms are presented. In general, very few of the alternative models could be fit because the items were so highly intercorrelated. The one factor model fit the data well relative to the baseline model (χ^2=87, df=27, Z=5.3, p<.01). The other models were all small improvements over the one factor model. In Table 44, the incremental fit indices are presented. Similar to the results for the current DIS-PTSD symptoms, the results for the lifetime DIS-PTSD symptoms demonstrated that

Table 41

Incremental Fit Indices for Current DIS-PTSD Items

MODEL	$d\chi^2$	dDf	dZ	p	BBI	TLI
M_{0000}	0	0	---	---	---	---
M_{1000}	10,819	9	61.3	.00	.997	.999
M_{2111}	4,550	9	44.4	.00	.419	.226
M_{2112}	10,820	10	62.1	.00	.997	.999
M_{2212}	10,824	11	62.9	.00	.997	.999
M_{2121}	3,647	9	40.8	.00	.336	.115
M_{2221}	4,579	9	44.5	.00	.422	.230
M_{2321}	6,424	10	51.2	.00	.592	.436
M_{2122}	10,820	10	62.1	.00	.997	.999
M_{2222}	10,821	10	62.2	.00	.997	.999

Table 42

Factor Loadings for Current DIS-PTSD Items

	M_{1000}	$M_{explore}$	
	F_1	F_1	F_2
Recurrent Thoughts/Dream	87	87	
Felt as if Event Recurring	83		85
Symptoms worsen in situations	86	87	
Numbing Experience	83		85
Avoids Situations that Remind	81	81	
Jumpy or Easily Startled	82	82	
Trouble Sleeping	92	93	
Ashamed of Being Alive	86		88
Forgetful or Trouble Concentrate	80	80	

Note: The correlation between the two factors for $M_{explore}$ = .96. The reported factor loadings for M_{1000} are unstandardized and multiplied by 100. Standard errors for the factor loadings did not exceed .02 for any model.

Table 43

Fit Indices for Lifetime DIS-PTSD Items

MODEL	χ^2	Df	Z	p	GFI	RMSR
M_{0000}	71,578	36	147.0	.00	.219	.665
M_{1000}	87	27	5.3	.00	.999	.027
M_{2111}	37,707	27	112.0	.00	.589	.471
M_{2112}	87	26	5.4	.00	.999	.027
M_{2312}	85	25	5.4	.00	.999	.027
M_{2121}	48,662	27	122.9	.00	.469	.506
M_{2221}	38,440	27	112.8	.00	.581	.471
M_{2321}	25,105	26	95.9	.00	.526	.398
M_{2322}	86	25	5.5	.00	.999	.027

Table 44

Incremental Fit Indices for Lifetime DIS-PTSD Items

MODEL	$d\chi^2$	dDf	dZ	p	BBI	TLI
M_{0000}	0	0	---	---	---	---
M_{1000}	71,491	9	120.4	.00	.999	.999
M_{2111}	33,871	9	92.5	.00	.473	.298
M_{2112}	71,491	10	122.3	.00	.999	.999
M_{2312}	71,493	11	124.0	.00	.999	.999
M_{2121}	22,916	9	80.5	.00	.320	.094
M_{2221}	33,138	9	91.8	.00	.463	.284
M_{2321}	46,473	10	105.1	.00	.649	.515
M_{2322}	71,492	11	124.0	.00	.999	.999

the one factor model fit the data quite well. Finally, the exploratory factor analysis using the tetrachoric correlations are presented in Table 45 along with the best fitting confirmatory factor model M_{1000}. Again, the results confirmed that a one factor model fit the data relatively well. In addition to fitting the previously described model, one model was fit with both the one-month symptoms and the lifetime symptoms. The correlation between the current DIS-PTSD factor and the lifetime DIS-PTSD factor was .934.

In Table 46, the correlation matrix is presented from fitting the best fitting two factor model for the Phone Interview PTSD items and the one factor model from the DIS Lifetime PTSD items simultaneously. The sample size for the analysis was considerably smaller than 15,000 subjects who were used to analyze the Phone Interview items because only subjects who attended the follow-up exam had scores on both sets of items. The correlations between the Phone Interview factors and the DIS factor were relatively large and positive. The correlation matrix suggests that the DIS factor was more closely related to the first factor of the Phone Interview ($r=.69$) than the second factor of the Phone Interview ($r=.55$). The correlations between the Phone Interview Items and the DIS items can also be conceptualized as a test-retest model for the PTSD symptoms.

Multiple Group Exploratory Factor Analysis

Phone Interview PTSD Items. The exploratory factor analysis for the combat and non-combat subjects was carried out using the exploratory factor procedure available in LISCOMP. In Table 47, the results of the exploratory factor analysis are

Table 45

Factor Loadings for Lifetime DIS-PTSD Items

	M_{1000}	$M_{explore}$
	F_1	F_1
Recurrent Thoughts/Dream	91	90
Felt as if Event Recurring	70	70
Symptoms worsen in situations	83	83
Numbing Experience	84	83
Avoids Situations that Remind	91	91
Jumpy or Easily Startled	95	95
Trouble Sleeping	93	93
Ashamed of Being Alive	75	73
Forgetful or Trouble Concentrate	76	76

Note: The reported factor loadings are unstandardized and multiplied by 100. Standard errors for the factor loadings did not exceed .02 for any model.

Table 46

Joint Factor Analysis of Phone-PTSD Items and Lifetime DIS-PTSD Items

	Phone F_1	Phone F_2	DIS F_1
Phone F_1	1.00		
Phone F_2	.87	1.00	
DIS F_1	.69	.55	1.00

Table 47

Exploratory Factor Model For Phone-PTSD Items based on Combat Experience

	Non-Combat (N=7,851)		Combat (N=7,235)	
PTSD Symptoms	F_1	F_2	F_1	F_2
Nightmares about Army	80		81	
Painful memories about Army	88		89	
Deja vu experience about Army	85		77	
Anxious about reminders of Army	84		75	
Lost interest in		77		80
Felt Distant from others		86		83
Life is not Meaningful		84		79
Avoid Reminders about Army	85		74	
Hyperarousal		69		68
Trouble Sleeping		61		63
Shame/Guilt about Army	78		69	
Trouble Concentrating/Memory		69		74

Correlation Matrix

	F_1	F_2	F_1	F_2
F_1	1.00	---	1.00	---
F_2	.66	1.00	.67	1.00

Note: Factor loadings below .40 were not included in table.

presented. Only factor loadings greater than .40 are included in the table. The factor structure across the two groups was almost identical. In addition, the factor correlation matrix was also very similar. The factor structure was also similar to the exploratory solution obtained for the entire sample. The results of the exploratory multiple group factor models suggest that the factors were invariant across combat-exposure groups.

DIS PTSD Items. The exploratory factor analysis was also run for the DIS PTSD items (See Table 48). The exploratory factor analysis revealed that a single factor fit the data quite well for both groups and that the factor loadings were relatively similar. The results support the hypothesis that the factor structure of the DIS-PTSD scale is invariant across combat-exposure groups.

Regression Models

Linear Regression Models using Phone-PTSD Total Score. The first set of linear regressions included subjects from the entire sample that had complete data from the phone interview (n=14,386). Both univariate and multiple regressions were tested using the total score from the Phone Interview PTSD items as the dependent variable (See Appendix 18 and 19 for summary of results). The positive skew associated with the PTSD total score suggested that the logarithm of PTSD total score (Phone-PTSD) would be a more statistically sound dependent measure. The univariate regression analyses for the logarithm of the PTSD total score are presented in Table 49. The largest univariate predictor of the PTSD total score was combat exposure ($B_1=.162$, $R^2=.133$, $p<.01$). Individuals who experienced higher levels of

Table 48

Exploratory Factor Model For Lifetime DIS-PTSD based on Combat Experience

DIS-PTSD Symptoms	Non-Combat (N=2,131)	Combat (N=2,265)
	F_1	F_1
Recurrent Thoughts/Dream	95	92
Felt as if Event Recurring	85	72
Symptoms worsen in situations	90	84
Numbing Experience	94	86
Avoids Situations that Remind	93	91
Jumpy or Easily Startled	90	92
Trouble Sleeping	98	94
Ashamed of Being Alive	79	76
Forgetful or Trouble Concentrate	90	78

Table 49

Univariate Regressions for Phone-PTSD in Total Sample (n=14,386)

Predictors	B_0	(se)	B_x	(se)	R^2
Age of Entry	3.41	(.081)	-.078	(.004)	.026 *
Ability	1.83	(.007)	-.133	(.007)	.024 *
Enlisted	1.77	(.008)	.152	(.014)	.008 *
Race	1.80	(.007)	.173	(.022)	.004 *
Single	1.82	(.013)	.001	(.015)	.001
Combat	1.56	(.008)	.162	(.003)	.133 *
Income	2.31	(.021)	-.111	(.004)	.042 *
Married	2.00	(.134)	-.247	(.016)	.017 *
Post-Test	1.80	(.008)	.080	(.015)	.002 *

Note: '*' represents a statistically significant value at $p<.01$

combat were more likely to report PTSD symptoms. In addition, age of entry into the military, ability score, and current income level each explained more than 2% of the variance in the PTSD total score.

The hierarchical multiple regression models are presented in Table 50. For M_1, the pre-military variables were all statistically significant. The largest effects were for age of entry into the military (B=-.06, β=-.13, p<.01) and pre-service ability score (B=-.11, β=-.13, p<.01). Younger, less intelligent soldiers reported higher levels of PTSD symptoms during the Phone Interview. In addition, volunteers, blacks, and men who were married at the time of entry into the military reported higher levels of PTSD symptoms than drafted, non-black, single men. The total R^2 for the five pre-military variables was .05. That is, five percent of the variance in the Phone Interview measure of PTSD can be explained from measures collected at the when the soldiers entered the military.

In M_2, the combat exposure index was entered into the equation. The increase in the R^2 of 12% represented a large statistically significant effect (B=.15, β=.35, p<.01). Higher levels of combat were associated with higher levels of reported PTSD symptoms. Finally, in M_3, the post-military variables were entered into the equation. All three post-military predictors were statistically significant and resulted in a two percent increase in the R^2. Subjects who were not married and earning low incomes at the time of the phone interview reported higher levels of PTSD symptoms. In addition, subjects who attended the follow-up exam reported higher levels of PTSD symptoms. The interaction model did not add more than one percent in explained

Table 50

Multiple Regressions for Phone-PTSD in Total Sample (n=14,386)

Predictors	M_1		M_2		M_3	
	B	(β)	B	(β)	B	(β)
Intercept	3.09	(.00) *	2.52	(.00) *	2.87	(.00) *
Age of Entry	-.06	(-.13) *	-.05	(-.10) *	-.04	(-.09) *
Ability	-.11	(-.13) *	-.09	(-.11) *	-.05	(-.06) *
Enlisted	.10	(.06) *	.11	(.07) *	.10	(.07) *
Race	.06	(.02) *	.08	(.03) *	.05	(.02)
Single	-.06	(-.03) *	-.05	(-.03) *	-.08	(-.05) *
Combat			.15	(.35) *	.15	(.35) *
Income					-.07	(-.13) *
Married					-.14	(-.08) *
Post-Test					.05	(.03) *
R^2	.05 *		.17 *		.19 *	
R^2-Change	.05 *		.12 *		.02 *	

Note: '*' represents a statistically significant value at p<.01;

The interaction terms added less than 1% explained variance.

variance so the individual effects for the interaction model were not reported. In Figure 6, a path model for the relative effect size of each independent variable in M_3 is presented. The dashed lines represent statistically significant βs that were less than .10. The solid lines represent statistically significant βs that were greater than or equal to .10 and less than .20. The thick solid lines represent statistically significant effects that were greater than or equal to .20.

In Table 51, the results of the univariate regression analyses for the follow-exam sample are presented. At the follow-up exam, additional information was collected on the subjects including information about early adolescent behavior problems and military herbicide exposure. A total of n=3,899 subjects had complete data for the follow-up exam measures. The largest pre-military univariate predictors of the PTSD total score were age of entry, ability score, and conduct disorder. The largest military univariate predictors of the PTSD total score were combat exposure and herbicide exposure. Finally, the best post-military univariate predictor of the PTSD total score was the Keane-PTSD-R scale.

