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Examining the factor structure of the Acquired Capability for Suicide Scale in a military population: Initial development and validation of a 4-factor version of the ACSS

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Abstract

Suicide occurs at high rates in both military and veteran populations. The Interpersonal Theory of Suicide (ITS) is a widely applied framework incorporating the requisite construct of acquired capability for suicide, which is the ability to engage in suicidal behaviors developed through painful and provocative life experiences. The Acquired Capability for Suicide Scale (ACSS) was developed to assess this construct. Despite substantial literature examining ITS in military samples, many versions of ACSS have been used without adequate validation. The goal of this study was to examine the factor structure of the ACSS and derive a version of the ACSS with initial validity for use in military populations. We also examined the stability of acquired capability over time.

Data were collected among Wisconsin Army National Guard service members, who were deployed to the Middle East from 2008-2010, at three assessment points: before deployment (n = 714), immediately after return from deployment (n = 2,553), and 6-9 months post-deployment (n = 646).

Exploratory and confirmatory factor analyses of post-deployment data suggest adoption of a novel, abbreviated 15-item, four-factor version of the ACSS (ACSS-4f). Analyses provided preliminary support for discriminant and predictive validity. Results also revealed that acquired capability for suicide increases after deployment and remains stable for at least 6-9 months after return from the combat.

The ACSS-4f shows promise as a theory-relevant and empirically supported instrument for research and clinical applications in the military population.

(234 words)

Public significance statement

Suicide in military populations occurs at high rates, and there is an urgent need for better suicide prevention strategies. One construct that is crucial in assessing for suicide risk is acquired capability for suicide, defined as the ability to engage in suicidal behaviors that is developed through painful and provocative life experiences. Results of the current study provide psychometric evidence in support of a measure of acquired capability for suicide in a large sample National Guard servicemembers, which can track change in acquired capability over time and offers a promising approach to brief assessment of acquired capability in military samples. (100 words)

Examining the factor structure of the Acquired Capability for Suicide Scale in a military population: Initial development and validation of a 4-factor version of the ACSS

Suicide in military populations occurs at high rates, with an average of 17.5 veterans per day dying by suicide in 2021, highlighting the need for better suicide prevention strategies (U.S. Department of Veteran Affairs, 2023). Veterans continue to die by suicide at a significantly higher rate than that of non-Veteran civilians (in 2021, the rate was 71.8% higher; U.S. Department of Veteran Affairs, 2023). Recent data from the Department of Defense (2021) indicates that rates of suicide in National Guard servicemembers increased significantly in recent years, with an annual rate of 27.0 deaths per 100,000 servicemembers in 2020 compared to 20.5 in 2019.

One way of understanding veterans' risk for suicidal behavior is through the Interpersonal Theory of Suicide (ITS), which posits that thwarted belongingness (i.e., feeling isolated and alone in the world, and the belief that one is unable to connect with others) and perceived burdensomeness (i.e., the belief that one's life creates a burden on others) lead to a psychological desire to die (Joiner, 2005). Joiner (2005) suggested that the combination of thwarted belongingness and perceived burdensomeness leads to suicidal ideation (i.e., the desire to die by suicide), but these factors alone do not lead to suicidal behavior; the desire to die by suicide leads to suicidal behavior only when one also has the acquired capability for suicide.

Acquired capability for suicide is defined as the ability to engage in suicidal behaviors that is developed through painful and provocative life experiences. It is comprised of two constructs: fearlessness about death and pain tolerance (Joiner, 2005). Both are related to suicidal

behavior, as research has shown that one must be sufficiently habituated to both the physical pain and fear involved in suicide to engage in lethal suicidal behavior (Smith & Cukrowicz, 2010; Orbach et al., 1996; Linehan et al., 1983; Van Orden et al., 2010). Joiner (2005) posited that acquired capability occurs through repeated painful life events which overrides the human tendency for self-preservation, thus leading to a static increased risk for suicidal behavior. Such painful life events include impulsive behaviors, non-suicidal self-injury, physical injuries, combat exposure, exposure to violence, prior suicide behaviors, and childhood abuse. According to the theory, fearlessness about death leads one from suicidal desire to suicidal intent, and increased pain tolerance leads to more lethal suicide attempts (Ribeiro et al., 2014). Prior research has shown that people with histories of suicidal behavior tend to report more painful and provocative life events than people without a history of suicidal behavior (Smith et al., 2010). Further, Van Orden et al. (2008) found that people who reported prior painful and provocative life events had higher acquired capability for suicide.

To measure acquired capability for suicide, Van Orden et al. (2008) developed the 20-item Acquired Capability for Suicide Scale (ACSS), which has been used widely in a variety of populations, including military samples (Kramer et al., 2020). Although the 20-item version was designed to yield a single total score, an empirically derived factor structure has not yet been determined (Ribeiro et al., 2014). Recent research has revealed that the 20-item ACSS has poor model fit, such that the 20 items do not load onto a latent variable as theorized, and thus researchers have recommended against the use of the full ACSS to assess capability for suicide (Rogers et al., 2021). To support theory development and inform suicide prevention efforts, there is a need for brief, yet comprehensive, measurement of this construct.

Various versions of the ACSS have been used in research with military populations despite a lack of validation, such that nearly half of the studies with military populations utilized a 4-item version of the ACSS which has not been validated (Kramer et al., 2020). A recent review (Kramer al., 2020) identified various shortened versions of the ACSS that have been used in military and veteran samples, including: 4 items on a 5-point response scale (Chiurliza et al., 2016; Chu, Podlogar et al., 2016; Chu, Stanley, et al., 2016; Podlogar et al., 2017; Ribeiro et al., 2015; Rogers et al., 2017; Silva et al., 2017); 4 items on a 7-point response scale (Bryan et al., 2015); 5 items on a 5-point response scale (Gutierrez et al., 2016); 5 items on a 7-point response scale (Bryan, Morrow, et al., 2010a; Bryan, Cukrowicz, et al., 2010, 2012, 2013; Bryan and Anestis, 2011; Bryan and Cukrowicz, 2011); and 7 items on a 5-point response scale (Anestis et al., 2015; Assavedo et al., 2018; Bryan et al., 2018; Khazem et al., 2015; Monteith et al., 2017; Pennings et al., 2017; Poindexter et al., 2017).

