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Suicide and Violent Cognitions, Emotions, and Behaviors in U.S. Military Personnel

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BACKGROUND

Rare incidents of violence toward others and suicide occurring together are often highly sensationalized in the media. Although this study acknowledges the relationship between violence and suicide, its goal is not to further exacerbate stigmatization. Instead, we aim to understand the nature of violent cognitions, emotions, and behaviors of U.S. Service members who died by suicide.

This study used a sample of U.S. military personnel who died by suicide ($n = 700$), and a comparison group who died by other means ($n = 552$) across two data sources: publicly-available social media data, and online articles. Statistical analyses were conducted to determine if there was an association between violence and suicide, and whether there were differences between Service members in the suicide group who exhibited violent cognitions, emotions, or behaviors (VCEB) versus those who did not (non-VCEB). The nature of several homicide-suicide incidents identified in online articles is also explored.

HIGHLIGHTS

Results indicate that Service members who died by suicide were significantly more likely to exhibit VCEB than Service members who died from other reasons. VCEB Service members who died by suicide were younger, expressed greater hostility on social media, and were also higher in life stressors, substance use, and complaints than non-VCEB Service members who died by suicide. VCEB Service members who died by suicide were also significantly lower in self-esteem than non-VCEB Service members, suggesting that low self-esteem might be a unique indicator of both suicide and VCEB. Life stressors also represented a possible area for intervention with Service members who exhibited VCEB and died by suicide.

Finally, 11 homicide perpetrators were identified in the sample, all of whom were in the suicide group. Recommendations for future research and possible interventions are discussed.

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<p>ABSTRACT: Rare incidents of violence and suicide are often highly sensationalized in the media. This report describes a research effort to understand the emotions, cognitions, attitudes, and behaviors expressed on social media by Service members who died by suicide and exhibited violent cognitions, emotions, or behaviors (VCEB). Using social media and online news articles, results demonstrated that Service members who showed VCEB were more hostile online, discussed more life stressors, used more substances, and were the subject of greater negative peer influence. In addition, Service members who died by suicide used a significantly more negative tone than Service members who died by other means. Finally, Service members who died by suicide and exhibited VCEB showed many of the same characteristics as those who only showed VCEB; however, they also showed lower self-esteem, suggesting that this is a unique predictor of the combination of violence and suicide. Recommendations for policy are discussed, including possible areas for intervention and training with respect to social media.</p>				
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PREFACE

High profile cases of U.S. military Service members committing acts of violence before dying by suicide, although rare, have been sensationalized in the media, bringing widespread public attention to these events. This study represents an attempt to leverage the rich data contained on social media profiles to understand the identifying characteristics of Service members who might be at risk for both suicide and violence. Social media data and online articles were examined to explore the cognitive, emotional, and behavioral indicators of the combination of violence and suicide.

The findings from this study offer a characterization of factors that may predispose Service members who are struggling with suicidality to exhibit violent cognitions, emotions, or behaviors, and possible intervention strategies for how the Department of Defense and military services may intervene in order to assist them.

Eric L. Lang, Ph.D.
Director, PERSEREC

EXECUTIVE SUMMARY

INTRODUCTION

Sensationalized media portrayals of violent and suicidal incidents have brought public attention to the potential overlap between individuals at risk for both suicide and violent behavior toward others. Although these incidents are rare, they are often highly publicized. Despite the media's undue emphasis on these events, there is evidence of a link that exists between violence and suicide (O'Donnell, House, & Waterman, 2015). The goal of this effort is to explore the online media content posted by Service members who exhibit both suicidality and violent cognitions, emotions, or behaviors (VCEB), and compare them to those Service members who died by suicide but did not exhibit violent cognitions, emotions, or behaviors (non-VCEB).

Using a broad definition of violence that focuses on violent cognitions and emotions, as well as actual violent behavior, we identify those Service members who exhibit VCEB, and then explore possible indicators of the high-risk combination of VCEB and suicide using social media data.

In order to understand the combination of suicide and VCEB, this effort first explored VCEB on social media, then suicide on social media, and, finally, characteristics of Service members who were both suicidal and exhibited VCEB. We did so using the following research questions:

- (1) Do military personnel express VCEB on social media?
- (2) Do military personnel provide indicators of intent to die by suicide on social media?
- (3) How are Service members who died by suicide and exhibited VCEB different from Service members who died by suicide, but did not show VCEB?

METHODOLOGY

This study used a sample of 1,252 Service members ($n = 700$ of whom died by suicide, $n = 552$ of whom died from other causes) that was originally selected for a 2014 Defense Suicide Prevention Office (DSPO) effort that examined indicators of suicide on social media (Hesse, Bryan, & Rose, 2015; Rose & Hesse, 2015). The social media data were collected by a vendor for the 2014 effort and recoded for the present study to determine if they can assist in identifying cognitive, emotional, and behavioral indicators of violence and suicide. In addition, online news article searches were conducted to gather additional contextual information about the subjects' deaths and possible violent behavior towards others. Data from the two sources were examined together in the analyses, the goal of which was to explore possible VCEB in the sample, and evaluate its overlap with suicide.

EXECUTIVE SUMMARY

FINDINGS

Of the 1,252 subjects in the sample, 81 (6.5%) of the subjects exhibited VCEB, 57 (8% of 700) in the suicide group and 24 (4% of 552) in the non-suicide group. We organize the findings using the research questions described earlier, beginning with the differences between Service members who exhibited VCEB and those who did not, then suicidal and non-suicidal Service members, and finally, the primary focus: Service members who are both suicidal and exhibit VCEB.

First, an examination of the social media data showed that Service members do express VCEB on social media. In addition, these VCEB Service members were less positive, more hostile, discussed more life stressors, complained more about others, used more substances, made more derogatory comments, and were higher in suicidality than their peers. Of these differences, hostility on social media was the only unique predictor, with VCEB Service members expressing more hostility online than non-VCEB Service members.

Service members who died by suicide, in general, were significantly less positive on social media, expressed more life stressors, and were higher in suicidality than Service members who died by other means. Positivity was the only significant predictor, with a more negative tone significantly predicting death by suicide. Notably, Service members who died by suicide were not significantly higher in ratings of physical violence on social media, suggesting that the association between VCEB and suicide in this sample is small, albeit significant.

The primary focus of the study was to compare the extremely limited population of Service members who died by suicide and exhibited VCEB to those who died by suicide but did not exhibit VCEB. Service members who exhibit VCEB represent a unique, small subset of the overall population of Service members struggling with suicide; thus, the primary focus was to understand their specific needs and concerns. Results showed that there was a significant association between VCEB and suicide, such that Service members who died by suicide were more likely to display VCEB. Service members who died by suicide and displayed VCEB were younger, expressed greater hostility on social media, and were also higher in life stressors, substance use, and complained more about others than non-VCEB Service members who died by suicide. VCEB Service members who died by suicide were also significantly lower in self-esteem than non-VCEB Service members who died by suicide, suggesting that low self-esteem might be a unique indicator of those Service members who are both suicidal and show VCEB.

Finally, online articles revealed that there were 11 cases of homicide-suicide in the sample. As cases of homicide-suicide are a rare circumstance in which violence and suicide occur together, we conducted a demographic analysis of the perpetrators. Here, results generally mirror what has been found in past work: perpetrators were generally male, White, and married individuals who committed homicide against current or past female partners.

CONCLUSION

The goal of this project was to explore the characteristics that differentiate the small group of Service members who died by suicide and who also exhibit VCEB from the larger group of Service members who died by suicide and who do not exhibit VCEB, using social media data. In general, Service members who died by suicide were more likely to show VCEB than Service members who died by other means. Service members who display VCEB were significantly more angry or hostile on social media than non-VCEB Service members, whereas Service members who died by suicide were significantly less positive than those who died by other means. Among Service members who died by suicide, those who also showed VCEB were younger, higher in anger and hostility, life stressors, suicidality, substance use, and complaints about others in their social media posts. They were also lower in positivity and self-esteem. Interestingly, the difference in self-esteem did not occur for Service members who exhibited VCEB in general, but was specific to those individuals who died by suicide, suggesting this may be a potential area for intervention.

RECOMMENDATIONS

- (1) Publicly available social media data might be useful for identifying Service members at risk for suicide or violence, but this process likely involves human interpretation. Future efforts should focus on developing training to assist co-workers, friends, and family members in interpreting social media information when trying to assess a Service member's state of mind and suicide risk.
- (2) Future research should review policies and procedures for responding to violent incidents and suicidal events, and determine the level of communication that exists between responding personnel and agencies. Although different organizations and personnel are involved in responding to these different incidents, the results of this report suggest that there is an overlap between individuals at risk for both kinds of behaviors, and that communication between responding agencies might help to mitigate risk of both violence and suicide.
- (3) Individuals at risk for violence and suicide might engage in the same maladaptive responses to life stressors. Interventions might focus on providing them with strategies for how to manage life stressors and maintain a healthy self-esteem, another factor that was uniquely predictive of risk for both suicide and violence.
- (4) This study should be replicated with a larger sample in order to have adequate statistical power to examine the relationship between violent cognitions, emotions, and behaviors and suicide. Future efforts should combine social media data with other data sources (for instance, law enforcement information), in order to have a more complete set of predictors of suicide and violence risk.

TABLE OF CONTENTS

INTRODUCTION	1
PROBLEM	1
CURRENT STUDY	1
BACKGROUND	2
Continuum of Violence	2
Suicide and VCEB	3
Research Questions	3
METHODOLOGY	5
SAMPLE	5
COLLECTION OF SOCIAL MEDIA DATA	5
CODING OF SOCIAL MEDIA DATA	6
ONLINE NEWS ARTICLE SEARCHES	10
Purpose of Online News Article Searches	10
Online News Article Search Methodology	10
RESULTS	12
VCEB ON SOCIAL MEDIA	12
Summary of VCEB and Suicide on Social Media	24
Online News Articles	24
DISCUSSION	27
VIOLENCE IN ONLINE MEDIA	27
VIOLENCE AND SUICIDE ON SOCIAL MEDIA	28
VCEB vs. Non-VCEB Service Members	28
Service Members who Died by Suicide vs. Other Means	28
VCEB vs. Non-VCEB Service Members who Died by Suicide	29
ONLINE ARTICLES AND HOMICIDE-SUICIDE PERPETRATORS	30
LIMITATIONS	30
CONCLUSION	31
RECOMMENDATIONS	31
REFERENCES	33
APPENDIX A : LITERATURE REVIEW	A-1
APPENDIX B : CAUSES OF DEATH FOR SUBJECTS IN NON-SUICIDE GROUP	B-1
APPENDIX C : DEMOGRAPHICS	C-1
APPENDIX D : SOCIAL MEDIA CODING	D-1
APPENDIX E : DATA DICTIONARY OF SOCIAL MEDIA LIKERT SCALES	E-1

LIST OF TABLES

Table 1 Social Media Ratings Correlations and Inter-Rater Reliability	9
Table 2 Quotations from Social Media for Service Members Rated 4-5 on Physical Violence Scale	13

TABLE OF CONTENTS

Table 3	VCEB vs. Non-VCEB Service Members in each Data Source _____	14
Table 4	VCEB vs. Non-VCEB Service Members _____	15
Table 5	Binary Logistic Regression Predicting VCEB _____	16
Table 6	Suicide vs. Non-Suicide Groups _____	18
Table 7	Binary Logistic Regression Predicting Suicide vs. Non-Suicide _____	19
Table 8	VCEB vs. Non-VCEB Service Members who died by Suicide _____	21
Table 9	Life Stressors among VCEB Service Members who died by Suicide__	23
Table 10	Binary Logistic Regression on VCEB vs. Non-VCEB Service Members who died by Suicide _____	24

LIST OF TABLES IN APPENDICES

Table A-1	Suicide and Violence: Prevalence and Overlap in different Populations _____	A-4
Table B-1	Causes of Death in Non-Suicide Group _____	B-3
Table C-1	Demographic Data _____	C-3
Table C-2	Military Status _____	C-4
Table E-1	Scale Definitions, Anchors, and Examples _____	E-3

INTRODUCTION

PROBLEM

In recent years public attention has been directed at the association between violence and suicide. Although it is rare that an individual is violent and suicidal, these incidents are often sensationalized in the media. For instance, when Airman Marcell Travon Willis killed two Walmart employees in Grand Forks, North Dakota, news sources interviewed his friends and family in search of a motive. Reporters uncovered that he posted “RIP to me Love Yall” on his Facebook page prior to the incident, and reports connected Willis to a trend within military personnel of dying by suicide in a violent and public way (Rupard, 2015).

