PROXIMAL ASSOCIATIONS OF ALCOHOL USE WITH SUICIDAL IDEATION AND BEHAVIORS IN COLLEGE STUDENTS

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ABSTRACT

Despite the high levels of alcohol use among college students, the proximal role it plays in the development of suicide risk is not well understood. A theory-guided understanding of the connection between alcohol use and suicide risk, such as that afforded by the interpersonal-psychological theory of suicide and alcohol myopia model, will advance efforts to prevent this leading cause of death in college students. The present dissertation is the first to test an integration of these theories. Using a repeated measures design, daily data on alcohol use and suicidal ideation and behaviors (aborted, interrupted, and actual attempts) were collected from 206 (150 women, 53 men, 3 "Other") college students over 90 days. Participants completed 7,342 (39.6%) of the 18,540 surveys sent. Hypotheses were generally not supported. Alcohol use (drinking day, binge drinking day, number of drinks) was *negatively* associated with suicidal ideation, and the hypothesized three-way interaction among perceived burdensomeness, thwarted belongingness, and alcohol was not significant. Drinking occurring on a given day was positively associated with daily acquired capability; however, such capability did not mediate the relation between drinking day and suicidal behavior. Finally, suicidal ideation and drinking day positively associated with suicidal behavior; however, the hypothesized interaction between acquired capability and suicidal ideation was not associated with suicidal behavior. These results provide no evidence that alcohol use amplifies the effects of unmet interpersonal needs on suicidal ideation, but alcohol use is associated with increased acquired capability and suicidal behavior. Furthermore, the tenets of the interpersonal psychological theory were not replicated in this study. These findings may be sample-specific given that the participants were young and in college. Additional tests of this model in different samples are needed.

TABLE OF CONTENTS

Chapter One Introduction 1
Chapter Two Literature Review 4
  Alcohol Use and Suicide Risk 4
    Alcohol Use and Suicidal Ideation 5
    Alcohol Use and Suicidal Behaviors 7
  Theoretical Considerations 9
    Suicide 9
    Alcohol 11
    An Integrated Model of the Proximal Associations of Alcohol Use with Suicide Risk 12
  Purpose and Hypotheses 15
Chapter Three Materials and Methods 17
  Design Considerations 17
  Participants 18
    Daily Data Compliance Rates 19
  Procedures 19
  Measures 21
    Baseline Measures 21
    Daily Measures 24
  Data Analytic Strategy 27
Chapter Four Results 31
  Descriptives 31
    Differences between Non-completers and Completers 31
    Baseline Descriptives 31
    Daily Data Descriptives and Basic Associations 32
  Hypothesis Tests 34
    Specific Aim, Hypothesis 1 34
    Exploratory Aim, Hypothesis 2a 35
    Exploratory Aim, Hypothesis 2b 36
    Post-Hoc Exploratory Analyses 37
Chapter Five Discussion 38
  Proximal Correlates of Suicidal Ideation 38
  Proximal Correlates of Acquired Capability and Suicidal Behavior 41
  Future Directions 44
  Clinical Implications 46
  Limitations 47
  Conclusions 49
List of References 50
Appendix 70
Vita 78

LIST OF TABLES

Table 1. Bivariate Correlations and Descriptive Statistics for Baseline Study Measures 72
Table 2. Parameters for Hypothesis 1 Model Predicting Suicidal Ideation using Any Drinking Day Variable 73
Table 3. Parameters for Hypothesis 1 Model Predicting Suicidal Ideation using Binge Drinking Day Variable 74
Table 4. Parameters for Hypothesis 1 Model Predicting Suicidal Ideation using Number of Drinks Variable 74
Table 5. Parameters for Hypothesis 2a Models Predicting Acquired Capability 76
Table 6. Parameters for Hypothesis 2b Model Predicting Suicidal Behavior 77

LIST OF FIGURES

Figure 1. Integrated Model of the AMM and IPTS 71

CHAPTER ONE
INTRODUCTION

Suicide is a substantial public health concern and is the third leading cause of death in young adults ages 18 to 24 years old in the United States (Centers of Disease Control and Prevention [CDC], 2013). Moreover, millions of young adults suffer the psychologically and physically harmful consequences of suicide-related thoughts and behaviors. In the past year, approximately 2.9 million young adults experienced suicidal ideation, defined as thoughts of suicide that range in levels of intent to die, and an estimated half a million young adults attempted suicide, defined as potentially injurious, nonfatal behavior enacted with a nonzero level of intent to die (Crosby, Gfroerer, Han, Ortega, & Parks, 2011; Silverman, Berman, Sanddal, O'Carroll, & Joiner, 2007). In addition, an unknown number of aborted or interrupted suicide attempts occur each year. Although the prevalence of aborted and interrupted attempts is unknown, their occurrence is dangerous as they are often accompanied by a resolve to die that is strikingly similar to that involved in suicide attempts (Barber, Marzuk, Leon, & Portera, 1998; Steer, Beck, Garrison, & Lester, 1988). Further, the mental rehearsal and planning that occur during aborted/interrupted attempts may prepare one for a later attempt and possible death by suicide (Joiner, 2005; Van Orden et al., 2010). Therefore, identifying the processes underlying the development of suicidal ideation and behaviors (i.e., actual, aborted, and interrupted attempts) is of chief importance to reduce deaths by suicide.

College students are a subsample of the young adult population who are especially vulnerable to suicide, as it is a leading cause of death on college campuses (Turner, Leno, & Keller, 2013). A substantial number of college students engage in suicidal ideation, although the prevalence rates vary considerably by severity of suicidal ideation. Approximately 33-56% of

college students have thought about suicide in their lifetime, with 12% of students engaging in these thoughts in college and 25-45% of ideators experiencing multiple episodes of ideation (Chan, Straus, Brownridge, Tiwari, & Leung, 2008; Drum, Brownson, Burton Denmark, & Smith, 2009; Garlow et al., 2008; Tupler, Hong, Gibori, Blitchington, & Krishnan, 2015; Wilcox, Arria, Caldeira, Vincent, Pinchevsky, & O'Grady, 2010). In a study of introductory psychology students at the University of Tennessee, 10% of the sample reported having experienced suicidal ideation within the prior two weeks (Wolford-Clevenger, Elmquist, Brem, Zapor, & Stuart, 2015). These high prevalence rates may be partly due to studies' inclusion of passive suicidal ideation items (e.g., I wish I were dead; Joiner et al., 1999). However, many college students engage in active suicidal ideation, with a high percentage (92%) of ideators having considered or decided on a plan and method for suicide (Drum et al., 2009). Thus, suicidal ideation, regardless of the severity, is a major concern among college students.

Suicidal behaviors are less prevalent than suicidal ideation but no less concerning given their dangerous consequences. A number of studies on college students have shown that roughly 10% of students have a history of ever attempting suicide and 2% of students attempt suicide each year (Kisch, Leino, & Silverman, 2005; Meehan, Lamb, Saltzman, & O'Carroll, 1992; Mishara, Baker, & Mishara, 1976). Among college students who seriously consider suicide, 17% begin to attempt suicide but abort such attempts (Drum et al., 2009). Although the prevalence of suicidal behaviors is low among college students, these behaviors carry significant consequences that warrant study and prevention efforts. For example, data support that college students' suicidal behavior has the potential to place peers at risk for suicide (i.e., contagion; Crepeau-Hobson & Leech, 2013; Swanson & Coleman, 2013). Thus, the prevalence and

consequences of suicide-related thoughts, behaviors, and deaths in college students highlight the need to identify targetable risk factors for suicide that are pertinent to this population.

CHAPTER TWO
LITERATURE REVIEW

Alcohol Use and Suicide Risk

Alcohol use is a risk factor for suicide that may be especially germane to college students, given its pervasiveness in this population (Hingson, Zha, & Weitzman, 2009). Alcohol use can be described in the following, non-mutually exclusive categories that increase in severity: intoxication, binge drinking, heavy drinking, and alcohol use disorder. Alcohol intoxication is defined as the acute consequences of alcohol use (e.g., impaired attention/consciousness, disinhibition, and poor judgment) and is experienced by approximately 70% of college students (American Psychiatric Association [APA], 2013). Forty percent of college students binge drink, defined as drinking an excessive amount of alcohol in a short period of time (four standard drinks of alcohol for women and five for men in a two-hour period; National Institute on Alcohol Abuse and Alcoholism [NIAAA], 2015; Substance Abuse and Mental Health Services Administration [SAMHSA], 2014). Approximately 13% of college students engage in heavy drinking, which involves drinking five or more alcoholic beverages on the same occasion five or more times per month (SAMHSA, 2014). Further, this prevalence of heavy drinking in college students is significantly higher than in peers who are not enrolled in college full time (9.3%; SAMHSA, 2014). Alcohol use disorders (APA, 2013) are also common among college students, with 20% of college students meeting diagnostic criteria (Blanco et al., 2008). Troublingly, most students with alcohol use disorders avoid or defer seeking treatment, which limits opportunities to intervene for related suicide risk (Hunt & Eisenberg, 2010). Thus, understanding the role of alcohol use in college student suicide will be vital to informing primary and secondary prevention efforts.

Despite the alarmingly high levels of alcohol use among college students (SAMHSA, 2014; Windle, 2003), the proximal role it serves in the development of suicide risk is not well understood (Bagge & Sher, 2008). Such an incomplete understanding may be partly due to the lack of studies testing differential pathways to suicidal ideation and behaviors. That is, alcohol use may serve a proximal function in the development of suicidal ideation that differs from that in the progression to suicidal behavior.

Alcohol Use and Suicidal Ideation

A large body of literature supports that alcohol consumption at various levels (i.e., use, binge drinking, heavy drinking, and use disorder) is associated with suicidal ideation. Nationally representative, cross-sectional surveys have shown robust associations of binge drinking and alcohol use disorders with suicidal ideation (Glasheen, Pemberton, Lipari, Copello, & Mattson, 2015; Nock et al., 2008). Similar findings have emerged in large college student samples. A greater number of students who considered suicide in the past year engaged in heavy drinking over the past month (44%) than those who did not consider suicide (34%; Brener, Hassan, & Barrios, 1999). Correspondingly, past alcohol use and binge drinking were found to be associated with a history of suicidal ideation (Schaffer, Jeglic, & Stanley, 2008). Finally, in a large sample of college students, alcohol use disorders have been found to be independently associated with suicidal ideation (Arria et al., 2009). In contrast to the aforementioned studies, one large study of college students demonstrated a null relation between alcohol use and suicidal ideation; however, this finding may be due to poor measurement (i.e., one item measured presence of alcohol consumption in one's lifetime; Garlow et al., 2008). Overall, this body of work indicates a robust association between various levels of alcohol use and suicidal ideation;

however, these studies do not inform the temporality of, proximity of, or mechanisms underlying the association between alcohol use and suicidal ideation.