The multiple regression models using the more elaborate set of independent variables from the follow-up exam are presented in Table 52. For M_1, all the pre-military predictors were statistically significant except for race. Younger men were more likely to report PTSD symptoms ($B=-.06$, $\beta=-.13$, $p<.01$), as well as men of lower ability ($B=-.11$, $\beta=-.13$, $p<.01$). Volunteers and men who were married at the time of entry into the military reported more PTSD symptoms than draftees and single men. Finally, individuals who reported four or more conduct disorder

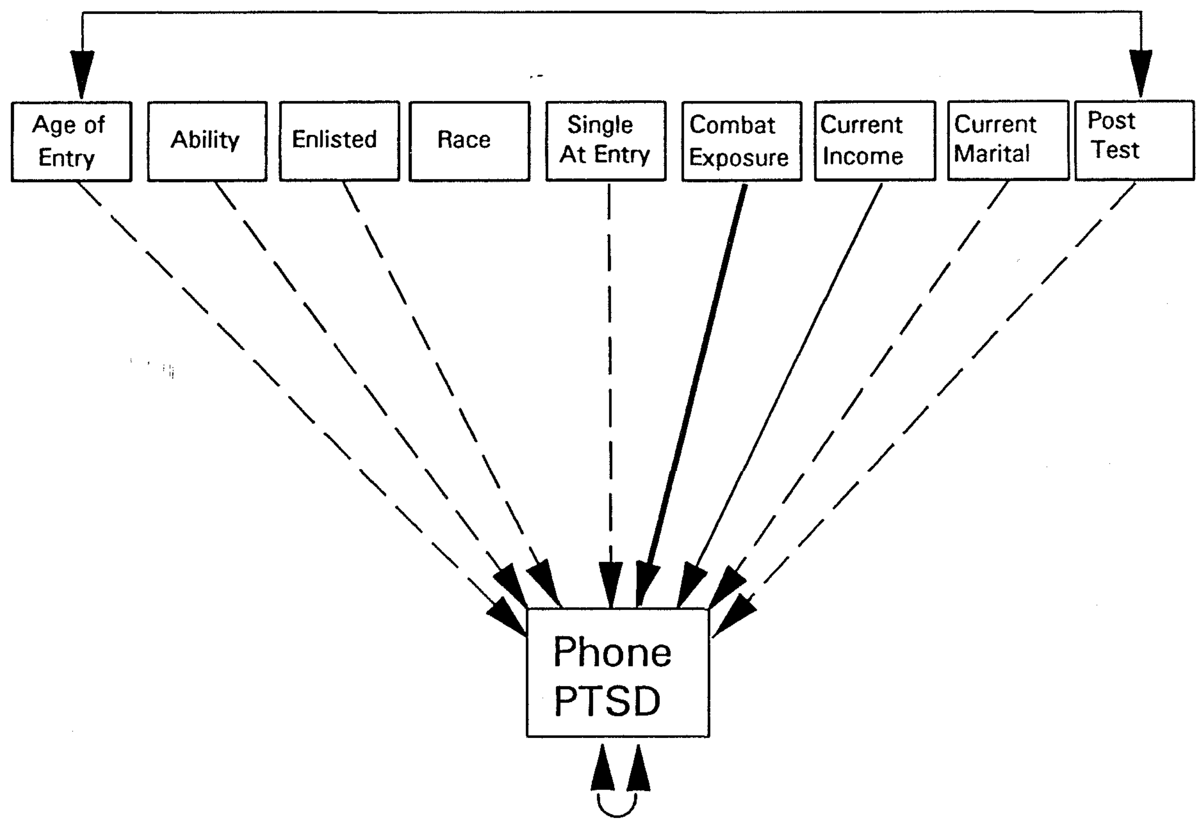


Figure 6: Multiple Linear Regression Predicting Phone PTSD in Total Sample

Table 51

Univariate Regressions for Phone-PTSD in Exam Sample (n=3,899)

Predictors	B_0	(se)	B_x	(se)	R^2
Age of Entry	3.57	(.149)	-.084	(.007)	.033 *
Ability	1.85	(.013)	-.141	(.013)	.028 *
Enlisted	1.77	(.016)	.164	(.026)	.010 *
Race	1.81	(.014)	.148	(.040)	.003 *
Single	1.85	(.024)	-.021	(.028)	.001 *
Conduct	1.78	(.013)	.421	(.038)	.031
Combat	1.83	(.011)	.160	(.006)	.148 *
Wounded	1.82	(.013)	.308	(.062)	.006 *
Herbicide	1.65	(.013)	.400	(.015)	.153 *
Income	2.29	(.039)	-.105	(.008)	.039
Married	2.03	(.025)	-.272	(.029)	.022
Keane-PTSD-R	1.36	(.017)	.057	(.001)	.269 *

Note: '*' represents a statistically significant value at $p<.01$

Table 52

Multiple Regressions for Phone-PTSD in Exam Sample (N=3,899)

Predictors	M_1			M_2			M_3		
	B	(β)		B	(β)		B	(β)	
Intercept	3.09	(.00)	*	2.59	(.00)	*	1.61	(.00)	*
Age of Entry	-.06	(-.13)	*	-.04	(-.09)	*	-.03	(-.07)	*
Ability	-.11	(-.13)	*	-.08	(-.10)	*	.01	(.01)	
Enlisted	.09	(.06)	*	.10	(.06)	*	.08	(.05)	*
Race	.03	(.01)		.06	(.02)		.02	(.01)	
Single	-.09	(-.05)	*	-.08	(-.05)	*	-.06	(-.04)	*
Conduct	.35	(.15)	*	.34	(.14)	*	.16	(.07)	*
Combat				.09	(.22)	*	.08	(.19)	*
Wounded				-.13	(-.03)		-.07	(-.02)	
Herbicide				.24	(.23)	*	.18	(.18)	*
Income							-.03	(-.05)	*
Married							-.09	(-.05)	*
Keane-PTSD-R							.04	(.40)	*
R^2	.08 *			.24 *			.39 *		
R^2-Change	.08 *			.16 *			.15 *		

Note: '*' represents a statistically significant value at $p<.01$;

The interaction terms added less than 1% explained variance.

problems experienced higher levels of PTSD symptoms ($\underline{B}$=.35, β=.15, $\underline{p}$<.01). The overall R^2 for the pre-military effects was .08. The largest independent effect from the pre-military variables was for conduct disorder. Interestingly, the effects for age of entry and ability score were identical to the previous analyses using a much larger sample size. The result may indicate that the selection process into the follow-up exam had minimal effects on parameter estimates.

When the military variables were entered into the model, the R^2 increased from .08 to .24. Combat exposure ($\underline{B}$=.09, β=.22, $\underline{p}$<.01) and herbicide exposure ($\underline{B}$=.24, β=.23, $\underline{p}$<.01) were both statistically significant independent predictors of PTSD symptoms reported during the Phone Interview. Being wounded during the tour of duty did not independently predict PTSD symptoms.

Finally, for M_3, each of the three independent variables contributed a statistically significant amount of variance to the overall equation (change in R^2=.15). Individuals who reported lower income levels at the time of the interview were more likely to report more PTSD symptoms (B=-.03, β=-.05, p<.01) while individuals who were married were less likely to report PTSD symptoms (B=-.09, β=-.05, p<.01). Finally, individuals who scored higher on the Keane-PTSD-R scale were more likely to report PTSD symptoms during the Phone Interview (B=.04, β=.40, p<.01). The increase in the R^2 of 15% was largely due to the Keane-PTSD-R scale. In Figure 7, a path model for the relative effect size of the independent variables in M_3 is presented.

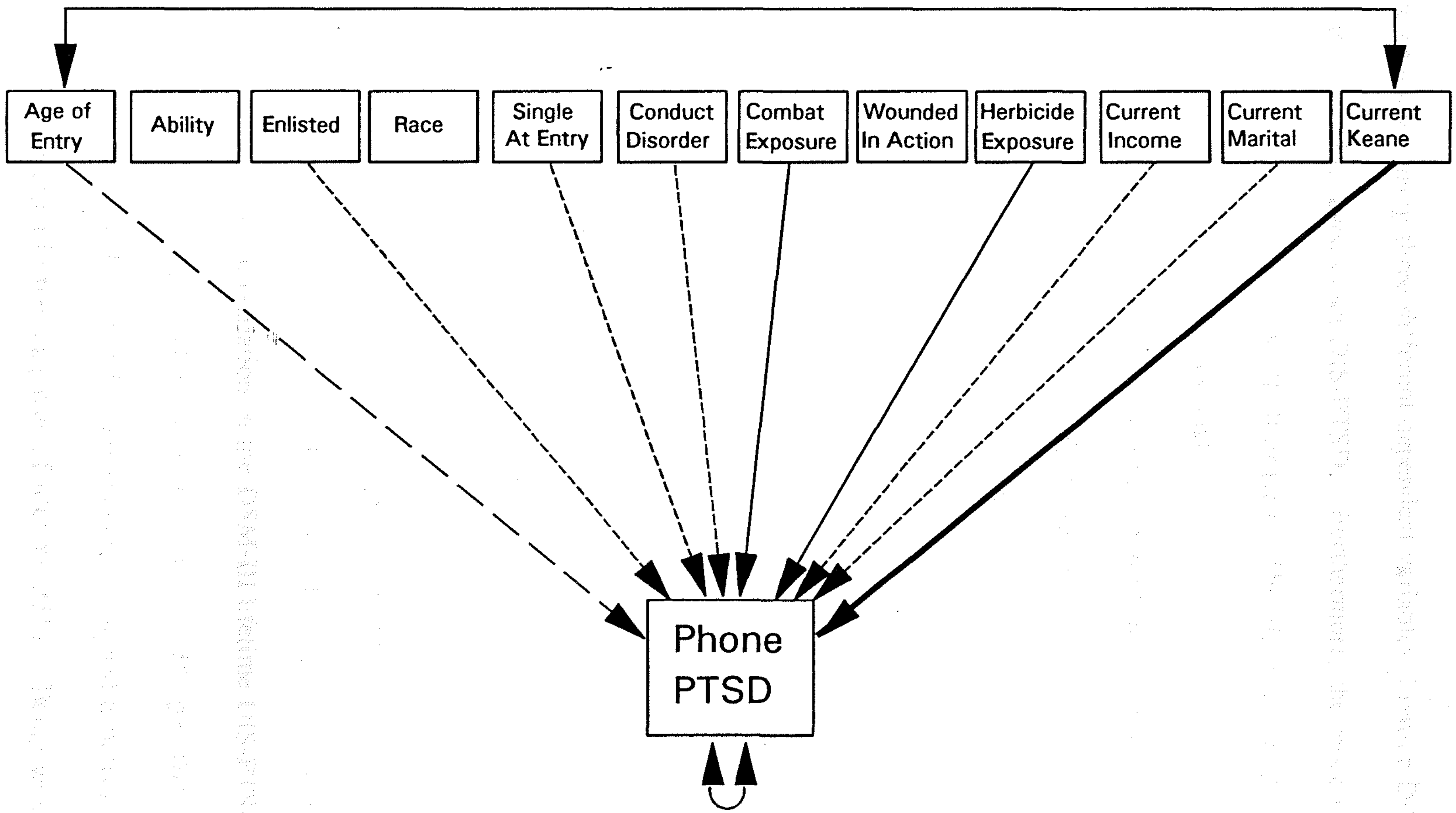


Figure 7: Multiple Linear Regression Predicting Phone PTSD in Exam Sample

Logistic Regressions using the DIS-PTSD scale. Logistic regression models were estimated using three different dependent variables: lifetime DIS-PTSD, current DIS-PTSD and delayed-onset DIS-PTSD. Furthermore, the models were tested using both DSM-III criteria and DSM-III-R criteria. Therefore, a series of six hierarchical logistic regression models were estimated.

In Table 53, the results for the prediction of the DSM-III lifetime DIS-PTSD diagnosis are presented. For model M_1, there were statistically significant effects for age of entry, ability score and self-reported conduct disorder problems. Individuals who entered the military at a younger age were more likely to be diagnosed with a lifetime diagnosis of PTSD according to DSM-III criteria (B=-.13, β=-.12, p<.01). Subjects who scored lower on the ability scales were also more likely to be diagnosed with PTSD (B=-.22, β=-.12, p<.01) . Finally, individuals who reported four or more conduct disorder problems were more likely to be diagnosed with a lifetime diagnosis of PTSD (B=.86, β=.16, p<.01). The pseudo-R^2 for the pre-military regression model was .04. The direction of effects for the pre-military variables were identical to the direction of effects for the phone interview PTSD total score. In addition, the size of the effects (β's) were also very similar.

For model M_2, the addition of the three military predictors dramatically increased the explained covariation in the DSM-III lifetime DIS-PTSD diagnosis (pseudo-R^2=.21). Both combat exposure (B=.49, β=.61, p<.01) and herbicide exposure (B=.36, β=.15, p<.01) independently predicted a statistically significant amount of covariation in the diagnosis of lifetime PTSD. Being wounded during the

Table 53

Logistic Regressions for Lifetime DSM-III DIS-PTSD (N=3,899)

Predictors	M_1			M_2			M_3		
	B	(ß)		B	(ß)		B	(ß)	
Intercept	-.15	(.00)	*	-1.91	(.00)	*	-2.97	(.00)	*
Age of Entry	-.13	(-.12)	*	-.07	(-.06)		-.04	(-.03)	
Ability	-.22	(-.12)	*	-.12	(-.07)		.06	(.03)	
Enlisted	.19	(.05)		.31	(.12)		.31	(.08)	
Race	-.09	(-.02)		.01	(.01)		-.10	(-.02)	
Single	-.15	(-.04)		-.09	(-.01)		-.01	(-.01)	
Conduct	.86	(.16)	*	.92	(.17)	*	.67	(.12)	*
Combat				.49	(.61)	*	.48	(.51)	*
Wounded				-.21	(-.02)		-.14	(-.02)	
Herbicide				.36	(.15)	*	.26	(.11)	*
Income							-.04	(-.03)	
Married							-.14	(-.03)	
Keane-PTSD-R							.08	(.31)	*
Pseudo R^2	.04 *			.21 *			.26 *		
Pseudo R^2-Change	.04 *			.17 *			.05 *		

Note: '*' represents a statistically significant value at p<.01;
The interaction terms added less than 1% explained variance.

war did not independently predict the diagnosis. In terms of the direction of effects, subjects who reported higher levels of combat exposure and herbicide exposure were more likely to be diagnosed with lifetime DIS-PTSD.

In M_3, the addition of the three post-military variables resulted in a five percent increase in explained covariation in the lifetime DIS-PTSD measure. Only the Keane-PTSD-R scale was a statistically significant independent predictor of the DSM-III lifetime DIS-PTSD diagnosis (β=.31). Individuals who scored higher on the Keane-PTSD-R scale were more likely to be diagnosed with lifetime DSM-III PTSD. For the full model, there were only four statistically significant independent predictors of the DSM-III lifetime DIS-PTSD diagnosis: conduct disorder, combat exposure, herbicide exposure, and the Keane-PTSD-R scale. The addition of the combat interaction terms into the regression model resulted in a non-statistically significant increase in the explained covariation of the outcome variable (See Figure 8 for path diagram of effect sizes).

