

EXAMINATION OF CONCURRENT AND LONGITUDINAL ASSOCIATIONS AMONG
EMOTIONAL REACTIVITY TO STRESS, INTERPERSONAL PROBLEM-SOLVING,
AND ADOLESCENT NONSUICIDAL SELF-INJURY

Caroline Bliss Adelman

A dissertation submitted to the faculty of the University of North Carolina at Chapel Hill in
partial fulfillment of the requirements for the degree of Doctor of Philosophy in the
Department of Psychology (Clinical)

Chapel Hill
2011

Approved by:

Mitchell J. Prinstein, PhD

Jonathan S. Abramowitz, PhD

Barbara L. Fredrickson, PhD

Anna M. Bardone-Cone, PhD

Catherine A. Forneris, PhD

ABSTRACT

CAROLINE BLISS ADELMAN: Examination of Concurrent and Longitudinal Associations Among Emotional Reactivity to Stress, Interpersonal Problem-Solving, and Adolescent Nonsuicidal Self-Injury
(Under the direction of Mitchell J. Prinstein)

This study examined five hypotheses related to negative emotional reactivity and problem-solving as risk factors for nonsuicidal self-injury among adolescents. In a sample of 60 adolescents aged 12-16 years, measures of positive and negative affect and interpersonal problem-solving were administered before and following an in-vivo stressor task. Measures of depressive symptoms and NSSI also were administered at an initial time point.

Adolescents completed additional measures of self-injury 3-months and 6-months after the initial time point. Results revealed support for several components of the proposed model. Specifically, results indicated that poorer problem-solving was concurrently associated with engagement in NSSI, and individuals who engaged in NSSI reported higher levels of negative affect following the experience of stress than individuals with no history of NSSI. In addition, exploratory longitudinal analyses provided preliminary evidence that low levels of problem-solving self-efficacy following stress may be predictive of the onset of NSSI over time. Odds ratios for longitudinal analyses indicated that levels of self-efficacy following the stressor task were substantially associated with risk for NSSI onset over time. However, longitudinal analyses lacked sufficient power to detect statistically significant effects. Results provide replication of recent research indicating impaired interpersonal problem-solving among self-injurious adolescents, as well further evidence of increased emotional reactivity

among self-injurious adolescents and pilot data suggesting that poorer interpersonal problem-solving may serve as a longitudinal risk factor for NSSI onset among adolescents.

ACKNOWLEDGEMENTS

First and foremost, I would like to thank my advisor, Mitch Prinstein, who has been a constant support and exceptional mentor throughout my graduate years. I would also like to thank my husband, Zac Adelman, for being such an encouraging, loving presence in my life and for helping to keep me grounded throughout the dissertation process. Finally, I would like to thank my dissertation committee, who provided me with thoughtful feedback throughout the various phases of the dissertation project, as well as Howell Browne, Noah Berman and Sophie Choukas-Bradley, who provided valuable feedback on earlier drafts of this manuscript.

TABLE OF CONTENTS

LIST OF TABLES.....	vii
LIST OF FIGURES.....	viii
Chapter	
I. INTRODUCTION.....	1
II. METHODS.....	24
Participants.....	24
Measures.....	26
Procedure.....	30
III. DATA ANALYSES.....	32
IV. RESULTS.....	38
Preliminary Analyses.....	38
Impact of stress on interpersonal problem-solving skills.....	40
Impact of stress on interpersonal problem-solving skills of self-injurers	41
Emotional reactivity to stress among self-injurers.....	42
Decrements in interpersonal problem-solving skills predict onset of NSSI.....	44
Association between negative emotional reactivity and longitudinal NSSI mediated by interpersonal problem-solving deficits.....	45
V. DISCUSSION.....	47

REFERENCES..... 70

LIST OF TABLES

Tables

1. Means for Primary Variables at Time 1 and Time 2 65
2. Bivariate Associations among Primary Variables..... 66
3. Means and standard deviations of problem-solving (across time) by
NSSI status, before and after controlling for depressive symptoms 67
4. Estimated marginal means of pre-stressor and post-stressor positive
affect and negative affect by NSSI status, before and after controlling
for depressive symptoms 68

LIST OF FIGURES

Figures

1. Estimated marginal means of pre-stressor and post-stressor negative affect by NSSI status, before and after controlling for depressive symptoms..... 69

CHAPTER 1

INTRODUCTION

Overview of NSSI: What is it, and what function does it serve?

Nonsuicidal self-injury (NSSI) refers to any direct, intentional destruction of one's own body tissue that occurs without suicidal intent and does not represent a socially sanctioned form of self-inflicted tissue damage, such as body piercing or tattoos (Nock, Joiner, Gordon, Lloyd-Richardson, & Prinstein, 2006). The most common forms of NSSI among adolescents include cutting and burning, although other forms of NSSI are also frequently cited (Muehlenkamp & Gutierrez, 2004). NSSI has received increasing attention in recent years as both a surprisingly common and clinically concerning behavior among adolescents. Recent community-based studies have indicated that 14-15% of adolescents report having engaged in NSSI at some point in their lives (e.g., Laye-Gindhu & Schonert-Reichl, 2005; Ross & Heath, 2002), and an estimated 2.5-12.5% of high-school students engage in NSSI each year (Garrison et al., 1993; Muehlenkamp & Gutierrez, 2007). Among psychiatric inpatients, the rates of adolescent NSSI are startling, with estimates of NSSI prevalence in this population ranging from 40-80% (Klonsky & Muehlenkamp, 2007; Nock & Prinstein, 2004). Of particular concern, there is evidence that NSSI may be a strong risk factor for suicidal behaviors. A study by Nock and colleagues (2006) found that 70% of adolescents who had engaged in recent NSSI also reported at least one previous suicide attempt (Nock, Joiner, Gordon, Lloyd-

Richardson, & Prinstein, 2006). This same study revealed that individuals who have a longer history of NSSI, who use a wider range of methods for engaging in NSSI, and who report a lack of physical pain during NSSI are at the greatest risk of suicide (Nock et al, 2006).