Despite the need for valid assessment tools and wide interest in using versions of the ACSS, there is a dearth of research examining the psychometrics of these various shortened scales in military populations. Of the many iterations of the ACSS used in military samples, only two versions have been psychometrically validated in this population, specifically a 5-item scale (Van Orden et al., 2008; Gutierrez et al., 2016) and a 7-item subscale designed to measure fearlessness about death only (ACSS-FAD; Ribeiro et al., 2014; Kramer et al., 2020). Given the highly unique experiences of military servicemembers, both in training and combat deployment situations, it is essential that research establish the psychometric properties of the ACSS in this specific population to ensure valid and reliable assessment of suicide risk for research and clinical purposes. Thus, empirical examination of the ACSS in military samples – in particular, those with deployment experiences – is a critical need.

In addition, the stability of acquired capability for suicide over time has received limited attention (Smith & Cukrowicz, 2010; Zuromski et al., 2018; Velkoff & Smith, 2019), despite being of immense importance in military populations for whom deployment brings experiences predicted to add to acquired capability and thus increase risk of suicide (Joiner, 2005). Prior research has shown that greater exposure to combat experiences predicts higher rates of acquired capability for suicide, but it is unclear whether acquired capability for suicide remains elevated over time or returns to baseline (Bryan, Cukrowicz, et al., 2010).

To begin address these gaps in the literature, the present study examines the factor structure of the 20-item ACSS in a large National Guard sample through exploratory and confirmatory analyses. Our goal was to identify items appropriate for a valid, brief scale to assess acquired capability in this population.

Subsequently, we assess discriminant, incremental, and construct validity of the ACSS by examining associations between the ACSS and validated measures of other distinct suicide risk factors, including hopelessness, depression, PTSD, and suicidal ideation. Finally, we leveraged our rich longitudinal dataset to examine stability of acquired capability from pre-deployment, immediately post-deployment, and 6-9 months post-deployment in this non-clinical sample of military servicemembers.

Method

The current study is a secondary data analysis utilizing data collected as part of a larger study of mental health and social functioning among Wisconsin Army National Guard service members who were deployed to the Middle East during 2008-2010, and the study was approved by the Institutional Review Boards of the University of XXX and the associated Veterans Affairs medical centers in XXX. Participants were recruited during mandatory preparation sessions and

reintegration events, during which they visited a series of stations including a station staffed by study staff inviting them to participate in the current study. The original study utilized voluntary, anonymous paper-format surveys distributed during mobilization and reintegration events at an Army base in Wisconsin at three assessment points: before deployment (pre-deployment, T1, n = 714), immediately after return from deployment (post-deployment, T2, n = 2,553), and 6-9 months post-deployment (follow-up, T3, n = 646). Data was collected in an adapted repeated cross-sectional design, in which each time point had a different set of participants, rather than a cohort model, and participants who completed the survey at multiple time points were identified manually. The use of paper surveys allowed for immediate and completely anonymous data collection at these on-site, partially outdoor events (i.e., without internet or computer access) , and participants were invited to complete a "contact sheet" to provide their identifying information (e.g. full name, unit, phone, address, and last 4 of social).

The number of missing values was relatively small; at T2, a total of 2,240 participants (95.28%) provided complete data for demographic items and other study variables. Pairwise deletion was used, as Roth (1994) established that, when less than 5% of data are missing and data are missing in random patterns, any missing data technique, including pairwise deletion, does not introduce bias in parameter estimates or significance tests. Self-reported demographic characteristics were used to match respondents across timepoints (see Kline et al., 2013 for a similar approach), with 310 participants matched from T1 to T2 and 336 participants matched from T2 to T3 (see Table 1). Given that completing a contact sheet at each timepoint was completely voluntary, many participants did not complete contacts sheets across all multiple timepoints and therefore it was not possible to match their data. The factor analysis (including both exploratory and confirmatory factor analyses) in the current study utilizes data collected

during T2. We chose to conduct the factor analysis using T2 data for two reasons. First, given that T2 data was collected immediately post-deployment, we posited that T2 ACSS data would be most relevant in understanding the potential impact of combat-related stressors on acquired capability for suicide. Second, T2 had the largest sample size and therefore maximal statistical power. Validity analyses use data collected at T1, T2, and T3. Examination of the stability of acquired capability was done using T1, T2, and T3.

Measures

Demographic Items. Demographic items included age, race, gender, highest level of education, and relationship/marital status.

Acquired Capability for Suicide Scale (ACSS). The 20-item Acquired Capability for Suicide Scale (ACSS) was developed to assess capability to enact lethal self-injury (Joiner et al., 2009). A sample item is "The fact that I am going to die does not affect me." Ratings were made on a Likert scale from 0 ("not at all true for me") to 4 ("very true for me"), with higher scores indicating greater suicide risk. A total score is calculated by summing all items with a maximum score of 80. Participants completed the ACSS at all three times point (T1: M =11.07 , SD = 21.60; T2: M = 43.18, SD = 23.99, and T3: M = 9.75, SD = 20.81) in this study. In prior studies, the 20-item ACSS (α = .81 - .88) and the ACSS-FAD (α = .77 - .83) demonstrated adequate internal consistency reliability (Ribeiro et al., 2014).

