A MULTIMETHOD APPROACH TO ASSESSING SUICIDAL
BEHAVIOR AMONG SELF-INJURERS

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ABSTRACT

Non-suicidal self-injury (NSSI) and suicidal behavior are prevalent problems, particularly among young adults. However, previous research on factors that might impact the severity of NSSI is limited, with no studies examining concurrently demographic and psychological risk factors, along with how reasons for engaging in, and emotional states surrounding, NSSI might impact its course. Furthermore, no studies to date have examined how these variables may be associated with laboratory-based behavioral indicators of NSSI severity. Similarly, the relationship between NSSI and suicide has been largely unexplored until recently. The few studies that have been conducted to date have relied primarily on self-report batteries of symptoms, largely neglecting interview and performance-based methodologies. The current study used a multi-method approach to elucidate factors associated with: 1) co-morbid suicidal behavior and 2) NSSI severity among a sample of young adults who engage in NSSI. Finally, the current study sought to develop an algorithm for predicting suicidal behavior among self-injurers by simultaneously examining all study variables to determine which variables best differentiated between those with and without a history of suicidal behavior. **Hypotheses:** It was hypothesized that: 1) greater endorsement of self-punishment, emotion regulation, sensation seeking, and addiction functions of NSSI, along with decreases in negative affect and increases in positive affect during NSSI, would be independently associated with a history of suicidal behavior after controlling for relevant demographic and diagnostic characteristics, and 2) greater endorsement of self-punishment, emotion regulation, sensation seeking, and addiction functions, along with decreases in negative affect and increases in positive affect during NSSI, each would

be independently associated with a more severe course of NSSI as indicated by a greater number of self-reported acts and methods of NSSI, stronger implicit associations with NSSI, and higher levels of behavioral self-aggression. **Methods:** Participants were 68 undergraduates aged 18-26 who had engaged in at least 5 acts of NSSI, with at least one in the past six months. Twenty-eight participants endorsed little or no previous suicidal ideation and were in the NSSI Only group. Forty participants endorsed clinical levels of suicidal behavior (plans or attempts) in their lifetime and were in the NSSI+Suicidal Behavior group. Participants completed a screening procedure during which they completed self-report measures of lifetime history of NSSI and suicidal behavior, as well as self-report measures of impulsivity and affect regulation. Participants who met inclusion criteria were enrolled in the full study during which they completed diagnostic interviews for Axis I and II psychopathology, structured interviews to assess detailed lifetime self-injurious and suicidal behavior, self-report measures to assess current mood, and behavioral tasks assessing implicit associations with NSSI and self-aggression. **Results:** In terms of predicting group membership, mean level of behavioral self-aggression in the lab and engaging in NSSI for the purpose of emotion regulation significantly predicted membership in the NSSI+S study group. Regarding NSSI severity, engaging in NSSI because one feels addicted, significantly predicted more self-reported lifetime acts and methods of NSSI. Engaging in NSSI in order to meet interpersonal needs was significantly associated with implicit associations with NSSI, and increases in positive affect during NSSI were significantly associated with greater mean behavioral self-aggression in the lab. Finally, a simple algorithm was developed that correctly classified 87% of study participants into their correct study groups. This algorithm

included only four variables: a history of suicidal ideation, trait sensation seeking, mean level of behavioral self-aggression in the lab, and current alcohol abuse. **Conclusions:** The current study revealed that although NSSI and suicidal behavior have several similarities, they are distinct in several ways and many self-injurious individuals are not suicidal. Furthermore, the two study groups did not differ significantly on any Axis I or II diagnosis, suggesting that focusing primarily on diagnostic differentiators between NSSI and suicide may be misguided. Rather, the current study found that reasons for engaging in NSSI, affective states surrounding NSSI, and behavioral self-aggression, contribute significantly to NSSI severity and the relation between NSSI and suicide.

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CHAPTER 1

INTRODUCTION

Literature Review

Non-suicidal self-injury (NSSI), the intentional and direct destruction of one's bodily tissue without the intent to commit suicide, has received increasing research attention in recent years (e.g., Klonsky, Oltmanns, & Turkheimer, 2003; Nock, Joiner, Gordon, Lloyd-Richardson, & Prinstein, 2006). Self-injurious behavior is a surprisingly prevalent phenomenon, with approximately 4-6% of the general population engaging in at least one act of NSSI, (such as cutting or burning oneself, or banging one's head or pulling out one's hair), annually (Briere & Gil, 1998; Klonsky, 2011). Although NSSI has been observed across the lifespan, the highest prevalence rates have been observed in young adulthood, with between 17% and 35% of college-aged students endorsing at least one act of NSSI in their lifetime (Gratz, 2001; Nock, Teper, & Hollander, 2007; Whitlock, Eckenrode, & Silverman, 2006). Non-suicidal self-injury has been associated with a variety of deleterious outcomes, the most serious of which include severe injury and increased risk for suicide (Muehlenkamp, 2005; Selby, Bender, Gordon, Nock, & Joiner, 2011; Shaffer & Jacobson, 2009). Despite the significant adverse outcomes associated with NSSI, little is known about what factors may place individuals at greatest risk for a more severe course of NSSI or eventual suicide.

Non-suicidal self-injury is a complex behavior that may take many forms and vary widely in severity. For example, self-reported lifetime frequency of NSSI might range

from one incident to thousands, with some individuals experimenting with NSSI only once or twice, and others going on to engage in multiple episodes over many years (Walsh, 2006). In addition, research suggests that individuals may engage in multiple forms of NSSI (such as cutting, burning, or punching oneself) and that the number of forms used by any one individual may range from one to more than ten (e.g., Laye-Gindhu & Schonert-Reich, 2005; Whitlock et al., 2006). Although multiple studies have revealed heterogeneity in NSSI severity, research has only begun to examine variables that may be associated with more severe trajectories of NSSI. These variables are discussed in detail below.

Similar to NSSI, suicide is a distressing problem among adolescents and young adults. Indeed, suicide is the second leading cause of death for 15-to-24-year-olds and the fourth leading cause of death for 5-to-14-year-olds in the United States (Hoyert & Xu, 2012). Nearly one million individuals kill themselves worldwide each year (World Health Organization, 2005). These statistics, however, do not account for those who engage in the wide range of suicidal behaviors including thoughts, plans, gestures, and attempts (hereafter referred to as suicidal behaviors), which are far more prevalent than completed suicides. In the general U.S. population, it is estimated that approximately 4.6% of people attempt suicide and approximately 13.5% think about committing suicide in their lifetime (Kessler, Borges, & Walters, 1999). The estimates are higher for adolescents and young adults, with 19% seriously considering suicide, 15% making a specific suicide plan, and almost 9% attempting suicide each year (Grunbaum et al., 2002). As a history of suicidal behavior is considered to be the best predictor of eventual completed suicide, assessing

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all forms of suicidal behavior is of utmost importance (e.g. Joiner, Steer, Brown, Beck, Pettit, & Rudd, 2003; Kessler et al., 1999; Nock et al., 2008).

Despite the high prevalence rates of NSSI and suicidal behavior among young adults, as well as the frequent co-occurrence of these two behaviors, relatively little is known about the relationship, or lack thereof, between these phenomena. Some experts theorize that NSSI and suicide exist on a continuum of self-harm, with suicide as the most severe endpoint (e.g. Brausch & Guttierez, 2009; Guertin, Lloyd-Richardson, Spirito, Donaldson, & Boergers, 2001; Muehlenkamp & Guttierez, 2007). Others argue that NSSI and suicide are distinct phenomena characterized by distinct phenomenology, correlates, and trajectories (e.g. Cloutier, Martin, Kennedy, Nixon, & Muehlenkamp, 2009; Laye-Gindhu & Schonert-Reischl, 2005; Selby et al., 2011). Several researchers have even suggested that some individuals may engage in NSSI in an attempt to mitigate suicidal thoughts and behaviors (Klonsky, 2009). Despite debate concerning the relationship between NSSI and suicide, research suggests that NSSI and suicide share several risk factors, including general negative emotionality, deficits in effective coping, impulsivity, aggression, and psychiatric diagnoses (Nock et al., 2006; Walsh, 2007). Recent research also suggests that NSSI may be a risk factor for suicide (Asarnow et al., 2011; Toprak, Ilhan, Cetin, Guven, Can, & Demircan, 2011; Whitlock & Knox, 2009; Wilkinson, 2011), with prevalence rates of suicide attempts among self-injurers as high as 70% among clinical samples (Nock et at., 2006).

To better understand the course of NSSI and more clearly elucidate the relationship between NSSI and suicide, recent research has begun to examine factors that may place

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self-injurers at increased risk for severe courses of NSSI, as well as for suicide attempts. These studies have examined primarily demographic characteristics, intrapersonal risk factors, psychopathology, and course characteristics of NSSI (number of acts, number of methods, pain experienced, etc.). Recent research has also begun to examine how reasons for engaging in NSSI (e.g. emotion regulation, self-punishment, etc.) may place self-injurers at increased risk for suicide. Each of these risk factors will be discussed in turn.

Demographic Characteristics

The most commonly examined demographic characteristic related to NSSI is sex, as researchers have historically considered NSSI a behavior restricted to young girls and women. As such, a large proportion of the research on NSSI has focused on all-female samples (e.g. Favazza & Conterio, 1989; Suyemoto, 1998), much to the exclusion of male or mixed sex samples. To address this gap, Gratz and Chapman (2007) examined the prevalence of NSSI among male undergraduates and found that 44% had engaged in at least one act of NSSI, which is consistent with previous research among female samples. Furthermore, several studies with mixed-sex samples have found no significant sex differences in the prevalence of self-injury (Briere & Gil, 1998; Gratz, Conrad, & Roemer, 2002; Lloyd-Richardson, Perrine, Dierker, & Kelly, 2007).

In terms of suicide, women make attempts two to three times as often as men, particularly during adolescence (CDC, 2008; Lewinsohn, Rohde, Seeley, & Baldwin, 2001). However, males *commit* suicide at nearly four times the rate of females, representing approximately 79% of all completed suicides in the U.S. To date, very few studies have examined the possible role of sex in the relation between NSSI and suicide.

Two studies conducted with clinical samples found no sex differences between self-injurers with and without lifetime histories of attempts (Muehlenkamp, Ertelt, Miller, & Claes, 2011; Nock et al., 2006). One study conducted with high school students, however, found significantly more females in the group of self-injurers with a history of suicide attempts (Muehlenkamp & Gutierrez, 2007) relative to female self-injurers with no history of suicide attempts.

In addition to sex, other demographic characteristics such as age and race have been strongly associated with suicide risk (e.g. CDC, 2008). Specifically, suicide rates increase with age and are highest among Caucasian and Native American individuals (CDC, 2008). Although age has been robustly associated with NSSI (with highest prevalence rates among late adolescents and young adults), results are mixed regarding the relation between race and NSSI. Some studies suggest that being Caucasian is a risk factor for NSSI (e.g. Whitlock, et al., 2006), whereas others find no racial differences (e.g. Selby et al., 2011). In terms of the relation between NSSI and suicide, no study to date has found ethnicity or age to significantly distinguish between self-injurers with and without a history of suicide attempts (Muehlenkamp et al., 2011).

One demographic characteristic that has received increased research attention, particularly in regards to NSSI and suicide, is sexual orientation. Recent research suggests that lesbian, gay, and bisexual youth are more likely than heterosexual youth to experience mental health problems, engage in NSSI, and commit suicide (Beautrais, 2003; Whitlock & Knox, 2007). The extent to which non-heterosexual orientation places self-injuring individuals at risk for suicide is yet unknown. In sum, although several

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demographic characteristics have been implicated in NSSI and suicide, very few studies have examined how demographics might play a role in increasing risk for suicide among those engaging in NSSI.

Intrapersonal Risk Factors

Research on suicide, and more recently on NSSI, has examined a few key intrapersonal variables in relation to these behaviors. First, previous research has revealed that individuals who self-injure tend to experience more frequent and intense emotion, (both positive and negative), than those who do not self-injure (Gratz & Roemer, 2004; Nock, Wedig, Holmberg, & Hooley, 2008). These individuals also often exhibit difficulties in understanding, expressing, and regulating their emotions (Klonsky & Muehlenkamp, 2007). Linehan (1993) theorized that individuals who experience emotionally invalidating environments at a young age may develop maladaptive mechanisms (such as NSSI) for coping with emotional distress. Several studies have supported this theory, finding that emotion dysregulation is significantly associated with the presence and/or frequency of NSSI (Brown, Comtois, & Linehan, 2002; Gratz, 2003; Gratz & Chapman, 2007).

Although emotion dysregulation has been implicated in NSSI, the relationship between emotion regulation skills and suicidal behavior is less clear. Whereas research supports a link between lacking emotion regulation skills and suicidal ideation (Lynch, Cheavens, Morse, & Rosenthal, 2004), findings regarding the relation between emotion dysregulation and suicide attempts have been inconsistent (Selby et al., 2009; Tamas et al., 2007). To date, only one study has examined what role emotion regulation skills play,

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if any, in increasing self-injurers' risk of suicide. This study found that emotion dysregulation significantly differentiated the groups of self-injurers with and without histories of suicidal behavior, with the suicidal group reporting significantly more emotion dysregulation (Muehlenkamp et al, 2011).

Next, impulsivity, the tendency towards rapid, unplanned actions without regard for consequences, has been considered an important component of self-harm, particularly in regards to suicide (Mann, Waternaux, Haas, & Malone, 1999). However, studies of impulsivity in NSSI have produced mixed results (Janis & Nock, 2009; Lynam, Miller, Miller, Bornovalova, & Lejuez, 2011; McCloskey, Look, Chen, Pajoumand, & Berman, 2012). According to a recent study, individuals with a history of both NSSI and suicide attempt reported higher levels of both self-reported and behavioral impulsivity than those with NSSI alone (Dougherty et al., 2009). Conversely, Klonsky and Olino (2007) found that impulsivity was actually lower among a group of self-injurers characterized by previous suicidality than among other groups of self-injurers.

Other factors that have significantly distinguished self-injurers with and without histories of suicide attempt include hopelessness, suicidal ideation, and attitudes towards life/reasons for living (Muehlenkamp & Gutierrez, 2004, 2007). Still other variables, such as general negative emotionality, impaired behavioral inhibition, and aggression, have been implicated in both NSSI and suicide, but their ability to predict suicide risk among self-injurers has not been examined empirically (e.g. Wilkinson, 2011).

