A Cluster Analysis Typology of Suicide in the United States Air Force

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Abstract

Background. Suicide remains a significant public health problem in the United States (U.S.) military. Given the heterogeneity among suicide decedents, what remains unclear is whether subgroups, or *typologies*, exist that characterize suicide decedents and whether these typologies can be effectively targeted in preventing suicide.

Purpose. A decade of surveillance data of U.S. Air Force (USAF) suicides was examined to determine whether a useful typological model of suicide could be constructed. Specific aims of the current study were (1) to describe the characteristics of USAF suicide decedents for the past decade; (2) to compare characteristics of USAF suicide decedents before the onset of Operation Enduring Freedom (OEF) with suicides occurring afterwards; (3) to employ hierarchical cluster analysis to determine the presence of subgroups based on demographic and psychosocial characteristics; and (4) to evaluate the stability and external validity of these subgroups.

Method. Data on all USAF active duty suicides registered in the Suicide Event Surveillance System (SESS) database, between 1999 and 2009, were obtained from the USAF Suicide Prevention Program (USAFSPP). Preliminary analyses focused on general characteristics of suicide decedents and potential differences between pre- and post- OEF suicides. Next, hierarchical cluster analysis of demographic and psychosocial variables was used to assign all cases to initial clusters and determine cluster centroids. Iterative partitioning clustering procedures were employed to determine cluster stability via split-half analysis. Members of the observed clusters were compared on their utilization of helping services to assess external validity and usefulness of the cluster solution.

Results. The USAF suicide decedents ($N = 376$) were predominately male, enlisted, Caucasian with ages ranging from 19 to 59; approximately 41% had a documented diagnosed psychiatric disorder and 11% had at least one documented prior suicide-related behavior. Firearms were used in over half of suicides. Life stressor precipitants, during the 72 hours prior to death, were noted in 64% of cases, with an argument with significant other or family member being the most common. Nearly half of the sample communicated their suicide intent prior to death – family members were the most common recipients. Nearly a quarter of the sample had no contact with any of the available helping agencies captured in the SESS in the 12 months prior to death. Military medical treatment facility was the most frequently accessed helping service followed by behavioral health. There were no significant differences in either demographic characteristics or total number of life stressors between suicides occurring pre- and post- OEF.

Three distinct clusters were identified using hierarchical cluster analysis and the unique characteristics of individuals within each cluster are reviewed in depth in this dissertation. Cluster 1 (Autonomous/Isolationist Typology) consisted mostly of single or divorced individuals, junior enlisted rank, who lived alone or in dormitories. Cluster 2 (Escapist/Controlling) consisted of mostly married individuals, who were in the senior enlisted or senior officer ranks. Cluster 3 (Attached/Dependent) consisted mostly of married or divorced, mid-grade enlisted individuals. Split-half analysis indicated that the three cluster solution had fair stability. Clusters differed significantly in their utilization patterns on four of the nine available helping services. Cluster 3 (Attached/Dependent) had the highest usage of mental health and Family Advocacy services whereas Cluster 1 had the lowest usage of these services.

Discussion. This study is the first scientific effort in understanding suicide typologies within a sample of U.S. military service members. Three distinct clusters for the USAF suicides have been identified. While further research on typologies in general as well as a replication of findings presented here in other military samples are needed, the identified clusters are expected to have clinical and policy related implications for the USAF Suicide Prevention Program. A more targeted approach in suicide screening, prevention, and intervention appears to be much needed.

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INTRODUCTION

Suicide is a significant preventable public health problem for both civilian and military populations. Established risk factors include psychological disorders (e.g., Arsenault-LaPierre et al., 2004), substance use disorders (e.g., Rihmer, 2007), divorce (e.g., Kposowa, 2000), history of suicide-related behaviors (e.g., Nordstrom et al., 1995), family history of suicide (e.g., Moscicki, 1995), impulsivity (e.g., Brent et al., 2003), hopelessness (e.g., Brown et al., 2000), and adverse life events such as interpersonal conflict or job loss (e.g., Kolves et al., 2006). Military personnel may be at an increased risk for suicide due to occupational factors such as combat exposure during deployment (Hoge et al., 2004; Kang & Bullman, 2008), relationship problems (Kindt, 2009; Patterson et al., 2001), and increased incidence of Posttraumatic Stress Disorder (PTSD) (Goodale, 1999; Paykel et al., 1975). Conversely, protective factors such as participation in psychotherapy (Thompson et al., 2000), restriction of access to lethal means (Humeau et al., 2007), social support (Resnick et al., 1997), and religion (Dervic et al., 2004) have also been identified.

While suicidal individuals may share a number of risk factors, suicide decedents do not appear to be a homogenous group (Henderson & Williams, 1978). Nevertheless, suicide prevention efforts continue to be framed around what is socially constructed as the typical suicidal person. Typologies characterized by varying degrees and combinations of individual biopsychosocial vulnerabilities (Reynolds & Berman, 1995) may explain different pathways to suicide. In an effort to capture these different pathways to suicide, numerous typologies have previously been proposed. The majority of suicide typologies have been based almost entirely on theory or clinical observations with little to no empirical support. To date, no typologies pertaining to military suicides have been proposed and scientifically evaluated. Developing

empirically supported typologies of military suicide could lead to improved identification, prevention, and intervention practices based on a more precise appreciation of the differences that exist among suicide decedents.

The primary aim of this dissertation is to examine typologies of suicide in the United States Air Force (USAF), based on surveillance data collected over the past decade. The manuscript is organized into the following major sections: (1) Background; (2) Rationale and Significance; (3) Aims and Hypotheses; (4) Research Design and Methodology; (5) Results; and (6) Discussion. Section 1 (Background) reviews the literature on the public health significance of suicide, risk and protective factors for both civilian and military suicide, as well as the emerging science of suicide typology and cluster analysis. Section 2 (Rationale and Significance) provides a synthesis of the literature, the scientific justification for the study, and highlights clinical as well as policy implications. Section 3 (Aims and Hypotheses) outlines the specific objectives and hypotheses of the dissertation and shows a conceptual model for USAF typologies based on the existing body of literature on suicide decedents. Section 4 (Research Design and Methodology) describes the participants, measures, study procedures, and data analytic strategy. Section 5 (Results) details the findings of the study for each of the stated aims and hypotheses. Finally, section 6 (Discussion) provides a detailed critical analysis and summarizes the findings in the context of actionable items for suicide prevention efforts within the USAF. Due to the complexity of the analytic strategy, a step-by-step procedural guide for the hierarchical cluster analysis is provided in Appendix B.

BACKGROUND

Global and National Public Health Significance of Suicide

Suicide is a serious public health problem with significant emotional and economic costs. From 1950 to 1995, suicide incidence has increased by 60% globally (WHO, 2006). Suicide ranks as the 10th leading cause of death worldwide at a rate of 14 per 100,000 (DoD, 2010). As of 2007, the suicide rate in the United States (US) was 11.5 per 100,000 (DoD, 2010), resulting in over 30,000 deaths annually (CDC, 2009). The most recent violent death statistics indicate that suicide is the 10th leading cause of death in the US overall and the second leading cause of death among 25-34 year olds (CDC, 2009).

On average, more than 80 Americans die by suicide daily (CDC, 2006). While females attempt suicide at a higher rate than males, the aggregate U.S. suicide rate of females is roughly four times lower than males (WISQARS, 2007). This disparity is largely due to method, with males using firearms in 50-60% of cases (CDC, 2004; WISQARS, 2007). Among the 184,749 U.S. suicide deaths from 1999-2004, 54.6% were from firearms, 20.4% suffocation, and 17.2% from poisoning (WISQARS, 2007).

United States Military. The U.S. active duty military is comprised predominantly of young male adults, with approximately 50% of the population between the ages of 17 to 26 (Eaton, Messer, Wilson, & Hoge, 2006). According to CDC data (2007), suicide remains a third leading cause of death among this age group. Suicide has historically ranked as the second most common cause of death in the military population next to accidents (Ritchie, Keppler, & Rothberg, 2003). From 2001-2009, the average suicide rate for the *Department of Defense* (DoD) increased from 10.3/100,000 to 18.4/100,000 (DoD, 2010). A recent Rand report (Ramchand et al., 2011) indicated that the average suicide rate for each service 2001-2008 was lowest in the Air Force (10.3/100,000), followed by the Navy (10.5/100,000), Army (13.1/100,000), and

Marine Corps (15.4/100,000). Two recent reports (DoD, 2010, Ramchand et al., 2011) acknowledged an association between increased deployments and increased suicide rates. Carr and colleagues (2004) suggest that corrections of reporting and classification mistakes may increase the reported suicide rates in the military by as much as 21%. To date, there is no reliable data available on the rate of suicide attempts in the military.

> **United States Air Force.** From 1990-1994, rates of suicide across the USAF increased from 10.0 per 100,000 to 16.4 per 100,000, accounting for 23% of all deaths among active duty (CDC/MMR, 1999). This rise provoked systemic changes and resulted in the development of a population based prevention program aimed at prevention and reducing stigma. Knox et al. (2003) reported a 33% relative risk reduction of suicide in those exposed to the program. There have been several spikes in USAF suicide rates over the last decade observed in 2004 (14.6/100,000), 2006 (12.1/100,000) and 2008 (12.0/100,000) (DoD, 2010, Kindt, 2009). Despite this, the average suicide rate for the USAF (10.7/100,000) has remained the lowest among service components from 2001-2009 and substantially lower than demographically adjusted civilian rates (19.2/100,000) for the same time period (CDC, 2009; DoD, 2010; Kindt, 2009).

Risk Factors for Suicide

Due to the complex, multifactorial nature of suicide, no single risk assessment instrument has been developed yet which incorporates adequate sensitivity and specificity for predicting fatal and nonfatal suicide-related events. There are, however, a host of frequently cited factors associated with increased risk for suicide-related behaviors. Risk factors can be categorized into the following: (1) sociodemographics; (2) clinical psychopathology; (3) behaviors & psychological features; and (4) adverse life events.

Sociodemographics. Although the elderly account for about 10% of the U.S. population, they account for 20% of the national suicide deaths (Hoyert, Arias, Smith, Murphy, & Kochanek, 2001). The highest suicide rate among all age groups consists of men 75 years of age and older (Pearson, Conwell, Lindesay, Takahashi, & Caine, 1997), with white males over 85 years of age dying by suicide at a rate of 59 per 100,000 (DHHS, 2004). White and American Indian/Alaska Native males and females have consistently had the highest suicide rates among all races 1950-2005 (DHHS, 2007).

Being married has long been considered a protective factor in the suicide literature (Goldsmith, Pellmar, Kleinman, & Bunney, 2002). In the 1979-1989 National Longitudinal Mortality Study (Kposowa, 2000), a large nationally representative sample ($N = 471,922$) was used to study the impact of marital status on suicide risk. After controlling for numerous sociodemographic confounds, divorcees were found to be two times more likely to die by suicide than married individuals. Single or widowed persons, however, did not demonstrate any significant risk. Once the sample was stratified by sex, marital status did not significantly impact risk of suicide for women but did for men. For divorced men, the risk of suicide was more than two times greater than for married men.

Clinical Psychopathology. Although most individuals with a psychiatric disorder do not engage in suicide-related behaviors, the majority of individuals involved in suicidal events have some level of clinical psychopathology. In a meta-analysis (Arsenault-Lapierre, Kim, & Turecki, 2004) of 27 different studies on completed suicides, 87.3% of suicide decedents compared with 34.9% of controls had a history of psychiatric disorder prior to death. Similarly, a systematic review (Cavanagh, Carson, Sharpe, & Lawrie, 2003) of 54 case series studies and 22 case-control psychological autopsy studies found that 90% of those who died by suicide had a

psychiatric disorder compared with 27% of controls. The most frequently documented axis I psychiatric disorder, at the time of suicide death, is Major Depressive Disorder (MDD), with a mood disorder being antecedent to 30-90% of all suicides (Arsenault-Lapierre et al., 2004; Isometsa, 2001; Rihmer, 2007). In a prospective study (Brown, Beck, Steer, & Grisham, 2000), of 6,891 psychiatric outpatients, those with MDD and bipolar disorder were at a significantly increased risk for suicide. More recently, Cavanagh et al. (2003) found that affective disorders were present in 60% of the suicide cases but only 10% of non-suicidal controls.

The second most frequent disorder among suicide deaths is substance-related disorders. A recent review (Rihmer, 2007) found that a history of substance-related disorder was present in 26-55% of suicides. Alcohol-related disorders have repeatedly been shown to be a statistically significant predictor of suicide and it is estimated that 20-25% are under the influence of alcohol at the time of death (Allen, Cross, & Swanner, 2005; Arsenault-Lapierre et al., 2004; Esposito-Smythers & Spirito, 2004; Goldsmith et al., 2002; Kolves et al., 2006). In a case-control psychological autopsy study of 427 completed suicides, 10% were found to have alcohol abuse disorder, 51% had diagnosable alcohol dependence (Kolves et al., 2006). This is markedly different from the controls in this study where 7% presented with alcohol abuse disorder and 14% with alcohol dependence. As expected, men who died by suicide had higher rates of alcohol related disorders than women (69% and 29% respectively).

In the U.S. population, comorbidity, or the co-occurrence of two or more psychiatric disorders, is common. Over half of all lifetime disorders found within the National Comorbidity Survey (NCS) occurred in a small subset of the population who had a history of three or more comorbid disorders (Kessler et al., 1994). This trend appears to be particularly relevant when considering that persons who engage in suicide-related behaviors frequently have co-occurring

disorders; notably, depression and substance-related disorders. Cavanagh et al. (2003) found that comorbidity of psychiatric disorder and substance-related disorders preceded suicide deaths in significantly more suicide cases (38%, CI: 19-57%) than non-suicidal controls (6%, CI: 0-13%).

There are also differences in the prevalence of specific psychiatric disorders across genders in both suicidal and non-suicidal samples. In non-suicidal samples, women have a greater lifetime prevalence of all affective disorders (except mania) and all anxiety disorders (Arsenault-Lapierre et al., 2004; Kessler et al., 1994). Men have about double the lifetime prevalence of substance-related disorders and approximately four times the prevalence of antisocial personality disorder than women. In a meta-analysis (Arsenault-Lapierre et al., 2004), males who died by suicide had a higher odds of also having substance-related problems (Odds Ratio [OR] = 3.6; 95% CI: 2.8-4.6), personality disorders (OR = 2.0; 95% CI: 1.4-3.0), and childhood disorders (OR = 5.0; 95% CI: 2.7-9.3) in comparison to females.

More often than not, these psychiatric disorders are untreated or under-treated at the time of suicide-related behaviors (Isometsa, 2001; Rihmer, 2007). In one study, less than 40% of individuals with a lifetime history of psychiatric illness had received treatment and less than 20% of those with a recent psychiatric disorder had been in treatment over the last 12 months (Kessler et al., 1994). Even among those with a lifetime history of three or more comorbid disorders, less than half ever obtained specialized treatment (Kessler et al., 1994).

Behaviors and Psychological Features. In addition to the factors described above, there are certain behaviors and psychological features which have also been associated with an increased risk for suicide. A history of psychiatric hospitalization and/or a suicide attempt, a family history of suicide, impulsivity, maladaptive problem solving, and hopelessness have all been linked to increased risk. Additionally, help seeking behaviors have shown an association

with suicide-related behaviors. These constructs and their association with suicide risk are described below.

The most predictive factor for suicide is a history of suicide-related behavior (Fawcett et al., 1990; Nordstrom et al., 1995). Prospective studies indicate that a history of suicide attempts increases the risk of future attempts (Coryell et al., 2002; Leon et al., 1999; Paykel & Dienelt, 1971). The National Comorbidity Survey-Replication (NCS-R) study suggests that even after controlling for sociodemographics, individuals with a history of suicide attempts had an extremely elevated risk for a subsequent suicide attempt within the 12 months of the index attempt (OR = 58.0, 95% CI: 19.8-169.8) (Borges et al., 2006).

If a person has been hospitalized for a suicide-related behavior, the relative risk (RR) for future suicidal events has been shown to be especially high (RR = 105.4, 95% CI: 76.2-145.9) in the weeks following release from an inpatient setting (Conner, Langley, Tomaszewski, & Conwell, 2003). In one retrospective study (Grossman, Soderberg, & Rivara, 1993), those who died by suicide had greater odds of having been hospitalized prior to death for psychiatric reasons (OR = 56.0, 95% CI: 27-120.0), unintentional injury (OR = 5.0, 95% CI: 2.2-11.5), and assaults (OR = 4.5, 95% CI: 1.1-18.0) as compared to age and sex matched controls.

Family history of suicide is also associated with increased risk (Moscicki, 1995). In a large-scale study using the Swedish cause of death registry, the rate of suicide was found to be two times higher in families of suicide decedents (Runeson & Asberg, 2003). Family history of suicide is a significant predictor of suicide and has been associated with earlier age of first attempt (Roy, 2004) and a greater likelihood of multiple attempts (Jeglic, Sharp, Chapman, Brown, & Beck, 2005; Tremeau et al., 2005). Some hypothesize that this familial aggregation of suicide is due to variations in the serotonin transporter (5-HTT) gene (Lopez de Lara et al.,

2006). One possible explanation of the link between family history of suicide and increased risk is that these alterations contribute to the familial transmission of an impulsive-aggressive trait (Roy, 2006). Due to this predisposition, some individuals are more likely to act impulsively on their suicidal ideation (Brodsky et al., 2001; Kim et al., 2005; Silverman et al., 1991).

Impulsivity is a frequently cited risk factor for suicide-related behaviors (Brent et al., 2003; Mann, Waternaux, Haas, & Malone, 1999). Impulsivity may play a dual role in suicide-related behavior, serving as a trait of the individual and as a characteristic of the suicidal act (Zouk et al., 2006). An association between impulsivity and suicide attempt has been found in numerous studies (Brent et al., 2003; Brodsky, Malone, Ellis, Dulit, & Mann, 1997; Mann et al., 1999; Zouk et al., 2006). Exemplifying this is the finding from the NCS-R that 43% of all attempts among respondents were described as unplanned (Borges et al., 2006).

Moreover, individuals who engage in suicide-related behaviors have been conceptualized as having deficits in problem-solving (Rudd et al., 1994) due to certain cognitive factors or styles (Rudd, Rajab, & Dahm, 1994). When faced with a stressor, the incapability to apply adaptive coping or effective problem-solving strategies may result in a depletion of resources, dichotomous thinking, and ultimately suicide-related behaviors (Cavanagh et al., 1999; King et al., 2000). Cognitive rigidity has been defined as an inability to identify potential solutions to problems and is considered to be one factor believed to be related to poor problem-solving. When a cognitively rigid person is faced with a stressor, they can become easily overwhelmed, and subsequently, cannot generate alternative solutions to deal with the stressor effectively (Rudd et al., 1994). In essence, they become fixated on a finite range of solutions. In one study (Schotte & Clum, 1987), when individuals with suicidal ideation were presented with an interpersonal crisis, they were unable to produce even half as many potential solutions compared

with controls without suicidal ideation. Moreover, those with suicidal ideation were more likely to focus on potentially negative outcomes of their proposed solutions than controls (Schotte & Clum). Further, individuals who attempt suicide also exhibit poor problem-solving ability compared with matched psychiatric controls; this deficit appears to persist despite changes in mood (Pollock & Williams, 2004).

Hopelessness is a core cognitive feature of depression (Beck, Rush, Shaw, & Emery, 1979) that has been shown to be more predictive of suicidal intent than other depressive symptoms (Lester & Beck, 1975; Lester, Beck, & Mitchell, 1979). Brown and colleagues (2000) found that patients who scored nine or more on the *Beck Hopelessness Scale* (Beck & Steer, 1988) were over four times more likely to die by suicide in the following year compared to those who scored eight or less.

When individuals are hopeless, it is likely that they also lose faith in the helping professionals who can help them. Although utilization of helping services such as primary care physicians or mental health providers is not necessarily a "risk factor," help seeking behavior is highly relevant to suicide. Of civilians who die by suicide, as many as 75% have been in contact with a physician in the 30 days prior to death, whereas only 25% have been in contact with mental health professionals (Luoma, Pearson, & Martin, 2002; Vastag, 2001). Despite high use of primary care services prior to death, many persons at risk go undetected (Claassen & Larkin, 2005). Males and older individuals (e.g., ages 55 or older) appear to be less likely to access mental health services (Lee, Lin, Liu, & Lin, 2008) whereas single, separated, widowed, or divorced individuals are more likely to utilize health care services in general (Lin, Goering, Offord, Campbell, & Boyle, 1996; Wang et al., 2005).

Our previous research on USAF suicides (Martin, 2009) indicates that 33% of decedents accessed at least one of the following helping services in the month prior to death: military treatment facility (MTF), mental health clinic (MHC), Alcohol and Drug Prevention and Treatment (ADAPT) program, Family Advocacy, Chaplain, Legal, or Family Support. Of the available helping services, MTF (19%) and MHC (14%) ranked as the top two services utilized. Increasing rank and documented alcohol misuse history were negatively associated with health care services utilization (i.e., usage of MTF, MHC, and/or ADAPT).

Adverse Life Events. While many of the risk factors reviewed thus far may result in an additional vulnerability, the individual's perception and appraisal that a life stressors has exceeded their coping resources may be the critical factor that serves as the tipping point. Suicidology literature consistently shows that suicide decedents are more likely to have experienced recent adverse life events as compared to controls (Cavanagh et al., 1999; Cheng, Chen, Chen, & Jenkins, 2000; Kolves et al., 2006; Phillips et al., 2002). Commonly cited events preceding suicide death are interpersonal conflict or loss, work, financial, or legal problems, and major illness. Some researchers (Cheng et al., 2000; Kolves et al., 2006) propose that the number of life events is not important as the idiographic meaning (i.e., the perception of a loss of status, a person, or cherished idea) of the event and the likely outcome (i.e., disposition). While many individuals experience adverse life events, the majority do not engage in suicide behavior. Moreover, suicide is a complex behavior that can rarely be attributed to a single event or factor. When one considers that significant adverse life events often occur on a substrate of other previously mentioned risk factors, it is not difficult to see how the interaction may result in increased risk.

Protective Factors for Suicide

Protective factors are often regarded as simply the absence of risk factors. As such, strategies proven to reduce the correlates of suicide risk, such as psychotherapy to improve depressive symptomatology, impulse control, and interpersonal problem solving, also reduce the risk of future suicide-related events (Borowsky, Resnick, Ireland, & Blum, 1999; Nisbet, 1996; Rubenstein et al., 1989; Thompson, Eggert, & Herting, 2000). Exemplifying this focused effort to reduce the stigma of help-seeking and to provide access to effective care is the US Surgeon General's Call to Action (USPHS, 1999). The report highlights two key protective factors: (1) access to a broad continuum of ongoing, effective clinical care, and (2) social support from family and community. Improving individual skills in problem solving and nonviolent conflict resolution are also reported to mitigate suicide risk. Due to evidence indicating an association with decreased risk for suicide-related behaviors, the following factors are briefly reviewed below: (1) restricting access to lethal means; (2) social support and connectedness; and (3) level of commitment to a religion.

Restricting Access to Lethal Means. There appears to be a positive association between accessibility to lethal means and suicide behavior (Resnick et al., 1997; Shenassa, Rogers, Spalding, & Roberts, 2004). The significant positive relationship between firearm availability and suicide risk has been highlighted in a recent literature review (Humeau et al., 2007) where nearly all of the studies reviewed found this association. Moreover, 15 of the 16 studies reviewed noted a decline in suicide rates following the institution of more restrictive gun laws.

Social Support and Connectedness. It is well accepted that social support buffers individuals against various psychological stressors. A sense of connectedness and high levels of social support have demonstrated an association with lower suicide behavior and ideation

(Resnick et al., 1997; Stroebe, Stroebe, & Abakoumkin, 2005). Similarly, the presence of a spouse/significant other or having feelings of responsibility for children can also be protective factors against suicide (Smith, Mercy, & Conn, 1988).

