

AN EXAMINATION OF THE RELATIONSHIP BETWEEN ALCOHOL USE AND
CAPABILITY FOR SUICIDE

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An examination of the relationship between alcohol use and the capability
for suicide

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ABSTRACT

The relationship between alcohol use and suicide has been well documented in past research. However, there have been few studies interested in examining potential mediators to explain the alcohol-suicide link. The current study used the interpersonal theory of suicide to examine a potential mechanism of the alcohol use and capability for suicide relationship. 195 college individuals participated in the current study. Results confirmed an indirect effect of painful and provocative events on alcohol use and pain tolerance and an indirect effect of painful and provocative events on alcohol use and heat-induced pain sensitivity. Furthermore, painful and provocative events mediated the relationship between alcohol use and cold-induced pain sensitivity. These results may inform suicide assessments in identifying drinkers who are at greater risk of lethal self-injury.

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First and foremost, I would like to thank my adviser and mentor, Dr. Kathryn Gordon, for allowing me to work in her lab for the last six years. Working in your lab laid the foundation for my research interests. Thank you for all of your support throughout the years, especially with this document. You have been an inspiration to me and have instilled within me an unmeasurable amount of compassion toward those affected by mental illness and passion toward the mental health field. You have taught me more than you can ever imagine. Thank you for always expecting the best from me.

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Lastly, thank you to my thesis committee, including Dr. Kathryn Gordon, Dr. Rob Dvorak, Dr. Clay Routledge, and Dr. Dennis Cooley. Your support, direction, and constructive feedback were greatly appreciated throughout the process of writing this document. I wish you all the very best.

DEDICATION

This document is dedicated to those who are affected by mental illness. May you find peace in this lifetime and the help and support you need to overcome the challenges you face. Even in your darkest moments, you are never alone.

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INTRODUCTION

Suicide is a major public health problem that warrants serious scientific attention. One million people die by suicide worldwide every year (World Health Organization, 2013), and suicide is the second leading cause of death among college students (American Association of Suicidology, 2010). One factor that is repeatedly linked to suicidal behavior is alcohol use (e.g., Brenner, Barrious & Hassan, 1999; Lamis & Malone, 2011; Schaffer, Jeglic, & Stanley, 2008). This is a significant concern because approximately four out of five college students report alcohol consumption (National Institute on Alcohol Abuse and Alcoholism, 2013).

Research has revealed that high levels of alcohol consumption are associated with higher odds of having a past suicide attempt (Shaffer, Jeglic, & Stanley, 2008), fewer objections to dying by suicide (Lamis, Ellis, Chummney, and Dula, 2009), increased levels of suicide proneness (Boenisch et al., 2009; Dvorak, Lamis, & Malone, Malone, 2013; Lamis, Malone, Langhinrichsen-Rohling, & Ellis, 2010; Gau et. al, 2008; Boenisch et al., 2009), beliefs that one is likely to engage in a future suicide attempt (Shaffer, Jeglic, & Stanley, 2008), and death by suicide (Sher, 2006). Furthermore, a meta-analysis conducted by Anestis, Joiner, Hanson, and Guierrez (2015) found that approximately 33 percent of individuals who died by suicide in their sample had a blood alcohol content above zero at the time of their death.

Altogether, the literature suggests that there is a relationship between alcohol use and suicidal behavior (including suicidal desire, attempts, and death by suicide). However, there are notable limitations to existing research. Most previous work does not identify the mechanisms by which alcohol and suicidal behavior are related, and there is a lack of an underlying theory explaining the relationship between alcohol and suicidal behavior.

Interpersonal Theory of Suicide

The interpersonal theory of suicide may help to explain the connection between alcohol and suicide. Evidence supporting the interpersonal theory of suicide has emerged in a variety of populations including undergraduate, military, and clinical samples (e.g., Anestis et al., 2011; Bender et al., 2011; Bryan et al., 2010; Bryan et al., 2013; Davidson et al., 2010, Fink et al., 2012; Franklin et al., 2012; Van Orden et al., 2008; Witte et al., 2012). The theory proposes that individuals die by suicide if they have the desire and capability to end their lives (See Figure 1; Joiner, 2005; Van Orden et al., 2010). Within this framework, the desire for suicide occurs when individuals believe they lack social connection (i.e., have high levels of thwarted belongingness) and when they believe their death would be beneficial to others (i.e., perceived burdensomeness; Joiner, 2005; Van Orden et al., 2010).

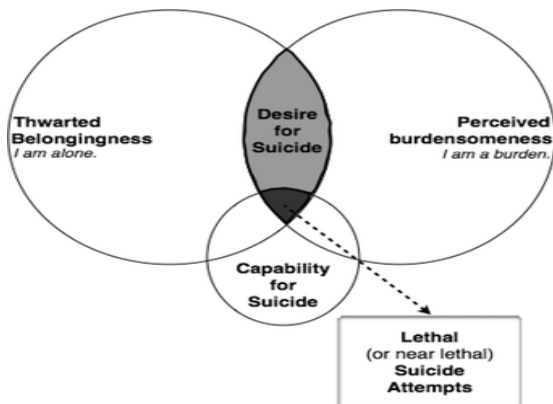


Figure 1. The interpersonal theory of suicide. Used with permission from Van Orden et al., 2010.

To our knowledge, only three previous studies have utilized the interpersonal theory of suicide to examine the relationship between alcohol and suicide. Lamis and Malone (2011) found that thwarted belongingness and perceived burdensomeness were both significant mediators in the relationship between problems with alcohol and suicide proneness in a cross-sectional college study. Meanwhile, a second study found that individuals in residential substance use disorder programs who perceived a lack of social connectedness had higher levels of desire for

suicide. Furthermore, those with greater alcohol use had higher odds of desiring suicide and reporting a past suicide attempt (You, Van Orden, & Conner, 2011). Finally, contrary to the other findings, Silva, Ribeiro, and Joiner (2015) found that alcohol use disorders were associated with lower levels of thwarted belongingness and not related to perceived burdensomeness. Silva and colleagues (2015) suggested that their finding might reflect individuals with alcohol use disorder perceiving their needs of social connection with others as being met in social situations in which alcohol is involved (Silva, Ribeiro, and Joiner, 2015).