A small number of studies using various designs and methodologies have examined the temporal nature of the association between alcohol use and suicidal ideation. A longitudinal study of two cohorts of adolescents demonstrated that depression and alcohol use predicted suicidal ideation occuring six months later (Reifman & Windle, 1995). Additional longitudinal work has demonstrated alcohol use to predict suicidal ideation over longer periods of time. For example, one prospective study demonstrated that alcohol use in adolescence predicted suicidal ideation in young adulthood (Duncan, Alpert, Duncan, & Hops, 1997), and a longitudinal study of women showed that hazardous drinking predicted suicidal ideation years later (S. Wilsnack, R. Wilsnack, Kristjanson, Vogeltanz-Holm, & Windle, 2004). These data suggest a potential distal effect of alcohol use on suicidal ideation, leaving question about the proximal relation between these phenomena. One study on suicide attempters, albiet retrospective, suggested a proximal effect of alcohol use on suicidal ideation, demonstrating that acute alcohol use predicted increases in suicidal ideation in the subsequent hour (Bagge, Littlefield, Conner, Schumacher, & Lee, 2014). Alternatively, suicidal ideation may precede alcohol use, as college students may use alcohol to cope with suicidal ideation; however, this hypothesis has only been supported in cross-sectional studies (Gonzalez, Bradizza, & Collins, 2009; Gonzalez & Hewell, 2012). In short, the distal effect and temporal precedence of alcohol use on suicidal ideation have largely been supported by longitudinal work; however, the proximal relations between these two constructs have yet to be closely examined using repeated measures designs.

Alcohol Use and Suicidal Behaviors

Several reviews of the literature have linked alcohol use to suicidal behaviors, estimating varying percentages of suicide attempts (10-73%) and deaths (10-69%) in which acute alcohol intoxication is involved (Bagge & Sher, 2008; Boenisch et al., 2010; Cherpitel, Borges, & Wilcox, 2004; Esposito-Smythers & Spirito, 2004; Flensborg-Madsen et al., 2009). A recent meta-analysis refined these wide-ranging estimates of alcohol involvement in suicides, concluding that a majority of suicide decedents did not use alcohol proximately prior to their death; however, the percentage of decedents to use alcohol before their death was not negligible (34%; Anestis, Joiner, Hanson, & Gutierrez, 2014a,b; Conner, 2015). In response to the meta-analysis, Conner (2015) maintained that suicide is caused by a complex interaction of risk factors and cautioned that alcohol use should not be overlooked as a risk factor. This meta-analysis and its commentators suggest that, although alcohol is involved in a minority of suicide deaths, it is nonetheless a risk factor that requires additional, theory-guided research to understand its role in the trajectory to suicidal thoughts, behaviors, and deaths (Anestis et al., 2015a,b; Conner, 2015).

Given that suicide attempts confer significant risk for death by suicide, examining the proximal role alcohol use plays in suicide attempts is important to reduce deaths by suicide (Joiner et al., 2005). A number of cross-sectional studies have supported an association between alcohol use at various levels (i.e., use, binge drinking, heavy drinking, and use disorder) and suicide attempts (Archie, Kazemi, & Akhtar-Danesh, 2012; Borges, Walter, & Kessler, 2000; Preuss et al., 2002; Schaffer et al., 2008; Sung et al., 2015; c.f. Garlow et al., 2008). Further, cross-sectional data have supported that ideators who go on to attempt suicide are more likely to use alcohol (Reifman & Windle; 1995), engage in heavy drinking (Schilling, Aseltine, Glanovsky, James, & Jacobs, 2009), and suffer from an alcohol use disorder than non-attempters

(Nock et al., 2008). Cross-sectional data also support a proximal association between alcohol use and suicide attempts, as alcohol use and heavy drinking frequently occur on the day of a suicide attempt (Borges et al., 2004; Cornelius, Salloum, Day, Thase, & Mann, 1996). Further, data indicate that the acute effects of alcohol use on an attempt may be stronger than distal effects associated with chronic binge and heavy drinking (Borges & Rosovsky, 1996). Taken together, these data suggest that alcohol use may play an acute role in turning ideation into action; however, theory-guided, repeated measures studies are needed to test this hypothesis.

Many prospective studies have explored the relation between alcohol use and suicide attempts, but like the literature on suicidal ideation, have generally examined the distal effects of alcohol use. Among alcohol-dependent men and women, increases in the severity of the course of alcohol use disorders predicted suicide attempts occurring in the subsequent five years (Preuss et al., 2003). Similarly, among clinical outpatients, increased severity in the course of substance use disorders (including alcohol) predicted suicide attempts a month later, while controlling for borderline personality disorder (Yen et al., 2003). An epidemiological study demonstrated that alcohol use predicted suicide attempts one to two years later (Petronis, Samuels, Moscicki, & Anthony, 1990). In short, these studies support a relatively distal relation between alcohol use and suicide attempts; however, no studies to date have used methods apt to examine the proximal role alcohol plays in the development of suicide attempts.

In summary, there is converging evidence from various studies linking alcohol use with suicidal ideation and behaviors. However, many studies, including those examining proximal associations, employ cross-sectional, retrospective designs and the longitudinal studies have primarily focused on the distal effects of alcohol use on suicide risk. Theory-guided studies that

focus on the proximal associations between alcohol use and suicide-related thoughts and behaviors are clearly needed to advance the understanding of the process by which alcohol use confers risk for suicide (Bagge & Sher, 2008). Such research will help contextualize suicide risk and identify targetable areas for prevention and intervention in college students.

Theoretical Considerations

Suicide

Numerous theoretical considerations of the causes of suicide have been articulated. Early theories focused on the unique roles of social or psychological factors. Durkheim (1897/1951) described suicide as a consequence of social causes, such as social strain. Focusing more on psychological factors, Beck (1967) purported that hopelessness was a key causal determinant to suicide. Similarly, Shneidman (1985/1993) posited that suicide results from unbearable psychological pain, termed *psychache*. Baumeister (1990) expanded on the concepts of hopelessness and psychache, proposing that hopelessness about painful self-awareness akin to psychache causes a restricted cognitive state that reduces one's problem-solving skills and inhibitions such that a suicide attempt occurs. Although these theories have contributed meaningful pieces to the puzzle of understanding suicide, modern theoretical advances have highlighted important gaps to be filled. Namely, only in the past decade have theorists begun to articulate "ideation-to-action" frameworks that include distinct mechanisms in the development of risk for suicidal ideation and suicide attempts (e.g., Joiner, 2005; Klonsky & May, 2015).

The *interpersonal-psychological theory of suicide* (IPTS; Joiner, 2005; Van Orden et al., 2010) represents the first theory that describes separate, but related, processes that lead to suicidal ideation and behaviors. The theory posits that suicidal ideation results from the

concurrent presence of thwarted belongingness (i.e., social disconnectedness and low reciprocal care), perceived burdensomeness (i.e., self-hatred and liability), and hopelessness about the resolution of these states (Joiner, 2005; Van Orden et al., 2010). However, the theory states that those who consider suicide do not make a serious suicide attempt unless they have developed a sense of fearlessness about death and physical pain tolerance—termed *the acquired capability for suicide*. This acquired capability for suicide is theoretically partly heritable and partly developed in response to repeated physically painful and fearsome events (e.g. violence, self-harm) via habituation processes (P. Smith & Cukrowicz, 2010).

The main predictions of the IPTS have received substantial empirical support. The theory's predictions about thwarted interpersonal needs and suicidal ideation have been supported in clinical and nonclinical samples (Christensen, Batterham, Mackinnon, Donker, & Soubelet, 2014; Cukrowicz, Cheavens, Van Orden, Ragain, & Cook, 2011; Van Orden et al., 2010). Acquired capability has also been supported in its predicted associations with painful and fearsome events including combat exposure, violence exposure in prison inmates, over-exercise associated with disordered eating, and euthanasia exposure in veterinarians (Bryan, Cukrowicz, West, & Morrow, 2010; A. Smith et al., 2013; P. Smith, Wolford-Clevenger, Mandracchia, & Jahn, 2013; Van Orden, Witte, Gordon, Bender, & Joiner, 2008a; Witte, Correia, & Angarano, 2013). However, this literature comprises primarily cross-sectional studies. Only one longitudinal study has tested the IPTS, which supported its main predictions (Czyz, Berona, & King, 2014). Further, no studies have examined the proximal effects of alcohol use on the development of suicidal ideation and attempts within the framework of the IPTS.

Alcohol

Theory regarding the proximal effects of alcohol on behavior may help elucidate how alcohol increases acute risk for suicidal ideation and behaviors. The *alcohol myopia model* is one such theory that provides predictions about the role alcohol plays in the development of suicide risk (AMM; Josephs & Steele, 1990; Steele & Josephs, 1990). The AMM theorizes that acute alcohol intoxication limits one's cognitive and attentional resources such that attention is only allocated to the most immediate, salient, and easily processed stimuli, creating a myopic effect on attention (Josephs & Steele, 1990; Steele & Josephs, 1990). That is, during intoxication, if triggers for suicidal ideation are the most immediate, salient, and easily processed stimuli, attentional resources would be directed toward these external and/or internal cues, leaving minimal attention towards suicide-inhibiting stimuli (e.g., alternative coping skills; Giancola et al., 2010).

The AMM has received support in regards to the acute effects of alcohol on potentially harmful behaviors including risky sex, driving under the influence, tobacco use, interpersonal violence, and binge eating (see Giancola et al., 2010, for a review). A number of theorists have suggested the effects of alcohol myopia (or similarly described cognitive states) on suicidal thoughts and behavior (Baumeister, 1990; Giancola et al., 2010; Hufford, 2001a; Rogers, 1992). However, no studies have been conducted to test the AMM's predictions regarding the association between alcohol use and suicide risk. The lack of tests of the AMM with respect to suicidal thoughts and behaviors may be due to the standard of studies testing the AMM with laboratory-based experiments. Clearly such experiments would not be possible regarding suicidal ideation and behavior; however, studies using ecological momentary assessment methods may provide a strong test of the role alcohol use plays in suicide risk.

An Integrated Model of the Proximal Associations of Alcohol Use with Suicide Risk

Theory regarding the causes of suicide (Joiner, 2005; Van Orden et al., 2010) and effects of alcohol (Josephs & Steele, 1990; Steele & Josephs, 1990), and numerous literature reviews (e.g., Bagge & Sher, 2008; Brady, 2006; Giancola, Josephs, Parrott, & Duke, 2010; Rogers, 1992), strongly implicate the acute effects of alcohol intoxication in the development of suicide risk. The IPTS suggests differential mechanisms for the development of suicidal ideation and attempts; however, the specific role alcohol use may play in facilitating these mechanisms has not been clearly articulated or tested. Extensions of the AMM, on the other hand, state clearly the acute effects of alcohol use on suicide risk, but do not describe how these effects may differ in the development of suicidal ideation and attempts (Giancola et al., 2010). Thus, an integration of these two models may provide the most comprehensive description of the proximal associations of alcohol use with suicidal ideation and behaviors.