Psychopathology

Extant research has demonstrated a robust relationship between psychopathology and NSSI, which has led many to conceptualize NSSI primarily as a symptom of psychiatric disorder (Andover, Pepper, Ryabchenko, Orrico, & Gibb, 2005). In the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition-Text Revision* (DSM-IV-TR; American Psychiatric Association, 2000), NSSI appears only once, as a symptom of BPD. Therefore, until recently, the majority of research on NSSI has been conducted with samples of individuals, usually women, diagnosed with Borderline Personality Disorder. Indeed, the prevalence of NSSI among those with BPD is high, with studies reporting rates between 66 and 91% (Shearer, 1994; Zanarini, Frankenburg, Ridolfi, Jager-Hyman, Hennen, & Gunderson, 2006). Similarly, the rate of suicide attempt among individuals with BPD is also quite high, with estimates between 38 and 84% (Black, Blum, Pfohl, & Hale, 2004; Soloff, Lis, Kelly, Cornelius, & Ulrich, 1994; Soloff, Lynch, Kelly, Malone, & Mann, 2000). Despite these high rates, not all individuals with BPD engage in NSSI and not all those with BPD who do engage in NSSI go on to attempt suicide. However, previous research suggests that individuals with BPD engage in more acts of NSSI than those without BPD (Chapman, Specht, & Cellucci, 2005), that BPD symptom severity is associated with number of NSSI acts and suicide attempts (Muehlenkamp et al., 2011), and that individuals with BPD who self-injure are willing to give themselves stronger shocks than those with BPD who do not self-injure (McCloskey, in preparation).

The conceptualization of NSSI as a symptom of BPD rather than a distinct clinical syndrome does not account for the fact that NSSI behaviors are present in many

disorders, including depression, post-traumatic stress disorder, eating disorders, obsessive-compulsive disorder, and substance use disorders, as well as in non-clinical samples (Jacobson, Muehlenkamp, Miller, & Turner, 2008; Muehlenkamp, 2005; Nock et al., 2006; Nock, 2009). In terms of the relations between BPD, NSSI and suicide, a latent class analysis by Klonsky and Olino (2007) revealed that the class of self-injurers most likely to think about or attempt suicide endorsed significantly higher levels of BPD, anxious, and depressive symptoms than other classes of self-injurers. In addition, several studies have revealed that self-injurers with comorbid suicidality exhibit more severe psychopathology overall (Guertin et al., 2001; Muehlenkamp & Gutierrez, 2004; Stanley, Gameroff, Michalsen, & Mann, 2001). A particular problem with this research is that the majority of studies have relied on self-report inventories of symptoms rather than diagnostic interviews to assess the diagnostic correlates of NSSI. Therefore, additional research is needed to examine psychopathology among self-injurers, particularly within community samples (Nock et al., 2006).

NSSI Characteristics

Many self-injurers report a history of past suicide attempts (i.e. Nock et al., 2006) and the relationship between NSSI and a history of suicide attempts has been statistically supported (Whitlock & Knox, 2007). Furthermore, individuals with comorbid NSSI and suicide attempt display higher levels of suicidal ideation than individuals with either NSSI or suicide attempt alone (Muehlenkamp & Gutierrez, 2007; Stanley et al., 2001). Several studies have also revealed that engaging in NSSI over a longer time period, engaging in more acts, self-injuring alone, and using more methods of NSSI are each

associated with an increased frequency of suicide attempts (Andover & Gibb, 2010; Klonsky & Olino, 2007; Nock et al., 2006; Whitlock & Knox, 2007). Furthermore, a study by Anodover and Gibb (2010) revealed that NSSI history and frequency predicted attempted suicide, as well as suicidal ideation, even better than hopelessness, depression, and BPD symptoms.

<div align="center">Functions of NSSI</div>

Along with other characteristics of NSSI, several investigators have begun to examine the reasons why people engage in NSSI, commonly known as the functions of NSSI (e.g. Gratz, 2003; Klonsky, 2007; Nock & Prinstein, 2004). To date, many functions have been examined empirically (see Klonsky, 2007 for a review) and are described briefly below. Rather than being discrete reasons for engaging in NSSI, these functions overlap conceptually and may manifest to varying degrees within any given individual (Klonsky, 2007).

First, research has shown *emotion regulation* to be perhaps the most commonly-endorsed function of NSSI (Chapman, Gratz, & Brown, 2006). According to an emotion regulation model, the purpose of NSSI is to alleviate negative emotions and to dampen overwhelming emotional arousal (Klonsky, 2007; Nock, 2009). Consistent with this hypothesis and as discussed previously, research has found that individuals who self-injure experience more frequent and intense negative emotion than those who do not self-injure (Gratz & Roemer, 2004). These individuals also exhibit difficulties in understanding, expressing, and regulating their emotions (Klonsky & Muehlenkamp, 2007). Whereas many people report strong negative emotions prior to engaging NSSI,

others report episodes of dissociation or depersonalization (van der Kolk, Perry, & Herman, 1991). The *anti-dissociation* model of NSSI describes self-injury as a means of generating emotional and physical sensation in an attempt to relieve these dissociative episodes (Brown et al., 2002). It is hypothesized that the sight of blood or intense physical sensation interrupts the dissociative episode, allowing the individual to feel real or alive again (Favazza, 1998).

Another function commonly associated with self-injury is *self-punishment*. Self-injuring individuals endorse self-punishment functions second only to emotion regulation functions (Klonsky, 2007). Among those who self-injure, anger is conceptualized as being self-directed as opposed to outwardly directed (e.g. Herpertz, Sass, & Favazza, 1997). This may be particularly true among people who engage in NSSI as a means of self-punishment. As with affect regulation, self-punishment via NSSI is associated with decreases in negative affect (Klonsky, 2007).

Whereas several reasons for engaging in NSSI involve the reduction of negative affect, the *sensation seeking* model contends that self-injury may be used as a means for generating excitement or positive affect (Glenn & Klonsky, 2009). This function of NSSI has received little attention, perhaps due to its relatively infrequent endorsement by self-injurers (Nixon, Cloutier, & Aggarwal, 2002). However, research has revealed that adolescents who report higher levels of sensation seeking and negative affect are more likely to engage in risky behaviors in general (Desrichard & Denarie, 2005).

In addition to regulating one's emotions, NSSI may be used as a means of impacting others. An *interpersonal influence* model contends that individuals engage in NSSI in

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order to communicate with or influence others (Hilt, Nock, Lloyd-Richardson, & Prinstein, 2008). According to this model, NSSI may serve a myriad of interpersonal functions, such as eliciting affection, asking for help, avoiding abandonment or punishment, seeking revenge upon, or otherwise manipulating others (e.g. Nock & Prinstein, 2004).

Finally, an *addiction* model asserts that certain individuals may feel addicted to NSSI and endorse many of the same symptoms of dependence seen in other disorders characterized by addiction. These include tolerance, more frequent use than intended, and failure to meet social or occupational obligations due to NSSI (Csorba, Dinya, Plener, Nagy, & Pali, 2009; Favazza & Conterio, 1989; van der Kolk, Greenberg, Boyd, & Krystal, 1985; Whitlock, Muehlenkamp, & Eckenrode, 2008).

A recent study of the relationship between NSSI functions and NSSI severity revealed that certain functions are associated with a more severe course of NSSI characterized by more acts of NSSI or more methods of NSSI used (Jenkins, Jager-Hyman, Conner, & Alloy, 2010). Results revealed that greater endorsement of addiction and self-punishment functions was significantly associated with endorsement of more lifetime acts of NSSI. In addition, emotion regulation, self-punishment, and sensation seeking functions were significantly associated with endorsement of more methods of NSSI used. These results suggest that the functions of NSSI may play an important role in self-reported NSSI severity. This study, however, did not examine how these functions might be related to behavioral indicators of NSSI severity, such as implicit associations with NSSI or responses on a behavioral analogue of self-aggression. Furthermore, this study did not

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examine whether these functions were associated with increased risk for suicidal behaviors.

In terms of the relationship between functions and suicide risk, a latent class analysis by Klonsky and Olino (2007) revealed that the class of self-injurers who were most likely to have a history of suicidal behavior primarily endorsed an intrapersonal function of NSSI (i.e. engaging in NSSI for emotion-regulation or self-punishment purposes rather than to achieve interpersonal goals). The authors, however, did not assess individual functions such as emotion regulation, self-punishment, or sensation seeking, for example. In a related study among college students, Glenn & Klonsky (2009) confirmed that self-injurers who endorsed intrapersonal functions of NSSI were more likely to have attempted suicide. This finding is consistent with previous research with a clinical sample suggesting that intrapersonal functions conferred greatest risk for suicide attempts among self-injurers (Nock & Prinstein, 2005).

Among a sample of self-injuring adolescents, Csorba and colleagues (2009) found that self-injurers with a history of suicide attempt were more likely than their counterparts with no suicidal history to say they self-injured "to relieve nervousness/fearfulness." This is consistent with an emotion regulation function. These results are consistent with previous research suggesting that self-injurers with suicidal histories are more likely to endorse intrapersonal functions. On the other hand, Csorba and colleagues (2009) also found that self-injurers with a history of suicide were more likely to engage in NSSI due to fear of abandonment than self-injurers with no suicidal history, implicating an *inter*personal influence function of their NSSI.

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As research quite clearly supports NSSI as an emotion regulation strategy, recent studies have begun to examine the temporal events and affective states surrounding an act of NSSI and how these might impact the severity of NSSI. The research that has been conducted to date has focused primarily on negatively reinforcing factors of NSSI. This work has revealed that reduction in negative affect during NSSI leads to more acts of NSSI over the lifetime (e.g. Nock & Mendes, 2008). Recent research has shown that NSSI may also be positively reinforcing with higher levels of positive affect experienced after NSSI predicting more lifetime acts of NSSI (Jenkins & Schmitz, 2013). To date, however, no study has examined how the emotional consequences of NSSI may be associated with performance-based indicators of NSSI severity or with risk for suicide.

Next Steps

Overall, research examining the relationship between NSSI and suicidal ideation and behavior is relatively scarce, particularly given the overlap in risk factors and incidence of these behaviors. Furthermore, extant research has focused on classifying groups of self-injurers or examining correlates of self-harm behaviors, broadly, rather than examining variables that may predict which self-injurers are most at risk of becoming suicidal. Additionally, previous research has primarily examined self-harm behaviors in clinical samples and has neglected to examine suicidal ideation in addition to suicide attempts. This is an important distinction, as few people who engage in NSSI actually attempt suicide, particularly among community samples. For example, Glenn & Klonsky (2009) found that only 8.8% of young adults with a history of self-injury had attempted suicide. This is consistent with previous research by Lloyd-Richardson and colleagues

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(2007), who found that 7% of community adolescents with a history of NSSI had also attempted suicide. Thus, although the rates of suicide are relatively low in community samples, the outcome of suicide is so unexpected among these individuals that it is imperative to assess variables (such as suicidal ideation) that are known risk factors for suicide.

Finally, much of the extant research examining the severity of NSSI, as well as the relationships between NSSI and suicide, has been limited by reliance on self-reports of NSSI (i.e., asking how many NSSI acts and methods individuals have engaged in). Although the confidentiality of this modality may be useful in eliciting sensitive information, research participants may purposely conceal information about their self-harm behaviors or ideation, not deem such information relevant during clinical assessments, lack conscious awareness of their thoughts, or simply not be able to accurately recall how many times they have engaged in the behavior (particularly if it has involved many acts over a long period of time). Recently, performance-based methodologies have emerged that may provide insight into NSSI severity. For example, Nock and Banaji (2007) have developed a computer-based task to assess individual's implicit associations with NSSI (described in Measures). Among a community sample, higher scores on the task significantly predicted the presence of self-injury, even after controlling for known demographic and psychiatric risk factors (Nock & Banaji, 2007). Another behavioral task that may provide insight into the severity of self-injury is the Self-Aggression Paradigm (SAP; McCloskey & Berman 2003; Berman & Walley, 2003). The SAP (described in Measures), is a behavioral measure of self-aggression in which

participants self-administer electric shocks. Research with this task has revealed and that individuals with a history of self-harm and suicidal ideation select higher average self-shocks and are more likely to select severe self-shocks (Walley & Berman 2003, Berman and McCloskey, 2003). Furthermore, among individuals with Borderline Personality Disorder (BPD), those who self-injure are willing to give themselves stronger shocks than those with BPD who do not self-injure, (McCloskey, in preparation). Thus, both of these tasks have been associated with the presence of NSSI. Furthermore, to the extent that a more severe course of NSSI is associated with suicidal behavior, these tasks may also be useful in identifying individuals at increased risk for suicide. No research to date, however, has examined the relation between scores on these tasks and self-reported NSSI severity or suicidal behavior.

In sum, these gaps in the existing literature make imperative the search for risk factors that place individuals at greatest risk for severe self-injury suicidal behavior.

Specific Aims and Hypotheses

The aim of the current study was to use a multimethod approach to identifying factors associated with NSSI severity and co-morbid suicidal behavior among a sample of self-injuring young adults. Specifically, the current study examined factors that may distinguish self-injuring individuals with and without a history of suicidal behavior and to identify variables associated with increased NSSI severity (both self-reported and behavioral). Finally, taking into consideration all variables in the study, an algorithm was developed to predict which self-injurers are most at risk for suicide. The current study was conducted among a college sample of young adults engaging in NSSI and employed

multiple methods, including self-report measures, behavioral tasks, and clinical interviews to assess NSSI, suicidal behavior, and correlates of these behaviors.

Aim 1

The first aim of this study was to assess factors that differentiate individuals engaging in NSSI with and without comorbid histories of clinically significant suicidal behavior, after controlling for relevant demographic and diagnostic correlates.

Hypothesis 1a

Increased behavioral self-aggression and implicit associations with NSSI stimuli will be independently associated with a history of suicidal behavior.

Hypothesis 1b

Decreases in negative affect and increases in positive affect during NSSI will be independently associated with a history of suicidal behavior.

Hypothesis 1c

Stronger endorsement of self-punishment, emotion regulation, sensation seeking, and addiction functions of NSSI will be independently associated with a history of clinically significant suicidal behavior.

Aim 2

The second aim of this study was to examine whether the functions of NSSI (affect regulation, self-punishment, interpersonal influence, autonomy, sensation seeking, and addiction) and emotional states surrounding NSSI (increased or decreased negative or positive affect) are associated with self-report and behavioral indicators of NSSI severity.

Hypothesis 2a

Greater endorsement of self-punishment, emotion regulation, sensation seeking, and addiction functions will each be independently associated with self-report and behavioral (i.e. implicit associations with NSSI and self-aggression) measures of NSSI severity.