In an effort to better understand how NSSI is initiated and maintained, several theories of the motivations underlying NSSI have been proposed and tested in recent years. Chief among these theories is the Four-Function Model of NSSI, which suggests that NSSI may be either positively or negatively reinforcing in either interpersonal (“social”) or intrapersonal (“automatic”) domains (Nock & Prinstein, 2004). Positive automatic reinforcement refers to the introduction of a desired internal state following an act of NSSI. This can include both psychological and physical factors, such as increased feelings of control, “just feeling something,” and endorphin release. By contrast, positive social reinforcement of NSSI refers to attention, communication, care taking, and other desirable interpersonal outcomes of NSSI. Negative automatic reinforcement of NSSI refers to the removal of an undesired internal state, and therefore describes the “emotion regulation” function of NSSI (Nock & Cha, 2009). Finally, negative social reinforcement of NSSI relates to escape from aversive interpersonal situations, such as unwelcome responsibility or the anger of a loved one (Nock & Prinstein, 2004). The functions of NSSI proposed in the Four-Function Model are not mutually exclusive. NSSI is considered to be an over-determined behavior, meaning that it may serve multiple functions for a given individual at a given time (Nock & Prinstein, 2004). The functions served by NSSI, for youth in particular, may also vary across development (Lloyd-Richardson, 2008; Lloyd-Richardson, Nock & Prinstein, 2009).

Among inpatient adolescents, the emotion regulation functions (i.e., those related to negative automatic reinforcement) of NSSI are endorsed most frequently, though social functions are also frequently endorsed (Lloyd-Richardson, Perrine, Dierker & Kelley, 2007; Nixon, Cloutier, & Aggarwal, 2002; Nock & Prinstein, 2004). These findings suggest that adolescents are primarily using NSSI as a strategy for regulating strong aversive emotions (i.e., negative affect), and also frequently using NSSI as a way of influencing their social environments (e.g., Lloyd-Richardson, Perrine, Dierker & Kelley, 2007). The use of NSSI as a strategy for emotion regulation and interpersonal communication may seem puzzling, given the availability of other, more adaptive strategies for achieving these same effects (Nock, 2009). There are several potential explanations for why adolescents who engage in NSSI may choose this strategy for emotion regulation and social communication when they are distressed. In particular, there is now evidence (discussed below) that problem-solving deficits among nonsuicidal self-injurers may help to explain why some individuals engage in NSSI in response to strong negative emotions, while others find alternate means of coping (e.g., Nock & Mendes, 2008).

Context for the Current Study

Building on recent research in this domain (Nock & Mendes, 2008), the current study focused on the role that relative deficits in interpersonal problem-solving may play in mediating the association between the experience of negative affect and engagement in NSSI. As context for this focus, an integrated model of NSSI is depicted below (Figure 1). This model, which is an expanded and modified version of other integrated models of NSSI (e.g., Nock, 2009; Nock & Cha, 2009; Prinstein et al., 2009), is intended to briefly

summarize a much broader literature than is relevant for the current study. Following the presentation of this broader conceptual model, this paper will provide a detailed review of existing research on the focus of the current project—the role that interpersonal problem-solving deficits may play in the initiation and maintenance of NSSI. Limitations of the existing research in this domain will then be discussed, and the value of the current study in overcoming previous limitations in the literature will be outlined.

Integrated Biopsychosocial Model of Adolescent NSSI

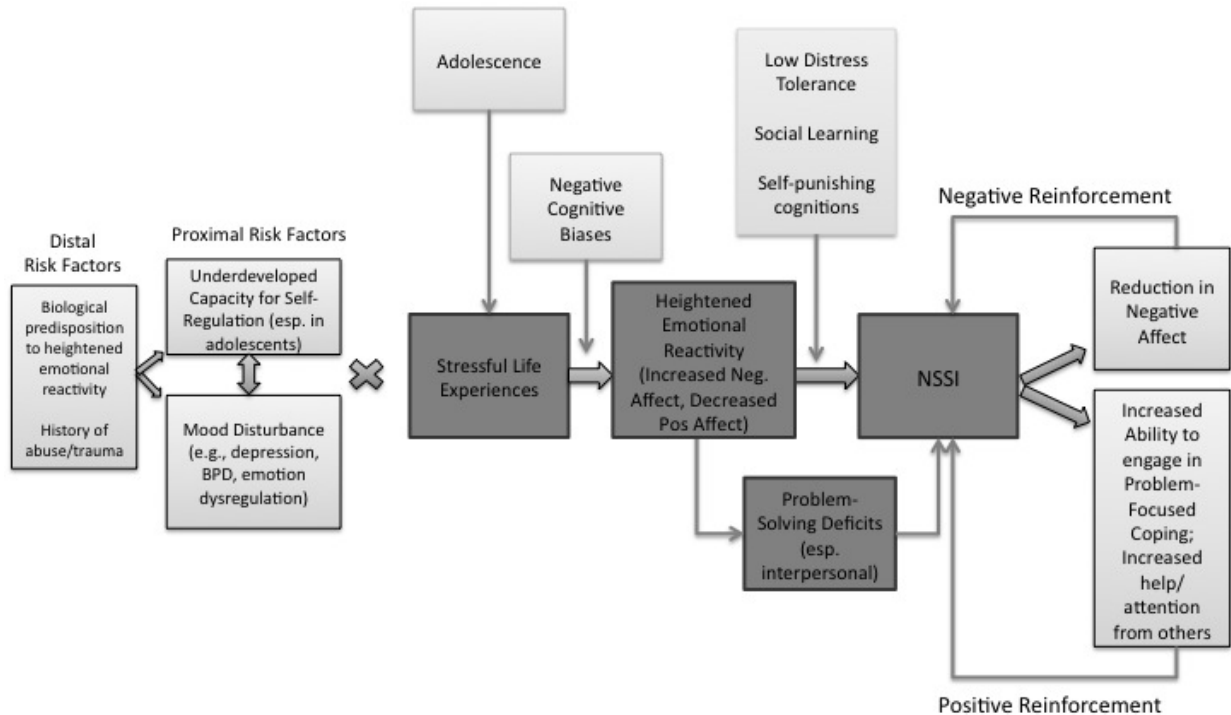


Figure 1: Biopsychosocial Model of Adolescent NSSI

The hypotheses tested in the current study are nested within the broader integrated model of NSSI among adolescents depicted in Figure 1. While the current study focused

specifically on the associations among negative emotional reactivity to stress, interpersonal problem-solving abilities and NSSI, it is important to note that these constructs represent only a small subset (indicated by darker grey boxes in figure 1) of the variables identified in the NSSI literature, and are best understood in the context of this broader model.