According to the IPTS, the concurrent presence of thwarted belongingness and perceived burdensomeness promotes suicidal ideation (Joiner, 2005). The AMM (Steele & Josephs, 1990) would further suggest that, during intoxication, if thwarted belongingness and perceived burdensomeness are the most immediate and salient stimuli, attention would be directed toward these psychological states, with minimal attention directed toward suicide-inhibiting stimuli (e.g., cognitive reappraisals; Giancola et al., 2010). Therefore, the integration of these models suggests that alcohol use may facilitate suicidal ideation by intensifying negative states of thwarted belongingness and perceived burdensomeness. Additionally, according to the IPTS, alcohol use may increase acquired capability for suicide by reducing pain sensitivity and fear about death proximally through its acute numbing and disinhibiting effects, respectively (P. Smith & Cukrowicz, 2010). According to the AMM, intoxicated, suicidal individuals may be

more focused on the immediate benefits of death (e.g., absence of emotional pain) and less cognizant of the finality of death and its long-lasting effects on loved ones. Further, suicidal individuals who are intoxicated may have limited attention to direct towards the pain and fear involved in dying, and thus may be less likely to experience trepidation about attempting suicide. No studies have tested such an integrated model. A study using ecological momentary assessment methods will provide a unique test of this model's predictions regarding the role of alcohol in the trajectory to suicidal ideation and behaviors among college students.

Some data support the hypothesis that thwarted interpersonal needs increase risk for suicidal ideation and that alcohol use may strengthen this association. Across various samples, feelings of belongingness, connectedness, and social reciprocity have been found to be protective against suicidal ideation (Arria et al., 2009; Cukrowicz et al., 2011; Heisel, Flett, & Hewitt, 2003; Lamis, Leenaars, Jahn, & Lester, 2013; Langhinrichsen-Rohling, Snarr, Slep, Heyman, & Foran, 2011; Van Orden et al., 2008a,b; Van Orden, Cukrowicz, Witte, & Joiner, 2012; You, Van Orden, & Conner, 2011). Although there are no known studies that have tested whether alcohol use moderates the association between thwarted interpersonal needs and suicidal ideation, there are some data that indirectly support this notion. For instance, perceived burdensomeness and thwarted belongingness mediated the relation between alcohol use and suicide proneness, defined as a propensity for engaging in suicidal behavior (Lamis & Malone, 2011). Repeated measures data are needed to more robustly test the theoretical notion that alcohol use strengthens the effects of thwarted interpersonal needs on suicidal ideation.

Limited data support the hypothesis that alcohol use proximally increases acquired capability, which ultimately enables the transition from suicidal ideation to an attempt. Only one

study—of cross-sectional design and retrospective methods—has examined the association between alcohol use and acquired capability, demonstrating a positive relationship between alcohol use and the pain tolerance facet of acquired capability in college students (Wolford-Clevenger et al., 2014). Additional preliminary support exists regarding alcohol use playing an integral role in the transition from suicidal ideation to attempt. In a sample of adolescent inpatients, suicide attempters had greater levels of alcohol use than individuals with suicidal ideation (McManama O'Brien et al., 2014). Across several samples, alcohol use increased the likelihood that suicide ideators would attempt suicide (Borges et al., 2004; Conner et al., 2007; Cornelius et al., 1996; McManama O'Brien et al., 2014). A study implementing ecological momentary assessment methods will inform whether alcohol use is proximally associated with acquired capability and subsequent risk for suicide attempt.

In sum, the literature suggests that for college students, a population that is vulnerable for suicide, alcohol use is a salient correlate of suicide-related thoughts and behaviors. However, the research on the proximal associations of alcohol use with suicidal ideation and attempts in college students is underdeveloped and suffers many limitations. Such limitations include the underutilization of repeated measures designs, no use of ecological momentary assessment methods, and limited theoretical guidance in the evaluation of these associations. The AMM and IPTS are robust models of the consequences of alcohol use and causes of suicide that together may provide valuable guidance in understanding the relation between alcohol use and suicide-related thoughts and behaviors in college students. Theory-guided research on the development of suicide risk in college students will enhance our efforts to prevent the loss of life and social, psychological, and economic costs associated with suicide-related consequences of alcohol use.

Purpose and Hypotheses

Consistent with an integrated model of the AMM and IPTS, this present study aimed to test the proximal associations of alcohol use with suicidal ideation and attempts in college students using repeated measures design and ecological momentary assessment methods, an improvement upon the literature concerning the alcohol use-suicide risk association. The study explored the effects of alcohol use on suicidal events, defined as aborted, prevented, or interrupted attempts, given the low base rate behavior of suicide attempts (Brent et al., 2009; Burns, Angold, Magruder-Habib, Costello, & Patrick, 1997; Posner et al., 2011; Posner, Oquendo, Gould, Stanley, & Davies, 2007).

The first research aim of the study was to evaluate the proximal associations among alcohol use (any, binge drinking, and number of drinks), thwarted belongingness, perceived burdensomeness, and suicidal ideation in college students. In accordance with an integrated model of the IPTS and AMM, 1) it was hypothesized that thwarted belongingness and perceived burdensomeness will interact to predict suicidal ideation, and this relationship will be moderated by alcohol use occurring before suicidal ideation. That is, on drinking days, the combined effects of thwarted belongingness and perceived burdensomeness on suicidal ideation will be stronger relative to nondrinking days (with drinking occurring after suicidal ideation coded as a nondrinking day). On binge drinking days, the concurrent effects of thwarted belongingness and perceived burdensomeness on suicidal ideation will be stronger relative to non-binge drinking days (with binge drinking occurring after suicidal ideation coded as a non-binge drinking day). As the number of drinks increase, the combined effects of thwarted belongingness and perceived burdensomeness on suicidal ideation will increase (with alcohol use occurring after suicidal ideation coded as zero drinks).

The second aim of the study was exploratory given the expected low frequency of suicide attempts. Specifically, the study will explore the effects of alcohol use on acquired capability and suicidal behaviors, which include aborted, prevented, interrupted, and actual attempts. Although it was expected that the frequency of suicidal behavior will be too low to draw statistical inferences, the following *a priori* hypotheses were made. 2a) Consistent with an integrated model of the IPTS and AMM, it is hypothesized that the effects of alcohol use on suicide attempts will be mediated by acquired capability. That is, alcohol use will increase the likelihood of a suicide attempt through increases in acquired capability. 2b) In accordance with the IPTS, it was hypothesized that acquired capability and suicidal ideation will interact to predict suicide attempts. Namely, only at high levels of acquired capability will suicidal ideation predict a suicide attempt (See Figure 1 in Appendix).

CHAPTER THREE
MATERIALS AND METHODS

Design Considerations

The present study aimed to collect repeated measures, ecological momentary assessment data over the course of 90 days from 230 (115 men, 115 women) college students attending the University of Tennessee-Knoxville. Ecological momentary assessment (Shiffman, 2009; Shiffman, Stone, & Hufford, 2008; Stone & Shiffman, 1994) involves real- or near-time, repeated sampling of individuals in their natural environment. This method was chosen as it affords the benefits of increasing external validity, reducing recall bias, and establishing temporal associations (Shiffman, 2009). The study collected such data using online, daily surveys and a fixed time-based sampling (Shiffman et al., 2008). Subjects were emailed their daily survey at each day 6 AM for 90 days to report on the previous day.

It was concluded that collecting data over 90 days (rather than 30 or 60 days) would provide a wider observation period of the relatively low base rate events of suicidal ideation and behaviors. Acceptable compliance with daily survey methods have been demonstrated in clinical and college student samples (Hufford, Shields, Shiffman, Paty, & Balabanis, 2002; Stone, Shiffman, Schwartz, Broderick, & Hufford, 2003), including surveys designed to assess suicide-related thoughts and behaviors (Nock, Prinstein, & Sterba, 2009) and alcohol use (Moore, Elkins, McNulty, Kivisto, & Handsel, 2011; Shorey, Stuart, McNulty, & Moore, 2014a; Shorey, Stuart, Moore, & McNulty, 2014b).

Further, participation in the present study was confidential, while participants' data were completely anonymous. Data collection procedures were made anonymous for the participants to reduce risk of confidentiality breaches and potential harm resulting from information being

disclosed to a third party. For example, other forms of violence (e.g., sexual violence) are being measured as part of a larger study, and mandated disclosures of such violence may harm the participant. The screener, baseline, and daily surveys were completed using Qualtrics.com, which uses encryption to protect participant responses and has the option of anonymizing the responses by removing personally identifiable information, including IP address. Although participants' e-mails and names were collected to send the daily surveys and contact them regarding compensation for their participation, these were stored securely and no personally identifiable information was connected to their individual data.

Participants

Undergraduate students (n = 1,338) from the University of Tennessee's psychology subject pool participated in the screener survey. Four-hundred and forty (33%) of those undergraduate students met criteria for study and participated in the baseline portion of the study. At least three daily data points per participant were needed for the analyses; 206 participants had completed three or more days (150 women, 53 men, and 2 "other" gender).

Participants were, on average, 19.05 years old (SD = 2.39; range: 18-46). Participants' self-identified race/ethnicity of the sample was 82.4% White/Caucasian, 4.9% African American/Black, 2.4% Asian, 5.4% Multiracial, 3.9% "Other," and 1% unknown. In addition, 7.8% of the sample identified as Hispanic or Latino(a). A majority of the sample identified as heterosexual (85%), followed by bisexual (8.8%), gay (3.4%), lesbian (2.0%), and "other" (1%). Regarding marital status, most participants (89.5%) identified as single, not living with a partner, followed by single, living with a partner (9%), and married, living with a spouse (1.5%). Most participants reported living with friends/roommates (65%), with family (15%), alone (12%), with

partner (6.5%), and other (1.5%). Most of the sample was freshman (69.3%). Yearly household income distribution was as follows: less than $50,000 (38.8%), $50,000-$100,000 (27.7%), $100,000-$150,000 (16%), $150,000-$200,000 (6.4%), greater than $200,000 (11.2%).

Daily Data Compliance Rates

Participants completed a total of 7,342 (39.6%) of the 18,540 surveys sent. The compliance rates of the 206 participants were the following: 30 days (57.7%), 60 days (33.8%), and 90 days (26.9%). Out of the 90 daily surveys sent out, 50 participants (24.27%) completed between 30 and 60 days, and 51 participants (24.8%) completed 61 or more days. Thus, we had at least 1 month of data from 49% of the sample. Although the compliance rates were poor, the final sample size fell within the target sample size estimated by an *a priori* power analysis, which assumed standard regression models to estimate the needed sample size to detect a small-to-moderate effect (i.e., $r = .20$; Cohen, 1988; Roberts & Monacco, 2006) with two-tailed significance tests at the .05 alpha level. This analysis suggested that a sample ranging from 152 (power = .70) to 258 participants (power = .90) was needed.

Procedures

Participants were recruited via the University of Tennessee online SONA website. Students enrolled in Introduction to Psychology at the University of Tennessee may participate in the research studies listed on the SONA website for partial course credit. A brief description of the proposed study was presented on the SONA website. If students decided to participate they were directed by SONA to a brief, anonymous, screener questionnaire in Qualtrics.com to determine eligibility. The inclusion criteria were that students must a) be at least 18 years old, b) have consumed alcohol within the past month, and c) have ever thought about or attempted

suicide. Individuals who met inclusion criteria viewed an informed consent page.