The media’s tendency to sensationalize these events, however, should not undermine the fact that there is a documented link between suicide and violence. Research indicates that there is an overlap between risk factors for suicide and violence (O’Donnell, House, & Waterman, 2015). Violence can take many forms, from behavioral acts of physical violence to threats or intimidation. As such, throughout this report, we refer to violent cognitions, emotions, and behaviors (hereafter VCEB) in order to encompass all forms of violence. Suicidal individuals who exhibit VCEB are a specific subset of those at risk for suicide, and it is important to identify and understand some of the unique characteristics of this group. By understanding the destructive combination of violence and suicide, policy-makers, law enforcement, and mental health professionals can be better equipped to prevent these events.

CURRENT STUDY

In 2015, the Defense Suicide Prevention Office (DSPO) funded the Defense Personnel and Security Research Center (PERSEREC), a division of the Defense Manpower Data Center (DMDC), to conduct a research study investigating the relationship between suicide and violence among Service members. The aim of this effort was to identify the unique indicators of individuals who were suicidal and exhibited VCEB, and compare them to Service members who died by suicide and were non-VCEB. This study acknowledges the relationship between VCEB and suicide; however, its goal is not to exacerbate stigmatization of individuals who died by suicide. Instead, we will explore the differences in VCEB of Service members who died by suicide in order to identify any unique indicators that differentiate VCEB and non-VCEB individuals.

This study used a sample of 1,252 deceased military personnel, some of whom died by suicide, and some of whom died from accidental or health-related causes¹. This

¹ The original sample used in the previous effort contained 1,400 subjects, including Service members who died by homicide. Service members who died by homicide were removed from the sample for this effort. The reasons for this exclusion are discussed in the Methodology section.

INTRODUCTION

sample was originally selected for a 2014 DSPO effort, *Early Indicators of Suicide Found on Social Networks and Other Online Forums* (Hesse, Bryan, & Rose, 2015) from the Suicide Data Repository (SDR). The current effort focused on data available online, using both publicly-available social media pages and online news articles². The social media data were collected by a commercial social media vendor, Social Intelligence, for the 2014 effort and recoded for cognitions, emotions, and behaviors related to suicide and violence. Online searches of news articles were conducted to provide contextual information about subjects' deaths. Taken together, analysis of the data from these sources provides insight into the possible associations between VCEB and suicide among Service members.

BACKGROUND

In order to study the relationship between VCEB and suicide, it is critical to clearly define what constitutes as VCEB, and what previous literature has indicated about the relationship. The rest of this section will provide a detailed conceptual description of violence as a construct, and an overview of the existing literature.

Continuum of Violence

Violence exists along a continuum, and exact definitions of violence vary widely across the literature. The World Health Organization (WHO) defines violence as “the intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community, which either results in or has a high likelihood of resulting in injury, death, psychological harm, mal-development, or deprivation” (World Health Organization, 2014). Given this definition, violence includes not only acts of behavioral or physical violence, but also threats of violence, or acts that result in psychological rather than physical harm. This definition is consistent with psychological research on this topic, which explores violence that is physical, emotional, verbal, or social in nature. Violence might range from verbal attacks to targeted violence (defined as premeditated violence against a specific person or persons). Because of the wide range of what might be considered violent, in this effort we explore not only physical violence, but also violent cognitions and emotions, threats, and beliefs. Here, we define violence as the presence of a subject's thoughts or emotions about violence, actual acts of violence (excluding lawful violence, such as hunting or boxing), or threats of violence against another person (i.e., violent cognitions, emotions, or behaviors – VCEB). Our definition of violence for this effort remains distinct from anger or hostility, but rather focuses on cognitions, emotions, and behaviors that reflect possible physical violence as reflected on social media and in online articles.

² The present effort also originally used Defense Incident-Based Reporting System (DIBRS) law enforcement data. However, during the course of the study, we developed concerns about the quality of that data source (see DODIG-2015-182) and decided to eliminate it from final analyses and the report.

Using this definition of violence, we will identify individuals who exhibit VCEB using social media and online news articles. Then, we will explore possible indicators of the high-risk combination of VCEB and suicide on social media.

Suicide and VCEB

Past research suggests that there is an overlap between risk factors for suicide and violence (O'Donnell, House, & Waterman, 2015). For example, both suicide and violence have been found to be associated with hostility, aggression, anger, and impulsivity (Conner, Duberstein, Conwell, Seidlitz, & Caine, 2001; Ilgen et al., 2010; Mann, Waternaux, Haas, & Malone, 1999; Romanov et al., 1994). In addition, violent behavior and suicidal behavior frequently co-occur. For example, among patients in treatment for substance use disorders, all forms of prior violence (e.g., physical assault, sexual assault) were associated with a greater risk of multiple suicide attempts (Ilgen et al., 2010). See Appendix A for a detailed literature review on the association between suicide and violence on social media.

Despite the link between VCEB and suicide in civilian populations, few studies have examined this relationship in a military sample. Recent work suggests that precursors toward violence or suicide among Service members differ from those within a civilian population. Specifically, researchers recently explored the differences between civilian and military homicide-suicide perpetrators (Patton, McNally, & Fremouw, 2015). Homicide-suicide occurs when a person kills one or more individuals and then dies by suicide shortly after (Patton et al., 2015). In general, military homicide-suicide perpetrators were substantially older than civilian perpetrators. They were also more likely to be married, had more physical health problems, and were less likely to abuse substances than civilians. Military perpetrators also had substantially different motives than civilians. They were much more likely than civilian perpetrators to be motivated by their declining health or the declining health of their victim (Patton et al., 2015). Because of the differences in the characteristics and motive of homicide-suicide perpetrators in the military versus civilians, this study highlights the need for more research focusing specifically on precursors of violence and suicide within the military population.

Research Questions

This effort used online data sources to explore the cognitions, emotions, and behaviors of Service members who exhibited VCEB and died by suicide. This group represents a potentially unique set of struggles that should be addressed differently through policy and intervention than those Service members who are struggling with suicide with a lower risk for violence. In order to understand how Service members at risk for both suicide and violence are different from Service members at risk for suicide but not violence, we will first explore the continuum of violence online (i.e., how violence manifests itself on social media and how are individuals who exhibit VCEB different from non-VCEB individuals?). Then, we will explore potential indicators of suicide on social media. Having addressed those two questions, we will then be able to evaluate how Service members who both died by

INTRODUCTION

suicide and displayed VCEB are different from those whom died by suicide, but did not show VCEB.

This effort will explore the following three research questions:

- (1) Do military personnel express violent cognitions, emotions, or behaviors on social media?
- (2) Do military personnel provide indicators of intent to die by suicide on social media?
- (3) How are Service members who died by suicide and exhibited VCEB on social media different from Service members who died by suicide but did not show VCEB?

METHODOLOGY

The following section provides information concerning the study's sample, data collection process, scale construction, and methods used for analyzing data from social media reports and online article searches.

SAMPLE

The subjects included in this study were originally selected from the Suicide Data Repository (SDR) for a 2014 effort entitled *Indicators of Suicide Found on Social Networks, Phases I and II* (Hesse et al., 2015 and Rose & Hesse, 2015). The SDR is a repository containing data from the National Death Index (NDI) and the Defense Casualty Analysis System (DCAS). The original data set included Service personnel who died by suicide between January 1, 2010 and December 31, 2011 ($n = 700$), and Service personnel who died from a selection of reasons other than suicide (e.g., car accident, health-related causes, homicide) during the same time frame ($n = 700$). See Appendix B for a complete list of the causes of death included in this study. Initial analyses indicated that subjects who were victims of homicide were significantly different from subjects who died by accident or from health-related causes; therefore, they were excluded from any further analyses³. The final sample used in the present study consisted of 1,252 military Service personnel, 700 of whom died by suicide (suicide group) and 552 of whom died from reasons other than suicide (non-suicide group).

Detailed demographics for both groups can be found in Appendix C. Individuals from all Service Components, as well as the Reserves, National Guard, and Coast Guard, were included in this effort. Both groups were primarily male (94% in both groups), and ranged in age from 17 to 80 years old (non-suicide $M=30.73$, $SD=11.16$; suicide $M=29.57$, $SD=9.34$). The subjects were primarily identified as White (non-suicide group $n = 248$, or 45%; suicide group $n = 320$, or 46%), although a large number of subjects also had no listed racial affiliation (non-suicide group $n = 241$, or 44%; suicide group $n = 328$, or 47%). Subjects were also primarily Christian in both groups (non-suicide group $n = 324$ of 552, or 62%; suicide group $n = 374$ of 700, or 53%), and were Junior Enlisted (non-suicide group $n = 268$ of 552, or 49%, suicide group $n = 372$ of 700, or 51%).

COLLECTION OF SOCIAL MEDIA DATA

The social media reports analyzed during this effort were originally generated for a previous study (see Hesse et al., 2015; Rose & Hesse, 2015). During that effort a social media vendor used subjects' identifiable information to conduct automated

³ Victims of homicide were significantly more likely to show VCEB than individuals who died by suicide or other causes ($\chi^2(2) = 24.71$, $p < .001$; standardized residual = 4.02, $p < .001$). Including those individuals in the sample here might skew the results with regard to the association between VCEB and suicide.

METHODOLOGY

searches for publicly available online content from social networks (e.g., Facebook), microblogs (e.g., Twitter), and blogs (e.g., Wordpress) posted within a year of the subject's death. Publicly available information referred to information returned in searches that was not meaningfully restricted. No usernames or passwords were provided to the vendor; therefore, none of the information used was secured behind a password or required log-in or special access. After the data were collected and aggregated, the vendor leveraged its proprietary identity resolution process to indicate how the returned data were matched to the individual that was searched⁴. The vendor de-identified the social media reports by redacting such information as the subject's full name, date of birth, addresses, email addresses, etc. Images were also de-identified by placing black boxes over any visible faces. Finally, the vendor supplied researchers with de-identified reports of all the collected information⁵.

CODING OF SOCIAL MEDIA DATA

The initial coding approach used for this study involved a set of codes based on the 36 indicators of suicide from the original effort (Hesse et al., 2015), a prior study of indicators of insider threat that also examined suicide (Pogson, Shechter, Leather, & Smith-Pritchard, 2013), and a list of indicators of violence toward oneself and others provided by subject matter experts from the University of Nebraska-Lincoln (UNL). However, issues with inter-rater reliability led researchers to determine that this coding approach was not appropriate for this effort. Details on the initial coding scheme are presented in Appendix D.

As a result of these issues, the researchers decided to switch from coding each post separately to a person-centered coding approach. In doing so, the researchers gained an ability to consider each post in the context of the entire profile, and to use a number of Likert scales that were conceptually and empirically related to suicide and violence. This person-centered approach took into account the entire profile, in contrast to separately coding each social media post (as has been done in previous studies; Hesse et al., 2015).

A series of Likert scales were used to code the social media data. These scales were derived from the original coding scheme mentioned earlier. Each profile was *always* rated on the following five dimensions: positivity, anger/hostility, life stressors, suicidal/depression, and self-esteem. Profiles were also rated on an additional ten dimensions *only* if there were relevant data present in the social media profile: physical violence, social/supportive third party interactions, negative peer

⁴ Third party personally identifiable information (PII) was not collected during this process.

⁵ Because the social media reports were collected using deceased participants' identifiable information originally drawn from the NDI, PERSEREC/DMDC researchers had to request the use of the identifiable information for the present study by submitting an application to the Suicide Data Repository (SDR) Board of Governors (BoG) which governs releases of the SDR-NDI data to approved participants. The BoG approved the submitted request, giving permission to use the social media reports for the present study.

influence, substance use, legal/disciplinary issues, weapons, derogatory comments/deviant behavior, sleeping problems, complaints about others, and threats. If the subject had no content relevant to a particular scale (e.g., the subject never mentioned use of any substances), the subject was assigned a rating of “99” on that scale. Ratings on each of the scales took into account the frequency of relevant posts as well as the intensity of the posts. A shortened definition of the Likert ratings is presented here; see Appendix E for a data dictionary with complete descriptions of each Likert scale.

- Positivity: The subject’s overall tone across all posts.
- Anger/Hostility: The subject’s overall anger and hostility level across all posts.
- Life Stressors: The presence of life stressors in the subject’s life, including financial, employment, mental health, physical health, or relationship issues, or interpersonal loss.
- Suicidality/Depression: The subject’s overall suicidality and/or depression level across all posts.
- Self-Esteem: The subject’s self-view across all posts.
- Violence⁶: The presence of the subject’s thoughts or attitudes about violence, or actual acts of violence. Excludes lawful acts of violence (e.g., hunting and boxing).
- Social/Supportive Interactions: The overall tone of the third party posts directed towards the subject on his/her social media profile.
- Negative Peer Influence: The presence of third-party posts encouraging illegal, deviant, violent, or generally negative behavior.
- Substance Use: The presence of the subject’s posts related to alcohol or drug use (prescription drug use or illegal drug use).
- Legal/Disciplinary Issues: The presence of the subject’s posts related to illegal behavior, legal issues, and disciplinary violations.
- Weapons: The presence of the subject’s posts about weapons, weapon use, or pictures of weapons. Exclude all duty-related weapons, defined as when the subject is in uniform, but include mention of weapon use in legal activities such as hunting.
- Derogatory Comments: The presence of racist, sexist, homophobic, or otherwise offensive comments by the subject, as well as negative comments about American society or government.
- Sleeping problems: The presence of posts mentioning subject’s sleeping issues.
- Complaints about Others: The presence of complaints about specific people, work, co-workers, or people in general, not including threats.