Hypothesis 2b

Decreases in negative affect and increases in positive affect after NSSI, will each be independently associated with self-report and behavioral (i.e. implicit associations with NSSI and self-aggression) measures of NSSI severity.

<div align="center">*Aim 3*</div>

An exploratory aim of this study was to develop a model of variables that may place self-injurers at highest risk for suicide. Using the exploratory analytical technique of recursive partitioning, all study variables, including independent, dependent, and control variables were examined simultaneously to determine which best differentiate those with and without a history of suicidal behavior.

CHAPTER 2

METHODS

Study Design

The current study examined cross-sectionally several factors that may differentiate self-injuring undergraduates with and without histories of suicidal behavior, as well as factors that may be associated with a more severe course of NSSI. Next, all variables examined in this study were entered into an exploratory statistical model to create an algorithm which may be used to predict suicide risk among individuals engaging in NSSI.

Dependent (Criterion) Variables

The outcome variables of interest in this study included history of clinically significant suicidal behavior and NSSI severity. First, suicidal behavior was assessed with multiple measures, which are discussed below. In the current study, severity of NSSI was calculated by creating a linear combination of number of NSSI acts and number of NSSI methods (# acts + # methods). In addition, scores from the two behavioral tasks (i.e. strength of implicit associations with NSSI, mean level of shock, and number of extreme shocks) served as outcome variables in tests of Hypothesis 2, which concerns the prediction of self-report and behavioral indicators of NSSI severity.

Predictor Variables

The primary predictor variables of interest in the current study included functions of NSSI and changes in positive and negative affect during NSSI. To assess changes in affect during NSSI, participants were asked via questionnaire about their affect both

before and after an act of NSSI. Change scores were calculated by subtracting affect, (positive and negative) before an act from affect after an act. Implicit associations with NSSI and behavioral self-aggression were also used as predictor variables in the tests of Hypothesis 1, which concerns the differentiation of self-injurers with and without a history of clinically significant suicidal behavior.

<center>*Covariates*</center>

In addition to primary dependent and independent variables, several variables related to NSSI and suicidal behavior were also assessed. These included: 1) demographic characteristics such as sex, age, race, ethnicity, and sexual orientation, 2) Axis I and Axis II diagnoses, affect dysregulation (as assessed by the Difficulties in Emotion Regulation Scale and Emotion Reactivity Scale), impulsivity (as assessed by the UPPS+P scale), and mood on the day of the study (as assessed by the Positive and Negative Affect Scale and Quick Inventory of Depressive Symptoms – Self-Report version). For a detailed description of all study measures, see the Measures section.

<center>*Design Issues*</center>

Several decisions regarding study design warrant further explanation. First, participants' age range was restricted to 18-26. This range was chosen to capture the period in which NSSI is most prevalent, as NSSI is known to peak in late adolescence and taper off after young adulthood (Walsh, 2006). On the other hand, as risk for suicide attempts increases with age, this age restriction may limit the number of individuals in the study who have attempted suicide. Therefore, rather than including only individuals with a history of suicide attempts, participants with a wider range of suicidal behavior,

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including suicidal plans, were considered. As formulating a plan for suicide is a known risk factor for eventual attempts, inclusion of participants who have histories of this behavior is warranted. Furthermore, inclusion of these participants may reduce the likelihood of false negatives (incorrectly categorizing people as non-suicidal who may in fact be at risk for future suicidal ideation/behavior).

Participant Selection and Study Sample

Inclusion Criteria

Participants were included in this study if they: 1) were between the ages of 18 and 26 at the time of screening, 2) endorsed a lifetime history of at least 5 acts of NSSI (consistent with criteria for NSSI disorder in the DSM-5), with at least 1 act in the last 6 months, and 3) read/speak English fluently. Participants were included in the non-suicidal group (NSSI Only) if they did not endorse a history of clinically significant suicidal behavior on the Suicidal Behaviors Questionnaire – Revised (SBQ-R; Osman et al., 2010). Specifically, participants in this group must have endorsed no history of suicidal plans or attempts on Item 1 of the SBQ-R ("Have you ever thought about or attempted to kill yourself?"). Participants must have also obtained an overall score of 4 or below (the lowest possible score being 3). A score of 4 allows for mild suicidal ideation "It was just a brief passing thought," but no other suicidal behaviors. Participants were included in the comorbid suicidality group (NSSI+S) if, in addition to meeting all other inclusion criteria, they endorsed a lifetime history of clinically significant suicidal behavior, as determined by endorsing a history of suicidal plans or attempts on Item 1 and obtaining a

score of at least 7 (the recommended cutoff for classifying those at increased risk for suicide, on the SBQ-R (Osman et al., 2010).

In addition to completing the SBQ-R at screening, participants also completed the Self-Injurious Thoughts and Behaviors Interview (SITBI; Nock, Holmberg, Photos, and Michel, 2007) during Phase II of the study. This is a clinical interview that comprehensively assesses the lifetime presence, frequency, and characteristics of suicidal behavior. In the event that suicide history information obtained from this interview conflicted with that obtained on the SBQ-R, the participant was asked to rectify the discrepancy in order to determine study eligibility.

Exclusion Criteria

Participants were excluded from the study if they: 1) endorsed a history of a psychotic or pervasive developmental disorder, 2) screened positive for recent intake of recreational drugs (as these could impact behavioral task reaction times), 3) were currently (past month) taking psychotropic medication (as these could impact behavioral task reaction times), 4) were currently pregnant, or 5) were unwilling or unable to sign the informed consent document.

Eligible Participants

Of the 4,293 Temple undergraduates who completed the online screening measures, 308 (7.17%) individuals met study eligibility criteria. Eligible participants were 63.60% female with a mean age of 20.03 years (SD = 1.76 years). Participants self-identified as 71.75% White, 5.52% Black or African American, 9.74% Asian, 5.52% Multiracial, 4.87% Other, and 2.00% Prefer Not to Answer. In terms of ethnicity, 7.10% of

participants identified as Hispanic or Latino. Participants identified their sexuality as either Heterosexual (79.22%), Homosexual (4.22%), Bisexual (12.66%), and Other (2.60%). Of those eligible, 216 (70.13%) provided contact information and were contacted to participate in the study. Finally, of those who provided contact information, 138 (63.89%) participants expressed interest in participating in the current study. Of these, 37 (26.81%) could not be reached to schedule an appointment, 18 (13.04%) were deemed ineligible upon further screening due to recent recreational drug use or current psychotropic medication use, and 15 (10.90%) failed to arrive for their scheduled appointments. Finally, 68 (49.28% of those who expressed interest) participants successfully completed all study procedures.

Final Sample

Participants in the study sample were 68 Temple undergraduates, 40 with a history of NSSI and suicidal behavior (NSSI+S group) and 28 with a history of NSSI without suicidal behavior (NSSI Only group). Participants were 15 males (22.06%) and 53 females (77.94%) between the ages of 18 and 26, with a mean age of 19.96 years ($SD =$ 1.87 years). Participants self-identified as White ($n = 42$, 61.76%), Black or African American ($n = 5$, 7.35%), Asian ($n = 8$, 11.76%), Multiracial ($n = 5$, 7.35%), Other ($n = 5$, 7.35%), and Prefer Not to Answer ($n = 3$, 4.41%). In terms of ethnicity, seven participants (10.29%) identified as Hispanic or Latino. Participants identified their sexuality as either Heterosexual ($n = 50$, 73.53%), Homosexual ($n = 1$, 1.47%), Bisexual ($n = 13$, 19.12%), and Other ($n = 4$, 5.88%). Of note, the demographic characteristics of the final sample are generally consistent with those of several other large samples

recruited through Temple's online psychology research participation system (for a description of this system, see Procedures).

<div align="center">Measures</div>

Assessment instruments in the proposed study included a demographics questionnaire, diagnostic and clinical interviews, behavioral tasks, and self-reports.

<div align="center">*Demographics and Contact Information*</div>

A brief questionnaire was used to obtain participants' demographic information (age, race, ethnicity, gender, and sexual orientation), as well as contact information (full name, email address, and telephone number). Demographic information was used to assess generalizability of the sample and was controlled for in relevant analyses. Contact information was used for recruiting participants for participation in Phase II of the study. All identifying information contained on these questionnaires was stored in password-protected files on HIPAA-compliant computers.

<div align="center">*Diagnostic and Clinical Interviews*</div>

Two diagnostic interviews and one structured interview to assess suicidal behavior were employed in this study. First, the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I; First, Spitzer, Gibbon, & Williams, 1997) was used to assess Axis I psychopathology, (i.e., mood, psychotic, substance use, anxiety, somatoform, eating, and adjustment disorders). The SCID has adequate inter-rater reliability with kappa values for modules reported to be between .70 and 1.00. The second diagnostic interview was the Structured Interview for DSM-IV Personality (SIDP; Pfohl, Blum, & Zimmerman, 1995).

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The SID-P is a semi-structured clinical interview that assesses Axis II psychopathology. The SID-P shows good inter-rater reliability (ICC = .88 -.99).

The short version of the Self-Injurious Thoughts and Behaviors Interview (SITBI; Nock, Holmberg, Photos, and Michel, 2007) was used to comprehensively assess the lifetime presence, frequency, and characteristics of suicidal and self-injurious behavior. The SITBI is a structured interview that has demonstrated good test-retest reliability over a 6-month period (ICC = .44) and strong correspondence with other measures of suicidal ideation and attempts, (average kappas = .54 and .65, respectively).

Behavioral Tasks

The current study employed two behavioral tasks to assess constructs related to NSSI, including self-aggression, and implicit associations with NSSI. The first was the Self-Aggression Paradigm (SAP; McCloskey & Berman 2003; Berman & Walley, 2003): The SAP is a validated laboratory measure of self-aggression disguised as a competitive reaction-time task with another (fictitious) subject. The SAP begins with the experimenter attaching fingertip electrodes to the participant while explaining to the subject that they will be participating with another (fictitious) participant in an adjacent room. The subject's pain threshold is then determined by administering increasingly intense shocks until the subject identifies the shock level that is "extremely unpleasant," the level at which they are no longer willing to be shocked. This is set as their pain threshold (note that this threshold may never exceed 2.5 milliamps). This procedure is repeated with the other "subject" (audiotape played over an intercom). The purpose of the competitive task (to see which subject could lift a finger off a key fastest), and the

instructions are then provided. It is explained that after each trial, the participant who was slower on that trial must self-select a shock intensity from *0* (no shock) through *10* (pain threshold) or *20*. A *20* would administer a "severe" shock, twice the intensity of the *10* (in actuality, a *20* delivers a shock of the same intensity as a *10*). Participants receive the shock they self-select on losing trials. Delivery of shock is not in fact determined by reaction-time, but is controlled by a computer program. The participant completes 32 trials, which are divided into two 16-trial blocks (a low frustration block and a high frustration block). During the first (low frustration) block the participant wins on 50% of the reaction time trials. During the second (high frustration) block the participant loses on 75% of the reaction time trials. The dependent variables for the SAP are mean shock selected, and number of extreme (20) shock selections. Confirmation of study deception occurred with debriefing of the subject by the PI at the end of the study.

The second behavioral task was the Self-Injury Implicit Association Test (SI-IAT; Nock & Banaji, 2007). The SI-IAT is a behavioral reaction-time task that assesses individuals' automatic, uncontrolled associations with self-injury. The SI-IAT is administered via personal computer, which instructs participants to quickly classify stimuli presented on the screen. Participants are presented with either neutral images or images related to self-injury and must classify them as quickly as possible as representing the concept of "cutting" or "not cutting" or as self-relevant (e.g., "I" or "mine") or other-relevant (e.g., "they" or "them"). As individuals tend to classify related concepts together more quickly than unrelated concepts, individuals with faster reaction times towards self-injury-relevant and self-relevant words are thought to have stronger implicit associations

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with self-injury. The strength of the implicit association is represented as a standardized score for each participant. This score is calculated by subtracting the mean response latency for the "Cutting/Me" test block from the mean response latency for the "Cutting/Not Me" test block and then dividing by the standard deviation of response latency across all trials. Among a community sample, scores on the task significantly predicted the presence of self-injury (Nock & Banaji, 2007). Previous research on the standard IAT has shown that the task is predictive of future behavior and is resistant to attempts to conceal undesirable attitudes (Banse, Seise, & Zerbes, 2001).

Self-Report Measures

First, the Form and Function of Self-Injury Scale (FAFSI; Jenkins et al., 2011) was used to screen for and assess NSSI characteristics. The FAFSI is a multi-part self-report measure that assesses the methods, characteristics, and functions of NSSI. The first section inquires about the presence, age of onset, frequency, and recency of 13 distinct forms of NSSI: cutting, skin carving, burning, ingesting noxious substances, pinching to cause severe pain or bruising, banging head, poking self with sharp or blunt object, scratching or rubbing the skin to draw blood, biting self, pulling hair out, inserting objects under nails or skin, self-hitting or punching, and a fill-in 'other' category. If respondents endorse any of these 13 forms of NSSI, they proceed to provide information regarding age of onset, frequency, and recency of each type of NSSI. For the current study, total number of lifetime acts of NSSI was computed by summing the number of lifetime acts for each of the 13 different types of NSSI. Total number of NSSI methods was computed by summing "yes" responses to each of the 13 dichotomous NSSI items.

The FAFSI has demonstrated high internal consistency of the 13 dichotomous NSSI items (α =.82), with corrected item-total correlations ranging from .32 to .61 (Jenkins et al., 2011). The second portion of the FAFSI assesses six distinct functions of NSSI (emotion regulation, interpersonal influence, autonomy, self-punishment, sensation seeking, and addiction) with 24 Likert-type items. The factor structure and internal consistency of these functions are supported by previous research (Jenkins et al., 2011). The final portion of the measure assesses positive and negative affect before and after self-injury with the use of a modified version of the Positive Affect Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). The modified version of the PANAS was slightly expanded to 36 mood adjectives to assess more comprehensively multiple facets of positive and negative affect. Positive mood adjectives include: tranquil, active, alert, attentive, determined, enthusiastic, excited, calm, inspired, happy, interested, proud, strong, in a good mood, joyful, satisfied. Negative mood adjectives include: scared, angry, furious, nervous, jittery, irritable, hostile, enraged, guilty, agitated, mad, ashamed, upset, distressed, and frustrated. Responses for each mood adjective are keyed on a five-point Likert scale (1 = *Very Slightly or Not at All* to 5 = *Extremely*), with higher scores indicating higher levels of positive or negative affect. This revised PANAS has demonstrated high internal consistency (NA α =.90 and PA α =.89, Jenkins & Schmitz, 2012). This modified PANAS is administered twice during the FAFSI, immediately following the NSSI methods section and again at the very end of the measure to assess affect prior to and after acts of NSSI. The instructions of the PANAS were modified to

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read, "This scale consists of a number of words that describe different feelings and emotions. Indicate how much you have felt this way immediately before (or after) you hurt yourself".