Summary of the Full Model

The Biopsychosocial Model of Adolescent NSSI (figure 1) outlined above suggests several pathways by which NSSI may be initiated and maintained, largely based on previous research in this domain. It begins by naming distal risk factors for NSSI, which include a history of abuse or trauma (Glassman et al., 2007), as well as biological vulnerabilities that predispose an individual to affect dysregulation (e.g., irregularities in the hippocampus, amygdala, and prefrontal cortex; McEwen, 2007). These distal risk factors may, in turn, contribute to the development of more proximal risk factors for NSSI, including an underdeveloped capacity for self-regulation (e.g., impulsivity and behavioral undercontrol), and mood disturbances (e.g., depression and affect dysregulation). Consistent with other vulnerability-stress models of NSSI (e.g., Nock, 2009), these proximal risk factors for NSSI are thought to interact with the occurrence of stress in producing pathological outcomes (Guerry & Prinstein, 2010). In particular, the combination of an underdeveloped capacity for self-regulation among adolescents (e.g., Steinberg, 2004) and some pre-existing mood disturbance is thought to interact with the occurrence of stress to create high levels of negative emotional reactivity. This interaction is particularly relevant during adolescence, a developmental period marked by an increase in the occurrence of interpersonal stressors (Rudolph & Hammen, 1999) and

an underdeveloped capacity for self-regulation (e.g., Steinberg, 2004). The model suggests that heightened negative emotional reactivity to stress, in turn, may lead to engagement in NSSI as a coping mechanism (e.g., Nock & Prinstein, 2004). The mediation model above suggests that those who have greater difficulty generating or enacting effective solutions to problems (i.e., problem-solving deficits) when they are distressed may be at greater risk for choosing NSSI as a coping strategy (e.g., Nock & Mendes, 2008), and that the association between problem-solving deficits under stress and NSSI may mediate the association between negative emotional reactivity to stress and engagement in NSSI. Additional factors that may increase the likelihood of engaging in NSSI include difficulty in tolerating feelings of distress (i.e., low distress tolerance; Nock & Mendes, 2008), social exposure to NSSI as a coping mechanism (Nock, 2009), and self-critical beliefs (Glassman, Weierich, Hooley, Deliberto, & Nock, 2009). The act of engaging in NSSI, in turn, leads to a reduction in negative affect (i.e., negative automatic reinforcement; Nock & Prinstein, 2004), an increased ability to engage in problem-focused coping (i.e., positive automatic reinforcement; Nock & Prinstein, 2004; Franklin et al., 2010), and increased helping behaviors from others (i.e., positive social reinforcement; Nock & Prinstein, 2004). Each of these reinforcements serves to maintain NSSI by increasing the likelihood that an individual will find this strategy effective and select it as a future coping mechanism. Of note, this model suggests that NSSI is a complex phenomenon with multiple risk factors, and that risk factors for the initial onset of NSSI may differ from factors that serve to maintain NSSI over time. Longitudinal hypotheses of the current study are focused specifically on factors that may contribute to the *onset* of NSSI over time.

Two-Fold Association Between Problem-Solving Deficits and NSSI

Evidence of a link between problem-solving deficits and self-injurious behavior (both suicidal and nonsuicidal) among adolescents is well-established and supported by several complementary bodies of research (e.g. Speckens & Hawton, 2005; Biggam & Power, 1999; Nock & Mendes, 2008). Consistent with the model presented above, the current project conceptualizes the relationship between problem-solving and NSSI in two ways. First, NSSI is thought to be reinforced by a temporarily increased capacity for problem-focused coping (i.e., problem-solving ability) following an act of NSSI. Second, problem-solving deficits are proposed to play a role in mediating the association between negative emotional reactivity to stress and the selection of NSSI as a coping strategy. Past research in support of each of these theories, as well as research providing evidence more generally for an association between problem-solving deficits and NSSI, is presented below. Although previous research on this latter topic has relied on cross-sectional analyses and therefore cannot serve as a basis for firm conclusions about the exact nature of the association between problem-solving and NSSI (e.g., Nock & Mendes), it does provide preliminary evidence in support of the model—evidence which the current study aims to broaden and strengthen through the testing of its hypotheses.

Increased Problem-Solving as a Reinforcement of NSSI

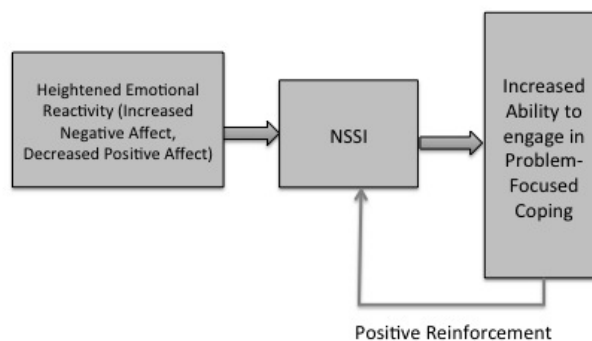


Figure 2: Problem-Solving Ability as Positive Reinforcement of NSSI

One recently proposed explanation for why some distressed individuals engage in NSSI is that NSSI and its physiological corollaries may function as a means of increasing cognitive access to other problem-solving strategies (e.g., Franklin et al., 2010). Evidence in support of this theory has been provided by both psychological and psychophysiological research. Psychological research among adolescents who engage in NSSI has revealed that adolescents often report feeling more “in control” after an episode of NSSI (Lloyd-Richardson et al., 2007), suggesting that there is something about the self-injurious act that increases one’s sense of being able to manage the situation at hand. Psychophysiological research has provided at least one compelling explanation for how NSSI may function to increase feelings of control. This research has suggested that, among individuals with high levels of emotion dysregulation, NSSI both reduces levels of distress and improves individuals’ abilities to engage in problem-focused coping (e.g., Franklin et al, 2010). Franklin and colleagues (2010) conducted a study in which college students with emotion regulation difficulties engaged in an NSSI proxy task (i.e., “the