⁶ As is discussed in more detail later in this section, the Likert scale “Violence” was the only scale used to operationalize violence in this study.

METHODOLOGY

- Threats: The presence of posts threatening others, including taking negative action as a consequence for another person's behavior.

Coders took detailed notes throughout the Likert scale rating process for all subjects and recorded specific examples that led them to assign a given rating. Two coders⁷ rated the data, with approximately 15% ($n = 46$) of the 288 profiles coded by both in order to assess inter-rater reliability. Due to research constraints, in some cases, coders were aware of the cause of death (i.e., suicide or other means). Coder awareness of cause of death was limited to the maximum degree possible, and coders were generally unaware of the cause of death for most cases. Each week, coders met to discuss ratings and to resolve coding discrepancies. Ratings were considered discrepant if they differed by ≥ 2 scale points, or if the coders disagreed, about when to apply a rating of "99" defined as non-applicable. Following a discussion of the discrepancies, the coders reached a consensus, changing the codes to reflect the group decision.

As a result of these discussions, a total of 69 codes (approximately 10% of all possible codes) were changed⁸. Correlations among all of the scales and inter-rater reliability (calculated as Cronbach's α ⁹) are presented in Table 1. Overall, inter-rater reliability ranged from acceptable (.68 for social supportive interactions) to excellent (.97 for sleeping problems), with an average of $\alpha = .85$.

⁷ One coder was trained in forensic psychology, and the other was a trained personality psychologist; thus, they both possessed subject-matter knowledge on risk indicators of suicide and violence.

⁸ Inter-rater reliability was calculated prior to these changes.

⁹ Other approaches to measuring inter-rater reliability, particularly Krippendorff's α , show very similar results.

Table 1
Social Media Ratings Correlations and Inter-Rater Reliability

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Positivity	.80														
2 Anger	-.49*	.89													
3 Life Stressors	-.30*	.47*	.94												
4 Self-Esteem	.21*	-.09	-.25*	.79											
5 Suicidality	-.49*	.52*	.57*	-.22*	.95										
6 Violence	-.32*	.45*	.20	-.06	.29*	.89									
7 Social or Supportive Interactions	.52*	-.34*	-.05	.07	-.15*	-.28*	.68								
8 Negative Peer Influence	-.19	.31*	.16	.05	.29*	.45*	-.39*	.85							
9 Substance Use	-.28*	.54*	.40*	.03	.34*	.34*	-.25*	.41*	.78						
10 Legal or Disciplinary Issues	-.07	.27	.42*	.14	.08	.21	.13	-.19	.19	.81					
11 Weapons	.09	-.03	-.22	.00	-.21	.35*	-.17	.17	.01	.02	.81				
12 Derogatory Comments	-.30*	.36*	.06	.09	.12	.48*	-.40*	.43*	.19	.06	.17	.94			
13 Sleeping Problems	-.36*	.05	.39*	.04	.51*	.17	.02	.26	.35	.06	-.41	-.02	.97		
14 Complaints about Others	-.42*	.69*	.29*	.00	.34*	.33*	-.36*	.19	.37*	.16	.03	.41*	.01	.82	
15 Threats toward Others	-.16	.42*	.04	.05	.08	.65*	-.27	.51*	.59*	.18	.20	.43*	.05	.36*	.86

Note. * $p < .05$. Correlations between the different scales are presented below the diagonal. Cronbach's α for the inter-rater reliability for each scale is presented on the diagonal. Differences between the suicide and non-suicide groups (including magnitude) are presented in Table 5.

METHODOLOGY

ONLINE NEWS ARTICLE SEARCHES

Purpose of Online News Article Searches

The social media data collected during the original Hesse et al. (2015) and Rose and Hesse (2015) efforts contained strictly user-generated content from micro-blogs, blogs, and social networking websites collected 1 year prior to subjects' deaths. Although these data were extremely rich in information about the subjects' internal cognitions and emotions, they potentially missed vital information about violent behavior that was crucial for the present effort. For example, if a subject who died by suicide also committed a homicide at the time of his/her death, this would not have been captured in the user-generated data. Similarly, during the original effort, the social media vendor was instructed to notify PERSEREC if there was any evidence of harm to a child. The social media vendor did alert PERSEREC to several instances where subjects were under investigation for sexual offenses involving minors (e.g., intent to participate in unlawful sexual conduct with a minor). However, the information regarding these offenses was not within the scope of the data collected and therefore was not provided in the final social media reports that were used for this study.

According to the anecdotal information provided by the social media vendor, subjects passed away prior to a full criminal investigation (in one case, the subject died by suicide the day he was expected to be arrested); therefore, it is unclear whether these instances would have been uncovered in the social media profile. The purpose of conducting online article searches for this effort was to provide further context to the circumstances of the Service member's death, and to determine if the subject engaged in violent acts that occurred immediately prior the subject's death (such as in the case of a homicide-suicide).

Online news article searchers provide a rich source of information regarding the circumstances surrounding the Service member's death. However, it is important to note that the information available is very different in each case. In addition, to be able to obtain adequate statistical power (because availability of online articles is limited to high-profile cases), research would require a very large sample. Nonetheless, they provide an important potential source of information about the context of events.

Online News Article Search Methodology

Searches only included open source data (e.g., newspaper articles, public arrest records) and excluded all user-generated data. Researchers did not collect or store any PII found in the articles. Any data uncovered during these searches was checked for entity resolution on the following parameters to ensure that it referenced the correct subject: full name, date of death, date of birth, death location, and military affiliation.

Researchers used the following four step process:

METHODOLOGY

- Search: Enter the subject's full name and military affiliation into the Google search engine.
- Review: Review news articles containing information that either provides additional details regarding the subject's death or indicates that the subject was engaged in violent behavior.
- Match: Ensure that the information contained within the article matches the subject's biographic data on at least three of the following parameters:
 - Date of Birth
 - Date of Death
 - Cause of Death
 - Death Location
 - Service
 - Component
 - Age
- Collect: Code the article, providing an indicator of whether or not the subject was violent, the number of victims, and a brief summary of the incident.

RESULTS

RESULTS

The primary goal of this effort was to determine the predictors of dying by suicide and exhibiting violent cognitions, emotions, or behaviors (VCEB). Statistical data analyses consisted of three phases: (1) exploring violent cognitions, emotions, and behavior on social media (comparing VCEB to non-VCEB Service members), (2) exploring indicators of suicide on social media (comparing Service members who died by suicide vs. other causes), and finally, the primary goal, (3) exploring the unique predictors of Service members who are at risk for both suicide and VCEB. Finally, we also conducted a qualitative analysis of the results of the online article searches.

VCEB ON SOCIAL MEDIA

For examples of VCEB on social media (quotations from subjects), see Table 2. These examples fit well with past literature and its broad definition of violence, ranging from threats of physical violence to attitudes or cognitions about physical violence. Thus, here, as in other work, violence exists along a continuum.

In order to explore VCEB in the sample, researchers created a dichotomous variable quantifying the number of individuals who exhibited VCEB within the sample. This variable identified a subject as either showing VCEB or non-VCEB¹⁰. Subjects were considered to exhibit VCEB if they were identified as exhibiting violence in the online news article searches, or if they received *any* rating of physical violence on social media¹¹. That is, if individuals received any rating (other than “99”) on the scale entitled “Violence” described in Methodology, they were considered in the VCEB group (vs. non-VCEB).

¹⁰ Creating a dichotomous variable from a continuous variable (i.e., the physical violence rating of social media profiles) can restrict its variance. However, in the interest of comparing subjects who exhibited VCEB with those who did not, and due to the fact that the physical violence variable had a highly non-normal distribution (Kolmogorov-Smirnov test = .39, $df = 288$, $p < .001$), researchers chose to dichotomize VCEB and use this variable for the analyses.

¹¹ A rating of physical violence on social media reflected violent cognitions, emotions, and behaviors.

Table 2
Quotations from Social Media for Service Members Rated 4-5 on Physical Violence Scale

Quotations
<ul style="list-style-type: none"> • I really want to punch someone right now. • The next person who says, "It's not the heat, it's the humidity," will learn that it's not my fist, but the impact. • Do not screw with me for when I decide to retaliate it will suck to be you • Criminals, please give me a reason to shoot you! • I kissed my sweetie with my fist. • Let's do this the old fashioned way. First blood from the torso. • My [New Year's resolution] is not to head-butt rabid clowns. Punch, shoot, kick, stab... all are still options. Of course if the clown doesn't have rabies, anything goes. • Put the boots to him... medium style. • So I had to pull out the hammer and punch set to change the grip on my XD and I suddenly had conflicting thoughts of which I would rather use for home defense. Right now I'm leaning toward the claw hammer. • My rifle is the envelope, these bullets are the ink, and this trigger is the stamp. Trust me, you don't want to get the message.

In order to understand the unique characteristics of individuals at risk for both suicide and violence, we explored the cognitions, emotions, and behaviors expressed on social media for three different sets of individuals:

- Service members who exhibited VCEB vs. non-VCEB.
- Service members who died by suicide vs. other means.
- Service members who exhibited VCEB vs. Service members who did not exhibit VCEB within the suicide group.

For each set of comparisons, we conducted independent sample *t*-tests comparing the scores on the Likert scales for VCEB vs. non-VCEB individuals, for individuals who died by suicide vs. other means, and, finally, for individuals who showed VCEB vs. non-VCEB who died by suicide. Following this, a binary logistic regression was used to determine if differences on social media were able to predict cause of death, VCEB or non-VCEB, or VCEB/non-VCEB within the suicide group.

Throughout the document, significant differences are presented in boldface text. Results are discussed in the order described in the previous section.

Table 3 presents rates of VCEB identified via the social media reports and online article searches for both groups of subjects.

RESULTS

Table 3
VCEB vs. Non-VCEB Service Members in each Data Source

	Non-Suicide	% of Non-Suicide Group	Suicide Group	% of Suicide Group	Total	% of Total
Social Media						
No Social Media Data	420	76%	544	78%	964	77%
Social Media Data	132	24%	156	22%	288	23%
VCEB	24	4%	40	6%	64	5%
Non-VCEB	108	20%	116	17%	224	18%
Online News Articles						
No Articles	415	75%	613	88%	1,028	82%
Articles	137	25%	87	12%	224	18%
Not Pertaining to Violence	137	25%	70	10%	207	17%
Pertaining to Violence	0	--	17	2%	17	1%

Of the 1,252 subjects in the sample, 288 (23%) had social media profiles with content (non-suicide, $n = 132$ or 24% of the non-suicide group; suicide group $n = 156$ or 22% of subjects in the suicide group). In total, 64 (22%) of the 288 subjects exhibited VCEB based on social media, 24 subjects were in the non-suicide group (4% of the 552 total non-suicide group, or 18% of 132 subjects with social media data in the non-suicide group¹²) and 40 subjects were in the suicide group (6% of the 700 total suicide group, or 26% of the 288 subjects in the suicide group with social media data). In addition, there were 224 individuals with online article data (non-suicide group $n = 137$, or 25%, suicide group $n = 87$ or 12%). Within the suicide group, there were 17 subjects that had at least one article pertaining to violence. The online news articles did not identify any VCEB subjects in the non-suicide group. In total, 81 Service members in the study exhibited VCEB, 57 (8% of 700) in the suicide group, and 24 (4% of 552) in the non-suicide group.

Comparing VCEB and Non-VCEB Subjects

Independent samples *t*-tests were conducted to explore differences in cognitions, emotions, and behaviors expressed on social media for VCEB and non-VCEB individuals. Mean-level differences and significance tests for the two groups are presented in Table 4.

¹² The previous DSPO effort regarding social media and suicide (Hesse et al., 2015) discusses in greater detail the differences between Service members with available social media data vs. those without, and this represents an important limitation of the results presented here.