In Table 54, the same analyses were run using the DSM-III-R lifetime DIS-PTSD diagnosis as the dependent variable. The results were essentially identical to the previous table except for a change in the intercept value based on the higher base rate for the DSM-III-R PTSD criteria. There were statistically significant effects for age of entry into the military, ability score, and conduct disorder when the pre-military variables were entered into the equation. Combat exposure and herbicide exposure both contributed statistically significant amounts of explained covariance to the model when the military effects were entered into the equation. Finally, the

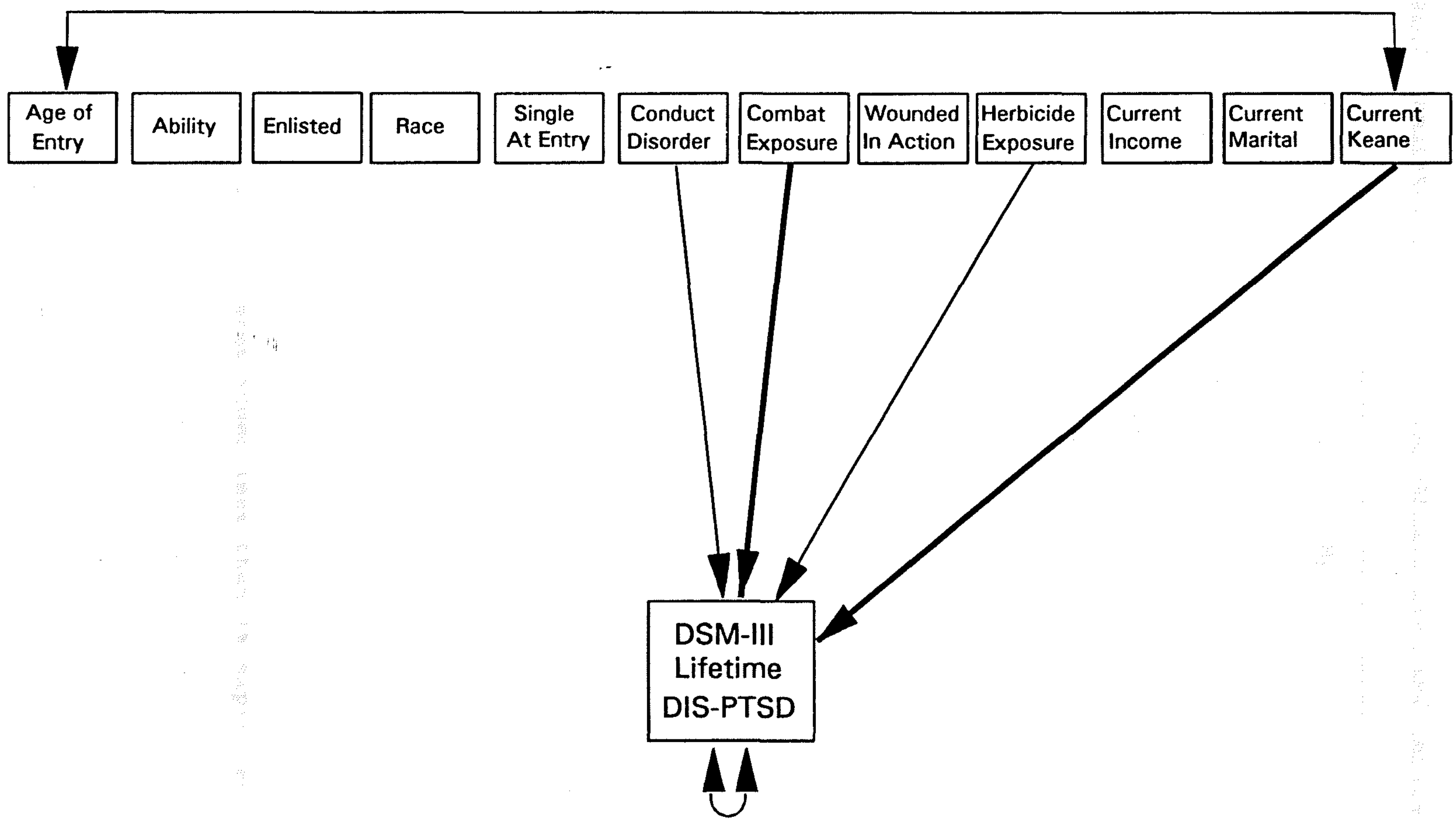


Figure 8: Logistic Regression Predicting DSM-III Lifetime DIS-PTSD

Table 54

Logistic Regressions for Lifetime DSM-III DIS-PTSD (N=3,899)

Predictors	M_1		M_2		M_3	
	B	(β)	B	(β)	B	(β)
Intercept	.99	(.00)	-.91	(.00)	-2.00	(.00)
Age of Entry	-.13	(-.13) *	-.08	(-.07)	-.05	(-.05)
Ability	-.25	(-.13) *	-.17	(-.09) *	-.02	(-.01)
Enlisted	.12	(.03)	.25	(.07)	.25	(.07)
Race	-.10	(-.02)	-.01	(-.01)	-.09	(-.01)
Single	-.17	(-.04)	-.14	(-.04)	-.08	(-.02)
Conduct	.70	(.13) *	.81	(.15) *	.57	(.10) *
Combat			.51	(.54) *	.50	(.53) *
Wounded			-.30	(-.04)	-.21	(-.02)
Herbicide			.40	(.17) *	.32	(.14) *
Income					-.01	(-.01)
Married					-.13	(-.03)
Keane-PTSD-R					.07	(.30) *
Pseudo R^2	.03 *		.24 *		.27 *	
Pseudo R^2-Change	.03 *		.21 *		.03 *	

Note: '*' represents a statistically significant value at p<.01;

The interaction terms added less than 1% explained variance.

Keane-PTSD-R scale added a statistically significant amount of explained covariance to the model when the post-military variables were entered into the equation. The direction of effects were the same as the previous model (See Figure 9 for path diagram of effect sizes).

In Table 55, the results for predicting the current DSM-III DIS-PTSD diagnosis are presented. The sample included only subjects who had been diagnosed with a lifetime DSM-III DIS-PTSD diagnosis (n=357). For Model M_1, the pre-military variables did not differentiate the individuals with a current diagnosis of PTSD from the individuals who had PTSD symptoms in remission. The pseudo-R^2 for the model was .04. For M_2, none of the military variables significantly predicted the current DSM-III DIS-PTSD diagnosis (pseudo-R^2=.06). Finally, for M_3, there was a statistically significant independent effect for the Keane-PTSD-R scale (B=.09, β=.46, $p<.01$). Individuals who scored higher on the Keane-PTSD-R scale were more likely to be given a current diagnosis of PTSD. The overall effect size for M_3 (pseudo-R^2=.16) was not as large as the previous lifetime DIS-PTSD diagnosis model and the effect was due solely to the Keane-PTSD-R scale.

In Table 56, the results of predicting the current DSM-III-R DIS-PTSD diagnosis are presented. The sample included only subjects who had been diagnosed with lifetime DSM-III-R DIS-PTSD. Similar to the results presented in the previous section, there were no statistically significant independent effects for any of the pre-military variables. For the military effects, there was one statistically significant predictor of the current DSM-III-R DIS-PTSD. Individuals who had been wounded

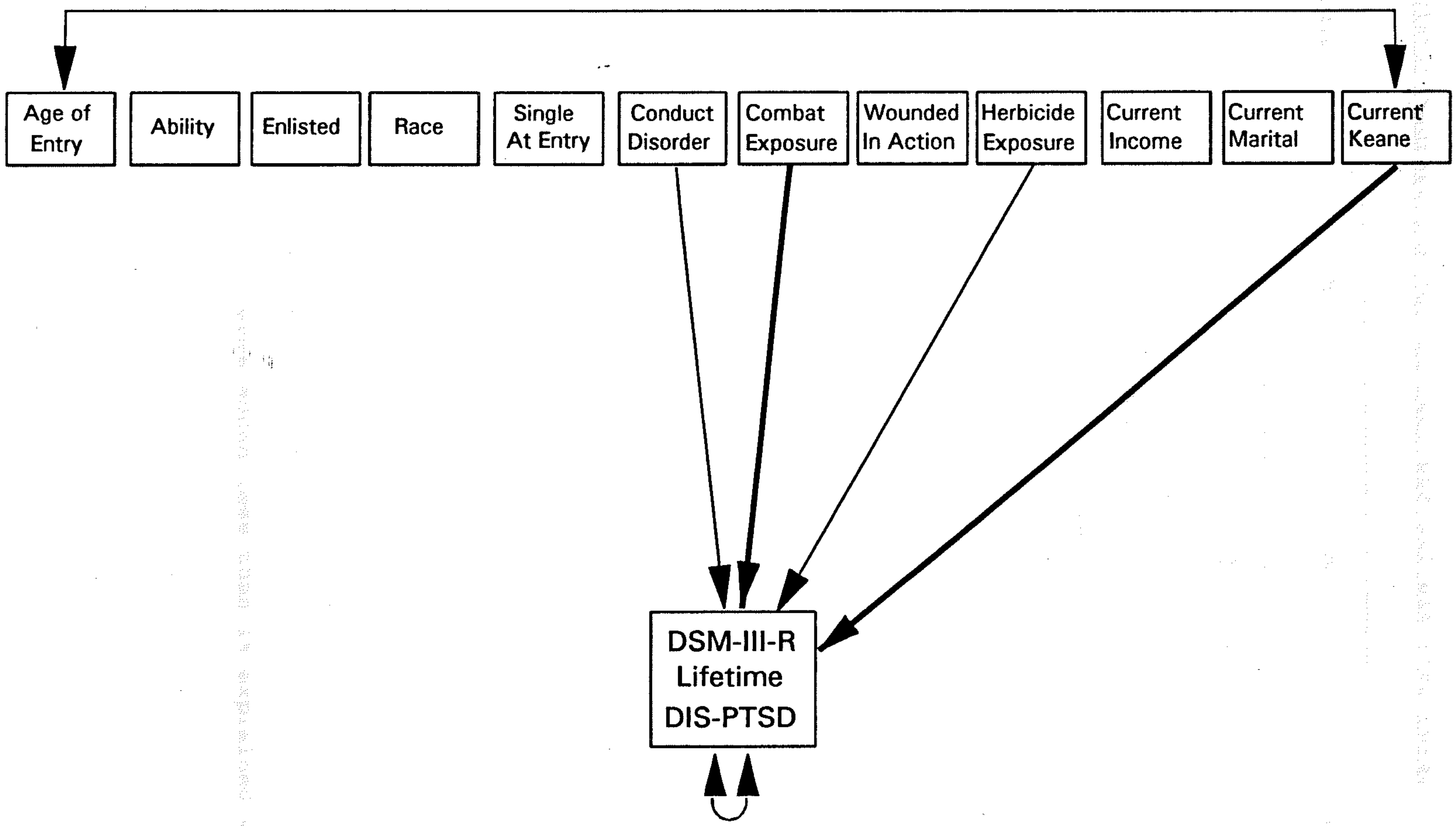


Figure 9: Logistic Regression Predicting DSM-III-R Lifetime DIS-PTSD

Table 55

Logistic Regressions for Current DSM-III DIS-PTSD (N=357)

Predictors	M_1		M_2		M_3	
	B	(β)	B	(β)	B	(β)
Intercept	2.65	(.00)	2.60	(.00)	.39	(.00)
Age of Entry	-.22	(-.20)	-.24	(-.18)	-.21	(-.18)
Ability	-.17	(-.09)	-.16	(-.11)	.01	(.01)
Enlisted	.13	(.04)	.18	(.12)	.30	(.13)
Race	.57	(.10)	.63	(.09)	.58	(.09)
Single	-.62	(-.16)	-.59	(-.14)	-.37	(-.09)
Conduct	-.22	(-.05)	-.22	(-.03)	-.49	(-.09)
Combat			.05	(.09)	.05	(.07)
Wounded			.87	(.15)	1.00	(.17)
Herbicide			-.02	(.01)	-.08	(-.04)
Income					.10	(.09)
Married					-.79	(-.21)
Keane-PTSD-R					.09	(.46) *
Pseudo R^2	.04		.06		.16 *	
Pseudo R^2-Change	.04		.02		.10 *	

Note: '*' represents a statistically significant value at $p<.01$;

The interaction terms added less than 1% explained variance.

Table 56

Logistic Regressions for Current DSM-III-R DIS-PTSD (N=610)

Predictors	M_1		M_2			M_3		
	B	(β)	B	(β)		B	(β)	
Intercept	1.87	(.00)	1.19	(.00)		-1.07	(.00)	
Age of Entry	-.20	(-.18)	-.20	(-.18)		-.18	(-.16)	
Ability	-.25	(-.13)	-.23	(-.11)		-.03	(-.02)	
Enlisted	.11	(.03)	.19	(.05)		.20	(.05)	
Race	.09	(.02)	.21	(.04)		-.09	(-.02)	
Single	-.51	(-.13)	-.47	(-.12)		-.24	(-.06)	
Conduct	.12	(.03)	.11	(.03)		-.34	(-.08)	
Combat			.12	(.13)		.13	(.14)	
Wounded			1.02	(.17)	*	1.17	(.18)	*
Herbicide			.07	(.04)		-.04	(.02)	
Income						.05	(.04)	
Married						-.73	(-.19)	
Keane-PTSD-R						.13	(.63)	*
Pseudo R^2	.03		.06			.22 *		
Pseudo R^2-Change	.03		.03			.16 *		

Note: '*' represents a statistically significant value at $p<.01$;
The interaction terms added less than 1% explained variance.

during the war were more likely to be diagnosed with current DSM-III-R PTSD (B=1.02, β=.17, p<.01). In the last model, M_3, there was a statistically significant effect for the Keane-PTSD-R scale (B=.13, β=.63, p<.01). Individuals who scored lower on the Keane-PTSD-R scale were more likely to be diagnosed with current DSM-III-R DIS-PTSD. The overall pseudo-R^2 of .22 for the M_3 was moderate in size.

In Table 57, the results for predicting the delayed-onset DSM-III DIS-PTSD diagnosis are presented. The sample included only subjects who had been diagnosed with lifetime DSM-III DIS-PTSD (n=357). The pre-military independent variables did not significantly predict the delayed-onset PTSD diagnosis (pseudo-R^2=.03). For the military variables, there were no statistically significant predictors of the delayed onset DSM-III DIS-PTSD diagnosis (pseudo-R^2=.05). For the last model, M_3, there was a statistically significant effect for current income level (B=-.33, β=-.30, p<.01) and the Keane-PTSD-R scale (B=.06, β=.06, p<.01). Individuals who reported lower levels of current income and scored higher on the Keane-PTSD-R scale were more likely to be diagnosed with delayed-onset PTSD. The overall pseudo-R^2 of .14 was small relative to the previous models.