Beck Depression Inventory (BDI). The BDI is a 21-item self-report inventory that measures symptoms of depression (Beck et al.,1996). Items assess relevant symptoms of depression such as hopelessness and irritability; cognitions such as guilt or feelings of being punished; and physical symptoms such as fatigue, weight loss, and lack of interest in sex. Items are scored 0 through 3, with total scores ranging from 0-63 and higher scores indicating greater

depressive symptoms. A sample item is: "0. I do not feel sad. 1. I feel sad. 2. I am sad all the time and I can't snap out of it. 3. I am so sad and unhappy that I can't stand it." Participants completed the BDI at T2 (immediately post-deployment) for the past week (M = 5.39, SD = 7.85) and their worst week of their recent deployment (M = 13.08, SD = 13.94). In the current study, only BDI data for the past week was used in analyses. Construct validity and internal consistency reliability has been established for the BDI in both psychiatric outpatients (α = 0.92) and college students (α = 0.93; Beck & Steer, 1987). The BDI has also been shown to have strong 1-week test-retest reliability (Beck et al., 1996).

Beck Hopelessness Scale (BHS). The Beck Hopelessness Scale (BHS) is a 20-item self-report inventory designed to measure three major aspects of hopelessness: feelings about the future, loss of motivation, and expectations (Beck, 1988). Participants select "True" or "False" for each item. Total scores on the BHS range from 0 to 20, with a higher score reflecting greater symptoms of hopelessness. Participants completed the BHS at T2 (immediately post-deployment) for the past week (M = 2.96, SD = 3.32) and their worst week of their recent deployment (M = 5.91, SD = 5.44). In the current study, only BHI data for the past week was used in analyses. The BHS has adequate internal reliability (r = .82 - .93) and one-week test-retest reliability (r = .69; Beck, 1988). The validity of the BHS has also been established, such that the BHS accurately differentiates people with depression from those without (Bouvard et al., 1992).

Beck Scale for Suicidal Ideation (BSSI). The BSSI is a 21-item questionnaire assessing severity of suicidal ideation and suicide risk (Beck & Steer, 1991). The first 19 items are scored on a 0 to 2 scale, and total scores on the BSSI range from 0 to 38, with higher scores reflecting higher levels of suicidal ideation. The last two items assess for previous suicidal behavior, and

thus are not included in the total score. A sample item is: "0. I have a moderate to strong wish to live. 1. I have a weak wish to live. 2. I have no wish to live." Participants completed the BSSI at T2 (immediately post-deployment) for the past week (M = 5.40, SD = 7.00) and their worst week of their recent deployment (M = 5.40, SD = 7.00). In the current study, only BSSI data for the past week was used in analyses. The BSSI has high internal consistency reliability (r = .89; Beck et al., 1974) and moderate one-week test-retest reliability (r = .54). The validity of the BSSI has also been established, such that the BSSI is highly correlated with clinical rated suicidal ideation (Beck et al., 1988).

Posttraumatic Stress Disorder Checklist Military (PCL-M). The PCL-M is a 17-item instrument for assessing symptoms of PTSD in accordance with the Diagnostic & Statistical Manual—Fourth Edition (DSM-IV-TR, 2000; Weathers et al., 1993). The PCL-M is scored on a 5-point Likert-type scale with anchors of 1 ("Not a little") to 5 ("Extremely"). A total score is calculated by summing all items, with a higher score indicating more severe PTSD symptoms. Participants completed the PCL-M at T2 (immediately post-deployment; M = 21.71, SD = 7.87). The PCL-M has been shown to have strong internal consistency reliability (r = .97; Weathers et al., 1993) and one-week test-retest reliability (r =.88; Ruggiero et al., 2003). Validity of the PCL-M was established through correlations with the Mississippi PTSD Scale (r = .85 - .93; Weather et al., 1993).

Suicide Behaviors Questionnaire (SBQ). The SBQ is a 19-item self-report measure designed to assess suicidal ideation, suicide expectancies, suicide threats and communications, and suicidal behavior (Linehan, 1981; Addis & Linehan, 1989). The SBQ version used in the current study was adapted for the primary research aims and included queries about suicidal ideation in multiple timeframes: throughout the participant's lifetime, during their most recent

deployment, and within the last four weeks. An example item is, "How often have you thought about killing yourself in your lifetime?" which is scored on a 1 ("Not at all") to 4 ("Very Often") scale. Items on the SBQ are scored on differing scales, ranging from Yes/No to a 0 to 6 scale. A total score is calculated by summing all items, with higher total scores indicative of higher levels of suicidal ideation and behaviors. Participants completed the SBQ at T2 (immediate post-deployment; $M = 8.67$, $SD = 8.15$) and T3 (6 months post-deployment; $M = 6.07$, $SD = 8.99$) in this study. The SBQ has been shown to have adequate internal consistency reliability ($r = .75$) and one-week test-retest reliability ($r = .95$; Cotton et al., 1995). Validity of the SBQ was established, such that the SBQ accurately distinguished between suicidal and non-suicidal participants (Osman et al., 2001).

Data Analysis

Prior to conducting the factor analysis, we calculated the Kaiser-Meyer-Olkin (KMO) index of sampling in R (R Core Team, 2019) to ensure that the data was suitable for factor analysis by measuring the proportion of variance shared among variables.