Table 4
VCEB vs. Non-VCEB Service Members

	Non-VCEB			VCEB			<i>t</i>	<i>df</i>	<i>p</i>	Cohen's <i>d</i>
	N	Mean	SD	N	Mean	SD				
Positivity	236	3.28	0.94	74	2.72	1.21	3.60	101.97	<.001	.55
Anger	236	1.39	0.82	74	3.02	1.46	-9.16	88	<.001	1.62
Life Stressors	236	1.60	1.06	74	2.56	1.44	-5.34	99.16	<.001	1.17
Self-Esteem	236	2.97	0.50	74	2.90	1.00	0.56	84.81	.577	.11
Suicidality	236	1.49	1.09	74	2.57	1.57	-5.50	95.94	<.001	.89
Social or Supportive Interactions	202	3.69	1.01	74	3.28	1.17	2.86	274	.005	.39
Negative Peer Influence	47	2.20	1.65	55	3.07	1.27	-3.01	100	.003	.60
Substance Use	78	2.01	1.24	52	3.32	1.57	-5.03	91.67	<.001	.96
Legal or Disciplinary Issues	14	2.14	1.03	25	2.58	1.30	-1.08	37	.286	.37
Weapons	29	2.17	1.43	37	2.03	1.33	0.43	64	.671	.10
Derogatory Comments	36	1.96	1.15	53	2.59	1.23	-2.46	87	.016	.53
Sleeping Problems	14	1.89	1.33	28	2.05	1.38	-0.36	40	.720	.12
Complaints about Others	65	2.51	1.44	57	3.41	1.28	-3.65	120	<.001	.66
Threats toward Others	6	2.17	0.75	39	3.60	1.36	--	--	--	1.10
Person Age (in years)	1,295	30.24	10.16	105	26.76	7.25	4.55	140.60	<.001	.34

Note. Fractional *df* are a result of non-equal variances across the two groups. Levene's test of Equality of Variances indicated that, for these scales, the variances of the two groups were significantly different; as a result, t-tests were conducted with the assumption of non-equal variances. The significance test for the "Threats toward Others" is not presented due to the very small sample size in the non-VCEB group.

RESULTS

In general, there were several significant predictors of exhibition of VCEB. Service members who showed VCEB were rated lower in positivity and social support than Service members who did not express VCEB. VCEB Service members were also rated significantly higher than non-VCEB Service members in anger, life stressors, suicidality, social support, negative peer influence, substance use, derogatory comments, threats, and complaints about others.

Of particular interest is that VCEB Service members were rated significantly and substantially higher in suicidality, suggesting a link between suicidality and VCEB on Service members' social media pages. In addition, by far the largest differences occurred for the scales of anger/hostility and life stressors. This suggests that Service members who display VCEB also express themselves in a hostile manner on social media, and discuss life stressors (such as marital problems, unemployment, financial issues) online.

A binary logistic regression was conducted to determine if differences on social media pages were able to predict the likelihood of being classified as VCEB. Results of this analysis are presented in Table 5. They show that, with all five social media Likert scales in the same model, only one predictor of VCEB on social media remains significant: Service members who were rated high in anger/hostility were 2.89 times more likely to show VCEB than Service members rated low in anger/hostility.

Table 5
Binary Logistic Regression Predicting VCEB

	<i>b</i>	Wald	<i>df</i>	<i>p</i>	Odds Ratio
Intercept	-5.45	20.67	1	<.001	0.00
Positivity	0.37	3.19	1	.074	1.44
Anger/Hostility	1.06	36.80	1	<.001	2.89
Life Stressors	0.15	0.78	1	.376	1.16
Self-Esteem	0.04	0.03	1	.863	1.04
Suicidality	0.26	2.61	1	.106	1.29

Note. Cox & Snell $R^2 = .27$, Nagelkerke $R^2 = .41$.

Comparing Suicide and Non-Suicide Groups

Next, in order to explore the nature of suicide on social media, we used the Likert scale ratings to assess differences in cognitions, emotions, and attitudes on social media between the suicide and non-suicide groups. Results of this analysis are presented in Table 6, along with mean-level comparisons and standardized mean differences (Cohen's *d*). Service members who died by suicide exhibited higher

levels of life stressors and suicidality, and lower levels of positivity, than subjects in the non-suicide group¹³.

¹³ The largest difference occurred for sleeping problems, although this difference was non-significant, probably as a result of the small sample size. Service members rarely discussed sleeping problems on social media; however, Service members who died by suicide discussed them more often.

RESULTS

Table 6
Suicide vs. Non-Suicide Groups

	Non-Suicide			Suicide			Total			<i>t</i>	<i>df</i>	<i>p</i>	Cohen's <i>d</i>
	N	Mean	SD	N	Mean	SD	N	Mean	SD				
Positivity	132	3.34	1.05	156	2.98	0.99	288	3.15	1.03	2.99	286	.003	.33
Anger	132	1.68	1.19	156	1.82	1.21	288	1.75	1.20	-0.98	286	.33	.12
Life Stressors	132	1.64	1.09	156	1.94	1.3	288	1.80	1.21	-2.10	285.96	.04	.25
Self-Esteem	132	2.99	0.68	156	2.88	0.61	288	2.93	0.64	1.41	286	.16	.17
Suicidality	132	1.5	0.99	156	1.93	1.47	288	1.73	1.29	-2.96	273.50	.003	.34
Violence	24	3.08	1.34	40	3.38	1.18	64	3.27	1.24	-0.91	62	.37	.25
Social or Supportive Interactions	120	3.6	1.17	136	3.54	0.97	256	3.57	1.07	0.41	231.92	.68	.06
Negative Peer Influence	37	2.59	1.4	55	2.73	1.62	92	2.67	1.53	-0.41	90	.69	.09
Substance Use	58	2.37	1.46	65	2.6	1.52	123	2.49	1.49	-0.85	121	.40	.16
Legal or Disciplinary Issues	14	2.54	1.37	22	2.34	1.19	36	2.42	1.24	0.45	34	.65	.16
Weapons	26	2.19	1.55	33	1.97	1.19	59	2.07	1.35	0.63	57	.53	.16
Derogatory Comments	37	2.28	1.3	45	2.27	1.16	82	2.27	1.22	0.06	80	.95	.01
Sleeping Problems	20	1.55	1.05	19	2.32	1.43	39	1.92	1.29	-1.92	37	.06	.63
Complaints about Others	51	2.73	1.5	60	2.99	1.4	111	2.87	1.45	-0.97	109	.34	.18
Threats toward Others	17	3.5	1.48	25	3.22	1.35	42	3.33	1.39	0.64	40	.53	.20

Note. Fractional *df* are a result of non-equal variances across the two groups. Levene's test of Equality of Variances indicated that, for these scales, the variances of the two groups were significantly different; as a result, *t*-tests were conducted with the assumption of non-equal variances. Only positivity emerged as a significant unique predictor of death by suicide when the other predictors were also in the model. A 1-point decrease in positivity was associated with a 1.33 increase¹⁴ in the odds of dying by suicide¹⁵.

¹⁴ 1.33 is the inverse of the Odds Ratio presented in Table 7 (.75) to make the number more interpretable.

¹⁵ Suicidality was not a significant unique predictor of dying by suicide despite the large mean difference between the suicide and non-suicide groups. This is likely the result of the fact that suicidality and positivity ratings on social media were highly correlated ($r = -.49$).

Note that, interestingly, Service members who died by suicide were not rated as higher on violence, threats, or derogatory comments. This contradicts the prior finding showing that VCEB and suicide are related. This suggests that the association between suicide and VCEB that exists in this sample of Service members is small (here, $d = .25$, a medium effect), and small enough to be non-significant. It also suggests that VCEB is related to different thoughts and emotions, as VCEB Service members were higher on anger, substance use, complaints, and negative peer influence, and these were not significant predictors of dying by suicide.

Following the overall comparison on all scales, a binary logistic regression was conducted to determine what cognitions, emotions, or attitudes might uniquely predict death by suicide. Due to sample size restrictions, the five scales that were always rated (positivity, anger/hostility, life stressors, self-esteem, and suicidality) were entered as predictors of cause of death¹⁶. Results of the analyses are presented in Table 7.

Table 7
Binary Logistic Regression Predicting Suicide vs. Non-Suicide

	B	Wald	df	p	Odds Ratio
Intercept	1.22	1.85	1	.17	3.39
Positivity	-0.29	4.05	1	.04	0.75
Anger	-0.17	1.59	1	.21	0.85
Life Stressors	0.08	0.33	1	.56	1.08
Self-Esteem	-0.10	0.26	1	.61	0.90
Suicidality	0.19	2.01	1	.16	1.21

Note. Cox & Snell $R^2 = .05$, Nagelkerke $R^2 = .06$.

Results of the logistic regression show that only positivity uniquely predicts death by suicide. Service members who were lower on positivity on social media were 1.33 times more likely to die by suicide than Service members higher in positivity.

VCEB and Non-VCEB Subjects who died by Suicide on Social Media

As stated previously, the primary goal of this study was to explore the characteristics of the small population of Service members who express VCEB and are at risk for suicide. First, a chi-square test of independence revealed that there was a significant association between cause of death and VCEB ($\chi^2(1) = 6.46$, $p = .01$; $\phi = .08$, indicating a small effect). Standardized residuals showed that Service

¹⁶ A number of other possible models were explored, particularly using anger/hostility, suicidality, physical violence, and substance use as potential predictors of suicide, as well as all possible two-way interactions between these variables. None of these were significant predictors (with the exception of the two-interaction between anger and substance use, which was significant in the opposite direction predicted). However, only 48 subjects received ratings on these scales, giving us very limited statistical power to explore these as possible predictors.

RESULTS

members who died by suicide were more likely to show VCEB, whereas Service members who died by other means were less likely to show VCEB.

T-tests and binary logistic regression were also used to compare the online cognitions, emotions, and behaviors of Service members who died by suicide who were violent vs. non-violent. Results are presented in Table 8.

Table 8
VCEB vs. Non-VCEB Service Members who died by Suicide

	Non-VCEB			VCEB			<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i>
	N	Mean	SD	N	Mean	SD				
Positivity	115	3.13	0.87	41	2.56	1.19	2.80	55.81	.007	.595
Anger	115	1.43	0.88	41	2.89	1.35	-6.43	52.78	<.001	1.436
Life Stressors	115	1.70	1.17	41	2.60	1.42	-3.61	60.53	.001	.731
Self-Esteem	115	2.96	0.47	41	2.67	0.86	2.02	48.75	.049	.480
Suicidality	115	1.60	1.24	41	2.87	1.67	-4.44	56.40	<.001	.937
Social or Supportive Interactions	95	3.64	0.92	41	3.33	1.06	1.70	134.00	.091	.324
Negative Peer Influence	23	2.37	1.99	32	2.98	1.26	-1.40	53.00	.167	.387
Substance Use	36	2.00	1.16	29	3.34	1.60	-3.78	49.67	<.001	.991
Legal or Disciplinary Issues	7	2.14	0.90	15	2.43	1.32	--	--	--	.251
Weapons	11	1.64	0.78	22	2.14	1.33	-1.36	30.04	.184	.437
Derogatory Comments	15	1.97	1.17	30	2.42	1.15	-1.23	43.00	.224	.398
Sleeping Problems	4	2.38	1.80	15	2.30	1.39	--	--	--	.058
Complaints about Others	30	2.55	1.39	30	3.43	1.28	-2.55	58.00	.013	.670
Threats toward Others	3	2.00	0.00	22	3.39	1.35	--	--	--	1.123
Person Age (in years)	640	29.79	9.46	60	27.22	7.50	2.48	77.75	.015	.279

Note. The significance tests for the “Threats toward Others,” “Sleeping Problems,” and “Derogatory Comments” scales are not presented due to the very small sample size in the non-VCEB group.

RESULTS

Service members who died by suicide and exhibited VCEB were younger, and were rated significantly higher in anger/hostility, life stressors, suicidality, substance use, and complaints about others than Service members who died by suicide and did not show VCEB. VCEB Service members who died by suicide were also rated significantly lower in positivity than non-VCEB Service members who died by suicide. VCEB Service members who died by suicide were also lower in self-esteem than non-VCEB Service members who died by suicide. This difference did not exist among Service members who merely exhibited VCEB, or those who died by suicide vs. other means, suggesting that low self-esteem might be unique to those Service members who are both suicidal and show VCEB. The largest difference here was for anger/hostility, suggesting that this is the key characteristic differentiating VCEB from non-VCEB Service members. Strategies for managing anger or hostility might therefore represent a useful starting point for intervention for Service members who exhibit VCEB.

Life stressors also represent one of the larger differences between VCEB and non-VCEB Service members who died by suicide, along with substance use. Because this is a potential target for intervention (that is, attempts to reduce life stressors or substance use might be an effective area for change in this high-risk population), we chose to explore the nature of the stressors among individuals who were rated highly on this scale. Some examples of life stressors are presented in Table 9. These examples come from all subjects who received a rating of “5” on the “Life Stressors” scale, and who died by suicide and exhibited VCEB.