In Table 58, the results for predicting the delayed-onset DSM-III-R DIS-PTSD diagnosis are presented. The sample included only subjects who had been diagnosed with lifetime DSM-III-R DIS-PTSD (n=610). For M_1, the pre-military variables did not significantly predict the delayed-onset DIS-PTSD diagnosis. For M_2, the military predictors also did not predict the delayed onset DIS-PTSD disorder. Finally, for M_3,

Table 57

Logistic Regressions for Delayed Onset DSM-III DIS-PTSD (N=357)

Predictors	M_1		M_2		M_3		
	B	(β)	B	(β)	B	(β)	
Intercept	-4.13	(.00)	-4.88	(.00)	-7.22	(.00)	*
Age of Entry	.08	(.07)	.09	(.08)	.18	(.16)	
Ability	-.14	(-.07)	-.13	(-.07)	.14	(.07)	
Enlisted	.44	(.12)	.48	(.13)	.45	(.13)	
Race	-1.29	(-.23)	-1.35	(-.24)	-1.55	(-.28)	
Single	.28	(-.07)	.28	(.07)	.35	(.09)	
Conduct	.50	(.12)	.61	(.15)	.51	(.12)	
Combat			.01	(.01)	-.02	(-.12)	
Wounded			.02	(.02)	.02	(.01)	
Herbicide			.50	(.25)	.52	(.26)	
Income					-.33	(-.30)	*
Married					1.10	(.29)	
Keane-PTSD-R					.06	(.30)	*
Pseudo R^2	.03		.05		.14 *		
Pseudo R^2-Change	.03		.02		.09 *		

Note: '*' represents a statistically significant value at p<.01;

The interaction terms added less than 1% explained variance.

Table 58

Logistic Regression for Delayed-Onset DSM-III-R DIS-PTSD (N=610)

Predictors	M_1		M_2		M_3		
	B	(β)	B	(β)	B	(β)	
Intercept	-3.15	(.00)	-4.01	(.00)	-4.87	(.00)	
Age of Entry	.03	(.02)	.04	(.04)	.08	(.07)	
Ability	.05	(.03)	.08	(.04)	.29	(.15)	
Enlisted	.61	(.16)	.65	(.18)	.70	(.19)	
Race	-.37	(-.07)	-.38	(-.07)	-.51	(-.09)	
Single	.05	(.01)	.06	(.01)	.12	(.03)	
Conduct	.44	(.10)	.48	(.11)	.32	(.07)	
Combat			.02	(.02)	.02	(.02)	
Wounded			.09	(.02)	.08	(.01)	
Herbicide			.36	(.19)	.31	(.16)	
Income					-.33	(-.30)	*
Married					1.10	(.28)	*
Keane-PTSD-R					.05	(.25)	*
Pseudo R^2	.02		.04		.11 *		
Pseudo R^2-Change	.02		.02		.07 *		

Note: '*' represents a statistically significant value at $p<.01$;

The interaction terms added less than 1% explained variance.

there was a statistically significant effect for income level (B=-.33, β=-.30, $p<.01$), current marital status (B=1.10, β=.28, $p<.01$), and the Keane-PTSD-R scale (B=.05, β=.25, $p<.01$). Individuals who report lower levels of income were more likely to be given a delayed onset diagnosis. Subjects who were married were also more likely to be given a delayed onset diagnosis. Finally, individuals who scored higher on the Keane-PTSD-R scale were more likely to be diagnosed with delayed-onset PTSD. The overall pseudo-R^2 of .11 was small relative to the previous models.

MMPI Profile Analysis

In Table 59 the MMPI profiles for three groups based on the type of the delayed-onset PTSD diagnosis are presented. The first group (controls: n=3,542) comprises subjects who had never been diagnosed with PTSD. The second group (non-delay: n=314) were subjects who had been diagnosed with lifetime DSM-III DIS-PTSD but did not experience a delay in the onset of PTSD symptoms. The third group (delayed-onset: n=43) were subjects who were diagnosed with lifetime DIS-PTSD based on DSM-III criteria and had experienced a delayed onset of the PTSD like symptoms. For subjects who had never been diagnosed with PTSD (controls), the MMPI profiles were in the normal range (See Figure 10). The most extreme MMPI profiles were found for subjects who had been diagnosed with a lifetime diagnosis of DIS-PTSD and had experienced a delayed onset of PTSD symptoms. The average MMPI profile for the group can be describe as an 8-2-7-4 codetype. These subjects were also elevated on the F scale. Individuals who did not experience the delayed onset of symptoms had a similar group profile to the delayed onset group

Figure 10.

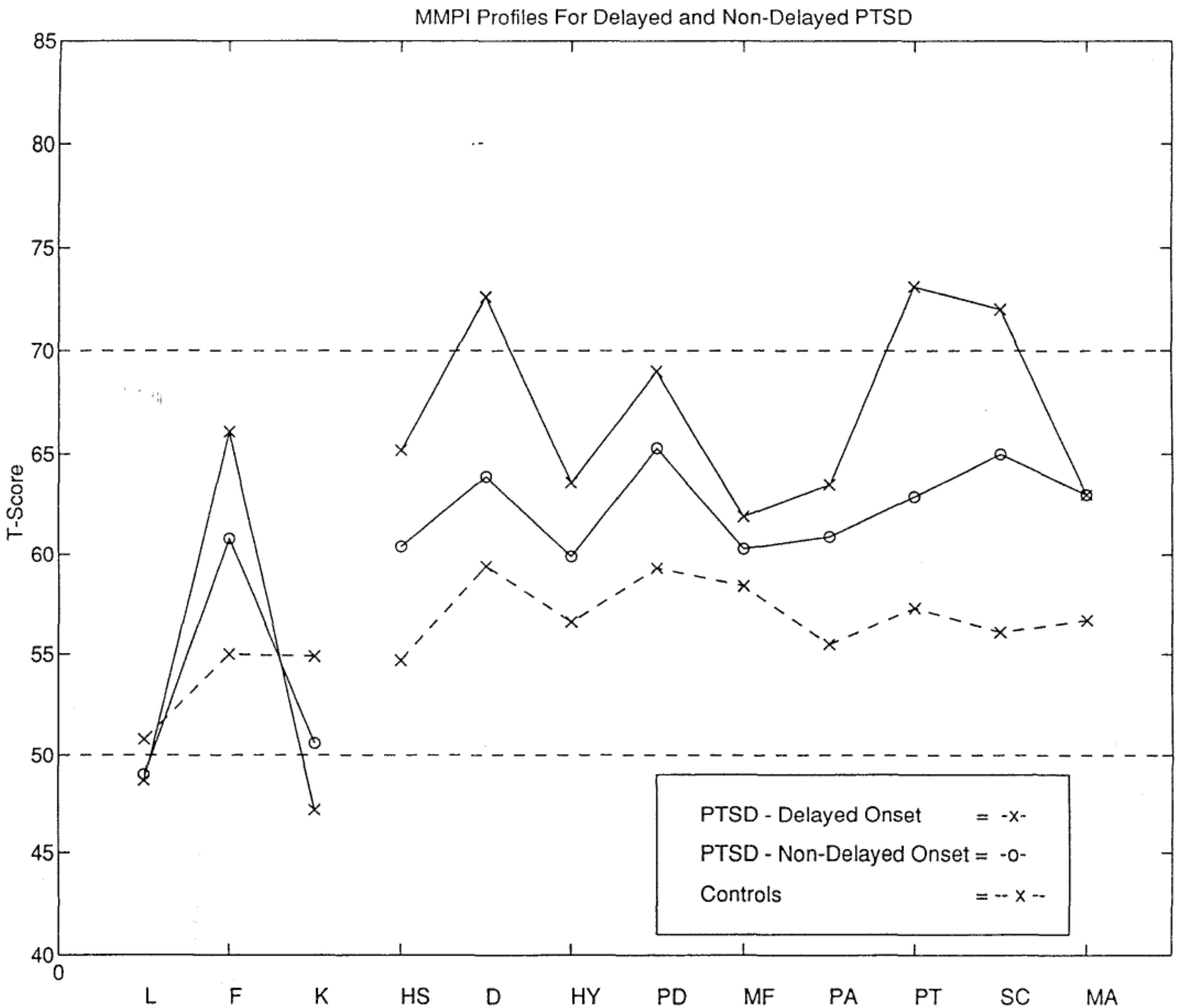

MMPI Profiles For Delayed and Non-Delayed PTSD
85
80
75
70
65
60
55
50
45
40
0
T-Score
L
F
K
HS
D
HY
PD
MF
PA
PT
SC
MA
PTSD - Delayed Onset = -x-
PTSD - Non-Delayed Onset = -o-
Controls = -- x --

Table 59

MMPI Profiles based on Delayed-Onset DSM-III DIS-PTSD

MMPI Profiles	Control (N=3,542) Mean	(Se)	Non-Delayed (N=314) Mean	(Se)	Delayed-Onset (N=43) Mean	(Se)	R^2
L	50.8	(.12)	49.0	(.40)	48.7	(1.2)	.005 *
F	55.0	(.15) *	60.8	(.60) *	66.1	(1.6)	.053 *
K	54.9	(.15) *	50.6	(.51)	47.2	(1.6)	.023 *
Hs	54.7	(.18) *	60.4	(.77) *	65.2	(2.2)	.028 *
D	59.4	(.21) *	63.9	(.80) *	72.6	(2.3)	.022 *
Hy	56.6	(.14) *	59.9	(.57) *	63.6	(1.7)	.017 *
Pd	59.3	(.18) *	65.3	(.64)	69.0	(1.6)	.031 *
Mf	58.4	(.16)	60.3	(.50)	61.9	(1.5)	.004 *
Pa	55.5	(.15) *	60.9	(.59)	63.5	(1.5)	.032 *
Pt	57.3	(.18) *	62.9	(.75) *	73.1	(1.7)	.040 *
Sc	56.1	(.20) *	65.0	(.83) *	72.0	(1.7)	.056 *
Ma	56.7	(.18)	63.0	(.60)	63.0	(1.4)	.029 *
Si	53.8	(.18) *	54.7	(.61) *	60.1	(2.0)	.039 *

Notes: Hs=Hypochondriasis; D=Depression; Hy=Hysteria; Pd=Psychopathic Deviate; Mf=Masculinity-Femininity; Pa=Paranoia; Pt=Psychasthenia; Sc=Schizophrenia; Ma=Hypomania; SI=Social Introversion; * represents p<.01.

but the average scores fell within normal limits.

In Table 60, the MMPI profiles for three groups based on current/remission categories of PTSD are presented. Similar to the delayed-onset comparison, the individuals with the current PTSD symptoms had more elevated MMPI profiles. The average profile can be described as an 8-4-2-7 codetype. A similar type of profile with less extreme elevations was found for the subjects with PTSD in remission (See Figure 11)

In Table 61, the delayed-onset dimension and the current/lifetime dimension are compared only for subjects who received a lifetime DSM-III DIS-PTSD diagnosis. The sample sizes were relatively small for the four groups with only nine subjects in the group that had both a delayed-onset of symptoms and a current diagnosis of DIS-PTSD. The small sample size was reflected in the large standard errors for the profile scores. The most extreme profiles were found for the group that had the current diagnosis and a delayed-onset of the PTSD symptomatology (See Figure 12).

Table 60

MMPI Profiles based on Current DSM-III DIS-PTSD

MMPI Profiles	Control (N=3,542) Mean	(Se)	Remission PTSD (N=317) Mean	(Se)	Current PTSD (N=40) Mean	(Se)	R^2
L	50.8	(.12)	49.0	(.40)	48.8	(1.2)	.005 *
F	55.0	(.15) *	60.8	(.59) *	66.5	(1.7)	.053 *
K	54.9	(.15) *	50.6	(.52)	46.7	(1.4)	.023 *
Hs	54.7	(.18) *	60.2	(.75) *	67.3	(2.4)	.031 *
D	59.4	(.21) *	64.1	(.81) *	72.2	(2.1)	.021 *
Hy	56.6	(.14) *	59.8	(.58) *	64.8	(1.5)	.018 *
Pd	59.3	(.18) *	64.9	(.63) *	72.5	(1.6)	.035 *
Mf	58.4	(.16)	60.4	(.52)	61.2	(1.1)	.004 *
Pa	55.5	(.15) *	60.5	(.56) *	67.3	(1.9)	.036 *
Pt	57.3	(.18) *	63.3	(.74) *	70.7	(2.2)	.036 *
Sc	56.1	(.20) *	64.8	(.79) *	74.5	(2.4)	.058 *
Ma	56.7	(.18) *	62.6	(.58)	66.8	(1.5)	.030 *
Si	53.8	(.18) *	54.7	(.63) *	60.5	(1.6)	.005 *

Notes: Hs=Hypochondriasis; D=Depression; Hy=Hysteria; Pd=Psychopathic Deviate; Mf=Masculinity-Femininity; Pa=Paranoia; Pt=Psychasthenia; Sc=Schizophrenia; Ma=Hypomania; SI=Social Introversion; * represents $p<.01$.

Figure 11.