cold pressor task”) following a stressor, and found that repeated engagement in NSSI served at least two psychophysiological functions for these individuals: a reduction in negative emotion consistent with emotion regulation functions of NSSI (Franklin et al., 2010) and an improvement in information processing, associated with an increased ability to engage in problem-focused coping strategies (Franklin et al., 2010). It appears that for some individuals, NSSI not only reduces distress; it may also better enable them to focus on and solve the problem underlying their distress, thus increasing their feelings of control in the situation. This finding extends previous psychophysiological research conducted among young adults, indicating that self-mutilation (i.e., NSSI) imagery is associated with a decrease in psychophysiological and subjective arousal among individuals with a history of NSSI, but not among non-self-injuring controls (Haines, Williams, Brain, & Wilson, 1995).

The findings of past physiological research in this domain also are consistent with theory related to the role of emotional states in problem solving. For example, the *broaden-and-build theory* of positive emotions (Fredrickson, 1998, 2001) suggests that positive emotions increase attention and broaden an individual’s thought-action repertoire. By contrast, negative emotions tend to limit a person’s thought-action repertoire, compared to neutral or positive emotional states (Fredrickson & Branigan, 2005). For example, the emotion of fear signals the brain to attend to the threatening situation, while simultaneously preparing the body for the action tendency to fight or flee the fear-inducing stimulus (Fredrickson & Branigan, 2005). In the case of an individual with emotion dysregulation, common among those who engage in NSSI, it is possible that the high level of distress experienced following a relatively manageable stressor

signals a more extreme narrowing of thought-action repertoire than is needed for the situation at hand (i.e., a thought-action repertoire that has evolved as a response to life-threatening situations, but is excessive for daily stressors). If this is the case, any effect that NSSI has on regulating emotions is also likely to increase an individual's thought-action repertoire to more adaptive levels (Fredrickson & Branigan, 2005). This possibility is supported by psychophysiological research indicating that, following an NSSI proxy task, emotionally dysregulated individuals display a pattern of neurological activity consistent with improved information-processing (Franklin et al., 2010). The combination of these findings suggests that, by temporarily reducing negative affect, NSSI may serve to increase access to the cognitive and attentional resources needed to engage in effective problem solving. Future studies are needed to determine whether engagement in NSSI (or an NSSI proxy task) actually improves performance on problem-solving tasks among individuals with emotion dysregulation.

Problem-Solving Deficits Mediate the Association Between Distress and NSSI

While the first proposed association between problem-solving and NSSI relates to one mechanism by which NSSI may be maintained (i.e., reinforced) over time, the second proposed association between problem-solving and NSSI suggested by the integrated biopsychosocial model (figure 1) relates to a risk factor for both the onset and maintenance of NSSI. This proposed association suggests that problem-solving deficits partially mediate the association between the experience of heightened negative affect and the selection of NSSI as a coping strategy. This proposed mediation model (figure 3) represents the primary focus of the current study, and is based on several complementary bodies of literature.

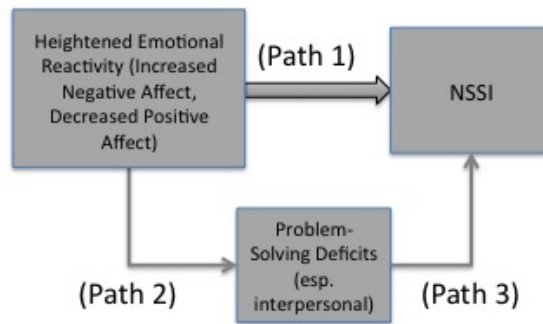


Figure 3: Partial Mediation Model (Negative Emotional Reactivity → Problem-Solving Deficits → NSSI)

In order to determine the presence of a mediation effect, several preliminary pieces of evidence are necessary: First, an association between the predictor variable (i.e., negative affect) and the outcome variable (NSSI) must be established. Therefore, evidence that negative affect is associated with increased levels of NSSI is presented first in this section. Second, an association between the predictor variable (i.e., negative affect) and the mediator (i.e., problem-solving deficits) must be established. Hence, evidence for the association between negative affect and problem-solving deficits is also presented in the following sections. Finally, an association between the mediating variable (i.e., problem-solving deficits) and the outcome (i.e., NSSI) must be established, and this association must account for at least part of the originally established association between the predictor and the outcome variable (i.e., the association between the predictor and the outcome variable must decrease in the presence of the mediating variable). Evidence for a link between problem-solving deficits and self-injury will be discussed below in great detail, based on evidence from decades of research linking problem-solving deficits to both suicidal and non-suicidal forms of self-injury.

Association between Negative Emotional Reactivity and NSSI

Perhaps the most convincing evidence of an association between negative emotional reactivity and NSSI comes from studies demonstrating that affect regulation (i.e., reduction of negative affect) is the most commonly cited function of NSSI among adolescents (e.g., Lloyd-Richardson, Perrine, Dierker & Kelley, 2007; Nock & Prinstein, 2004). In addition, there is evidence that adolescents and young adults who engage in NSSI exhibit higher levels of self-reported negative affect (Arney & Crowther, 2008; Crowell et al., 2008; Klonsky & Olino, 2008; Nock & Mendes, 2008) and higher levels of the physiological correlates of negative affect (Nock & Mendes, 2008; Franklin et al., 2010) than their non-self-injuring peers, particularly following the occurrence of stress. One recent study used ecological momentary assessments to examine the emotional states of young adults prior to acts of NSSI and found evidence of significant increases in negative affect and significant decreases in positive affect directly prior to engagement in NSSI (Muehlenkamp et al, 2009). This same study found that acts of NSSI led to significant short-term increases in positive affect, as measured by self-report on the positive affect subscale of the PANAS (Watson, Clark, & Tellegen, 1988; Muehlenkamp et al, 2009). These findings suggest that both positive and negative affect dysregulation may be related to engagement in NSSI, and that increases in positive affect may also serve to positively reinforce engagement in NSSI over time. Another recent study that also used ecological momentary assessment indicated that young adults who engage in NSSI experience increases in negative affect prior to an episode of NSSI, and that this negative affect peaks during an episode of self-injury and diminishes over the course of several hours after the NSSI (Arney, Crowther & Miller, 2011). Thanks to the increasing