Level of Commitment to Religion. Countries reporting high levels of religiosity have lower suicide rates than non-religious countries (Dervic et al., 2004). Moreover, there is an inverse relationship between level of religious commitment and suicide-related behaviors. The reason for the association between religiosity and decreased suicide-related behaviors is unclear but may be due to increased moral objections to suicide, lower individual aggression, or other factors such as greater sense of purpose, increased social support, or reasons for living (De Leo, Hickey, Neulinger, & Cantor, 1999).

Military Specific Risk Factors for Suicide

In addition to the biopsychosocial risk factors noted in the U.S. Surgeon General's Call to Action (U.S. Public Health Service [USPHS], 1999), service members may also have distinct factors related to their occupation (i.e., deployment, combat exposure, separation from family) that result in additional risk. Exposure to extreme stressors, PTSD, impulsivity, and traumatic brain injury (TBI) are not exclusive to military personnel. The stressful life events encountered during one's military service, however, may confer considerable risk for psychiatric disorders that are known to increase suicide risk (Hoge et al., 2004; Kang & Bullman, 2008). Therefore, these factors warrant special consideration when examining suicide-related behaviors in military personnel.

Stressful Life Events Associated with Military Service. Stressful life events have been implicated as a direct precipitant to many military suicides (Staal & Hughes, 2002). In USAF aviators who attempted suicide, failed/failing intimate relationships, legal problems, psychiatric

disorders, death of a spouse, and occupational problems have been identified as key precipitants (Patterson et al., 2001). Research examining the management and disposition of suicide attempts among USAF aviators between 1981 and 1996 found that failed/failing intimate relationships was the most common stressor preceding suicide-related behaviors. Substance abuse was common in aviator suicide attempts (54%) and in suicide deaths (77%). Of aviators who attempted suicide, 79% eventually received a recommendation to return to flying status.

In a more recent study, an analysis of USAF active duty suicides occurring between 2003 and 2008 ($n = 232$) shows that 70% of decedents had relationship problems, 44% legal problems, 29% financial problems, and 25% were engaged with behavioral healthcare services (Kindt, 2009). Although 21% of these USAF decedents had deployed in the previous year, the average time between return from deployment and suicide was 523 days and less than half (43%) of the examined cases had ever deployed (Kindt, 2009). To date, no conclusive evidence exists to indicate the presence or absence of a relationship between deployment and suicide for USAF personnel.

Nevertheless, sufficient evidence now exists to suggest that military deployments are stressful life events for many military personnel. Hoge and colleagues (2006) emphasized that personnel returning from deployment in support of the Global War on Terror (GWOT) face additional mental health risks. Data from Post Deployment Health Assessment (PDHA) surveys of troops returning from OIF suggests that 19.1% met the criteria for a *mental health concern* and 9.8% endorsed symptoms of PTSD. Approximately 1.1% of OIF veterans reported *some* suicidal ideation and 0.2% reported *a lot of* suicidal ideation. The rates of psychological distress and suicide ideation reported on the PDHA are suspected to underestimate the actual rates. Anecdotal evidence suggests that some military personnel do not report distress at this initial

screening due to the perception that this would result in additional delays that would slow or prevent their return home. Moreover, participation in military operations, especially during times of conflict, may increase risk for suicide-related behaviors in military personnel (Bullman & Kang, 1996). Recent research suggests that as many as 20% of U.S. suicides could be among veterans (Sundararaman, Panangala, & Lister, 2008).

Ritchie and colleagues (2003) examined the case files of 100 military personnel hospitalized for suicide attempt or ideation at Walter Reed Army Medical Center (WRAMC). Based on their sample, they developed a profile of elevated risk for this military sample with the following characteristics: unmarried, 22 year old, Caucasian male, junior enlisted, with occupational and/or relationship problems and symptoms of depression (Ritchie et al., 2003). A rarely reported, yet important, finding of this study is that approximately half of these individuals were returned to duty following discharge. Similar profile characteristics have been reported in other reviews of military suicide-related behavior (Allen, Cross, & Swanner, 2005; Holmes, Mateczun, Lall, & Wilcove, 1999).

Impulsivity and Traumatic Brain Injury. Although the relationship between impulsivity and suicide remains unclear, it may warrant additional emphasis considering the high proportion of young, Caucasian males, with high rates of alcohol misuse in the U.S. military. Moreover, military personnel performing combat duties are at increased risk for TBI (Tanielian & Jaycox, 2008) which may impact impulsivity.

Of OEF/OIF veterans wounded in action, over 60% are related to blast injuries. All individuals that have encountered blast injuries, a gunshot to the head/neck, vehicle accident, or falls are considered "at risk" for TBI and are screened by the Defense Veterans Brain Injury Center. Of those screened, 59% are eventually diagnosed with mild TBI or greater. These

injuries account for approximately 22% of all wounded returnees (Warden, 2006). Although the exact mechanism is still unclear, there appears to be accumulating evidence supporting a relationship between TBI and suicide (Teasdale & Engberg, 2001).

Posttraumatic Stress Disorder (PTSD). There appears to be increased risk for suicide-related behavior in individuals with severe, untreated PTSD in civilian, veteran, and military samples. Among civilian samples, 20% of individuals with PTSD reported they had attempted suicide (Paykel, Prusoff, & Myers, 1975). Vietnam veterans with PTSD have also been shown to have increased suicide rates (Goodale, 1999; Fontana & Rosenheck, 1995). The link between PTSD and suicide has also been noted by Ben-Ya'acov & Amir (2004) who suggest that specific PTSD symptom constellations may exacerbate risk. Specifically, they reported a positive association with the arousal symptom cluster and a negative association with the avoidance symptom cluster. Risk was highest when these two conditions co-occurred (i.e., high arousal and low avoidance). Other researchers (Bell & Nye, 2007), however, have found a positive relationship between suicide ideation and the re-experiencing symptom cluster.

Military Specific Protective Factors for Suicide

Resiliency. While there is a substantial body of research into factors that confer risk for suicide-related behaviors, more research into resilience or protective factors is sorely needed (Allen et al., 2005). There are certain exposures related to military lifestyle and occupation that may be unavoidable. With ongoing combat operations, many personnel will be separated from their family and friends for extended time periods and some will be exposed to combat trauma. To date, methodologically sound research into resiliency factors that may buffer against suicide-related behaviors is largely non-existent. Clinical evidence suggests that decreasing risk factors while increasing protective factors, such as adaptive coping, may reduce suicide risk. Factors

thought to be protective for military personnel, such as optimism, adaptive problem-solving, reasons for living, and strong social support, still needs to be empirically evaluated (CDC, 2006; DHHS, 2007).

The largest examination of mental health risk and resilience of military members to date was recently launched by the U.S. Army. The *Army Study to Assess Risk and Resilience in Servicemembers* (Army STARRS) is a collaborative effort between the Army and researchers from the Uniformed Services University of the Health Sciences, Harvard Medical School, University of Michigan, and the NIMH (Army STARRS, 2011). While the conclusions from this study still remain to be drawn, preliminary findings highlight several potential predictors of suicide among Army personnel. More specifically, data comparing suicides, accidental deaths, and combat deaths for active Army personnel (2004-2008) indicate that the rate of suicide within this sample has increased over time, particularly for women. Additionally, the suicide rate was highest among those currently deployed (18.3 per 100,000) and decreased following return from deployment (15.9 per 100,000). Additionally, "married" status was associated with lower rates of suicide while deployed and hence, marriage may serve as a protective factor. Although these results are preliminary, the scope and adaptive nature of this study are expected to enhance military suicide prevention efforts while providing near real-time data to Army leadership.

Typologies of Suicide: Review of the Literature

Much of what is known about suicide is derived from cross-sectional descriptive and analytic epidemiological research that compares factors that distinguish suicide decedents from a living sample (Bertolote, Fleischmann, Eddleston, & Gunnell, 2006; Borges et al., 2006; Kessler, Borges, & Walters, 1999). Prospective studies (Brown et al., 2000), meta-analyses (Cavanagh et al., 2003) and psychological autopsy studies (Arsenault-LaPierre, Kim, & Turecki, 2004;

Isometsa, 2001; Nademin et al., 2008; Rihmer, 2007) support, enhance, and clarify epidemiological findings to further our understanding of the idiographic factors often present in suicide. However, it is increasingly clear that suicide decedents are not a homogenous group and there is substantial diversity in how and why people die by suicide (Henderson & Williams, 1974; Wold, 1971). Several researchers and theorists (Baechler, 1979; Durkheim, 1951; Leonard, 1967; Menninger, 1938; Mintz, 1968; Reynolds & Berman, 1995; Shneidman, 1966; Wold, 1971) have proposed that subgroups, or *typologies*, exist among suicide decedents and that these typologies may differ markedly in how they present at different points along the pathway to suicide.

Typology has been defined by Mandara (2003) as "a hierarchical system of categories used to organize objects according to their similarities and dissimilarities" (p. 132). The current study conceptualizes a typology as the constellation of characteristics (i.e., behaviors, cognitions, and affective states) that may elucidate individual motivations. Typological research combines facets of variable oriented research (i.e., quantitative) and case oriented research (i.e., qualitative). Although typologies are typically used in classifying similar entities based on specific characteristics, they also embrace the concept of equifinality, where differing pathways may lead to the same outcome (Mandara, 2003). Typologies have been used to understand various topics related to psychology such as violent offenders (Tengstrom, Hodgins, & Kullgren, 2001), substance abusers (Dauber, Hogue, Paulson, Leiferman, & Jenn, 2009), domestic abusers (Hardesty, 2009), and suicide-by-cop (Homant & Kennedy, 2000). Unsurprisingly, theorists and researchers have also posited various typologies of suicide based on how certain factors cluster or interact to better describe potential pathways to suicide.

Typologies: Sociological. Over the years, suicidologists have utilized a variety of approaches in categorizing individuals who die by suicide. The first scholarly study of suicide to suggest different typologies was written by the 19th century French sociologist Emile Durkheim. In *Le Suicide* (1897/1951), Durkheim posited a theory of suicide which centered on the influence of social forces. He argued that suicide rates were a reflection of the degree to which individuals were integrated into, and/or regulated by, society. Integration, according to Durkheim, refers to the degree to which an individual accepts/rejects the shared values of a society, whereas regulation is the amount of external constraint imposed on the individual by society (1951).

Four types of suicide were described in the Durkheim (1951) model: (1) egoistic; (2) altruistic; (3) anomic; and (4) fatalistic. Egoistic suicides were explained to occur due to low social integration and a lack of purpose or meaning of the individuals in the society. In contrast, altruistic suicides were described to occur for those overly integrated into a strongly collective society similar to what is seen in mass suicides of religious cults. Anomic suicides were hypothesized to result from too little external regulation as well as a subsequent deterioration of societal norms and values resulting in lawless and destructive behavior. Lastly, fatalistic suicides were expected in situations where external regulation and discipline are so great that an individual cannot see the possibility of improving his or her situation or achieving personal goals. While Durkheim's theory was applauded for its unique contribution and emphasis of societal factors, it neglected the importance of the individual's intrapsychic experience later proposed by theorists such as Sigmund Freud, Edwin Shneidman and other suicidologists.

Typologies: Psychoanalytic. In contrast to Durkheim's theory and its emphasis on societal factors, many early psychological explanations of suicide were rooted in Sigmund Freud's psychodynamic theory. Freud wrote of two typologies, i.e., intentional and semi-

intentional suicide in the *Psychopathology of Everyday Life* (1904/1938), noting that the propensity for self-destruction was common to both. While Freud's term intentional suicide is self explanatory, his use of semi-intentional suicide refers to instances where the desire to take one's own life is either unconscious or sublimated and then typically emerges as a mishap or accident. Freud proposed that self-inflicted injuries were a compromise between the death instinct (i.e., Thanatos) and its opposite, the life instinct (i.e., Eros). In Freud's early conceptualizations, suicide was considered to be the desire to return to an earlier state of being through self-punishment for guilt and shame over repressed impulses such as wishing the death of a parent (Freud, 1913). Freud's concepts were extended by other early psychoanalysts who asserted that suicide was primarily an unconscious hostility toward the image of the father turned inward against the self.

Karl Menninger (1938), expanded Freud's theory and asserted that there were three primary motivations for suicide: (1) revenge/hate (i.e., a wish to kill); (2) depression/hopelessness (i.e., a wish to be killed); and (3) self-blame/punishment (i.e., a wish to die). In the wish to kill, there is hostility or a death wish directed at an external object, for instance, one's significant other. This type of suicide has been called "murder in the 180th degree" (Shneidman, 1980) and is often accompanied by anger, rage, hatred, and/or revenge (Menninger, 1938). On the other hand, individuals with a wish to be killed are thought to be trying to kill an introjected love object. The repression of murderous desires directed at the object can result in ego splitting, regression, depression, and guilt. Thus, these suicides involve not only a wish to kill but also a wish to be killed. Finally, the wish to die is thought to be related to the individual's experience of unbearable pain, self-blame and punishment. According to Menninger (1938), the three motivations for suicide are conceptually related based on the

severity of denial used as a defense mechanism. If one is in denial of the wish to kill, he/she transitions to a wish to be killed, and if further denial is experienced, this wish may be further sublimated into the wish to die.

Another psychodynamically oriented conceptualization of suicide, proposed by Edwin Shneidman (1966) centered around the idea of "cessation," defined as "the stopping of potentiality of any further conscious experience." Shneidman uses the term "Psyde" to represent cessation and delineates four subtypes: (1) psyde-seekers; (2) psyde-initiators; (3) psyde-ignorers; and (4) psyde-darers. Psyde-seekers consciously desire to end all conscious experience. Although their selected method of suicide is not an important determinant in being categorized as a psyde-seeker, their belief that the selected method will result in their cessation is. Moreover, individuals defined by this typology often plan their suicide where the chance for rescue is unlikely. While Shneidman acknowledged that individual orientations towards cessation shift and change over time, he posited that the psyde-seeker would have an ambivalent orientation towards cessation at the time of suicide. Psyde-initiators were conceptualized as making a final effort to take control of their life, even if it resulted in their demise. The belief that they are a failure or that they will inevitably suffer cessation in the near future drives their desire to take control of the cessation process. Subsequently, they do not have to accept a less than effective image of the self. This typology is usually represented by older persons, those with terminal illnesses, and those with a history of quitting jobs. Psyde-ignorers believe that termination does not necessarily result in cessation. Due to this belief system, which is often derived from religious or spiritual beliefs, psyde-ignorers believe that they continue to exist in some manner despite their termination. Lastly, psyde-darers are those who bet their continuation of existence on chance through exposure to activities that could potentially result in cessation (e.g., Russian

roulette). Although some might be tempted to include risk-takers (i.e., mountain climbers, parachutists, certain military occupations) in this typology, Shneidman notes that the match between skill level and risk must be taken into account to determine subgroup membership.

Typologies: Behavioral. Scott Henderson & Christopher Williams (1974) expanded upon Menninger's typologies in their six factor model that described the circumstances and behavior of individuals who engage in suicide-related behaviors. The six factors are as follows: (1) a depression factor (e.g., hostility directed at oneself, guilt, self blame, and worthlessness); (2) an extrapunitive factor (e.g., hostility directed at others); (3) an alienation factor (e.g., perception of being extruded from the desired social network); (4) an operant factor (e.g., an attempt to change others' behavior); (5) a modeling factor (e.g., acquires suicidal response vicariously); and (6) an avoidance factor (e.g., an attempt to avoid or escape from unpleasant or anxiety provoking experiences). While Henderson & William's (1974) depression and extrapunitive factors are similar to Menninger's wish to be killed and wish to kill, the addition of alienation, operant, modeling, avoidance factors expand upon the earlier conceptualization. The typologies provided describe suicide-related behaviors in general, not necessarily just suicide death. Similar to their predecessors, these theorists base their proposed model on their clinical work and observations while offering no empirical support. However, they encourage future researchers to use methods such as cluster analysis to further determine and study possible suicide subgroups.

Typologies: Relational. Stemming from more relational orientations, Calista Leonard (1967) employed a developmental framework to describe three suicide typologies which differ in their gained level of independence and differentiation from the parental figure in early childhood. The three types are as follows: (1) dependent-dissatisfied; (2) satisfied-symbiotic; and (3)

unaccepting. According to Leonard (1967), the dependent-dissatisfied type actively desires emotional closeness yet will attempt to orchestrate situations where rejection from others is likely. Individuals within this typology alternate between autonomy and submissiveness with others. Emotional blackmail, manipulative, short-lived relationships, high drama are common descriptors among this typology. Risk for suicide increases when the dependent-dissatisfied person no longer has a victim and/or source to play the "push-pull" game with. The satisfied-symbiotic type is characterized by an active over-dependent attachment to one love object (e.g., spouse, child, job). Individuals with this typology are rigid and inflexible, will endure anything to avoid losing their relationship with the love object, and appear to lack awareness of the level of over-attachment or any hostility towards another. Moreover, there is typically a history of an unusually close personal relationship with one person during childhood. The trigger for suicide in satisfied-symbiotic types is nearly always the actual or threatened loss of a primary relationship. Suicide in the case of the satisfied-symbiotic type is typified by Freud and Menninger's concept of killing of the introjected love object. The unaccepting suicidal type is characterized by a high level of independence, physical activity, a driven need to control one's environment and achieve, resistance to any attempts at control or assistance from external sources, denial of depression or illness, and a dogmatic, all or nothing, outlook. Suicide among the unaccepting type is typically sudden, with a high degree of lethality, and precipitated by the perception that one has lost or failed in controlling aspects of the environment. This type is similar to Shneidman's psyde-initiator type.

Typologies: Psychosocial. Recognizing that individuals who die by suicide do so for a variety of psychological motives, Shneidman (1968) posits a model of suicide to highlight the interplay between social and psychological factors. He proposes that all suicides can be viewed

as being one of three types: (1) egotic; (2) dyadic; or (3) ageneratic. The three types vary based on the degree to which psychological versus social factors contribute to the suicide event. Egotic suicides are the result of intrapsychic conflict where the impact of the individual's environment and social ties are secondary. Egotic suicides are essentially "egocide," where the psychological conflict within the self results in ego destruction. Narrowed attention, depression and isolation are common in this typology. Suicide notes of egotic suicides often contain symbolism and metaphor in an attempt to explain inner psychological states and unresolved existential struggles. As the name suggests, dyadic suicides are interpersonal in nature and are related to important significant others in the decedent's life. Dyadic suicides are often fueled by frustration, hate, rejection, shame, and other emotions related to the needs and wishes left unfulfilled from the relationship. Shneidman remarks that most suicides are dyadic and that one cannot understand them without taking into account the dyadic relationship. Suicide notes of the dyadic typology are common and often are addressed to specific individuals. Ageneratic suicides are sociological in nature and emerge out of a sense of isolation, loss of identity, and alienation from the individual's family lineage or even the human race. Loneliness and a feeling of not belonging are common in these type of suicides. Suicide notes of these individuals are often addressed "To whom it may concern," "to the police," or not addressed at all. Although Shneidman did not provide any empirical support for the three typologies similar to his predecessors, he did offer three examples of suicide notes to illustrate each typology.

Typologies: Needs/Motivations. Another method by which suicide acts have been classified is related to satisfying unfulfilled need states. Ronald Mintz (1968) proposed that suicidal acts can be viewed as three types: (1) a symptomatic act; (2) an adaptational act; or (3) a type of communication. The symptomatic act is thought to be driven by multiple motivations,

many of which may have originated in early development and are largely unconscious. Suicide, as an adaptational act, is characterized by the individual's final, albeit maladaptive, effort to solve some type of intolerable problem or unbearable situation. Suicide as a type of communication represents the suicide event as an appeal or a cry for help where decedents desire intervention from others.

Although Mintz acknowledged that there are often multiple, unconscious motivations in suicide, he proposed 11 potential motivational schemata: (1) to direct hostility against an introjected lost loved person; (2) to turn aggression inward; (3) to punish others or retaliate through guilt; (4) to gain affection from others; (5) to seek atonement, to reduce guilt, or to destroy intolerable feelings; (6) to destroy intolerable sexual or aggressive feelings; (7) to rebirth or to reincarnate; (8) to rejoin dead or lost loved ones; (9) to escape from pain or loss of esteem; (10) to counter a phobic response to death anxiety; and (11) to defensively regress to an infantile state. Mintz' formulation of motivation schemata were derived from a review of the literature and the various clinical and research reports on motivations of individuals demonstrating suicide-related behaviors.

Similarly, Shneidman (1980) extrapolated from Henry Murray's classification of the basic psychological needs of all humans (1938), to categorize potential motivations for suicide. Shneidman worked from the premise that most human problems are the result of frustrated or unsatisfied needs. According to Murray's *Explorations in Personality*, there are 21 core psychological needs: (1) abasement; (2) achievement; (3) affiliation; (4) aggression; (5) autonomy; (6) counteraction; (7) defendance; (8) deference; (9) dominance; (10) exhibition; (11) harmavoidance (including pain avoidance); (12) infa-voidance (relating to humiliation); (13) inviolacy; (14) nurturance; (15) order; (16) play; (17) rejection; (18) sentience; (19) sex; (20)

succorance; and (21) understanding. Shneidman acknowledged that most suicides probably

represent combinations of various needs so that any suicide might fit more than one need

category. The value of Shneidman's classification scheme based on Murray's 21 psychological

needs is questionable, as he offered no evidence to support his assertions.

In a more parsimonious model, the French social philosopher Jean Baechler (1979)

delineated four broad categories of suicide: (1) escapist; (2) aggressive; (3) oblative; and (4)

ludic. The three subtypes of escapist suicides are flight from an unbearable situation, grief over a

loss, and punishment for a perceived fault. According to Maris (1992), approximately 75% of all

suicides can be considered "escapist." The motivation to avoid some intolerable situation or

feeling state appears to cut across subtypes. Thus, escapist suicide can be thought of as

maladaptive problem solving. Depression and hopelessness are common in the escapist typology

(Baechler, 1979). Approximately 20% of all suicides are thought to be "aggressive suicides"

(Maris, 1992). Each of the four subtypes of aggressive suicide (e.g., vengeance, crime,

blackmail, and appeal) is interpersonal in nature where suicide is directed against another person

(Baechler, 1979). This typology is common in younger individuals and often driven by

motivations of anger, retribution, and manipulation. In oblative suicides, the individual hopes to

either increase the value of their life through suicide (i.e., sacrificial), or hopes to achieve a

heightened state such as religious martyrdom through death (i.e., transfigurational) (Baechler,

1979). Oblative suicides are conceptually similar to Durkheim's altruistic suicides. Similar to

Shneidman's psyde-darers, individuals classified as ludic suicides die as a result of engaging in

activities that places one's life at risk or out of trying to prove something to another. Some

engage in these risky activities in an intentional effort to fully experience life, or to do so more

intensely. Since individuals with ludic suicides do not consciously, or directly, intend to die, this particular typology remains questionable among suicidologists (Maris, 1992).

Typologies: Empirical. The first empirical study of suicide typology emerged in the 1970s. Carl Wold (1971) used two approaches to identify and examine subgroups of suicidal individuals. First, their group at the Los Angeles Suicide Prevention Center (SPC) developed 10 subgroups of suicidal patients based on clinical observations, using 4 to 8 clinical statements to describe each subgroup. The 10 identified clinical subgroups of SPC patients were: (1) discarded women; (2) violent men; (3) middle-aged depression; (4) harlequin syndrome; (5) I can't live without you; (6) I can't live with you; (7) adolescent-family crisis; (8) down and out; (9) old and alone; and (10) chaotic.

Wold's group subsequently developed a rating form with two sets of items – i.e., 58 clinical descriptors for the 10 subgroups and 73 descriptive statements covering demographics, suicide, psychiatric history, and clinical presentation. The clinical ratings were used to classify a selected SPC sample of suicide attempters (n = 500) and a selected SPC sample of suicide decedents (n = 42). The ratings classified 64% of the suicide attempts and 92% of the suicide deaths. Clustering procedures, consisting of repeated chi-square comparisons, were used to cluster along three main variables consisting of age, gender, and chronicity of suicide problem. While they were able to classify their samples into the clinically derived typologies and describe aspects of each cluster (i.e., age, gender, and chronicity), the small size of the suicide sample renders any conclusions based on these data speculative.