Table 9
Life Stressors among VCEB Service Members who died by Suicide

List of Life Stressors	Selected Quotes
<ul style="list-style-type: none"> Mental health problems (depression) 	<ul style="list-style-type: none"> "Well, I'm out of the hospital now. For those of u who don't know I was admitted Saturday evening, I basically had a mental breakdown."
<ul style="list-style-type: none"> Interpersonal loss (parents) 	<ul style="list-style-type: none"> "Gonna get [a tattoo] for my mom on my right arm." "I wish Heaven had a phone so I could hear your voice again."
<ul style="list-style-type: none"> Health problems (minor) 	<ul style="list-style-type: none"> "Damn got a massive headache and slept way late missed drill today."
<ul style="list-style-type: none"> Employment problems (searching for employment) 	<ul style="list-style-type: none"> "Got an interview tomorrow at Wal-mart!" but subsequently, "I need a different job, Walmart is killing me slowly on the inside..."
<ul style="list-style-type: none"> Health problems 	<ul style="list-style-type: none"> "Thinks he's becoming an insomniac, so tired my eyes are blurry and still can't sleep, prayin for a sporadic fit of narcolepsy."
<ul style="list-style-type: none"> Employment Problems (searching for employment) 	<ul style="list-style-type: none"> "Has three jobs pending... another weekend of waiting. ::cries softly::"
<ul style="list-style-type: none"> Mental Health Problems 	<ul style="list-style-type: none"> "I think I'm losing my mind, for fear I'm going insane." "Of all the things I've lost, I miss my mind the most. ~ Mark Twain"
<ul style="list-style-type: none"> Relationship problems (marital infidelity) 	<ul style="list-style-type: none"> "So much for being married. Gotta try everything at least once though right."
<ul style="list-style-type: none"> Health problems (severe injury) 	<ul style="list-style-type: none"> "So I got up this morning and decided I wanted to get me 8 new staples in my head..."
<ul style="list-style-type: none"> Health problems (multiple; migraines, sleep issues, minor injury) 	<ul style="list-style-type: none"> "I feel like shit again. Fucking migraines. I have had one every day for the past four days. FML."
<ul style="list-style-type: none"> Relationship problems (family, romantic) 	<ul style="list-style-type: none"> "Girl trouble. I just feel I shouldn't have broken up with [redacted]." "My mom fucked me over and somehow it's my fault."
<ul style="list-style-type: none"> Financial problems 	<ul style="list-style-type: none"> "Now I owe \$8000. FML."
<ul style="list-style-type: none"> Employment problems (searching for employment) 	<ul style="list-style-type: none"> No direct quotes, but discusses sleeping all day (rather than working) and eventually mentions, "I'm gonna be a bartender!"
<ul style="list-style-type: none"> Mental health problems 	<ul style="list-style-type: none"> "Somebody talk. I'm going insane."
<ul style="list-style-type: none"> Financial problems (home foreclosure) 	<ul style="list-style-type: none"> "I don't know if you know this Mom. The house we live in was foreclosed on. We have to move. We looked at a house today in a 'lesser' neighborhood."
<ul style="list-style-type: none"> Family health problems 	<ul style="list-style-type: none"> Posts photo of housecleaning service for women with cancer, "Mom?"
<ul style="list-style-type: none"> Health problems (chronic pain) 	<ul style="list-style-type: none"> "is having surgery to replace the disc between c5 & c6..." "My neck hurts..."
<ul style="list-style-type: none"> Relationship problems (marital dissolution) 	<ul style="list-style-type: none"> "Dude. Wife left me. 100% my fault though. I shoulda seen it coming but I'm too stupid for that."

As Table 9 shows, Service members who discuss life stressors on social media are frequently dealing with health issues (either mental or physical), or relationship, financial, and employment problems.

RESULTS

Finally, to determine which cognitions, emotions, and behaviors discussed on social media might be unique predictors of the VCEB-suicide combination, a binary logistic regression comparing VCEB vs. non-VCEB Service members who died by suicide is presented in Table 10. Results mirror those found for violent individuals in general. Service members who were rated as angry or hostile on social media were 2.74 times more likely to have exhibited VCEB.

Table 10
Binary Logistic Regression on VCEB vs. Non-VCEB Service Members who died by Suicide

	<i>b</i>	Wald	<i>df</i>	<i>p</i>	Odds Ratio
Intercept	-3.50	5.18	1	.02	0.03
Positivity	0.33	1.39	1	.24	1.39
Anger/Hostility	1.01	17.74	1	<.001	2.74
Life Stressors	-0.08	0.14	1	.71	0.92
Self-Esteem	-0.33	0.82	1	.37	0.72
Suicidality	0.25	1.76	1	.19	1.29

Note. Cox & Snell $R^2 = .25$, Nagelkerke $R^2 = .37$.

Summary of VCEB and Suicide on Social Media

Overall, analysis of the social media pages of Service members leads to several conclusions. VCEB is visible on social media, including threats of violence, attitudes toward violence, and discussions of actual violent behavior. In addition, there were differences between suicidal and non-suicidal Service members on social media, particularly with regard to overall tone—Service members who died by suicide were significantly more negative than Service members who died by other means. Finally, of most interest to the research questions addressed here, Service members who were both suicidal and exhibited VCEB had some unique characteristics. In particular, they were lower in self-esteem than Service members who died by suicide but were non-VCEB. In addition, they discussed life stressors more frequently online, and were significantly angrier in their social media posts. Taken together, the results suggest that anger management, management of life stressors, or interventions focused on improving self-esteem might be helpful areas to mitigate risk of suicide and violence.

Online News Articles

In order to gather information about the context of the death of individuals within this sample, we conducted online news article searches. There were 17 articles that indicated that a subject was violent prior to his or her death. Of these 17 subjects, 14 committed a homicide, a single subject fired on police officers, another subject assaulted an officer and made a violent threat, and a final subject brandished a

weapon in public¹⁷. In addition, online articles identified a number of incidents (11) of homicide-suicide. Because these cases represent a pairing of suicide and violence that is of particular concern, we conducted a deep-dive qualitative analysis into these cases. In doing so, we aimed to provide a demographic description of individuals who engaged in homicidal and suicidal acts.

Profile of Homicide-Suicide Perpetrators

Online news article searches revealed that there were 11 cases of homicide-suicides within this sample where the subject was the perpetrator. All but one of these perpetrators were males with female victims, and they were primarily within a marital or intimate relationship (8 subjects were married, 2 unmarried, and 1 divorced). The single exception to this was a subject who murdered another Service member prior to his own death by suicide. Subjects were on average 32 ($SD = 8.45$) years of age¹⁸.

All of the perpetrators in our sample were White or of unknown racial background. Five of the subjects were Active Duty, five were in the National Guard, and a single subject was in the Reserves. Seven of the subjects were in the Army, three were in the Air Force, and a single subject was in the Navy. They primarily had no religious preference ($n = 7$); the rest were Christian ($n = 4$). All had at least a high school education ($n = 6$), with many having at least some college ($n = 5$).

In most cases where the subject had dependents ($n = 6$), they were left unharmed ($n = 4$). For the two cases in which children were killed, one involved the biological child of the perpetrator; the other case involved the death of a former partner's child. Two other cases had more than one victim—the murder of the Service member mentioned earlier, and a single case of familicide, in which the subject killed his former partner and her mother and stepfather.

Unfortunately, online news articles often did not provide any information regarding the motive of the perpetrator. Two articles mentioned that the couple had been having financial issues; two cases also involve ex-partners. Two articles mentioned a prior history of domestic violence. In a single case, the incident occurred immediately after the subject's return from deployment, perhaps suggesting readjustment problems.

Overall, results here mirror the general profile of homicide-suicide perpetrators, who are most frequently male, White, married individuals with access to weapons. The small number of cases here did suggest that homicide-suicide perpetrators might be somewhat older than the general populace, although they were not as old

¹⁷ These are descriptions of the event rather than legal definitions as the subjects were not generally charged with a crime prior to their death.

¹⁸ Due to the small number of homicide-suicide cases, there was insufficient statistical power to test the significance of differences in demographics. Instead, descriptive differences are presented as guidelines for potential future research.

RESULTS

as prior studies might have suggested (Patton et al., 2015). There is some evidence that the relationship might have been in upheaval prior to the incident, with either financial issues or marital problems.

For one perpetrator, the online article indicates that he posted his intentions on Facebook prior to the incident; however, this Facebook post was not included in our dataset. Within our sample, there was available social media content on only one Service member who perpetrated a homicide-suicide, and there was very little data on his profile. Due to the lack of social media content from the homicide-suicide subjects, it is unclear whether or not indicators of risk for homicide-suicide might be present on social media.

DISCUSSION

The goal of the present effort was to explore cognitions, emotions, and behaviors of U.S. Service members who died by suicide. Results indicate that they were more likely to exhibit violent cognitions, emotions, or behaviors (VCEB) than Service members who died from other reasons, a finding that is consistent with past research (O'Donnell et al., 2015). This study also extends past literature by focusing on the U.S. military population, as it is one of the first studies to examine the association between violent cognitions, emotions, or behaviors and suicide in a population of U.S. Service members.

In general, Service members who died by suicide exhibited higher levels of life stressors and suicidality, and lower levels of positivity, than subjects in the non-suicide group. When comparing Service members who died by suicide who exhibited VCEB with those who did not show VCEB, the former were found to be younger and exhibited significantly higher levels of anger and hostility, life stressors, suicidality, substance use, and complaints about others than the latter. VCEB Service members who died by suicide also exhibited significantly lower levels of positivity and self-esteem in their social media posts. Finally, 11 homicide perpetrators were identified in the sample, all of whom were in the suicide group.

VIOLENCE IN ONLINE MEDIA

One of the goals of the present effort was to identify Service members who might express VCEB using social media and online articles. Service members were categorized as expressing VCEB versus non-VCEB based on information in their social media pages and online news articles. In total, 81 Service members in the study showed VCEB, 57 in the suicide group and 24 in the non-suicide group. Social media data identified 64 VCEB subjects (non-suicide $n = 24$, suicide $n = 40$) and the online news articles identified 17 VCEB subjects, all in the suicide group.

Although the number of Service members who exhibited VCEB and were in the suicide group might seem relatively small in relation to the entire sample of subjects who died by suicide (8% of 700), when it is considered in the context of the number of subjects for whom we had available data, it becomes more substantial. For this effort, categorization of a subject as VCEB versus non-VCEB was based largely on his or her social media data. Despite having 1,252 subjects in our sample, we only had social media data on 288 of them (23%), and of these subjects, 64 (22% of 288) received a rating on the physical violence Likert scale. Out of these 64 VCEB subjects, 40 were in the suicide group and 24 were in the non-suicide group. In sum, based on available social media, 26% of our subjects in the suicide group with social media data (156) were rated as exhibiting VCEB, compared to 18% of the 132 subjects with social media data in the non-suicide group.

DISCUSSION

VIOLENCE AND SUICIDE ON SOCIAL MEDIA

Findings from this effort suggest that social media is a rich landscape for expression of indicators of suicide and violent behavior for Service members. In order to understand the unique cognitions, emotions, and behaviors of Service members who died by suicide, we first began by examining the individuals who exhibited VCEB versus those who did not, and who died by suicide versus other means.

VCEB vs. Non-VCEB Service Members

Results from this study indicate that Service members who exhibited VCEB on their social media pages and online news articles expressed themselves differently online than Service members who did not exhibit VCEB. Subjects who showed VCEB posted more negative comments online and had less social support from third parties. In addition, VCEB individuals had higher levels of anger, life stressors, suicidality, social support, negative peer influence, substance use, derogatory comments, threats, and complaints about others. Anger and hostility expressed on social media was the strongest discriminating factor between VCEB Service members and non-VCEB Service members relative to other cognitions and emotions. On a conceptual level, this finding is consistent with literature that frames anger as an emotional substrate of violent behavior that often precedes its occurrence. The finding that Service members who exhibited VCEB also exhibited higher levels of life stressors and lower levels of social support from others is very important. It highlights the salience of providing military personnel with resources that can help them cope with stress, which an inevitable consequence of the pressures associated with military life and life in general. This finding also underscores the importance of social supportive interactions with others, and suggests that their absence can contribute to VCEB (or, conversely, that VCEB might drive family or friends away). This is unsurprising given past research suggests that aggression in reaction to life stressors is a major contributor to both suicide and violence (Conner, Duberstein, Conwell, & Caine, 2003).

Finally, subjects who showed VCEB were also rated higher for suicidality, suggesting a possible link between online displays of VCEB and suicidal ideation. Again, this underscores the association between violence and suicide, and suggests that a potential direction for interventions is to increase communication between agencies and personnel responding to violent and suicidal incidents, as Service members at risk for one behavior seem to also be at greater risk for the other.

Service Members who Died by Suicide vs. Other Means

Results suggest that the subjects' overall tone, and whether it was negative or positive, was the strongest predictor of whether they died by suicide or from other causes. Subjects who died by suicide were consistently more negative in their tone across posts and discussions on social media with other individuals. Interestingly, positive/negative tone was an even stronger predictor of being in the suicide group

than suicidality or presence of life stressors. These findings are consistent with past literature that shows that individuals do express suicidal cognitions and emotions online (e.g., Cash et al., 2013).