Next, the sample was randomly divided in half, and an exploratory factor analysis (EFA) was conducted on the first half ($n = 1{,}250$) to identify the appropriate number of factors and optimize item selection (Worthington & Whittaker, 2006) using the 'lavaan' package (Rosseel, 2012) in R (R Core Team, 2019). Because no prior research has confirmed a two-factor structure as theorized by the ITS, we first conducted an EFA to carefully consider all possibilities when a hypothesized model does not fit as recommended by Schmitt (2011, p. 315). Because we assumed the ACSS factors would be correlated, we conducted the EFA using oblimin rotation (i.e., an oblique rotation in which the factors are assumed to correlate with one another), with the full set of 20 ACSS items. Evaluation of the EFA models conformed to the recommendations of

Muthen and Muthen (2008), and we examined the scree plot and consulted the results of a parallel analysis to determine the number of factors that accounted for more than a random proportion of item variance (Fabrigar et al, 1999). Subsequently, a confirmatory factor analysis (CFA) was conducted on the resultant scale with the second half of the participants (n = 1,249) to evaluate the fit of the factor solution in an independent sample.

Next, after identifying items corresponding to confirmed factors, we then explored construct validity of the resultant version of the ACSS via its correlations with measures of other distinct suicide risk factors, including hopelessness, depression, PTSD, and suicidal ideation. Joiner's (2005) theory suggests that Acquired Capability for Suicide should predict suicidal *behavior*, rather than suicidal *ideation*; thus, we selected a measure of suicidal ideation to evaluate discriminant validity, as well as measures of hopelessness, depression, and posttraumatic stress. After evaluating discriminant validity, we tested the scale's association with suicidal behavior both as the sole predictor (predictive validity) and as an additional predictor in a model in which the other suicide risk factors were statistically controlled (incremental validity). To optimize statistical power for these analyses, the criterion variable and all risk variables were assessed at T2 (immediately post-deployment).

Finally, we examined the stability of the resultant version of the ACSS over time for the respondents for whom longitudinal data were available, as there are differing opinions as to whether the ACSS is stable (Joiner, 2005) or variable over time (Smith & Cukrowicz, 2010). To stability of the ACSS subscales over time, we computed test-retest reliability coefficients and standardized mean differences (Cohen's d) in scores on the four-factor ACSS from T1 to T2, and from T2 to T3. In addition to examining test-retest reliability, we provide data on mean changes in the four ACSS subscales across the three time points to document sensitivity to presumed

stressors experienced during combat, such as personal injury, witnessing injuries or death of others, and dangerous working conditions. We hypothesized that ACSS scores would increase from T1 to T2 (pre-post combat experience) and explored changes between T2 and T3 to learn about how acquired capacity changes, on average, in the initial post-discharge period.

Results

Participants

At T2, the average age of participants was 27.92 years (*SD* = 7.12), with an average level of education of 13.07 years (*SD* = 2.08). Participants were predominately male (89.6%), White (89.6%), and married or in a committed relationship (55.6%).

Kaiser-Meyer-Olkin Test

Prior to conducting the factor analyses, a Kaiser-Meyer-Olkin index of sampling adequacy was calculated to ensure that the data was suitable for a factor analysis. Results revealed an adequate KMO index (*KMO* = .85).

Factor Analysis

Exploratory Factor Analysis

An exploratory factor analysis (EFA) was conducted on a random half of the sample (*n* = 1,250) to identify the appropriate number of factors and optimize item selection. To guide our decisions about factor retention, we examined the scree plot and consulted the results of a parallel analysis, which identified 4 factors as accounting for more than a random proportion of item variance (Fabrigar et al, 1999). Conceptual meaning is also an important consideration in factor retention, so we opted to examine two, three, and four factor solutions to determine which performed best on both empirical and conceptual criteria.

Ultimately, we selected the four-factor solution, which yielded a reasonably simple factor structure and provided a conceptually, clinically, and theoretically meaningful factor solution, as recommended by Muthen and Muthen (2008). We selected the four-factor solution, rather than the three-factor or two-factor solution, because the fourth factor was conceptually, clinically, and theoretically meaningful. Item reduction procedures were conducted based on factor loadings. Criteria for inclusion of items included loadings of .32 or more on the primary factor and less than .32 on other factors as recommended by Worthington and Whittaker (2006). Three items ("I avoid certain situations (e.g., certain sports) because of the possibility of injury," "Killing animals in a science course would not bother me," and "I could kill myself if I wanted to") were excluded because they did not load onto any of the factors above .32. Two items ("I am very much afraid to die" and "The prospect of my own death arouses anxiety in me") were excluded from the Fearlessness About Death factor due to cross loadings above the cut-off of .32 on the Aversion to Violence and Death factor (see Table 2 for the factor loadings from the EFA and CFA).

After item reduction was completed, the EFA resulted in a novel, 15-item, four factor version of the scale (the ACSS-4factor or ACSS-4f) with satisfactory fit: RMSEA = .053; SRMR = .041; *CFI* = .91; χ^2 (132) = 1263; $p < .001$. See Table 2 for the factor loadings from the EFA. Based upon the content of the items, the factors were given the following names: (1) Fearlessness About Death (4 items), (2) Fascination with Aggression (3 items), (3) Aversion to Violence and Death (4 items), and (4) Fearlessness Social Comparison (4 items). See Table 3 for a list of items contained within each factor.

Confirmatory Factor Analysis

The 15-item ACSS-4f was then subjected to a Confirmatory Factor Analysis (CFA) on the other half of the sample (n = 1249). The four-factor measurement model demonstrated satisfactory fit: RMSEA = .055; SRMR = .048; CFI = .92; $\chi^2(105) = 437.81$; $p < .001$ (Hu & Bentler, 1999). See Table 2 for the factor loadings from the CFA. As expected, inter-factor correlations were moderate-to-large in magnitude (absolute values ranged from r = .26 to .56—see Table 4).

Internal Consistency Reliability

Internal consistency reliability was adequate for the four subscales (Fearlessness About Death: α = .69; Fascination with Aggression: α = .78; Aversion to Violence and Death: α = .65; Fearlessness Social Comparison: α = .70), as they fell above the .60 cut-off for acceptable internal consistency reliability in exploratory analyses established by Hair et al. (2010).