A more scientifically rigorous examination of suicide typologies was conducted by Francoise Reynolds and Alan Berman (1995). These investigators reviewed ten of the major suicide typologies previously posited by other authors (Baechler, 1979; Durkheim, 1951;

Henderson & Williams, 1974; Leonard, 1967; Menninger, 1938; Mintz, 1968; Shneidman, 1966, 1968, 1980; Wold, 1971) and commented on the utility of each in classifying suicides into subgroups. However, Reynolds and Berman noted the existence of over 100 identified subtypes of suicide in the literature and concluded that these growing typologies had stopped being clinically useful due to their pure number and general lack of specificity. They argued that suicide screening would be enhanced if instruments and procedures were based on a small number of suicide subtypes.

Consequently, the Reynolds and Berman (1995) study was an attempt to synthesize the major subtypes of suicide previously reported in the literature and to empirically reduce them to a useful number. These researchers abstracted from certified suicides occurring between 1979 to 1981 in Baltimore, Maryland and Philadelphia, Pennsylvania (n = 404) into brief vignettes containing information including gender, race, age, means of death, antecedent events, treatment and criminal history, motives, substance abuse, and suicide notes. Trained raters were then asked to assess if cases fit into the typology subtypes reviewed above. Subsequently, chi-square analyses were conducted on each combination to determine independence and overlap between subtypes to form useful clusters.

Three of the 69 subtypes were most characteristic of the completed suicides in their sample: (1) Baechler's escapist type described 64% of cases; (2) Durkheim's anomic type (i.e., low regulation and deteriorating societal norms) described 57%; and (3) Shneidman's psyde-seeker (i.e., consciously desire to end conscious experience) described 47% of all cases. Reynolds & Berman (1995) determined a lack of independence between the original ten typologies proposed by earlier theorists and further reduced them into five distinct subgroups: (1) escape; (2) confusion; (3) aggression; (4) alienation; and (5) depression/low self-esteem. The

case vignettes were then reclassified into the new five cluster typology by raters. Their five cluster typology was able to classify 86% of the cases.

Upon post-hoc analysis, 28% of the cases were classified as depression/low self-esteem, followed by 20% as escapist, 19% as aggression, 13% as confusion, and 6% as alienation. The depression/low self-esteem cluster were similar, demographically, to the total sample but differed from other subtypes in that unemployment and financial concerns were the most common precipitants. Escapist suicides consisted mostly of white, older males with health issues. The confusion cluster was characterized by intrapsychic conflict, chaotic/bizarre behavior, and a history of psychiatric disorder. Aggression suicides consisted of young, white and black males, with interpersonal conflict, substance history, minimal history of previous suicide-related behaviors, and high incidence of suicide notes. Lastly, the alienation cluster was characterized by the highest ratio of males to females (i.e., 7:1), middle-aged with drug use and a notable incidence (i.e., 1 out of 8) of both the death of loved ones and psychiatric disorders.

Summary. Typological research is a means of classification that has been applied to numerous complex issues (Mandara, 2003). In suicide research, typologies have been proposed which classify cases based on societal factors (Durkheim, 1951), psychological factors (Baechler, 1979; Henderson & Williams, 1974; Menninger, 1938), relational factors (Leonard, 1967), and on the basis of human needs or motives (Mintz, 1968; Shneidman 1968, 1980). There appears to be significant overlap among theories with certain core themes emerging repeatedly (i.e., escape, aggression, intrapsychic pain, and relational concerns). To date, only one empirical study (Reynolds & Berman, 1995) has attempted to systematically synthesize the existing suicide typological research. Findings indicate that suicidal decedents may be categorized into the following five subgroups: (1) escape; (2) confusion; (3) aggression; (4) alienation; and (5)

depression. It is important to note, however, that the typological models reviewed were predominately based on psychosocial theories and do not adequately address the potential role that genetics (Moscicki, 1995; Roy, 2004) and neurobiology (Lopez de Lara et al., 2006; Mann, Oquendo, Underwood, Arango, 1999; Statham, 1998) may play in suicide. While it is possible that the five proposed subtypes (Reynolds & Berman, 1995) include genetic and neurobiological factors indirectly (e.g., depression and serotonin dysregulation), it may be useful to consider these factors independently. For example, future typologies could include categories that more directly account for these potential contributors (i.e., family history of suicide and psychiatric disorder). Making indices of genetic and neurobiological factors more explicit may add to the existing typologies or result in new typologies altogether. Nevertheless, the lack of a scientific basis for the existing typologies indicates that a more empirically robust system of classification for suicidal individuals is needed.

Cluster Analysis Research

Cluster analysis is a general term for an array of statistical procedures that seek to classify data (Aldenderfer & Blashfield, 1984). The major catalyst for the development of cluster analytic procedures has been credited to biologists Robert Sokal and Peter Sneath (1963) who argued that a new method for efficiently classifying biological organisms was needed in the book, *Principles of Numerical Taxonomy.* They posited that gathering all potential data on organisms of interest and estimating the degree of similarity among organisms would assign similar organisms into clusters. Current use of the term refers to a multivariate procedure that assigns individual cases from within a population into clusters based on their similarity on selected variables (Clatworthy, Buick, Hankins, Weinman, & Horne, 2005). Clusters are expected to have high within-group homogeneity and low between-group homogeneity.

Historically, cluster analysis has been used to achieve one of four goals: (1) to develop a typology or classification scheme; (2) to confirm some theoretical means of grouping cases; (3) to generate hypotheses through the exploration of data; and (4) to test hypotheses derived from other procedures (Aldenderfer & Blashfield, 1984).

While cluster analytic procedures have been widely used in market research, geography, botany, and medicine (Everitt, Landau, & Leese, 2001; Kaufman & Rousseeuw, 1990; Romesburg, 2004), they appear to be particularly valuable in the arena of psychological research. Over the last two decades, cluster analysis has been used to develop classifications within a variety of populations, with particular utility in identifying groups at risk for developing health conditions or poor outcomes (Clatworthy et al., 2005). To illustrate, cluster analysis has been used to classify chronic pain patients based on level of distress (Scharff et al., 2005), youths with loss of control eating (Tanofsky-Kraff et al., 2007), parenting styles and subsequent outcomes related to youth delinquency (Hoeve et al., 2008), types of alcohol abusers (Morey, Skinner, & Blashfield, 1984), and typologies of youths with severe emotional disturbances (Fields & Ogles, 2002).

Cluster Analysis: Considerations. There are a number of advantages associated with the usage of cluster analysis in prevention research. First, cluster analysis provides a link between nomothetic and idiographic approaches to research (Clatworthy et al., 2005). Second, the method is useful in identifying and defining underserved groups who could benefit from existing interventions (Clatworthy et al., 2005). Further, gaining a better understanding of data driven typologies may highlight how current interventions can be tailored to better fit the specific needs of each group. Finally, examining the specific factors that differentiate various subgroups of suicide decedents may guide enhanced screening, prevention, and intervention practices.

The use of cluster analytic procedures, however, has been somewhat controversial in recent years and there are several criticisms (A. J. Waters, personal communication, September 1, 2009). First, cluster analysis is a relatively simple procedure that applies heuristics, or rules of thumb, via mathematical algorithms to assign individual cases to clusters (Aldenderfer & Blashfield, 1984). Thus, all clustering methods will impose structure on the data and classify cases into groups, regardless of whether meaningful groups truly exist. Choice of variables used to classify cases is paramount in being able to interpret the cluster solutions and whether the classifications are meaningful. Moreover, using different clustering procedures (i.e., hierarchical or iterative) on the same dataset can often result in different subgroups. This is largely attributable to the different rules used to form groups for each respective clustering method. While the above criticisms warrant close attention, adherence to recommended guidelines when designing, conducting, and reporting cluster analytic research can help to reduce the potential hazards while maintaining the value of this analytic approach.

Cluster Analysis: Best Practices. Clatworthy and colleagues (2005) provide a systematic review on the use and reporting of cluster analytic research in health psychology. For the purpose of the review, authors evaluated selected articles (n = 59) for appropriate use and reporting against five criteria recommended by Aldenderfer & Blashfield (1984): (1) the computer program used for computations; (2) the measure used to assess similarity on chosen variables (e.g., squared Euclidian distance and Pearson's correlation); (3) the method of cluster analysis (e.g., hierarchical agglomerative and iterative partitioning); (4) procedure used to determine the number of clusters; and (5) evidence for the stability and value (i.e., validity) of the clusters. Additionally, they determined whether the specific type of cluster analysis used in the hierarchical agglomerative method (e.g., single linkage, complete linkage, average linkage,

and Ward's method) or the iterative portioning method (e.g., K-means cluster analysis) was appropriate to the research question and design of the study. Findings indicated that the vast majority of research that was reviewed did not meet the criteria for proper reporting or use of cluster analytic methods.

In regards to reporting, neither the computer program used nor the measure used for assessing similarity was consistently reported. Although some of the articles did report the method used for determining the optimum number of clusters, many used questionable methods such as selecting the number of clusters based on previous research or selecting clusters that best facilitated interpretation. Neither of these two strategies for determining the number of clusters are recommended as they are highly subjective and prone to researcher bias (Clatworthy et al., 2005). More formal and objective rules for determining number of clusters are available to researchers such as the cubic clustering criterion (CCC) or the pseudo-F statistic (PFS)[1].

An important procedure in conducting a cluster analysis is to examine the stability (e.g., internal consistency) and external validity (e.g., criterion validity) of the cluster solution (Clatworthy et al., 2005). Internal consistency is referred to as the degree of consistency or homogeneity which can be evaluated via split-half analysis (Kazdin, 2003). Criterion validity is the correlation of a measure with an external criterion variable considered to be meaningful or of value to the field of study (Kazdin, 2003). Less than half of the studies evaluated by Clatworthy et al. (2005) provided information on both stability and external validity of the clusters as part of their validation procedures. Approximately a third followed the recommended procedures of determining cluster stability by repeating the analysis on split-halves of the sample or on a different sample from the same population. A majority of studies validated the cluster solution

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[1] The CCC procedure estimates the number of clusters by minimizing within-cluster sum of squares (SAS TR A-108, 1983). The PFS measures separation among clusters at each level in the hierarchy (Milligan & Cooper, 1985). Available only in select software packages.

by comparing groups on some external variable or predicting cluster membership from an external variable. However, it is important to note that 27 of the studies inappropriately used the same variables that were used to form clusters in their efforts to assess external validity. Since one would expect there to be a difference in the variables used to form clusters, using these same variables to predict group membership via discriminant function analysis, or comparing groups on these variables via analysis of variance (ANOVA), is not only meaningless, it demonstrates a lack of understanding regarding cluster validation.

Use of Cluster Analysis in Suicide Typology Research

      Cluster Analysis: Suicide Attempts. While there is a paucity of research using cluster analytic procedures to determine subgroups of individuals who die by suicide, this strategy has been used previously in the 1970s to develop typologies of individuals who attempt suicide (Kiev, 1976; Paykel & Rassaby, 1978). Kiev (1976) used cluster analysis to profile suicide attempters (n = 298) into seven typologies: (1) suicidal gesture; (2) acute depressive reaction; (3) passive-aggressive and passive-dependent personality disorder; (4) anxiety reaction with interpersonal conflict; (5) socially isolated; (6) suicidal preoccupation; and (7) chronic dysfunctional. The typologies delineated by Kiev differed predominately on the following factors: psychological symptomatology, level of dysfunction, severity of the attempt, prior planning, extent of interpersonal conflict, and the reactions of significant others. Kiev stressed the importance of how certain variables may interact in a synergistic manner to confer greater risk than if variables were merely additive.

      Using similar methodology, Paykel & Rassaby (1978) identified 3 distinct and stable groups from a 14 variable cluster analysis of patients (n = 236) who presented for emergency department services following a suicide attempt. The three clusters were classified based on

various characteristics of the attempt: (1) those who attempted via overdose (n = 171); (2) those

with more severe attempts (n = 51); and (3) those with mild attempts but previous history of

suicide-related behaviors (n = 13). The three typologies delineated by Paykel & Rassaby differed

on motivations for the attempt (i.e., interpersonal versus self-destructive), severity of the attempt

and methods used, history of previous attempts, and alcohol abuse. An analysis of variables not

included to classify cases to clusters revealed that there were no differences between the three

groups based on race, socioeconomic status, marital status, or life stressor precipitants.

Typology studies of suicide attempts may be useful in identifying and understanding the

variables important to different subgroups of those who specifically attempt suicide. However,

generalizing these findings to individuals who die by suicide is questionable. While it is accepted

that the most predictive factor for eventual suicide is past suicide-related behavior (Fawcett et al.,

1990; Nordstrom et al., 1995), there are notable differences between these groups, particularly

when considering sociodemographic variables. For instance, female gender, young age, low

socioeconomic status, and being previously married have been found to be associated with

nonfatal suicide attempts (Borges et al., 2006; Kessler et al., 1999; Moscicki, 1995). In contrast,

male gender, increasing age, and Caucasian or Hispanic race have been significantly associated

with suicide (Borges et al., 2006). While overlap in typologies between suicide attempts and

deaths is likely, focused data-driven typology research on suicides and additional typology

research on suicide attempts are both needed before any generalizations between groups can be

made.

Cluster Analysis: Suicide Deaths. One such study, (O'Connor, Sheehy, & O'Connor,

1999) exemplifies the value of using cluster analysis to determine typologies of suicide and to

the best of our knowledge, is the only cluster analysis conducted specifically on suicide deaths in

the field of suicidology to date. O'Connor et al. (1999) classified suicides (n = 142) using twenty

dichotomous variables related to clinical, psychological, and psychosocial aspects of suicide.

Three stable and internally consistent clusters emerged. Cluster one (n = 64) was the largest

cluster and was characterized as having moderate frequency of depression (44%), low frequency

of substance abuse or dependence (19%), low contact with available helping services (5%), low

previous attempt history (6%), and a higher proportion of individuals living alone at the time of

death than the other clusters (45%) (see Figure 1). Cluster two (n = 57) had a moderate frequency

of depression (52%), did not live alone (90%), marital issues (43%), a majority had previous

attempt history (67%), high unemployment (81%), relationship issues as the most common

stressor (43%), low contact with helping services (14%) but high psychiatric hospitalization

(48%), and many had communicated their intent to die by suicide (52%). Cluster three (n = 21)

had the highest frequency of depression (86%), previous suicide attempt (65%), and use of

medication (77%). All had contact with a general practitioner in the six months prior to death.

Figure 1. Comparison of O'Connor, Sheehy, & O'Connor (1999) Suicide Typologies
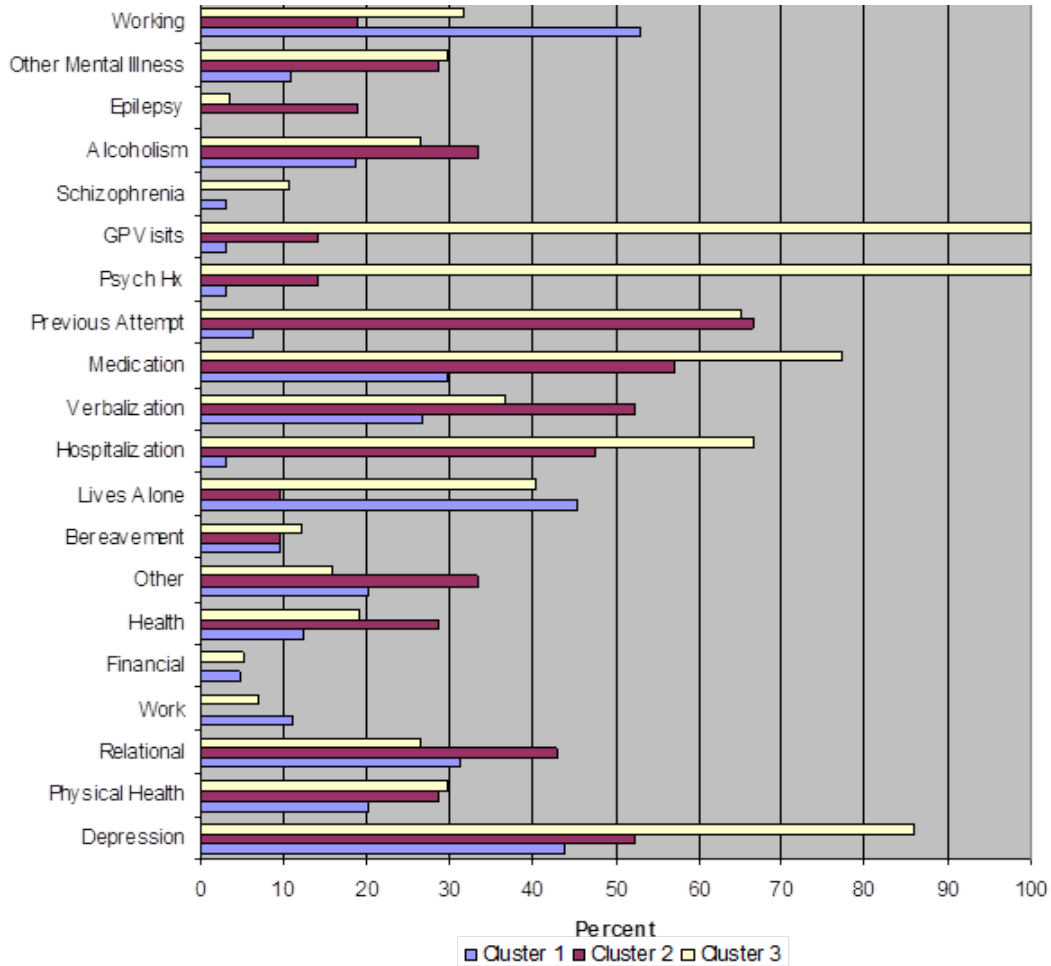
O'Connor and colleagues (1999) make a notable contribution to the suicide literature. Their study offered further evidence that suicides may not be a homogeneous group and that subtypes of suicide decedents can be differentiated based on various characteristics. As the first research team to employ cluster analysis in classifying suicide deaths into subtypes, they have also moved the field of suicidology beyond predominately theory-based typologies towards a more data-based approach that can be empirically tested, replicated, and refined. Hence, their study provides an ideal, and methodologically sound, launching point for the current study and is the only cluster analytic study of suicide death for comparison of findings.

RATIONALE AND SIGNFICANCE

The purpose of this study is to use a series of statistical procedures collectively referred to as cluster analysis to empirically identify typologies of USAF suicide decedents. This study is unique and adds to the existing suicidology literature in several important ways. To date, there has been no cluster analytic research on military suicide. Our review of death investigation files of USAF suicide decedents has given us anecdotal evidence that different typologies of USAF suicides may exist. For instance, the type of individual who isolates and does not seek help appears to be different from the type of individual who openly expresses psychological distress and seeks help. In addition, while we are not certain, at this point, about the level of generalizability of the USAF suicide data to the general U.S. civilian data, the research presented here is the second cluster analytic study in the suicidology literature which provides scientific data on typologies of suicide.

Problems exist with the current status of research involving typologies, particularly in relation to military populations. The findings from the civilian typology literature are based on studies on suicide attempts (Kiev, 1976; Paykel & Rassaby, 1978) and exclusively one study on suicide (O'Connor et al., 1999). Hence, these findings may not directly generalize to military populations. For instance, the U.S. military has a high proportion of 18 to 24 year old, Caucasian males, with access to firearms, high rates of alcohol use, and in some cases, exposure to trauma – all of which have been associated with an increased risk for suicide (Martin, 2009). Research to determine the specific subtypes of military personnel who die by suicide is needed. Once pathways to military suicide can be identified and better understood, the unique needs of different vulnerable subgroups can be more adequately met in screening and prevention campaigns, as well as, in the design of targeted evidence-based clinical interventions. It is hoped

that the findings from this research can be rendered into a list of actionable items that will help

guide policy, unit, and clinician level decision making processes.

Conceptual Model

To date, no typologies pertaining to military suicides have been proposed or scientifically

evaluated. Based on a comparative review of military and civilian suicide (Martin,

Ghahramanlou-Holloway, Lou, & Tucciarone, 2009) and an examination of USAF suicide death

investigation records (Martin, 2009), several of the subtypes noted in the literature may extend

to the military population. For instance, the level of societal integration and regulation espoused

in Durkheim's anomic and fatalistic suicide types seems especially pertinent to military suicide.

Clearly, regulation is high during certain points of an individual's military career (i.e., basic

training), but this level of societal regulation shifts and changes based upon rank, position, unit,

deployment status, and job specialty.

Moreover, the high suicide rate among socially isolated and first term military personnel

supports that failure to integrate into the military culture is a relevant aspect of some suicides.

The high independence, need to control, and denial of illness or weakness found among

Shneidman's 'psyde-initiators' and Baechler's 'unaccepting type' are descriptive of many

suicide cases we have reviewed to date. The typology expected to be most aligned with military

suicide is one of the empirically derived typologies posited by Reynolds and Berman (1995).

More specifically, the aggression typology shares a number of similarities with the

epidemiological findings on military suicide (i.e., young, male, with substance use history, no

previous suicide behavior, and precipitated by interpersonal conflict) and therefore, may be

highly applicable to suicidal military Service Members.

However, as described earlier, the existing typologies are primarily based on clinical observations and/or theory and lack an empirical basis. Therefore, research using more sophisticated data driven strategies such as cluster analysis should be used and replicated across populations. Moreover, these strategies will confirm and reduce the number of subtypes derived from theoretical orientations to a useful taxonomy of suicide.

The model depicted in figure 2 is based on a synthesis of the suicide typology and military suicide literature reviewed above, discussion among personnel at the Laboratory for the Treatment of Suicide-Related Ideation and Behavior at USUHS, as well as psychological autopsy research on USAF suicides (Martin, 2009). Four typologies of military suicide are proposed for the current study: (1) autonomous/isolationist; (2) attached/dependent; (3) escapist/controlling; and (4) externalizing/aggressive. This model will not be tested directly but will serve as a guide for interpreting the study findings. Table 1 presents each of the four proposed typologies for military suicide in relation to previous theoretical findings described earlier in the background section. Further, a description of each of the four types is provided below.