The social media profiles of Service members who died by suicide were rated higher for presence of life stressors and suicidality, and lower for positivity than the profiles of Service members who died by reasons other than suicide. In other words, subjects in the suicide group posted more about stressful life situations and their posts had an overall more depressed and negative tone than posts made by subjects in the non-suicide group. In addition, positivity was a statistical predictor of cause of death.

These findings indicate that there is a difference between the available social media pages of Service members who die by suicide and those who die from reasons other than suicide. Interpreting online thoughts and emotions of another individual is a subjective task that is not free of errors. To this end, attempting to understand a Service member's state of mind via their social media page will require friends, family, and other online connections to place his or her posts within the context of this person's offline life. A broader understanding of the individual's life is necessary in order to make a correct conclusion about whether negativity expressed on social media is a situational feeling or a chronic depressed mood that requires intervention and support. Training efforts aimed at friends, co-workers, and family members should focus on teaching these individuals how to interpret social media discourse, as it may be indicative of one's intent to die by suicide, and appropriate follow-up actions that should be taken.

VCEB vs. Non-VCEB Service Members who Died by Suicide

Finally, the main focus of this effort was to understand better those individuals who were both suicidal and exhibited VCEB. In general, Service members who died by suicide were significantly more likely to be show VCEB than Service members who died from reasons other than suicide. This relationship was expected and the association between VCEB and suicide here parallels prior work showing that suicide attempts are associated with a history of violence (Krakowski & Czobor, 2004). What is interesting and new about this finding is that it extends prior work that examined violence to expression of violent cognitions, emotions, and behaviors on social media. This suggests that the same association between violence and suicide shown in past work is also found in social media, with an overlap between suicide and VCEB that might or might not have been criminal.

In order to avoid furthering stigmatization, it is important to understand how Service members who died by suicide and showed VCEB differed from Service members who died by suicide and did not show VCEB. There are many trajectories taken by individuals who die by suicide, and it is vital to recognize that not every Service member who is at risk for suicide will also be at risk for harming others.

DISCUSSION

Analyses focusing on the differences between VCEB and non-VCEB subjects in the suicide group attempted to identify key differences between these two groups.

Service members who died by suicide who exhibited VCEB were younger and were rated significantly higher in anger and hostility, life stressors, suicidality, substance use, and complaints about others. They were also rated lower in positivity and self-esteem. In particular, the finding of higher life stressors among this group identifies a key area that suicide intervention and prevention programs for Service members may want to target. Results suggested that many of the Service members who died by suicide and showed VCEB discussed financial, employment, relationship, and health problems on social media. The findings here also underscore that not all individuals who are struggling with suicidality should be perceived as violent. Instead, only a subset that is experiencing a number of personal and situational stressors outlined earlier may be at risk for violence towards others.

ONLINE ARTICLES AND HOMICIDE-SUICIDE PERPETRATORS

Although homicide-suicide is a fairly rare occurrence, online news article searches identified 11 homicide perpetrators in the present sample, all of whom were in the suicide group. Almost all of these cases involved married men who committed homicide against their female partners, consistent with past research (Patton et al., 2015). Online news articles provided limited data on the subject's motive and events leading up to their death. However, past research has suggested that there are substantially different motives among military homicide-suicide perpetrators than among civilian perpetrators (Patton et al., 2015). In addition, there is a continued possibility that homicide-suicide perpetrators might express risk of violence or suicide on social media, or that they might broadcast their intent to commit violence online (as was found in a single subject here). However, because homicide-suicide is a rare event, and this effort had no relevant social media data for those perpetrators, there was no evidence of this potential broadcasting found in this sample. Nonetheless, future efforts should explore the possibility of detecting warning signs for these violence events online. The one case presented here of a subject broadcasting intent to commit violence on social media suggests that threats of violence or suicide online should be taken seriously by friends and family, and that they might provide an important imminent warning sign for law enforcement and military authorities.

LIMITATIONS

The primary limitation of this study was the lack of all available social media data on the subjects that we had at our disposal. The completeness of the data sources we examined impacted our ability to correctly identify Service members and draw appropriate conclusions. To this end, the number of subjects classified as VCEB in the present study is likely an underestimate of the actual number of subjects who exhibited violent cognitions, emotions, and behaviors in our sample.

This effort used social media data originally collected for a previous study, which consisted of 288 social media profiles for a sample of 1,400 subjects. The low percentage of subjects with available social media data can be explained in part by the gap in time between the subject's death and data collection. Subjects in this study all died between the years 2010-2011; however, data collection did not take place until 2014. During this time period, the subjects' social media pages may have been deactivated. In addition, due to privacy and legal concerns, only publicly available data were collected; therefore, if subjects had active social media profiles, but the content was protected with privacy settings, their data would not have been collected. Because of this, the conclusions that can be drawn from these data are limited to Service members with publicly-available social media data, which is necessarily a subset of the population, and, therefore, results here are not necessarily generalizable to all Service members who exhibit VCEB or who die by suicide.

As a result of these limitations, it was difficult to calculate the true rate of VCEB in our sample, and the resulting calculated rate is likely an underestimate. Despite this, violence is a low base rate event, and exploring the nature of violence requires very large samples, especially when examining social media data.

CONCLUSION

The findings from this study are consistent with previous work showing that Service members express indicators of suicide in their discourse on social media, and also that there is an association between suicide and violence. In addition, it also demonstrates that violence exists on social media, and is often communicated through violent cognitions, emotions, and behavioral intentions. While interpreting a person's violent discourse on social media, it is important to take into account the entire context of the posts, and to the extent possible, this person's offline life circumstances, and both risk and mitigating factors. Service members in the suicide group did exhibit greater levels of violent cognitions, emotions, and behavior than individuals who died from other causes. It is important to recognize, however, that suicidal struggles alone do not lead to violence. It is the additional risk factors of life stressors, anger and hostility, substance use, complaints about others, and low self-esteem that differentiated subjects who died by suicide who exhibited VCEB from those who did not show VCEB.

RECOMMENDATIONS

- (1) Publicly available social media data might be useful for identifying Service members at risk for suicide or violence, but this process likely involves human interpretation. Future efforts should focus on developing training to assist co-workers, friends, and family members in interpreting social media information when trying to assess a Service member's state of mind and suicide risk.

DISCUSSION

- (2) Future research should review policies and procedure for responding to violent incidents or suicidal events, and evaluate the level of communication that currently exists between responding personnel and agencies. Although different organizations and personnel are involved in responding to these different incidents, the results of this report suggest that there is overlap between individuals at risk for both kinds of behaviors, and that communication between responding agencies might help to mitigate risk of both violence and suicide.
- (3) Individuals at risk for violence and suicide might engage in the same maladaptive responses to life stressors. Interventions might focus on providing strategies for how to manage life stressors and maintain a healthy self-esteem, another factor that was uniquely predictive of risk for both suicide and violence.
- (4) This study should be replicated with a larger sample in order to have adequate statistical power to examine the relationship between violence and suicide. Future efforts should combine social media data with other data sources, for instance law enforcement information, in order to have a more complete set of predictors of suicide and violence risk.

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**APPENDIX A:
LITERATURE REVIEW**

APPENDIX A

BACKGROUND

VIOLENCE AND SUICIDE

Past research suggests that there is substantial overlap between individual risk factors for suicide and violence (see O'Donnell, House, & Waterman, 2015, for a review). Table A-1 presents a list of studies that examined the association between suicide and violence in both civilian and military populations. The exact rate of this overlap varies widely depending on the population of interest and the operationalization of either suicide or violence (O'Donnell et al., 2015).

Note: The list of studies in Table A-1 is not exhaustive, and focuses only on research that specifically examined subjects who had a history of suicidal thoughts, behavior, or attempts, or died by suicide, or those studies that focused on military populations. All of the findings discussed here are summarized in Table A-1.

Taken together findings from past work suggest that both suicide and violence are consistently and repeatedly associated with hostility, aggression, anger, and impulsivity (Conner, Duberstein, Conwell, Seidlitz, & Caine, 2001; Ilgen, Burnette, Conner, Czyz, Murray, & Chermack, 2010; Mann, Waternaux, Haas, & Malone, 1999; Romanov et al., 1994). Theory has long linked the concepts of aggression and self-harm, with the two behaviors even sharing common terminology (e.g., self- or other-directed violence, outward and inward-directed aggression; O'Donnell et al., 2015).

In addition to the strong theoretical relationship, empirical evidence also suggests that violent behavior and suicidal behavior frequently co-occur. For example, among patients in treatment for substance use disorders, all forms of prior violence (e.g., physical assault, sexual assault) were associated with a greater risk of multiple suicide attempts (Ilgen et al., 2010). Suicidal ideation was also more common for individuals who had engaged in prior violence (Ilgen et al., 2010). Another study found that, among patients admitted to New York hospitals, men who had prior issues with assault were substantially more likely to also have a history of suicidal behavior (Tardiff & Sweillam, 1980). However, because of the populations examined (individuals in treatment for mental health problems), it is unclear if the association between behavioral violence and suicide generalizes to Service members.

A number of psychological disorders has also been associated with increased risk of suicide and violence toward others. Specifically, both antisocial personality disorder and borderline personality disorder increase risk of suicide and violence (Nock & Marzuk, 2000). Past research has also shown that individuals at risk for suicide or violence often share a common background of family dysfunction, including physical abuse, poor parent-child relationships, and poor parental mental health (Nock & Marzuk, 2000). In sum, the literature suggests that there are underlying risk factors that might predispose individuals to both suicide and violence.

APPENDIX A

Table A-1
Suicide and Violence: Prevalence and Overlap in different Populations

Study Name	Population	Summary	Prevalence
Civilian Populations			
Apter et al., 1989	<i>N</i> = 60 psychiatric inpatients of the Bronx Municipal Hospital Center; <i>n</i> = 30 were admitted for attempted suicide, <i>n</i> = 30 were matched controls.	20 patients in the sample had to be secluded or restrained for assaulting a staff member or a fellow patient; 18 of these subjects were in the suicide group.	60% (18) of patients admitted for a suicide attempt assaulted a staff member or patient.
Conner, Duberstein, & Conwell, 2000	<i>N</i> = 40 men with alcohol abuse or dependence who died by suicide.	Examined the association between suicide and history of partner violence.	50% (20) of subjects who died by suicide had a history of partner violence.
Buri et al. 2009	<i>N</i> = 700 patients with alcohol-use disorders; <i>n</i> = 69 had a suicide attempt in the past 3 months.	Examined predictors of suicide among substance use patients with a history of suicide attempts in the past 3 months.	36% (25) of patients with a suicide attempt in the past 3 months had a lifetime history of violence.
Baca-Garcia et al., 2006	<i>N</i> = 657 individuals from NYC or Madrid, Spain; <i>n</i> = 310 had a history of suicide attempts (recruited from psychiatric hospitals), <i>n</i> = 407 healthy controls.	Examined differences in aggression (using lifetime history of violence) between NYC and Madrid, Spain, and how those differences predict suicide.	74% (178) of suicide subjects were considered to have high aggression scores as compared to 21% of controls. <i>Note: aggression scores obtained on only n = 240 suicide subjects.</i>
Ilgen, Burnette, Conner, Czyz, Murray & Chermack, 2010	<i>N</i> = 6,233 individuals with substance use disorders	Examined the association between self-report of lifetime violence and suicidal ideation (splitting into single or multiple prior attempts)	69% (<i>N</i> = 873) of individuals with ideation but no attempt had engaged in prior violence. 70% (<i>N</i> = 458) of subjects with one prior attempt had engaged in prior violence. 71% (<i>N</i> = 554) of individuals with multiple prior attempts had engaged in prior violence.
Mann, Wateraux, Haas, & Malone, 1999	<i>N</i> = 347 patients admitted to a psychiatric hospital, <i>n</i> = 184 who had attempted suicide	Examined the association between suicide attempts and the traits of aggression, hostility, and impulsivity	Individuals who had attempted suicide had significantly and substantially higher scores for lifetime aggression on three scales of aggression, hostility, and

Study Name	Population	Summary	Prevalence
			impulsivity.
Robinson & Duffy, 1989	<i>N</i> = 7887 admissions to a poison control center due to self-poisoning with or without a history of self-injury; <i>n</i> = 7312 were self-poisoning patients, <i>n</i> = 575 had a history of self-injury.	Looking at predictors of self-injury vs. self-poisoning.	22% (1,591) of patients in either group (self-injury or self-poisoning) had a history of violence in the preceding 5 years.
Sani et al. 2011	<i>N</i> = 4,441 psychiatric patients; <i>n</i> = 96 died by suicide, <i>n</i> = 4,345 were either alive or died by other means.	Followed up with psychiatric patients to determine predictors of completed suicide.	31% (30) of patients who died by suicide expressed aggressive behavior in the week before their deaths.
Tardiff & Sweillam, 1980	<i>N</i> = 9,365 patients admitted to public psychiatric hospitals in New York	Examined the association between prior assaultive behavior or suicidal problems in patients.	13% (<i>N</i> = 150) of individuals who had suicidal problems also had a history of violence prior to admission.
Military Populations			
Brown et al., 1979	<i>N</i> = 52: <i>n</i> = 26 male Naval subjects with a primary personality disorder and <i>n</i> = 26 male control subjects	11 subjects had a history of suicide attempt(s). Aggression was higher among those subjects than among subjects with no history of suicide.	21% (11) of subjects had a history of suicide attempt, and were significantly more aggressive than those without.
Brown et al., 1982	<i>N</i> = 12: 17-32 male Naval subjects with borderline personality disorder without major affective disorder.	5 subjects with a history of suicide attempt(s) were higher in aggression than subjects with no history of suicide attempts.	42% (5) of subjects had a history of suicide attempt, and were significantly more aggressive than those without.
Koslowsky et al., 1992	<i>N</i> = 94 male soldiers in the Israeli army complaining of mental distress; <i>n</i> = 28 had no history of suicidal attempts, thoughts, or threats, <i>n</i> = 43 had a history of suicidal thoughts or threats, and <i>n</i> = 18 had a history of suicide attempt in the past week	Suicide risk and violence were correlated at $r = .47$; suicide risk and anger were correlated at $r = .65$. Violence was not a precursor for suicide risk (model fit poorly).	Study examined linear association rather than prevalence rates. <i>M</i> rating of violence (on a 10-point scale) was 5.7, <i>SD</i> = 4.8.
Mehlum, 1992	<i>N</i> = 112 conscripts in the Norwegian army with a history of	Soldiers with a history of suicide also showed a history of	5.4% (6) of subjects showed signs of aggression; 39.6% reported some sort of

APPENDIX A

Study Name	Population	Summary	Prevalence
	suicide.	aggression or conflict.	conflict with parents, spouse, peers, or officers/military authority; most common was conflict between the conscript and officers/military authority.