Students who consented proceeded to complete the anonymous, baseline survey on Qualtrics.com. Following the baseline survey, participants were forwarded to a separate Qualtrics survey, where they entered their e-mail address (which was kept confidential). This allowed the PI to award research credit for the baseline survey and send them the daily surveys for the second phase of the study.

Given that the data were anonymous, participants' baseline and daily survey data were linked using subject-generated identification codes. Participants created a 7-letter unique identifier that was used to link their baseline and daily surveys. The unique identifier was anonymous while also being proximally relevant to the participant. This helped participants to recall each part of the code accurately, thus reducing errors when linking their daily surveys. The following formula to construct participants' unique identifier was used (Yurek et al., 2008): 1. First letter of your middle name (if no middle name, type "I"), 2. Second letter of first name, 3. Second letter of last name, 4. First letter of the month you were born in (e.g., February would be "F"), 5. First letter of the street you currently live on (e.g., Bennett Drive would be "B"), 6. First letter of your mother's first name (If unknown, type "X"), and 7. First letter of father's first name (If unknown, type "X").

The baseline set of questionnaires were more comprehensive than the screening questions and as such required approximately 30 minutes to complete. Following completion of the baseline survey, the participants were awarded their partial course credit. The day following the baseline survey, the researcher instructed Qualtrics to e-mail participants the 5-minute daily surveys each day at 6 AM, with a reminder at 12 PM, for 90 days. This time was selected to

decrease the likelihood that participants were intoxicated while completing the surveys. Each survey required participants to recall their previous day's behavior, defined as the time they awoke until the time they went to sleep. Like the baseline survey, the daily surveys were anonymous and linked using the subject-generated identification code. Qualtrics recorded the number of surveys (but not which surveys) participants took based on their e-mail address such that the investigator could pay them accurately.

During the first five months of data collection, participants were awarded 75 cents for each completed daily questionnaire ($67.50 for 90 days). To further incentivize participation, participants who completed at least 75% of their daily surveys were paid an additional $10, totaling to a possible $77.50. After five months of data collection, compensation was increased to one dollar per survey to improve compliance rates. This allowed participants to earn up to $100 (including the bonus). A similar payment method (50 cents per daily survey) was used in previous research that employed daily assessments of alcohol use and violence among college students at this university and obtained acceptable daily retention rates (i.e., 77% daily retention rate for 1 month, 61% for 3 months; Shorey et al., 2014a,b).

Measures

Baseline Measures

Baseline measures collected demographic information and history of alcohol use, suicidal ideation, suicidal events, suicide attempts and current thwarted belongingness, perceived burdensomeness, and acquired capability. These measures were administered to control for baseline levels of the primary study variables.

Demographics. The baseline measures gathered information on participants' demographic background, including age, gender identity, racial/ethnic identity, sexual orientation, relationship status, family income, year in school, and presence or absence of family history of suicide.

Alcohol Use. Baseline levels of alcohol use were measured using the Alcohol Use Disorders Identification Test (AUDIT). The AUDIT is a 10-item self-report measure that assesses alcohol use and problems over the past year, including quantity, frequency, intensity of drinking and symptoms alcohol use disorder (Saunders, Aasland, Babor, De la Fuente, & Grant, 1993). The total score ranges from 0 to 40 (Saunders et al., 1993). The AUDIT has been shown to be reliable and valid (Saunders et al., 1993) and had good internal consistency in the present study ($\alpha = .81$).

Thwarted Belongingness and Perceived Burdensomeness. Current thwarted belongingness and perceived burdensomeness were assessed using the 15-item Interpersonal Needs Questionnaire (INQ; Van Orden, Cukrowicz, Witte, & Joiner, 2012). The INQ has two subscales: thwarted belongingness (9 items) and perceived burdensomeness (6 items). The items are on a 7-point Likert scale, ranging from "1 = not at all true for me" to "7 = very true for me." Studies have demonstrated that the INQ has convergent validity in young adults (Van Orden et al., 2012) as well as excellent internal consistency in college students (e.g., perceived burdensomeness: $\alpha = .90$, thwarted belongingness: $\alpha = .92$; Lamis et al., 2013) and in the present sample (e.g., perceived burdensomeness: $\alpha = .94$, thwarted belongingness: $\alpha = .91$).

Acquired Capability for Suicide. Baseline levels of the acquired capability for suicide were measured using the 20-item Acquired Capability for Suicide Scale (ACSS, Van Orden et

al., 2008a). The scale assesses both aspects of the construct: pain tolerance and fearlessness about death on a 5-point Likert scale: 1 (*not at all like me*) to 5 (*very much like me*) and include such items as "I can tolerate a lot more pain than most people" and "The fact that I am going to die does not affect me." The reliability and validity of the measure has been supported in previous research (Van Orden et al., 2008a), and the internal consistency of the measure was good in the present sample ($\alpha = .84$).

Suicidal Ideation. Baseline levels of suicidal ideation were assessed using the Hopelessness Depression Symptom Questionnaire-Suicidality Subscale (HDSQ-SS; Metalsky & Joiner, 1997). The HDSQ-SS consists of four items, each containing four statements from which the participants select to indicate the frequency, planning content, controllability, and impulsive nature of their suicidal ideation over the past week. The total score for the four items assessing suicidal ideation ranges from 0 to 12, with higher scores indicating greater severity of suicidal ideation. The HDSQ-SS has demonstrated excellent internal consistency and construct validity in a college student sample ($\alpha = .96$; Metalsky & Joiner, 1997) and in the present sample ($\alpha = .91$).

Suicidal Behavior. History of previous suicide attempts was assessed using one item that will be added to the suicidal ideation scale. Participants selected whether they have never attempted suicide, attempted suicide once, or attempted suicide more than once. This categorization of suicide attempters is supported by research demonstrating that those with multiple suicide attempts are at greater risk for suicide than those with one or no attempt(s) (Rudd, Joiner, & Rajad, 1996).

To assess history of *suicidal events* at baseline (defined as aborted, prevented, or interrupted suicide attempts), items similar to those used in the Columbia-Suicide Severity

Rating Scale and Child and Adolescent Services Assessment were used (C-SSR; CASA; Brent et al., 2009; Burns, Angold, Magruder-Habib, Costello, & Patrick, 1997; Posner et al., 2011; Posner, Oquendo, Gould, Stanley, & Davies, 2007). These items are face valid and included "1. How many times have you ever started to do something to end your life but someone or something stopped you before you actually did anything? 2. How many times have you ever started to do something to try to end your life but you stopped yourself before you actually did anything?" Additional items were created to assess help-seeking behavior that may be interpreted as either an aborted or an interrupted attempt: "3. How many times have you ever called 911 or a crisis hotline for help with suicidal thoughts? 4. How many times have you ever gone to places such as the emergency department, crisis stabilization unit, or other inpatient facility for help with suicidal thoughts?" These items are on a 7-point Likert scale ranging from zero (0) to more than twenty (6) times. The items were summed as a total score of suicidal events. Since the baseline data are collected via online, self-report questionnaires, these items were created rather than using the C-SSR and CASA, which are semi-structured interviews. Given that these items are constructed for the present study, no data are available concerning their reliability and validity. The scale of suicidal events had a possible total score ranging from 0 – 12 and had inadequate internal consistency ($\alpha = .56$).

Daily Measures

Daily measures collected information on daily use of alcohol, suicidal ideation, suicidal behaviors (i.e., aborted, interrupted, and actual attempts), thwarted belongingness, perceived burdensomeness, and acquired capability. Additionally, covariates of daily depression, hopelessness, and drug use were assessed. The items were presented in the same order each day.

Alcohol Use. Participants were asked if they consumed alcohol during the previous day and responded to items by selecting "yes" (1) or "no" (0) scale. If participants consumed alcohol, they were asked the number of standard drinks they consumed, what type of alcohol they consumed (e.g., beer, wine, etc.), and what time they began and finished drinking. Binge drinking was computed as a dichotomous variable (> four standard drinks of alcohol for women and > five for men; NIAAA, 2015; SAMHSA, 2014). Alcohol use variables (i.e., drinking day, binge drinking day, or number of drinks) were coded as 0 (non-drinking) if drinking occurring after suicidal ideation). This was done to investigate the specific effects of alcohol use as an antecedent to suicidal ideation

Drug Use. Participants were asked if they consumed any drugs during the previous day to control for drug use in the analyses. Items were on a yes (1) – no (0) scale. If participants consumed drugs, they were asked what type of drug and at what time they started and stopped taking drugs that day.

Thwarted Belongingness and Perceived Burdensomeness. Participants were asked to rate their overall daily perceived burdensomeness and thwarted belongingness using four items from the INQ that most highly correlated with the thwarted belongingness and perceived burdensomeness subscales in the INQ validation study (Van Orden et al., 2012). Items were on a 7-point Likert scale (1 = "not at all true for me" to 5 "very true for me").

Acquired Capability for Suicide. Participants were asked to rate their overall daily fearlessness about death and perceived pain tolerance using the two items from the ACSS with highest factor loadings on the pain tolerance and fearlessness about death scales in the ACSS validation study (Smith, Wolford-Clevenger, Mandracchia, & Jahn, 2013). Items were on a 5-

point Likert scale (1 = "not at all like me" to 5 "very much like me"). In addition to these two items, an item was constructed to assess how capable participants felt for suicide after drinking "Please rate how capable you felt of killing yourself after drinking alcohol (whether or not you wanted to kill yourself" on a 5-point Likert scale (0 = "not all capable" to 4 = "extremely capable").

Suicidal Ideation and Attempts. Participants completed a modified version of the five-item Paykel Suicide Scale (PSS; Paykel, Myers, Lindenthal, & Tanner, 1974) regarding suicidal ideation and attempts during the previous day. The scale was modified to measure suicidal ideation and attempts over the previous 24 hours. The PSS in its original form has exhibited reliability and validity (Paykel et al., 1974). It assesses suicidal ideation that ranges from passive wishes for death to active planning and preparation for suicide, which is consistent with the most recent definition of suicidal ideation (Silverman et al., 2007). Items were on a yes (1) – no (0) scale. Participants who endorsed suicidal ideation were asked if they drank alcohol or took drugs before or after thinking about suicide. Finally, participants who endorsed suicide attempt(s) were also asked if they drank alcohol or took drugs before or after attempting suicide.

Suicidal Events. To assess daily suicidal events (aborted and interrupted attempts), we used the same items used to assess suicidal events at baseline. The items were modified to inquire whether the participant's attempt was interrupted or aborted as well as whether the participant sought formal help (e.g., hotline or inpatient treatment) for their suicidal ideation. These questions are modified items from the Columbia–Suicide Severity Rating Scale and Child and Adolescent Services Assessment (Brent et al., 2009; Burns, Angold, Magruder-Habib, Costello, & Patrick, 1997; Posner et al., 2011; Posner, Oquendo, Gould, Stanley, & Davies,

2007). Items were on a yes (1) – no (0) scale. Finally, participants who endorse suicidal event(s) were asked if they drank alcohol or took drugs before or after experiencing a suicidal event.