According to the theory, even those who strongly desire suicide will not make a lethal attempt if they do not have the capacity to enact lethal self-harm (referred to as the capability for suicide; Joiner, 2005; Van Orden et al., 2010). Capability for suicide is comprised of altered pain perception (i.e., higher pain tolerance, decreased pain sensitivity) and decreased fear of death (Van Orden, 2010). Genetic factors, which are associated with pain sensitivity, pain tolerance, and impulsivity (Smith et al., 2012), as well as experiences of repeated painful and provocative events (Joiner, 2005; Van Orden, 2010) appear to contribute to the capability for suicide. Painful and provocative events can be defined as experiences that are physically painful or emotionally provocative that initially elicit a fear of death response (Van Orden et al., 2010). Painful and provocative events such as combat exposure (Bryan, Hernandez, Allison, & Clemans, 2013) and past suicide attempts (Smith et al., 2010) are associated with greater fearlessness about death and pain tolerance. Lifetime traumas (Christensen Batterham, Mackinnon, Donker, & Soubelet, 2014), childhood physical and sexual abuse (Joiner et al., 2007), and exposure to natural disasters (Gordon et al., 2011) are also associated with higher levels of capability for suicide. It is worth noting that pain tolerance and fearlessness about death (the two facets of capability for suicide) variables were not analyzed separately in these studies.

Capability for suicide is posited to be influenced by opponent process theory (Solomon & Corbit, 1974). Opponent process theory states individuals' habituate to their primary response of fear with repeated exposure to painful and provocative events. With repetition, their fear response decreases while the opposite response, such as pleasure and exhilaration (Solomon & Corbit, 1974), increases with repetition. When this habituation process occurs, pain tolerance increases and individuals capability for suicide increases (Van Orden, 2010). For example, if an individual first engages in intravenous drug use to alleviate negative affect, it is likely that their first response would be met with fear and pain. Over time, if the individual continues to engage in intravenous drug use, the fear and pain that they initially experienced will decrease while their pleasure response will increase.

Previous studies have examined these posited pathways to the capability for suicide. For example, Bresin et al. (2010) found that positive and negative affect appear to decline immediately after exposure to physical pain; however, positive affect may increase over time (Muehlenkamp et al., 2009). Additionally, Gordon et al. (2010) found an association between increased deliberate self-harm (DSH) episodes and increased subjective pain on the most recent DSH episode. These studies are compatible with an opponent process theory framework. To our knowledge, no previous study has examined this proposed process for capability for suicide as related to alcohol use.

THE CURRENT STUDY

The current study focused on the capability for suicide component of the interpersonal theory of suicide and how this may explain part of the alcohol-suicide link found in previous research. Specifically, I proposed that number of alcoholic drinks consumed on a typical drinking day is positively associated with engagement in more painful and provocative events, and that painful and provocative events is positively associated with habituation of fear of death and altered pain perception (See Figure 2 for the proposed model). There are some data consistent with the idea that alcohol is related to painful and provocative events in intoxicated individuals if they desire suicide (Barrios, Everett, Simon, & Brener, 2000; Brener, Barrios, & Hassan, 1999). However, it is important to note that, although approximately 33 percent who die by suicide have some alcohol in their system at the time of their death, it is estimated that 22 percent of suicide deaths involved BAC's above .08 percent (the legal drinking limit, Anestis et al., 2015), which suggests that most individuals who die by suicide are not acutely intoxicated nor do they have any alcohol in their system at the time of their death (Anestis, Joiner, Hanson, & Gutierrez, 2014). The findings from the meta-analysis clearly suggests that the link between alcohol and suicide cannot be purely due to acute intoxication increasing capability for suicide in the moment of death.

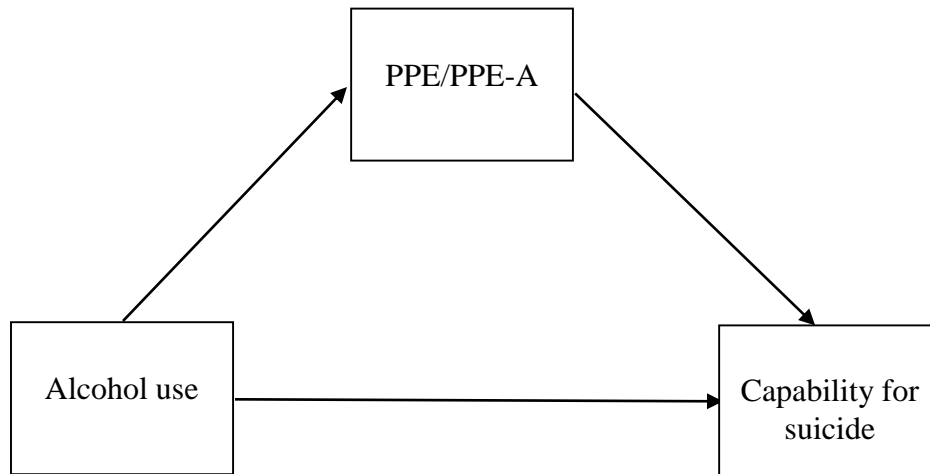


Figure 2. Proposed mediation model.

