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Research report

Killing and latent classes of PTSD symptoms in Iraq and Afghanistan veterans

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ABSTRACT

Background: Our goal was to better understand distinct PTSD symptom presentations in Iraq and Afghanistan Veterans ($N=227$) and to determine whether those who killed in war were at risk for being in the most symptomatic class.
Methods: We used latent class analysis of responses to the PTSD checklist and logistic regression of most symptomatic class.
Results: We found that a four-class solution best fit the data, with the following profiles emerging: High Symptom (34% of participants), Intermediate Symptom (41%), Intermediate Symptom with Low Emotional Numbing (10%), and Low Symptom (15%). The largest group of individuals who reported killing (45%) was in the High Symptom class, and those who killed had twice the odds of being in the most symptomatic PTSD class, compared to those who did not kill. Those who endorsed killing a non-combatant ($OR=4.56$, 95% CI [1.77, 11.7], $p<0.01$) or killing in the context of anger or revenge ($OR=4.63$, 95% $CI=[1.89, 11.4]$, $p<0.001$) were more likely to belong to the most symptomatic PTSD class, compared to those who did not kill.
Limitations: The study was retrospective and cross-sectional. The results may not generalize to veterans of other wars.
Conclusions: Killing in war may be an important indicator of risk for developing frequent and severe PTSD symptoms. This has implications for the mental healthcare of veterans, providing evidence that a comprehensive evaluation of returning veterans should include an assessment of killing experiences and reactions to killing.

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1. Introduction

1.1. Killing and latent classes of PTSD symptoms in Iraq and Afghanistan veterans

There is mounting evidence that there are different manifestations or typologies of PTSD symptoms (Bonanno, 2004; Elhai et al., 2011). To date, four studies have used latent class analysis (LCA), an approach that extracts best fitting subgroups of individuals with different heterogeneous PTSD symptom presentations. Breslau et al. (2005) examined latent classes of PTSD symptoms in trauma-exposed community sample participants; Ayer et al. (2011) examined latent classes in a nationally-representative community sample of adolescents; Naifeh et al. (2010) examined latent classes in a sample of Canadian veterans in treatment; and Steenkamp et al. (in press) examined latent classes in a national sample of Vietnam veterans. The modal finding is that PTSD appears to be represented by three classes: low, intermediate, and high levels of symptoms.

The key question that arises from this research is what variables predict class membership. Breslau et al. (2005) found that individuals with high symptoms endorsed more emotional numbing than those in the other classes. Ayer et al. (2011) found that the most severe class had a distinct combination of symptoms from the different clusters. Steenkamp et al., (in press) found that veterans in the most severe class reported significantly higher levels of peritraumatic and trait dissociation than those in the other classes. Finally, Naifeh et al. (2010) found only two latent classes consisting of intermediate and high levels of symptoms, which is likely due to their focus on treatment seeking veterans. Nevertheless, the veterans in the highest symptom class endorsed more emotional numbing symptoms than those in the intermediate symptom class.

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The primary aim of this study was to examine the latent classes of PTSD symptoms in a group of Iraq and Afghanistan veterans with PTSD and subsyndromal PTSD, groups with sufficient symptoms to warrant concern and/or intervention. Similar to the Naifeh et al. (2010) study, we included veterans who had subsyndromal PTSD because posttraumatic adaptation is not well-captured simply by the presence or absence of the disorder (Bonanno, 2004; Elhai et al., 2011). Subsyndromal levels of PTSD are associated with increased risk for delayed PTSD and comorbid disorders (Marshall et al., 2001; Pietrzak et al., 2011), as well as high levels of functional impairment, including occupational, relationship, and health problems (e.g., Breslau et al., 2004; Pietrzak et al., 2009; Zlotnick et al., 2002).

Our secondary aim was to determine which latent class best represents the subset of veterans who report killing in war. Veterans who report killing in war are at increased risk for posttraumatic stress disorder (PTSD), even after accounting for the impact of exposure to other high magnitude war stressors, such as general combat exposure and life threats (Fontana et al., 1999; Maguen et al., 2009; Maguen et al., 2010; Maguen et al., 2011). Those who kill non-combatants are particularly at risk for PTSD (e.g., Maguen et al., 2009). There is also evidence that certain emotional states experienced at the time of killing may be particularly toxic among war veterans. For example, Hendin and Haas (1991) found that in a sample of Vietnam veterans with PTSD and suicidal ideation, the killing of women and children was reported to have occurred during states of fear and rage. Accordingly, research about the impact of killing during war needs to evaluate not only whether killing occurred, but also the particular individuals who were killed and the emotional reaction during the killing. We hypothesized that those who killed, those who killed non-combatants, and those who killed in the context of anger or revenge would be in the highest PTSD symptom class.