Figure 2. Proposed Conceptual Model of Typologies for Military Suicide

Military Suicides

	Autonomous/Isolationist Typology	Attached/Dependent Typology	Escapist/Controlling Typology	Externalizing/Aggressive Typology
Core/Conditional Beliefs	"Ultimate independence is to be alone in life and death. If I die, then no one will really care."	"I can't tolerate living without the one I love. If they leave, then life is not worth living."	"I can't tolerate the pain or being out of control. If I end my life, then I'm in control and can escape the pain."	"Others are responsible for my pain. If I take my life, then others will know my pain."
Demographics	•Age: younger (18-24) •Resides: alone •Marital: unmarried	•Age: bimodal •Resides: w/ partner •Marital: married	•Age: middle (25-35) •Resides: alone, w/ other •Marital: married	•Age: younger (18-24) •Resides alone, w/ other •Marital: unmarried
Event Info	•Intent: severe •Communication: low •Precipitants: low •Chance of rescue: low •Method: hanging/firearm •Drugs/etoh: low •Notes: low	•Intent: moderate-severe •Communication: high •Precipitants: high •Chance of rescue: high •Method: hanging/firearm •Drugs/etoh: mod •Notes: high	•Intent: moderate-severe •Communication: mod •Precipitants: mod •Chance of rescue: mod •Method: poisoning (OD) •Drugs/etoh: high •Notes: high	•Intent: severe •Communication: high •Precipitants: high •Chance of rescue: high •Method: firearms •Drugs/etoh: high •Notes: mod

Risk Factors	•Self injury hx: low
	•Problems: none
	•Psychiatric hx: low
	  - Bereavement
	  - Mood/anxiety/PD*
		•Self injury hx: mod
		•Problems: spouse & s/o, civil legal (non-violent)
		•Psychiatric hx: high
		  - Personality
		  - Adjustment
		•Abuse/sexual assault hx
			•Self injury hx: high
			•Problems: medical, legal, financial, spouse & s/o, work
			•Psychiatric hx: high
			  - Psychotic
			  - Mood
			  - Anxiety
			  - Etoh
				•Self injury hx: low
				•Problems: military/civil legal, investigation, financial, spouse & s/o, work, criminal acts
				•Psychiatric hx: mod
				  - Personality
				  - Etoh
				•Abuse/sexual assault hx

Use of Military Helping Services

Table 1. Proposed Typologies of Suicide: Theoretical Foundations

Theorist	Subtype	Characteristics Described by Theorist
Proposed Military Typology: Autonomous/Isolationist		
Durkheim (1897/1951)	Egoistic	Lacks social integration and purpose
Menninger (1938)	Wish to Die	Unbearable psychic pain, blame, and guilt
Henderson & Williams (1974)	Alienation/Isolation	Feels alienated from social network
Shneidman (1966)	Psyde-seekers	High intent to die, plans suicide so rescue unlikely
Shneidman (1968)	Egotic	Psychic conflict, isolation, and narrowed attention
O'Connor et al. (1999)	Cluster 1	Lives alone, moderate depression, low on substance abuse, history of previous attempts, and contact with services
Reynolds & Berman (1995)	Alienation	Highest ratio of males/females, drug use, middle-aged, some incidence of recent death of loved one, and psychiatric history
Proposed Military Typology: Attached/Dependent		
Durkheim (1897/1951)	Altruistic	Over integration into society/group
Menninger (1938)	Wish to be killed	Desire to kill introject love object
Leonard (1967)	Satisfied-symbiotic	Over-dependent attachment, relationship loss precipitant
Shneidman (1968)	Dyadic	Motivated by interpersonal frustration, hate, rejection, shame
Baechler (1979)	Oblative	Increase value of life through death
O'Connor et al. (1999)	Cluster 2	Moderate depression, lives with others, high relational/marital precipitants, low contact with services, high communication of intent, high unemployment
Proposed Military Typology: Escapist/Controlling		
Shneidman (1966)	Psyde-initiators	Controls death to avoid ineffective view of self, older, unemployed, terminal illness
Henderson & Williams (1974)	Avoidance factor	Avoiding or escaping anxiety provoking experiences
Leonard (1967)	Unaccepting	Resists external control or dependence, denies illness
Baechler (1979)	Escapist	Flight from unbearable situation, maladaptive problem-solving, depression/hopelessness
O'Connor et al. (1999)	Cluster 3	High depression, schizophrenia, alcoholism, and other mental illness, high contact with services, medications, and hospitalization/attempt history,
Reynolds & Berman (1995)	Confusion	Intrapsychic conflict, chaotic/bizarre behavior, history of psychiatric disorder
Reynolds & Berman (1995)	Depression/low self esteem	Precipitants of unemployment, financial concerns
Proposed Military Typology: Externalizing/Aggressive		
Durkheim (1897/1951)	Fatalistic	Over regulation/discipline by society
Menninger (1938)	Wish to kill	Hostility towards external object
Leonard (1967)	Dependent-dissatisfied	Desires closeness yet invites rejection, vacillates between autonomy and submissiveness, manipulative
Baechler (1979)	Aggressive	Young, with motives of anger, retribution, manipulation
Reynolds & Berman (1995)	Aggression	Young, white/black, male, interpersonal conflict, substance history, low previous attempts, and suicide notes

Description of Proposed Military Suicide Typologies

      Autonomous/Isolationist Suicides. Primary features of this typology are expected to be social isolation and intrapsychic conflict. Individuals classified by this typology are assumed to hold core beliefs related to existential isolation and independence, leading to the conditional belief of "if I die, no one will care." Many characterizations published in the literature on military suicides fit with this typology where there is a high degree of planning, bereavement (Patterson et al., 2001; Ritchie et al., 2003; Trent, 1999), low contact with helping services (Martin, 2009), young age, first term enlisted, with perceived occupational and/or relationship problems (Ritchie et al., 2003). Several SESS variables are expected to be descriptive of the autonomous/isolationist suicide typology. Demographically, they are expected to be young (18-24), residing alone, and unmarried. The actual suicide event is expected to be characterized by severe suicide intent, low communication of intent to others, low documentation of precipitating events, isolated locations where the chance of rescue is unlikely, asphyxiation and firearms as primary methods, low use of alcohol or drugs in the event, and a low incidence of suicide notes. Although a high incidence of mood, anxiety and personality disorders might exist as risk factors among individuals in this typology, low contact with helping services and a lack of close confidants makes accurate assessment of this difficult and therefore, a low incidence of help seeking behavior is estimated for this typology to be observed in the SESS sample.

      Attached/Dependent Suicides. A primary feature of the attached/dependent typology is a high degree of interpersonal conflict. Core beliefs related to not being able to tolerate loss of the primary relationship and a conditional belief that life is not worth living without the relationship are expected among this group. Many characterizations published in the literature on military suicides fit with this typology where there is failed/failing interpersonal relationships as

a common precipitant, legal problems (Patterson et al., 2001), high incidence of communicating

distress and suicide intent and documented precipitating events (Martin, 2009). Based on our

psychological autopsy data (Martin, 2009), suicides with interpersonal issues as a primary

precipitant appear to have a bimodal age distribution with medians occurring in the mid 20's and

mid 30's. Individuals in this typology will likely live with a spouse or partner and be married or

separated at the time of death. Event information from the SESS is expected to indicate a

moderate to severe intent, high communication of intent to others, and a high incidence of

documented precipitants and suicide notes. Due to the interpersonal nature of these deaths,

suicide locations where the chance of rescues is likely are probable. Although mood and anxiety

disorders may be present in this cluster, a higher proportion of personality disorders is expected

which often result in an exacerbation of interpersonal problems. Problems related to non-violent

civil legal (i.e., separation, child custody, etc.), financial, and spouse or significant other are also

likely. Records of individuals in this typology may indicate a history of abuse or sexual assault.

Escapist/Controlling Suicides. Primary features of this typology are expected to be the

desire to exert personal control over, or escape from, some intolerable situation. Core beliefs

related to being out of control and unbearable psychological or physical pain may lead to the

conditional belief that "if I end my life, then I can take control and escape the pain." Many

characterizations published in the literature on military suicides fit with this typology where

there is high incidence of psychiatric disorders, history of self harm, pending administrative/legal

action, death of spouse, job conflicts (Allen et al., 2005; Holmes et al., 1999; Patterson et al.,

2001). In addition, demographic variables including being middle aged (25-35), residing alone or

with "other" (e.g., roommate), and being likely to be married are expected to be seen. The

suicide event will likely be characterized by moderate to severe intent, a moderate incidence of

communicating intent to others and a high incidence of suicide notes. Since this suicide typology is thought to be seeking an escape, high alcohol and drug use during the suicide event are expected and poisoning methods (i.e., overdose, carbon monoxide) will likely be the predominate method of suicide. Similarly, a history of nonfatal self injury, mood, anxiety, psychotic, alcohol abuse and problems related to medical, legal, financial, spouse, and occupation are anticipated.

Externalizing/Aggressive Suicides. A primary feature of this typology is the desire to punish others. Core beliefs such as "others are responsible for my pain" and a conditional belief of "if I take my life then others will know/feel my pain" are likely in this typology. Many characterizations published in the literature on military suicides fit with this typology where there is character and behavior disorders, disproportionate use of firearms (Eggerstein & Goldstein, 1968; Hauschild, 1968), personality and substance use disorders (Allen et al., 2005; Trent, 1999), and history of abuse/neglect, military/legal problems (Holmes et al., 1999). In addition, demographic variables including young age, residing alone or with others (i.e., roommate), and being unmarried are expected to be observed. The suicide event is expected to be characterized by severe intent, high communication of suicide intent to others, locations where suicide is likely to be seen/found by others (i.e. workplace, dormitory, common public areas), and a high incidence of documented precipitating events. Although this typology will likely use drugs or alcohol during the event, firearms will be the primary method of suicide. A high incidence of personality disorders and alcohol abuse is probable in this group. Additional SESS documented risk factors postulated to be relevant to this typology include a history of abuse or sexual assault, military or civil legal/administrative actions, criminal acts, under investigation or apprehension, financial concerns, spouse and occupation problems.

AIMS AND HYPOTHESES

Aim 1. To describe the SESS documented characteristics of USAF suicide decedents for the years between 1999 and 2009.[2]

Aim 2. To compare the SESS documented characteristics of USAF suicide decedents with a suicide before Operation Enduring Freedom (OEF; February 1, 1999 to October 7, 2001) and after OEF (i.e., October 8, 2001 to July 31, 2009).

- *Hypothesis 2A.* Pre- and post-OEF USAF suicides decedents will be similar in terms of demographic factors including sex, age, race, rank, and marital status.

    Independent Variable: Type of Group (Pre- OR Post-OEF)

    Dependent Variables: Sex, age, race, rank, and marital status.

- *Hypothesis 2B.* Pre- and post-OEF USAF suicides will differ in the total number of life stressors.

    Independent Variable: Type of Group (Pre- OR Post-OEF)

    Dependent Variables: Total number of life stressors

Aim 3. To determine the optimum number of clusters that can classify a randomly selected sample of USAF suicides occurring between 1999 and 2009 based on demographic and psychosocial characteristics documented in the SESS.

- *Hypothesis 3.* USAF suicide decedents are not a homogeneous group and can be classified into distinct subgroups via hierarchical cluster analysis based on demographic and psychosocial characteristics.

Aim 4. To evaluate the stability (e.g., internal consistency) and external validity (e.g., criterion validity) of the derived clusters that classify a randomly selected sample of USAF suicide

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[2] Aim 1 is descriptive. Therefore, no specific hypotheses are outlined.

decedents for the years between 1999 to 2009 based on demographic and psychosocial

characteristics documented in the SESS.

- *__Hypothesis 4A.__* The number and structure of clusters derived from the 1st randomly

   selected SESS cases will be similar (i.e., stable) to the 2nd randomly selected SESS cases

   (i.e., split-half analysis).

- *__Hypothesis 4B.__* There will be an association between cluster membership and helping

   services utilization (i.e., criterion validity).

          Independent variable: Cluster membership

          Dependent variables: Helping services utilization (i.e., captured by all visits to

          military treatment facility, mental health, family advocacy, etc.).

RESEARCH DESIGN AND METHODOLOGY

Database

Suicide Event Surveillance System (SESS)[3]. One of the 11 initiatives of the USAF

Suicide Prevention Program (Air Force Pamphlet [AFPAM] 44-160) established in 1996 was the

creation and maintenance of a central surveillance database for fatal and nonfatal self-injuries.

The result was the Suicide Event Surveillance System. The SESS database became operational in

early 1999 and was abandoned late 2009. It was replaced by the Department of Defense Suicide

Event Report (DoDSER) which became operational in 2008. This study was limited to available

data from the SESS and did not use data from the DoDSER. The SESS is a secure, web-based

epidemiological database constructed to track fatal and nonfatal suicide events. In addition to

demographic and military service variables, the database captures information related to the

suicide event (i.e., method, severity, intent, location, precipitating events, and toxicology),

military helping services use (i.e., medical, mental health, chaplain, legal, and other services),

and potential risk factors (i.e., psychological disorders; legal, work, and interpersonal

relationship problems). The categories of information included in the SESS (i.e., demographic,

military service, suicide event, helping services utilization, and risk factors) afford the ability to

analyze across-levels or within-levels. Considering the multi-factorial nature of suicide, the

across-levels approach was selected in an effort to capture as much context as possible in which

the suicide occurred.

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[3] **Previous Research Using SESS.** To date, there have been two manuscripts to our knowledge reported in the literature (Patterson et al., 2001; Staal & Hughes, 2002) that have used SESS data in at least some of their analyses. Patterson et al. (2001) found that failed or failing interpersonal relationships, administrative or legal problems, psychiatric disorders, and evidence of alcohol abuse were common variables present in USAF personnel who attempted suicide. Similarly, Staal & Hughes (2002) found that increasing age was positively associated with suicide event severity and that a documented history of work problems was inversely associated with suicide death. Moreover, a history of mental health disorder and treatment was individually predictive of suicide death.

A description of the SESS database and data entry protocol is derived from AFPAM 44-160 (2001). All data contained within SESS is subject to the Privacy Act of 1974 regulations. Thus, access to the database is restricted and all information is stored on high-security servers accessible only to authorized users from a ".mil" domain. Authorization to enter information into the SESS system is limited to two designated mental health professionals from each USAF installation and four Air Force Office of Special Investigations Headquarters (AFOSI/HQ) users at AAFB. Suicide cases are entered into the SESS by designated AFOSI personnel, regardless of installation where the event occurred. Following a suicide death, AFOSI/HQ personnel are responsible for recording the information into the SESS once the investigation is closed.

Participants

Inclusion and Exclusion Criteria. Suicide decedents identified for this study were active duty USAF Service Members. Although the SESS captures data related to nonfatal self-injurious events, reliability of data on suicide attempts is considered questionable due to underreporting and misclassification (D'Mello, Eaton, & Gould, 2006; Lt Col Mike Kindt, personal communication, August 5, 2009) and was therefore, not used for the purposes of our analyses. Similarly, suicides among personnel who were not active duty at the time of death (i.e., guard, reserve, other branches of service) were excluded. Our experience with OSI investigatory case files, the source data used by OSI personnel to complete SESS reporting, suggests that the case files of non-active duty personnel are less reliable due to missing data than what is typically observed in active duty case files. In summary, this study included active duty USAF suicides and excluded suicides of non-active duty personnel and events classified as nonfatal.

Case Selection. Identification of cases of active duty USAF suicide decedents were carried out during the data extraction phase by the USAF School of Aerospace Medicine, Public

Health and Readiness (USAFSAM/PHR), under the direction of the office of the USAFSPP. Due

to the strict protocol regarding data entry for suicide deaths outlined in AFMPAM 44-160 (e.g.,

trained OSI agents, investigations have been formally closed, corroboration of numerous data

sources prior to SESS data entry), SESS data on suicides was expected to be reliable. For the

purposes of this study, suicide was operationally defined as a manner of death involving an

active duty service member classified by OSI personnel as a "completed suicide" in the SESS

database.

Three groups of suicide decedent cases were selected for the current study. Group 1,

termed *active* consisted of all active duty USAF suicides occurring between 1999 and 2009.

Group 2, termed *pre-OEF*, consisted of all suicides occurring from February 1, 1999 to October

7, 2001. Group 2, termed *post-OEF*, consisted of all suicides occurring from October 8, 2001 to

July 31, 2009. The pre- and post- OEF groups were used to determine if characteristics of USAF

suicides have changed since the onset of sustained combat operations. The beginning date

(February 1, 1999) and end date (July 31, 2009) were selected based on available data within the

SESS.

Procedures

Data Share Agreement. A request for data use was first approved by the USAFSPP (Lt

Col Mike Kindt, personal communication, August 5, 2009). A standard data use agreement was

completed and placed on file with USAFSAM/PHR. The stated purpose of the data request was

to collect and analyze available surveillance information related to USAF suicide deaths. Data

extraction and de-identification was executed by USAFSAM/PHR. Moreover, USAFSAM/PHR

epidemiological services support personnel were responsible for insuring that all variables

required for planned analyses were included in the data extraction (Maj Matthew Shim, personal communication, August 5, 2009).

Data Restructuring. The de-identified dataset that was obtained from USAFSAM/PHR was converted for use with the Statistical Package for the Social Sciences (SPSS v. 16)[4]. Although the majority of variables in the SESS were ready for analyses immediately, the following dichotomous variables were constructed to facilitate analysis: (1) suicide pre-OEF; (2) suicide post-OEF; (3) communicated intent; (4) interpersonal problem. A count function capturing all life stressors documented in the SESS (i.e., precipitating event, victim of abuse or sexual assault, military legal or administrative problem, under investigation or apprehension, civil legal problem, financial difficulties, spouse problem, job loss, work problem, school problem, criminal act, family problem, significant other problem) was used to create a continuous variable termed, "total number of life stressors."

Data Analytic Plan

Statistical support was obtained from Dr. Cara Olsen, a biostatistician who is also a dissertation committee member. The choice of procedures and analytic strategy was based on a review of the resources on cluster analysis (Aldenderfer & Blashfield, 1984; Clatworthy et al., 2005; Everitt, Landau, & Leese, 2001; Kaufman & Rousseeuw, 2005; Milligan, 1980; Milligan 1981; Milligan & Cooper, 1985; Romesburg, 2004). Furthermore, the guidelines [as outlined by Aldenderfer & Blashfield (1984) and Clatworthy et al. (2005)] were followed as closely as possible. The step by step sequence of data analysis for each study aim is described below. Furthermore, the procedure used to conduct the cluster analysis is detailed in Appendix B.

Aim 1. To describe the SESS documented characteristics of USAF suicide decedents for the years between 1999 and 2009.

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[4] SPSS v. 16 was used for all study analyses.

Due to the descriptive nature of aim 1, no specific hypotheses were tested. The following five broad areas of sample characteristics captured in the SESS (Appendix A) were described: (1) *personal information* (i.e., age, gender, race, marital status, resides with); (2) *military information* (i.e., rank, duty status); (3) *event information* (i.e., communication of intent, location of the event, method used, drugs or alcohol used in the event, precipitating event within 72 hours); (4) *use of military helping services* (i.e., military treatment facility, mental health, substance abuse services, family advocacy, family support, financial counseling, legal, chaplain, Exceptional Family Member Program [EFMP], child/youth development; and (5) *risk factors of victim* (i.e., psychological disorders, drug or alcohol abuse, history of physical/sexual abuse/assault, and legal, financial, spouse, occupational, or school problems.

Aim 2. To compare the SESS documented characteristics of USAF suicide decedents with a suicide before Operation Enduring Freedom (OEF; February 1, 1999 to October 7, 2001) and after OEF (i.e., October 8, 2001 to July 31, 2009).

Hypothesis 2A and 2B examined select demographic characteristics and total number of life stressors in USAF suicide decedents from pre and post onset of OEF.

Independent Variable: Type of Group (Pre-OEF, Post-OEF)

Dependent Variables: Sex, age, race, rank, marital status, total number of life stressors

Analyses. All categorical variables (i.e., sex, race, rank, and marital) were analyzed using chi-square tests. Age was analyzed using independent groups t-test and total number of life stressors was examined by using Mann-Whitney rank sum test.

Power. Power calculations were performed using nQuery Advisor version 6.01. When the sample size in each group was set to 200[1], a two group χ^2 test with a 0.05 two-sided

significance level had 80% power to detect the following differences in each demographic

characteristic (Machin & Campbell, 1987; Leiss, Tytun, & Ury, 1980):

Table 2. Power Analysis for Pre and Post-OEF Comparisons.

	Smaller proportion (π_1)	Larger proportion (π_2)	Difference in proportions ($\pi_1 - \pi_2$)
Female	0.060	0.145	0.085
White	0.800	0.900	0.100
Enlisted	0.650	0.776	0.126
Married	0.430	0.570	0.140

Base percentages for these calculations were derived from a psychological autopsy study in a population of USAF suicide decedents (Martin, 2009).

A Mann-Whitney test was used to compare groups on the total number of documented

life stressors. Although power estimates for the Mann-Whitney were based on t-test parameters,

the Mann-Whitney has a relative efficiency of 0.864 to detect an effect in comparison to the t-

test. Thus, power calculations are based on a sample size of 173 in each group despite our larger

sample size ($n = 376$) from the SESS dataset. At the more conservative sample size, we had 80%

power to detect a difference in means of 0.302 (i.e., 0.30 stressors between groups) assuming that

the common standard deviation is 1.000 using a two group t-test with a 0.050 two-sided

significance level (Dixon & Massey, 1983; O'Brien & Muller, 1983).

Aim 3. To determine the optimum number of clusters that can classify a randomly

selected sample of USAF suicides occurring between 1999 and 2009 based on demographic,

suicide event, and psychosocial characteristics documented in the SESS.

Independent Variables: Select demographic, suicide event, and psychosocial

characteristics (Table 6)[5].

Dependent Variables: Cluster membership.

Analysis. A hierarchical cluster analysis was conducted using Ward's method of linkage

with squared Euclidean distance to the cluster means as the unit of measure for distance between

cases. Number of clusters was determined by visual inspection of the dendogram and

examination of the agglomeration table for disproportionate increases in the agglomeration

coefficient.

Power. Power analysis was not appropriate for hierarchical cluster analysis.

Aim 4. To evaluate the stability (e.g., internal consistency) and external validity (e.g.,

criterion validity) of the derived clusters that classify a randomly selected sample of USAF

suicide decedents for the years between 1999 to 2009 based on demographic and psychosocial

characteristics documented in the SESS.

The cluster solution derived from the 1st randomly selected SESS cases was expected to

be similar (i.e., stable) when subjected to split-half analysis on the 2nd randomly selected SESS

cases (hypothesis 4A). Further, an association between cluster membership and helping services

utilization (hypothesis 4B) was expected.

Independent Variable: Cluster membership

Dependent Variables: Percentage agreement between cluster solutions; use of military

helping services (i.e., overall, military treatment facility, mental health, family advocacy, etc.).

Analyses. Since the number of clusters derived from the split half analysis was similar

the kappa coefficient (Cohen, 1960) was used to compare percentage agreement between cluster

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[5] The variables used in the clustering procedure are intended to assess across-levels (i.e., demographic, military information, event information, and risk factors) and based on the premise that if elevated, could be actionable items at the policy, unit, or clinician level.

solutions (hypothesis 4A). A cross-tabulation comparing cluster membership of each case between initial and split-half cluster solutions was conducted. Multiple chi square tests were used to compare clusters on utilization of military helping services (hypothesis 4B).

Power. Since we could not predict the number of cases that would be classified into each cluster by cluster analysis, power calculations for the analyses related to aim 4 were not feasible.

Brief Note on Consideration of Alternative Data Analytic Plans. Other statistical procedures such as factor analysis and discriminant function analysis were considered. Cluster analysis is similar to factor analysis in that both methods reduce large amounts of data and identify latent patterns. However, cluster analysis aims to reduce the number of cases by grouping them into clusters based on their similarity on certain variables, whereas factor analysis seeks to reduce the number of variables into underlying constructs, or "factors." Similarly, discriminate function analysis assesses the linear combination of independent variables that best discriminate between *predetermined groups*. While this statistical procedure may be useful in follow-up studies to determine which combination of variables discriminates between typologies, it is not appropriate for exploratory studies such as this.

Human Subjects Protection

The study protocol was reviewed by the Uniformed Services University of the Health Sciences (USUHS) Institutional Review Board after approval from the dissertation committee. Given the de-identified nature of the data, the study was not considered human subjects research and was subsequently approved by the USUHS Office of Research. All data obtained was confirmed as de-identified and saved on password protected DoD computer systems accessible to study PI, Capt Jeffery Martin and his advisor, Dr. Marjan Holloway – both of whom have completed the appropriate research ethics trainings.

RESULTS

Sample Characteristics (AIM 1)

Demographics. The sample consisted of 376 deceased USAF personnel whose data was entered into the SESS database from February 1999 to July 2009. The cases were predominately male ($n = 355$; 94%). The average age at the time of death was 29.49 ($SD = 7.85$), with ages ranging from 19 to 59. Approximately 89% ($n = 333$) of the decedents were enlisted personnel with over two times as many cases from the ranks of E4-E6 as compared to other ranks. There were a comparable number of married ($n = 193$) and unmarried ($n = 177$) decedents. The racial composition of the sample was largely Caucasian (76%), followed by African American (13%), Hispanic (5%), Asian (4%), and other/unknown (3%). Table 3 (see page 76) provides a detailed summary of sample demographics.