Hopelessness and Depression. We assessed daily depression and hopelessness using the eight-item depression-dejection subscale of the Profile of Mood States, Short Form (POMS-SF; Shacham, 1983). Items were on a 5-point Likert scale (0 = "not at all" to 4 "extremely"). The POMS has been used in other daily diary studies and has been shown to be psychometrically sound (Cranford et al., 2006; Curran, Andrykowski, & Studts, 1995).

Data Analytic Strategy

Before testing hypotheses, differences in demographics and the primary study variables were explored between participants who did not take part in the daily survey portion of the study or who did not complete at least three days of daily surveys (i.e., non-completers) with those in the final sample (i.e., completers). Second, compliance rates for the daily data were computed by calculating the percentage of missed surveys in relation to total surveys.

Because repeated measures of daily data were nested within individuals and we were interested in the average effects of the predictors on the outcomes, multilevel modeling using fixed slopes and full information maximum likelihood estimation was used to test hypotheses. Hierarchical Linear Modeling, Version 7, was used to analyze the data. Level-1 variables consisted of the daily variables; level-2 variables consisted of baseline measures.

For the specific aim regarding suicidal ideation, 1) multilevel modeling was used to (a) test the association between suicidal ideation and the interaction among daily drinking (i.e., any drinking day, binge drinking day, and number of drinks; with alcohol use occurring after suicidal ideation coded as 0), thwarted belongingness, and perceived burdensomeness in the first level of

a multilevel model, (b) control for the effects of the daily substance use and depression/hopelessness in that same level-1 model, (c) control for the autocorrelation due to repeated measures in level 2 of the model and d) enter baseline levels of thwarted belongingness, perceived burdensomeness, alcohol use, and suicidal ideation to account for the intercept at level 2 to control for between-person differences in these tendencies.

That is, the interactive effect of daily alcohol use, thwarted belongingness, and perceived burdensomeness on suicidal ideation was examined by comparing $\pi 7$ to 0 using the following level-1 equation: Daily suicidal ideation = πo + $\pi 1$ (daily alcohol use; i.e., any drinking day, binge drinking day, and number of drinks; with alcohol use occurring after suicidal ideation coded as 0) + $\pi 2$ (daily thwarted belongingness) + $\pi 3$ (daily perceived burdensomeness) + $\pi 4$ (daily thwarted belongingness X daily perceived burdensomeness) + $\pi 5$ (daily thwarted belongingness X alcohol use) + $\pi 6$ (daily perceived burdensomeness X alcohol use) + $\pi 7$ (daily thwarted belongingness X daily perceived burdensomeness X daily alcohol use) + $\pi 8$ (daily other substance use) + $\pi 9$ (daily depression/hopelessness) + e, where baseline levels of suicidal ideation, thwarted belongingness, perceived burdensomeness, and alcohol use was entered to account for the intercept at level 2. Given the binary nature of the dependent variable, a Bernoulli sampling distribution was utilized, and a population-average model was interpreted to evaluate the sample rather than specific individuals. Simple slopes analysis was used to decompose interactions.

For the exploratory aim, hypothesis 2a, the mediating effect of acquired capability on the relation between alcohol use and suicidal behavior was explored by 1) examining the association between alcohol use (i.e., any drinking day, binge drinking day, and number of drinks occurring

before suicidal ideation) and acquired capability by comparing π1 to 0 using the level-1 equation—Daily acquired capability = πo + π1 (daily alcohol use; i.e., any drinking day, binge drinking day, and number of drinks; with alcohol use occurring after suicidal ideation coded as 0) + π2 (daily other substance use) + e, and then 2) estimating the indirect effect of acquired capability on suicide attempts/events by multiplying π1 from this model by π3 from the model below and comparing it to 0 by obtaining the 95% confidence interval using RMediation (Tofighi & MacKinnon, 2011). Given the aim is exploratory, we examined suicidal behaviors (i.e., attempts and events) and in the absence of significant associations, estimated effect sizes.

To explore hypothesis 2b, multilevel modeling was used to (a) test the association between daily suicidal behaviors (attempts and events) and the interaction between suicidal ideation and acquired capability in the first level of the multilevel model, (b) control for the effects of the daily depression/hopelessness in that same level-1 model, (c) control for the autocorrelation due to repeated measures, and d) enter baseline levels of suicide attempts, suicidal events, acquired capability, and suicidal ideation to account for the intercept at level 2 to control for between-person differences in these tendencies. Thus, the interactive effect of daily acquired capability for suicide and suicidal ideation on suicidal behaviors was explored by comparing π3 to 0 using the following level-1 equation: Daily suicidal behavior = πo + π1 (daily acquired capability) + π2 (daily suicidal ideation) + π3 (daily acquired capability X suicidal ideation) + π4 (daily depression/hopelessness) + π5 (daily alcohol use; any drinking day, binge drinking day, and number of drinks; with alcohol use occurring after suicidal ideation coded as 0) + π6 (daily drug use) + e, where baseline levels of suicidal ideation, attempts, events, and acquired capability were entered to account for the intercept at level 2 in order to control for

between-person differences in these tendencies. Given the binary nature of the dependent variable, a Bernoulli sampling distribution was utilized, and a population-average model was interpreted to evaluate the sample rather than specific individuals.

CHAPTER FOUR
RESULTS

Descriptives

Differences between Non-completers and Completers

Completers (i.e., individuals who completed three or more daily surveys) reported greater suicidal events at baseline (M = 1.76; SD = 2.12) than non-completers (i.e., individuals who only completed the baseline or less than three daily surveys; M = 1.33; SD = 2.34); t (440) = 1.98, p = .048. A greater percentage of women (53%) than men (31%) moved on from the baseline to complete the daily portion of the study; X^2 (1) = 20.03, $p < .001$). A greater percentage of completers (28%) experienced suicidal ideation within the past week at baseline than non-completers (19%); X^2 (1) = 6.86, p = .006. No differences between completers and non-completers emerged in race/ethnicity, age, or the primary study variables (ps > .05)

Baseline Descriptives

Due to the nature of the inclusion criteria, the entire sample reported experiencing suicidal ideation at some point over their lifetime. Twenty-eight percent (n = 56) of the sample reported experiencing suicidal ideation within the past week, and 25% (n = 50) reported ever attempting suicide. See Table 1 in the appendix for bivariate correlations, means, and standard deviations of baseline variables.

Gender differences were explored in the primary study variables. Men reported greater acquired capability for suicide (M = 68.60; SD = 13.37) than women (M = 62.20, SD = 12.14); t(200) = 3.21, p = .002. No differences emerged in alcohol use, perceived burdensomeness, thwarted belongingness, suicidal ideation, suicidal events, or suicide attempt history.

Daily Data Descriptives and Basic Associations

Of the daily surveys completed, some level of suicidal ideation occurred on 692 (9.5%) of the completed days. The number of days on which specific thoughts of suicide occurred were the following: thoughts of life not being worth living (477 days; 6.6%), wishing for death (511 days; 7%), thoughts of taking life (410 days; 5.6%), and serious thoughts of suicide with intent present (80 days; 1.1%). As expected, suicide attempts were infrequent, occurring on four of the completed days. Given the extremely low percentage of suicide attempts reported, suicide attempts were combined with suicidal events (i.e., aborted, interrupted, prevented attempts) to form a suicidal behavior variable. Of the completed daily data, a total of 31 (0.004%) suicidal behaviors occurred.

Participants reported consuming alcohol and taking drugs on 940 (12.9%) and 737 (10.1%) of the completed daily surveys, respectively. Participants reported binge drinking on 469 (50.1%) of the drinking days. On drinking days, participants reported drinking an average of 4.58 (*SD* = 3.89) drinks. The most frequently reported drug used on drug use days was marijuana (659 days of use). On the days that suicidal ideation occurred, participants reported drinking occurred before suicidal ideation on 34 (4.9%) of those days and after suicidal ideation on 60 (8.7%) of those days. On the remaining days when suicidal ideation occurred (86.4%), participants reported that they did not drink. For the binge drinking variable, drinking occurred before suicidal ideation on 15 days and after suicidal ideation on 34 days (the remaining of the suicidal ideation days were days in which binge drinking did not occur). Finally, on the 31 days that suicidal behavior (actual, aborted, or interrupted attempts) occurred, participants reported drinking before the behaviors on 2 (6.5%) of those days and after the behaviors on 3 (9.7%) of

those days. On the remaining 24 days (77.4%), participants reported no drinking (the remaining 3 days were missing data).

The means and standard deviations of the primary daily study variables were as follows: suicidal ideation ($M = 0.20$, $SD = 0.69$), suicidal behavior ($M = 0.01$, $SD = 0.09$), thwarted belongingness ($M = 6.06$, $SD = 3.50$), perceived burdensomeness ($M = 3.35$, $SD = 2.34$), acquired capability ($M = 5.52$, $SD = 2.66$), and number of drinks on drinking days ($M = 4.58$, $SD = 3.89$; range 1-32). Suicidal ideation exhibited positive skew and kurtosis; therefore, the dichotomized version of this variable is used in the remaining analyses. Furthermore, the number of drinks variable exhibited a number of outliers (38 days with number of drinks greater than 12). Analyses were run with the outliers capped at 12 drinks and with the outliers removed.

Gender differences were explored in the primary daily study variables. Women reported greater perceived burdensomeness ($M = 3.42$, $SD = 2.34$) than men ($M = 3.03$, $SD = 2.20$; $t(7{,}006) = -6.46$, $p < .001$). Whereas men reported greater thwarted belongingness ($M = 6.51$, $SD = 3.54$) than women ($M = 5.79$, $SD = 3.43$); $t(7{,}009) = 7.84$, $p < .001$). Men were more likely to have suicidal ideation days (11.12%) than women (8.76%); X^2 (1) = 9.15, $p = .002$. Men reported greater acquired capability for suicide after drinking ($M = 1.79$, $SD = 1.28$) than women [$M = 1.33$, $SD = 0.78$; $t(916) = 6.6$, $p < .001$]. Men and women did not differ in acquired capability for suicide, depressive symptoms, drinking day, binge drinking day, number of drinks, or suicidal behavior ($ps > .05$).

Finally, models were run testing the association between alcohol use (i.e., drinking day, binge drinking day, and number of drinks, with drinking occurring after suicide ideation coded as nondrinking day) and suicidal ideation (dichotomous with Bernoulli distribution specified)

without including covariates or the other model variables. Any drinking day (coefficient = -0.68, t = -5.04, OR = 0.51, 95% [0.39, 0.66], $p < .001$), binge drinking day (coefficient = -0.66, t = -3.56, OR = 0.51, 95% [0.36, 0.74], $p < .001$), and number of drinks (without outliers; coefficient = -0.12, t = -4.09, OR = 0.88, 95% [0.83, 0.94], $p < .001$) were *negatively* associated with suicidal ideation. Results did not change using capped number of drinks variable.