Factor Analysis Summary

As examined in a large sample of National Guard service members, the 15-item, four factor ACSS-4f suggests that four dimensions are relevant to describing ACSS item content: *Fearlessness About Death; Fascination with Aggression; Aversion to Violence and Death; and Fearlessness Social Comparison.* These factors do not directly align with the two subconstructs theorized to fall within Acquired Capability for Suicide: Fearlessness About Death and Pain Tolerance. The ACSS-4f included a Fearlessness About Death subscale, which aligns with the Interpersonal Theory of Suicide, but there was no subscale that captured Pain Tolerance.

Validity Analyses

Discriminant Validity

Discriminant validity was indicated by weak, nonsignificant correlations between the 4 factors of the ACSS and the Beck Hopelessness Scale (r = -.12 to .00), Beck Depression

Inventory (r = -.12 to -.01), Beck Scale for Suicidal Ideation (r = -.01 to .01), and Posttraumatic Stress Disorder CheckList-Military (r = .02 to -.11). See Table 5 for a correlation matrix of all measures included in this study.

Predictive Validity

To establish predictive validity, we first tested the ACSS as a predictor of score on the adapted Suicidal Behavior Questionnaire (SBQ), followed by a more stringent test in which the unique effects of the ACSS on the SBQ were examined after controlling for other known risk factors for suicide.

First, we conducted a hierarchical linear regression to determine whether the four-factor ACSS significantly predicted scores on the SBQ. Although the overall model was not significant, the ACSS Fearlessness Social Comparison subscale was a significant predictor of scores on the SBQ (p = .027). See Table 6.

Next, we conducted a hierarchical linear regression to determine whether the ACSS predicted scores on the SBQ when controlling for other known risk factors of suicide. In the first step of the regression, hopelessness (BHS), depression (BDI) and suicidal ideation (BSSI) significantly predicted suicidal behavior (SBQ), R^2 = .47, p < .001. In the second step, the four-factor ACSS was included in the model, R^2 = .50, p < .001 (see Table 7). The addition of the four-factor ACSS in the second step of the model led to a significant change in R^2, (F(4,293) = 4.18, p = .003), thus providing evidence of predictive and incremental validity of the four-factor ACSS. However, predictive validity of the individual four factors of the ACSS was not established, as only the ACSS Fearlessness Social Comparison subscale was a significant predictor of scores on the SBQ (p = .027).

Stability of ACSS Over Time

To examine changes in ACSS subscales over time, we computed standardized mean differences (Cohen's *d*) in scores on the four-factor ACSS from T1 to T2, and from T2 to T3 (Table 8). From T1 to T2, scores on Fearlessness About Death and Fearlessness Social Comparison subscales showed significant increases (*d*s = 0.32 [0.21, 0.44] and 0.13 [0.02, 0.24], respectively). From T2 to T3, the Fearlessness Social Comparison subscale again showed a significant increase (*d* = 0.29 [0.12, 0.45]). Mean changes on the remaining ACSS subscales were not significantly different from zero for these two time intervals.

Test-Retest Reliability of ACSS

Test-retest reliability coefficients were calculated for each of the four subscales of the ACSS from T1 to T2 and T2 to T3. Test-retest reliability coefficients ranged from .53 to .65 between T1 and T2 and .from .60 to .67 between T2 and T3. See Table 8.

Discussion

Assessment of suicide risk has high relevance for military servicemembers and veterans and there is urgent need for development of valid measures. Despite the substantial body of research examining Joiner's (2005) Interpersonal Theory of Suicide and its component elements, including the acquired capability for suicide, there is little research examining the psychometric properties of a widely used measure of this construct, the ACSS (Van Orden et al., 2008), in military samples (Kramer et al., 2020). The goal of the present study was to examine the factor structure of the 20-item ACSS in a large post-deployment National Guard sample and test discriminant, construct, and predictive validity of the resultant scale. In a final step, we leveraged longitudinal data to conduct exploratory analyses on the stability of acquired capability across time.

Results of our Exploratory and Confirmatory Factor Analyses provided preliminary support for a novel, abbreviated 15-item, four factor version of the ACSS (ACSS-4f) with adequate fit in a large National Guard sample. Based upon the content of the items, the factors were named: (1) Fearlessness About Death (2) Fascination with Aggression, (3) Aversion to Violence and Death, and (4) Fearlessness Social Comparison. In this large military sample assessed immediately after deployment, the identified factors do not directly align with the two subconstructs theorized to fall within Acquired Capability for Suicide: Fearlessness About Death and Pain Tolerance (Joiner, 2005).

The four-factor solution included a Fearlessness About Death subscale, which aligns with the Interpersonal Theory of Suicide, but failed to identify a subscale that captured Pain Tolerance. Only one item in the ACSS-4f captures the construct of pain tolerance, which provides support for the prior assertion that pain tolerance may be a distinct construct separate of acquired capability (Smith & Cukrowicz, 2010). Instead, two subscales are related to reactions to violence and aggression (Fascination with Aggression, Aversion to Violence and Death), and the third subscale is related to fearlessness relative to others (Fearlessness Social Comparison). These three additional constructs are still theoretically consistent with the ITS, as Joiner (2005) posited that experiences of both witnessing and experiencing painful and provocative events would increase capability. Two of these subscales, Fearlessness Social Comparison and Fascination with Aggression, capture a social aspect to acquired capability, such that the items capture a social comparison of levels of fearlessness and an enjoyment or fascination with witnessing violence and aggression; although these items do not directly align with the subconstructs theorized in ITS, they capture the theory's position that witnessing violence and painful events can lead to increased capability.