2. Methods

2.1. Participants

Participants were 227 OEF/OIF veterans who met DSM-IV criteria for sub-threshold or full PTSD symptoms related to their military service at the time of eligibility screening. Data were drawn from an ongoing study of PTSD and functional impairment in returning veterans. Participants were identified and recruited using VA databases, media sources, and postings at the San Francisco VA Medical Center (SFVAMC) and associated clinics, Vet Centers (community-based outpatient clinics for veterans), and the community (e.g., local colleges). For those recruited through the VA databases, participants were sent an invitation letter to participate in the study along with an 'opt out' postage paid postcard, which they could return if they did not wish to be further contacted. We re-contacted those from whom we did not receive any response to ensure that they received the materials and either did or did not desire to participate in the study. Participants who responded to recruitment solicitations were given information about the study and were asked to provide IRB approved verbal consent to complete a brief telephone screen to determine eligibility. Eligible participants were mailed a questionnaire booklet along with a self-addressed envelope and consent documents (with separate return envelope). The study received IRB approval at the San Francisco VA Medical Center and the University of California, San Francisco.

3. Measures

PTSD Symptoms were assessed using the *PTSD Checklist, Military Version*, a 17-item measure (PCL; Weathers et al., 1993; Blanchard et al., 1996). Each item was rated on a five-point Likert scale with responses ranging from *not at all* to *extremely*, and participants were asked to rate symptoms over the last month. The PCL is widely used as a screen for PTSD, has been shown to have very good internal consistency, and correlates strongly with other measures of PTSD symptoms (Weathers et al., 1993). The PCL also demonstrates high diagnostic efficiency (i.e., 0.90; Blanchard et al., 1996). For the purposes of this study, consistent with the DSM-IV, we defined subsyndromal PTSD as meeting two out of three symptom clusters, with full PTSD defined as meeting all three symptom clusters, i.e., at least one cluster B item (questions 1–5), three cluster C items (questions 6–12), and at least two cluster D items (questions 13–17). Symptoms rated as *moderately* or above were rated as present.

Combat exposure during deployment was assessed using the Deployment Risk and Resilience Inventory (DRRI) Combat Exposure subscale, a 15-item scale assessing potentially traumatic experiences during deployment on a dichotomous scale. The item indexing killing experiences was removed from the scale and examined separately, as described below. Combat exposure was included as a continuous measure in logistic regression analysis.

Killing in war was defined as either endorsing item 15 from the Combat Exposures subscale of the DRRI ("I killed or think I killed someone in combat"), or endorsing that they killed or think they killed enemy personnel, civilians, detainees, or American military personnel.

Types and circumstances of killing. Participants were asked whether they had killed or think they killed each of the following: enemy personnel, civilians, detainees, or American military personnel. Respondents who endorsed killing were asked additional questions regarding the types (e.g., women, children or elderly vs. others) and circumstances of the casualties (e.g., killing in the context of anger or revenge).

4. Analysis

Distinct classes of PTSD symptom profiles were identified with latent class analysis (LCA; Hagenaars and McCutcheon, 2002). The aim of LCA is to uncover latent classes that explain the observed relationships between multivariate categorical variables (e.g., PTSD symptoms) by clustering individuals such that the within-cluster responses are statistically independent. LCA assumes that there is a single underlying latent variable that is accounting for the associations between the observed dependent variables.

Each of the 17 PCL-M items was dichotomized by a score of *moderate* (3) or greater before being included as binary dependent variables in a LCA. The LCA was conducted using the robust maximum likelihood estimator. We built a series of models with two to eight latent classes. The following goodness-of-fit statistics were then compared across the seven models: bootstrapped likelihood ratio tests (BLRt), sample-size adjusted Bayesian Information Criterion (aBIC), and sample-size corrected Aikake Information Criterion (AICc). We focused on models with statistically significant BLRt p-values and lower aBIC values (Nylund et al., 2007; Henson, et al., 2007). Entropy, which is not a fitness statistic but a measure of the quality of classification, was also compared across models. Entropy values approaching one indicate clear delineation of classes (Celeux & Soromenho, 1996). Model selection was based on equal consideration of parsimony (only maintaining models that have classes with $\geq 10\%$ prevalence), practical interpretability, and goodness of fit statistics (BLRt and aBIC).