Hypothesis Tests

Specific Aim, Hypothesis 1

The hypothesized three-way interactions for the drinking day, binge drinking day, and number of drinks models were not significant (ps > .05); thus, we ran the same models but with just the two way interactions (i.e., perceived burdensomeness X thwarted belongingness, perceived burdensomeness X drinking variable, and thwarted belongingness X drinking variable). These two-way interactions were also not significant (ps > .05). Thus, the models with main effects of drinking, perceived burdensomeness, and thwarted belongingness are reported. Note that the models were also run with gender as a Level-2 covariate, which did not change the results and were therefore not reported.

Model using drinking day variable. Depressive symptoms and perceived burdensomeness positively associated with suicidal ideation at level-1. Drinking day negatively associated with suicidal ideation at level-1. Level-2 suicidal ideation positively associated with daily suicidal ideation (See Table 2 in the appendix for parameters).

Model using binge drinking day variable. Depressive symptoms and perceived burdensomeness positively associated with suicidal ideation at level-1. Binge drinking

negatively associated with suicidal ideation at level-1. Suicidal ideation at level-2 positively associated with daily suicidal ideation (See Table 3 in the appendix for parameters).

Model using number of drinks variable. Depressive symptoms and perceived burdensomeness positively associated with suicidal ideation at level-1. Number of drinks (without outliers) negatively associated with suicidal ideation at level-1. Suicidal ideation at level-2 positively associated with daily suicidal ideation (See Table 4 in the appendix for parameters; results did not differ using capped variable).

Exploratory Aim, Hypothesis 2a

The use of a continuous dependent variable allowed for the calculation of an intraclass coefficient. The null model predicting daily acquired capability by the intercept (starting levels of acquired capability) indicated the intraclass coefficient to be 0.85 (i.e., 85% of the variance in suicidal ideation was due to variation between individuals). This indicated that 15% of the variation is due to differences within individuals across time and that multilevel modeling was appropriate to use for testing the remaining analyses (model deviance = 19,332.16, parameters = 3). The following models were compared with the null model to test for improved model fit.

Model using drinking day variable. The model predicting acquired capability using the drinking day as the alcohol predictor variable while controlling for daily drug use fit the data better compared with the null model (Model deviance = 19,298.47, parameters = 5; χ^2 = 19,279.47, $df = 2$, $p < .001$). Drinking day was positively associated with acquired capability (See Table 5 in the appendix for model parameters). Tests of whether acquired capability mediated the relation between drinking day and suicidal behavior did not support this hypothesis (indirect effect estimate = -0.003, $SE = 0.004$, 95% CI [-0.01, 0.005]).

Model using binge drinking day variable. The model predicting acquired capability using binge drinking day as the alcohol predictor variable while controlling for daily drug use fit the data better compared with the null model (Model deviance = 2,855.85, parameters = 5; χ^2 = 2,836.85, $df = 2, p = <.001$). Binge drinking day was not associated with daily acquired capability (See Table 5 in the appendix for model parameters). Given that binge drinking day was not associated with acquired capability for suicide, we did not conduct mediation analysis using this variable.

Model using number of drinks variable. The model predicting acquired capability using number of drinks as the alcohol predictor while controlling for daily drug use variable fit the data better compared with the null model (Model deviance = 2,743.00, parameters = 5; χ^2 = 2724.00, $df = 2, p = <.001$). Number of drinks was not associated with daily acquired capability (See Table 5 in the appendix); therefore, mediation analysis using this variable was not conducted.[1]

Exploratory Aim, Hypothesis 2b

Given that drinking day was the only alcohol use variable to associate with acquired capability for suicide, this alcohol use variable, but not the binge drinking or number of drinks variables, was used when testing hypothesis 2b[2]. The model predicting suicidal behavior indicated that daily suicidal ideation and drinking day positively associated with suicidal behavior, and baseline lifetime history of suicide attempts associated with daily suicidal

[1] This analysis using the capped number of drinks variable revealed that number of drinks was associated with acquired capability for suicide ($B = 0.01, t = 2.07, p = .04$). Tests of whether acquired capability mediated the relation between drinking day and suicidal behavior did not support this hypothesis (indirect effect estimate = -0.07, SE = 0.04, 95% CI [-0.17, -0.004]) in the expected direction.

[2]This analysis using the capped number of drinks variable revealed the same results with exception to acquired capability *negatively* associating with suicidal behavior in this analysis ($B = -0.30, SE = 0.14, p = .02$).

behavior. The interaction between acquired capability and suicidal ideation did not associate with suicidal behavior (See Table 6 in the appendix for model parameters). The model was also run with gender as a Level-2 covariate, which did not change the results and was therefore not reported.

Post-Hoc Exploratory Analyses

To further explore the nature of the relation between alcohol use and suicidal ideation, additional, exploratory analyses were conducted. Whether suicidal ideation predicted alcohol use (any drinking, binge drinking, and number of drinks) *following* such ideation was explored. The alcohol use variables were recoded such that drinking occurring *before* suicide ideation was coded as a non-drinking day. The effect of daily suicidal ideation on daily alcohol use (any drinking, binge drinking, number of drinks) was examined by comparing $\pi 1$ to 0 using the following level-1 equation: Daily alcohol use (i.e., any drinking day, binge drinking day, and number of drinks) = $\pi o + \pi 1$ (daily suicide ideation) + e. Results indicated that daily suicidal ideation was not associated with any drinking ($B = -0.10$, OR = 0.90, 95% CI [0.79, 1.03], $t = -1.49$, $p = .14$), binge drinking ($B = 0.03$, OR = 1.04, 95% CI [0.87, 1.21], $t = 0.44$, $p = .66$), or number of drinks ($B = 0.02$, $t = 0.44$, $p = .66$).

CHAPTER FIVE
DISCUSSION

The current study is an important contribution to the movement in suicidology to improve prediction of suicide risk in the short-term, which has called for repeated measures studies of suicidal thoughts and behaviors among small, high-risk samples (Glenn & Nock, 2014). The purpose of the present dissertation was to further understand the proximal relations between alcohol use and suicidal ideation and behaviors by using a repeated measures design guided by empirically-supported theory. Generally, results did not support the hypotheses. First, in contrast to hypothesis 1, alcohol use (drinking day, binge drinking day, number of drinks) was negatively associated with suicidal ideation and did not amplify the effects of thwarted belongingness and perceived burdensomeness on suicidal ideation. Second, in support of hypothesis 2a, drinking alcohol on a given day was positively associated with acquired capability and suicidal behavior. However, contrary to hypothesis 2b, acquired capability did not mediate the relation between drinking day and suicidal behavior, and the relation between suicidal ideation and suicidal behavior was not strengthened by acquired capability.

Proximal Correlates of Suicidal Ideation

Baseline levels of suicidal ideation and daily experiences of perceived burdensomeness, depressive symptoms, and hopelessness were the sole positive correlates of suicidal ideation in the multivariate model, whereas daily alcohol use negatively associated with suicidal ideation. These findings replicate a pattern in the literature that perceived burdensomeness may be more pertinent than thwarted belongingness in the prediction of suicidal ideation (Cero, Zuromski, Witte, Ribeiro, & Joiner, 2015). In contrast to previous literature, alcohol use reduced the odds

of suicidal ideation on a given day and did not amplify the effects of perceived burdensomeness and thwarted belongingness on suicidal ideation.

These findings oppose retrospective data that revealed alcohol use to predict increases in suicidal ideation in the subsequent hour (Bagge et al., 2014). Bagge and colleagues (2014) collected data on the 24 hours prior to a suicide attempt from individuals receiving medical care for such attempts, whereas the present study collected daily data from college students with histories of suicidal ideation and attempts. These sample and methodological differences may explain the contradictory relations between alcohol use and suicidal ideation. The temporal order of drinking and suicidal ideation may differ among participants who experience a salient, life-threatening event of a suicide attempt. Indeed, the present study had infrequent daily suicidal behaviors. Similarly, the present sample was of less clinical severity. College students who experience stressors (e.g., break-up; Brent et al., 1993) may choose to consume alcohol as an alternative method of escaping negative feelings, whereas such stressors may lead to suicidal ideation in clinical populations. Indeed, Baumeister (1991) has argued that alcohol use and suicidal ideation can serve the same function of reducing painful self-awareness.

However, according to the AMM, the crux of this argument rests on the salience of the environmental cues. Steele and Josephs (1988) have argued that, depending on the salience of certain environmental cues, alcohol use will either reduce negative emotion or amplify it. For example, if negative emotion in relation to a break-up is less salient than other environmental cues (e.g., bonding with friends at a bar), alcohol use will decrease such negative emotion (and thus risk for suicidal ideation). If a break-up and related negative feelings are the more salient cue, alcohol use will amplify such emotion and thus increase risk for suicidal ideation (Steele &

Josephs, 1988). Unfortunately, the present study did not assess potential competing cues in one's environment nor the salience of such cues. Furthermore, participants were, on average, under the legal drinking age. Participants who drank may have focused a great deal of attention on illegally obtaining alcohol, thereby distracting them from any negative emotion that could transition into suicidal ideation.

An additional factor that may shed light on these contradictory findings is blood alcohol content. Reviews of the literature have revealed a biphasic effect of alcohol, with low doses of alcohol reducing negative emotion and high doses having a reverse effect (Hufford, 2001a). However, the relationship may differ depending on the individual's history of alcohol use, such that low dose, mood-ameliorating effects diminish among individuals with alcohol abuse or dependence (Hufford, 2001a). Although the present study assessed history of alcohol misuse and number of drinks consumed on a given day, blood alcohol content and its effects on negative feeling states cannot be inferred from these variables.

Another unmeasured factor that may have affected the results are alcohol-related expectancies. Alcohol-related expectancies are defined as beliefs about the cognitive and behavioral effects of alcohol use (Goldman, Del Boca, & Darkes, 1999). Studies have shown that alcohol-related expectancies increase alcohol use (Leigh & Stacy, 2004), and individuals experiencing negative mood states are more likely to expect alcohol to have positive, ameliorating effects on mood (Birch et al., 2004; Hufford, 2001b). Alternatively, researchers have posited that individuals may hold suicide-related alcohol expectancies, such as expectations that alcohol will fuel pain tolerance and courage to attempt suicide (Hufford, 2001a). Individual

differences in these expectancies and how they interact with mood states to impact drinking behavior and suicidal ideation may have impacted the present results.

Finally, alternative explanations exist for the consistent positive relation between alcohol use and suicidal ideation found in the literature. First, the extensive cross-sectional literature demonstrating a positive relation between alcohol use and suicidal ideation assesses these behaviors over longer windows of time. Thus, these findings may result from distal relations between these behaviors (Arria et al., 2009; Brener et al., 1999; Glasheen et al., 2015; Schaffer et al., 2008; Nock et al., 2008). Indeed, longitudinal studies have supported a distal effect of alcohol use on suicidal ideation (Duncan et al., 1997; Reifman & Windle, 1995; S. Wilsnack et al., 2004). Another possible explanation is that the relations found the literature are due to the effects of suicidal ideation on alcohol use, rather than the reverse. That is, individuals may drink in response to or to cope with suicidal ideation (Gonzalez et al., 2009; Gonzalez & Hewell, 2012). However, exploratory analyses in the present study did not support the notion that suicidal ideation predicted alcohol use.