use of ecological momentary assessment methods, there is mounting evidence of a real-time association between negative emotional reactivity and engagement in NSSI. In addition, indirect evidence for a connection between negative reactivity to stress and NSSI comes from treatment outcome studies for Dialectical Behavior Therapy (DBT). There is extensive evidence that DBT, which specifically teaches strategies for regulation and tolerance of negative affect, is effective in the reduction of multiple forms of self-injury among adolescents and adults (e.g., Linehan, 1993; Miller, Rathus & Linehan, 2007).

Association between Negative Reactivity to Stress and Problem-Solving Deficits

Evidence of the association between negative affect and problem-solving deficits comes from several sources. First, as previously discussed in this paper, research addressing the association between affect and problem-solving (e.g., Fredrickson & Branigan, 2005) suggests that negative emotions lead to a narrowing of the thought-action repertoire, resulting in narrowed attention, and a decreased ability to engage in creative problem-solving. By contrast, a decrease in negative affect increases creativity and attentional resources for problem solving (Fredrickson & Branigan, 2005) and results in psychophysiological activity consistent with improved information-processing (Franklin et al., 2010). A recent study examining negative physiological reactivity to stress among adolescents demonstrated that adolescents with a history of NSSI are both more dysregulated (i.e., experience greater increases in physiological measures of stress reactivity) by the experience of stress, and demonstrate greater interpersonal problem-solving deficits, compared to adolescents with no history of NSSI (Nock & Mendes, 2008). In addition, there is evidence that affect plays a critical role in the formulation of

goals during social information processing, the cognitive precursor to interpersonal problem-solving (Crick & Dodge, 1994; Forgas, 1995). In particular, negative affect has been shown to motivate a social-cognitive information-processing strategy that focuses on “mood repair” (i.e., decreasing negative affect), rather than focusing on solving the social problem underlying the feelings of distress (Forgas, 1995). A final piece of evidence for the association between negative affect and problem-solving deficits comes from research indicating that depressed youth are more prone to interpersonal problem-solving deficits than non-depressed youth (Quiggle, Garber, Panak, & Dodge, 1992).

Association between Problem-Solving Deficits and NSSI

Much previous research suggests that there is an association between problem-solving deficits and risk for self-injurious behaviors (e.g., Speckens & Hawton, 2005; Linehan et al., 1987; Biggam & Power, 1999). In particular, past research has demonstrated that problem-solving deficits are related to suicide ideation and attempts (e.g., Orbach, Rosenheim, & Hary, 1987; Schott, Colls, & Payvar, 1990), “parasuicide” (Linehan, Camper, Chiles, Strosahl, & Shearin, 1987) and NSSI (Nock & Mendes, 2008). Of particular relevance to the current study, Nock and Mendes (2008) examined the association between interpersonal problem-solving ability and NSSI and found that individuals who engaged in NSSI displayed several interpersonal problem-solving deficits relative to their non-self-injuring peers (Nock & Mendes, 2008). Consistent with the Social Information Processing Model (Crick & Dodge, 1994), several possible deficits in problem-solving were investigated. The Social Information Processing Model (Crick & Dodge, 1994) suggests that there are a variety of steps that individuals go through in encoding and responding to social situations, and several corresponding ways

in which individuals may display deficits in interpersonal problem-solving. These potential deficits include problems with cue interpretation (i.e., attributions), response generation, response evaluation, and response selection and enactment, each of which is influenced by additional factors (e.g., prior experience, self-efficacy, etc.; Crick & Dodge, 1994). While Nock & Mendes (2008) expected that individuals who engaged in NSSI would produce fewer or less effective responses to a series of hypothetical social scenarios (i.e., response generation deficits), they instead found that individuals who engaged in NSSI generated as many solutions as their non-self-injuring peers, and were equally likely to generate effective solutions in their response set (Nock & Mendes, 2008). The interpersonal deficits that were observed in this study among those who engaged in NSSI instead related to lower likelihood of *choosing* an effective solution from the solution set, and a decreased sense of *self-efficacy* related to carrying out the more effective solutions (Nock & Mendes, 2008). If replicated, these findings may suggest that, despite intact response generation among self-injurers, information processing deficits related to self-efficacy and response decision processes lead to a less effective behavioral response (For full review of the Social Information-Processing Model, see Crick and Dodge, 1994).

Crick and Dodge's (1994) Social Information-Processing model states that self-efficacy is one of the criteria that youth use in evaluating responses before selection and enactment of a particular response. Thus, to select a generated response for enactment, adolescents must first feel confident that they can produce the behavior of interest (Crick & Dodge, 1994). While the impact of low self-efficacy on response selection makes sense from an information-processing perspective (Crick & Dodge, 1994), one may still

be left wondering why adolescents who engage in NSSI develop lower self-efficacy related to interpersonal problem solving in the first place. Low self-efficacy for interpersonal problem-solving is conceptualized in the problem-solving literature as part of a negative problem-solving orientation, which is an approach to problems characterized by emotions and cognitive schemas that inhibit effective problem-solving (D’Zurilla, 1986). Two possibilities related to known distal risk factors for NSSI are proposed in the current model to explain the development of low self-efficacy among self-injurious adolescents. First, it is possible that adolescents who are predisposed to respond to stress with greater levels of negative emotional reactivity (i.e., those who are emotionally dysregulated, prone to mood disorders, etc.) have learned through experience that their level of emotional arousal following stress impairs their ability to carry out effective solutions to interpersonal problems. These adolescents may therefore develop a negative problem-solving orientation, including negative beliefs about their ability to respond effectively to social problems (i.e., low self-efficacy). A second possibility relates to an additional distal risk factor for NSSI -- a history of trauma or abuse (e.g., Glassman, Weierich, Hooley, & Nock, 2007). People who have experienced traumatic or abusive situations may develop cognitive schemas that lead them to believe they are unable to predict or control their social environments, a belief that could easily result in a negative or avoidant problem-solving orientations (i.e., a sort of learned helplessness related to interpersonal problem-solving). Evidence for this possibility comes from studies indicating that childhood abuse is a risk factor for NSSI (Glassman, Weierich, Hooley, & Nock, 2007), as well as studies demonstrating lower self-efficacy among

children with a history of abuse or trauma (e.g., Diehl & Prout, 2002; Saigh, Mroueh, Zimmerman, & Fairbank, 1995).