To test the proposed model, number of alcoholic drinks consumed on a typical day of drinking, trait sensation-seeking, painful and provocative events (PPE), painful and provocative events under the influence of alcohol (PPE-A), pain tolerance, pain sensitivity, and fearlessness about death were assessed in undergraduate participants. In the current study, sensation-seeking was controlled for, as past research has shown it to be related to PPE (Bender et al., 2011), alcohol use (Pederson et al., 2012; Quinn, Stappenbeck, & Fromme, 2011) and capability for suicide (Anestis et al., 2011; Bender et al., 2011; Witte, Gordon, Smith, & Van Orden, 2012). Sensation-seeking is defined as a personality trait associated with high levels of desire for sensory stimulation, which is often met by individuals engaging in thrilling experiences (Cyders, et al., 2007). Statistically controlling for the variance accounted for by sensation seeking allowed us to test for a relationship between number of alcoholic drinks consumed on a typical drinking day and capability for suicide beyond connections with the third variable of sensation-seeking. It was hypothesized that there would be an indirect effect of number of alcoholic drinks consumed on a typical day of drinking on capability for suicide variables (i.e., pain tolerance, pain sensitivity, and fearlessness about death) through PPE, even after controlling for sensation-

seeking. Additionally, I hypothesized there would be an indirect effect of number of alcoholic drinks consumed on a typical drinking day on capability for suicide through PPE-A after controlling for sensation-seeking.

METHOD

Participants

Participants were recruited on a secure online website at North Dakota State University. In addition to open recruitment, a mass screening survey was used to identify individuals who have had a past suicide attempt or endorsed consuming five or more alcoholic drinks in one sitting in the past month on one or more occasions. The mass screening survey was used in an effort to increase the number of participants that have higher levels of these variables.

A total of 221 undergraduate students completed the study. Twenty-six participants were excluded from the analyses because of computer problems, being left-handed, or endorsement of either a circulatory disorder or an autoimmune disease (all which affect pain perception; al Absi & Rokke, 1991; Ozcan, Tulum, Pinar, & Baskurt, 2004). The final sample consisted of 195 undergraduate students (54.9% female; $n = 107$) from North Dakota State University. The majority indicated that they were White (91.3%; $n = 178$). The remaining ethnic composition of the sample was: 3.6% African American/Black ($n = 7$), 4.1% Asian ($n = 8$), 3.1% Hispanic/Latino ($n = 6$), 2.6% Other ($n = 5$), and 4.6% selected more than one ethnicity ($n = 9$). The mean age of the participants was 19.51 ($SD = 2.61$; range = 18-44).

Measures

Alcohol Use

Alcohol use was measured through a question from the Alcohol Use Disorder Identification Test (AUDIT; Saunders, Aasland, Babor, De La Fuente, & Grant, 1993). I modified the answers to include an option for participants to report if they do not drink alcohol. Participants responded on a 6-point scale (0 = No drinks, 1 = 1 or 2 drinks, 2 = 3 or 4 drinks, 3 = 5 or 6 drinks, 4 = 7 to 9 drinks, 5 = 10 or more drinks) to the question, "How many alcoholic

drinks do you have on a typical day when you are drinking?” Higher scores indicated greater quantity of alcohol consumption on a typical day of drinking.

Urgency (Negative) Premeditation Perseverance Sensation-Seeking Positive Urgency Scale (UPPS-P; Cyders et al., 2007)

Sensation-seeking was measured via the UPPS-P Sensation-Seeking subscale. The Sensation-Seeking subscale is a 12-item self-report questionnaire that is designed to measure an individual’s tendency to want to engage in thrilling experiences (e.g., skydiving, water skiing, parachute jumping, learning how to fly an airplane, etc.). Participants rated items on a 4-point Likert scale (1 = agree strongly, 4 = disagree strongly). The UPPS-P Sensation-Seeking subscale has high internal consistency and is a valid facet of impulsivity (Cyders et al., 2007; Whiteside and Lynam, 2001). Cronbach’s alpha for the Sensation-Seeking subscale was .84 for the current sample.

Painful and Provocative Events Scale (PPES; Bender, Gordon, & Joiner, 2007)

PPE and PPE-A were measured using a 35-item self-report version of the PPES. The measure asks participants about the frequency with which they have experienced a variety of events that the interpersonal theory of suicide proposes plays a significant part in acquiring the capability to die by suicide. Participants were asked to indicate the frequency they have experienced events (e.g. been in physical fights, used intravenous drugs, been in a car accident, shot a gun, broken a bone, been a victim of abuse, etc.) generally and while under the influence of alcohol. Higher scores indicate more frequent experiences of physically painful and fear-inducing events (Bender, Gordon, Bresin, & Joiner, 2011).

Acquired Capability for Suicide Scale-Fearlessness about Death (ACSS-FAD; Ribeiro et al., 2013)

The ACSS-FAD subscale is a seven-item self-report measure that assesses one's fearlessness about death (FAD). Participants were asked to rate each item on a 5-point Likert scale (0=not at all like me, 4=very much like me) with higher scores reflecting higher levels of fearlessness about death (e.g., "I am not at all afraid to die"). The ACSS-FAD has been shown to be related to higher perceived pain tolerance, higher levels of perceived courage to make a suicide attempt, and lower levels of fear of suicide (Ribeiro et al., 2013). The FAD subscale has also demonstrated discriminant validity with suicidal ideation and depression (Ribeiro et al., 2013). Cronbach's alpha for the FAD subscale was .77 for the current sample.