Proximal Correlates of Acquired Capability and Suicidal Behavior

The hypotheses regarding acquired capability and suicidal behavior were partially supported and mirror some of past literature. First, drinking alcohol on a given day was positively associated with acquired capability, while controlling for daily drug use. This finding supports theory that alcohol use proximally increases pain tolerance and fearlessness about death (Joiner, 2005; P. Smith & Cukrowicz, 2010; Van Orden et al., 2010). This finding also replicates research demonstrating positive correlations between long-term alcohol use and acquired capability (Wolford-Clevenger et al., 2014). However, this conclusion is weakened by the null

relations between binge drinking and number of drinks with acquired capability. If alcohol use proximally increased acquired capability, one would expect binge drinking and number of drinks to be associated with daily acquired capability. The study design also does not settle the question of temporality. Indeed, individuals who are feeling more fearless and tolerant of pain on a given day may be more likely to engage in risky behavior such as drinking. Finally, if alcohol use does precede acquired capability, questions regarding mechanisms remain. According to the IPTS, alcohol use would increase pain tolerance and fearlessness about death via its numbing and disinhibiting effects (P. Smith & Cukrowicz, 2010). However, AMM would predict a slightly different mechanism depending on the environment of the individual. That is, if pain and fear are less salient cues, an intoxicated individual's attention may be drawn elsewhere, thus lessening their fear and pain sensitivity (Josephs & Steele, 1990; Steele & Josephs, 1990).

Drinking on a given day (prior to experiencing suicidal ideation) was also associated with daily suicidal behavior, while controlling for baseline levels of acquired capability, suicidal behavior, suicidal ideation, and alcohol use. This finding replicates prior cross-sectional results that alcohol use and heavy drinking frequently occur on the day of a suicide attempt (Borges et al., 2004; Cornelius et al., 1996). These data also add to the cross-sectional and longitudinal studies that have revealed more distal associations between alcohol use and suicide attempts (Archie et al., 2012; Borges et al., 2000; Petronis et al., 1990; Preuss et al., 2002; Schaffer et al., 2008; Sung et al., 2015; Yen et al., 2003). Finally, this finding is consistent with prior research showing that the acute effects of alcohol use on a suicide attempt may be stronger than such

distal effects (Borges & Rosovsky, 1996), as the present study controlled for baseline levels of alcohol use.

Although this was expected, it is difficult to reconcile with the finding that drinking on a given day decreased the odds of suicidal ideation. The very low base rate of daily suicidal behavior (33 days) may explain these apparently contradictory findings. Drinking on a given day may have been, on average, associated with decreased odds of suicidal ideation. However, on the few days which suicidal behavior occurred, this pattern may have differed. Put simply, the relation between drinking and suicidal ideation may differ between people who end up attempting suicide/nearing an attempt and those who do not attempt suicide. Within the framework of AMM, those who engaged in suicidal behavior may have experienced thwarted belongingness, perceived burdensomeness, and other negative emotions as more salient, thus allowing alcohol to have more dangerous consequences (Josephs & Steele, 1990; Steele & Josephs, 1990).

Finally, although drinking on a given day was associated with both acquired capability and suicidal behavior; acquired capability did not mediate the relation between drinking day and suicidal behavior. Further, suicidal ideation was associated with suicidal behavior regardless of levels of acquired capability. These data are inconsistent with prior findings that ideators who go on to attempt suicide are more likely to use alcohol (Reifman & Windle; 1995), engage in heavy drinking (Schilling et al., 2009), and suffer from an alcohol use disorder than non-attempters (Nock et al., 2008). However, these studies did not examine the proximal relations of these constructs at the daily level. The present findings suggest that ideators do not go on to engage in suicidal behavior via the effects of alcohol use on acquired capability. Analyses were also

conducted examining the interaction between suicidal ideation and alcohol use in predicting suicidal behavior. This interaction was not significant. The findings further suggest that suicidal ideation can transition into suicidal behavior regardless of acquired capability levels. This is inconsistent with many studies finding an association between acquired capability and suicide attempt history (e.g., P. Smith, Cukrowicz, Poindexter, Hobson, & Cohen, 2010; Van Orden et al., 2008a); however, these prior studies did not examine the proximal associations of these constructs. Nonetheless, these conclusions are preliminary, as the frequency of suicidal behavior was low and included aborted and interrupted attempts.

Future Directions

The present findings provide some direction for future work. First, to better understand the proximal relation between alcohol use and suicidal ideation, additional constructs require examination. Future daily diary or ecological momentary assessment (EMA) studies should attempt to assess the nature and strength of environmental cues that might change the effects of alcohol use on the trajectory to suicidal ideation. Alternatively, laboratory paradigms may control for cue salience and examine the effects of alcohol use on outcomes analogous to suicidal ideation, such as perceived burdensomeness. Indeed, experiments have tested the AMM in explaining alcohol-related interpersonal aggression. Similar experiments could be conducted with regards to suicidal thoughts; however, debriefing and risk assessment would have to be carefully planned, and ethical considerations must be evaluated.

Such experiments, if deemed ethical, could also reveal the potential effects of blood alcohol content on suicidal ideation. Alternatively, future EMA studies could estimate blood alcohol content by collecting data on number of standard drinks during a given period of time,

weight, and sex. Transdermal alcohol sensor devices have also been used (Luczak, Rosen, & Wall, 2015). This may help to explicate the negative association found between alcohol use and suicidal ideation in the present study. Examining whether blood alcohol content has a biphasic effect on mood that is closely related to suicidal ideation would be an important advancement in understanding alcohol-related suicidal ideation and behavior.

Future studies, lab-based or daily diaries, should also examine the potential moderating effects of alcohol expectancies. The relation between alcohol use and suicidal ideation may depend on an individual's preconceived notions about whether alcohol will improve mood, or in contrast, allow them the pain tolerance and courage to attempt suicide. Examination of individual differences in these expectancies in conjunction with temporal data on mood, suicidal ideation, and behavior is needed.

Temporal data are also needed to better understand whether alcohol use proximally influences acquired capability for suicide. Experimental design may also allow for testing whether alcohol use affects pain tolerance and fearlessness about death via alcohol myopia, depending on environmental cues (Josephs & Steele, 1990; Steele & Josephs, 1990). Perhaps more important, however, is the need to consider the evolving conceptualizations of acquired capability. Factor analyses have supported a one-factor construct of fearlessness about death, excluding the factor of pain tolerance (Ribeiro et al., 2014). Klonsky and May (2015) proposed a capability for suicide that is acquired, dispositional, as well as practical (e.g., access to means, knowledge about lethal methods, etc.). Additional research on whether the capability for suicide is cognitive and/or physiological is needed to better understand how alcohol use may affect it. Finally, the hypotheses from the present study need to be examined in different samples,

preferably samples of individuals of drinking age or clinical samples with higher base rates of suicidal behavior.

Clinical Implications

The present findings have preliminary clinical implications. First, the proximal association of perceived burdensomeness and depression/hopelessness with suicidal ideation supports prior recommendations that these experiences should warrant assessment of suicidal ideation. These findings also suggest that among college students experiencing suicidal ideation, treatments that increase self-worth, promote hope, and decrease other depressive symptoms may decrease risk for suicidal thoughts. Cognitive-behavioral therapy is an empirically supported treatment for depression that may effectively target these symptoms and reduce suicidal ideation (Rudd, Joiner, & Rajab, 2011). Finally, on a broader scale, universities and colleges can seek to reduce risk for suicidal ideation by creating campus initiatives that target perceived burdensomeness. There are no known current prevention programs designed to increase self-love, self-worth, or feelings of contribution among college students; thus, development and empirical tests of such a program are needed.

Given the contradictions between the present findings and past work (e.g., Bagge et al., 2014) on the effects of alcohol use on suicidal ideation, clinicians should err on the side of safety and consider alcohol use a risk factor for suicide among college students. This is further supported by the present finding that alcohol use was associated with increased odds of suicidal behavior. Thus, history of alcohol use and suicidal thoughts/behaviors among college students should warrant assessment of the other. Furthermore, among college students with histories of

suicidal behavior, treatment of current alcohol misuse may help reduce their risk for suicidal behavior; however, treatment studies are needed to further evaluate these recommendations.

Limitations

Although the present study improved upon common limitations in the literature (e.g., limited tests of proximal associations, few daily diary designs, limited test of integrated theories of consequences of alcohol use and causes of suicide), study weaknesses remain. First, the days in which drinking occurred before suicidal ideation were very infrequent. It is possible that for some individuals, drinking and suicidal ideation are potential outcomes of similar processes (e.g., desire to escape psychological pain such as perceived burdensomeness or thwarted belongingness; Baumeister, 1990). Further, participants from the present sample were, on average, under the legal age to drink. Individuals experiencing suicidal ideation may not have the social connections needed to acquire alcohol illegally, and those that do have social connections may thus be protected from suicidal ideation. This limitation reduces the generalizability of the findings. Future work testing this model in other samples (such as individuals over the age of 21) may elucidate this question.

Another limitation of the present study is the low compliance rates (30 days: 57.7%; 60 days: 33.8%, and 90 days: 26.9%). However, we had at least 1 month of data from 49% of the sample. One potential reason for this poor compliance rate is that the sample consisted of individuals with previous histories of alcohol use and suicidal behavior. The sample could have been reasonably prone to emotional dysregulation or dysfunction in their daily life that limited their abilities to take the daily surveys consistently. Another, more serious, limitation is that individuals who engaged in serious suicidal ideation, suicidal behavior, or alcohol misuse the

day prior may have been prone to skipping the daily survey the following day (e.g., due to recovering from the previous day's events or desire not to revisit previous day events). More frequent prompting, or prompting via a phone call to the participant, may increase compliance—however, this method has the limitation of reminding the participant that they are being observed (i.e., Hawthorne effect), which has its own potential negative impact on the validity of the study.

Furthermore, given that participants reported on previous day behavior, there may be recall bias introduced in the study. Recall bias could be improved through event-based or random sampling within each day. However, these methods may negatively impact validity due to participants' acute intoxication or merely be difficult given the event being measured (e.g., suicidal ideation and behavior).

Finally, the current study did not assess the temporal nature of all model constructs. Although we attempted to measure whether drinking occurred prior to suicidal ideation and behavior, we were unable to assess the temporality of feelings of thwarted belongingness, perceived burdensomeness, and capability for suicide in relation to alcohol use and suicide ideation. The relations among these variables are likely complex, with reciprocal influences on each other. For example, someone may engage in drinking and suicidal ideation due to feelings of perceived burdensomeness, but experience greater feelings of burdensomeness due to the negative consequences of their drinking. These data may allow for assessing the cyclical nature of these constructs across days, but not within days. Future work on method development is needed to assess the latter.