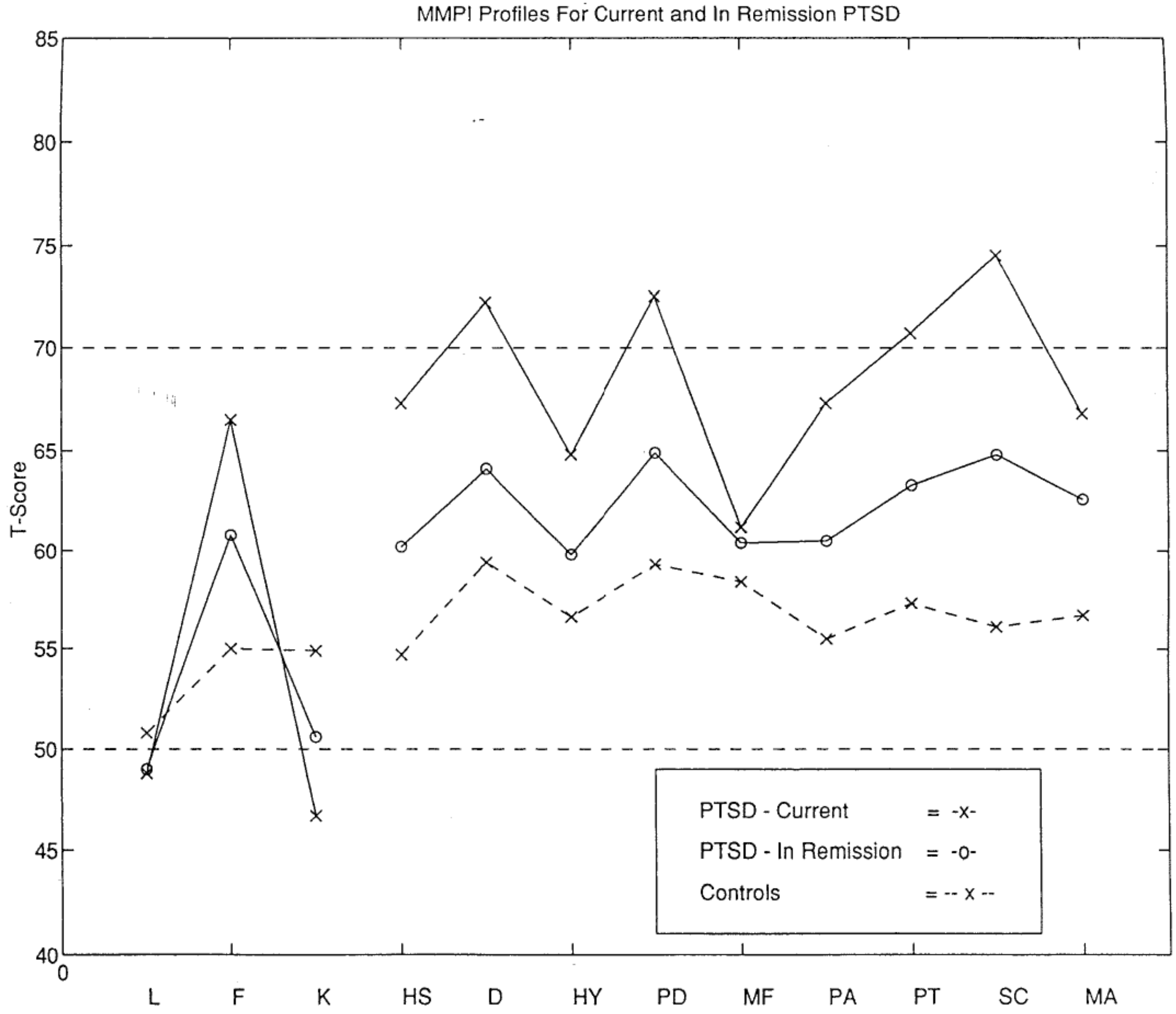

MMPI Profiles For Current and In Remission PTSD
85
80
75
70
65
60
55
50
45
40
0
T-Score
L
F
K
HS
D
HY
PD
MF
PA
PT
SC
MA
PTSD - Current = -x-
PTSD - In Remission = -o-
Controls = -- x --

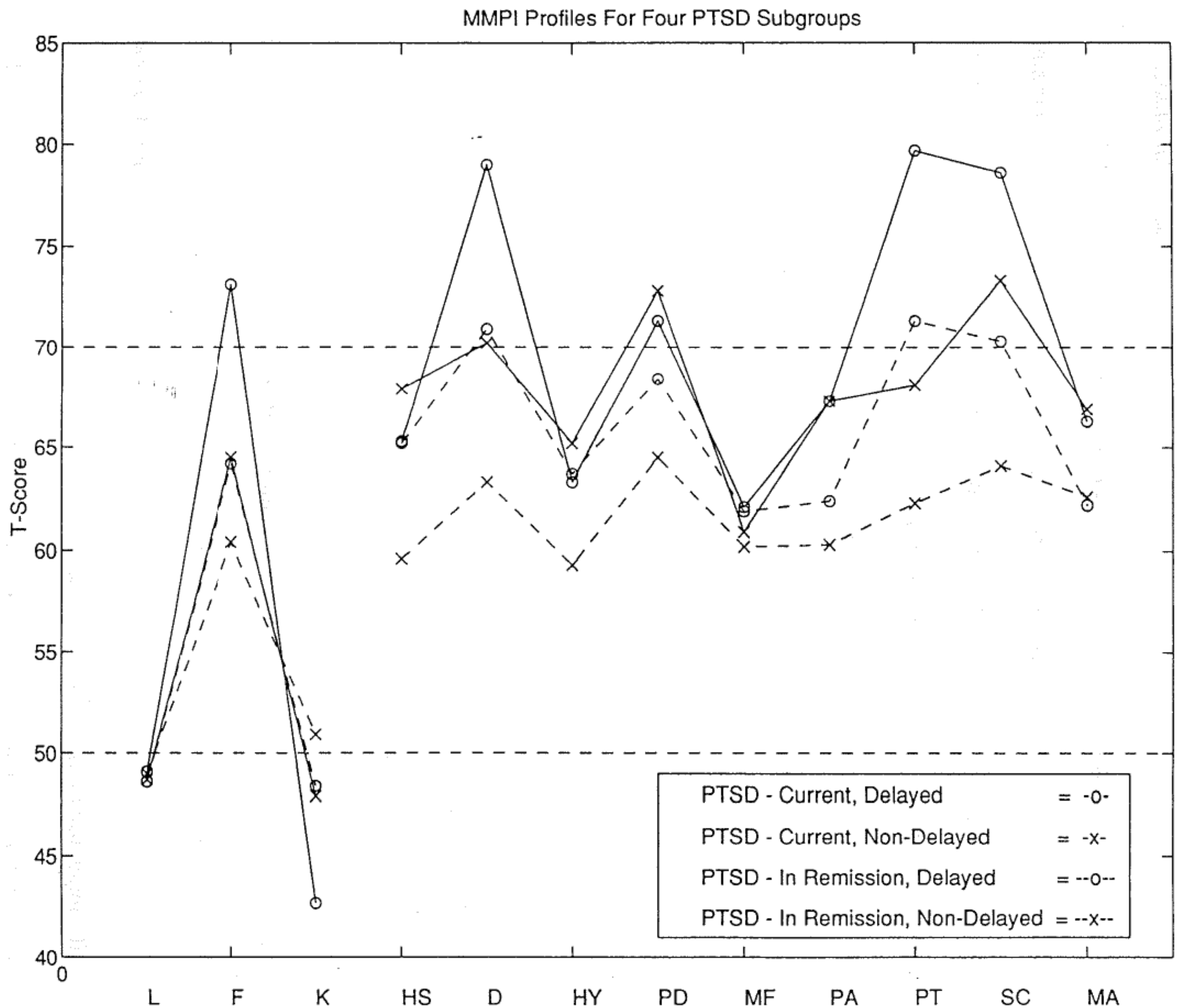
Table 61

MMPI Profiles for Subgroups of DIS-PTSD Positive Subjects

	Remission Non-Delay (N=283)		Remission Delay (N=34)		Current Non-Delay (N=31)		Current Delay (N=9)	
	Mean	(Se)	Mean	(Se)	Mean	(Se)	Mean	(Se)
L	49.0	(.41)	48.6	(1.4)	48.7	(1.5)	49.1	(1.9)
F	60.4	(.63)	64.2	(1.6)	64.5	(1.8)	73.1	(3.8)
K	50.9	(.53)	48.4	(1.9)	47.9	(1.7)	42.7	(2.3)
Hs	59.6	(.78)	65.2	(2.6)	67.9	(2.8)	65.3	(4.6)
D	63.3	(.84)	70.9	(2.7)	70.2	(2.3)	79.0	(4.1)
Hy	59.3	(.61)	63.7	(1.9)	65.2	(1.5)	63.3	(3.9)
Pd	64.5	(.66)	68.4	(1.8)	72.8	(1.7)	71.3	(4.0)
Mf	60.2	(.54)	61.9	(1.8)	60.9	(1.4)	62.1	(2.0)
Pa	60.3	(.60)	62.4	(1.6)	67.3	(2.2)	67.3	(3.1)
Pt	62.3	(.78)	71.3	(1.7)	68.1	(2.3)	79.7	(4.0)
Sc	64.1	(.85)	70.3	(1.8)	73.3	(2.9)	78.6	(4.1)
Ma	62.6	(.63)	62.2	(1.6)	66.9	(1.8)	66.3	(3.3)
Si	54.4	(.65)	57.7	(2.2)	58.0	(1.6)	69.0	(2.8)

Notes: Hs=Hypochondriasis; D=Depression; Hy=Hysteria; Pd=Psychopathic Deviate; Mf=Masculinity-Femininity; Pa=Paranoia; Pt=Psychasthenia; Sc=Schizophrenia; Ma=Hypomania; SI=Social Introversion.

Figure 12.


MMPI Profiles For Four PTSD Subgroups
T-Score
85
80
75
70
65
60
55
50
45
40
0
L
F
K
HS
D
HY
PD
MF
PA
PT
SC
MA
PTSD - Current, Delayed = -o-
PTSD - Current, Non-Delayed = -x-
PTSD - In Remission, Delayed = --o--
PTSD - In Remission, Non-Delayed = --x--

Chapter IV.

Discussion

Hypothesis Testing

This study provides important results to the body of literature pertaining to the internal consistency and construct validity of the PTSD concept. The study was comprised of one of the largest randomly selected samples of Vietnam-era veterans to date and, as a result, provided parameter estimates for the factor analysis models and regression models with great precision relative to previously reported studies. There were eight primary hypotheses put forward in the study and each hypothesis will be discussed with respect to the results of the experiment.

The first hypothesis stated that the factor structure for PTSD-related symptoms would conform best to the DSM-III-R conceptualization of PTSD. Specifically, an oblique three factor model was hypothesized to fit the PTSD scales better than the alternative one, two, or three factor models. For the Phone Interview PTSD scale, the results suggested that 1) the DSM-III factor structure fit the PTSD symptoms better than the DSM-III-R factor structure, 2) some two factor models fit as well as the three factor models, and 3) the oblique factor rotations fit the data much better than the orthogonal factor rotations largely due to the high positive intercorrelations between factors.

For the DIS-PTSD battery, the results showed that a one factor model fit the data better than any alternative factor structure for both the current and the lifetime PTSD symptoms. The one factor model did not provide evidence for either the

DSM-III or the DSM-III-R conceptualization of PTSD but the results did indicate that the PTSD symptoms were all highly intercorrelated. The results from the factor analyses of the Phone Interview PTSD items and the DIS-PTSD items lead to the rejection of the null hypothesis (H_{n1}). The oblique three factor DSM-III-R factor model was not the most parsimonious organization of the PTSD symptoms for either the Phone Interview PTSD scale or the DIS-PTSD scale.

The second hypothesis stated that there would be similarities between the factor structures represented by the two alternative measures of PTSD symptoms and that there would be statistically significant positive correlations across time for PTSD factors that measured similar constructs. Based on the results of the study, the null hypothesis (H_{n2}) was rejected. The Phone Interview PTSD factors correlated highly with the DIS-PTSD factor. The high correlations across the two sets of factors suggest that the two scales measure similar constructs. In addition, the between battery correlations were considered quasi test-retest stability coefficients. The large positive correlations across the two batteries suggest that individual differences in PTSD symptomatology are relatively stable over a one year period.

The third hypothesis stated that the factor structure for the PTSD symptoms would differ across groups based on exposure to combat. More specifically, the hypothesis stated that the factor structure for subjects who were exposed to combat would be unique relative to the factor structure for subjects who were not exposed to combat. Based on the results of the study, the null hypothesis (H_{n3}) was not rejected. The exploratory factor analysis of the Phone Interview PTSD items and the DIS-

PTSD items suggested that the factor structure for the PTSD symptoms was relatively invariant across both combat exposure groups. The results were very important. They suggest that extreme trauma does not create a PTSD-type construct. Rather, there appears to be an invariant PTSD factor structure that can be measured reliably in both combat and non-combat groups. Furthermore, the results suggest that the differences between the two combat groups on the PTSD factors were in the mean structure rather than the covariance structure. If the DSM manual were going to take this result into account, it might not require a severe trauma as a prerequisite to diagnosing PTSD. Theoretically, the accumulation of many small traumas could also result in the expression of high levels of PTSD symptomatology in vulnerable individuals.

The fourth hypothesis stated that a measure of pre-military cognitive functioning would be associated with higher levels of PTSD symptomatology. Specifically, higher pre-military cognitive functioning would be associated with lower levels of PTSD. The null hypothesis (H_{n4}) was rejected in favor of the alternative hypothesis (H_{a4}). The pre-military ability measure predicted both the Phone Interview PTSD symptoms and the DIS-PTSD lifetime symptoms, providing strong support for the alternative hypothesis. Individuals who scored higher on the ability measures were less likely to experience PTSD symptoms after the war.

The fifth hypothesis stated that measures of pre-military psychological functioning would be associated with post-military measures of PTSD. Specifically, it was hypothesized that higher levels of conduct disorder would be associated with lower levels of post-military PTSD. The null hypothesis (H_{n5}) could not be rejected in this case. The direction of the effect was opposite of the predicted direction of the effect. Higher levels of pre-military conduct disorder were associated with higher levels of post-military PTSD symptoms using both the Phone Interview PTSD total score and the lifetime DIS-PTSD measure.