We also conducted a Monte Carlo analysis in order to determine whether there was adequate power to select a model with the correct number of classes (Muthén, 2002). We defined a true model as having four latent classes and based the within-class

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probability of each item on parameter estimates from an LCA of our observed data. We generated 500 Monte Carlo datasets each with 227 observations. Monte Carlo analysis of models with two to eight latent classes was conducted, and fit statistics were averaged over the 500 models. From these results, it was shown that based on BLRt and aBIC criteria, there was adequate power to select the true number of classes.

We examined the distribution of demographic and military characteristics, which included age, gender, race/ethnicity, level of education, marital status, military service start and separation dates, branch of military service, military rank, number of deployments, and total number of months deployed. The association between having killed in war and these variables was examined using chi-square test for categorical and Mann–Whitney test for continuous variables.

Most-likely latent class membership was determined for each participant and used to define the binary outcome of most symptomatic class versus all other classes combined. We then used logistic regression to examine the associations between the most symptomatic class and having killed in war variables (unadjusted and adjusted for general level of combat exposure). The interactions between level of combat exposure and each of the types and circumstances of killing variables were also tested. Note that because the likelihood of killing while at war is strongly associated with higher levels of combat exposure, it is difficult to distinguish their independent effects (*point biserial correlation*=0.65).

The LCA and Monte Carlo analysis were conducted with the Mplus statistical modeling software (Version 6.12; Muthen & Muthen, 2011). Descriptive statistics, chi-square, Mann–Whitney tests and logistic regression analyses were carried out with SAS (Version 9.2, Cary, NC).

5. Results

The sample was predominantly male (84%) and the mean age was 34.1 years (*SD*=9.6 years). The distribution of self-reported race/ethnicity was White/Caucasian (63%), Black or African American (3%), Hispanic or Latino (12%), Asian or Asian Pacific Islander (9%), American Indian or Alaskan native (3%), and multiracial or other (10%). The distribution of participants by branch of service was as follows: Army (54%), Marine Corps (25%), Navy or Coast Guard (16%) and the Air Force (6%). The majority were active duty (67%) and of enlisted rank (93%) at the time of deployment. The mean number of deployments was 2.1 (*SD*=1.8) and the mean total number of months deployed was 16.9 (*SD*=11.9).

Thirty-nine percent of respondents reported having killed or think they may have killed in war. A subset of those individuals was asked about the type and circumstances of killing: 50.7% reported killing enemy combatant(s) only, and 48.5% reported killing both enemy combatant(s) and at least one of other type of person (i.e., male civilian; women, child or elder; detainee; or, American military personnel). One respondent did not indicate which type of person was killed. The mean number of combat exposures (excluding killing) was 7.3 (*SD*=3.8).

In order to assess potential confounders of association between having killed in war and PTSD symptom profile, the demographic and military service characteristics were compared by self-report of having killed in war or not. Those who killed were slightly younger, had more numerous deployments and greater number of months deployed, were in the Army, active duty service at the time of deployment, enlisted rank and had experienced more combat exposure.

Model fit statistics showed that the latent class models with 4 or 5 classes were best (Table 1). However, since the smallest class in the 5-class model represented only 7.8% of the sample and did not enhance practical interpretability, we proceeded with the more parsimonious 4-class model.

Table 1
Fit statistics for latent class models of the 17 dichotomized PCL-M item responses by OEF/OIF veterans (*N*=227).

Model	AICc	aBIC	BLRt*	Entropy
1-class	4787.39	4788.81		
2-class	4073.35	4069.1	<0.001	0.88
3-class	3932.71	3913.17	<0.001	0.91
4-class	3917.67	3869.86	<0.001	0.93
5-class	3923.77	3829.59	<0.001	0.93
6-class	3999.61	3832.75	0.38	0.95
7-class	4116.63	3836.71	0.67	0.92
8-class	4300.31	3840.68	0.19	0.93

* BLRt *p*-value.

In Fig. 1, the latent classes are presented in terms of the within-class probability of endorsing each PCL-M item. The first class, which was the second most prevalent class (High Symptom Class; 34% of sample), was characterized by a very high probability (> 0.75) of endorsing each of the 17 PTSD symptoms.

The second (Intermediate Symptom Class; 41% of sample) and third (Intermediate Symptom with Low Emotional Numbing class; 10% of sample) classes were both characterized by symptoms of reexperiencing (particularly intrusive memories and psychological reactivity), as well as avoidance, and some symptoms of increased arousal (particularly concentration problems, hypervigilance and exaggerated startle). These two classes diverged sharply on particular symptoms of emotional numbing with the Intermediate Symptom Class being very likely to endorse having diminished interest, feeling detached and restricted affect and Intermediate Symptom with Low Emotional Numbing Class having a low probability of endorsing these symptoms. The Intermediate Symptom Class was also highly likely to endorse irritability, while the Intermediate Symptom with Low Emotional Numbing class was not likely to do so. Latent class 4 (Low Symptom Class; 15% of sample) was the least symptomatic class with a low probability (< 0.3) of endorsing PTSD symptoms except for feeling detached, insomnia and irritability.