Participants were screened for lifetime suicidality with the Suicidal Behaviors Questionnaire – Revised (SBQ-R; Osman et al., 2001). The SBQ-R is a 4-item self-report questionnaire that assesses four dimensions of suicidality (lifetime presence of suicidal ideation and attempt, past year frequency of ideation and attempt, threat of suicidal behavior, and likelihood of future suicidal behavior). This measure has been validated with psychiatric and community samples. Past research also demonstrates the ability of the SBQ-R to differentiate between individuals at risk for suicide and non-suicidal individuals, with a cutoff score of 7 providing optimal sensitivity and specificity in undergraduate samples (Osman et al., 2001).

Affect regulation was assessed with two measures. First, the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004), is a 36-item measure that assesses dysregulated emotion across six domains: non-acceptance of emotional responses, difficulties engaging in goal-direct behavior, impulse control difficulties, lack of emotional awareness, limited access to emotion regulation strategies and lack of emotional clarity. Each item is rated on a 5-point Likert scale ranging from 1 = *Almost Never* to 5 = *Almost Always*, with higher scores representing higher levels of emotion dysregulation. The DERS has demonstrated strong internal consistency and test-retest reliability, as well as adequate construct and predictive validity (Gratz & Roemer, 2004).

The second measure of affect regulation was the <u>Emotion Reactivity Scale (ERS;</u> <u>Nock et al., 2008)</u>, a 21-item self-report measure designed to assess individuals' subjective experience of sensitivity to emotions, as well as the intensity and persistence of emotions. Items are rated on a Likert-type scale from 1 to 5 (1 = *Not at All Like Me* to 5 = *Completely Like Me*), with higher scores indicating higher levels of emotional reactivity. Research has demonstrated good internal consistency (α = .94) as well as a single factor structure, supporting a unidimensional construct of emotional reactivity (Nock et al., 2008).

Impulsivity was assessed with the <u>UPPS+P Impulsive Behavior Scale (Whiteside &</u> <u>Lynam, 2001)</u>. The UPPS+P consists of 59 items that assess five dimensions of impulsivity, including Premeditation, Negative Urgency, Positive Urgency, Sensation Seeking, and Perseverance. Each item is rated on a 4–point Likert scale. Individuals high on impulsivity are characterized by low urgency and perseverance scores, and high urgency and scores. The subscales have demonstrated good internal consistencies (Whiteside & Lynam, 2001).

Momentary affect on the day of Phase II was assessed twice during Phase II (prior to and after the SAP) with select subscales of the <u>Positive and Negative Affect Schedule –</u> <u>Expanded (the PANAS-X; Watson & Clark, 1999)</u>. For the proposed study, the fear, sadness, guilt, hostility, joviality, self-assurance, attentiveness, and serenity subscales were used. These subscales consist of 45 items, in total, which are keyed on a five-point Likert scale (1 = *Very Slightly or Not at All* to 5 = *Extremely*). The PANAS-X has

demonstrated a robust factor structure, has good internal consistency, and may be validly used in both state and trait affect applications (see Clark & Watson, 1999 for a review).

Depressive symptoms on the day of Phase II were assessed with the Quick Inventory of Depressive Symptomatology – Self-Report version (QIDS-SR; Rush et al., 2003). The QIDS-SR is a 16 measure that assesses the nine symptom domains that define a major depressive episode (sad mood, sleep disturbance, appetite/weight disturbance, concentration/decision making, self-criticism, thoughts of death or suicide, general interest, energy level, and restlessness/agitation). Total test score can range from 0 to 27, with higher scores reflecting increasing amounts of pathology. The QIDS-SR has demonstrated good reliability and construct validity (Rush et al., 2003).

Procedure

Recruitment

Participants were recruited through Temple University's secure online Psychology Research Participation System. This system allows researchers to set up their studies online, view which participants have signed up, and schedule participants. Researchers can use the system to define prerequisite or disqualifier criteria for a study and may restrict participation in their studies to students who meet certain requirements based on their responses to a screening procedure. Therefore, participants who provided consent to the brief screening portion of the study and who also met screening criteria were invited to participate in the full study.

Screening (Phase I)

Young adults were invited to participate in the screening portion of the study via Temple University's online research system. Consent for Phase I was obtained via computer prior to the screening procedures. Phase I consisted of a brief demographic questionnaire and six self-report measures (the FAFSI, SBQ-R, DERS, ERS, and UPPS+P). Phase I took approximately 45 minutes to complete. Eligible participants who provided contact information were then contacted by the PI and invited to participate in Phase II of the study. Participants received 1 research credit for their participation in the screening phase.

Full study (Phase II)

Participants provided written informed consent prior to participation in Phase II of the study. During Phase II, participants completed two diagnostic interviews (the SCID-II and SID-P), one clinical interview (SITBI), two self-report measures (PANAS-X and QIDS-SR), and two behavioral tasks (SI-IAT and SAP).

Upon completion of the consent document, participants were tested for recent intake of recreational drugs via a urine drug screen. Participants who failed the screen were informed and asked to reschedule for a later day. Those who passed the screen continued with study procedures. First, the diagnostic and clinical interviews (SCID-I, SID-P, SITBI) were administered by the PI. The interviews took approximately 2 to 2.5 hours. As described above, if information regarding suicidal or self-injurious behavior obtained from the interview conflicted with that obtained during screening, the PI attempted to resolve the discrepancy in order to determine the participant's Phase II eligibility. If the

PI was unable to resolve the discrepancy to her and her mentor's satisfaction, the participant was excluded from the study. Next, participants completed the QIDS-SR self-report measure via computer. Participants then completed the behavioral tasks, which took approximately 40 minutes, in total. The order of the two tasks was blocked to control for the possibility of order effects. Participants completed the PANAS-X prior to and after the SAP to assess the impact of this task on mood. The complete Phase II assessment took approximately 3 to 3.5 hours. Participants had the option to receive either 3.5 research credits or $30 for their participation.

Risk Assessment

Participants were selected for inclusion in this study because they engage in NSSI and are, by definition, at risk of future episodes of this behavior as well as at increased risk for suicidal behavior. Although it was not expected that participation in the proposed research would increase psychological distress, procedures were in place to ensure all possible risks were minimized to the fullest extent possible. Participants were informed during the consent procedure that if the investigators learned that they or another identifiable person were at imminent risk of serious harm, steps would be taken to inform the appropriate and necessary people or agencies (e.g., the police or child protective services if another person was at risk of harm, and Temple security, Temple Psychiatric Emergency Services, or a person's clinician [if applicable] if they were at imminent risk of suicide).

All risk assessments were conducted by the PI, who has research and clinical experience in the assessment of suicidal and self-injurious behavior. Furthermore, the

PI's advisor and licensed psychologist, Dr. Michael McCloskey (or his proxy), was on call to provide clinical supervision during all risk assessments. In the case of all risk assessments, a detailed protocol was followed. This protocol and associated interview draw directly from the American Psychiatric Association's Practice Guideline for the Assessment and Treatment of Patients with Suicidal Behaviors (APA, 2003). In brief, the protocol describes the appropriate steps to take if the participant: 1) reports a vague wish to die with no suicidal plan, 2) has a suicidal plan without means or serious intent, or 3) appears to be in imminent danger of making a suicide attempt.

Analytic Strategy

Preliminary Analyses

First, descriptive statistics were examined for all study variables to identify possible problems with distributions (e.g. skewness, kurtosis). Next, Pearson χ^2 and independent samples *t*-tests were used to examine the relations between predictor and outcome variables and to determine potential control variables. Finally, zero-order correlations were conducted among all predictor and dependent variables, as well as relevant covariates. The demographic, diagnostic, and psychological variables significantly associated with both predictor and dependent variables were included as covariates in all relevant analyses.

Tests of Study Aims

Logistic regression, linear regression, and recursive partitioning analyses were used to examine study aims.

Aim 1, Hypotheses 1a-c

(1a) Responding on laboratory analogues of self-aggression and implicit associations with NSSI, (1b) lower levels of negative affect and higher levels of positive affect after NSSI, and (1c) greater endorsement of self-punishment, emotion regulation, sensation seeking, and addiction functions of NSSI will be associated with a history of clinically significant suicidal behavior, after controlling for relevant demographic and diagnostic correlates.

Test of Hypotheses 1a-c

A series of hierarchical logistic regressions was used to examine the ability of the various independent variables to differentiate those with and without a history of clinically significant suicidal behavior (Aim 1).

To test hypothesis 1a, three logistic regressions were conducted. Relevant demographic and diagnostic variables were entered in step one, and scores of behavioral self-aggression (mean shock intensity and number of extreme shocks), and implicit associations with NSSI (standardized D scores) were each entered separately into step two. For hypothesis 1b, relevant covariates were entered in step one and change scores of positive and negative affect before and after NSSI were included together in step two. To assess hypothesis 1c, relevant covariates were entered in step one and scores of the six antecedent functions of NSSI assessed by the FAFSI (emotion regulation, interpersonal, autonomy, self-punishment, sensation seeking, and addiction) were simultaneously entered in step two.

Aim 2, Hypotheses 2a-b

(2a) Stronger endorsement of self-punishment, emotion regulation, sensation seeking, and addiction functions, along with (2b) lower levels of negative affect and higher levels of positive affect after NSSI, will each be independently associated with a more severe course of NSSI (as indicated by NSSI severity score, as well as stronger implicit associations with NSSI, and higher levels of behavioral self-aggression).

Test of Hypothesis 2

Negative binomial and hierarchical linear regressions were used to examine the ability of the predictor variables to independently predict NSSI severity. To test each hypothesis, one negative binomial and three hierarchical linear regressions were conducted. Negative binomial regressions were used to examine the association between functions and affect on NSSI severity score, because although this variable was not notably skewed, the variance was much greater than the mean. Hierarchical logistic regressions were used to test the relation between functions and affect and SI-IAT score, SAP mean level of shock, and SAP number of extreme shocks.

To test hypothesis 2a, relevant covariates were entered in step one and scores of the six antecedent functions of NSSI assessed by the FAFSI (emotion regulation, interpersonal, autonomy, self-punishment, sensation seeking, and addiction) were simultaneously entered in step two. To test hypothesis 2b, relevant demographic and diagnostic variables were entered in step one, and scores of behavioral self-aggression and implicit associations towards NSSI were entered together in step two.

Test of Aim 3

Recursive partitioning was used to explore which of all study variables (demographic, diagnostic, self-report, behavioral task outcomes, and characteristics of NSSI and suicidal behavior) best differentiated between self-injuring individuals with and without co-morbid suicidal behavior (NSSI Only versus NSSI+S groups). Recursive partitioning is an exploratory, non/semi-parametric statistical method used to examine many variables simultaneously. This method has advantages of logistic or linear regression because it allows for non-normally distributed data and is not affected by colinearity, thus permitting several similar constructs to be analyzed simultaneously. Unlike linear regression, which cannot accommodate non-linear data, different classes of responses, or data that involve many predictors and few observations, recursive methods consider only one predictor variable at a time and sequentially test for all possible interactions of variables that best split the sample into more homogeneous subgroups at each decision point (Zhang & Singer, 1999). This method has been used increasingly to develop risk models for an array of medical and psychological issues, including suicide risk (e.g., Asarnow, McArthur, Hughes, Barbery, & Berk, 2012).

Recursive partitioning analyses were conducted with the statistical software R (Venables, Smith, & R Development Core Team, 2011). Through the creation of decision trees, recursive partitioning classifies members of the population based on any combination of categorical or continuous criterion variables. In the first split, the "trunk", the variable that best discriminates between high- and low-risk groups within the full sample (youth with a history of NSSI with and without suicidal ideation and attempts) is

determined. With each subsequent split, the process is repeated to generate a series of "branches" which identify the dichotomous split at each node that yields the greatest improvement in predictive accuracy. This process continues until additional splits are infeasible based on a set of stopping rules. The final branches, or "terminal nodes," are obtained when predictive accuracy cannot be improved with additional splits. For the current study, the terminal nodes consist of population members who have similar profiles of the risk factors (out of the original 109 variables) that best predict the likelihood that youth will be in one of three categories (NSSI Only, NSSI + Ideation, or NSSI + Attempt).

A common concern with recursive partitioning is that using all available information in the data set leads to overfitting of the decision tree to the sample under study (Hellemann, Conner, Anglin, & Longshore, 2009). To mitigate this issue, resampling of smaller subsets of the data is used to produce cross-validation samples. These cross-validation samples allow for an estimate of the average performance of the decision tree, as well as an estimate of the variability of the performance of the tree. These parameters are comparable to explained variance (1-R^2). To determine which features of the tree are most fundamental to the underlying population, the overfit tree is pruned such that later splits are removed one by one and then the cross-validated error rate compared across trees. The tree with the fewest splits and the smallest cross-validated error rate is selected as the optimal, or best-fitting tree (Helleman et al., 2009). For the current study, the original decision tree was examined and terminal nodes (risk factors for NSSI group

status) were pruned in a stepwise fashion until the tree with the fewest number of splits and highest predictive validity was reached.

<div align="center">Statistical Power</div>

Hypotheses 1a-c

Previous research with the Self-Injury Implicit Association Task conducted with 89 participants was associated with strong statistical power (1-β = 0.96) to detect large group differences between those with and without a history of self-injury, even after controlling for demographic and psychiatric variables (*OR* = 11.32, *p* < = .02; Nock & Banaji, 2007). Power estimates from the G*Power software (Buchner, Erdfelter, & Faul, 1997) suggest that a sample of 65 is sufficient to detect moderate effects (*OR* = 2.40) with α = .05, and 1-β = .80, and up to 10% of the variance explained by covariates using logistic regression.

Hypotheses 2a-b

Previous work on the relation between positive affect and NSSI severity with comparable sample sizes, suggests a large effect (r^2 = .26) (Jenkins & Schmitz, 2012). Using a more conservative estimate of a moderate effect (f^2 = .15), with α = .05, our sample of 68 participants provided adequate power 1-β = .93 for the proposed analyses with up to six predictors.

Recursive Partitioning

As this is an exploratory statistical technique, power cannot be conducted because no parameters are known a priori. Theoretically, recursive partitioning may be conducted

with just one individual. Thus, minimum sample size is not relevant to this statistical technique (Zhang & Singer, 1999).