Further, the four factors are consistent with a prior factor analysis examining the ACSS in a prison sample (Smith et al., 2013), which identified almost the exact same items in each factor as the current study. Smith and colleagues (2013) also found a factor involving witnessing violence (which they described as spectating violence), and the author discussed the need for theoretical work clarifying the role of spectating or witnessing violence in acquired capability. This study provides further support for the need to clarify the role of witnessing violence and social comparison as they are relevant for acquired capability in military personnel.

Our findings provided preliminary support for discriminant validity, as the four factors of the ACSS-4f were not significantly correlated with other distinct suicide risk factors, including hopelessness, depression, suicidal ideation, and symptoms of posttraumatic stress disorder, as capability should be distinct from suicide desire and other suicide risk factors (Ribeiro et al., 2014). Further, predictive and incremental validity was established, such that the ACSS-4f explained additional variance in the SBQ above and beyond the impact of hopelessness, depression, and suicidal ideation. Preliminary analyses examining the predictive validity of each of the four subscales of the ACSS-4f did not provide substantial support for using each of the four factors individually to predict the SBQ, as only the Fearlessness Social Comparison subscale was a significant predictor of the SBQ. This may be due, in part, to the fact that the SBQ is not just a measure of suicidal behavior; instead, the SBQ was designed to measure suicidal ideation, suicide expectancies, suicide threats and communications, as well as suicidal behavior (Linehan, 1981; Addis & Linehan, 1989). A systemic review and meta-analysis of the ITS discussed how suicide risk measures, including the SBQ, do not delineate between suicidal ideation and behaviors and therefore do not allow for specific tests of the ITS (Chu et al., 2017). Further, Joiner's (2005) theory suggests that Acquired Capability for Suicide should predict

suicidal *behavior*, rather than suicidal *ideation*; thus, the SBQ is not an ideal measure for predictive validity. Further research is needed to better understand how well the ACSS-4f predicts suicidal behavior. Specifically, as recommended by Chu and colleagues (2017), future research should utilize measures of suicidal behavior that are continuous (i.e., measure the number of prior attempts), use precise definitions of suicide-related terms, and allow for nuanced reporting of suicidal behavior. Although the SBQ is not an ideal outcome measure to test the ITS, the SBQ is a well-validated, widely used measure of suicide risk (Chu et al., 2017), and thus the predictive validity analyses provide preliminary support for the use of the ACSS-4f in the brief assessment of suicide risk.

Finally, we examined the stability of the ACSS-4f over time, as there are differing opinions as to whether acquired capability is stable (Joiner, 2005; Velkoff & Smith, 2019) or variable over time (Smith & Cukrowicz, 2010; Zuromski et al., 2018). This is a particularly important question in military populations, as prior research has shown that greater exposure to combat experiences predicts higher rates of acquired capability for suicide, yet it is unclear whether these increased rates of acquired capability for suicide remain elevated over time or gradually return to baseline (Bryan, Cukrowicz, et al., 2010). We computed test-retest reliability coefficients and standardized mean differences (Cohen's *d*) in scores on the four-factor ACSS from T1 to T2, and from T2 to T3; both approaches to assessing scores over time (Cohen's *d* and reliability coefficients) supported the hypothesis that capability increases after deployment and remains stable for at least 6-9 months after return from the combat theater. Specifically, results revealed that the Fearlessness About Death subscale and Fearlessness Social Comparison subscale significantly increased from pre-deployment (T1) to immediately post-deployment (T2), which provides evidence for construct validity since acquired capability is expected to increase

following combat experiences according to the ITS (Joiner, 2005). Additionally, the Fearlessness Social Comparison subscale significantly increased from immediately post-deployment (T2) to follow-up 6-9 months later (T3). Thus, this study provided preliminary evidence that acquired capability tends to increase following deployment and remains elevated in the months following return from deployment. Future research should collect data over a longer period of time to determine how long levels of acquired capability may remain elevated after deployment.

Limitations and Future Directions

It is important to acknowledge the potential limitations of the ACSS-4f, in light of recent research demonstrating that measurement invariance of the ACSS-FAD was not supported across suicide attempt histories, military department histories, and gender, suggesting that the ACSS-FAD is interpreted differently by different groups (Rogers et al., 2021). Further, a recent study found that the ACSS-FAD does not differ significantly by suicide method as expected by the theory, further raising concerns about the clinical utility of the ACSS-FAD (Bauer et al., 2020). Further research is needed to establish predictive validity of the ACSS-4f, as establishing construct validity is an incremental process (Chronach & Meehl, 1955) and no single study can provide definitive validity evidence. As described above, the measure of suicidal behavior (SBQ) used for the predictive validity analyses in this study was not ideal, as it is not a pure measure of suicidal behavior but instead measures several constructs (i.e., suicidal ideation, suicide expectancies, suicide threats and communications, and suicidal behavior). Further, the SBQ includes items that measure suicidal ideation across one's lifetime, including experiences that occurred prior to the current study, and thus the SBQ is not an ideal measure for predictive validity analyses. Future research with a measure of suicidal behavior separate of other suicide-related constructs is needed to better understand the predictive validity of the four-factor solution

of the ACSS. Further, while the current study provided evidence of discriminant validity, we were unable to explore convergent validity since the dataset used in our secondary data analysis did not contain an appropriate variable to use as a comparison point. Additionally, future research can explore how the ACSS-4f may be combined with a measure of dispositional (i.e., genetic variables such as pain sensitivity or blood phobia) and practical (i.e., concrete factors that make a suicide attempt easier such as access to means) capability, as theorized in Klonsky & May's (2015) Three-Step Theory of Suicide (Klonsky & May, 2015; Gallyer et al., 2020).