Additional evidence of interpersonal problem-solving deficits among self-injurious individuals comes from studies conducted with suicidal, “parasuicidal” and self-harming individuals (e.g., Biggam & Power, 1999; Linehan et al., 1987; Sadowski and Kelley, 1993; Speckens & Hawton, 2005). “Parasuicide” and “self-harm” are both terms that are often used to refer to a spectrum of self-injurious behaviors, including those committed with and without suicidal intent. Sadowski and Kelley (1993) conducted a study among suicidal adolescent psychiatric inpatients, with both psychiatric (“distressed”) and normative (“non-distressed”) control groups, and found that suicide attempters displayed poorer interpersonal problem-solving abilities than their distressed and non-distressed peers. Specifically, adolescent suicide attempters in this study “tended to think about problems in a less accurate fashion, to respond more emotionally to dilemmas, and to adopt more avoidant responses to problematic situations” (Sadowski & Kelley, 1993). A similar study conducted among suicidal, chronically ill, and normal children (mean age 8.3 years) provided evidence that the association between problem-solving deficits and suicidality is evident by early to middle childhood (Orbach, Rosenheim, & Hary, 1987). Hawton and colleagues (1999) conducted a study among inpatient adolescents admitted to a hospital after intentional overdose, and found that lower scores for self-esteem, self-rated problem-solving and effectiveness of problem-solving all predicted repetition of deliberate self-harm (i.e., both suicidal and nonsuicidal self-injury) over a 12-month period (Hawton, Kingsbury, Steinhardt, James & Fagg, 1999). Of note, the effects of these variables were no longer significant when the authors

controlled for depression, suggesting that depression may be related to problem-solving deficits and may be the most salient predictor of self-harm repetition among suicidal individuals (Hawton et al., 1999). Other studies of adolescent self-injury have revealed an association between problem-solving deficits and self-injury (especially NSSI) even after controlling for levels of depression (Webb, 2002), perhaps suggesting that the link between depression and self-injury varies across different forms of self-injury (i.e., suicidal vs. non-suicidal).

In addition to evidence of problem-solving deficits among self-injurious children and teenagers, there is evidence that the link between problem-solving deficits and self-injury persists into adulthood (e.g., McAuliffe et al., 2005). A large, multi-site study examining the link between problem solving style and repetition of “deliberate self-harm” (i.e., both suicidal and nonsuicidal self-injury) among individuals who had been medically treated for deliberate self-harm found that problem-solving deficits successfully differentiated self-injury repeaters and non-repeaters (McAuliffe et al., 2005). In particular, this study found that a problem-solving style characterized by passive avoidance of problems, especially when combined with low self-esteem, was strongly associated with repetition of self-injury (McAuliffe et al., 2005). Although this study was conducted among adults (mean age = 36 years), it is worth noting that the types of problem-solving deficits (i.e., poor solution quality and low self-efficacy) observed among repeated self-injurers in this study were remarkably similar to those observed in studies conducted among self-injurious adolescents. This similarity in findings may suggest that the association between problem-solving deficits and self-injurious behavior persists across development. The notion that problem-solving abilities

may be relatively consistent from adolescence to adulthood is consistent with developmental literature indicating that logical reasoning abilities are fully developed by the age of 15 (e.g., Steinberg, 2004). Although helpful in highlighting the association between self-injury and problem-solving deficits, studies conducted among suicidal or “parasuicidal” individuals may not generalize to adolescents who engage exclusively in nonsuicidal forms of self-injury. While commonalities in the results of studies conducted across various self-injurious populations may imply some shared problem-solving deficits, suicidal and nonsuicidal self-injury remain distinct clinical phenomena (Lloyd-Richardson et al., 2007), and results from studies of one form of self-injury should be applied cautiously to alternative forms of self-injury. More research examining the applicability of these findings to adolescents who engage in NSSI is needed.

Limitations of Previous Research

While previous research has been highly fruitful in establishing an association between self-injury and problem-solving deficits, several limitations of prior research need to be addressed. One critical limitation of prior research in this area is that it has largely been cross-sectional in nature, and therefore does not allow for definitive conclusions related to the temporal nature of the association between NSSI and problem-solving deficits. In particular, cross-sectional research cannot effectively examine risk factors for the *onset* of NSSI without relying on retrospective reporting of risk factors. In order to understand whether problem-solving deficits are actually predictive of the onset of NSSI, more longitudinal research in this domain is needed. The current study was intended, in part, to fill this gap in the NSSI literature by examining the longitudinal

association between negative reactivity to stress, problem-solving deficits, and the onset of NSSI.

An additional limitation of prior research in this domain is that adolescents have often been recruited on the basis of self-reported NSSI (e.g., Nock & Mendes, 2008). While this recruitment strategy is valuable in its ability to attract the population of interest (i.e., self-injurious adolescents), it may result in a non-representative sample of high-risk adolescents (i.e., those who already identify as engaging in NSSI), may be particularly likely to attract adolescents who have already undergone treatments for NSSI (by recruiting participants from clinical settings), and does not allow for investigation of factors that may lead to NSSI among those not yet engaging in this behavior. The current study includes a wide range of both clinically-referred adolescents and normative adolescents, thus allowing for a more externally valid investigation of concurrent and longitudinal risk factors for NSSI among adolescents.