The sixth hypothesis stated that measures of combat exposure would be associated with post-military measures of PTSD. Specifically, higher levels of combat exposure would be associated with higher levels of PTSD, independent of pre-military functioning. Based on the results of the study, the null hypothesis (H_{n6}) was rejected in favor of the alternative hypothesis (H_{a6}). Higher levels of combat exposure predicted higher levels of PTSD.

The seventh hypothesis stated that the self-reported levels of current social support would mediate levels of reported PTSD symptoms. Specifically, higher levels of social support would be associated with lower levels of PTSD independent of the pre-military and military predictors of PTSD. The null hypothesis (H_{n7}) was rejected in favor of the alternative hypothesis (H_{a8}). Measures of current social support represented by marriage were negatively associated with levels of PTSD symptoms. Subjects who were currently married experienced fewer PTSD symptoms then subjects who were not currently married.

The eighth hypothesis stated that the Keane-PTSD measure would be associated with measures of post-military PTSD. Specifically, higher scores on the Keane-PTSD scale would be associated with higher PTSD scores, independent of pre-military functioning or combat exposure. The null hypothesis (H_{n8}) was rejected in favor of the alternative hypothesis (H_{a8}). Higher scores on the Keane-PTSD-R scale were associated with higher levels of PTSD symptomatology. The Keane-PTSD-R scale represented a broad measure of psychopathology and probably represents comorbid symptoms associated with PTSD.

In summary, the results of the study provide a vast amount of information to the literature on the internal consistency and construct validity of the PTSD concept. Specifically, PTSD was related to pre-trauma characteristics such as psychological functioning and general ability scores. PTSD was also related to the amount of trauma experienced during the war. Individuals who experienced higher levels of combat tended to experience higher levels of post-war PTSD symptoms. Finally, post-war measures of social support and psychological functioning predicted PTSD symptoms well.

Additional Discussion of the Factor Analytic Results

Phone Interview PTSD Scale. For the Phone Interview PTSD items, the best fitting confirmatory two factor solution (See M_{2312} in Table 31) closely resembled the results of Zilberg et al. (1982). Using the IES, they estimated an exploratory two factor model and labelled the factors intrusion and avoidance, consistent with previous research using the IES (Horowitz et al. 1979). Zilberg and colleagues found that symptoms associated with arousal and re-experiencing loaded onto one factor while symptoms associated with detachment and avoidance loaded onto the other factor (See Table 3). The results of this study were also similar to Davidson et al. (1989) who found that the DSM-III criteria described the results of their exploratory factor solution better than the DSM-III-R criteria. In the Davidson study, there was one factor associated with re-experiencing and arousal symptoms. Unlike the Davidson study, the current study allowed the factors to be correlated and thus, may have resulted in the identification of fewer factors.

For the exploratory factor analysis of the Phone Interview PTSD symptoms, the best fitting model organized the PTSD symptoms according to 1) re-experiencing and avoidance symptoms related to past military experiences and 2) symptoms related to anxiety and depression. This result is slightly different from the confirmatory factor models, as well as previous studies of PTSD. Few studies to date have organized symptoms on a time continuum. The results may suggest that different factors are more prominent during different phases of the post-traumatic adjustment period. For example, McFarlane (1988) described the development of intrusive symptoms early in the developmental sequence of the PTSD disorder and the symptoms were subsequently replaced by more neurotic type symptoms. On the other hand, it may be misleading to describe the symptoms as independent because of the high correlation between the two factors that comprise the set of symptoms ($\underline{r}$=.77).

DIS-PTSD Scale. The best fitting model for the DIS-PTSD items was a one factor model. This was true for both the lifetime symptoms and the current symptoms. The lifetime DIS-PTSD factor correlated mostly highly with the re-experiencing factor from the phone interview items. Finding only one factor for the DIS-PTSD scale was somewhat unique relative to the current literature. The results support the notion developed by Slater (1943) who suggested that soldiers often developed PTSD-type symptoms that could be described by a single factor, neurotic constitution. Slater also showed that neurotic constitution was most closely associated with childhood neuroses and a positive family history for abnormal personality. More recently, McFarlane (1989) supported the findings of Slater by determining that PTSD was closely associated with neurotic symptoms one year after the experience of a traumatic event. Similarly, in this study, the re-experiencing factor measured by DIS-PTSD could be considered a neurotic constitution factor.

The failure to identify more than one factor for the DIS-PTSD items may have occurred for several reasons including 1) the loss of information when using dichotomous items that are proxies for continuous scales, 2) potential problems associated with the administration of DIS-PTSD such as the possible dependency of some of the DIS-PTSD questions on earlier DIS-PTSD questions, and 3) a lack of appropriate item content in the DIS-PTSD.

Similarities and Differences between the Two Batteries. The similarities between the two PTSD scales were made apparent by examining the intercorrelation matrix between the sets of factors across the two scales. The DIS-PTSD factor was significantly correlated with both of factors from the Phone Interview scale. The highest correlation was between the re-experiencing factor of the Phone Interview scale and the DIS-PTSD factor ($r = .69$). The two measures were administered approximately one year apart so the results provide an indication of the test-retest reliability of the PTSD construct. Unfortunately, the two scales were not identical so the results must be interpreted cautiously. Mikulincer & Solomon (1988) also found a relatively stable one-year test-retest coefficient for PTSD in a sample of Israeli combat soldiers measured 3 years after the Lebanon war ($r = .62$). Similarly, McFarlane (1989) found that the best predictor of PTSD related symptoms 11 months after a traumatic event was the previous measure of PTSD taken 4 months after the trauma ($\beta = .43$). Furthermore, the predictive effects of the 4 month PTSD measure persisted 29 months after exposure to the traumatic event, even after controlling for a wide range of other factors ($\beta = .24$). In general, the findings support the notion that PTSD-related symptoms experienced after a traumatic event demonstrate somewhat stable individual differences over time.

The differences in the factor structure between the two sets of items could be due to a number of reasons. The differences may be related to the actual items that comprised each scale. The phone interview items were comprised of 12 PTSD symptoms while the DIS-PTSD scale used only nine PTSD symptoms. Comparison of the items with the DSM criteria reveals that the DIS-PTSD items did not cover the range of DSM criteria as well as the phone interview items. Specifically, the DIS-PTSD included only one item from the avoidance symptoms of the DSM-III PTSD criteria. Conversely, the items from the second factor of the best fitting confirmatory factor model for the phone interview items consisted of three avoidance symptoms from the DSM-III PTSD criteria.

Another possible reason for differences in results between the two scales was the scaling of the variables. The phone interview items were scaled on a zero to three scale and were more likely to approximate a normal distribution while the DIS-PTSD items were dichotomous scales. Scales that approximate a normal distribution have greater power to discriminate between alternative factor structures (See McDonald, 1985).

Additional Discussion of the Regression Results

Phone Interview PTSD Total Score. The linear multiple regression models using the Phone Interview PTSD total score as the dependent variable revealed some rather important results. First, the notion that any one time period (i.e. pre-military, military, or post-military) is essential to the development of PTSD symptoms does not appear to be the case for this sample. All three measurement periods contributed a significant amount of variance to the development of PTSD symptoms. Pre-military characteristics consistently predicted PTSD symptoms with moderate effects for age of entry, ability score, and conduct disorder.

Military characteristics also demonstrated large predictive effects with R^2 values ranging from .12 to .16. The largest significant effects were for combat exposure and herbicide exposure. Interestingly, the herbicide exposure item was equally good at predicting PTSD symptoms when compared to the combat exposure scale. This may have occurred for two reasons: 1) the herbicide exposure scale may be another measure of combat intensity due to the fact that high herbicide exposure occurred most often in the high combat areas or 2) the herbicide exposure may have had a long-term biological effect that increased symptoms related to PTSD.

Finally, the post-military effects were good predictors of PTSD symptoms independent of the pre-military and military effects. The best independent predictor of PTSD symptoms was the Keane-PTSD-R scale. This may not be too startling given that the scale was developed to measure PTSD. What is surprising is that the effect was independent of combat exposure as well as many other pre-military and military predictors. In addition, the Keane-PTSD-R items did not specifically reference military experiences and the scale was administered one year after the phone interview. This suggests that the Keane-PTSD scale is identifying the more trait-like personality qualities associated with PTSD.

There were no significant two-way interactions with combat exposure and the other independent variables. It was hypothesized that the combat exposure indices would interact with certain variables like marital status to create increased levels of PTSD symptomatology. For example men that were married could have feared the consequences of death more that single men and an effect could have been generated from this relationship. Given that there were no two-way interactions with combat exposure, other more complex interactions could be tested.

Lifetime DIS-PTSD Diagnosis. The logistic regressions for the lifetime diagnosis of PTSD using the DIS were similar to the results of the previously described linear regressions using the Phone Interview PTSD scale. Age of entry, ability score and conduct disorder were all statistically significant pre-military predictors of PTSD symptoms using either the DSM-III or the DSM-III-R criteria. The direction of effects were the same as the models using the Phone Interview PTSD total score but the effect sizes were somewhat smaller. For the military predictors, combat exposure and herbicide exposure were both statistically significant predictors of the lifetime DIS-PTSD scale. The standardized estimate of the effects demonstrated a larger effect for combat exposure relative to the herbicide exposure index. Finally, the Keane-PTSD-R scale was the only statistically significant post-military predictor of the lifetime DIS-PTSD scale. The Keane-PTSD-R scale was also the largest effect when controlling for the other predictors. Similar to the previous linear regression analyses, the interaction of combat exposure with the other predictors resulted in no statistically significant increase in the explained covariance.

Current DIS-PTSD Diagnosis. For the regression estimates using the current diagnosis of DIS-PTSD, there was only one consistent statistically significant predictor, the Keane-PTSD-R scale. For individuals who were diagnosed with PTSD, subjects who scored higher on the Keane-PTSD-R scale were more likely to be diagnosed with a current diagnosis of DIS-PTSD. The results suggest that the Keane-PTSD-R scale may be an appropriate tool for differentiating between current PTSD and PTSD in remission.

Delayed Onset PTSD Diagnosis. The two best independent predictors of the delayed-inset DIS-PTSD were the Keane-PTSD-R scale and current annual income. Higher Keane-PTSD-R values were associated with higher rates of delayed-onset DIS-PTSD while higher income levels were associated with lower rates of delayed-onset DIS-PTSD. The results suggest that delayed-onset PTSD is associated with both psychological indicators as well as economic indicators of well being. The causal direction for the level of income measure is difficult to discern. The deterioration of psychological functioning associated with PTSD could lead to the loss of job opportunities which in turn could lead to lower earned income. On the other hand, the experience of fewer economic benefits could lead to an increase in the experience of PTSD symptoms. The predictive effects of the Keane-PTSD-R measure suggests that the scale is identifying characteristics associated with the delayed-onset symptomatology.

Incorporating the Regression Results into the Current Literature. The pre-military results for Phone Interview PTSD scale and lifetime DIS-PTSD scale were similar to the findings of Green et al. (1990) who found that pre-military factors of education, age of entry into the service, and conduct disorder were predictive of post-military functioning. As with the current study, Green and colleagues found that higher levels of conduct disorder were associated with higher levels of post-military stress. Similarly, Helzer et al. (1987) found a positive relationship between conduct disorder and PTSD symptoms in the ECA sample. McFarlane (1989) also found that pre-trauma neuroticism and psychological functioning were the best predictors of post-trauma functioning one year after exposure to severe fires in a sample of firefighters. Arnold (1985) suggests that individuals with a history of unstable relationships and repeated job changes are often diagnosed with antisocial personality disorder when, in fact, they may be suffering from chronic PTSD. The results of this study suggest that the two disorders may be related developmentally to one another. Conversely, the pre-military results did not support a number of studies that found no statistically significant effects for pre-military measures (Card, 1987; Carroll, et al. 1985; Foy et al. 1984; Resnick et al. 1989).

Military effects in this study added additional evidence to the growing literature on the negative impacts of combat exposure. (Card, 1987; Carrol et al. 1985; Foy & Card, 1987; Goldberg et al. 1990; Kulka et al. 1990; True et al. 1993). Higher levels of combat were associated with higher levels of PTSD. Combat was not the only predictor of PTSD symptoms but was one of the largest effects. Herbicide exposure during the war was also a consistent predictor of PTSD symptoms. The effects of herbicide exposure on PTSD symptomatology have not been discussed in the literature and it is difficult to determine exactly why herbicide exposure has not been reported in previous studies. Obviously, understanding the relationship between herbicide exposure and PTSD seems important.

Finally, the post-military effects in this study were similar to previous studies (Kulka et al. 1991; McFall et al. 1990). The interesting result in this study was that the Keane-MMPI-R scale was predictive of PTSD symptoms independent of combat exposure as well as a number of other measures. McFall et al. (1990) also found that the Keane-PTSD scale predicted the Mississippi PTSD scale independent of combat exposure.

MMPI Profiles

The MMPI profiles revealed that both current PTSD and delayed onset PTSD are related to intensity of PTSD symptomatology. Elevated MMPI profiles were found for both current PTSD subjects and the delayed-onset PTSD subjects. The exploratory ANOVAS revealed that the subjects with both current and delayed-onset symptomatology exhibited the highest MMPI elevations. The MMPI profiles seem to identify the state-trait characteristics of the PTSD symptoms. Similarly, the Keane-PTSD-R scale also differentiated between the state-trait characteristics of PTSD (i.e., current and delayed-onset of PTSD symptoms). The results are consistent with the previous reviews of the Keane-PTSD scale (See Penk et al. 1988).

Limitations of Study

Selection Effects. Selection effects were important to characterize because of the bias the selection process may impart on parameter estimates in the regression models. The subjects who could not be located in the follow-up study were more likely to be younger, single, minorities, who enlisted and scored lower on the ability measures. Some of these same characteristics were also important predictors of PTSD symptomatology. With respect to reported deaths, the young, single, less intelligent subjects were more likely to have died prior to the beginning of the study. The results make it difficult explain the higher number of blacks in the NONP group based on a disproportionate number of deaths for the blacks. This may suggest that the higher number of blacks in the NONP group may be due to other factors such as lack of interest in the study or homelessness. Rosenheck & Fontana (1994) found that PTSD did not have a direct causal effect on homelessness in Vietnam veterans while factors such as social isolation and being unmarried predicted increased rates of homelessness. Based on the selection effects, it is likely that the regression coefficients in this study are biased in the direction of underestimating the true effects due to the restriction in range that seems to have occurred for some of the predictors.