Another limitation of the study is that data were self-report in nature, and thus may be prone to response biases such as under-reporting due to social desirability. Participants may have under-reported their mental health symptoms and suicidal thoughts and behaviors since these constructs are sensitive and are often stigmatized, which may have led to a restricted range in measures of suicidal thoughts and behaviors. However, respondents could remain fully anonymous if they chose, reducing the threat of response bias. Further, participants were all recruited from National Guard service members in one midwestern state, and thus the data may not generalize to other military populations or other civilian populations. National Guard service members tend to have poorer mental health outcomes than their active-duty counterparts (Polusny et al., 2016); how specific military setting may impact utility of the ACSS-4f in predicting risk will be an important focus for future research. Additionally, a limitation of this study is racial and gender homogeneity, as the majority of participants in this study were white and male. Further research should examine the psychometrics of the ACSS in a more diverse military sample. Finally, this study did not include a measure of suicidal behavior at T1, thus limiting our ability to control for prior suicidal history. Nevertheless, our study has many

strengths, including a large, well-defined sample, a rigorous statistical approach, and longitudinal data collected before and after deployment.

Establishing a psychometrically valid measure of acquired capability is essential for suicide prevention in military samples, as the desire to die by suicide leads to suicidal behavior only when one also has the acquired capability for suicide according to Joiner's (2005) ITS. Thus, a psychometrically valid measure of acquired capability facilitates rapid identification of military servicemembers and veterans who are at high risk for suicidal behavior, with the goal of facilitating prompt intervention for people at high risk for suicide. The empirically supported ACSS-4f can track change in acquired capability over time and offers a promising approach to brief assessment of acquired capability in military samples. This study adds to the growing literature around suicide risk in military populations, informing important future efforts to refine measurement, risk identification, and suicide prevention in this population.

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Table 1. Demographic Characteristics in Cross-Sectional (T1, T2 and T3) and Longitudinal Samples (T1 – T2 and T2 – T3)

	Cross Sectional Samples			Longitudinal Samples	
	Predeployment (T1, *n* = 714)	Postdeployment (T2, *n* = 2553)	Follow-Up (T3, *n* = 646)	T1-T2 (*n* = 310)	T2-T3 (*n* = 336)
Demographic characteristics	n(%)	n(%)	n(%)	n(%)	n(%)
Gender					
Male	614(88.2)	2273(89.6)	514(84.5)	272(87.7)	284(84.0)
Female	82(11.8)	263(10.4)	94(15.5)	38(12.20	54(16.0)
Age					
17-25	368(52.8)	1151(45.08)	197(34.02)	172(55.48)	121(35.91)
25-30	150(21.52)	700(27.41)	128(22.10)	63(20.32)	84(24.93)
30-40	125(17.93)	485(19.0)	154(26.60)	58(18.71)	85(25.22)
Over 40 years	54(7.75)	217(8.5)	100(17.27)	17(5.48)	47(13.95)
Race/Ethnicity					
American Indian, Alaska Native	15(2.2)	38(.04)	7(1.17)	9(2.9)	5(1.5)
Asian, Pacific Islander	11(1.6)	52(2.1)	10(1.7)	6(1.94)	5(1.5)
Black	20(2.9)	79(3.2)	21(3.5)	5(1.61)	12(3.6)
Hispanic	27(3.9)	91(3.6)	23(3.9)	11(3.54)	14(4.1)
Non-Hispanic White	622(89.5)	2245(89.6)	535(89.8)	279(90.0)	302(89.3)
Years of School					
High School or less	381(55.7)	1388(55.41)	267(45.64)	15(48.39)	140(42.54)
Some College	215(31.4)	759(30.3)	183(31.28)	112(36.13)	115(34.12)
College and more	88(12.9)	358(14.29)	135(23.08)	48(15.48)	82(24.33)
Marital Status					
Married	256(36.7)	923(36.4)	258(42.7)	106(34.3)	135(40.2)
In a Committed Relationship	128(18.3)	486(19.2)	115(19.0)	60(19.42)	65(19.3)
Dating	111(15.9)	330(13.0)	75(12.4)	48(15.53)	36(10.7)
Not Dating	154(22.1)	630(24.9)	106(17.5)	78(25.24)	26(7.7)
Divorced, Widowed, Separated	49(7.0)	166(6.5)	50(.8.3)	17(5.5)	74(22.0)

Table 2. EFA and CFA Factor Loadings.

EFA and CFA Factor Loadings				
Item	Fearlessness About Death	Fascination with Aggression	Aversion to Violence and Death	Fearlessness Social Comparison
	EFA(CFA)	EFA(CFA)	EFA(CFA)	EFA(CFA)
The fact that I am going to die does not affect me	**.68(.70)**	.04	.06	.1
I am very much afraid to die (R)	**-.54**	.04	**.39**	.07
It does not make me nervous when people talk about death	**.40(.48)**	.1	.01	.1
The prospect of my own death arouses anxiety in me (R)	**-.39**	.04	**.46**	.14
I am not disturbed by death being the end of life as I know it	**.52(.58)**	.06	.09	.1
I am not at all afraid to die	**.72(.72)**	.03	.00	.09
I like watching the aggressive contact in sports games	.00	**.62(.64)**	-.05	.08
The best parts of hockey games are the fights	.00	**.83(.79)**	.02	-.04
When I see a fight, I stop to watch	.03	**.72(.75)**	-.01	-.02
The sight of blood bothers me a great deal (R)	.15	.00	**.54(.56)**	-.27
The pain involved in dying frightens me (R)	-.21	.02	**.46(.51)**	-.03
The sight of a dead body is horrifying to me (R)	-.06	-.04	**.52(.63)**	-.09
I prefer to shut my eyes during the violent parts of movies (R)	.10	-.23	**.49(.59)**	.10
Things that scare most people do not scare me	.11	-.05	-.02	**.62(.68)**
The sight of my own blood does not bother me	.01	.03	-.19	**.39(.46)**
I can tolerate a lot more pain than most people	.03	-.01	-.03	**.69(.74)**
People describe me as fearless	.08	.09	.01	**.56(.68)**

Note: Factor loadings over .32 appear in bold. R = reverse scored.