Conclusions

The present dissertation advanced the literature on alcohol-related suicidal ideation and attempts by testing an integrated theory in college students. Although the findings were generally inconsistent with the hypotheses, they shed light on proximal correlates of suicidal ideation and attempts among college students. The findings suggest that perceived burdensomeness, depressive symptoms, and hopelessness are important factors to consider regarding proximal risk for suicidal ideation and suicidal ideation and alcohol use may convey risk for suicidal behaviors among college students. This study provides impetus for future research regarding alcohol-related suicide risk.

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APPENDIX

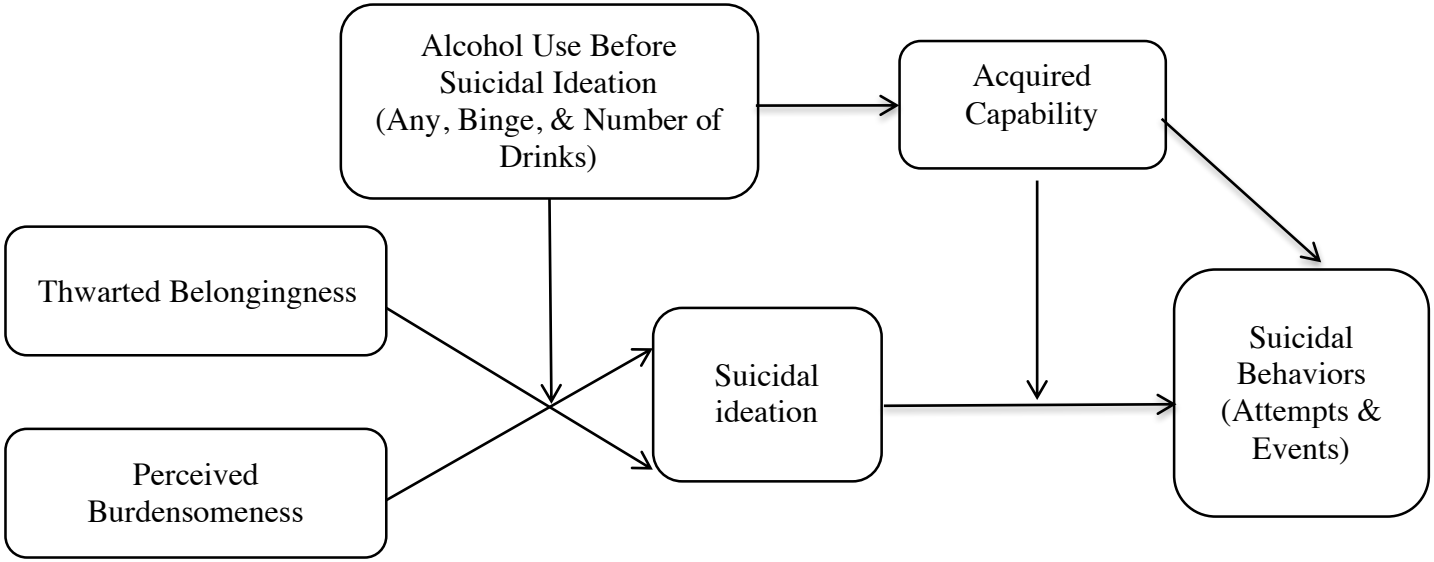


Figure 1. Integrated Model of the AMM and IPTS

Table 1. Bivariate Correlations and Descriptive Statistics for Baseline Study Measures

	1	2	3	4	5	6	7	8	9
1. Alcohol Use and Problems	-	-	-	-	-	-	-	-	-
2. Depressive Symptoms	.13	-	-	-	-	-	-	-	-
3. Hopelessness	-.01	.54**	-	-	-	-	-	-	-
4. TB	.10	.58**	.58**	-	-	-	-	-	-
5. PB	.08	.55**	.60**	.65**	-	-	-	-	-
6. Acquired Capability	.09	.08	.12	.22**	.29**	-	-	-	-
7. Suicidal Ideation	.11	.37**	.49**	.46**	.58**	.27**	-	-	-
8. Suicidal Events	.15*	.20*	.32**	.27**	.44**	.23**	.38**	-	-
9. Suicide Attempt History	.05	.13	.22**	.18**	.38**	.18*	.24**	.57**	-
Mean	9.28	28.01	2.98	29.14	12.85	64.02	0.94	1.73	-
(*SD*)	(6.10)	(10.39)	(2.46)	(12.34)	(7.66)	(12.87)	(1.81)	(2.12)	-

Note: TB = Thwarted Belongingness; PB = Perceived Burdensomeness; *SD* = Standard Deviation; *$p < .05$, **$p < .01$ (two-tailed).

Table 2. Parameters for Hypothesis 1 Model Predicting Suicidal Ideation using Any Drinking Day Variable

	B	Odds Ratio, [95% CI]	*SE*	*t*	*df*	*p*
Intercept	-4.81	0.01 [0.004, 0.02]	0.42	-11.46	186	<.001
Any drinking day (yes/no)	-0.66	0.52 [0.35, 0.76]	0.19	-3.41	6394	<0.001
Drug use day (yes/no)	0.19	1.21 [0.80, 1.84]	0.21	0.89	6394	.37
Depression/hopelessness	0.18	1.20 [1.18, 1.22]	0.01	18.37	6394	<.001
Thwarted belongingness (TB)	0.03	1.03 [0.98, 1.09]	0.03	1.30	6394	.19
Perceived burdensomeness (PB)	0.10	1.10 [1.04, 1.16]	0.03	18.37	6394	<.001
Level-2 Variables predicting Level-1 Intercept	*B*	Odds Ratio, [95% CI]	*SE*	*t*	*df*	*p*
Suicidal ideation	0.39	1.48 [1.24, 1.77]	0.09	4.29	186	<.001
Thwarted belongingness	-0.001	1.00 [0.97, 1.03]	0.01	-0.09	186	.93
Perceived burdensomeness	0.001	1.00 [0.95, 1.05]	0.03	0.04	186	.97
Alcohol use	0.01	1.01 [0.97, 1.06]	0.02	0.65	186	.51

Table 3. Parameters for Hypothesis 1 Model Predicting Suicidal Ideation using Binge Drinking Day Variable

	B	Odds Ratio, [95% CI]	*SE*	*t*	*df*	*p*
Intercept	-4.87	0.01 [0.003, 0.012]	0.42	-11.60	186	<.001
Binge drinking day (yes/no)	-0.70	0.49 [0.29, 0.84]	0.27	-2.62	6391	0.01
Drug use day (yes/no)	0.17	1.19 [0.78, 1.22]	0.21	0.81	6391	.42
Depression/hopelessness	0.18	1.20 [1.18, 1.22]	0.01	18.32	6391	<.001
Thwarted belongingness (TB)	0.04	1.04 [0.99, 1.09]	0.03	1.51	6391	.13
Perceived burdensomeness (PB)	0.10	1.10 [1.04, 1.16]	0.03	3.31	6391	<.001
Level-2 Variables predicting Level-1 Intercept						
	B	Odds Ratio, [95% CI]	*SE*	*t*	*df*	*p*
Suicidal ideation	0.39	1.48 [1.24, 1.77]	0.09	4.30	186	<.001
Thwarted belongingness	-0.002	1.00 [0.97, 1.03]	0.01	-0.10	186	.92
Perceived burdensomeness	0.002	1.00 [0.95, 1.05]	0.03	0.08	186	.94
Alcohol use	0.01	1.01 [0.97, 1.06]	0.02	0.60	186	.55

Table 4. Parameters for Hypothesis 1 Model Predicting Suicidal Ideation using Number of Drinks Variable

	B	Odds Ratio, [95% CI]	*SE*	*t*	*df*	*p*
Intercept	-4.87	0.01 [0.003, 0.02]	0.42	-11.54	186	<.001
Number of drinks	-0.11	0.90 [0.83, 0.98]	0.04	-2.52	6359	.01
Drug use day (yes/no)	0.20	1.22 [0.80, 1.85]	0.21	0.92	6359	.36
Depression/hopelessness	0.18	1.20 [1.18, 1.22]	0.01	18.30	6359	<.001
Thwarted belongingness (TB)	0.04	1.04 [0.99, 1.09]	0.03	1.45	6359	.15
Perceived burdensomeness (PB)	0.09	1.10 [1.04, 1.16]	0.03	3.29	6359	.001
Level-2 Variables predicting Level-1 Intercept						
	B	Odds Ratio, [95% CI]	*SE*	*t*	*df*	*p*
Suicidal ideation	0.39	2.48 [1.23, 1.77]	0.09	4.25	186	<.001
Thwarted belongingness	-0.002	1.00 [0.97, 1.03]	0.01	-0.10	186	.92
Perceived burdensomeness	0.002	1.00 [0.95, 1.06]	0.03	0.10	186	.92
Alcohol use	0.02	1.02 [0.97, 1.06]	0.02	0.73	186	.47

Table 5. Parameters for Hypothesis 2a Models Predicting Acquired Capability

	B	*SE*	*t*	*df*	*p*
Intercept	5.71	0.17	34.16	196	<.001
Any Drinking Day (yes/no)	0.10	0.04	2.70	6418	0.007
Drug Use (yes/no)	0.09	0.05	1.81	6418	0.07
	B	*SE*	*t*	*df*	*p*
Intercept	5.77	0.20	29.52	161	<.001
Binge Drinking Day (yes/no)	0.08	0.07	1.16	731	.25
Drug Use (yes/no)	0.10	0.10	1.01	731	.31
	B	*SE*	*t*	*df*	*p*
Intercept	5.73	0.20	28.52	159	<.001
Number of Drinks	0.01	0.01	0.86	689	.39
Drug Use (yes/no)	0.15	0.10	1.41	689	.16

Table 6. Parameters for Hypothesis 2b Model Predicting Suicidal Behavior

	B	Odds Ratio, [95% CI]	*SE*	*t*	*df*	*p*
Intercept	-8.98	<0.001, [0.00, 0.002]	1.50	-5.98	192	<.001
Depression/hopelessness	0.04	1.04, [0.98, 1.10]	0.03	1.28	6353	0.20
Acquired capability	-0.20	0.82, [0.63, 1.05]	0.13	-1.59	6353	0.11
Suicidal ideation (SI)	1.40	4.05, [2.68, 6.13]	0.21	6.64	6353	<.001
Acquired capability x SI	-0.03	0.97, [0.89, 1.07]	0.05	-0.57	6353	0.57
Drinking day (yes/no)	1.34	3.83, [1.40, 10.53]	0.52	2.61	6353	0.01
Drug use (yes/no)	-0.08	0.93, [0.29, 3.00]	0.60	-0.13	6353	0.90
	B	Odds Ratio, [95% CI]	*SE*	*t*	*df*	*p*
Suicidal ideation	-0.16	0.85, [0.67, 1.09]	0.13	-1.26	192	0.21
Acquired capability	0.02	1.02, [0.98, 1.07]	0.02	0.97	192	0.34
Suicidal events	-0.11	0.90, [0.68, 1.19]	0.14	-0.77	192	0.44
Suicide attempt history	2.00	7.39, [2.40, 22.77]	0.57	3.51	192	<.001

VITA

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