For selection into combat, age of entry and ability scores were the best predictors of combat exposure. Younger, less intelligent men were more likely to see higher levels of combat. Similarly, Green et al. (1990) found that younger, less well educated soldiers were more likely to be exposed to grotesque events during the Vietnam war.

Subjects who attended the follow-up exam reported more PTSD symptoms during the phone interview. The prevalence and incidence of PTSD must be estimated with caution when the sample was selected in this manner. For this study, the prevalence estimates in the exam sample probably tend to overestimate the prevalence of PTSD in the general population of Vietnam veterans. Other studies should be equally concerned with this effect (Keane et al. 1993; Kulka et al. 1990;).

<u>Random Assignment</u>. The major limitation to this study is that subjects were not randomly assigned to treatment effects. Studying negative life events usually results in the use of quasi-experimental designs and therefore, precludes one from drawing strong causal inferences. Ideally, the best experimental design would have randomly assigned subjects to different levels of combat. In addition, PTSD would have been measured before and after exposure to combat. Obviously, this would not be an ethical experimental design to implement but it would be the most effective experimental design.

<u>Measurement Instruments</u>. Another limitation of the design was that subjects were not measured repeatedly with the same PTSD instrument. Because two different PTSD instruments were used in this study, it is difficult to draw causal inferences

about the changes in PTSD symptoms over time. For example, if the same measure had been used, it would have been possible to discuss group differences in PTSD symptoms over time. This would allow one to answer additional questions about the developmental process of PTSD symptoms.

Future Research

Future studies should attempt to collect more extensive data on military personnel at the time of entry into the military. The data should include measures of PTSD related symptoms as well as criminal and academic records. The developmental process associated with PTSD could be examined more closely by requiring that military personal be given annual psychological exams that include measures of PTSD. Collecting repeated measures of PTSD over time would allow one to map out the changes in PTSD symptoms across occasions and provide the opportunity to investigate the precursors to these important developmental changes.

Conclusion

This study provided important results concerning the time course and developmental processes associated with PTSD. The internal consistency of the PTSD construct was demonstrated by a variety of factor analytic models. In addition, a high test-retest correlation for PTSD symptoms suggests that the PTSD construct is relatively stable over short periods of time. The construct validation of PTSD was demonstrated by a series of multiple regressions. The regression analyses revealed that pre-military, military, and post-military measures significantly predicted PTSD symptoms. Contrary to many published reports, pre-military measures of psychological functioning were predictive of PTSD symptoms 20 years after exposure to the stressful life event.

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Appendix 1

DSM-III Criteria for Post-traumatic Stress Disorder

A. Existence of a recognizable stressor that would evoke significant symptoms of distress in almost everyone.

B. Re-experiencing of the trauma as evidenced by at least one of the following:

(1) Recurrent and intrusive recollections of the event.

(2) Recurrent dreams of the event.

(3) Sudden acting or feeling as if the traumatic event were reoccurring because of an association with an environmental or ideational stimulus.

C. Numbing of responsiveness to or reduced involvement with the external world, beginning some time after the trauma, as shown by at least one of the following:

(1) Markedly diminished interest in one or more significant activities.

(2) Feeling of detachment or estrangement from others.

(3) Constricted affect.

D. At least two of the following symptoms that were not present before the trauma:

(1) Hyperalertness or exaggerated startle response.

(2) Sleep disturbance.

(3) Guilt about surviving when others have not or about behavior required for survival.

(4) Memory impairment or trouble concentrating.

(5) Avoidance of activities that arouse recollection of the traumatic event.

(6) Intensification of symptoms by exposure to events that symbolize or resemble the traumatic event.

Appendix 2

DSM-III-R Criteria for Post-traumatic Stress Disorder

A. The person has experienced an event that is outside the range of usual human experience and that would be markedly distressing to almost anyone, e.g., serious threat to one's life or physical integrity; serious threat or harm to one's children, spouse, or other close relatives and friends; sudden destruction of one's home or community; or seeing another person who has recently been, or is being seriously injured or killed as a result of an accident or physical violence.

B. The traumatic event is persistently re-experienced in at least one of the following ways.

(1) Recurrent and intrusive distressing recollections of the event.

(2) Recurrent distressing dreams of the event.

(3) Sudden acting or feeling as if the traumatic event were recurring.

(4) Intense psychological distress at exposure to events that symbolize or resemble an aspect of the traumatic event.

C. Persistent avoidance of stimuli associated with the trauma or numbing of general responsiveness as indicated by at least three of the following:

(1) Efforts to avoid thoughts or feelings associated with the trauma.

(2) Efforts to avoid activities or situations that arouse recollections of the trauma.

(3) Inability to recall an important aspect of the trauma.

(4) Markedly diminished interest in significant activities.

(5) Feeling of detachment or estrangement from others.

(6) Restricted range of affect

(7) Sense of foreshortened future.

D. Persistent symptoms of increased arousal as indicated by at least two of the following:

(1) Difficulty falling or staying asleep.

(2) Irritability or outbursts of anger.

(3) Difficulty concentrating.

(4) Hypervigilance.

(5) Exaggerated startle response

(6) Physiologic reactivity upon exposure to events that symbolize or resemble an aspect of the traumatic event.

Appendix 3

Factor Labels Associated with the Abbreviations used in Table 11.

Factor Labels	Factor Abbreviations
Adjustment Problems	AP
Anger	AN
Anti-Social Behavior	AS
Anxiety	AX
Avoidance	AV
Borderline	BL
Cognitive Interference	CI
Depression	DP
Detachment	DT
Drug Problems	DP
Guilt, Survival Guilt	GT
General PTSD Symptoms	GS
Interpersonal Difficulty	ID
Intrusion, Re-Experiencing	IN
Job Problems	JP
Lability of Affect	LA
Numbing	NB
Obsessive-Compulsive	OC
Paranoid Ideation	PI
Psychoticism	PS
Reactivity	RA
Sleep Difficulty	SD
Somatization	SO

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Contr
Atlanta GA 30333

Dear Veteran:

The Centers for Disease Control of the U.S. Public Health Service is conducting one of the largest health studies it has ever undertaken. Over 30,000 U.S. Army veterans will be asked to take part in this project, which is called the Veterans Health Survey. The purpose of the Veterans Health Survey is to find out if certain groups of veterans have more health problems than others and, if so, why.

I am writing to ask your cooperation in this very important health research study. Your name was chosen from Army service records using a scientific random selection procedure.

The enclosed Fact Sheet explains this study in detail. It should answer most questions you may have about how you were selected, what will happen to any information you provide, and the precautions that will be taken by the Centers for Disease Control to protect your privacy and other rights.

Each veteran selected for this study will be invited to take part in a telephone interview about his health and general background. The interviews will be conducted by professional interviewers from Research Triangle Institute, a private research firm located in North Carolina.

In the near future, an interviewer from Research Triangle Institute will try to reach you by telephone. If you have no telephone, if you have an unlisted number, or if you would simply like to schedule your interview at a convenient time, please call 1-800-334-3494, which is RTI's toll-free number. (If you live in North Carolina or outside the 48 contiguous United States, please call 1-919-541-6869 collect.) Give the operator your name, the ID number in the lower left corner of this letter, and a telephone number and time when you can be reached.

If you have questions or would like more information about this study, you may call or write Robert C. Diefenbach, Centers for Disease Control (C-25), 1600 Clifton Road, Atlanta, Georgia 30333 (Phone: 404-454-4472).

We hope we can count on your participation in the Veterans Health Survey.

Sincerely yours,

James O. Mason

James O. Mason, M.D., Dr.P.H.
Assistant Surgeon General
Director

Enclosure

Appendix 5

PTSD Symptoms asked during Phone Interview

1) During the past six months, how often have you had trouble falling asleep, staying asleep, or sleeping too much?

2) During the past six months, how often have you had trouble concentrating?

3) During the past six months, how often have you had trouble with your memory?

4) During the past six months, how often have you been irritable and short-tempered?

5) During the past six months, how often have you had explosions of aggressive or angry behavior?

6) During the past six months, how often have you lost interest in your daily activities?

7) During the past six months, how often have you felt distant from everyone, even those people you care about?

8) During the past six months, how often have you felt that life is not meaningful?

9) During the past six months, how often have you felt jumpy and easily startled or felt that you had to stay on guard all the time?

10) During the past six months, how often have you had repeated dreams or nightmares about things that happened to you while in the Army?

11) During the past six months, how often have you avoided activities that might remind you of things that happened to you while in the Army?

12) During the past six months, how often have you had painful memories of things that happened to you while in the Army?

Appendix 5

Continued:

---

13) During the past six months, how often have you started to feel and act as though a disturbing event that you experienced in the Army was happening all over again?

14) During the past six months, how often have you felt ashamed or guilty about the kinds of things you did to survive while in the Army?

15) During the past six months, how often have you felt anxious or troubled when you were in situations that reminded you of times in the Army?

Appendix 6

Combat Questions asked during Phone Interview

---

1) Did you ever receive incoming fire from artillery, rockets, or mortars? [If yes, ask A]

    A) About how many times, altogether, did you receive incoming fire from artillery, rockets, or mortars?

2) Did you ever encounter mines or booby traps? [If yes, ask A]

    A) About how many times, altogether, did you encounter mines or booby traps?

3) Did you receive sniper or sapper fire? [If yes, ask A]

    A) About how many times, altogether, did you receive sniper or sapper fire.

4) Were you ever ambushed? [If yes, ask A]

    A) About how many times, altogether, were you ambushed?

5) Were you ever involved in a firefight with the Vietcong or the North Vietnamese Army? [If yes, Ask A]

    A) About how many times, altogether, were you involved in a firefight?

Appendix 7.

NCS Trans-Optic MP30-15404-321 A9107

COMBAT EXPOSURE INDEX

PARTICIPANT NUMBER	TEST DATE (MONTH / DAY / YEAR)	TEST NO	TESTER CODE	SCORER CODE
0–9	JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC / 0–9 / 0–9	0–9	0–9	0–9

PARTICIPANT NAME

REMARKS

TOTAL SCORE

	NEVER	RARELY	SOMETIMES	OFTEN	VERY OFTEN
1. I was part of a land or naval artillery unit which fired on the enemy	0	1	2	3	4
2. I flew in aircraft over South or North Vietnam	0	1	2	3	4
3. I was stationed at a forward observation post	0	1	2	3	4
4. I received incoming fire from enemy artillery, rockets or mortars	0	1	2	3	4
5. My unit patrols encountered mines and booby traps	0	1	2	3	4
6. My unit received sniper or sapper fire	0	1	2	3	4
7. My unit patrol was ambushed	0	1	2	3	4
8. My unit patrol engaged the Vietcong (or guerilla troops) in a firefight	0	1	2	3	4
9. My unit patrol engaged the NVA (organized military forces) in a firefight	0	1	2	3	4
10. I saw Americans killed or injured	0	1	2	3	4
11. I saw Vietnamese killed or injured	0	1	2	3	4
12. I killed someone or thought I killed someone	0	1	2	3	4

COMPLETED? ○ YES ○ NO ○ TERMINATED ○ REFUSED

Appendix 8

SAS Program for simulation of latent factor structure.

```
DATA sim_data;
*-------------------------------------;
* setting parameters  ;
*-------------------------------------;
      Theta_M    =  0.00;
      Theta_SD   =  1.00;
      a1         =  0.8;
      a2         =  0.8;
      a3         =  0.8;
      a4         =  0.8;
      b1         =  0.8;
      b2         =  0.8;
      b3         =  0.8;
      b4         =  0.8;

      N          =  10000;

      seed1      = 921003;
      seed2      = 921004;
      seed11     = 921005;
      seed12     = 921006;
      seed13     = 921007;
      seed14     = 921008;
      seed21     = 921009;
      seed22     = 921010;
      seed23     = 921011;
      seed24     = 921012;

*-------------------------------------;
* generating raw data                 ;
*-------------------------------------;
  DO _N_   = 1 TO N;

      ID = _N_;

    *---------------------------------------------------------;
    * Specify Expectation for Independent Variables           ;
    *---------------------------------------------------------;
      Theta1    = Theta_M + (Theta_SD * RANNOR(seed1));
      Theta2    = (.6 * Theta1) + (sqrt(1-.6**2) * RANNOR(seed2));

      y11       = (a1 * Theta1) + (sqrt(1-a1**2) * Rannor(seed11));
      y12       = (a2 * Theta1) + (sqrt(1-a2**2) * Rannor(seed12));
      y13       = (a3 * Theta1) + (sqrt(1-a3**2) * Rannor(seed13));
      y14       = (a4 * Theta1) + (sqrt(1-a4**2) * Rannor(seed14));

      y21       = (b1 * Theta2) + (sqrt(1-b1**2) * Rannor(seed21));
      y22       = (b2 * Theta2) + (sqrt(1-b2**2) * Rannor(seed22));
      y23       = (b3 * Theta2) + (sqrt(1-b3**2) * Rannor(seed23));
      y24       = (b4 * Theta2) + (sqrt(1-b4**2) * Rannor(seed24));
```