Despite the link between violence and suicide in civilian populations, few studies have examined these outcomes in a military sample. One goal of this effort was to identify VCEB and their overlap with suicide among Service members. Recent work has suggested that precursors toward violence or suicide among Service members can be quite different from those within a civilian population (e.g., Patton, McNally, & Fremouw, 2015). This study aims to determine whether there are common underlying risk factors for VCEB and suicide within a military population.

Aggression, Violence, and Suicide in Military Populations

As shown in Table 1, there have only been a small number of studies focused on the association between violent behavior and suicide within military populations. In general, results of these studies show a similar overlap as in the civilian population individuals with a history of suicidal thoughts or behavior are also more likely to engage in or have a history of violent behavior. For instance, one study found that among Service members receiving inpatient treatment for personality disorders, patients with a history of suicide attempts also showed a stronger history of past aggressive behaviors (Brown, Goodwin, Ballenger, Goyer, & Major, 1979). This finding was replicated in a later study, again showing that psychiatric inpatient Service members with a history of attempted suicide had higher levels of aggressive behaviors than Service members with no history of suicide (Brown et al., 1982). The authors suggest that the link might be related to altered serotonin levels underlying both behaviors. However, both studies focused on Service members receiving inpatient treatment only, and it is therefore unclear whether these findings may apply to all Service members.

In addition to studies in a U.S. Military population, two studies have explored the association between violence and suicide in foreign military service populations. A study using a sample of Israeli soldiers receiving outpatient treatment for mental health issues found that risk for suicide and violence were strongly associated (Koslowsky et al., 1992). Violence in this case included attitudes and feelings about violence, as well as a lifetime history of violent behavior.

Finally, among a sample of Norwegian Service members receiving treatment for a suicide attempt, approximately half of the subjects had shown signs of aggressive behavior prior to the attempt or a history of conflict with superiors (Mehlum, 1992).

The small number of studies described here demonstrates the need for further exploration of the link between suicide and violence, particularly within the U.S. military population.

In the present study, we will aim to identify common indicators of suicide and violence among deceased Service members, focusing specifically on the emotions and cognitions that they express on social media, as well as contextual information from online articles.

APPENDIX A

Suicide and Social Media

Social media serves as a rich landscape for the study of suicide for several reasons. First of all, there is evidence that suicidal individuals seek out resources for suicide prevention online. For example, the organization “Battle in Distress” provides crisis support for Service members in distress (see Hesse et al., 2015, for more detail). Second, linguistic analyses suggest that suicidal individuals behave differently online and use different language when posting on the Internet (e.g., Barak & Miron, 2005). Third, there is preliminary evidence that there might be risk indicators of suicide that are present online. One study demonstrated that adolescents on the social networking site MySpace shared comments about their suicidal thoughts (Cash et al., 2013).

A recent DSPO effort analyzing the social media pages of the same sample of Service members utilized in the present study (Hesse et al., 2015; Rose & Hesse, 2015) found interesting differences between posts of Service members who died by suicide and posts of Service members who died due to other reasons. The former were more likely to contain mention of hopelessness, social withdrawal, and insomnia than the latter.

In Hesse et al. (2015) some of the indicators theoretically related to suicide in clinical research (e.g., depression) did not predict Service members’ cause of death. This finding may suggest that clinical signs of suicide found on social media are of limited utility when it comes to predicting suicide. Via a follow-on qualitative analysis of the social media data (Rose & Hesse, 2015), the researchers identified a set of additional risk factors associated with being in the suicide group: negative employment experiences, personal access to, or ownership of, firearms, emotional distress, and posts about imminent departure/wishes for suicide.

Despite only a small amount of preliminary evidence examining risk indicators of suicide on social media, there is strong evidence that individuals do discuss suicidal thoughts online, including on social media pages (Barak & Miron, 2005; Baume, Cantor, & Rolfe, 1997; Hesse et al., 2015; Rose & Hesse, 2015).

Violence and Social Media

There is a large body of literature examining the manifestation and intensity of cyber-bullying (i.e., non-physical hostility or aggression) on social media (see Whittaker & Kowalski, 2015, for a review). In addition, sexual harassment (Barak, 2005) and stalking (cyberstalking; Spitsberg & Hoobler, 2002) occur on the Internet as well as in the offline world. Online violence can consist of harassing messages, sending of unwanted images, and obsessional following, and can also escalate to real-world violence. There is also evidence of gang violence (Patton, Eschmann, & Butler, 2013; Patton et al., 2014) on social media, with gang members planning future acts of violence, inciting violence through dares, or discussing or mocking recent victims of violent acts perpetrated by the gang.

Increasingly, youth violence, including bullying, gang violence, and self-directed violence, is occurring online and on social media (Patton et al., 2014). However, there are no studies exploring the nature of online violence within a military population. The present study will be the first to examine the social media pages of deceased Service members to determine if their posts contained information about violent cognitions, emotions, and behaviors. This effort aimed to identify any unique indicators that may differentiate Service members who are at risk for either suicide, violent behavior directed towards others, or both suicide and violence toward others.

Homicide-Suicide in Civilians vs. Service Members

Homicide-suicide incidents are the most extreme example of the merging of violence and suicide. They occur when a person kills one or more individuals immediately before or at the same time as dying by suicide (Patton et al., 2015). Although statistically rare, these events (such as the case of SPC Ivan Lopez) are often highly publicized in the media.

Perpetrators of homicide-suicide are most frequently male, often have issues with depression, a history of intimate partner violence, and a history of substance use problems (Eliason, 2009). Quite frequently, homicide-suicide cases involve a male perpetrator aggressing against a female partner following a domestic incident, although older male caregivers (e.g., fathers) are also at risk. Perpetrators of homicide-suicides are also often much older than those who commit homicide alone.

Recent research suggests that homicide-suicides might have different predictors within a military population than in a civilian population (Patton et al., 2015). Specifically, military homicide-suicide perpetrators were substantially older than their civilian counterparts and more likely to be married or formerly married, have more physical health problems, and less likely to abuse substances. Military perpetrators also had substantially different motives when compared to civilians. They were much more likely than civilian perpetrators to be motivated by their declining health or the declining health of their victim—that is, their goal was to end their own suffering or the suffering of a loved one as a result of a serious, often terminal, health problem.

Results of the aforementioned Patton et al. (2015) study support the need for further research of military homicide-suicide perpetrators. In the present study we will use guided Internet searches of online news articles to provide context to the deaths of Service members. In doing so, we will develop a profile of the perpetrators of homicide-suicide cases within the military in order to better understand the possible demographic and risk factors that might have predisposed them to commit these acts.

**APPENDIX B:
CAUSES OF DEATH FOR SUBJECTS IN NON-SUICIDE GROUP**

APPENDIX B

Table B-1
Causes of Death in Non-Suicide Group

Category and Description	N
<i>Accident</i>	
• Accidental inhalation and ingestion of food or other objects causing obstruction of respiratory tract	4
• Air and space transport accidents	56
• Cataclysmic storm and flood	5
• Fall from one level to another	21
• Fall on same level	7
• Unspecified fall	8
• Motorcyclist involved in any accident except collision with railway train	221
• Occupant of car, pickup truck or van involved in collision with other motor vehicle	74
• Occupant of heavy transport vehicle or bus involved in collision with other motor vehicle	1
• Occupant of motor vehicle involved in collision with other (non-motorized) road vehicle, streetcar, animal or pedestrian	46
• Occupant of motor vehicle involved in noncollision accident	55
• Occupant of special-use motor vehicle involved in any accident	19
• Water transport accidents	8
<i>Medical</i>	
• Asthma	8
• Congestive heart failure	9
• Other and unspecified heart failure	6
• Obstetric causes	1
• Obstetric death of unspecified cause	1
• Other deaths related to pregnancy, childbirth and the puerperium	2
<i>Total</i>	552

**APPENDIX C:
DEMOGRAPHICS**

APPENDIX C

**Table C-1
Demographic Data**

	Non-Suicide Group	% of Non-Suicide Group	Suicide	% of Suicide Group	Total	% of Total
Sex						
Male	518	94%	659	94%	1,177	94%
Female	34	6%	41	6%	75	6%
Race						
American Indian/Alaskan Native	11	2%	10	1%	21	2%
Asian	8	1%	6	1%	14	1%
Black/African American	44	8%	36	5%	80	6%
White	248	45%	320	46%	568	45%
Unknown or Other	241	44%	328	47%	569	45%
Religious Affiliation						
Atheistic/Agnostic/No pref.	132	24%	219	31%	351	28%
Christian	342	62%	374	53%	716	57%
Buddhist	3	1%	5	1%	8	1%
Other Eastern religion	1	0%	0	0%	1	0%
Jewish	1	0%	3	0%	4	0%
Wicca or witchcraft	0	0%	1	0%	1	0%
Unclassified or Unknown	73	13%	98	14%	171	14%
Marital Status						
Never married	253	46%	322	46%	575	46%
Married	238	43%	333	48%	571	46%
Divorced	47	9%	37	5%	84	7%
Legally separated	2	0%	5	1%	7	1%
Widowed	1	0%	1	0%	2	0%
Unknown	11	2%	2	0%	13	1%
Education						
Less than High School	15	3%	16	2%	31	2%
High School or Equivalent	392	71%	518	74%	910	73%
Some college	35	6%	51	7%	86	7%
Associate's Degree	27	5%	34	5%	61	5%
Bachelor's Degree	60	11%	45	6%	105	8%
Post-Graduate Degree	14	3%	19	3%	33	3%
Unknown	9	2%	17	2%	26	2%

APPENDIX C

**Table C-2
Military Status**

	Non-Suicide Group	% of Non-Suicide Group	Suicide	% of Suicide Group	Total	% of Total
Service Component						
Guard	141	26%	160	23%	301	24%
Regular	223	40%	319	46%	542	43%
Reserve	188	34%	221	32%	409	33%
Service						
Air Force	84	15%	112	16%	196	16%
Army	309	56%	428	61%	737	59%
Coast Guard	14	3%	11	2%	25	2%
Marine Corps	71	13%	67	10%	138	11%
Navy	73	13%	82	12%	155	12%
Public Health Services	1	-	0	-	1	<1%
Rank						
Junior Enlisted	268	49%	372		640	51%
NCO	202	37%	255		457	37%
Officer	58	11%	49		107	9%
Senior Enlisted	11	2%	19		30	2%
Warrant Officer	13	2%	5		18	1%

**APPENDIX D:
SOCIAL MEDIA CODING**

APPENDIX D

BACKGROUND

The initial coding effort used three sets of indicators: a set of codes based on the 36 indicators of suicide from the original effort (Hesse et al., 2015), a prior study of indicators of insider threat that also examined suicide (Pogson, Shechter, Leather, & Smith-Pritchard 2013), and a list of indicators of violence toward oneself and others provided by subject matter experts from the University of Nebraska-Lincoln (UNL). Based upon these three sets of indicators, a set of dichotomous codes was created that tapped into suicide and violence on social media. These codes were then reviewed by UNL subject matter experts mentioned earlier, who provided comments leading to additional revisions and additions. This process resulted in a final list of 82 codes¹⁹. Using these codes, each post was then rated dichotomously for presence or absence of each indicator.