Since the High Symptom class represents the most highly endorsed symptom group, we dichotomized by High Symptom class versus all others. The associations between the High Symptom class and killing during deployment are presented as unadjusted odds ratios in Table 2. Those who reported having killed had twice the odds of belonging to most symptomatic PTSD class, compared to those who did not kill (*OR*=2.13, 95% *CI*=[1.21, 3.7], $p<0.01$). The particular types and circumstances of killing were strongly associated with the High Symptom class. Specifically, the odds of belonging to the High Symptom class were 4.6 times greater for those who reported killing a woman, child or elderly person, compared to those who did not kill (*OR*=4.56, 95% *CI*=[1.77, 11.7], $p<0.01$). The odds were also 4.6 times greater for those who killed in the context of anger or revenge, compared to those who did not kill (*OR*=4.63, 95% *CI*=[1.89, 11.4], $p<0.001$).

We also examined odds ratios adjusted for level of combat exposure and found that the increased likelihood of belonging to the most symptomatic class for those who killed a woman, child or elderly person and for those who killed in the context of anger or revenge persisted, though the magnitude and statistical significance of the association was attenuated.

6. Discussion

A four-class solution, namely Low, Intermediate, Intermediate with Low Emotional Numbing, and High Symptom profiles best described the varied PTSD symptom presentations. The two

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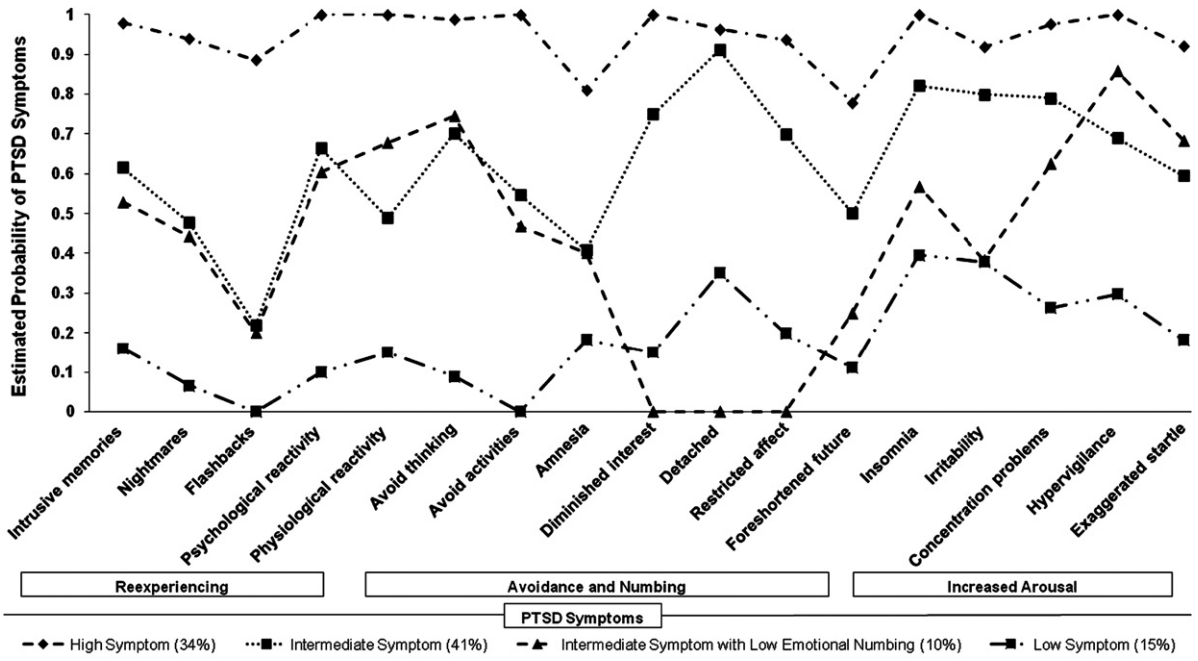

Fig. 1. Estimated probabilities of endorsing PCL-M items by latent PTSD class.

Table 2
Associations between High Symptom class ($n=78$) and having killed or think killed in war.