Appendix 8

Continued ..

```
Item001 = 0; Item002 = 0; Item003 = 0; Item004 = 0;
Item005 = 0; Item006 = 0; Item007 = 0; Item008 = 0;
IF y11 > 0.0 then item001 = 1;
IF y12 > 0.0 then item002 = 1;
IF y13 > 0.0 then item003 = 1;
IF y14 > 0.0 then item004 = 1;
IF y21 > 0.0 then item005 = 1;
IF y22 > 0.0 then item006 = 1;
IF y23 > 0.0 then item007 = 1;
IF y24 > 0.0 then item008 = 1;

Item101 = 0; Item102 = 0; Item103 = 0; Item104 = 0;
Item105 = 0; Item106 = 0; Item107 = 0; Item108 = 0;
IF y11 > 1.0 then item101 = 1;
IF y12 > 1.0 then item102 = 1;
IF y13 > 1.0 then item103 = 1;
IF y14 > 1.0 then item104 = 1;
IF y21 > 1.0 then item105 = 1;
IF y22 > 1.0 then item106 = 1;
IF y23 > 1.0 then item107 = 1;
IF y24 > 1.0 then item108 = 1;

Item151 = 0; Item152 = 0; Item153 = 0; Item154 = 0;
Item155 = 0; Item156 = 0; Item157 = 0; Item158 = 0;
IF y11 > 1.5 then item151 = 1;
IF y12 > 1.5 then item152 = 1;
IF y13 > 1.5 then item153 = 1;
IF y14 > 1.5 then item154 = 1;
IF y21 > 1.5 then item155 = 1;
IF y22 > 1.5 then item156 = 1;
IF y23 > 1.5 then item157 = 1;
IF y24 > 1.5 then item158 = 1;

Item171 = 0; Item172 = 0; Item173 = 0; Item174 = 0;
Item175 = 0; Item176 = 0; Item177 = 0; Item178 = 0;
IF y11 > 1.75 then item171 = 1;
IF y12 > 1.75 then item172 = 1;
IF y13 > 1.75 then item173 = 1;
IF y14 > 1.75 then item174 = 1;
IF y21 > 1.75 then item175 = 1;
IF y22 > 1.75 then item176 = 1;
IF y23 > 1.75 then item177 = 1;
IF y24 > 1.75 then item178 = 1;

Item191 = 0; Item192 = 0; Item193 = 0; Item194 = 0;
Item195 = 0; Item196 = 0; Item197 = 0; Item198 = 0;
IF y11 > 1.90 then item191 = 1;
IF y12 > 1.90 then item192 = 1;
IF y13 > 1.90 then item193 = 1;
IF y14 > 1.90 then item194 = 1;
IF y21 > 1.90 then item195 = 1;
IF y22 > 1.90 then item196 = 1;
IF y23 > 1.90 then item197 = 1;
IF y24 > 1.90 then item198 = 1;
```

Appendix 8

Continued

```
      Item201 = 0; Item202 = 0; Item203 = 0; Item204 = 0;
      Item205 = 0; Item206 = 0; Item207 = 0; Item208 = 0;
      IF y11 > 2.0 then item201 = 1;
      IF y12 > 2.0 then item202 = 1;
      IF y13 > 2.0 then item203 = 1;
      IF y14 > 2.0 then item204 = 1;
      IF y21 > 2.0 then item205 = 1;
      IF y22 > 2.0 then item206 = 1;
      IF y23 > 2.0 then item207 = 1;
      IF y24 > 2.0 then item208 = 1;

    OUTPUT;
  END;
RUN;
```

Appendix 9

Reliabilities for Phone-PTSD Symptoms

Item	Total Correlation	Alpha Without Item
Nightmares about army	.643	.893
Painful memories of army	.680	.891
Deja vu experience about army	.645	.894
Anxious about reminders of army	.693	.891
Lost interest	.602	.895
Felt distant others	.700	.890
Life not meaningful	.630	.893
Avoid reminders of army	.629	.893
Hypervigilance	.645	.892
Trouble with Sleep	.561	.899
Shame/guilt about army	.569	.896
Trouble Memory/Concentrating	.619	.893

Note: Cronbach's Alpha = .901

Appendix 10

Reliabilities for Lifetime DIS-PTSD Symptoms

Item	Total Correlation	Alpha Without Item
SYMP210	.702	.854
SYMP220	.442	.876
SYMP230	.616	.862
SYMP310	.629	.861
SYMP320	.728	.851
SYMP410	.704	.854
SYMP420	.746	.850
SYMP430	.439	.876
SYMP440	.563	.868

Note: Cronbach's Alpha = .876

Appendix 11

Reliabilities for Current DIS-PTSD Symptoms

Item	Total Correlation	Alpha Without Item
SYMP210	.563	.764
SYMP220	.451	.800
SYMP230	.522	.791
SYMP310	.516	.792
SYMP320	.506	.793
SYMP410	.527	.792
SYMP420	.643	.773
SYMP430	.450	.802
SYMP440	.473	.796

Note: Cronbach's Alpha = .811

Appendix 12

Reliabilities for Ability Measures

Item	Total Correlation	Alpha Without Item
VE1	.755	.865
AR1	.760	.864
PA1	.656	.887
GIT1	.675	.883
AFQT1	.861	.839

Note: Cronbach's Alpha = .892

Appendix 13

Reliabilities for DIS-Conduct Disorder Items

Item	Total Correlation	Alpha Without Item
Expelled/Suspended	.399	.611
Played Hooky	.375	.615
Fighting in School	.340	.621
Fighting out of School	.294	.633
Ran away from home	.314	.627
Told many lies as a child	.283	.632
Stealing	.287	.642
Damaged Property	.318	.625
Arrested	.372	.618
Alcohol Use	.301	.629
Drug Use	.182	.649
Gambling	.066	.654

Note: Cronbach's Alpha = .651

Appendix 14

Reliabilities for Keane MMPI Items

Item	Total Corr	Alpha Without Item
PTSD01	.184	.916
PTSD02	.347	.916
PTSD03	.398	.915
PTSD04	.172	.918
PTSD05	.355	.916
PTSD06	.537	.914
PTSD07	.386	.915
PTSD08	.414	.915
PTSD09	.468	.914
PTSD10	.448	.915
PTSD11	.386	.915
PTSD12	.521	.914
PTSD13	.448	.915
PTSD14	.481	.914
PTSD15	.434	.915
PTSD16	.409	.915
PTSD17	.410	.915
PTSD18	.501	.914
PTSD19	.446	.914
PTSD20	.481	.914
PTSD21	.373	.915
PTSD22	.595	.913
PTSD23	.553	.913
PTSD24	.482	.914
PTSD25	.418	.915

Appendix 14

<u>Continued:</u>

Item	Total Corr	Alpha Without Item
PTSD26	.526	.914
PTSD27	.429	.915
PTSD28	.493	.914
PTSD29	.418	.915
PTSD30	.405	.915
PTSD31	.492	.914
PTSD32	.493	.914
PTSD33	.481	.914
PTSD34	.343	.915
PTSD35	.493	.914
PTSD36	.511	.914
PTSD37	.430	.915
PTSD38	.373	.915
PTSD39	.448	.914
PTSD40	.475	.914
PTSD41	.402	.915
PTSD42	.562	.913
PTSD43	.400	.915
PTSD44	.462	.914
PTSD45	.490	.914
PTSD46	.556	.913
PTSD47	.061	.919
PTSD48	-.284	.921
PTSD49	.534	.914

Note: Cronbach's Alpha = .917

Appendix 15

Tetrachoric Correlations for Phone Interview PTSD Symptoms

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
S1	1.00											
S2	.78	1.00										
S3	.77	.79	1.00									
S4	.73	.78	.79	1.00								
S5	.45	.45	.49	.51	1.00							
S6	.53	.55	.59	.60	.66	1.00						
S7	.51	.52	.58	.58	.63	.75	1.00					
S8	.71	.78	.73	.76	.45	.56	.51	1.00				
S9	.55	.54	.57	.57	.59	.67	.61	.54	1.00			
S10	.48	.46	.49	.48	.52	.55	.50	.46	.56	1.00		
S11	.65	.72	.69	.76	.45	.54	.52	.66	.51	.44	1.00	
S12	.49	.50	.53	.53	.59	.61	.58	.49	.60	.59	.49	1.00

Notes: Matrices were generated in LISREL.

Appendix 16

Tetrachoric Correlations for Current DIS-PTSD Symptoms

	S1	S2	S3	S4	S5	S6	S7	S8	S9
S1	1.00								
S2	.78	1.00							
S3	.77	.64	1.00						
S4	.71	.70	.68	1.00					
S5	.68	.64	.75	.66	1.00				
S6	.68	.69	.69	.67	.67	1.00			
S7	.82	.74	.80	.74	.74	.77	1.00		
S8	.70	.74	.64	.77	.70	.67	.78	1.00	
S9	.60	.62	.69	.69	.61	.70	.73	.72	1.00

Notes: Matrices were generated in LISREL.

Appendix 17

Tetrachoric Correlations for Lifetime DIS-PTSD Symptoms

	S1	S2	S3	S4	S5	S6	S7	S8	S9
S1	1.00								
S2	.70	1.00							
S3	.74	.67	1.00						
S4	.80	.62	.74	1.00					
S5	.80	.71	.81	.81	1.00				
S6	.82	.74	.82	.78	.86	1.00			
S7	.90	.71	.79	.81	.86	.86	1.00		
S8	.65	.61	.68	.71	.71	.67	.65	1.00	
S9	.70	.56	.71	.74	.75	.73	.77	.68	1.00

Notes: Matrices were generated in LISREL.

Appendix 18

Univariate Regressions for Non-transformed Phone-PTSD (n=14,386)

Predictors	B_0	(se)	B_x	(se)	R^2
Age of Entry	19.5	(.63)	-.59	(.03)	.025 *
Ability	7.38	(.05)	-1.40	(.05)	.044 *
Enlisted	6.93	(.07)	1.22	(.11)	.008 *
Race	7.13	(.06)	1.94	(.17)	.009 *
Single	7.39	(.10)	-.07	(.12)	.001
Combat	5.35	(.06)	1.33	(.03)	.148 *
Income	11.90	(.16)	-1.04	(.03)	.061 *
Married	8.93	(.10)	-2.13	(.12)	.021 *
Post-Test	7.18	(.06)	.56	(.11)	.002 *

Note: '*' represents a statistically significant value at p<.01

Appendix 19

Multiple Regressions for Non-transformed Phone-PTSD (n=14,386)

Predictors	M_1			M_2			M_3		
	B	(β)		B	(β)		B	(β)	
Intercept	16.02	(.00)	*	11.38	(.00)	*	14.4	(.00)	*
Age of Entry	-.42	(-.11)	*	-.29	(-.08)	*	-.24	(-.07)	*
Ability	-1.22	(-.18)	*	-1.07	(-.16)	*	-.71	(-.11)	*
Enlisted	.92	(.07)	*	1.05	(.08)	*	.91	(.07)	*
Race	.67	(.03)	*	.85	(.04)	*	.59	(.03)	*
Single	-.53	(-.04)	*	-.48	(-.03)	*	-.71	(-.05)	*
Combat				1.26	(.37)	*	1.26	(.37)	*
Income							-.67	(-.16)	*
Married							-1.22	(-.08)	*
Post-Test							.30	(.02)	*
R^2	.07			.20			.24		
R^2-Change	.07			.13			.04		

Note: '*' represents a statistically significant value at $p<.01$;

The interaction terms added less than 1% explained variance.

Appendix 20

Mean Differences in Phone-PTSD Symptoms by Combat Level

	Non-Combat (N=7,851)		Combat (N=7,235)	
PTSD Symptoms	Mean	(Se)	Mean	(Se)
Nightmares about army	.20	(.51)	.56	(.76)
Painful memories of army	.21	(.52)	.71	(.79)
Deja vu experience about army	.13	(.42)	.33	(.61)
Lost interest	.70	(.74)	.98	(.85)
Felt distant others	.60	(.77)	.97	(.92)
Life not meaningful	.34	(.66)	.58	(.83)
Hypervigilance	.83	(.94)	1.19	(1.05)
Trouble with Sleep	.83	(.94)	1.19	(1.05)
Shame/guilt about army	.12	(.42)	.37	(.71)
Trouble Memory/Concentrating	.55	(.74)	.88	(.88)
Anxious about reminders of army	.19	(.49)	.53	(.72)
Avoid reminders of army	.20	(.55)	.63	(.92)

Appendix 21

Mean Difference in Lifetime DIS-PTSD Symptoms by Combat Level

DIS-PTSD Symptoms	Non-Combat (N=2,131)		Combat (N=2,265)	
	Perc	(Std)	Perc	(Std)
Recurrent thoughts/dreams	1.8	(13.6)	34.3	(47.5)
Felt as if event was recurring	0.4	(6.4)	10.0	(30.0)
Numbing experience	0.9	(9.6)	18.4	(38.7)
Jumpy or easily startled	2.9	(16.7)	47.8	(50.0)
Trouble sleeping	2.0	(14.1)	36.6	(48.2)
Ashamed of being alive	0.2	(4.3)	8.7	(28.3)
Forgetful or trouble concentrating	0.7	(8.1)	14.3	(35.1)
Symptoms worsen in situations	1.0	(9.9)	18.0	(38.4)
Avoids situations that remind	1.4	(11.8)	30.6	(46.1)

Appendix 22

Army Classification Battery

During the late 1950's and 1960's, enlisted men took both the AFQT and ACB. Few studies have been published in public domain journals regarding the ACB. Montague et al. (1957) described the shared relationships between subscales of the ACB and the subscales of the Wechsler-Bellevue(WB) for N=100 enlisted men. They present the median correlations for the ACB from five large samples of enlisted men measured in the early 1950's and describe relationships between the ACB and the WB. The highest correlation between the ACB-VE and WB subscales was with WB-Information (.76) and WB-Vocabulary (.76). The highest correlations between the ACB-AR and the WB subscales was with WB-Information (.71), WB-Arithmetic (.70) and WB-Vocabulary (.70). For the ACB-PA subtest, the highest correlations were with the WB-Information (.63), WB-Block Design (.58), WB-Vocabulary (.55), and WB-Picture Arrangement (.55).

Maier & Fuchs (1969) studied a large sample of military recruits (N=26,500) who entered the Army between 1964 and 1965 and determined that the ACB appears to be a valid indicator of job performance in the military (Maier & Fuchs, 1969; Maier & Fuchs, 1972; Maier & Fuchs, 1973; Olson, 1968).