Pain Sensitivity

Pain sensitivity was assessed using a neurosensory analyzer. The neurosensory analyzer is a computerized device utilized for the quantitative assessment of individual differences in experiences of physical pain. Previous studies have used this device as an index of the pain sensitivity aspect of acquired capability for suicide (Smith et al., 2013; Witte et al., 2012). A sensory device was secured behind the first knuckle of the index finger on participants' left hand. Baseline temperature began at 25 degrees Celsius, in which previous studies have demonstrated participants to report as neither hot nor cold and increased by 1 degree Celsius per second, similar to previous studies (e.g., Bresin, Gordon, Bender, Gordon, & Joiner, 2010). Participants were instructed to click on a computer mouse the moment when they first started experiencing pain, at which point the trial ended and temperature decreased to baseline. The maximum temperature obtainable was 50.5 degrees Celsius, at which point the trial ended and the temperature decreased to baseline. Participants' pain sensitivity was assessed in five separate

trials. After each trial, there was a 30-second time block before the next trial began to prevent habituation effects from one trial to the next. Consistent with previous research (Bresin et al., 2010), a pain sensitivity score was computed by averaging the participants' five scores once all trials were completed.

Pain sensitivity and pain tolerance were also assessed through a cold pressor task. Participants were asked to place their left hand wrist-deep into a five gallon insulated pail comprised of ice and water. The ice was placed outside a net to keep participants skin from coming in contact with the ice. An aquarium pump continuously circulated the water immediately surrounding the participants' hand to prevent habituation to the water temperature. A thermometer was used to monitor that the temperature of the water was maintained between zero and one degree Celsius for each participant. Participants were instructed to click "split" on an online stopwatch the moment they started to experience pain (to measure pain sensitivity) and to click "pause" when they could no longer tolerate the pain (pain tolerance). The maximum time permitted was two minutes, in which participants were asked to remove their hand from the water, a method used in the past by others to prevent injury from the cold water (e.g., Uman, Stewart, Watt, & Johnson, 2006).

Procedure

After providing consent, participants completed the self-report questionnaires listed above, pain sensitivity trials, and the pain tolerance task. Full counterbalancing was used with self-report questionnaires, pain sensitivity trials, and the pain tolerance trial to reduce influence of ordering effects. When finished, participants received course credit for their participation and were fully debriefed and provided with information about mental health resources. All procedures were approved by the university's Institutional Review Board.

RESULTS

Preliminary Analyses

Descriptive statistical analyses for all variables including means, standard deviations, skewness, ranges, and correlations are displayed in Table 1. As expected, the pain sensitivity measures were positively correlated with each other and both were positively correlated with the pain tolerance measure. Additionally, the number of alcoholic drinks consumed on a typical drinking day was positively correlated with PPE, and PPE was positively associated with the pain sensitivity and pain tolerance measures. It is also important to note that 87.7% of the final sample endorsed alcohol use ($n = 171$), and 40.9% of those who endorsed alcohol use reported consuming five or more alcoholic drinks on a typical drinking day ($n = 70$).

Table 1

Zero Order Correlations and Descriptive Statistics for all Measures

	Quantity	PPE	PPE-A	PTol	CPSen	HPSen	FAD	SS
Quantity	--							
PPE	.25**	--						
PPE-A	.06	.46**	--					
PTol	.12	.25**	.05	--				
CPSen	.18*	.14*	.16*	.56**	--			
HPSen	.04	.19**	.04	.38**	.32**	--		
FAD	.09	.11	-.10	.25**	.02	.26**	--	
SS	.24**	.34**	.19**	.27**	.16*	.11	.15*	--
Mean	2.03	23.71	6.56	43.05	13.76	48.16	14.9	36.93
SD	1.29	10.39	10.00	33.32	18.34	2.20	6.10	6.38
Skewness	.24	.71	1.96	1.31	4.43	-.91	-.01	-.52
Range	0-5	4-60	0-58	3.85-120	1.51-120	41.7-50.5	0-28	18-48

Note. Quantity = number of alcoholic drinks consumed on a typical drinking day; PPE = painful and provocative events; PPE-A= painful and provocative events while under the influence of alcohol; PTol = pain tolerance; CPSen = cold induced pain sensitivity; HPSen = heat induced pain sensitivity; FAD = fearlessness about death; SS = sensation-seeking.

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

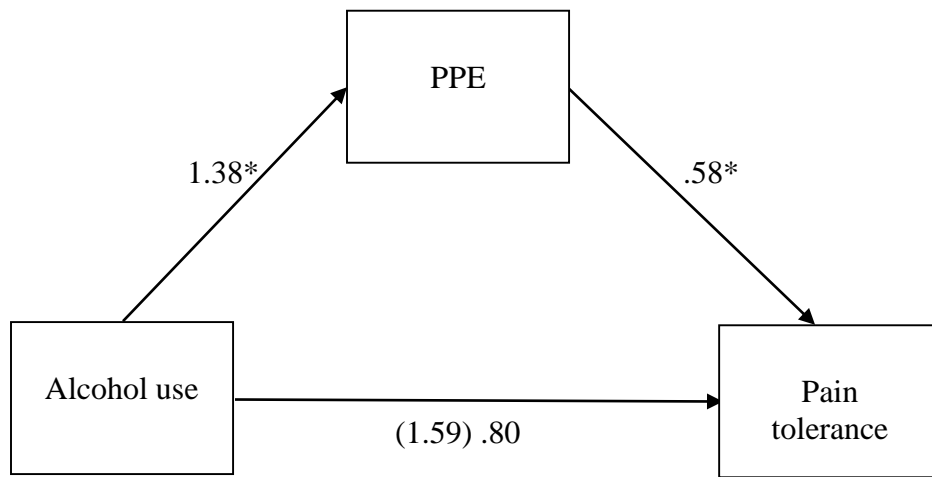
Main Analyses

Mediational analyses were then conducted to test for indirect effects of the primary hypotheses. Regression coefficients for each path of the analyses, along with total and direct effects for each analysis can be found in Figures 3-10. It is important to note that all mediational analyses controlled for sensation-seeking, as it was found to have a significant association with

quantity of alcoholic drinks consumed on a typical drinking day, pain tolerance, PPE, PPE-A, cold-induced pain sensitivity, pain tolerance, and FAD (See Table 1). All mediational analyses were conducted using 5,000 bootstrap resamples (Preacher & Hayes, 2008). The first set of analyses included each of the capability for suicide variables as the outcome variable (i.e., pain tolerance, pain sensitivity, and fearlessness about death) with the mediator as PPE, and the second set of analyses for the capability for suicide variables used PPE-A as the mediating variable. One participant was excluded from the pain tolerance and cold induced-pain sensitivity analyses ($n=194$) and three participants were excluded from the heat-induced pain sensitivity analyses ($n=192$) due to missing data. All participants were included in the fearlessness about death analyses.