Event Information. The majority of USAF suicides (57%) occurred at the decedent's personal residence, followed by a public but isolated location (12%), and a public but not isolated location (8%). The most common living situation in which USAF suicides occurred was the decedent living alone (44%), followed by living with a partner and child (26%), and living with a partner without a child (14%). Firearms were used in 52% of USAF suicides. Of decedents that used firearms, 93% were privately owned and 7% were issued service weapons. The second most common method of suicide was asphyxiation (25%). Table 4 (see page 77) provides a detailed summary of event information.

Psychiatric Diagnoses. Less than half of the sample (41%) had a previously diagnosed psychiatric disorder at the time of death. Of those with a previously diagnosed disorder, 24% had one disorder, 11% had two, and approximately 6% had three or more. Alcohol related disorders were the most common diagnoses observed in the SESS case files (27%), followed by mood

disorders (25%), anxiety disorders (11%) and adjustment disorders (10%). When including other markers of alcohol misuse (alcohol related incident, contact with ADAPT), there was some indication of a substance misuse history in 35% of suicide cases. Table 4 (see page 77) provides a detailed summary of psychiatric diagnoses.

Life Stressor Precipitants. Life stressor precipitants occurring 72 hours prior to death were annotated in 64% of suicide case files. The top five precipitants were (1) argument with spouse, significant other, or family member (29.2%); (2) argument with other (9%); (3) separation or divorce from spouse or significant other (6.6%); (4) legal proceedings (5.5%); and (5) alcohol related incident (4.3%). Approximately 11% had a documented history of suicide-related behaviors. When more distal stressors were included (i.e., beyond the 72hr timeframe), 92% of the sample had documented stressors, with multiple life stressors precipitants identified in 75% of sample. Table 4 (see page 77) provides a detailed summary of life stressor precipitants.

Communication of Intent. Nearly half of the sample (44.1%) communicated their suicide intent to someone prior to death. The most common recipients of suicide intent communications were family members (19%) and friends/coworkers (14%). Approximately 4% communicated their intent to one of the helping services captured in the SESS and less than 2% communicated their intent to someone in their chain of command. Refer to Table 4 (see page 77) for a detailed summary.

Helping Services Utilization. Twenty-three percent of the sample (almost a fourth) had no documented contact with any of the nine helping agencies captured in the SESS in the 12 months prior to death. The average number of services contacted prior to death was 1.73 (SD = 1.60). In the 12 months prior to death, the four most frequently contacted helping agencies were

(1) medical treatment facility (63%); (2) mental health (37%); (3) legal (17%); and (4) chaplain

services (13%). This same order was also observed when examining services utilization one

month prior to death. Refer to Table 5 (see page 81) for a detailed summary.

Pre- and Post- OEF Comparisons (AIM 2)

To compare characteristics of USAF suicides occurring before and after the start of

combat operations in support of OEF, the sample was split into two groups using October 7,

2001 (i.e., start of OEF) to stratify cases. Pre-OEF ($n = 81$) and post-OEF ($n = 275$) USAF

suicides were expected to be similar in terms of demographic factors including sex, age, race,

rank, and marital status but different in terms of the total number of documented life stressors. A

series of chi-square tests were conducted to examine categorical demographic variables and an

independent t-test was used to examine interval demographic data. There were no significant

differences in pre- post-OEF samples in regards to gender $\chi^2(1) = 0.14$, $p = 0.709$; race $\chi^2(6) =$

3.50, $p = 0.744$; marital status $\chi^2(4) = 2.34$, $p = 0.674$; or military pay grade $\chi^2(14) = 17.91$, $p =$

0.211. Similarly, there was no significant difference ($t_{(374)} = 0.039$, $p = 0.97$) in the ages of

suicide decedents from pre- to post-OEF.

A Mann-Whitney test was used to determine if suicides occurring pre-OEF differed from

those occurring post-OEF in the total number of documented life stressors. The median number

of life stressors observed for pre-OEF suicides ($m = 3.00$, $sd = 1.94$) as compared to post-OEF

suicides ($m = 3.00$, $sd = 2.09$) were not significantly different ($p = 0.353$). Thus, the hypothesis

that pre- and post-OEF suicides would significantly differ in total number of life stressors (i.e.,

due to the addition of deployment related stressors) was not supported. Figure 3 (page 70) is a

bar graph that visually illustrates the findings associated with Aim 2 of the study.

Figure 3. Total Number of Documented Life Stressors for Pre- and Post- OEF Suicide Decedents
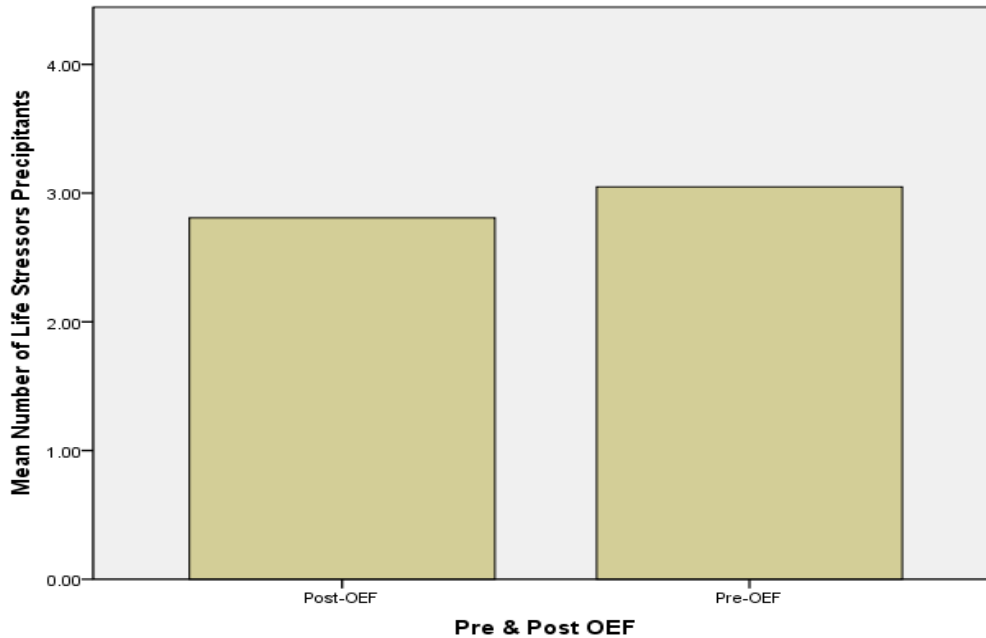
Hierarchical Cluster Analysis (AIM 3)

A hierarchical cluster analysis was conducted using Ward's method of linkage with squared Euclidean distance to the cluster means as the unit of measure for distance between cases. Using the methods recommended by Aldenderfer & Blashfield (1984) for determining the optimum number of clusters, three distinct clusters were identified. First, a visual inspection of the dendogram was conducted which suggested a three cluster solution (figure 4, page 71).

Next, the agglomeration schedule coefficients were examined for disproportionate increases at each step in the clustering process. As seen in figure 6 (page 71), a substantial increase in the agglomeration coefficient would be required to move from a three cluster solution to a two cluster solution, indicating that the three cluster solution best fit the data (figure 4, page 71).

Figure 4. Dendogram of Clustering Procedure
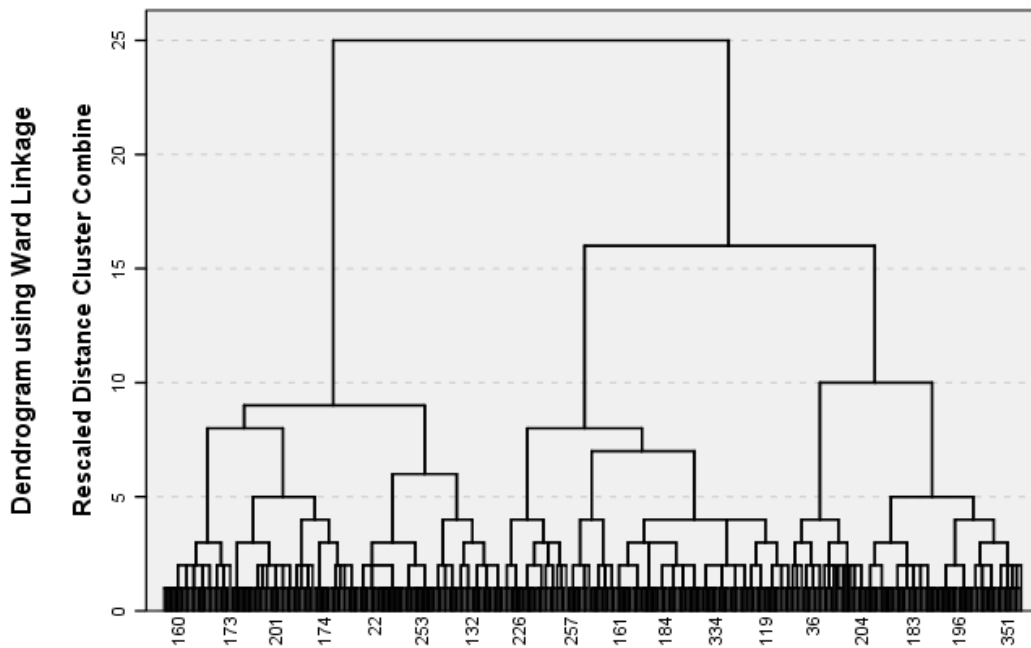

Figure 5. Scree Plot of the Agglomeration Coefficients[6]

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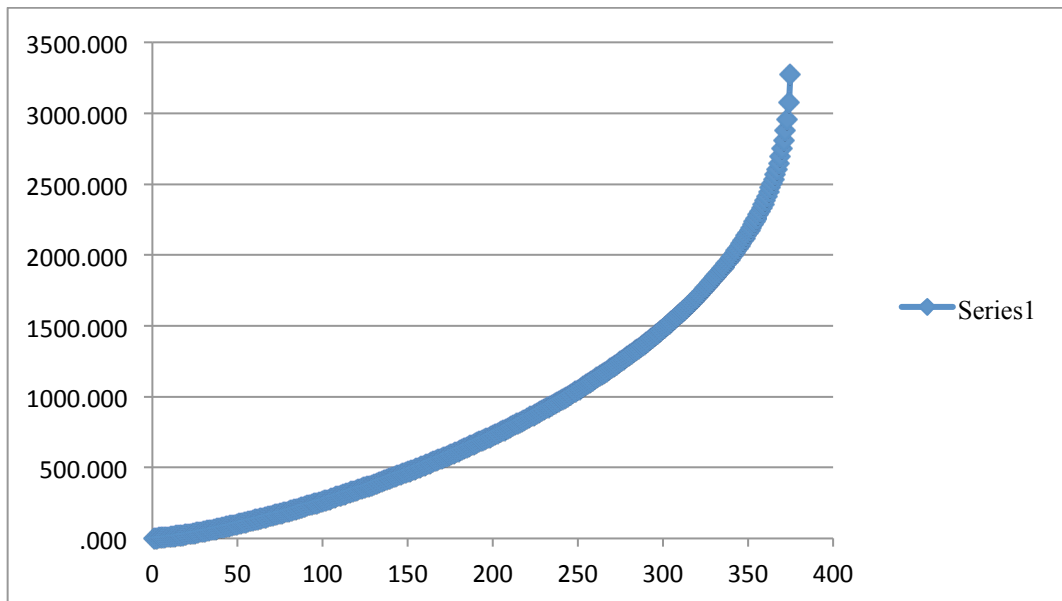
[6] Scree plot graphically depicts the agglomeration coefficients at each stage of the clustering process. In agglomerative clustering (i.e., hierarchical cluster analysis), the process starts with each case as an individual cluster. Each subsequent stage is depicted left to right until all cases are grouped into one cluster.

Demographic Characteristics of the Clusters. Table 3 (page 76) provides a detailed breakdown of demographic characteristics for each of the three identified clusters. Overall, there were comparable numbers of individuals assigned to cluster 1 ($n = 149$), cluster 2 ($n = 126$) and cluster 3 ($n = 101$). Significant findings on demographic characteristics can be summarized as follows[7]. In terms of racial differences, the distribution of black USAF decedents was notably higher in cluster 3 (19%) in comparison with cluster 2 (6%) and cluster 1 (14%). Cluster 1 had significantly fewer married individuals (2%) in comparison with cluster 2 (87%) or cluster 3 (76%). Additionally, cluster 1 had significantly more divorced decedents (22%) and single decedents (71%) in comparison with cluster 2 (6% and 7% respectively) or cluster 3 (19% and 6% respectively). The highest proportion of decedents in the junior enlisted ranks (E1-E3) was observed in cluster 1 (37%) in comparison with cluster 3 (18%) and cluster 2 (14%). Cluster 3 had the highest proportion of E4-E6's (68%), followed by cluster 1 (51%) and cluster 2 (48%). The highest proportion of senior enlisted (E-7-E9) was observed in cluster 2 (19%) in comparison with cluster 1 (3%) and cluster 3 (8%). Significantly more field grade officers (O4-O6) were also observed in cluster 2 (13%) in comparison with cluster 1 (2%) and cluster 3 (3%). In summary, cluster 1 in comparison with the other two clusters was made up of the highest percentage of single, divorced, and lower ranking enlisted decedents and the lowest percentage of married decedents. Cluster 2 in comparison with the other two clusters was made up of the highest percentage of married decedents and the lowest percentage of divorced, black, and enlisted E1–E6 decedents. Finally, cluster 3 in comparison with the other two clusters was made

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[7] Although statistically significant differences between clusters are highlighted in this section, it is important to note that by design, clustering procedures maximize within-group homogeneity and between-group heterogeneity. Thus, significant differences between clusters are expected. These variables are highlighted to emphasize variables which differ the most between clusters.

up of the highest black and E4-E6 decedents as well as the lowest percentage of single

decedents. Table 3 (page 76) provides a detailed summary of demographic factors for each

cluster in relation to the highest and lowest observed percentages.

Description of the Clusters (AIM 3)

Cluster 1. In addition to the unique demographic makeup described above, decedents

who were categorized in cluster 1 showed a number of other distinguishing characteristics (Table

4, page 77). In terms of documented precipitants 72 hours prior to suicide, cluster 1 decedents

had the lowest occurrence (20%) of argument with a spouse, significant other, or family member

and the highest occurrence (7%) of an alcohol related incident. In comparison with the other two

clusters, decedents of cluster 1 had the lowest percentage of documented psychiatric conditions

including Mood Disorders (10%), Adjustment Disorders (3%), Personality Disorders (3%), and

Psychotic Disorders (1%) as well as the lowest percentage of prior suicide-related events (1%).

Problems with a significant other (30%) served as the leading stressor within this cluster and in

comparison with the other two clusters. Roughly half of individuals in cluster 1 did not

communicate their intent to others according to SESS data. Of those who did communicate their

intent, friends or coworkers (combined 26%) were the most common recipients and family

members were the least common recipients (4%). Although approximately 50% died at a

personal residence, this cluster had the highest proportion of individuals who died by suicide in a

military dormitory (18%) and lived alone (65%) or residing with a friend (15%). In comparison

with the other two clusters, cluster 1 had the lowest percentage of living with a partner with or

without a child. Similar to the entire SESS sample, firearms and asphyxiation were the top two

suicide methods.

Cluster 2. In addition to the unique demographic makeup described above, decedents who were categorized in cluster 2 showed a number of other distinguishing characteristics (Table 4, page 77). The top precipitant noted within the cluster was an argument with spouse, significant other or family member (23%). The level of documented psychiatric conditions was lower in this cluster as compared to cluster 3 but higher than what was observed in cluster 1 on all psychiatric conditions except substance-related. The most unique characteristic of decedents within this cluster was that the majority (91%) did not communicate their suicide intent and died by suicide in a public and yet isolated location. Further, cluster 2 decedents in comparison with the other two clusters, were most likely to live with a partner with (43%) or without (24%) a child. Finally, in comparison with the other two clusters, cluster 2 decedents had the highest percentage of firearm usage (56%) as the method of death.

Cluster 3. In addition to the unique demographic makeup described above, decedents who were categorized in cluster 3 showed a number of other distinguishing characteristics (Table 4, page 77). In comparison with the other two clusters described above, cluster 3 had the highest percentage of arguments with spouse, significant other, or family member (42%) as a documented precipitant 72 hours prior to their suicide. Similarly, cluster 3 members in comparison with the other two clusters, had the highest percentage of documented interpersonal stressors including problems with family (41%) and spouse (83%). In terms of documented psychiatric conditions, cluster 3 decedents in comparison with those belonging to the other two clusters had the highest percentage of all diagnoses across the board – i.e., Mood Disorders (42%), Adjustment Disorders (19%), Personality Disorders (11%), and Psychotic Disorders (6%) as well as a documented prior suicide-related event (19%). The most notable and unique marker of this cluster was that nearly all the decedents (98%) communicated their suicide intent in

comparison with only 19% observed in cluster 2 and 48% in cluster 1. Cluster 3 decedents also had the highest level of communication with the helping services (9%) as well as the chain of command (4%), in comparison with the other two clusters. Approximately 3 out of 4 decedents within cluster 3 chose their personal residence as the location for the suicide and this was the highest percentage when compared to decedents of the other two clusters. Similarly, cluster 3 members were the least likely to choose a public isolated location for their suicide compared with the other two clusters. Decedents of cluster 3 had the lowest use of firearms (49%) and the highest use of asphyxiation (32%) in comparison with the other two clusters.

Table 3: Summary of Sample Demographics and Distribution Across Three Clusters

Variable	Cluster 1 (*n* = 149) n (%)	Cluster 2 (*n* = 126) n (%)	Cluster 3 (*n* = 101) n (%)	Total (*n* = 376) n (%)	USAF Base Rate (N = 349,094) (%)
Demographics					
Gender					
Male	139 (93.3)	123 (97.6)	93 (92.1)	355 (94.4)	(80.4)
Female	10 (6.7)	3 (2.4)	8 (7.9)	21 (5.6)	(19.6)
Race					
Caucasian	112 (75.2)	103 (81.7)	71 (70.3)	286 (76.1)	(75.2)
Black*	21 (14.1)	8 (6.3)	19 (18.8	48 (12.8)	(13.4)
Hispanic	4 (2.7)	8 (6.3)	5 (5.0)	17 (4.5)	(4.7)
Asian	8 (5.4)	3 (2.4)	2 (2.0)	13 (3.5)	(3.7)
Other/Unknown	4 (2.7)	4 (3.2)	4 (4.0)	12 (3.2)	(1.0)
Marital status					
Married**	3 (2.0)	109 (86.5)	77 (76.2)	189 (50.3)	(57.0)
Single**	105 (70.5)	9 (7.1)	4 (4.0)	118 (31.4)	(32.6)
Divorced**	33 (22.1)	7 (5.6)	19 (18.8)	59 (15.7)	(6.5)
Separated	2 (1.3)	1 (0.8)	1 (1.0)	4 (1.1)	(--)
Rank					
E1 – E3**	55 (36.9)	18 (14.3)	18 (17.8)	91 (24.2)	(18.1)
E4 – E6**	76 (51.0)	60 (47.6)	69 (68.3)	205 (54.5)	(50.5)
E7 – E9**	5 (3.4)	24 (19.0)	8 (7.9)	37 (9.8)	(10.4)
O1 – O3	10 (6.7)	8 (6.3)	3 (3.0)	21 (5.6)	(12.5)
O4 – O7**	3 (2.0)	16 (12.7)	3 (3.0)	22 (5.9)	(8.5)

Note. Values represent observed frequencies in the SESS with % of subgroup represented in parentheses.

*p < .05, **p < .01.

USAF Base Rates based on AFPC statistics database for FY 2005.

Table 4A: Summary of SESS Variables and Distribution Across Three Clusters

Variable	Cluster 1 (n = 149)	Cluster 2 (n = 126)	Cluster 3 (n = 101)	Total (N = 376)
Precipitant 72 hours prior to suicide				
Argued with s/o**	30 (20.1)	29 (23.0)	42 (41.6)	101 (26.9)
Sep/Divorce	4 (2.7)	9 (7.1)	10 (9.9)	23 (6.1)
Legal	6 (4.0)	8 (6.3)	5 (5.0)	19 (5.1)
ARI**	11 (7.4)	4 (3.2)	-- (--)	15 (4.0)
Risk Factors - Psychopathology				
Alcohol	41 (27.5)	27 (21.4)	33 (32.7)	101 (26.9)
Mood**	15 (10.1)	34 (27.0)	46 (45.5)	95 (25.3)
Anxiety	10 (6.7)	17 (13.5)	16 (15.8)	43 (11.4)
Adjustment**	4 (2.7)	15 (11.9)	19 (18.8)	38 (10.1)
Personality*	5 (3.4)	10 (7.9)	12 (11.9)	27 (7.2)
Illegal drugs	11 (7.4)	4 (3.2)	7 (6.9)	22 (5.9)
Rx drugs**	2 (1.3)	9 (7.1)	11 (10.9)	22 (5.9)
Psychotic*	2 (1.3)	1 (0.8)	6 (5.9)	9 (2.4)
Risk Factors - Other				
Spouse problems**	27 (18.1)	79 (62.7)	84 (83.2)	190 (50.5)
Work problems	54 (36.2)	50 (39.7)	42 (41.6)	146 (38.8)
Military legal	45 (30.2)	38 (30.2)	27 (26.7)	110 (29.3)
Financial**	25 (16.8)	41 (32.5)	44 (43.6)	110 (29.3)
Family problems**	26 (17.4)	32 (25.4)	41 (40.6)	99 (26.3)
S/O problems*	44 (29.5)	19 (15.1)	29 (28.7)	92 (24.5)
Criminal acts	28 (18.8)	33 (26.2)	17 (16.8)	78 (20.7)
Previous event**	2 (1.3)	20 (15.9)	19 (18.8)	41 (10.9)

Note. Values represent observed frequencies in the SESS with % of subgroup represented in parentheses. Alcohol related incident (ARI). $*p < .05, **p < .01$.

Table 4B: Summary of SESS Variables and Distribution Across Three Clusters

Variable	Cluster 1 (*n* = 149)	Cluster 2 (*n* = 126)	Cluster 3 (*n* = 101)	Total (N = 376)
Communication of intent				
None/unknown**	88 (59.1)	115 (91.3)	7 (6.9)	210 (55.9)
Stated intent**	72 (48.3)	24 (19.0)	99 (98.0)	195 (44.1)
Family member**	6 (4.0)	8 (6.3)	57 (56.4)	71 (18.9)
Friend/coworker**	38 (25.5)	-- (--)	15 (14.9)	53 (14.1)
Helping services**	3 (2.0)	1 (0.8)	9 (8.9)	13 (3.5)
Chain of command*	1 (0.7)	-- (--)	4 (4.0)	5 (1.3)
Location				
Residence**	74 (49.7)	65 (51.6)	77 (76.2)	216 (57.4)
Public (isolated)*	14 (9.4)	24 (19.0)	8 (7.9)	46 (12.2)
Public (common)	7 (4.7)	15 (11.9)	9 (8.9)	31 (8.2)
Dorm**	27 (18.1)	1 (0.8)	3 (3.0)	31 (8.2)
Work	6 (4.0)	7 (5.6)	1 (1.0)	14 (3.7)
Resides with				
Alone**	97 (65.1)	29 (23.0)	39 (38.6)	165 (43.9)
Partner/child**	4 (2.7)	54 (42.9)	38 (37.6)	96 (25.5)
Partner/no child**	6 (4.0)	30 (23.8)	17 (16.8)	53 (14.1)
Friend**	23 (15.4)	5 (4.0)	2 (2.0)	30 (8.0)
Method				
Firearm*	78 (52.3)	70 (55.6)	49 (48.5)	197 (52.4)
Asphyxiation	33 (22.1)	27 (21.4)	32 (31.7)	92 (24.5)
Carbon monoxide	3 (2.0)	8 (6.3)	5 (5.0)	16 (4.3)
Poison/OD	9 (6.0)	4 (3.2)	6 (5.9)	19 (5.1)
Other	2 (1.3)	4 (3.2)	1 (1.0)	7 (1.9)
Cutting/piercing	3 (2.0)	1 (0.8)	1 (1.0)	5 (1.3)

Note. Values represent observed frequencies in the SESS with % of subgroup represented in parentheses.