An additional limitation of prior research assessing the link between NSSI and problem-solving deficits relates to the context in which problem-solving abilities were measured. With at least two notable exceptions (Haines et al., 1995; Nock & Mendes, 2008), the majority of studies in this area have relied on self-reported questionnaire data, and occasionally “stressor tasks” that may not have been adequate in eliciting true differences in stress reactivity (Nock & Mendes, 2008). For example, prior research has relied on the brief presentation of unpleasant stimuli, such as a sad movie scene or an unpleasant picture (e.g., Crowell et al., 2005; Herpertz, et al., 2001). There is now evidence that differences between self-injuring and non-self-injuring individuals’ stress reactivity may only be elicited by longer (i.e., several minutes), more involved stressor

tasks (Nock & Mendes, 2008). Due to this methodological limitation, most previous studies in this domain cannot draw firm conclusions about the problem-solving abilities of individuals who engage in NSSI when they are actually under stress. This is an important limitation of previous research, given that emotion-regulation is the most frequently endorsed function of NSSI (Nixon, Cloutier, & Aggarwal, 2002; Nock & Prinstein, 2004) and that prior research has demonstrated a decrement in problem-solving skills following a stressor (Nock & Mendes, 2008).

Current Study Hypotheses

The current study builds on previous research in this domain by examining several facets of the association between negative reactivity to stress, interpersonal problem-solving skills, and NSSI among adolescents. In order to increase the ecological validity of results, this study examined emotional reactivity (i.e., negative affect) and social problem solving deficits before and following an in-vivo social stressor task. NSSI was measured at two time-points over a 6-month follow-up period, to allow for conclusions regarding the longitudinal association between stress reactivity (i.e., changes in negative and positive affect following the stressor task), problem-solving deficits, and NSSI. Specific study hypotheses are outlined below.

Consistent with previous research demonstrating worse problem-solving in the presence of negative affect (Nock & Mendes, 2008), it was expected that problem-solving abilities (as measured by the SPST) would decrease following the stressor task for all participants in this study. Second, the current study hypothesized that individuals with a history of NSSI at baseline would demonstrate greater problem-solving deficits, both overall (i.e., across time) and following the stressor task. If confirmed, this

hypothesis would replicate recent research indicating that individuals who engage in NSSI demonstrate greater problem-solving deficits than their non-self-injurious peers (Nock & Mendes, 2008). Of note, Nock and Mendes (2008) used a similar study paradigm and did not find that the interpersonal problem-solving skills of those with a history of NSSI were *more* affected by the stressor task than the problem-solving skills of those with no history of NSSI. However, this result was contrary to their study hypotheses and counter to what would be expected based on previous research in this domain. In addition, the current study used a social stressor task, which was thought to be more effective in eliciting interpersonal problem-solving deficits than the performance-based task used by Nock and Mendes (2008). Therefore, the second hypothesis of the current study maintained that individuals with a history of NSSI would be more functionally impaired by the experience of stress than individuals with no history of NSSI. Third, it was hypothesized that individuals with a history of NSSI (at baseline) would report greater increases in negative affect and greater decreases in positive affect than their non-self-injuring peers following the stressor task. This hypothesis was based on past research indicating emotion regulation difficulties among self-injurers (e.g., Muehlenkamp et al., 2009; Adrian, Zeman, Erdley, Lisa & Sim, 2010), and was intended to parallel the findings of a recent study showing increased physiological reactivity to stress among adolescents with a history of NSSI (e.g., Nock & Mendes, 2008). It was also expected that decrements in interpersonal problem-solving skills following the stressor task would be *longitudinally* predictive of NSSI onset, such that decreased interpersonal problem-solving abilities following the stressor task would be associated with greater likelihood of NSSI onset at follow-up, among those with no history of NSSI

at baseline. Finally, the current study proposed a partial mediation model in which the longitudinal association between negative reactivity to stress and NSSI would be partially accounted for by the presence of interpersonal problem-solving deficits following the stressor task.

The first three hypotheses of the current study were intended to identify factors that are concurrently associated with engagement in NSSI among adolescents, and to replicate recent research in this domain (e.g., Nock & Mendes, 2008). By contrast, the fourth and fifth hypotheses of the current study utilized longitudinal data, and were unique in their exploration of risk factors for the *onset* of NSSI over time. In addition, previous studies have tended to explore NSSI among older adolescents - an age at which a higher incidence of NSSI may be observed, but several years above the average age of NSSI *onset* (e.g., Nock & Mendes, 2008). By including participants closer to the age at which adolescents first tend to engage in self-injury, the current study was potentially able to capture first episodes of NSSI and therefore examine factors that may increase risk for the *onset* of NSSI. Finally, previous studies in this domain have not tested the potential mediating role of problem-solving deficits in explaining the association between emotional reactivity to stress and NSSI. The current study seeks to fill these gaps in the literature by extending the work of previous studies with a longitudinal study design, and a more representative sample of clinically referred and normative adolescents.

CHAPTER 2

METHODS

Participants

Participants included 60 clinically referred and community-based adolescents (75% female). All participants were between the ages of 12 and 16 years ($M = 14.4$, $SD = 1.45$) at baseline. The sample was composed of 75% Caucasian, 5% Asian-American, 8% African-American, 8% Latino-American, and 4% multi-ethnic or unspecified ethnicity students. All measures were administered to participants at an initial time point, and measures assessing self-injury were re-administered by phone approximately three and six months later. Participants were recruited from a variety of clinical and non-clinical settings, with over half (51%) of participants recruited from inpatient and outpatient psychiatric hospital settings in the southeastern United States, and the remaining participants recruited from a combination of mass emails (39%), flyers (1%), and other recruitment strategies (9%). For reasons unrelated to the current study's hypotheses, all participants were required to have a friend participate in the baseline lab assessment. Participants who did not have a friend that could participate were not included in the study. A total of 73 participants were initially consented for participation in this study. However, due to attrition ($n=6$) or incomplete baseline measures ($n=7$), thirteen participants had missing or incomplete data for Time 1. The final time 1 sample therefore included 60 participants with complete data for all baseline measures. Of the 60

participants for whom all baseline measures were administered, 14 adolescents (23%) reported a lifetime history of NSSI.