Pain tolerance was assessed first, and we found a significant indirect effect of PPE on quantity of alcoholic drinks consumed on a typical drinking day and pain tolerance (See Figure 3). Meanwhile, A test for an indirect effect with PPE-A as the mediator yielded a non-significant finding (See Figure 4). Cold-induced pain sensitivity was examined next, and a test for an indirect effect of PPE on quantity of alcoholic drinks consumed on a typical drinking day and pain sensitivity yielded a result that was not statistically significant. However, the direct effect of quantity of alcoholic drinks consumed on a typical drinking day on pain sensitivity was no longer statistically significant, suggesting mediation (See Figure 5). An indirect effect was not found (See Figure 6) when PPE-A was tested as the mediator. Next, heat-induced pain sensitivity was tested, and the analysis yielded a significant indirect effect of PPE on quantity of alcoholic drinks consumed on a typical drinking day and pain sensitivity (See Figure 7). There was no indirect effect found for PPE-A when tested as the mediator (See Figure 8). Lastly, fearlessness about death was tested, and the analyses indicated no indirect effect of PPE on quantity of

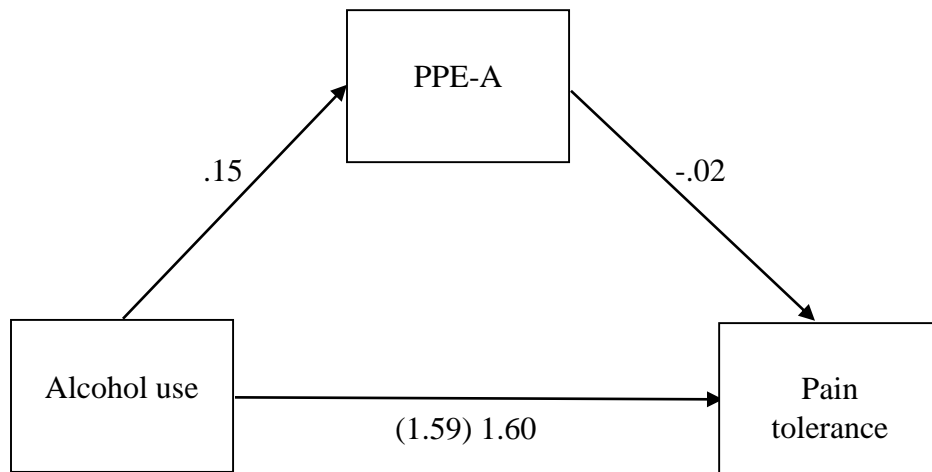
alcoholic drinks consumed on a typical drinking day and FAD (See Figure 9). PPE-A was then tested as the mediator, and again, no indirect effect was found (See Figure 10).



Indirect effect ($\beta = .80$ CI = .11, 2.18)*

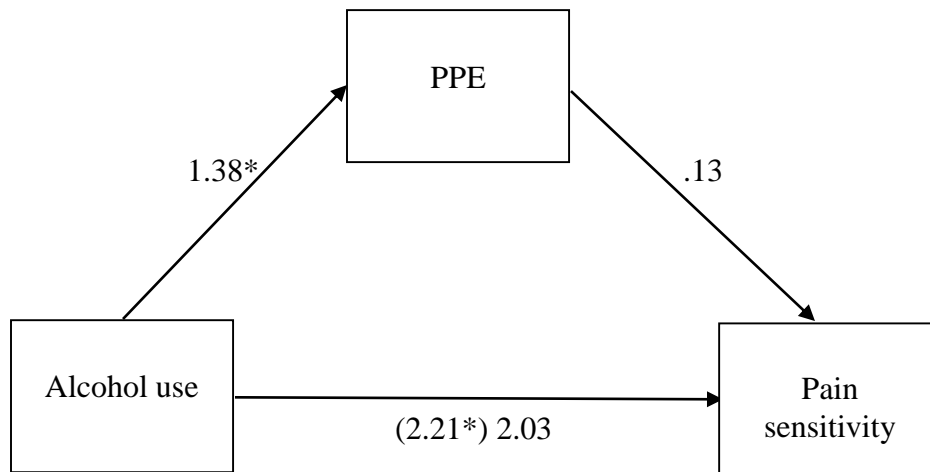
Note: * $p < .05$

Figure 3. Indirect effect of PPE on alcohol use and pain tolerance using 95% confidence intervals while controlling for sensation-seeking.