*p < .05, **p < .01.

Stability of Cluster Solution: Split-Half Analysis (AIM 4)

To assess the stability of the initial three cluster solution derived from the entire sample ($n = 376$), a split-half analysis was conducted. First, the sample was divided in half based on a random number generator. Second, an agglomerative clustering procedure (i.e., hierarchical cluster analysis) was used to cluster only the first half of cases into subgroups. Each case in the second half of the sample was then assigned to one of the clusters developed using the first half of the sample by using the k-means clustering algorithm non-iteratively. This procedure assesses the distance between each observation and each cluster centroid, assigning the observation to the nearest cluster. This process was repeated by applying hierarchical cluster analysis to the second half of the sample and assigning each observation from the first half of the sample to the nearest cluster. These two randomly selected samples were then recombined resulting in a second dataset with all cases assigned to one of three clusters. This dataset was then cross-tabulated against the dataset including the initial cluster analysis to assess stability of the cluster solution via level of agreement (i.e., kappa value)[8]. If clusters are stable a high percentage of cases should be assigned to same cluster in both datasets. The level of agreement between cluster solution in this study was fair (*kappa* $= 0.401$, $p = 0.000$). See Appendix C (page 140) for crosstabulation data.

External Validity: Comparison of Clusters on Outcome Variables. To assess the external validity of the cluster solution (see Table 5, page 81), clusters were compared on variables not used in the clustering procedure (i.e., helping services utilization). Although there were no significant differences across the three clusters in MTF utilization at 12 months or 30 days prior to death, there were significant differences in utilization of other services. At 12 months prior to death, there were significant differences between clusters in utilization of the

[8] [8] Landis and Koch (1977) offered the following guidelines for interpreting kappa values: < 0 indicates no agreement, 0–$.20$ as slight, $.21$–$.40$ as fair, $.41$–$.60$ as moderate, $.61$–$.80$ as substantial, and $.81$–1 as near perfect agreement.

following services: MH, Chaplain, Family Advocacy, and Family Support. At 30 days there were

significant differences in utilization of MH and Family Advocacy. In all of the helping services

where significant between clusters differences were observed, cluster 1 demonstrated the lowest

utilization and cluster 3 demonstrated the highest utilization.

Table 5: External Validity - Comparison of Clusters on Helping Services Utilization

Variable	Cluster 1 (*n* = 149)	Cluster 2 (*n* = 126)	Cluster 3 (*n* = 101)	Total (N = 376)
Helping services utilization 12months prior to death				
MTF	84 (56.4)	84 (66.7)	70 (69.3)	238 (63.3)
Mental health**	37 (24.8)	49 (38.9)	52 (51.5)	138 (36.7)
Legal	25 (16.8)	21 (16.7)	19 (18.8)	65 (17.3)
Chaplain**	14 (9.4)	12 (9.5)	22 (21.8)	48 (12.8)
Family advocacy**	7 (4.7)	14 (11.1)	27 (26.7)	48 (12.8)
ADAPT	17 (11.4)	16 (12.7)	12 (11.9)	45 (12.0)
Financial services	9 (6.0)	12 (9.5)	7 (6.9)	28 (7.4)
Family support**	6 (4.0)	7 (5.6)	15 (14.9)	28 (7.4)
EFMP	2 (1.3)	4 (3.2)	1 (1.0)	7 (1.9)
Child development	1 (0.7)	3 (2.4)	1 (1.0)	5 (1.3)
Helping services utilization 30 days prior to death				
Any Service	57 (38.3)	55 (42.7)	48 (47.5)	160 (42.6)
MTF	32 (21.5)	31 (24.6)	27 (26.7)	90 (23.9)
Mental health*	25 (16.8)	31 (24.6)	29 (28.7)	85 (22.6)
Legal	12 (8.1)	13 (10.3)	10 (9.9)	35 (9.3)
Chaplain	7 (4.7)	7 (5.6)	11 (10.9)	25 (6.6)
ADAPT	6 (4.0)	9 (7.1)	6 (5.9)	21 (5.6)
Family advocacy**	3 (2.0)	4 (3.2)	10 (9.9)	17 (4.5)
Financial services	2 (1.3)	7 (5.6)	3 (3.0)	12 (3.2)
Family support	1 (0.7)	2 (1.6)	4 (4.0)	7 (1.9)
EFMP	-- (--)	1 (0.8)	-- (--)	1 (0.3)
Child development	-- (--)	1 (0.8)	-- (--)	1 (0.3)

Note. Values represent observed frequencies in the SESS with % of subgroup represented in parentheses.

Military Treatment Facility (MTF), Alcohol and Drug Abuse Prevention and Treatment program (ADAPT), Exceptional Family Member Program (EFMP).

*$p < .05$, **$p < .01$.

DISCUSSION

A cluster analytic study was conducted in order to generate empirically driven typologies

that best characterize the USAF suicides for the past decade (1999-2009). In this section, a

summary of the demographic, psychiatric, and event-related SESS information that was

documented for all suicide decedents within our sample is first provided. Next, the study's

findings, in particular the three-cluster solution, are discussed in the context of the existing

scientific literature. Moreover, information about how to best interpret the external validity and

stability of these clusters is provided. A number of strengths and limitations of the study are

reviewed. Finally, research-, clinical- and policy- related implications of the findings are

presented. The USAF's public health approach in addressing the problem of suicide is expected

to benefit from the implementation of a more targeted series of prevention programs which are

tailored to directly meet the unique needs of USAF personnel within each of the identified three

clusters.

General Characteristics of USAF Suicide Decedents (1999-2009)

The first specific aim of this dissertation was to describe the SESS documented

characteristics of USAF decedents between 1999 and 2009. The findings associated with this aim

are discussed in the sections below.

Demographics. USAF suicides occurred mostly among enlisted men with an average age

of 29 years old. There were comparable numbers of married and unmarried suicide decedents.

The disproportionate number of suicides observed among enlisted ranks of E4-E6 should be

qualified by noting that these ranks made up nearly half of the total enlisted force during this

time period (AFPC, 2011). This finding is still noteworthy to insure that prevention efforts do

not overlook this demographic factor while targeting junior enlisted. The racial distribution of

USAF suicides 1999-2009 closely mirrored the average racial composition of the total force 1999-2009 (i.e., Caucasian 75%, African American 13%, Hispanic 5%, Asian 4%). The demographic findings observed in this study were also comparable to those previously reported by Stall & Hughes (2002) who examined the SESS data for the period of 1997 through 2000.

Documented Psychiatric History. One of the more notable findings was the overall low levels of documented psychopathology among USAF suicide decedents. Less than half of decedents had a documented history of a psychiatric disorder at the time of death. Alcohol-related disorders were most common, followed by mood, anxiety, and adjustment disorders. Data is not readily available regarding base rates of psychiatric disorders in the general USAF population so it is unknown if the rates of psychiatric disorders observed in this study are similar or different from the general USAF population. They do appear to be discrepant in comparison to civilian suicides. Meta-analytic findings from the civilian literature suggest that over 80% of those who die by suicide have a diagnosable psychiatric disorder at the time of death with mood disorders being the most common, followed by substance related disorders (Arsenault-Lapierre, Kim, & Turecki, 2004; Cavanagh, Carson, Sharpe, & Lawrie, 2003; Isometsa, 2001; Rhimer, 2007). As stated previously, the SESS data collection methods may not allow for the most reliable estimates of psychopathology prior to suicide. An alternate explanation is that USAF personnel may choose not to disclose psychiatric history prior to entry into the military. If the rates of psychopathology observed in the SESS are an underestimate, enhancements in the DoDSER surveillance system will provide a more precise estimate in the years to come. Nevertheless, even if USAF decedents are truly less likely, compared with the civilian population, to have a prior psychiatric history, clinical attention to alcohol-related disorders, adjustment, mood, and anxiety disorders as risk indicators is a must. The finding that alcohol

related disorders superseded mood disorder among USAF suicides may be useful to disseminate in education and training materials of both the AFSPP and Culture of Responsible Choices (CoRC) programs.

Approximately 11% of suicide decedents had a documented history of suicide-related behaviors compared to civilian estimates of 20-50% (AFSP, 2008). One explanation for the observed discrepancy may be due to the screenings employed by the USAF at the time of entry which are aimed to produce a healthier force. However, the more plausible explanations are similar to what was stated earlier – specifically the following: (1) the concealment and/or underreporting of prior psychiatric diagnoses, psychiatric hospitalizations, and suicide-related behaviors at time of entrance into military service or while serving on active duty; and (2) the SESS data collection methods not cross referencing military health records for the documentation of such history.

Documented Life Stress Precipitants. Life stressor precipitants were annotated in 92% of suicides with 65% occurring in the 72 hours prior to death. The absence of life stressor precipitants for the remaining 8% indicate either a valid observation or most likely issues related to the documentation of such events in the SESS database. The number of documented life stressor precipitants among decedents ranged from zero to ten (average of 2.86), with approximately75% experiencing multiple precipitants. The average number of documented life stressors prior to suicide reported in the civilian literature (Kolves et al., 2006; Marttunen et al., 1998) ranges from one to three which is comparable to the averages observed in this study. One may argue that military personnel face a greater number of life stressor precipitants prior to death – especially those with deployment and combat related exposure. However, to date, there is no scientific data available on this issue.

What is known is that identifiable precipitants are present in the majority of suicides (Cavanagh et al., 1999; Cheng, Chen, Chen, & Jenkins, 2000; Kolves et al., 2006; Phillips et al., 2002; Staal & Hughes, 2001). While some researchers (Cheng et al., 2000) have argued that the meaning of an adverse life event (i.e., loss of a cherished idea) is more relevant to increased suicide risk than the cumulative number of stressors, other researchers have cited the mounting number of life stressors as a major contributor to suicide (e.g., Kolves et al., 2006). Considering our findings (25% with 1 or less stressors, 75% with 2 or more) and the expectation that each typology presents a different path to suicide, both perspectives above may be important to consider when assessing suicide risk in military personnel. As noted earlier, the high percentage with identifiable precipitants observed in this study may reflect the additional stressors associated with military service and/or the comprehensive approach utilized in the AFOSI death investigations. However, a noteworthy finding is that the most common documented life stressor precipitant occurring in the 72 hours prior to death (i.e., noted in 27% of cases) is not related to a military specific stressor but instead an interpersonal stressor – i.e., an argument with one's spouse, significant other, or family member.

Communication of Suicide Intent and Help Seeking Behaviors. Approximately half of the decedents communicated their suicide intent to someone prior to death. One-third of these communications were to a family member or friend/coworker (i.e., family member was the most likely recipient), 1% to someone in their military chain of command, and 4% to a helping services professional and/or agency. The frequency of communication observed in this study is comparable to the civilian literature which ranges from 40-80% depending on how communication of intent is defined (Canter, Giles, & Nicol, 2004; Isometsa, 2001; Robins, Gassner, Kayes, Wilkinson, & Murphy, 1959). Spouses and relatives have similarly been cited as

top recipients among civilian suicides. The total percentage of USAF decedents who communicated their intent (51%) was substantially higher than the 25-28% reported in recent surveillance reports on DoD suicides (ASER, 2007; DoDSER, 2008; DoDSER, 2009).

At the time of 1-month prior to suicide, the services of primary care physicians (PCPs) and mental health providers (MHPs) were equally sought (PCPs = 24%, MHPs = 23%). This finding differs from the estimated higher civilian rates of PCP (45-75%) versus MHP service utilization (25%) at 1-month prior to suicide (Appelby et al., 1999; Luoma et al., 2002; Vastag, 2001); yet the finding is in accord with the rates of service utilization among military suicide decedents (ASER, 2007; Hoge et al., 2004; Rowan & Campise, 2006; Stander et al., 2004). The observed differences between the military and civilian rates may be due to the more heterogenous age range captured in the civilian suicides compared to the more homogenous age range captured in the military suicides. A significant prevention related implication of the findings noted is that almost one-fourth of suicide decedents are presenting to either primary care or mental health within 30 days of suicide. With an enhancement of program wide evidence-based suicide risk management practices within the USAF, the assessment and treatment needs of this highly vulnerable subgroup may be better met.

Pre- and Post- OEF Comparisons of USAF Suicide Decedents (1999-2009)

The second specific aim of this dissertation was to compare the characteristics of USAF suicide decedents with recorded deaths prior to the onset of OEF (i.e., 1999-2001) against those with deaths occurring after 2001 (i.e., 2002-2009). USAF suicides that occurred prior to the onset of OEF did not differ from those occurring after the onset of OEF on any of the demographic variables examined (i.e., age, gender, race, marital status, or military rank).

Given the understanding of a multitude of life stressors associated with deployment during times of conflict (e.g., Hoge et al., 2006), the post-OEF USAF suicide decedents were expected to demonstrate a greater number of life stressor precipitants prior to suicide in comparison to their pre-OEF counterparts. However, such differences were not noted within the SESS. Approximately 13% of the USAF suicide decedents had a documented history of at least one deployment. Given that the SESS database does not accurately capture number, dates, location, and duration of military deployments as well as the types of exposure encountered during one's deployment, no conclusions about the association of deployment and suicide may be drawn from this study. In addition, it remains unknown whether the USAF personnel tasked with entering data into the SESS have a menu of various life stressor precipitants to choose from and are adequately trained to systematically document all relevant stressors versus selecting the primary precipitants perceived to be the most salient in each case. Recent efforts by the DoD and the ARMY STARRS to refine data entry fields and procedures for DoDSER cases are expected to address some of the mentioned concerns.

Our null finding about deployment is congruent, however, with recent reports that also fail to show a relationship between USAF suicides and deployment to a combat zone (DoDSER, 2008; DoDSER, 2009; Kindt, 2009). Current data indicate that less than a third of USAF personnel who die by suicide have deployed in support of OEF/OIF and less than 10% have any direct combat experiences (DoDSER, 2009). Despite these findings, existing programs should continue their efforts to address deployment as a potential stressor to the individual, the family, and the organization. Maintaining day-to-day operations in units that are undermanned due to deployment taskings may confer additional strain on members in-garrison.

Empirically Derived Typologies of USAF Suicide Decedents (1999-2009): Cluster Solutions

The third specific aim of this dissertation was to determine the optimum number of clusters that could classify a randomly selected sample of USAF suicides based on their demographic, psychiatric, and psychosocial characteristics as documented in the SESS database. A three-cluster solution was found.

A typology was conceptualized as the constellation of characteristics (i.e., behaviors, cognitions, and affective states) that may elucidate individual motivations of suicide subgroups. Our intent of proposing a "typology" for each empirically derived subtype of suicide was threefold: (1) to provide the clinician with a useful heuristic to better understand how demographic and psychosocial risk factors converge in suicide, (2) to begin a line of research on military suicide that could more clearly identify and target the unique needs of subgroups of individuals at risk, and (3) to identify actionable items that can be engaged and mitigated at the individual, clinician, unit, and policy levels. Although we proposed four typologies prior to this investigation, this was speculative and secondary to our primary aim of empirically identifying subgroups based on the data. The typologies proposed prior to analyses were derived from the suicide typology theoretical literature. The sections below will present the three-cluster solution as an empirically derived typology of USAF suicides.

Autonomous/Isolationist (A/I). Cluster 1 appears to match closely our proposed Autonomous/Isolationist typology. Distinguishing demographic features of this typology are single or divorced marital status, junior enlisted rank, and living alone. In terms of suicide-event related factors, Cluster 1 appears to have a low number of documented life stressor precipitants with a high incidence of alcohol related incidents in comparison with the other two clusters. In comparison with the other two clusters, decedents of cluster 1 also have the least number of documented psychiatric conditions as well as prior suicide-related events. Problems with a

significant other serve as the leading stressor within this cluster and in comparison with the other two clusters. Roughly half of individuals in cluster 1 did not communicate their intent to others according to SESS data. Of those who did communicate their intent, friends or coworkers were the most common recipients and family members were the least common recipients. Although approximately half died at a personal residence, this cluster had the highest proportion of individuals who died by suicide in a military dormitory. In comparison with the other two clusters, cluster 1 had the lowest percentage of living with a partner with or without a child. Similar to the entire SESS sample, firearms and asphyxiation were the top two suicide methods. This cluster had the highest proportion of deaths by overdose. It is speculated that the core belief of this typology is related to alienation and isolation.

Of the typology literature reviewed, aspects of three of previously proposed theoretical typologies are consistent with the proposed A/I typology of suicide. The low levels of social integration and lack of purpose/meaning proposed in Durkheim's "egoist" appears to fit this group of suicides as does the "alienation factor" proposed by Henderson & Williams (1974). The low communication of intent, inability of those surrounding the individual to identify an acute trigger for suicide, and demographics (i.e., junior enlisted, single/divorced, and living alone) reflect this alienation and isolation. Although the escapist typology proposed by Baechler (1979) could be viewed as fitting all of our typologies, it is particularly relevant to our A/I suicides. Baechler proposed three subtypes of escapist suicides. The "flight from an unbearable situation" may be the most relevant to our A/I suicides. The higher incidence of documented substance related incidents and diagnoses may be conceptualized as an attempt to escape. Similarly, the lack of social integration into a highly collective society (i.e., USAF) may be perceived as an unbearable or intolerable situation where suicide becomes a potential solution.

Considering the low levels of social integration and high rates of substance use behavior among this typology, coworkers and ADAPT personnel may be most likely to encounter and identify individuals at risk. Since this typology is not likely to directly communicate suicide intent, it may be helpful for wingmen and supervisors to reach out to junior enlisted personnel who are not well integrated socially, especially if excessive substance use is suspected. Including information regarding the importance of social integration in primary prevention efforts such as annual training may be beneficial. Although none of our typologies were significantly more likely to have been in contact with ADAPT services prior to death, it may be useful for ADAPT personnel to be aware that the above constellation of factors may represent an individual in distress who warrants a more careful assessment of suicide risk. At the organizational level, unit commanders and first sergeants could routinely assess levels of perceived social integration in their unit, identify individuals who may not be integrating as expected, and provide countermeasures (i.e., assign a wingman, provide social opportunities for personnel, etc.).

Escapist/Controlling (E/C). Although cluster 2 did not have many of the hypothesized features initially proposed with the Escapist/Controlling typology, the high lethality, low chance of rescue and likely core beliefs of this cluster appear to fit the E/C typology with some modifications. Distinguishing demographic characteristics of this typology are married, senior enlisted and/or field grade officers who live with a partner (with or without child). This typology has the lowest percentage of African Americans and divorced decedents among all clusters. Top precipitant preceding suicide is an argument with a significant other. The E/C typology appears to have a moderate level of documented psychopathology in comparison to the other clusters with mood disorders being the most common diagnosis. Although not statistically significant, it is noteworthy that this cluster has the highest proportion of suicides where a criminal act was

documented. It is possible that for a portion of this group, suicide is an escape from embarrassment or shame. Similarly, the high lethality and low chance of rescue observed in the E/C suicides may be related to exerting control. Although the most common location for suicide among E/C suicides is a personal residence, they are more likely to select an isolated public location than other typologies. They also have the highest use of firearms of all clusters and the lowest use of overdose. The vast majority (i.e., over 90%) will not communicate their suicide intent. It is speculated that the core belief among this typology is related to exerting control over unacceptable situation such as shame or failure.

Specific features of previously proposed theoretical typologies are consistent with our E/C typology. The over integration into a strongly collective society proposed by Durkheim's "altruistic" suicide is reflected by the senior enlisted/officer ranks among this cluster as well as the low communication of suicide intent prior to death. The self-blame and avoidance of unbearable pain, humiliation and punishment seen in our E/C typology was also noted by several theorists typologies such as Menninger's "wish to die", Henderson & Williams (1974) "avoidance factor", Shneidman (1980) infa-avoidance, and Baechler (1979) "escapist" typology. An additional feature of this typology appears to be the need to control one's environment and/or an attempt to solve an intolerable problem (i.e., criminal prosecution, failure of primary relationship, conflict between occupational and family demands). This controlling or problem solving feature noted in our E/C typology is consistent with both Leonard's (1967) "unaccepting" suicidal type (i.e., denial of illness, problems, or weakness and dogmatic, all or nothing, outlook) as well as Mintz's (1968) "adaptational" suicide where suicide is viewed as an individual's maladaptive effort to solve some type of intolerable problem or unbearable situation.

The E/C typology appears to be the most neglected in current primary suicide prevention campaigns. The senior ranks and almost total absence of suicide intent communications observed among this typology presents a unique secondary prevention challenge. Since junior members may be hesitant to ask a more senior member if they are in distress, an additional module of suicide prevention training targeting senior ranking individuals may increase peer recognition and reporting. Although more research is still needed, if individuals in this typology are in fact using suicide as a method of "controlling" an unacceptable situation, this motive may be capitalized on when tailoring interventions and campaign materials (e.g., taking control means seeking professional help).

Attached/Dependent (A/D). Cluster 3 appears to be most closely aligned with our proposed A/D typology. Although certain demographic factors initially proposed in our A/D typology were not consistent (i.e., bimodal age and rank) many of the "event information" and "risk factor" variables projected for the A/D typology are highly consistent. Key demographic features of this typology are highest percentage of mid-grade enlisted (E4-E6) and African Americans among all clusters. A/D suicides have the highest percentage of argument with spouse, significant other, or family member as a precipitant and documented interpersonal stressors. This typology also has the highest percentage of all psychiatric diagnoses documented in the SESS with mood disorders being the most common diagnosis. This typology has the highest communication of intent prior to death of all clusters, with nearly all decedents communicating intent prior to death. Similarly, this typology has the highest communication of intent with helping services and chain of command. In comparison to the other clusters, A/D decedents are most likely to choose their personal residence as the suicide location and least likely to choose an isolated public place. Although firearm is the most common method of

suicide for decedents within this cluster, this typology has lowest use of firearms overall among the three clusters and the highest use of asphyxiation. It is speculated that the core belief of this typology is related to the perception that living without a romantic partner is intolerable.

Several features of typologies covered in our review are consistent with our attached/dependent suicide typology. The experience of, and attempt to flee from, unbearable pain as demonstrated by the high rate of psychopathology and partner relational problems as a precipitant is congruent with Menninger's "wish to die" and Baechler's escapist "grief over a loss" subtype. The interpersonal nature and prominence of relational problems in the A/D suicide typology was also posited by Shneidman (1968) in his "dyadic" suicide where the interplay between social and psychological factors related to significant others in the decedent's life is prominent. Lastly, the high percentage of individuals that communicated their intent prior to death is consistent with Mintz's (1968) "communication" subtype where the suicide event is conceptualized as a type of appeal or a cry for help where decedents actually desire intervention from others. The lower use of firearms also appears to be consistent with Mintz's hypothesis.

Considering the high rates of psychopathology and communication of suicide intent among this typology, this group is most likely to have already been identified, or at least been in contact with, helping services prior to death. It is important to note, that despite diagnosed psychopathology and communication of intent, they still died by suicide. It is unclear if the progression towards suicide continued because they were not identified as "at risk" due to something in their clinical presentation that masked risk or if individuals fitting this typology still perceive no option but suicide despite the best efforts of those who had contact. It may be useful to qualitatively study individuals fitting this typology who attempt suicide to improve secondary and tertiary prevention measures. Understanding the interaction of cognitions and efforts at help

seeking occurring prior to a suicide attempt may provide insight into how to best address their needs when in distress. Since these suicides appear to be largely interpersonal in nature, including military spouses and/or romantic partners in primary prevention efforts may lead to increased identification of suicide risk by the primary recipient of their suicide intent communications.