CHAPTER 3

RESULTS

Preliminary Analyses

First, descriptive statistics were examined for all study variables to identify possible

problems with distributions. No variables of interest were excessively skewed or kurtotic

and no data were missing. Outliers emerged in only one variable - total lifetime acts of

NSSI. In order to preserve these cases, the two outliers in the lifetime acts variable (4,300

and 834 acts) were capped at the next highest value (500 acts).

Demographic characteristics of the entire study sample and of each study group are

presented in Table 1. *T*-tests and omnibus Pearson χ^2 analyses revealed that NSSI Only

and NSSI+S study groups did not differ significantly on age, gender, race, or ethnicity.

Study groups only significantly differed on sexual orientation, omnibus $\chi^2(3) = 9.39$, $p =$

.025. Z-tests comparing column proportions revealed that more heterosexual individuals

were in the NSSI Only group than expected and more bisexual individuals were in the

NSSI+S than expected (significance set at .05 level).

Group differences on self-report measures, including PANAS, DERS, ERS, UPPS+P,

and QIDS are presented in Table 2. Independent samples *t*-tests revealed that those in the

NSSI+S group had significantly higher scores than those in the NSSI Only group on the

UPPS+P Negative Urgency, $t(66) = 2.50$, $p = .015$, and UPPS+P Sensation Seeking, $t(66)$

$= 2.19$, $p = .032$, subscales. Study groups were not significantly different on any other

self-report measures.

Table 1. Demographic Characteristics by Study Group.

Variable	Total Sample (*n* = 68)	NSSI Only (*n* = 28)	NSSI+S (*n* = 40)
Age	19.96 (1.87)	19.61 (1.66)	20.20 (1.99)
Gender (% female)	77.94%	71.43%	82.50%
Race			
% White	61.76%	71.43%	55.00%
% Black/African American	7.35%	0%	12.50%
% Asian	11.76%	7.14%	15.00%
% Multiracial	7.35%	3.57%	10.00%
% Other	7.35%	14.29%	2.50%
Ethnicity (% Hispanic/Latino)	10.29%	10.71%	10.00%
Sexual Orientation			
% Heterosexual	73.53%	92.86%	60.00%*
% Homosexual	1.47%	0%	2.50%
%Bisexual	17.65%	3.57%	27.50%*
% Other	7.35%	3.57%	10.00%

Note. NSSI = Non-suicidal self-injury; *p* < .05.

Table 2. Scores of Emotion Dysregulation, Impulsivity, and Mood by Study Group.

Variable	Total Sample (*n* = 68)	NSSI Only (*n* = 28)	NSSI+S (*n* = 40)
DERS Total Score	85.27 (22.45)	79.25 (23.01)	89.50 (21.32)
ERS Total Score	31.28 (17.23)	27.11 (16.15)	34.20 (17.55)
UPPS+P Negative Urgency	29.38 (3.72)	30.68 (3.15)	28.48 (3.85)*
UPPS+P Lack of Premeditation	27.93 (3.13)	27.61 (3.07)	28.15 (3.19)
UPPS+P Lack of Perseverance	28.29 (2.96)	28.14 (2.66)	28.40 (3.18)
UPPS+P Sensation Seeking	32.06 (4.10)	33.32 (3.41)	31.18 (4.34)*
UPPS+P Positive Urgency	37.38 (5.07)	38.71 (3.92)	36.45 (5.60)
PANAS Positive	54.62 (17.44)	58.71 (19.60)	51.75 (2.43)
PANAS Negative	53.69 (14.99)	52.64 (13.43)	54.43 (16.12)
QIDS Total Score	7.88 (4.73)	6.61 (4.01)	8.78 (5.03)

Note. NSSI = Non-suicidal self-injury; DERS = Disorders of Emotion Regulation Scale; ERS = Emotion Reactivity Scale; UPPS+P = UPPS+P Impulsive Behavior Scale; PANAS = Positive and Negative Affect Scale; QIDS = Quick Inventory of Depressive Symptomology; *p* < .05.

Rates of current and past Axis I and II diagnoses by study group are presented in Table 3. Pearson χ^2 analyses revealed that the frequency of Axis I or II diagnosis was significantly different between the two study groups. Independent samples *t*-tests revealed, however, that the NSSI+S group met criteria for significantly more lifetime

Axis I diagnoses, $t(66) = 2.11$, $p = .039$, as well as more lifetime total diagnoses, $t(66) =$

2.19, $p = .032$, than those in the NSSI Only group.

Table 3. Lifetime DSM-IV Axis I and Axis II Diagnoses by Study Group.

Diagnosis	Total Sample ($n =$ 68) n (%)	NSSI Only ($n =$ 28) n (%)	NSSI+S ($n = 40$) n (%)
Axis I			
Major Depressive Disorder	42 (61.76%)	17 (60.71%)	25 (62.50%)
Dysthymia	6 (8.70%)	1 (3.57%)	5 (12.50%)
Bipolar Disorder	6 (8.70%)	1 (3.57%)	5 (12.50%)
Any Alcohol Use Disorder	24 (34.78%)	9 (32.14%)	15 (37.50%)
Any Drug Use Disorder	12 (17.39%)	3 (10.71%)	9 (22.50%)
Panic Disorder	12 (17.39%)	5 (17.86%)	7 (17.50%)
Obsessive Compulsive Disorder	10 (14.49%)	2 (7.14%)	8 (20.00%)
Posttraumatic Stress Disorder	7 (10.14%)	3 (10.71%)	4 (10.00%)
Social Anxiety Disorder	18 (26.09%)	6 (21.43%)	12 (30.00%)
Generalized Anxiety Disorder	6 (8.70%)	2 (7.14%)	4 (10.00%)
Anxiety Disorder NOS	12 (17.39%)	5 (17.86%)	7 (17.50%)
Intermittent Explosive Disorder	14 (20.29%)	7 (25.00%)	7 (17.50%)
Any Eating Disorder	18 (26.09%)	5 (17.86%)	13 (32.50%)
Somatoform Disorder	6 (8.70%)	1 (3.57%)	5 (12.50%)
Conduct Disorder	6 (8.70%)	2 (7.14%)	4 (10.00%)
Oppositional Defiant Disorder	6 (8.70%)	2 (7.14%)	4 (10.00%)
Axis II			
Paranoid PD	5 (7.25%)	1 (3.57%)	4 (10.00%)
Borderline PD	18 (26.09%)	5 (17.86%)	13 (32.50%)
Narcissistic PD	6 (8.70%)	2 (7.14%)	4 (10.00%)
Avoidant PD	11 (15.94%)	4 (14.29%)	7 (17.50%)
Obsessive-Compulsive PD	12 (17.39%)	3 (10.71%)	9 (22.50%)
Personality Disorder NOS	9 (13.04%)	4 (14.29%)	5 (12.50%)
Summary Variables (M and SD)			
Total # Diagnoses (Axis I & II)	4.29 (2.69)	3.46 (2.23)	4.87 (2.84)*
Total # Axis I Diagnoses	3.41 (1.98)	2.82 (1.70)	3.82 (2.07)*
Total # Axis II Diagnoses	.88 (1.08)	.64 (.95)	1.05 (1.15)
Total # Current Axis I Diagnoses	1.42 (1.27)	1.14 (1.29)	1.63 (1.23)

Note. Only disorders endorsed by at least 5 participants are displayed; NSSI = Non-suicidal self-injury; *p < .05.

Zero-order correlations between primary predictor and outcome variables, as well as self-report covariates, (DERS, ERS, UPPS+P, QIDS, and baseline PANAS on day of study) were examined. These are displayed in Table 4. Briefly, measures of theoretically similar constructs were significantly positively correlated (i.e. ERS and DERS scores), whereas measures of theoretically distinct constructs were either non-significant or significantly negatively correlated (i.e. UPPS+P scores and ERS/DERS scores). In general, FAFSI functions were significantly positively correlated with one another, as well as with measures of emotion dysregulation (ERS and DERS), depressive symptoms (QIDS), and baseline negative affect (PANAS negative). As expected, baseline positive mood (PANAS positive) was significantly negatively correlated with baseline negative mood, depressive symptoms (QIDS), and emotion dysregulation (ERS and DERS). Results were opposite for baseline negative mood (PANAS negative).

Because there were significant group differences with respect to sexual orientation, number of lifetime Axis I and total lifetime (Axis I and II) diagnoses, and UPPS+P Negative Urgency and Sensation Seeking subscales, these variables were correlated with all of the primary outcome and predictor variables via point-biserial and Pearson correlations. Only UPPS+P Negative Urgency was significantly associated both with group differences (a primary outcome variable) and several FAFSI functions (primary predictor variables). Therefore, primary analyses on NSSI functions included UPPS+P Negative Urgency as a covariate. No other variables were significantly correlated with primary outcome or predictor variables, range of $r = .006 - .22.$, all $p > .06$

Table 4. Zero-Order Correlations between Primary Predictor and Outcome Variables, and Self-Report Covariates.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	-																					
2	.19	-																				
3	.25*	-.04	-																			
4	.26*	.20	.71**	-																		
5	-.12	-.22	-.02	-.11	-																	
6	.10	.21	-.06	.22	-.01	-																
7	.11	-.02	.09	.14	.28*	.31*	-															
8	.02	.01	.19	.22	.10	.09	.37**	-														
9	.35**	.23*	.08	.18	.02	.38**	.44**	.39**	-													
10	.08	.42**	.00	.22	.04	.26*	.24*	.46**	.44**	-												
11	.06	.05	.25*	.10	-.16	-.18	-.06	.07	.02	-.01	-											
12	-.10	.01	-.03	-.06	.10	-.22	-.09	-.19	-.32**	-.22	.01	-										
13	-.19	-.03	.03	.07	.26*	-.09	-.20	-.07	-.25*	-.07	.7	.01	-									
14	.06	-.01	.24*	.19	.01	.15	.42**	.25*	.26*	.18	-.02	.04	-.33**	-								
15	.23	.05	.23	.28*	-.08	.26*	.36**	.28*	.44**	.27*	.17	-.08	-.45**	.66**	-							
16	-.29*	-.10	-.07	-.19	-.19	-.12	-.24	-.14	-.32**	-.21	-.17	-.11	-.01	-.26*	-.32**	-						
17	.09	-.01	.20	.18	.09	.10	.26*	.41**	.16	.38**	.19	.07	.05	.22	.17	-.47**	-					
18	.04	.04	.04	.14	.09	.14	-.06	-.01	.17	.09	-.06	-.20	.35**	-.24	-.15	-.13	.17	-				
19	-.26*	-.05	-.31*	-.25*	.01	-.03	-.08	-.27*	-.12	-.14	-.16	-.08	-.07	-.30*	-.23	.42**	-.59**	-.25*	-			
20	-.22	.09	-.25*	-.23	-.03	.00	-.12	-.31*	-.09	-.09	-.21	-.12	-.05	-.29*	-.17	.48**	-.56**	-.21	.75**	-		
21	.23	.10	-.01	.15	.02	.42**	.36**	.30*	.51**	.30*	-.05	-.26*	-.38**	.42**	.52**	-.25*	.19	-.10	-.05	-.16	-	
22	.20	.05	.19	.10	.19	.11	.35**	.32**	.31**	.13	.12	-.06	-.25*	.61**	.56**	-.48**	.36**	-.30*	-.27*	-.32**	.35**	-

Note. 1 = Study Group; 2 = FAFSI NSSI Severity; 3 = Mean SAP Shock; 4 = Number of Max SAP Shocks; 5 = SI-IAT D-Score; 6 = Self-Punishment Function; 7 = Interpersonal Function; 8 = Sensation Seeking Function; 9 = Emotion Regulation Function; 10 = Addiction Function; 11 = FAFSI PANAS Positive Change; 12 = FAFSI PANAS Negative Change; 13 = Baseline PANAS Positive Mood; 14 = Baseline PANAS Negative Mood; 15 = QIDS Total; 16 = UPPS+P Negative Urgency; 17 = UPPS+P Lack of Premeditation; 18 = UPPS+P Lack of Perseverance; 19 = UPPS+P Sensation Seeking; 20 = UPPS+P Positive Urgency; 20 = DERS Total; 21 = ERS Total; *p < .05; **p < .001.

Characteristics of self-injury and suicide by study group are presented in Table 5. Aside from significantly different scores on the SBQ-R (the measure used to divide the sample into groups), results of Pearson χ^2 analyses revealed that participants in the NSSI+S group were significantly more likely to cut ($\chi^2 = 6.05$, $p = .014$) and to ingest noxious substances ($\chi^2 = 6.16$, $p = .013$) than those in the NSSI Only group. Also, participants in the NSSI+S group endorsed significantly more discrete episodes of suicidal ideation than did those in the NSSI Only group, $t(45.85) = 3.12$, $p = .003$.

Table 5. NSSI and Suicide Characteristics by Study Group.

Variable	Total Sample (*n* = 68) M (*SD*)	NSSI Only (*n* = 28) M (*SD*)	NSSI+S (*n* = 40) M (*SD*)
NSSI			
NSSI Acts Lifetime	80.01 (121.75)	52.86 (86.23)	99.03 (139.34)
NSSI Acts Past 6 Months	7.68 (14.34)	6.63 (14.61)	7.84 (14.36)
NSSI Methods	3.56 (2.10)	3.18 (1.42)	3.83 (2.45)
NSSI Age of Onset	12.85 (3.24)	13.18 (3.29)	12.63 (3.24)
% Cutting	60.29%	42.86%	72.50%*
% Carving Skin	22.06%	21.43%	22.50%
% Burning	25.00%	25.00%	25.00%
% Poisoning	22.06%	7.14%	32.50%*
% Pinching	38.23%	46.43%	32.50%
% Banging Head	51.47%	53.57%	50.00%
% Poking	19.12%	10.71%	25.00%
% Scratch / Scrape	35.82%	28.57%	40.00%
% Biting	22.06%	17.86%	25.00%
% Pulling Hair	20.59%	21.43%	20.00%
% Embedding	4.41%	7.14%	2.50%
% Hitting / Punching	26.47%	28.57%	25.00%
% Other	8.82%	7.14%	10.00%
Suicide			
SBQ-R Total Score	7.34 (3.62)	3.68 (.48)	9.90 (2.46)**
Suicide Ideation Onset	14.46 (2.54)	14.94 (3.06)	14.23 (2.28)
Episodes of Ideation	15.42 (25.39)	4.89 (6.71)	20.28 (29.21)**
% Suicide Attempt	31.00%	0%	52.50%**

Note. NSSI = Non-suicidal self-injury; SBQ-R = Suicidal Behavior Questionnaire – Revised; *$p < .05$; **$p < .01$.