Indirect effect ($\beta = -.002$, CI = -.33, .28)

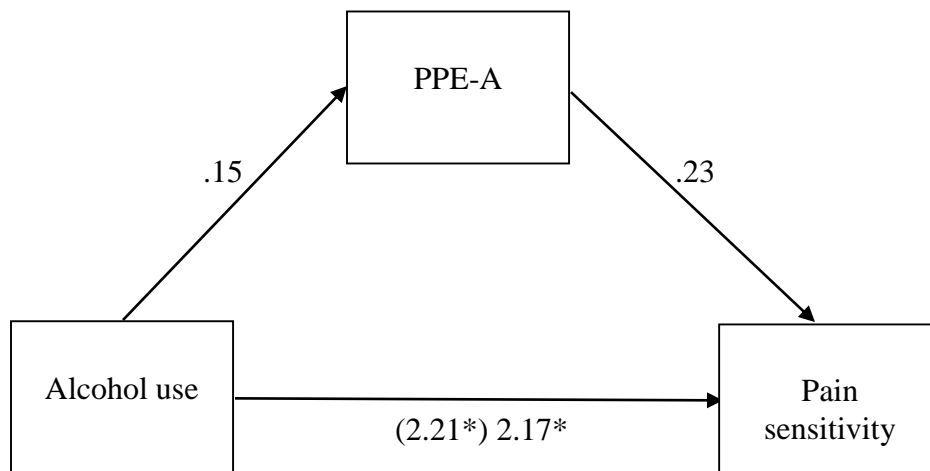
Figure 4. Indirect effect of PPE-A on alcohol use and pain tolerance using 95% confidence intervals while controlling for sensation-seeking.



Indirect effect ($\beta = .18$, CI = $-.18, 1.00$)

Note: * $p < .05$

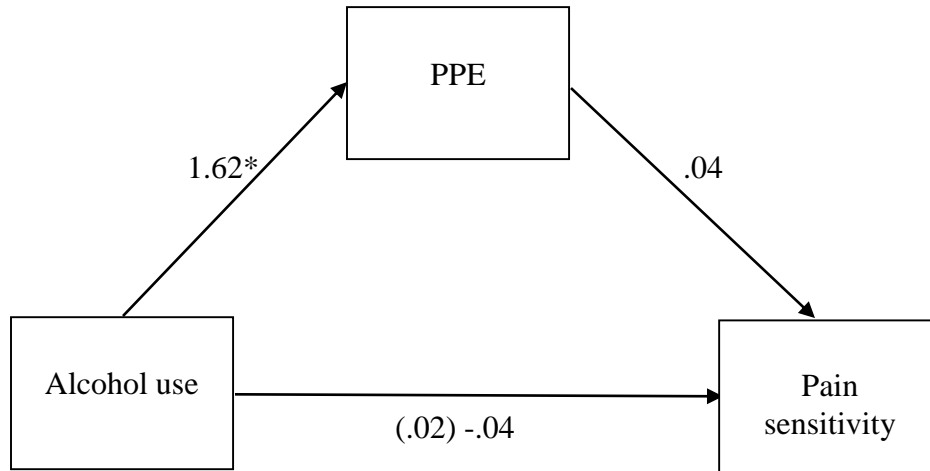
Figure 5. Indirect effect of PPE on alcohol use and cold induced pain sensitivity using 95% confidence intervals while controlling for sensation-seeking.



Indirect effect ($\beta = .04$, CI = $-.21, .50$)

Note: * $p < .05$

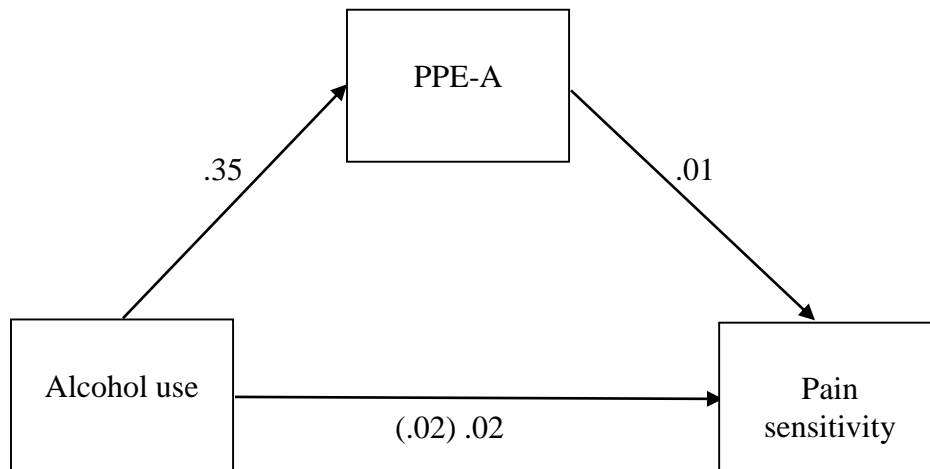
Figure 6. Indirect effect of PPE-A on alcohol use and cold induced pain sensitivity using 95% confidence intervals while controlling for sensation-seeking.



Indirect effect ($\beta = .06$, CI = .01, .16)*

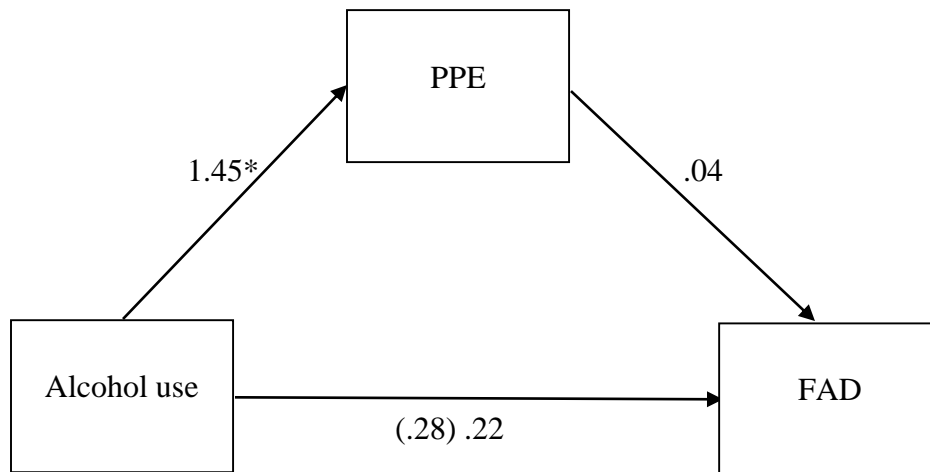
Note: * $p < .05$

Figure 7. Indirect effect of PPE on alcohol use and heat induced pain sensitivity using 95% confidence intervals while controlling for sensation-seeking.