Independent variable	Value	High Symptom class		Unadjusted		Adjusted	
		Frequency	Percent	OR	95% CI	OR	95% CI
Killed	No	38	28	1.0		1.0	
	Yes	40	45	2.1*	[1.2, 3.7]	1.0	[0.47, 2.1]
Killed woman, child, or elderly person	Did not kill	38		1.0		1.0	
	Killed other	19	41	1.8	[0.9, 3.7]	1.0	[0.41, 2.2]
	Killed woman, child, or elder	14	64	4.6*	[1.8, 11.7]	1.9	[0.62, 5.9]
Killed in context of anger or revenge	Did not kill	38	28	1.0			
	Not out of anger or revenge	17	40	1.7	[0.8, 3.5]	0.9	[0.39, 2.2]
	In context of anger or revenge	16	64	4.6**	[1.9, 11.4]	2.0	[0.66, 5.8]

Note: OR=odds ratio; *CI*=confidence interval. The model with killed as the independent variable has 226 observations and the other models have 205 observations. The adjusted ORs are from models that included combat exposure as a continuous covariate.

* $p<0.01$.
** $p<0.001$.

largest PTSD classes were individuals with the High Symptom (34%) and Intermediate Symptom (41%) profiles. As predicted, the largest group of individuals who reported killing (45%) was in the High Symptom profile class, and those who killed had twice the odds of being in the most symptomatic PTSD class, compared to those who did not kill. Furthermore, three-quarters of individuals who killed were in the two most severe PTSD symptom classes (High and Intermediate Symptoms).

We also found that participants who endorsed killing a non-combatant or killing while experiencing feelings of anger/revenge were more likely to be in the most symptomatic PTSD class, compared to those who did not kill. This may be due to the emotional and environmental context in which killing takes place in war. For example, killing in the context of anger or revenge may also be associated with greater exposure to life-threat and casualties of comrades. The combination of life-threat, loss of comrades, and killing understandably may lead to greater difficulty in recovery following combat exposure.

Finally, our finding that a four-class solution best fit the data is different than prior studies, most of which have found a three-class solution (Ayer et al., 2011; Breslau et al., 2005; Steenkamp et al., in press); however, this is the first investigation to focus on veterans returning from Iraq and Afghanistan. The fact that the Intermediate Symptom with Low Emotional Numbing profile was a class that was different from prior studies suggests that among newly returning veterans, there may be a small group (i.e., 10% of the sample) in which emotional numbing symptoms are not as severe or impairing. It could be that after sustained experience with re-experiencing symptoms, the relational and appetitive constraints brought about by avoidance behaviors, and chronic hyperarousal, that emotional numbing may develop over time in these veterans (e.g., Flack et al., 2000). A longitudinal analysis is needed to address this issue.

There are a number of limitations that should be considered when interpreting our findings. First, the study was retrospective and cross-sectional. Second, the results may not generalize to veterans of other wars. Third, we were interested in veterans who evidenced PTSD or sub-threshold PTSD symptoms, given that these veterans are highest risk of adverse mental health and functional outcomes; however, results may have been different

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when including those without PTSD symptoms and future studies should replicate these findings with Iraq and Afghanistan veterans with a wider range of PTSD symptom presentations.

Our finding that killing in war is an important variable to consider among those with the worst PTSD symptoms has important implications for the mental healthcare of veterans. These results provide evidence that a comprehensive evaluation of veterans returning from combat should include an assessment of killing experiences, including the emotional and environmental context (e.g., events preceding killing), and reactions to killing. This information can be incorporated into a treatment plan, which would include specific interventions targeted at the impact of killing.

Although killing experiences are important to evaluate and incorporate into treatment, doing so in the most sensitive fashion and within the context of a sound therapeutic relationship is of critical importance. Military personnel who have killed may experience significant shame and/or guilt and need to know that they will be allowed to explore the impact of killing in a safe and supportive environment (e.g., VA). They also may have received criticism or been subject to insensitive questioning by acquaintances, friends, or family members that cause them to be weary of speaking to others about this sensitive issue, especially when they fear others will not understand or judge them for their actions.

Overall, our results suggest that Iraq and Afghanistan veterans who kill in war and have PTSD or sub-threshold PTSD are at risk of being in the most symptomatic PTSD groups, and that those with particular killing experiences involving non-combatants and/or anger or revenge are most at risk. These results have direct implications for the evaluation and treatment of our newly returning veterans, particularly in healthcare environments where the impact of killing is not being directly evaluated and considered as one of several factors that place veterans at risk of adverse mental health outcomes and impaired functioning. Future studies examining the relationship between killing and PTSD latent classes across veterans of different eras are important in order to provide the best guidelines for assessment and care of all veterans who suffer from warzone-related adverse mental health outcomes.

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Conflict of interest

The authors have no conflicts of interests to report.

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