Aim 1, Hypotheses 1a-c

(1a) Responding on laboratory analogues of self-aggression and implicit associations with NSSI, (1b) lower levels of negative affect and higher levels of positive affect after NSSI, and (1c) greater endorsement of self-punishment, emotion regulation, sensation seeking, and addiction functions of NSSI will each be independently associated with a history of suicidal behavior, after controlling for relevant demographic and diagnostic correlates. For aim 1 regression analyses, tolerances were all $> .54$.

Tests of Hypothesis 1a

Three logistic regressions were conducted with 1) mean SAP shock, 2) number of maximum SAP shocks, and 3) SI-IAT D-score entered alone into step one to predict group membership. Results revealed that higher mean shock intensity on the SAP significantly increased the odds of an individual being in the NSSI+S group, $B = 0.18$ ($SE = 0.09$), $OR = 1.91$ ($CI = 1.01 - 1.41$), $p = .044$. Number of extreme shocks on the SAP led to non-significant increases in the odds of being in the NSSI+S group, $B = 0.13$ ($SE = 0.07$), $OR = 1.14$ ($CI = 0.99 - 1.30$), $p = .062$, whereas SI-IAT D-scores led to no significant increases in the odds of either group membership, $B = -0.40$ ($SE = 0.42$), $OR = .67$ ($CI = 0.30 - 1.51$), $p = .34$.

Test of Hypothesis 1b

A logistic regression was conducted with changes in FAFSI positive affect and negative affect entered together in step one to predict group membership. Changes in

negative and positive FAFSI PANAS scores did not significantly increase the odds of either group membership. See Table 6 for results.

Table 6. Results of Hypothesis 1b. FAFSI PANAS Change Scores Predicting Study Group Membership.

Variable	*B*	*SE*	Sig.	*OR*	95% CI for OR Lower	95% CI for OR Upper
FAFSI PANAS Pos Change	0.03	0.06	.63	1.03	0.92	1.14
FAFSI PANAS Neg Change	-0.03	0.03	.39	0.97	0.92	1.04
(Constant)	0.24	0.32	.46	1.27		

Note. FAFSI = Form and Function of Self-Injury Scale; PANAS = Positive and Negative Affect Scale.

Test of Hypothesis 1c

Negative Urgency was entered in step one and scores of the six antecedent functions of NSSI assessed by the FAFSI (emotion regulation, interpersonal, autonomy, self-punishment, sensation seeking, and addiction) were simultaneously entered in step two. Of the six functions entered in step two, only the Emotion regulation Function significantly increased the odds of study group membership (see Table 7). Specifically, higher scores on Emotion regulation significantly increased the odds of being in the NSSI+S study group. There were no other significant results for the other functions. Of note, this pattern of results was the same whether or not UPPS+P Negative Urgency was entered into step one.

Table 7. Results of Hypothesis 1c. FAFSI Functions Predicting Study Group Membership.

Variable	*B*	*SE*	Sig.	*OR*	95% CI for *OR* Lower	95% CI for *OR* Upper
Step 1						
Negative Urgency	-0.18	0.08	.021	0.83	0.71	0.97
(Constant)	5.82	2.40	.015	335.14		
Step 2						
Negative Urgency	-0.15	0.09	.092	0.86	0.72	1.03
Self-Punishment	-0.02	0.08	.80	0.98	0.83	1.15
Interpersonal	-0.04	0.11	.73	0.96	0.78	1.19
Autonomy	0.03	0.19	.86	1.03	0.72	1.49
Sensation Seeking	-0.11	0.13	.40	0.90	0.69	1.16
Emotion regulation	0.15	0.06	.015	1.16	1.03	1.31
Addiction	-0.06	0.13	.65	0.94	0.72	1.23
(Constant)	3.56	2.78	.20	35.16		

Note. FAFSI = Form and Function of Self-Injury Scale.

Aim 2 Results

Aim 2, Hypotheses 2a-b

   (2a) Stronger endorsement of self-punishment, emotion regulation, sensation seeking, and addiction functions of NSSI, along with (2b) lower levels of negative affect and higher levels of positive affect after NSSI, will each be independently associated with a more severe course of NSSI (as indicated by self-report, implicit associations with NSSI, and behavioral self-aggression). For aim 2 regression analyses, tolerances were all > .57.

Test of Hypothesis 2a

   Scores of the six antecedent functions of NSSI assessed by the FAFSI (emotion regulation, interpersonal, autonomy, self-punishment, sensation seeking, and addiction) were entered simultaneously in step 1 to predict 1) NSSI severity score (see Table 8), 2) SI-IAT D-Score, 3) SAP mean shock level, and 4) SAP number of extreme shocks (see Table 9). In terms of predicting NSSI severity, the FAFSI addiction function was the only

function that significantly predicted NSSI severity score. The emotion regulation function trended towards significance, $p = .065$. In predicting SI-IAT D-Scores, the FAFSI interpersonal function was the only one that significantly predicted stronger associations with NSSI. The Autonomy function trended towards significance, negatively predicting SI-IAT D-Scores, $p = .084$. No FAFSI functions significantly predicted mean level of shock on the SAP, nor did they predict number of extreme shocks administered. The self-punishment function, however, trended towards significance, with higher levels of self-punishment predicting a greater number of maximum shocks, $p = .072$.

Table 8. Results of Hypothesis 2a. FAFSI Functions Predicting Self-Report NSSI Severity.

Variable	B	SE	Wald χ^2	Sig.
(Intercept)	3.12	0.31	101.80	$< .001$
Self-Punishment	0.06	0.04	2.44	.12
Interpersonal	-0.09	0.06	2.38	.13
Autonomy	0.06	0.09	0.48	.49
Sensation Seeking	-0.05	0.07	0.48	.49
Emotion Regulation	0.05	0.03	3.40	.065
Addiction	0.28	0.07	17.00	$< .001$

Note. FAFSI = Form and Function of Self-Injury Scale; NSSI = non-suicidal self-injury.

Table 9. Results of Hypothesis 2a. FAFSI Functions Predicting SI-IAT and SAP Scores.

Variable	B	SE	β	t	Sig.
SI-IAT D-Score					
(Constant)	-0.17	0.17		-1.05	.30
Self-Punishment	-0.03	0.02	-.17	-1.19	.24
Interpersonal	0.08	0.03	.43	2.91	.005
Autonomy	-0.09	0.05	-.27	-1.76	.084
Sensation Seeking	0.01	0.04	.06	0.39	.70
Emotion Regulation	-0.01	0.02	-.06	-0.39	.70
Addiction	0.01	0.04	.05	0.33	.74
SAP Mean Shock					
(Constant)	4.95	0.86		5.78	< .001
Self-Punishment	-0.01	0.12	-.01	-0.08	.93
Interpersonal	-0.06	0.14	-.06	-0.39	.70
Autonomy	0.35	0.25	.22	1.40	.17
Sensation Seeking	0.24	0.18	.20	1.36	.18
Emotion Regulation	0.02	0.08	.04	0.27	.79
Addiction	-0.19	0.18	-.16	-1.05	.30
SAP # Maximum Shocks					
(Constant)	0.55	1.53		0.36	.72
Self-Punishment	0.38	0.21	.26	1.83	.072
Interpersonal	-0.19	0.25	-.12	-0.75	.46
Autonomy	0.72	0.44	.24	1.62	.11
Sensation Seeking	0.31	0.32	.14	0.97	.34
Emotion Regulation	-0.02	0.14	-.02	-0.11	.91
Addiction	0.11	0.31	.05	0.36	.72

Note. FAFSI = Form and Function of Self-Injury Scale; SI-IAT = Self-Injury Implicit Association Task; SAP = Self-Aggression Paradigm.

Test of Hypothesis 2b

Changes in positive and negative affect were entered together in step 1 to predict 1) NSSI severity score, 2) SI-IAT D-Score, 3) SAP mean shock level, and 4) SAP number of extreme shocks. Changes in negative and positive PANAS scores did not significantly predict NSSI severity score (see Table 10). Similarly, PANAS change scores did not significantly predict SI-IAT D-Score (see Table 11). Increases in positive affect significantly predicted higher mean shock levels on the SAP. Changes in negative affect

did not significantly predict mean shock level. Finally, changes in positive and negative affect were not significantly associated with number of extreme shocks on the SAP.

Table 10. Results of Hypothesis 2b. FAFSI PANAS Change Scores Predicting Self-Report NSSI Severity.

Variable	B	SE	Wald χ^2	Sig.
(Intercept)	4.41	0.12	843.35	< .001
FAFSI PANAS Positive Change	0.01	0.03	0.28	.60
FAFSI PANAS Negative Change	0.00	0.01	0.00	.96

Note. FAFSI = Form and Function of Self-Injury Scale; PANAS = Positive and Negative Affect Scale.

Table 11. Results of Hypothesis 2b. FAFSI PANAS Change Scores Predicting SI-IAT and SAP Scores.

Variable	B	SE	β	t	Sig.
SI-IAT D-Score					
(Constant)	-0.20	0.10		-2.02	.048
FAFSI PANAS Pos Change	-0.02	0.02	-.20	-1.37	.18
FAFSI PANAS Neg Change	0.01	0.01	.11	0.92	.36
SAP Mean Shock					
(Constant)	5.61	0.49		11.53	< .001
FAFSI PANAS Pos Change	0.17	0.08	.25	2.10	.040
FAFSI PANAS Neg Change	-0.01	0.05	-.04	-0.30	.77
SAP # Maximum Shocks					
(Constant)	2.79	0.92		3.04	.003
FAFSI PANAS Pos Change	0.12	0.15	.10	0.78	.44
FAFSI PANAS Neg Change	-0.04	0.09	-.06	-0.47	.64

Note. FAFSI = Form and Function of Self-Injury Scale; PANAS = Positive and Negative Affect Scale; SI-IAT = Self-Injury Implicit Association Task; SAP = Self-Aggression Paradigm.

Aim 3 Results

Recursive partitioning was used to explore which of all study variables best differentiate between self-injuring individuals with and without co-morbid suicidal behavior. In the current study, 120 variables were used as potential predictors of study group (NSSI Only vs. NSSI+S). As a reminder, participants were grouped by their SBQ-R scores. Those with scores ≤ 4 were categorized as NSSI Only and those with scores ≥ 7 were categorized as NSSI+S. Predictors of group membership included demographic and

diagnostic variables, functions of NSSI, emotional antecedents and consequences of NSSI, SAP and SI-IAT scores, and variables related to trait emotion regulation and impulsivity. The original model, before pruning, contained eight splits and explained 86% of the variance in the study sample, but only 13% of the variance in the population. After bootstrapping and cross-validating the sample, a decision tree with four splits represented the best fitting model for the data (Figure 1). The prediction error for the pruned tree was .32, and thus the variance explained by the model in this sample is 68%. The mean cross-classification error for the model was .68, and thus the model explains $32\% \pm 13\%$ of the variability in the population.

The final model revealed that a lifetime history of suicidal ideation best differentiated between those with and without a history of clinically significant suicidal behavior. Those who endorsed no suicidal ideation were most likely to be in the NSSI Only group and comprised the first terminal node of the model. This first split correctly classified 10 participants and misclassified 1 participant. Specifically, it identified 10 participants as NSSI Only who were actually in the NSSI Only group and it identified one participant as NSSI Only who was actually in the NSSI+S group.

Figure 1. Final decision tree depicting the classification of suicide risk among individuals with a history of NSSI.
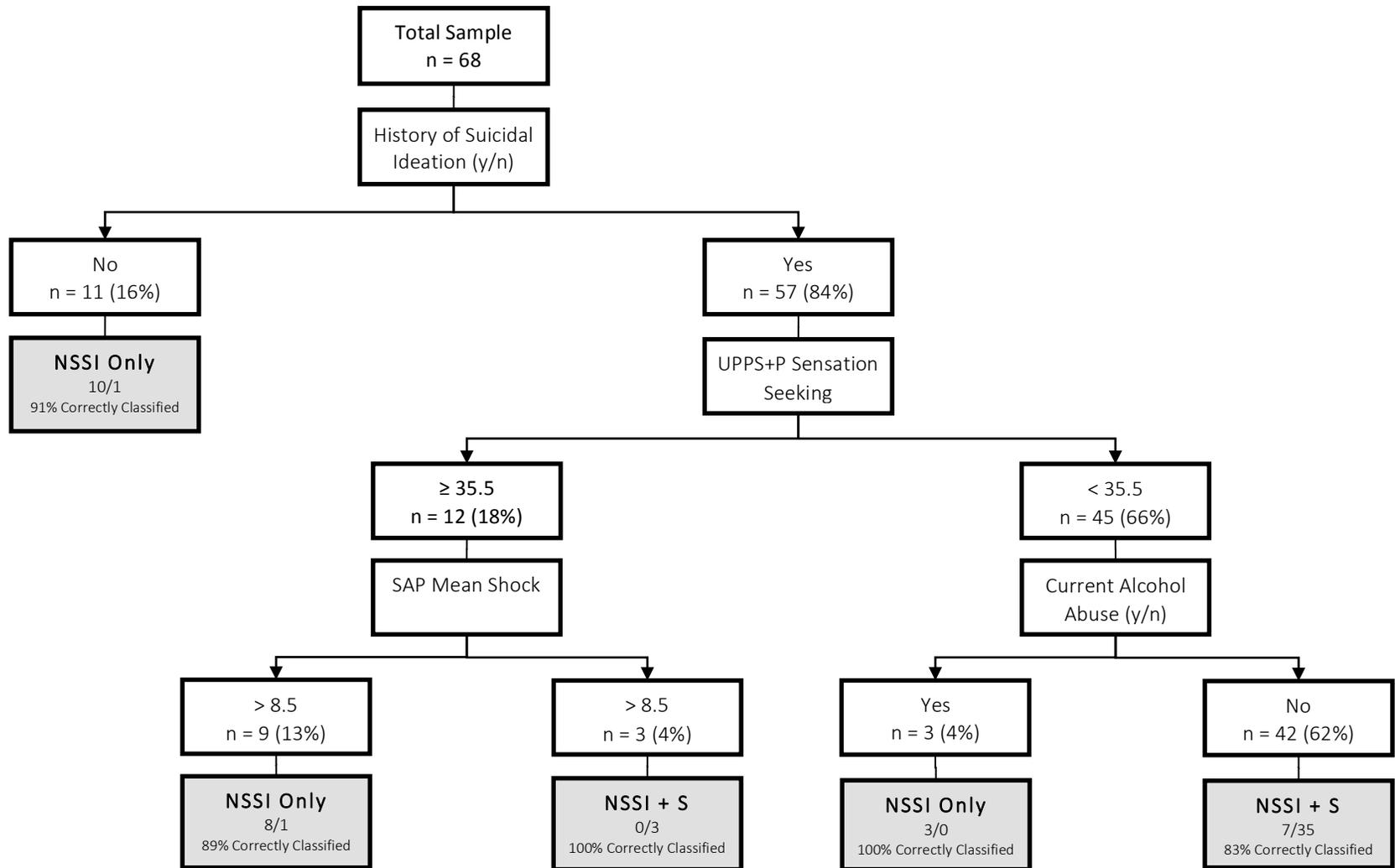
Note. Gray boxes represent terminal nodes in which classification cannot be further improved. Numbers on the left side of the ratio in these boxes represent the number of individuals who originally belonged in the NSSI Only group. Numbers on the right represent individuals who originally belonged in the NSSI+S group.