Indirect effect ($\beta = .002$, CI = -.01, .04)

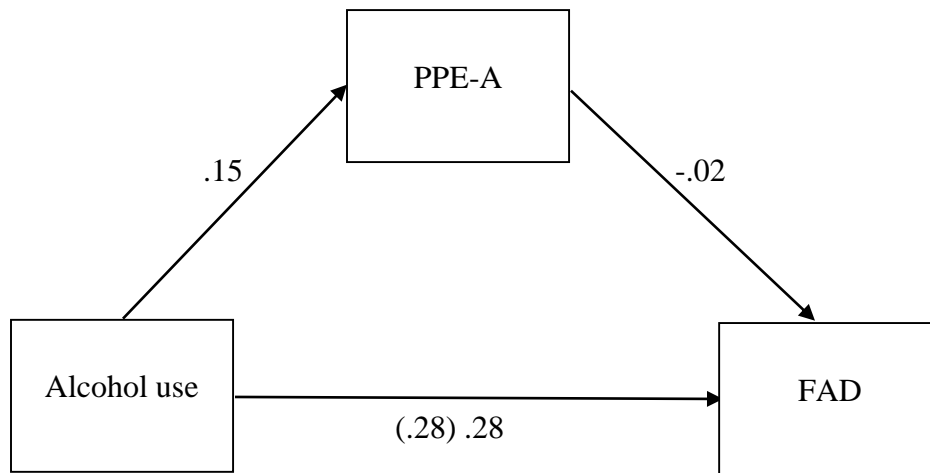
Figure 8. Indirect effect of PPE-A on alcohol use and heat induced pain sensitivity using 95% confidence intervals while controlling for sensation-seeking.



Indirect effect ($\beta = .05$, CI = -.05, .23)

Note: * $p < .05$

Figure 9. Indirect effect of PPE on alcohol use and FAD using 95% confidence intervals while controlling for sensation-seeking.



Indirect effect ($\beta = -.01$, CI = -.15, .09)

Figure 10. Indirect effect of PPE-A on alcohol use and FAD using 95% confidence intervals while controlling for sensation-seeking.

Summary of Results

In line with our hypotheses, there was a positive association between quantity of alcoholic drinks consumed on a typical drinking day and PPE. Additionally, PPE was positively associated with pain tolerance and-heat induced pain sensitivity. Contrary to our hypotheses,

PPE was not associated with cold-induced pain sensitivity and fearlessness about death. As such, there were no indirect effects found for PPE on quantity of alcoholic drinks consumed on a typical drinking day and pain sensitivity, nor was there an indirect effect found for PPE on quantity of alcoholic drinks consumed on a typical drinking day and FAD. There were also no indirect effects found for PPE-A on quantity of alcoholic drinks consumed on a typical drinking day and acquired capability variables of pain tolerance, pain sensitivity, and FAD.

Moreover, there were no total effects found for quantity of alcoholic drinks consumed on a typical drinking day on pain tolerance, heat induced pain sensitivity, and FAD. It is important to note that, according to Rucker, Preacher, Tormala, and Petty (2011), indirect effects can be meaningful even in the absence of direct effects. In addition, conducting analyses on indirect effects can facilitate understanding about processes between predictor and outcome variables (Hayes, 2009; Rucker et al, 2011).

The main finding of the current study was a significant indirect effect of the quantity of alcoholic drinks consumed on a typical drinking day and pain tolerance through PPE. There was also an indirect effect of PPE on quantity of alcoholic drinks consumed on a typical drinking day and heat-induced pain sensitivity. These findings suggest that quantity of alcohol consumed may predict greater endorsement of painful and provocative events, which in turn may predict higher pain sensitivity and pain tolerance. It is interesting to note that although there was not a significant indirect effect of quantity of alcoholic drinks consumed on a typical drinking day on cold-induced pain sensitivity through PPE, PPE mediated the relationship between quantity of alcohol use and cold-induced pain sensitivity.

DISCUSSION

The current study sought to build on previous work demonstrating an empirical relationship between alcohol use and suicide (Boenisch et al., 2009; Dvorak, Lamis, & Malone, 2013; Lamis, Malone, Langhinrichsen-Rohling, & Ellis, 2010; Gau et. al, 2008; Shaffer, Jeglic, & Stanley, 2008). Specifically, our primary aim was to test hypotheses derived from the interpersonal theory of suicide that have not been addressed in previous studies (Lamis & Malone, 2011; Silva, Ribeiro, & Joiner, 2015; You, Van Orden, & Conner, 2011). We sought to test the hypothesis that heavy alcohol use would be related to capability for suicide, and that this link would be mediated through the experience of painful and provocative events. The results of this study suggest that, after controlling for the influence of sensation-seeking, there is an indirect relationship between quantity of alcoholic drinks consumed on a typical drinking day and pain tolerance, as well as an indirect relationship between quantity of alcoholic drinks consumed on a typical drinking day and heat-induced pain sensitivity through PPE. These findings partially support the hypotheses that PPE serves as a mediator in the relationship between alcohol use and some aspects of the capability for suicide. Contrary to my hypotheses, quantity of alcoholic drinks consumed on a typical drinking day and cold-induced pain sensitivity, as well as quantity of alcoholic drinks consumed on a typical drinking day and FAD, did not have an indirect relationship through PPE. Furthermore, there was no indirect relationship between quantity of alcoholic drinks consumed on a typical drinking day and all capability for suicide variables (pain tolerance, pain sensitivity, and FAD) through PPE-A.