Comparison to O'Connor, Sheehy, & O'Connor (1999)

As the only empirical investigation of suicide death to employ hierarchical cluster analysis, the design, methodology, and findings from O'Connor and colleagues (1999) warrant special consideration. First, many of their variables used in the clustering procedure were comparable to those available and used for the current study (e.g., psychiatric diagnoses, previous hospitalization or suicide attempt, living situation, verbalization of intent, distal and proximal stressors, and visits to general practitioner). Moreover, they used similar procedures in their cluster analysis (i.e., step-wise criterion, split-half stability analysis). It is noteworthy that O'Connor et al. also found three clusters in their data and aspects of their clusters were parallel to our findings. The following characteristics noted in the O'Connor et al. cluster 1 were also found in cluster 1 of the current study: highest proportion of decedents that were younger, single or divorced, living alone, and the lowest proportion with a previous suicide attempt or a visit to a general practitioner in the 6 months prior to death. Their cluster 2 was similar to our cluster 2 in that they were older, had relationship problems, and a moderate level of psychopathology. However, a marked difference was that over half of decedents in the O'Connor et al. cluster 2 communicated their intent and this was largely absent among our cluster 2. Lastly, their cluster 3 was similar to ours in terms of having the highest rates of psychopathology, previous suicide attempt, and contact with a helping service (e.g., general practitioner) but theirs had much lower

communication of intent (37%) as compared to ours (98%). The differences noted above may be related to differences in the specific variables used in the analyses or possibly related to more heterogeneity in their sample (i.e., unemployed, higher percentage of females and decedents over the age of 56).

Comparison to Cluster Analytic Findings on Nonfatal Suicide Behavior

It is generally accepted that nonfatal suicide behavior (i.e., suicide ideation, gestures, and attempts) differs from death by suicide on several factors such as age, gender, intent, and outcome. However, there were several notable similarities worth mentioning between our findings and the cluster analytic findings on nonfatal suicide behavior previously reviewed. The most relevant study was conducted by Kiev (1976) who used cluster analysis to identify seven typologies: 1) suicidal gesture, 2) acute depressive reaction, 3) passive-aggressive and passive-dependent personality disorder, 4) anxiety reaction with interpersonal conflict, 5) socially isolated, 6) suicidal preoccupation, and 7) chronic dysfunctional. Kiev's socially isolated typology is aligned with our A/I typology in regards to prominence of social alienation. Our E/C typology appears to be similar to two of Kiev's clusters (i.e., acute depressive reaction and anxiety reaction with interpersonal conflict). The depression, perceived inability to cope with current stressors and high lethality of attempters noted among the acute depressive reaction typology is similar to aspects of our E/C typology (i.e., high use of firearms, low communication of intent, attempt to exert control via suicide). Similarly, the high tension, guilt, and interpersonal conflict noted among Kiev's anxiety reaction with interpersonal conflict typology corresponds with the higher incidence of criminal acts and prominence of interpersonal conflict observed in our E/C typology. Lastly, the high levels of psychopathology, communication of intent, acute and non-acute life stressors, and lower level of lethality observed among our A/D typology

seems to encompass aspects of three typologies described by Kiev (i.e., passive-aggressive and passive-dependent personality disorder, suicidal preoccupation, and chronic dysfunctional). A similar cluster analysis study was conducted by Paykel & Rassaby (1978) who found a three cluster solution (i.e., overdose, more severe attempts, and multiple mild attempts) among suicide attempters. While there were some similarities in the differing motivations of each cluster (i.e., interpersonal, self-destructive, overtly hostile) their emphasis on method of attempt in interpreting their clusters and their null findings regarding demographics and precipitants make this study less relevant.

Stability and External Validity of Observed Clusters

The fourth specific aim of this dissertation was to evaluate the stability and external validity of the observed cluster solutions to confirm that the number and the structure of clusters derived from the first randomly selected SESS suicide records were similar to the second randomly selected SESS suicide records.

Stability of Cluster Solution: Split-Half Analysis. Since clustering procedures will impose structure (i.e., groups) on data, some method of assessing stability of the cluster solution must be used. One of the most common, and recommended, methods is to use a split-half analysis previously described (Aldenderfer & Blashfield, 1984). Ideally, the split-half analysis should render a "substantial" kappa value of 0.61 or greater. Aldenderfer & Blashfield (1984) note that "failure of a cluster solution to replicate (across samples) is reason for rejecting the solution" (p. 65). They do not, however, offer clear standards for what should be an acceptable level of agreement between cluster solutions or at what point one should reject the cluster solution.

In fact, many cluster analytic studies in the literature either fail to assess or fail to clearly report how they addressed cluster stability (Clatworthy et al., 2005). While using a split-half analysis or similar strategy to assess stability is recommended, only 29% of studies evaluated by Clatworthy and colleagues used such procedures. A review of available articles revealed wide variance in the methods used to assess agreement between samples and/or clarity in reporting. The majority of studies reviewed did not report a kappa coefficient or Rand index (Bombardier, Divine, Jordan, & Brooks, 1993; Denollet, 1993; Dew et al., 1998; Guck, Meilman, Skultety, & Poloni, 1988; Litt, Kalinowski, & Shafer, 1999). In the studies reporting kappa values (Jamison, Rock, & Parris, 1988; Raja, Williams, & McGee, 1994), these ranged from $k = 0.31$ to $k = 0.64$. Two studies reported the percentage of cases reassigned during the comparison of cluster solutions (Denollet, 1993; Dew et al., 1998) which ranged from 11% to 16% of cases. Perhaps most relevant to our study, O'Connor et al. (1999) used a similar strategy in their cluster analysis of suicides. These authors reported both the percent reassigned between linkage methods for the entire sample (18%) as well as for the split-half analysis (30% and 32%).

While the level of agreement in this study was less than expected ($k = 0.401$, $p = 0.000$), our findings are still of significant value to this area of research. Hierarchical cluster analysis is most often used as a hypothesis generating statistical procedure. This is particularly pertinent in studies such as this where there have been no previous empirical investigations into subgroups or typologies. Additional research is warranted and this study may serve as a useful point of departure for future investigations. Future inquiries into military suicide typologies could test and/or refine the empirically derived typologies observed in this study.

External Validity: Comparison of Services Utilization Across Clusters. An association between cluster membership and helping services utilization was hypothesized.

Health care utilization services such as primary care (noted as MTF), mental health, and ADAPT

were particularly of interest within the nine helping services categories registered in the SESS.

Based on observed characteristics of each of the three identified clusters, decedents within

cluster 2 were expected to demonstrate the lowest rates of helping services utilization and those

within cluster 3 were expected to show the highest.

Of our empirically derived clusters, cluster 3 actually had the highest utilization of

helping services prior to death at both 12 months and 30 days prior to death. There were no

significant differences in MTF utilization across the clusters for either time points. Clusters

differed significantly in their utilization of mental health services at both time points with cluster

3 showing the highest and cluster 1 showing the lowest. While there is no existing military-

related research study that can be used for comparative purposes, there is one civilian study

similar to ours that found differential utilization of helping services prior to death among their

three cluster solution (O'Connor et al., 1999).

In terms of demographic characteristics, based on our previous psychological autopsy

research on USAF suicides (Martin, 2009), the variables of marital status and rank were of most

interest. There were significant differences in marital status, rank and race observed among our

clusters. Cluster 2 had the highest percentage of married individuals and cluster 1 had the lowest.

Cluster 1 also had the highest percentage of single and divorced persons. Regarding rank, the

highest percentage of junior enlisted and junior officers were in cluster 1, the highest percentage

of senior enlisted and senior officers were in cluster 2, and the highest percentage of mid-level

NCOs were in cluster 3. The only differences regarding race were that cluster 2 had a

substantially lower number of African Americans when compared with the other two clusters.

Due to the overall low number of African Americans among our suicide cases (n = 48), this

finding may be spurious. However, the trend for key demographic variables to differ among clusters is consistent with the O'Connor et al. (1999) findings. Moreover, this lends support to the validity of our three-cluster solution. Since our clusters differed when compared on variables not included in the clustering process, it suggests that these groups differ in clinically meaningful ways.

Standard Reporting of Cluster Analysis Findings. In their systematic review, Clatworthy and colleagues (2005) provided a set of clear guidelines for the reporting of cluster analytic findings. This dissertation was designed to follow these recommendations as closely as possible. The following criteria were addressed and reported throughout this manuscript: (1) the specific computer program used for statistical computations (page 62); (2) the measure used to assess similarity between cases (pages 64, 70); (3) the method of cluster analysis employed (pages 64, 70); (4) the procedure used to determine the number of clusters (pages 64-64, 70-71); and (5) evidence for both the stability (pages 65, 79) and value (page 65, page 79) of the clusters.

Additional Clustering Procedure Including Helping Services Utilization. All variables related to suicide decedents' use of military helping services were intentionally excluded from the initial clustering procedure. The rationale for excluding variables related to helping services utilization was to have unused variables to assess external validity of the clusters in the second stage of analyses. This is in accordance with Clatworthy and colleagues' (2005) recommendation of comparing clusters on some meaningful outcome variable that was not used in the clustering procedure. The decedents' use of military helping services is thought to be meaningful to suicide prevention efforts and policies. Moreover, prior research with this population (Martin, 2009) suggests that there is an association between some of the variables used in clustering (i.e., age, race, rank, and marital status) and utilization of health care services.

However, excluding helping services overemphasizes individual factors and neglects the

potential role of environmental factors (i.e., stigma, barriers to care, etc.) that might be captured

by including utilization of helping services in the clustering variables. Thus, a secondary

hierarchical cluster analysis procedure was conducted. This additional analysis included helping

services utilization in the variables used for assigning cases to clusters. This strategy also

broadens the scope of analyses beyond primary prevention targets to include secondary and

tertiary points of intervention such as help seeking behavior prior to suicide.

Inspection of the denodgram indicated that a three or four cluster solution may both be

viable cluster solutions. Since this analysis was secondary to the primary cluster analysis, which

excluded utilization of helping services, the intent here was to determine percentage agreement

(i.e., kappa coefficient). Thus, a three cluster solution was imposed on the secondary procedure

to allow direct comparisons with the initial cluster solution. The overall agreement between the

cluster solutions (e.g., with and without helping services utilization) was moderate ($k = .457$, $p =$

000). However, it is important to note that the low kappa value may be related to the high

percentage (54%) of cases reassigned in the Attached/Dependent cluster. Reassignment

percentages for the Autonomous/Isolationist cluster (18%) and the Escapist/Controlling typology

(36%) were reasonable, suggesting some stability among these two clusters.

Study Strengths and Limitations

As only the second study using cluster analysis to examine suicide typologies, the intent was

largely to explore available data and generate hypotheses for future research. As such, this study

has several strengths and limitations worth noting.

Methodological. First, given the retrospective design, the potential for recall bias exists.

While retrospective designs are common in suicide research due to the low base rate of suicide,

prospective designs may be used in future studies to examine typologies of individuals with suicide ideation or suicide attempt. The potential for recall bias exists not only in regards to the data analysis and interpretation but also applies to the initial investigation and data entry by OSI personnel. All data entry occurred after the individual had died by suicide. It is possible that foreknowledge that a death is potentially a suicide may impact informant, OSI investigator, and coder recall.

There have also been concerns regarding the accuracy and reliability of SESS data reported by military researchers (D'Mello, Eaton, & Gould, 2006). This was carefully considered during the design phase of this study and was partially responsible for our decision to exclude attempter data and use only suicide data which is believed to be more reliable. While each base typically has a designated person to enter attempter data into the SESS, the level of training, infrequent access to the SESS system, and sheer number of bases entering data into the system likely introduce great variability in coding. Suicide deaths, however, can only be entered by three investigators specifically designated by Headquarters USAF/OSI. We consider the level of experience and small number of coders in death cases to be a relative strength of the study that reduces variability and likelihood of errors in coding. Moreover, the source documents used to complete the SESS are collected and compiled by highly trained USAF/OSI investigators as part of their death investigation files described elsewhere (Martin, 2009). The level of attention and scrutiny each suicide case receives within the USAF makes major errors in coding less likely.

Although the SESS data collection form (Appendix A) was originally designed with the input of suicide subject matter experts, there were inherent limitations. The SESS operationalized life stressor precipitants as stressors occurring in the period 72 hours prior to death. It is possible that this timeframe is too restrictive and relevant precipitants could be overlooked. Making this

variable categorical (i.e., 24 hours, 72 hours, 1 week, 2 weeks) may be more appropriate to capture potentially relevant precipitants. Similarly, questions regarding deployment in the SESS were extremely limited and did not include an index of combat exposure. It is recommended that future suicide surveillance address these two areas. It may be useful to have suicide surveillance data collection forms reviewed and revised regularly by a multi-disciplinary panel (i.e., researchers, military clinicians, suicidologists, DoD suicide prevention program managers). An initial move towards standardization has already been made by replacing service-specific suicide surveillance systems with the DoDSER. It is unknown if data entry across services has been standardized or if regular quality control measures have been implemented to date. It is recommended that standardization of accurate data entry for fatal and nonfatal suicide behavior be a program priority.

Statistical Procedure. Hierarchical cluster analysis also has inherent limitations. This statistical procedure will assign cases to groups regardless of whether those groupings are meaningful. While this concern has been partially mitigated by our finding that clusters did in fact differ in ways meaningful to suicide prevention (i.e., significant differences among cluster in utilization of certain helping services), more research is needed to refine and strengthen our findings. Similarly, the level of agreement when examining the stability of our cluster solution was fair, suggesting that the ability to replicate in future USAF samples may be questionable. However, as the first study to employ a method intended to generate hypotheses, refinement rather than replication may be a more appropriate second step. Future inquiries can now start with the clusters in which some stability was demonstrated (A/I and E/C clusters) and add to the field's understanding. An additional consideration is that this study was limited to the variables available in the SESS for all analyses. It is possible that the three cluster solution observed in this

study is reflective of the available variables and the addition of other variables may result in a different cluster solution. Since all variables in the SESS are considered relevant to suicide prevention and the intent was to assess across-levels, the variables included for this initial, exploratory study was justified. However, future cluster analytic research examining military suicide may consider eliminating variables that did not appear to be significant factors in the clustering procedure or possibly include additional variables that were absent from the SESS data collection form.   **Generalizability.** Lastly, since this study only examined active duty USAF suicides, our findings may not generalize to samples of civilians or other military service components. In 2009, the SESS system was disbanded and supplanted by the Department of Defense Suicide Event Report (DoDSER) system. Future investigators now have the capacity to apply our typologies to additional USAF samples and to examine generalizability to other service components within the DoD.

Implications and Future Directions

   Clinical Implications. Having a useful typological model of USAF suicides has numerous clinical implications. First, understanding the various motivations and pathways to suicide among USAF decedents may improve primary prevention efforts by better targeting groups at risk with prevention materials that more closely address their specific needs. Using a "one size fits all" approach to suicide prevention and treatment does not account for the between group differences that appear to exist. This rationale also holds for reducing stigma, improving access to care and treatment options for USAF personnel at risk for suicide. It is important to note that all previously established risk and protective factors still apply and should be assessed with every patient. The typological model proposed here is an additional tool to help the clinician

identify constellations of psychosocial factors indicative of risk based on typology that may otherwise be missed if focused strictly on the prototypical "suicidal person."

For instance, in the Escapist/Controlling typology, the extremely low rates of helping services utilization among this higher ranking group suggests that concerns regarding career impact may be a prominent barrier to seeking care. A primary prevention strategy may be informing all personnel that there are resources available to them that have increased confidentiality and are removed from the documentation requirements of the military medical system such as Chaplains or Military Family Life Consultants. This may reduce concerns regarding career impact. Moreover, emphasizing that our wingman responsibilities extend "up the chain" may mitigate the low communication of intent among this group and encourage peers or junior members to more openly express their concerns if they recognize individuals in their chain of command that appear to be in distress.

Similarly, the low social integration observed in the Autonomous/Isolationist typology is a secondary prevention strategy that can be targeted at the individual (i.e., peers), unit (i.e., supervisors and coworkers), and strategic levels (i.e., commanders and USAF leadership). Requiring a multi-level assessment of social integration for members may be useful at early identification of individuals that are struggling to fit in so countermeasures can be implemented. Since the Autonomous/Isolationist typology exhibits high rates of documented substance use behavior, providing additional training for ADAPT personnel in thoroughly assessing suicide risk is a secondary prevention strategy that may also increase identification when at risk individuals present for assessment.

Lastly, finding some way to effectively include spouses and significant others in primary prevention efforts such as annual suicide prevention training appears to be warranted. While this

appears to be particularly important for the Attached/Dependent typology where interpersonal conflict with romantic partners is highly salient, this additional "point of intervention" may be useful in the majority of USAF suicides as the romantic partner is best positioned to notice changes in behavior that may suggest increased suicide risk.

Policy Implications. Based on the above study, we would like to offer five policy level recommendations: (1) update training materials (e.g., the Air Force Guide for Managing Suicidal Behaviors) to address that subgroups may exist, (2) revise the wingman concept to encourage peer and subordinate recognition/identification of individuals at risk, (3) provide additional training for helping services personnel on possible typologies of suicide and how to best tailor evidence-based assessment and treatment practices to the unique needs of each identified group, (4) include assessment of social integration for new personnel in commander ratings and promote programs that enhance social support and minimize isolation, (5) invest in research that can adequately demonstrate the relationship between timely help seeking and career impact in order to reduce stigma and perceived barriers to care (Hoge et al., 2004), and (6) make suicide prevention trainings 'open source" so all significant others may receive.

Although current suicide prevention material address that individual differences in the pathway to suicide exist, stronger emphasis on this factor may be necessary for non-clinicians to overcome the prototypical picture painted by the popular media (i.e., young, Caucasian, male, junior enlisted, with romantic problems, etc.). Although we would expect clinicians and helping services personnel to know that the pathway to suicide may be highly individualized, it is unknown how well they identify suicide risk if not accompanied by the common markers (i.e., relationship problems, depression, and substance abuse). Knowing that one subgroup of USAF suicides includes senior enlisted/officer personnel that are not likely to seek help may encourage

senior members in distress to seek help and/or provide justification for peers or subordinates to be more effective wingman.

Nonfatal Suicide Behavior. While the findings of this study are derived from individuals who died by suicide, the intent is to better identify and help those at risk *before* they are in crisis. Given that individuals who attempt suicide may differ on a host of factors from those who die by suicide, additional cluster analytic research on those with nonfatal outcomes is much needed. The above clinical and policy implications are based on findings reported in this dissertation on suicide decedents. However, it is possible that those with nonfatal suicidal behaviors demonstrate a different set of typologies. In these cases, understanding that each typology may have a very different set of characteristics (i.e., relevant stressors, motivations, communication and help seeking patterns, etc.) could improve secondary and tertiary prevention efforts. Since the DoD now collects surveillance data on fatal and nonfatal suicide behavior across the services using the DoDSER, it has the potential to make significant contributions to both areas of suicide research. With some improvements, such as standardization of data collection across the services and quality control measures regarding data entry, the DoD suicide surveillance program could possibly serve as the model for state and national suicide surveillance registries.

Future Directions. Additional cluster analytic research examining military suicide appears to be warranted. Applying procedures similar to those used in this study to additional military samples now captured in the DoDSER may help to extend or refine the USAF suicide typologies to other service components. It is also unknown what the general, non-clinical, military population considers indicative of elevated risk for suicide. Research assessing military personnel's ability to identify various constellations of risk factors may identify shortfalls in suicide prevention training. Similarly, assessing spouses and significant others level of knowledge regarding

available helping agencies and markers of increased suicide risk appears to be highly relevant. Finally, research examining how units assess and address level of social integration of new or junior members may identify environmental or organizational factors that need attention from a strategic perspective.

Summary

This study makes an important contribution to our understanding of typologies pertaining to USAF suicides within the past decade. Given that individual pathways to suicide differ, this study lends support to the position that homogeneous subgroups of suicide exist within the USAF. These groups can be differentiated from one another by the constellation of demographic and psychosocial variables documented prior to death. While exploratory in nature, cluster analytic studies could improve suicide prevention efforts at all levels by tailoring our prevention and interventions to better align with the needs and motivations of highly vulnerable subgroups at risk. Moreover, our typologies may serve as a useful heuristic for clinicians working with USAF members to more effectively identify and treat individuals in distress. Although use of a strictly USAF population may preclude direct generalization to the larger civilian population and other branches of the military, this study addresses a much needed gap in a largely non-existent empirical literature on suicide typologies.

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Appendix A

Suicide Event Surveillance Database Entry Template

Investigation Form for Completed Suicides and Nonfatal Self-Injurious Events

Identifying Information: *Only people who have access to care in an Air Force facility (i.e., those whose records the Air Force can access) should be entered.*	
Victim's Last Name	Sponsor's SSN
Victim's First Name	Event Date *(mm/dd/yyyy)*
Victim's Middle Initial	**Type of Event** *(circle one)* Completed suicide
Family Member Prefix *(FMP)*	Nonfatal self-injurious event *(any intentional injury to the self that did not result in death)*

Personal Information	
DOB *(mm/dd/yyyy)*	**Marital Status** *(circle one)* Single *(never married)* Married *(includes separated but not legally separated)* Legally separated Divorced Widowed Annulled Unknown
Gender *(circle one)* Male Female	
Race *(circle one)* American Indian/Alaskan Asian/Pacific Islander Black (non-Hispanic) Hispanic White (non-Hispanic) Other Unknown	**Resides With** *(circle one)* Alone Spouse or Partner (with children) Spouse or Partner (without children) Children Only Parents *(biological, step, or adoptive)* Mother Only Father Only Friend Other Unknown
Ethnic Group *(circle one)* Chinese Spanish Descent Japanese Puerto Rican Korean Cuban Descent Filipino None Eskimo Other Aleut Unknown Mexican-American	

Military Information	
Military Service *(circle one) (Civilians who are not affiliated with the military and others who do not fit into the categories below should not be entered into this database.)* Air Force Army Marine Corps Navy Coast Guard Foreign military Other Uniformed Service Veteran's Administration Unknown	**Military Status** *(circle one)* Active duty Military academy cadet Basic trainee Technical Student Guard or Reserve Retired Family member of active duty Family member of retired/deceased Other Unknown

If retired, enter only Pay Grade. If the victim is a dependent, the following questions apply to the victim's sponsor.	
Pay Grade	**MAJCOM of Unit** *(MAJCOM to which the UNIT belongs)* ACC attached to AIA? yes no AETC AFMC AFSOC AFSPC AMC PACAF USAFA USAFE HQ USAF Other
Duty Status *(circle one)* Present for duty Temporary duty *(TDY)* Annual tour of duty *(Guard or Reserve only)* Ordinary leave Terminal leave Other Unknown **Job Title**	
AFSC *(Air Force Specialty Code)*	Unit
DAFSC *(Duty Air Force Specialty Code)*	Permanent Duty Station *(base)*

Temporary Duty Station (*if TDY at the time of the event*)	**MAJCOM of Permanent Duty** (*MAJCOM to which the UNIT is physically located*) ACC attached to AIA? yes no AETC
Deployed at Time of Event? Yes No Unknown	AFMC AFSOC AFSPC AMC PACAF
Deployed in the Last 12 Months? Yes No Unknown	USAFA USAFE HQ USAF Other
Number of Times Deployed? (*within last 12 months*)	**Did clients command conduct suicide prevention training** (*within 12 months*) Yes No Unknown
	Did client attend the suicide prevention training? Yes No Unknown

Event Information

Medical Severity of Event (*circle one*) Mild (*superficial, transient, or self-limited event*) Moderate (*required treatment, but was not life-threatening*) Severe (*was likely to be fatal without treatment*) Unknown	**Primary Method Used** (*circle one*) Cutting or piercing instrument Firearm or explosive Hanging, strangulation, or suffocation Jumping from a high place Motor vehicle crash Poisoning by utility gas Poisoning by vehicle exhaust Poisoning by solid or liquid substance (*overdose*) Submersion (*drowning*) Other Unknown
Victim's Intent (*circle one*) Mild (*self-injury with primary goal to receive attention or assistance*) Moderate (*self-injury with primary goal to harm self*) Severe (*self-injury with primary goal to kill self*) Unknown	
Communicated Intent to (*circle one*) No one (*do not use for suicide*) Family member Friend or coworker Helping services Supervisory chain Other Unknown	**Firearm Type** (*if applicable, circle one*) Handgun Rifle Shotgun Other Unknown
General Location of Event (*circle one*) On base Off base Unknown	**Firearm Source** (*if applicable, circle one*) Military issue Privately owned Unknown
Specific Location of Event (*circle one*) Personal residence Dormitory Temporary lodging (*hotel/motel/billeting*) Victim's workplace Public area, common Public area, isolated Medical facility Confinement facility Other Unknown	**Were Drugs** (*Illicit, Prescription, or Over-the-counter*) **Used During the Event?** (*circle one*) Yes (*confirmed by toxicology screen*) Likely (*suspected because of presence at the site or interview(s); toxicology screen not performed*) Unlikely (*not suspected; toxicology screen not performed*) No (*negative toxicology screen*)
	Specify Drugs (*if applicable and if known*)
Precipitating Event within 72 hours? Yes (*Argument with spouse/family/sig other, Physical* No *fight with spouse/family/sig other, Discovered* Unknown *sexual infidelity of spouse/partner, Spouse/partner discovered sexual infidelity of victim, Death of family/friend, Arrest/detainment for other than alcohol/drugs, Alcohol-related incident, Positive test or possession of illegal drugs, Other legal proceedings, Military discipline (LOR, LOC, Art 15), Nonselect for promotion, Separation from spouse/partner, Significant medical condition/diagnosis, Foreclosure, Bankruptcy, Repossession, Acute financial crisis*)	**Was Alcohol Used During The Event** (*circle one*) Yes (*confirmed by lab*) Likely (*suspected because of presence at the site or interview(s); blood alcohol level not performed*) Unlikely (*not suspected; blood alcohol level not performed*) No (*blood alcohol level < 0.01 g/dl*) *If Yes, then* **Blood Alcohol Level** (*g/dl*)

Use of Military Helping Services *Records from each agency must be reviewed for one year prior to the event.*

Within the past year, was the individual seen by any of the following helping services?