Next, among participants who endorsed a history of suicidal ideation, scores on the Sensation Seeking subscale of the UPPS+P determined the second split. Those with Sensation Seeking scores greater than or equal to 35.5 were more likely to be in the NSSI Only group, with 8 participants correctly classified and 4 participants misclassified. Those with scores less than 35.5 were more likely to be in the NSSI+S group, with 35 participants correctly classified and 10 participants misclassified.

Among those higher on Sensation Seeking, mean shock level on the SAP determined the next split in the decision tree. At this split, participants with a history of suicidal ideation, Sensation Seeking scores ≥ 35.5 *and* a mean SAP shock level below 8.5 were most likely to be in the NSSI Only group. These individuals represented the second terminal node. This split correctly classified 8 non-suicidal individuals into the NSSI Only group and misclassified on at-risk individual into the NSSI Only group. Those with a mean SAP shock level above 8.5 represented the third terminal node and these individuals fell into the NSSI+S group. All three individuals in this node were correctly classified.

Finally, for individuals endorsing a history of suicidal ideation and lower sensation seeking scores, current alcohol abuse, as measured by the SCID, determined the last split in the decision tree. Individuals who currently met criteria for current alcohol abuse were most likely to be in the NSSI Only group. These three individuals comprised the fourth terminal node and were all correctly classified into the NSSI Only group. Those who did *not* meet criteria for current alcohol abuse were most likely to be in the NSSI+S group and comprised the final terminal node. In this node, 35 at-risk individuals were correctly

classified into the NSSI+S group and seven non-suicidal individuals were misclassified

into the NSSI+S group.

CHAPTER 4

DISCUSSION

The aims of this study were threefold. First, the current study sought to determine whether the reasons people engage in NSSI, along with changes in positive and negative affect after an act of NSSI, are associated with increased risk for suicidal behavior. Second, the current study examined whether reasons for engaging in NSSI and changes in affect during NSSI predicted NSSI severity, as measured by self-reported number of acts and methods, as well as laboratory measures of implicit associations with NSSI and behavioral self-aggression. Finally, the current study simultaneously examined a wide range of variables (demographic, diagnostic, and self-report, and behavioral) to determine which might best predict suicide risk among young adults engaging in NSSI and to develop an algorithm to best classify who is at greatest risk for suicidal behavior.

Aim 1

The goal of Aim 1 was to determine whether reasons for engaging in NSSI (the functions of NSSI), changes in affect during NSSI, implicit associations with NSSI, and a laboratory measure of self-aggression significantly predicted study group membership (self-injurers with or without comorbid clinically significant suicidal behavior). In terms of the six NSSI functions examined (self-punishment, interpersonal, autonomy, sensation seeking, emotion regulation, and addiction) only the emotion regulation function significantly predicted group membership, with those more strongly endorsing the emotion regulation function being in the comorbid suicidal behavior (NSSI+S) group. According to an emotion regulation model of self-injury, the purpose of NSSI is to

alleviate negative emotions and to dampen overwhelming emotional arousal (Klonsky, 2007; Nock, 2009). It may be that, compared to people who use NSSI for other reasons, those who self-injure primarily for the purpose of emotion regulation may be generally more dysregulated and susceptible to suicidal behavior. This hypothesis is supported by correlations between the emotion regulation function and other study variables. Specifically, the emotion regulation function of NSSI was significantly positively correlated with negative affect and depressive symptoms on the day of the study, along with higher scores on two measures of emotion dysregulation (see Table 4). These findings are consistent with Joiner's interpersonal theory of suicide (2005; Van Orden et al., 2010), which posits that a suicide attempt requires both the desire and capability for suicide. Recent research suggests that NSSI may confer risk for both desire and capability, as those who engage in NSSI 1) typically experience high levels of interpersonal and *intra*personal distress, increasing desire for suicide, and 2) habituate to self-inflicted aggression and pain, increasing capability for suicide (Klonsky, May, & Glenn, 2013; Klonsky & Meuhlenkamp, 2007; Nock et al., 2006). The current results suggest that those who engage in NSSI with the intent to regulate their emotions may be experiencing more distress, generally, and may therefore have an increased desire to attempt suicide.

Additionally, emotion regulation was the only function significantly negatively correlated with UPPS+P Negative Urgency, the tendency to act rashly when distressed. This finding may suggest that those who self-injure for the purposes of emotion regulation, specifically, are more intentional and planful in their self-injury, expecting that it will reduce their negative affect. This expected effectiveness of NSSI, in turn, may

prove to be a risk factor for suicidal behavior when attempts to improve affect via NSSI fail (Walsh, 2006). As this is the first study to examine how the reasons for engaging in NSSI may increase risk for suicide, research with larger and more diverse samples is sorely needed. Additionally, no known study has assessed individuals' expectations of the effectiveness of NSSI. Such assessment may provide additional insight into why people self-injure and whether their self-injury progresses to suicidal behavior.

Next, changes in affect during NSSI did not significantly predict study group membership. As previous research has shown increases in positive affect during NSSI to predict more lifetime acts of NSSI (Jenkins & Schmitz, 2012), and greater frequency of NSSI to predict suicidal behavior (Andover & Gibb, 2010), it was hypothesized that changes in affect would be significantly associated with risk for suicidal behavior. Contrary to this previous research, however, changes in affect were not associated with self-reported NSSI severity, and NSSI severity was not associated with suicide risk regardless of study group membership. In terms of the relation between affect changes during NSSI and comorbid suicidal behavior, it could be that the operationalization of suicidality in the current study (SBQ score) limited the ability to see a relationship between affect changes during NSSI and study group. To test this hypothesis, an exploratory logistic regression with FAFSI positive and negative change scores predicting a history of an actual suicide attempt, as opposed to other suicidal behavior (as assessed by the SITBI clinical interview) was conducted. Results showed that changes in positive, but not negative affect during NSSI, significantly increased the likelihood of having attempted suicide, $B = .15$ ($SE = .072$), $OR = 1.16$ ($CI = 1.04 - 1.33$), $p = .044$. This finding suggests that affect changes during NSSI may indeed predict suicide

attempts, but perhaps not suicidal behavior more generally. A limitation of the current study in regards to the measurement of affect is that participants retrospectively reported their affect before and after acts of NSSI. Although assessing individuals' perceived affective states surrounding NSSI may be beneficial and predictive, novel methods for assessing affect are needed. Some research has begun to examine affective changes associated with NSSI in real time via ecological momentary assessment methods (Nock, Prinstein, & Sterba, 2009). As yet, however, no such research has examined how this affect may be associated with suicidal behavior, above and beyond NSSI. Such prospective research is needed to assess more accurately how changes in affect during NSSI may reinforce the behavior and how this may be related to suicidal behavior.

Inconsistent with study hypotheses, implicit associations with NSSI did not significantly predict group membership. Previous research with the Self-Injury Implicit Association Task (SI-IAT) has examined the ability of the measure to differentiate self-injurers from non-injurers (Nock & Banaji, 2007). As the current study included only individuals who have engaged in repetitive self-injury, the variability in responses on the task may have been limited. Another possible limitation of the SI-IAT in the current study is that it employs pictures and words only related to cutting, which is only one of many possible forms of NSSI. Thus, the task may have only been particularly salient to the approximately 60% of the current sample who reported a history of cutting. To test whether the SI-IAT may have predicted study group membership among only those who had engaged in cutting, an exploratory logistic regression was conducted among these 41 individuals. The results of this regression were non-significant, $p = .18$, suggesting that

even among those who have engaged in cutting, the SI-IAT does not help to differentiate between self-injurers at low versus heightened risk for suicidal behavior.

Finally, consistent with hypotheses, higher mean shock intensity on the SAP was significantly associated with increased risk for suicidal behavior, as those with higher mean shocks were more likely to be in the NSSI+S study group. This is consistent with previous research that has revealed that individuals with a history of suicidal ideation select higher average self-shocks (Walley & Berman 2003, Berman and McCloskey, 2003). This is the first study to replicate this finding among a sample of young adults engaging in self-injury. Additionally, number of maximum shocks selected on the SAP trended towards significance in predicting group membership. Again, to test whether this variable not meeting full significance may have been a function of the study's operationalization of suicide risk, an exploratory logistic regression was run to test whether number of maximum shocks on the SAP might predict history of suicide attempt as assessed by the SITBI interview. The result of this analysis was non-significant, $p = .29$. It may be that different mechanisms drive these two SAP outcomes. For example, whereas mean shock level may be related to general level of self-aggression, perhaps number of maximum shocks may be more related to frustration/distress intolerance or a tendency to punish oneself when one perceives that he or she is performing poorly. Additional research is needed to examine how average versus extreme levels of self-aggression may be associated with adverse outcomes like suicidal behavior.

Taken together, results from the SAP suggest that, among those engaging in NSSI, higher levels of behavioral self-aggression are associated with engagement in comorbid suicidal behavior. Again, this is consistent with Joiner's interpersonal theory of suicide

(2005; Van Orden et al., 2010), as a willingness to engage in higher levels of self-aggression and to endure more pain is consistent with a heightened capability for suicide. Not only did participants in the NSSI+S study group administer stronger average shocks, they also had significantly higher upper shock thresholds than those in the NSSI Only group, $t(66) = 2.08$, $p = .041$. This finding is consistent with previous research suggesting that increased pain tolerance during NSSI (i.e. feeling less pain when engaging in NSSI) is significantly associated with suicide attempts (Nock et al., 2006).

Aim 2

The purpose of Aim 2 to was to determine whether the functions of, and affect changes associated with, NSSI significantly predicted self-reported and laboratory-based behavioral indicators of NSSI severity. In terms of functions, the addiction function was the only significant predictor of self-reported NSSI severity (the sum of lifetime NSSI acts and methods). These results are somewhat consistent with previous research, which has shown addiction, sensation seeking, emotion regulation, and self-punishment functions to be significantly associated with greater severity of NSSI (Jenkins et al., 2010). These results suggest that individuals who more strongly endorse engaging in NSSI because they feel addicted to harming themselves are more likely to engage in more acts and methods of NSSI. Although little previous research has examined an addiction function specifically, severally studies have shown that, among self-injurers, those who engage in NSSI more severely (i.e. engage in more acts and methods) are most likely to describe NSSI as "addictive" (Nixon et al., 2002; Whitlock et al., 2008). In examining the correlations between study variables (see Table 4), it is difficult to explain why the addiction function, above and beyond the other functions, significantly predicted NSSI

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severity, as all six functions were similarly correlated with one another and with other constructs.

Recent research examining NSSI within an addiction framework suggests that those who engage in more severe self-injury are also more likely to also endorse substance abuse, disordered eating, and sexual compulsivity (MacLaren & Best, 2010). Severe self-injurers have also been characterized with certain personality traits, such as higher Neuroticism and lower Agreeableness and Conscientiousness (MacLaren & Best, 2010). Furthermore, recent research has revealed lower levels of endogenous opioids among those who engage in repetitive NSSI, further implicating the potentially addictive qualities of NSSI (see Groschwitz & Plener, 2012, for a review). Additional research is needed to explore why some individuals come to *feel* addicted to NSSI and why these individuals are at greater risk for more severe courses of NSSI.

Next, the interpersonal function was the only function significantly associated with implicit associations with NSSI. Specifically, individuals who endorsed engaging in NSSI for the purposes of influencing others (i.e. seeking help, communication, revenge, etc.) tended to have stronger automatic associations with self-injury. For those who engage in NSSI for *intra*personal reasons, the behavior may remain hidden from caregivers and friends. However, among those who engage in NSSI for interpersonal reasons, caregivers and peers may be aware of the behavior and may intervene in some way (e.g. parents expressing concern or peers seeking to engage in NSSI together). These social responses may inadvertently serve to strengthen one's identity as a "self-injurer." Research suggests that those who engage in NSSI tend to perceive improvements in their relationships with caregivers when they self-injure due to increased care-taking behaviors

or attention on the part of parents (Hilt et al., 2008). Observational research conducted in online chat rooms and message boards related to self-injury suggests that youth often find support and acceptance in these "communities" of self-injurers. As adolescence is a time of identity-development, and self-injuring youth tend to struggle even more to define their identity, the perceived support and care-taking they receive from caregivers or peers because of their self-injurious behavior may serve to strengthen their identities as "self-injurers" (Whitlock, Lader, & Contero, 2007; Walsh, 2006). Conversely, results of the current study showed that the autonomy function of NSSI negatively predicted implicit associations with NSSI; however, these results only approached significance. Research on the autonomy function of NSSI suggests that for some self-injuring individuals, NSSI is used as a means to individuate from primary caregivers and to actively establish a unique identity (Suyamoto, 1998). If supported by further research, these results may suggest that the extent to which individuals seek social support related to their self-injury may play a role in the possible development of a self-injuring identity.

No NSSI functions significantly predicted mean SAP shock or number of extreme shocks. The self-punishment function, however, non-significantly predicted number of extreme SAP shocks. In the context of the reaction time game, those who more highly endorsed a self-punishment function may have become more quickly frustrated, particularly when their losses increased in the second block of the task, and may have been more likely to administer more severe shocks. Previous research related to pain tolerance and NSSI has revealed that people with highly-critical cognitive styles are willing to endure more pain (Hooley, Ho, Slater, & Lockshin, 2010). Although this study did not examine directly the functions of NSSI, specifically, they hypothesized that

enduring more pain may serve as a means of self-punishment among those who engage in NSSI and have particularly negative beliefs about themselves. For all of these hypotheses related to functions, it must be kept in mind that very little research has examined how the reasons for engaging in NSSI may be related to self-reported or behavioral outcomes. Therefore, additional research with a variety of samples is needed to examine how the reasons for engaging in NSSI may be associated with adverse outcomes.