The findings are the first to highlight a potential mechanism behind the relationship between alcohol use and capability for suicide. Although the direct effect of the primary findings was non-significant (quantity of alcoholic drinks consumed on a typical drinking day did not

have a significant direct relationship with pain tolerance and heat-induced pain sensitivity), there was an indirect effect in both cases. This may suggest that individuals who are heavier drinkers are more likely to have increased pain tolerance and pain sensitivity because of their increased engagement in PPE.

It is also worth noting the findings that did not support my hypotheses. Although PPE did not yield a significant indirect relationship between quantity of alcoholic drinks consumed on a typical drinking day and cold-induced pain sensitivity, a mediation effect was found. Adding PPE as the mediating variable made the relationship between quantity of alcoholic drinks consumed on a typical drinking day and cold-induced pain sensitivity become non-significant. This may explain why individuals who consume more alcoholic drinks on a typical drinking day have higher pain sensitivity.

Additionally, it is possible that the college population used in the study may explain why an indirect relationship was not found between quantity of alcoholic drinks consumed on a typical drinking day and FAD through PPE. Perhaps heavier drinking days only lead to FAD over a longer period of drinking beyond the college years. It may also be the case that PPE and FAD were not significantly related to each other because college individuals that are exposed to PPE may be increasing their pain tolerance and at the same time, may not be repeatedly engaging in events that would cause habituation to fear of death. It is possible that over time, the participants' in the study would experience a decrease in fear of death with continued exposure to PPE.

Lastly, the finding that an indirect relationship between quantity of alcoholic drinks consumed on a typical drinking day and capability for suicide variables was not found through PPE-A suggests that PPE-A does not mediate this relationship. It may be the case that alcohol

acts as a numbing effect to pain and FAD while engaging in PPE-A. Individuals who engage in PPE-A may not experience the total effect of pain or habituate to the fear involved in these events as they would if they engaged in PPE without being under the influence of alcohol. Additionally, it appears that individuals engage in less PPE-A than PPE (See Table 1). This may be partially explained by the PPE questionnaire in which it may be rare for an individual to experience the painful and provocative event while under the influence of alcohol (i.e., Have you had surgery?, Have you gone skydiving?). This may explain why PPE-A endorsement may have been lower than general PPE, however, PPE-A was positively associated with PPE, but was not associated with pain tolerance, heat-induced pain sensitivity, and was negatively associated with fearlessness about death.

The current study has limitations. The study is cross-sectional. Future studies that compare heavier drinkers to people who drink less frequently longitudinally would build on this study's findings to predict whether capability for suicide increases over time as a function of repeated exposure to PPE in drinkers compared to nondrinkers. Moreover, the alcohol use, FAD, and PPE measures were self-report and may have been influenced by recall or self-enhancing bias.

Additionally, the participants in this study were exclusively college students who were enrolled at North Dakota State University and were predominately White. Although this population can be considered a strength in terms of alcohol research, our findings may not be generalizable to other age groups, ethnicities, or other regions in the United States. It may also be the case that education acts as a protective factor, particularly to FAD. College students may focus their attention on their future career aspirations and may either not think about death as much as the general population, or the fear of death may arouse anxiety, in which death is

viewed as a threat to their future goals. There is some data that suggests that there is a curvilinear relationship between educational attainment and suicide (Shah & Bhandarkar, 2009). The findings from the Shah & Bhandarkar (2009) study suggest those low and high educational attainment is positively associated with suicide. However, there have been few studies that have investigated the relationship between educational attainment and suicide. Future studies that examine this relationship would add to the literature. Lastly, although suicide is the second leading cause of death among college students, suicide is more prevalent in older ages, with the highest prevalence of suicide occurring in middle age from 45 – 54 years (American Foundation for Suicide Prevention, 2013). Future studies may build on this study by including different age groups who are more ethnically diverse to determine if this study's findings generalize outside of the college population.

Despite its limitations, this study also had notable strengths. Bootstrap analysis is considered gold-standard of mediation analysis (Hayes, 2009). This is because it does not rely on the assumption of normal distribution for the mediating variable as in the Sobel test, nor does it assume that each variable needs to be related to each other as in the causal-steps approach to mediation. Because it does not rely on assumptions, bootstrap analysis is a more powerful and valid test than the Sobel test and the causal-steps approach to mediation (Hayes, 2009).

Another strength of the current study is the direct measures of pain tolerance and pain sensitivity. By using the cold-pressor task and the neurosensory analyzer measures, I was able to obtain a more precise measure of participants' pain tolerance and pain sensitivity and did not have to rely on more subjective measures, such as self-report.

An additional strength of the study is that it controlled for sensation-seeking as past research found it to be associated with PPE (Bender et al., 2011), alcohol use (Pederson et al.,

2012; Quinn, Stappenbeck, & Fromme, 2011), capability for suicide (Anestis et al., 2011; Bender et al., 2011; Witte, Gordon, Smith, & Van Orden, 2012). By controlling for sensation-seeking, the findings are less likely to be a result of confounding variables (variables that are not measured in a study that could influence results). Lastly, because suicide is the second leading cause of death (American Association of Suicidology, 2010) and alcohol consumption is common among college students (National Institute on Alcohol Abuse and Alcoholism, 2013), this population can be viewed as a strength in conducting alcohol and suicide prevention research.

The findings of the current study may have implications. The findings may help clinicians better predict who may be at higher risk for capability for suicide. Those who consume more alcohol on drinking days may be more likely to be capable of inflicting lethal self-injury because they engage in more PPE. Prevention efforts that target individuals who consume higher amounts of alcohol on drinking days in order to minimize exposure to PPE may help to prevent individuals from the capability of enacting lethal self-injury, which may potentially save lives. Further work that replicates and expands on the findings of this study will help clinicians and researchers better understand the mechanisms that drive the alcohol-suicide relationship and may help create better suicide prevention efforts.

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