Several problems quickly surfaced with the original coding approach. First, posts often contained more than one indicator. A single post might have reflected, for example, both sleep problems and a negative mood (e.g., “cranky today because I couldn’t sleep last night”). However, coding a single post for multiple indicators introduced the issue of non-independence of scores, which is a key assumption of many statistical analyses. By its nature, content on social media often reflects multiple cognitions, thought processes, and emotions within a single post. Thus, attempting to dichotomously code each post for a set of orthogonal indicators was an extremely difficult task. Unsurprisingly, due to this issue, an initial calculation of inter-rater reliability from the original coding approach showed that consistency across coders was extremely low ($K = .05$ for some scales). This is likely the result of attempting to code each post for only one indicator, and each coder choosing a different single indicator that they felt applied to the post.

¹⁹ A full list of codes and the references used to develop them is available from the authors upon request.

**APPENDIX E:
DATA DICTIONARY OF SOCIAL MEDIA LIKERT SCALES**

APPENDIX E

Table E-1
Scale Definitions, Anchors, and Examples

Scale	Definition	Scale Anchors	Examples/Set Points
ALWAYS CODED			
<i>Positivity</i>	The subject's overall tone across all posts.	<ul style="list-style-type: none"> • 1= Negative tone • 3 = Neutral tone • 5 = Positive tone 	<ul style="list-style-type: none"> • 1 is characterized by consistent negativity and complaints, with little positivity or optimism. • 3 is characterized by either neutral tone (e.g., "bored," "new tattoo"), or by an equal number of positive and negative posts. • 5 is characterized by positive, optimistic, and cheerful tone, with few or minor complaints or negativity.
<i>Anger/ Hostility</i>	The subject's overall anger and hostility level across all posts. This includes expressions of anger, angry mood, hostility toward third parties, threats toward others, excessive use of profanity, rage, and posts about feeling annoyed, frustrated, and displeased.	<ul style="list-style-type: none"> • 1 = No evidence of anger or hostility • 3 = Moderate level of anger or hostility • 5 = Severe level of anger or hostility 	<ul style="list-style-type: none"> • 1 is characterized by no posts indicating anger or hostility. • 3 is characterized by a moderate level of anger or hostility, either a single intense comment (e.g., "I hate everything about you"), or several minor comments (e.g., "highly irritated"). • 5 is characterized by consistent and intense anger or hostility (e.g., "I hate a LOT of people," consistent use of profanity) • "Fuck you all" or similar statements would qualify the profile to be rated at least a 3
<i>Life Stressors</i>	The presence of life stressors in the subject's life that include one of the following: <ul style="list-style-type: none"> • Financial issues • Employment issues • Interpersonal loss (including deaths of pets) • Mental health issues • Relationship problems • Physical health issues. 	<ul style="list-style-type: none"> • 1 = No evidence of life stressors • 3 = Moderate evidence of life stressors • 5 = Severe/frequent mention of life stressors 	<ul style="list-style-type: none"> • 1 is characterized by no mention of life stressors • 3 is characterized by moderate life stressors, or inconsistent mention (e.g., several posts mentioning minor illness, complaints about missing family). • 5 is characterized by consistent or severe complaints about life stressors (e.g., financial, employment, interpersonal loss, and health problems).
<i>Suicidality/ Depression</i>	The subject's overall suicidality and/or depression level across all posts.	<ul style="list-style-type: none"> • 1= No evidence of depression or suicidal ideation • 2-3 = Moderate evidence of depression 	<ul style="list-style-type: none"> • 1 is characterized by no mention of depression, death, or suicide. • 3 is characterized moderate mention of depression, but no self-harm (e.g., complaints about sadness, hurt feelings, betrayal, "I feel like dying," but no explicit mention of suicide/self-harm). • 5 is characterized by severe depression with possible wish for death,

APPENDIX E

Scale	Definition	Scale Anchors	Examples/Set Points
		<ul style="list-style-type: none"> or suicidal ideation 4-5 = Evidence of severe depression and/or suicidal ideation 	<p>suicide, or self-harm (e.g., “just shoot me,” “[My job] is killing me on the inside,” “shoot me,” “I... had a mental breakdown,”).</p>
<i>Self-Esteem</i>	The subject’s self-view across all posts.	<ul style="list-style-type: none"> 1-2 = Negative self-view 3 = Neutral self-view, or no evidence 4-5 = Positive self-view 	<ul style="list-style-type: none"> 1 is characterized by self-hatred, self-deprecation, or a very negative self-view (e.g., “wasting time is all I’m good at I guess,” “I’m amazed at how many times I can make a mistake in a month”). 3 is characterized by either no mention of a self-view or a neutral self-view. 5 is characterized by a positive, confident, or cocky self-view (e.g., “I’m GOOD, in the morning, in the evening, baby even in the afternoon,” “I love to hate you, but I really love to love myself better.”).
CODED IF APPLICABLE			
<i>Physical Violence</i>	The presence of subject’s thoughts or attitudes about violence, or actual acts of violence. Excludes lawful acts of violence (e.g., hunting and boxing).	<ul style="list-style-type: none"> 1-2 = Mild or weak evidence of violence or attitudes toward violence 3 = More severe or more frequent comments about violence 4-5 = Frequent or extreme comments about violence 	<ul style="list-style-type: none"> 1 is characterized by very few, mild comments about violence (e.g., a single comment that seeing someone blown away by jet exhaust would have “made for an interesting night,” and would be “funny as hell”) 3 is characterized by more severe or frequent comments about physical violence (e.g., “gets in fights at midnight with crackheads,” “I’m gonna punch you in the face”). 5 is characterized by severe comments about physical violence or attitudes (e.g., a subject who admits to intentionally killing a dog, threats or approval of homicide). A single comment about assault (e.g., “beat your ass”) qualifies the profile to receive at least a 3, but more than one comment warrants a 4-5. A comment about violence not perpetrated by the subject (e.g., “kill yourself”) should make the rating at least a 3.
<i>Social/ Supportive Interactions</i>	The overall tone of the third party posts directed towards the subject on his/her social media profile.	<ul style="list-style-type: none"> 1-2= Negative tone 3 = Neutral tone 4-5 = Positive tone 99 = No third-party posts 	<ul style="list-style-type: none"> 1 is characterized by negative, insulting, dismissing, or sarcastic comments (e.g., “You really need to get a life,” “you need some serious help”). 3 is characterized by neutral comments, or a mixture of positive and negative comments (e.g., a profile that contains comments such as “Be safe,” and “Sucks to be you!”). 5 is characterized by positive, supportive, friendly comments (e.g., “Miss you,” “Be safe,” “Love you,” “Take care”).

Scale	Definition	Scale Anchors	Examples/Set Points
<i>Negative Peer Influence</i>	The presence of third-party posts encouraging illegal, deviant, violent, or generally negative behavior.	<ul style="list-style-type: none"> • 1-2 = Mild negative peer influence • 3 = Moderate peer influence • 4-5 = Extreme negative peer influence 	<ul style="list-style-type: none"> • 1 is characterized by mild negative peer influence (e.g., encouraging subject to drink or party, but no evidence of subject having substance abuse issues). • 3 is characterized by more serious negative peer influence (e.g., daring a subject to cut down a tree on a golf course for Christmas). • 5 is characterized by consistent negative influence or encouraging more serious bad behavior (e.g., “[Subject] is learning the joys of alcoholism. You make me so proud, son.”). • Encouraging the subject to drink when s/he seems to have substance use issues should warrant the profile receiving at least a 4-5.
<i>Substance Use</i>	The presence of subject’s posts related to alcohol or drug use (prescription drug use or illegal drug use).	<ul style="list-style-type: none"> • 1 = Minor evidence of substance use • 2-3 = Repeated mentions of substance use • 4-5 = Frequent mention of substance use, or use of substances in an illegal or problematic manner 	<ul style="list-style-type: none"> • 1 is characterized by few mentions of legal substance use (e.g., “going out for a drink”). • 3 is characterized by more serious substance use, or consistent mention of substance use (e.g., mentions of drunkenness or binge drinking, illegal drinking). • 5 is characterized by illegal substance use, or evidence of substance abuse issues (e.g., use of cocaine, mentions of dealing drugs, use of alcohol as a coping mechanism). • Multiple mentions of alcohol warrant a rating of 2-3. • Multiple examples of binge drinking justify a rating of at least a 3.
<i>Legal/Disciplinary Issues</i>	The presence of subject’s posts related to illegal behavior, legal issues, and disciplinary violations.	<ul style="list-style-type: none"> • 1 = Very mild legal problems • 3-4 = More severe legal problems • 5 = Extreme legal problems 	<ul style="list-style-type: none"> • 1 is characterized by very minor legal issues (e.g., parking ticket). • 3 is characterized by more serious legal issues (e.g., moving violations). • 5 is characterized by serious legal problems (e.g., mention of arrest, court dates, or encounters with law enforcement)
<i>Weapons</i>	The presence of subject’s posts about weapons, weapon use, or pictures of weapons. Exclude all duty-related weapons, defined as when the subject is in uniform, but include mention of weapon use in legal activities such as hunting.	<ul style="list-style-type: none"> • 1 = Very mild weapon use • 2-3 = Multiple mentions of weapon use • 4-5 = Frequent mention of weapons, pictures of weapons. 	<ul style="list-style-type: none"> • 1-2 is characterized by evidence of occasional recreational use of weapons. • 3 is characterized by more frequent use of weapons, or posts about weapons. • 5 is characterized by frequent discussion of weapons and weapon-related content (e.g., many posts about weapon use, pictures of weapons collections). • Expressing intent to purchase a weapon should warrant at least a 2.
<i>Derogatory</i>	The presence of racist, sexist, homophobic, or otherwise	<ul style="list-style-type: none"> • 1 = Minor derogatory comments 	<ul style="list-style-type: none"> • 1 is characterized by few minor derogatory comments (e.g., use of “gay” as a derogatory term) or by minor complaints about the Service,

APPENDIX E

Scale	Definition	Scale Anchors	Examples/Set Points
<i>Comments</i>	offensive comments by the subject, as well as negative comments about American society or government.	<ul style="list-style-type: none"> • 2-3 = Moderate derogatory comments • 4-5 = Extreme derogatory comments 	<p>government, or the U.S.</p> <ul style="list-style-type: none"> • 3 is characterized by more frequent use of derogatory terms, or more severe terms (e.g., multiple uses of racial slurs), or by multiple complaints about American society or government (e.g., “those 15 marines died for you, Lindsay [Lohan] in Afghanistan”). • 5 is characterized by consistent use of derogatory language, participation in extreme groups (e.g., dressing up as a member of the KKK, consistent use of racial slurs), or severe complaints about American society (e.g., “The Army and a condom share one thing in common: they both give you a false sense of security while you’re being screwed”). • Mention of violence against a group or support for extremist groups should be assigned at least a 4-5.
<i>Sleeping Problems</i>	The presence of posts mentioning subject’s sleeping issues.	<ul style="list-style-type: none"> • 1 = Minor sleeping problems • 3 = Moderate sleeping problems • 4-5 = Severe or consistent sleeping problems 	<ul style="list-style-type: none"> • 1 is characterized by very few complaints about sleeping problems (e.g., a single mention of “can’t sleep”). • 3 is characterized by multiple mentions of sleeping issues (e.g., repeated complaints about insomnia). • 5 is characterized by frequent or intense complaints about sleeping issues (e.g., “thinks he’s becoming an insomniac” and repeated complaints about sleeping problems).
<i>Complaints about others</i>	The presence of complaints about specific people, work, co-workers, or people in general, not including threats.	<ul style="list-style-type: none"> • 1= Mild or infrequent complaints • 2 -3 = More frequent or severe complaints • 4-5 = Frequent or intense complaints about others 	<ul style="list-style-type: none"> • 1 is characterized by minor complaints about others (e.g., a single complaint about having to go to work). • 3 is characterized by more frequent or severe complaints about others or work (e.g., multiple complaints about going to work, wanting the day off, minor complaints about people in general). • 5 is characterized by severe or frequent complaints about others or work (e.g., “Army C02 training. Death by PowerPoint.”).
<i>Threats</i>	The presence of posts threatening others, including taking negative action as a consequence for another person’s behavior.	<ul style="list-style-type: none"> • 1= Mild threat • 3-4 = More frequent or severe threats • 5 = Severe or frequent threats 	<ul style="list-style-type: none"> • 1 is characterized by minor or infrequent threats toward others (e.g., “I’m a lover not a fighter. But I’m also a fighter, so don’t get any ideas.”) • 3 is characterized by more serious or frequent threats (e.g., “You want me to fuck her up bro?”) • 5 is characterized by serious or frequent threats toward others (e.g., “The next infantryman who tells me his unit fucked him on his CIB is getting stabbed in the neck.”).