Next, affect changes during NSSI were not significantly associated with self-reported NSSI severity or implicit associations with NSSI. This is inconsistent with previous research that has shown that increases in positive affect during NSSI positively predict more lifetime acts of NSSI (Jenkins & Schmitz, 2012). A notable difference between the current study and that of Jenkins & Schmitz (2012) is that the current study included only individuals who had self-injured five or more times, whereas the Jenkins & Schmitz study included any individual who had self-injured even one time. Perhaps affective states surrounding NSSI play a lesser role among individuals engaging in repetitive NSSI, as these individuals may have habituated to the effects of NSSI. For example, it may be that affective states surrounding NSSI are more important early on in the development of self-injury, because if individuals experience increased positive affect and decreased negative affect after an act of NSSI, they will learn that self-injury is effective and will continue to engage in it. If, on the other hand, their affect does not change in a way that would be reinforcing, they would have no reason to continue with the behavior. As no research has yet to prospectively examine the development of NSSI, these questions have yet to be addressed.

Consistent with hypotheses, however, increases in positive affect significantly positively predicted higher mean levels of shock on the SAP. This result suggests that those who experience greater increases in positive affect after an act of NSSI are willing to be more aggressive towards themselves than those whose positive affect does not increase during NSSI. Changes in negative affect were not significantly associated with SAP outcomes. These results are inconsistent with the results reported above related to affect changes and self-reported NSSI severity. This inconsistency may suggest that individuals may not realize the extent to which NSSI impacts their emotional state, particularly when asked to retrospectively self-report their affect.

Previous research suggests that individuals who engage in repetitive NSSI display lower baseline levels of endogenous opioids and that NSSI may serve as a means to increase endogenous opioids during times of stress (see Groschwitz & Plener, 2012, for a review). As endogenous opioids are associated with feelings of pleasure, it follows that among repetitive self-injurers, a higher degree of injury may be associated with increased positive affect. This is the first study to examine how self-reported affect may be related to behavioral assessments of self-aggression and highlights the importance of employing multiple assessment methods in assessing NSSI. Future research should continue this line of inquiry and employ prospective assessments to more accurately assess affective states before and after acts of self-injury.

Aim 3

In the current sample of young adults, out of 120 variables, only four: a history of suicidal ideation, sensation seeking score, mean shock level, and a diagnosis of current alcohol abuse were necessary to distinguish between young adults in the NSSI Only and

NSSI+S study groups (see Figure 1). The proposed algorithm correctly classified 87% of participants in the current study. Seven individuals in the NSSI Only group were misclassified into the NSSI+S group (Type I error) and 2 individuals in the NSSI+S group were misclassified into the NSSI Only group (Type II error). Furthermore, the algorithm explained 68% of the variance in the current sample and 32% ± 13% of the variability in the population. As a point of comparison, psychological and medical studies employing recursive partitioning have reported classification rates between 39% and 100% and between 11% and 56% of population variance explained. Therefore, the results of the current study fall soundly towards the high end of correct classification and the middle range of variance explained.

In terms of the variables that emerged as the best differentiators between NSSI Only and NSSI+S study groups, a history of suicidal ideation emerged as the foremost predictor of increased suicide risk in the current sample. This is consistent with existing research, which has revealed that history of suicidal ideation is a strong predictor of suicidal behavior (Nock et al., 2008; Witte, Fitzpatrick, Joiner, & Schmidt, 2005).

Next, among individuals with a history of suicidal ideation, lower sensation seeking scores were associated with increased risk for suicidal behavior. Previous research on the relationship between sensation seeking and suicidal behavior has been mixed, with some research suggesting that high sensation seeking is associated with suicidal behavior (e.g., Vermeiren, Schwabe-Stone, Ruchkin, King, Heeringen, Deboutte, 2003) and other research finding no such association (e.g., Yen et al., 2009). It may be that high sensation seeking, defined as "the seeking of varied, novel, complex, and intense sensations and experiences, and the willingness to take physical, social, legal, and financial risks for the

sake of such experiences" (Zuckerman, 1994, p. 27), does not, in and of itself, predict suicidal behavior because suicide would thwart a sensation-seeker's ability to have novel experiences. Rather, the relation between sensation seeking and suicide may be moderated by other constructs such as emotion dysregulation, negative affect, or negative views of the self. Furthermore, considering the sensation seeking theory of self-injury, which posits that self-injury may be used as a means for generating excitement or positive affect (Glenn & Klonsky, 2009), it does not follow that sensation seeking, alone, would contribute to suicidal behavior. Instead, sensation seeking in the absence of other risky behaviors may serve as a protective factor against suicide, as these individuals may be motivated to continue to pursue novel experiences with the hope of generating positive affect. In the current sample, higher UPPS+P Sensation Seeking scores were significantly correlated with lower levels of negative affect on the day of the study. This finding may suggest that these individuals have lower levels of negative affect, generally, which would be a protective factor against suicide. Finally, several of the UPPS+P Sensation Seeking items inquire whether individuals would be interested in engaging in a variety of behaviors (i.e., scuba diving, surfing, skiing fast, flying an airplane, etc.). As highly depressed individuals would probably be less likely to endorse interest in engaging in such behaviors, particularly if experiencing anhedonia, it follows that individuals scoring high on UPPS+P Sensation Seeking may be less likely to be suicidal. As sensation seeking is often conceptualized slightly differently across measures, it is unclear whether this result would hold if alternative measures of sensation seeking were used. Thus, additional research is necessary to examine the possibly protective nature of sensation seeking across other samples and with various measures.

Next, among individuals with a history of suicidal ideation and with higher sensation seeking scores, higher mean shock level on the SAP was associated with increased risk for suicidal behavior. This finding is not surprising, as shocking oneself and suicidal behavior can both be classified as self-aggression. Furthermore, this result is consistent with the results of Aim 1, in which mean shock level significantly predicted, and number of maximum shocks trended towards predicting, membership in the NSSI+S group. This is the first study to examine how performance on the Self-Aggression Paradigm may be related to suicidal behavior among self-injuring young adults.

Finally, among individuals with a history of suicidal ideation and lower sensation seeking scores, meeting criteria for current alcohol abuse was associated with *lower* suicide risk. Again, this result was not expected given the well-researched link between substance use and suicide. Surprisingly, all three participants who met criteria for current alcohol abuse were in the NSSI Only group. On examination of these participant's symptoms, they primarily reported that they had missed class or work on multiple occasions due to drinking. According to DSM-IV, endorsement of this one symptom is enough for a diagnosis of Alcohol Abuse. Therefore, these individuals may not be using alcohol to the extent that it may increase their risk for suicide. Conversely, these individuals may be engaging in behavior typical of many college students. Similar to the result of higher sensation seeking predicting lower risk for suicide, these student's use of alcohol may be associated with having fun, experiencing new things, and being social, rather than with coping with negative emotions, impulsivity, and/or suicidal behavior. Furthermore, individuals who may be at increased risk for suicide due to more severe substance abuse or dependence are likely not represented in the current sample. It must

be kept in mind that only three participants met criteria for current alcohol abuse. Although the addition of this variable to the model significantly improved the variance explained by the model, additional research is necessary to determine whether this finding may generalize to other samples.

General Discussion

In their proposal to the DSM-5 Mood Disorder Work Group, Shaffer and Jacobson (2009) identified two important gaps in the field's understanding of NSSI. First, NSSI has been commonly viewed as pathognomonic of Borderline Personality Disorder, leading many researchers to examine NSSI only in the context of this disorder. Second, the majority of research on NSSI fails to distinguish between NSSI and suicidal behavior, often grouping them together under the broad term "self-harm." Thus, researchers who study self-injury hope that the recognition of NSSI as a distinct syndrome will stimulate new ways of examining and understanding the disorder. "Non-Suicidal Self-Injury Disorder" is currently included in DSM-5 as a "condition for further study".

The current study aimed to address both of these gaps in the following methodologically and conceptually innovative ways by: 1) examining NSSI among a college sample of young adults rather than among a clinical sample characterized by personality pathology, 2) using multiple methods (diagnostic interviews, behavioral tasks, and self-report measures) to simultaneously examine a variety of known, as well as novel, risk factors for both suicidal behavior and NSSI severity, and 3) using population-based along with person-centered statistical techniques to explore which factors best distinguish between self-injuring individuals with and without comorbid suicidal

behavior, with the hope of increasing the ability to accurately predict which individuals engaging in NSSI are at most risk for suicide.

The current study was the first to employ a multimethod approach to assessing risk for suicidal behavior among self-injuring young adults. No previous studies have combined diagnostic interviews, self-report measures, and behavioral tasks in assessing suicide risk among self-injuring individuals. To date, the majority of studies have looked primarily at symptoms of depression, anxiety, or Borderline Personality Disorder. As results of the current study revealed no diagnostic distinctions between those at low versus high risk of suicidal behavior, the importance of broadening the variables researchers employ when examining distinctions between NSSI and suicide cannot be overstated. In particular, the current study highlights the importance of including behavioral tasks in the assessment of self-harm behaviors. In the current study, the self-aggression paradigm (SAP; McCloskey & Berman 2003; Berman & Walley, 2003) not only significantly predicted comorbid suicidal behavior among self-injurers, but also served as a laboratory analogue of self-injurious behavior and a behavioral indicator of NSSI severity. As it is very difficult to observe self-injury as it occurs, employing laboratory measures that approximate NSSI is critical to the advancement of self-injury research.

The current study also revealed some surprising diagnostic characteristics of a college sample. Of the 68 young adults in the current study, 83.8% endorsed a history of suicidal ideation, 36.8% endorsed a history of having a plan for suicide, and 30.9% endorsed at least one suicide attempt. Diagnostically, 94.1% of the sample met criteria for one past or present Axis I disorder, 67.4% met criteria for a current Axis I Disorder, and 51.5% met

criteria for a personality disorder. These numbers suggest that although this was not a clinical sample in the traditional sense, many of these young adults were suffering from a high degree of psychological distress. These findings emphasize the importance of continuing to examine NSSI and suicidal behavior among non-clinical samples. In many ways, college samples are an ideal place to study NSSI, as self-injurious behavior is at its highest rate among young adults.

The findings from this study also highlight some important distinctions between NSSI and suicidal behavior and suggest that not all young adults engaging in NSSI are at imminent risk for suicide. Although many individuals in the current study had thought about suicide at one time or another, the majority had never planned nor attempted suicide. This is not to say that individuals who engage in NSSI and have not thought about or attempted suicide will not do so in the future, but medical and mental health professionals should keep in mind that a high level of emergent care may not always be appropriate when an individual reports engaging in self-injurious behaviors. Furthermore, the current study supports the notion that NSSI may be diagnostically independent of Borderline Personality Disorder. Indeed, of the 68 self-injurious youth in the current study, only 18 met criteria for Borderline Personality Disorder. As seen in Table 3, Major Depressive Disorder and Alcohol Use Disorders were more prevalent among this sample of self-injurious young adults than Borderline Personality Disorder. Furthermore, rates of Borderline Personality Disorder were not significantly different between the two study groups. Taken together, these results suggest that although Borderline Personality Disorder may be significantly associated with NSSI and suicidal behavior, the diagnosis, in and of itself, may only account for a minority of individuals who self-injure.

Similarly, the NSSI Only and NSSI+S study groups did not significantly differ on the prevalence of any single diagnosis. The groups differed, however, on number of diagnoses, with those in the comorbid suicidality group meeting criteria for significantly more diagnoses, on average, than those in the NSSI Only group. These results are also somewhat surprising given the strong associations between several diagnoses and suicidal behavior such as depression, substance use, posttraumatic stress disorder, and personality disorders, to name a few. These results preliminarily suggest that psychiatric diagnoses, in and of themselves, may not best differentiate between self-injurers with and without comorbid suicidal behavior. Although the current study comprehensively assessed psychiatric diagnoses, it is also among the first to examine what other risk factors may play a role in NSSI severity and comorbid suicidal behavior.

Limitations

Although the current study has many strengths, several limitations are worthy of note. First, the current study included only undergraduates from one large, urban university, thus limiting generalizability of the findings to other settings and populations. This may be particularly true in regards to suicidal behavior, which is far more prevalent in clinical settings and among somewhat older populations. Furthermore, the sample in the current study was fairly small. Although all analyses were sufficiently powered, analyses with larger samples are needed to replicate these results.

Next, the current study operationalized suicide risk on the basis of a brief self-report measure. Although past research has demonstrated the ability of the SBQ-R to differentiate between individuals at risk for suicide and non-suicidal individuals with a

cutoff score of 7, this may not be the optimal way to differentiate between self-injurious young adults at high versus low risk for suicide. Larger samples that determine groups based on suicidal ideation, suicidal plans, and suicide attempts may lead to more accurate and nuanced prediction of suicidal behavior.

Finally, the current study was cross-sectional and relied heavily on retrospective reports of symptoms, attitudes, behaviors, and emotions. Given the emotional intensity associated with NSSI and suicidal behaviors, the reliability of retrospective self-report is unclear. Although the current study found several significant findings despite this limitation, prospective, longitudinal research of NSSI and suicidal behavior is sorely needed.

Summary

In sum, the current study revealed several important findings. First, NSSI is distinct from suicidal behavior in many ways, and may also present independently from Borderline Personality Disorder. Second, diagnostic variables are likely not the best way to distinguish between self-injuring individuals with and without suicidal behavior or to predict NSSI severity. Rather, reasons for engaging in NSSI, affect changes associated with NSSI, and laboratory measures of self-aggression may best help us understand who is at risk for a more severe course of self-injury or even suicidal behavior. Finally, results of the current study suggest that a relatively simple algorithm may help to evaluate which individuals NSSI may be at increased risk for suicidal behavior. Although the current model was not designed to be a diagnostic tool, it reveals that only a few, perhaps surprising, variables are needed to best distinguish between self-injurers at low versus heightened risk for suicide. This is the first study to date to conduct an exploration of

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more than 120 variables to atheoretically determine which may best predict suicide risk. Additional studies of this nature are needed because, as mentioned above, existing studies have focused primarily on variables that may have relatively little predictive power.

Implications

More closely examining how known risk factors, along with the functional and emotional correlates of NSSI, impact the course of NSSI, and how these factors might differentiate self-injuring individuals with and without comorbid suicidal behavior, has important clinical implications. First, identifying factors that may lead to a worse course of NSSI may help clinicians to provide more timely interventions for those at most risk for severe injury prior to the onset of these behaviors. Second, understanding the factors that may impact the relation between NSSI and suicidal behavior may help clinicians better assess and identify the self-injuring individuals most at risk for suicide. This understanding will allow researchers and clinicians to tailor interventions that may best serve the unique needs of specific subsets of the heterogeneous group of individuals who engage in NSSI.

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