Medical Treatment Facility		Y	N	Family Support		Y	N
If yes, when?	Within 1 month of the event?	Y	N	If yes, when?	Within 1 month of the event?	Y	N
	1-3 months prior to the event?	Y	N		1-3 months prior to the event?	Y	N
	3-12 months prior to the event?	Y	N		3-12 months prior to the event?	Y	N
Medical Facility Type *(if yes to MTF above)*				Financial Counseling		Y	N
	PHA/Preventive Services?	Y	N	If yes, when?	Within 1 month of the event?	Y	N
	Acute illness/injury care?	Y	N		1-3 months prior to the event?	Y	N
	Chronic disease follow-up?	Y	N		3-12 months prior to the event?	Y	N
		Other		Legal		Y	N
		Unknown		If yes, when?	Within 1 month of the event?	Y	N
Mental Health		Y	N		1-3 months prior to the event?	Y	N
If yes, when?	Within 1 month of the event?	Y	N		3-12 months prior to the event?	Y	N
	1-3 months prior to the event?	Y	N	Chaplain		Y	N
	3 12 months prior to the event?	Y	N	If yes, when?	Within 1 month of the event?	Y	N
Substance Abuse Services		Y	N		1-3 months prior to the event?	Y	N
If yes, when?	Within 1 month of the event?	Y	N		3-12 months prior to the event?	Y	N
	1-3 months prior to the event?	Y	N	Exceptional Family Member Program		Y	N
	3-12 months prior to the event?	Y	N	If yes, when?	Within 1 month of the event?	Y	N
Family Advocacy		Y	N		1-3 months prior to the event?	Y	N
If yes, when?	Within 1 month of the event?	Y	N		3-12 months prior to the event?	Y	N
	1-3 months prior to the event?	Y	N	Child/Youth Development		Y	N
	3-12 months prior to the event?	Y	N	If yes, when?	Within 1 month of the event?	Y	N
					1-3 months prior to the event?	Y	N
					3-12 months prior to the event?	Y	N

Risk Factors of Victim *Medical and mental health records for one year prior to the event must be reviewed. Also, interview the victim, a surviving family member, and/or others as needed.*

Within the past year, did the individual have any of the following problems?

	Y	N		Y	N
Previous Nonfatal Self-injurious Events	Y	N	Victim of Abuse or Sexual Assault *(i.e., emotional abuse, physical abuse, domestic violence, or sexual assault)*	Y	N
If yes, was it within the past 3 months?	Y	N			
Mood Disorder *(i.e., major depressive disorder, bipolar disorder, dysthymic disorder, cyclothymic disorder, or strong suspicion of a mood disorder)*	Y	N	If yes, was it within the past 3 months?	Y	N
			Military Legal or Administrative Problems *(i.e., court martial, Article 15, involuntary discharge, unfavorable information file, AWOL or desertion, EEO or EOT complaint, or other military legal or administrative problem)*	Y	N
If yes, was it within the past 3 months?	Y	N			
Psychotic Disorder *(i.e., schizophrenia, schizoaffective disorder, delusional disorder, brief psychotic reaction, schizophreniform disorder, or strong suspicion of a psychotic disorder)*	Y	N	If yes, was it within the past 3 months?	Y	N
If yes, was it within the past 3 months?	Y	N	Under Investigation or Apprehension *(i.e., IG or unit/command-directed inquiry, AFOSI investigation, civilian investigation, or SP investigation)*	Y	N
Anxiety Disorder *(i.e., panic disorder, panic attacks, agoraphobia, specific phobia, social phobia, posttraumatic stress disorder, acute stress disorder, or strong suspicion of an anxiety disorder)*	Y	N			
			If yes, was it within the past 3 months?	Y	N
If yes, was it within the past 3 months?	Y	N	Civil Legal Problems *(i.e., divorce, child custody dispute, bankruptcy, civil trial, or other civil legal problem)*	Y	N
Personality Disorder *(i.e., borderline, paranoid, schizoid, schizotypal, antisocial, histrionic, narcissistic, avoidant, dependent, obsessive-compulsive, or strong suspicion of a personality disorder)*	Y	N			
			If yes, was it within the past 3 months?	Y	N
			Financial Difficulties *(i.e., gambling, indebtedness)*	Y	N
Adjustment Disorder?	Y	N	If yes, was it within the past 3 months?	Y	N
If yes, was it within the past 3 months?	Y	N	Spouse Problems	Y	N
Bereavement *(i.e., death of a loved one)*	Y	N	If yes, was it within the past 3 months?	Y	N
If yes, was it within the past 3 months?	Y	N	Job Loss *(i.e., involuntary separation, laid-off, relieved of duty, fired)*	Y	N
Medical Problems *(i.e., history of chronic illness or severe physical illness)*	Y	N	If yes, was it within the past 3 months?	Y	N
If yes, was it within the past 3 months?	Y	N	Work Problems *(i.e., work dissatisfaction, problems with supervisor or coworker, poor performance review, not selected for promotion, or other work problems)*	Y	N
Alcohol Abuse *(i.e., alcoholism or binge drinking)*	Y	N			
If yes, was it within the past 3 months?	Y	N	If yes, was it within the past 3 months?	Y	N
Illegal Drug Abuse	Y	N	School Problems	Y	N
If yes, was it within the past 3 months?	Y	N	If yes, was it within the past 3 months?	Y	N
Prescription Drug Abuse	Y	N	*Risk Factors continued on the next page*		
If yes, was it within the past 3 months?	Y	N			

Criminal Acts *(i.e., collateral homicide, sexual misconduct, traffic-related, narcotics, crimes against person/property, criminal trial, or other criminal acts)*	Y	N	Family Problem *(Parent, sibling, or other family member)*	Y	N
			If yes, was it within the past 3 months?	Y	N
If yes, was it within the past 3 months?	Y	N	Significant Other Problem	Y	N
Last DSMIV Diagnosis			If yes, was it within the past 3 months?	Y	N
			Other Risk Factors		

Disposition at 2 weeks after the event *(for victims of nonfatal self-injurious events only)*		
Days Admitted to MTF	Current Status *(circle one)* Returned to duty	
Days Quarters	Restricted duty Job transfer	
Days Limited Duty	Medically retired Medically evacuated	
Date Report Submitted	Outpatient treatment Unknown	

Name of Individual Who Collected This Information *(for future reference in your institution)*

Comments: *Please comment on any aspect of this case (i.e., information that you believe is important but was not requested).*

Appendix B

Procedural Guide for Conducting Cluster Analysis in the Proposed Study

The procedures presented here will serve as a guide for the principal investigator of the proposed research as well as those evaluating the proposed analytic strategy. The steps outlined, choice of procedures, and analytic strategies are based on multiple consultations with Dr. Cara Olsen, the biostatistician serving on this dissertation committee as well as based on information gathered from the following references on cluster analytic methods: Aldenderfer & Blashfield, 1984; Clatworthy, Buick, Hankins, Weinman, & Horne, 2005; Everitt, Landau, & Leese, 2001; Garson, 2009; Kaufman & Rousseeuw, 2005; Milligan, 1980; Milligan 1981; Milligan & Cooper, 1985; and Romesburg, 2004.

1) *Acquire and prepare the data for analyses*. In collaboration with the USAF Suicide Prevention Program Manager, de-identified data will be obtained from the USAF School of Aerospace Medicine Epidemiology Consult Service (USAFSAM/PHR) at Brooks City Base, TX. The received data will be converted into an SPSS v16 data file. This statistical software package, hereafter abbreviated as "SPSS," will be used for all analyses in the proposed study. While many of the variables available in the SESS dataset are dichotomous (i.e., yes or no), those variables with categorical responses (i.e., resides with = alone, spouse, roommate, etc.) will be converted into individual binary variables and dummy coded (i.e., resides alone = yes/no, resides with spouse = yes/no, etc). The rationale for this conversion is that cluster analysis can be used with interval, frequency, or binary data. When a dataset contains multiple levels of measurement, it is recommended that either the data be converted or transformed prior to analyses (Everitt, Landau, & Leese, 2001). Since the majority of the

SESS data are binary, the decision to convert categorical data to binary prior to analysis is justifiable.

2) *Random selection of subsample for initial analysis*. Hierarchical cluster analysis is not appropriate for sample sizes over 250 (Garson, 2009). Since there are roughly 40 USAF suicides per year, it is expected that the dataset of all USAF suicides occurring between 1999 and 2009 will total approximately 400. Thus, a random sample of the entire data set will be used for the initial hierarchical analysis by selecting the following SPSS operand: *data/select cases/random sample of cases/approximately 50% of all cases*. Once the optimum number of clusters has been established using this random subsample (see section below), the cluster solution can then be replicated in the remaining sample of suicide cases. Replicating the cluster solution in another sample is a recommended method to assess cluster stability (Clatworthy et al., 2005).

3) *Select the clustering method*. In SPSS, the clustering procedure will be initiated by selecting: *analyze/classify/hierarchical cluster*. The decision to use hierarchical, as opposed to iterative partitioning methods, is based on the observation that the proposed study will be the first to use cluster analysis in determining subgroups of USAF suicides. Thus, forcing the data into a specific number of predetermined groups, as required in iterative partitioning methods, is premature and would be inappropriate for this largely exploratory study (Aldenderfer & Blashfield, 1984).

a) SPSS allows for clustering based on either cases or variables. The current study will cluster based on cases by selecting: *analyze/classify/hierarchical cluster/cases.*

4) *Select and enter variables for clustering into the analysis*.

a) The choice of variables is one of the most critical, yet least understood, steps in cluster analysis (Milligan, 1980). It is recommended that the selection of clustering variables should be based on theory and not merely including as many variables as possible hoping for structure to emerge (Aldenderfer & Blashfield, 1984). Table 1 below depicts the proposed variables to be used in classifying cases to clusters. The table is derived from variables captured in the SESS *Investigation Form for Completed Suicides and Nonfatal Self-Injurious Events* (Appendix 1). The specific variables selected for clustering are based on the theoretical model used to guide the proposed study (pg 48).

b) All variables related to suicide decedents' use of military helping services and certain demographic characteristics have been intentionally excluded from the table. The rationale for this decision is that they will be used in the second stage of analyses to assess external validity of the clusters. This is in accordance with Clatworthy and colleagues' (2005) recommendation of comparing clusters on some meaningful outcome variable that was not used in the clustering procedure. In the proposed study, decedents' use of military helping services is thought to be meaningful to suicide prevention efforts and policies. Moreover, prior research on this population (Martin, 2009) suggests that there is an association between some of the variables used in clustering (i.e., age, race, rank, and marital status) and utilization of health care services. After entering variables used for clustering, the specifics of the analysis must be designated as well as SPSS output options.

Table 6. Variables Used in Clustering Procedure

Personal Information	
Age	
Gender	Male, female
Race	American Indian/Alaskan, Asian/Pacific Islander, Black, Hispanic, White, Other
Marital Status	Single, Married, Divorced, Separated, Widowed, Annulled
Resides With	Alone, Spouse or partner (with/without children), Children, Parents, Mother, Father, Friend, Other
Military Information	
Military Status	Active duty, Academy Cadet, Basic Trainee, Technical Training
Pay Grade	E1-E9, O1-O10
Duty Status	Present for Duty, TDY, On Leave, Other
Deployed Suicide	Yes, No, Unknown
Deployed Last 12 Months	Yes, No, Unknown
Event Information	
Intent	Mild, Moderate, Severe, Unknown
Communicated Intent To	No One, Family member, Friend/Coworker, Helping Services, Chain of Command
General Location of Event	On Base, Off Base, Unknown
Specific Location of Event	Personal Residence, Dormitory, Temporary Lodging, Workplace, Common Public Area, Isolated Public Area
Precipitating Event[9]	Yes, No, Unknown
Primary method Used	Cutting, Firearm, Asphyxiation, Jumping, MVA, Poisoning (gas, exhaust, or overdose), Submersion, Other
Drugs Used in Event	Yes, Likely, Unlikely, No
Alcohol Used in Event	Yes, Likely, Unlikely, No
Risk Factors of Victim	
Previous Self-Injury	Yes, No
Mood Disorder	Yes, No
Psychotic Disorder	Yes, No
Anxiety Disorder	Yes, No
Personality Disorder	Yes, No
Adjustment Disorder	Yes, No
Bereavement	Yes, No
Medical Problem	Yes, No
Alcohol Abuse	Yes, No
Illegal Drug Abuse	Yes, No
Prescription Drug Abuse	Yes, No
Victim of Abuse or Sexual Assault	Yes, No
Military Legal Pending	Yes, No
Under Investigation	Yes, No
Civil Legal Problems	Yes, No
Financial Difficulties	Yes, No
Spouse Problems	Yes, No
Job Loss	Yes, No
Work Problems	Yes, No
School Problems	Yes, No
Criminal Acts	Yes, No
Family Problem	Yes, No
Significant Other Problems	Yes, No

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[9] Precipitating events occurring within 72 hours of suicide

5) *Input specifics of the analysis (statistics, plots, method) and select output options.*

a) In SPSS select: *analyze/classify/hierarchical cluster/statistics*

i) Both proximity matrix and agglomeration schedule should be selected for the SPSS
output. The proximity matrix, similar to a correlation matrix, is a table that shows the
distance of each case to every other case. The agglomeration schedule depicts which
specific cases are included at each stage and a coinciding agglomeration coefficient.
The agglomeration coefficient, also known as the distance coefficient, is an indicator
of similarity between each stage of clustering. Large, disproportionate increases in the
agglomeration coefficient are indicative that a particular case is a poor fit to the
cluster and suggest that the previous stage cluster solution may be more appropriate.
This coefficient will be used, in combination with visual inspection of the dendogram,
to determine when clustering has reached an optimum cluster solution.

ii) At this step, one must also select whether clusters will be formed based on one of the
following three options: 1) a specified range of cluster solutions, 2) a single solution
(i.e., 4 clusters), or 3) none. Again, since the proposed study is largely exploratory,
the third option (i.e., none) will be selected and no specific number of clusters will be
designated a priori. Detailed procedures for where to stop clustering will be described
below.

b) Then select: *analyze/classify/hierarchical cluster/plots*

i) Both dendograms and icicle plots should be selected for SPSS output. The dendogram
is a visual representation of the sequential mergers of cases into hierarchical clusters.
Both will be used in determining the appropriate stopping point for clustering
procedures.

c) Then select: *analyze/classify/hierarchical cluster/method*

    i) At this point, one must choose 1) the cluster method, 2) the measure of distance/similarity, and 3) transform the data if necessary.

        (1) There are a range of clustering methods available in SPSS that determine how the cases are "linked" (i.e., within-groups or between-groups linkage, nearest or furthest neighbor, centroid or median clustering, and Ward's method). There are advantages and disadvantages to each linkage method and differing methods can result in completely different clusters. Ultimately, the appropriate linkage method is the one best suited to address the specific research question using the available data (Everitt, Landau, & Leese, 2001). The proposed study will use Ward's minimum variance hierarchical method to link cases. The rationale for this decision is that Ward's method minimizes within-group differences while maximizing between-group differences resulting in highly homogeneous groups. As a "minimum distance" hierarchical method, it calculates the sum of squared Euclidean distances from each case in a cluster to the mean of all variables. Cases are then merged into clusters in a way that increases the sum of squares the least. A review article (Milligan, 1981) of Monte Carlo tests of cluster analysis suggests that the group average procedure (i.e., between-groups linkage) may be preferable over Ward's method in certain circumstances. However, Milligan acknowledged that Ward's method is superior in its ability to deal with outliers and the presence of overlap in cluster structure. Since it is expected that the SESS data will contain outliers and overlap in cluster structure, the selection of Wards method of linkage is justified.

(2) The next step is to select the measure to be used in calculating proximity (i.e., distance or similarity) between cases. Measures of proximity essentially represent how alike two cases are on selected variables. Each measure, however, calculates distance between cases slightly different. A primary consideration of which measure of distance is most appropriate is whether the data are interval, frequency, or binary. Since the SESS data are predominately binary (i.e., present or not present), we will follow the recommendations reported in the literature for assessing similarity in binary data (Aldenderfer & Blashfield, 1984; Everitt, Landau, & Leese, 2001) and use Jaccard's coefficient; also known as the similarity ratio. A key reason for using Jaccard's coefficient is that this measure does not use joint absences when calculating similarity. For instance, treating two cases as highly similar merely because they both exhibit zeros (i.e., not present) on a large number of variables may not be advisable. This will be particularly important in the proposed study due to the number of variables being considered for inclusion in the clustering procedure and the potential for joint absences in the data.

(3) Based on our dummy coding of the SESS categorical variables, no transformations of the data will be required for this study.

d) Prior to running the actual cluster analysis, it is important to save the file after selecting the statistics, plots, method, and output options. This is done by selecting: *analyze/classify/hierarchical cluster/save*. Saving at this stage will create a new variable for each cluster which serves two purposes. First, it allows us to create a table of means and variances to examine how each cluster relates to each variable used in clustering.

Moreover, it provides a way to compare clusters to each other on outcome variables of interest (i.e., use of military helping services, demographics) during the subsequent analyses.

6) *Run the analyses.*

7) *Determine the optimum number of clusters.*

a) Visual inspection of the dendogram is the most basic method of determining the number of clusters. While this method will be used in this study to get an initial sense of the number and composition of clusters, it is highly subjective, prone to researcher biases, and requires more objective "stopping rules" for determining an optimum cluster solution.

b) The agglomeration schedule will be inspected for significant increases in the agglomeration coefficient to more objectively determine when to stop clustering. This method, termed the stepsize criterion, has been used since the 1960's (Johnson, 1967; Sokal & Sneath, 1963) and has been evaluated in Monte Carlo studies comparing different procedures used to determine number of clusters in a dataset (Milligan, 1985). The basic premise of the stepsize criterion is to examine the fusion values at each level of the hierarchy (i.e., the agglomeration coefficient in SPSS) for large differences suggesting over-clustering in the last merger (Milligan, 1985). Disproportionate increases in this coefficient are indicative that two relatively dissimilar clusters have been merged at that stage and that the number of clusters prior to the merger is the most probable cluster solution (Aldenderfer & Blashfield, 1984). In a review of use and reporting of cluster analysis in the health psychology literature (Clatworthy et al., 2005), this was the most common stopping rule used. In accordance with their recommendations, relevant

sections of the agglomeration schedule and dendogram will need to be included when reporting this research so readers can evaluate our decisions more fully.

8) *Assess the validity of the cluster solution.*

   a) There are several ways that researchers have attempted to "validate" cluster analysis solutions (i.e., cophenetic correlation, significance tests on variables used to create clusters, replication, significance tests on variables not used to create clusters, and Monte Carlo procedures) reported in the literature (Aldenderfer & Blashfield, 1984; Clatworthy et al., 2005). However, cophenetic correlation and significance tests on variables used to create clusters are essentially meaningless as one would expect the variables used in these methods to be significantly different between-groups (Clatworthy et al., 2005). Monte Carlo studies are beyond the scope of the proposed study. Replication (i.e., internal consistency), and significance tests on variables not used in creating clusters (i.e., external validity) appear to be the most feasible and appropriate methods to validate our cluster solution (Aldenderfer & Blashfield, 1984).

      i) Replication is essentially checking for internal consistency, or stability, of a cluster solution. Thus, arriving at the same cluster solution in a different sample of the population used to determine clusters provides some evidence for stability of the cluster solution. In the proposed study, an attempt will be made to replicate the cluster solution in the remaining subsample of randomly selected SESS cases that were not used to create the clusters as described above (see step 2).

      ii) To assess the cluster solution for external validity, each cluster will be compared on variables related to use of military helping services and demographics. We plan to use several methods to assess external valdity:

(1) Multiple chi-square tests will be used to compare groups on use of available military helping services. In these analyses, cluster membership will serve as the independent variable and use of military helping services will serve as dichotomous dependent variables. Individual analyses will be conducted for the following:

(a) Any available military helping service (used, not used).

(b) Military treatment facility services (used, not used).

(c) Mental health services (used, not used).

(2) Additionally, clusters will be compared using an ANOVA where cluster membership is the independent variable and total number of military helping services accessed is the dependent variable.

(3) Similarly, we plan to compare clusters on demographic variables not included used to form clusters such as:

(a) Age

(b) Gender

(c) Race

(d) Marital Status: single, married, divorced, separated, widowed, annulled

(e) Resides With: alone, spouse or partner (with/without children), children, parents, mother, father, friend, other

(f) Military Status: active duty, academy cadet, basic trainee, technical training

(g) Pay Grade: E1-E9, O1-O10

iii) Lastly, we will combine relevant findings related to the variables used in forming clusters with the findings related to the variables used for assessing external validity

to describe the typologies of USAF suicides. In accordance with Clatworthy et al.

(2005), concurrent validity will then be assessed by examining these typologies in the

context of the existing literature on USAF suicide (DoD, 2009; Patterson et al., 2001;

Staal & Hughes, 2002) to determine if they are consistent with previous findings.

Appendix C

Figure 6. Crosstabulation of Hierarchical and K-Means Cluster Solutions

Ward_Method_HCA * K_Means Crosstabulation

			K_Means			
			1	2	3	Total
Ward_Method_HCA	1	Count	109	16	24	149
		% within Ward_Method_HCA	73.2%	10.7%	16.1%	100.0%
		% within K_Means	78.4%	10.5%	28.6%	39.6%
		% of Total	29.0%	4.3%	6.4%	39.6%
	2	Count	23	81	22	126
		% within Ward_Method_HCA	18.3%	64.3%	17.5%	100.0%
		% within K_Means	16.5%	52.9%	26.2%	33.5%
		% of Total	6.1%	21.5%	5.9%	33.5%
	3	Count	7	56	38	101
		% within Ward_Method_HCA	6.9%	55.4%	37.6%	100.0%
		% within K_Means	5.0%	36.6%	45.2%	26.9%
		% of Total	1.9%	14.9%	10.1%	26.9%
Total		Count	139	153	84	376
		% within Ward_Method_HCA	37.0%	40.7%	22.3%	100.0%
		% within K_Means	100.0%	100.0%	100.0%	100.0%
		% of Total	37.0%	40.7%	22.3%	100.0%

Symmetric Measures

	Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Measure of Agreement Kappa	.401	.037	10.956	.000
N of Valid Cases	376			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.