Table 3. Factors and Items.

Factor	Item
Fearlessness About Death	The fact that I am going to die does not affect me
	It does not make me nervous when people talk about death
	I am not disturbed by death being the end of life as I know it
	I am not at all afraid to die
Fascination with Aggression	I like watching the aggressive contact in sports games
	The best parts of hockey games are the fights
	When I see a fight, I stop to watch
Aversion to Violence and Death	The sight of blood bothers me a great deal (R)
	The pain involved in dying frightens me (R)
	The sight of a dead body is horrifying to me (R)
	I prefer to shut my eyes during the violent parts of movies (R)
Fearlessness Social Comparison	Things that scare most people do not scare me
	The sight of my own blood does not bother me
	I can tolerate a lot more pain than most people
	People describe me as fearless

Table 4. Inter-factor Correlations.

Item	Fearlessness About Death	Fascination with Aggression	Aversion to Violence and Death	Fearlessness Social Comparison
Fearlessness About Death				
Fascination with Aggression	.26			
Aversion to Violence and Death	-.44	-.29		
Fearlessness Social Comparison	.56	.30	-.50	

Table 5. Correlation between ACSS-4f Subscales and Beck Hopelessness Scale, Beck Depression Inventory, Posttraumatic Stress Disorder Checklist – Military, Beck Scale for Suicidal Ideation, and Suicide Behavior Questionnaire at T2.

	ACSS – Fearlessness About Death	ACSS – Fearlessness Social Comparison	ACSS – Fascination with Aggression	ACSS – Aversion to Violence and Death
Beck Hopelessness Scale – Worst Week	-.01	-.07	.00	-.05
Beck Hopelessness Scale – Past Week	-.02	-.10	-.01	-.12
Beck Scale for Suicidal Ideation – Worst Week	.01	.01	.01	-.01
Beck Scale for Suicidal Ideation – Past Week	.01	.01	.01	.01
Beck Depression Inventory – Worst Week	-.03	-.01	-.03	-.02
Beck Depression Inventory – Past Week	-.12	-.09	-.04	-.09
Posttraumatic Stress Disorder Checklist – Military	-.11	.02	.04	.04
Suicide Behavior Questionnaire	.06	.15*	.03	.03

* $p < .05$.

Table 6. Predictive validity analyses: hierarchical linear regression predicting the Suicidal Behavior Questionnaire (SBQ) at T2.

Predictors	*Standardized B*	R^2
ACSS – Fearlessness About Death	-.16	.026
ACSS – Fearlessness Social Comparison	2.22*	
ACSS – Fascination with Aggression	-.50	
ACSS – Aversion to Violence and Death	.68	

* $p < .05$.

Table 7. Incremental Validity Analyses: hierarchical linear regression predicting the Suicidal Behavior Questionnaire (SBQ) at T2.

Predictors	*Standardized B*	R^2
Step 1:		
Beck Suicide Scale	13.91***	.47***
Beck Hopelessness Scale	12.94***	
Beck Depression Inventory	-.033	
Step 2:		
Beck Suicide Scale	12.93***	.50***
Beck Hopeless Scale	.003	
Beck Depression Inventory	2.81**	
ACSS – Fearlessness About Death	-.19	
ACSS – Fearlessness Social Comparison	2.74**	
ACSS – Fascination with Aggression	-.59	
ACSS – Aversion to Violence and Death	1.62	

*** $p < .001$, ** $p < .01$, * $p < .05$.
The addition of the four-factor ACSS in the second step of the model led to a significant change in R^2, ($F(4,293) = 4.18$, $p = .003$).

Table 8. Stability of ACSS Scores from T1 (pre-deployment) to T2 (post-deployment), and T2 to T3 (follow-up; 6-9 months post-deployment).

	Earlier M(SD)	*Later M(SD)*	*d [95% CI]*	*t*	*p*	r_{XX}
			T1 to T2 (n = 312)			
ACSS – Fearlessness About Death subscale	2.38 (0.77)	2.63 (0.86)	0.32 [0.20, 0.44]	5.52	.000	.53
ACSS - Fearlessness Social Comparison subscale	2.51 (0.72)	2.61 (0.77)	0.13 [0.20, 0.24]	2.33	.020	.55
ACSS - Fascination with Aggression subscale	2.60 (1.09)	2.67 (1.10)	0.06 [-0.03, 0.16]	1.34	.182	.65
ACSS - Aversion to Violence and Death subscale	3.02 (0.70)	3.06 (0.75)	0.06 [-0.04, 0.17]	1.14	.254	.59
			T2 to T3 (n = 133)			
ACSS – Fearlessness About Death Subscale	2.52 (0.89)	2.54 (0.76)	0.03 [-0.12, 0.19]	0.43	.665	.67
ACSS - Fearlessness Social Comparison subscale	2.55 (0.78)	2.75 (0.70)	0.29 [0.12, 0.45]	3.45	.001	.60
ACSS - Fascination with Aggression subscale	2.61 (1.13)	2.70 (1.04)	0.09 [-0.06, 0.23]	1.13	.260	.62
ACSS - Aversion to Violence and Death subscale	3.04 (0.73)	3.09 (0.77)	0.07 [-0.08, 0.23]	0.95	.345	.65

Note. r_{XX} = test-retest reliability coefficient, T1 = pre-deployment; T2 = immediate post-deployment; T3 = 6-month follow-up. Possible score ranges for the ACSS subscales are as follows: Fearlessness About Death subscale = 0-16; Fearlessness Social Comparison subscale = 0-16; Fascination with Aggression subscale = 0-12; Aversion to Violence and Death subscale = 0-16.