Attrition analyses comparing adolescents with and without complete baseline measures indicated that those with incomplete baseline measures were significantly more depressed than those for whom all baseline measures were available. This difference is most likely explained by two distinct aspects of the baseline data collection process: First, individuals who initially consented for the study while on the inpatient unit of certain hospitals were administered the clinical symptoms interview (i.e., C-DISC; Shaffer, Fisher, Lucas, Dulcan & Schwab-Stone, 2000) during the course of their inpatient hospitalizations, and these individuals were both more likely to be depressed than non-clinical participants, and also less likely to attend the full lab-based baseline assessment. In addition, individuals who reported active suicidal ideation during the baseline interview, or became acutely distressed during the interview portion of the baseline assessment, were more likely to have the baseline assessment stopped prior to the stressor task as a way of avoiding additional distress and so that imminent risk interviews could be conducted to ensure the safety of adolescents. The non-random attrition of adolescents with higher risk clinical profiles highlights one of the challenges of conducting research in clinical patient populations.

Follow-up phone calls for the study (i.e., Time 2 data) were completed three and six months post-baseline. Follow-up data concerning NSSI was obtained for 48 of the 60 adolescents included in the baseline analyses. Twelve adolescents either declined to participate in follow-up phone calls, or were unavailable at the time of their scheduled follow-up calls. Attrition analyses revealed that adolescents who either dropped out of the

study or were unavailable for follow-up did not differ significantly on age, NSSI status, gender, ethnicity, or depressive symptoms from those who participated in the follow-up portion of the study. Of the 48 adolescents with full baseline and follow-up data available, 35 had reported no history of NSSI at baseline. Concurrent hypotheses were examined among participants with complete data for all baseline study variables (n=60), and longitudinal hypotheses were examined among participants with complete data for all study variables at both baseline and follow-up, who had reported no lifetime history of NSSI at baseline (n=35).

Measures

Nonsuicidal Self-Injury (NSSI). NSSI was assessed as a dichotomous (i.e., grouping) variable in the current study, with individual participant scores derived from responses on the Self-Injurious Thoughts and Behaviors Inventory (SITBI; Nock, Holmberg, Photos, & Michel, 2007). The SITBI is a structured interview that assesses the presence, frequency, and nature of a wide range of self-injurious thoughts and behaviors, including both suicidal self-injury and nonsuicidal self-injury (NSSI). Among adolescents, this instrument has been shown to have strong inter-rater reliability (average $k = .99$, $r = 1.0$) and test-retest reliability (average Kappa = .70, intraclass correlation coefficient = .44) over a 6-month period (Nock et al., 2007). The SITBI has been shown to have perfect 6-month test-retest reliability ($k=1.0$) for the presence vs. absence of lifetime NSSI, but has somewhat lower test-retest reliability for the lifetime frequency of NSSI ($k=.71$). To maximize reliability of results, engagement in NSSI was examined as a dichotomous variable in the current study. Trained post-baccalaureate research assistants or doctoral students administered all SITBI interviews. The SITBI was slightly modified

for the current study, based on early feedback that certain items were difficult for adolescents to understand. All modifications were made in consultation with, and approved by, Dr. Nock, who led the original development of this measure (Nock et al., 2007). Although the SITBI includes questions about a wide range of suicidal thoughts and behaviors, only the items on the SITBI specifically related to engagement in NSSI were included in analyses for the current study. The SITBI was administered to participants at both baseline and follow-up. New-onset NSSI during the follow-up period (i.e., longitudinal NSSI) was calculated by combining reports of NSSI at 3-month and 6-month follow-ups (n=5) among participants with no history of NSSI at baseline (n=35). Longitudinal NSSI scores reported in the current study reflect a dichotomous (i.e., yes/no) lifetime history of NSSI reported at one of the follow-up time points, among participants who reported no history of NSSI at baseline. Therefore, longitudinal NSSI engagement in the current study is defined as NSSI *onset* between baseline and 6-months post-baseline.

Interpersonal Problem-Solving Skills. Social problem-solving skills were assessed with a performance-based task called the Social Problem-Solving Skills Test (SPST; Nock, 2006). The SPST measures a broad range of problem-solving skills on the basis of performance responding to eight social scenarios in four different domains (i.e., two scenarios in each domain). Specifically, the SPST asks participants to listen to a series of audio recordings involving potential problems with peers, a romantic partner, a parent and a teacher or boss.

After hearing each scenario, the participants perform various problem-solving tasks that examine different facets of their social problem-solving abilities. First,

participants are asked to make an attribution for each hypothetical social problem. Then, participants are asked to generate as many responses as possible in a 15-second interval (i.e., response generation). Participants are then asked to choose which of the generated responses to enact (i.e., response selection). Finally, participants are asked to rate their likely effectiveness at enacting an “ideal” solution to the problem (i.e., self-efficacy). Participants’ performance on each part of the SPST was audio recorded and scored by expert raters, blind to NSSI-status of participants, following a revised version of the manualized SPST coding system (Nock, 2006). In line with previous research using this measure (Nock & Mendes, 2008), all tapes were coded for the number of responses generated by each participant in a 15-second time span (i.e., response generation). In addition, the quality of the generated solutions, as well as the quality of the selected solution, were coded on a 3-point scale (1= negative response; 2 = neutral response; 3 = positive or effective response). Self-efficacy was rated by participants on a 5-point scale (0-4). Previous analysis of this rating system has revealed adequate inter-rater reliability for each construct examined in the current study (Nock & Mendes, 2008). The use of this measure allows for assessment of several types of problem-solving deficits, including the following: low response generation, generation of ineffective responses (i.e., poor *response quality*), selection of ineffective responses from among those generated (i.e., poor *chosen response quality*), and low self-efficacy with regard to carrying out effective solutions to social problems.

Negative and Positive Affect. Subjective levels of negative and positive affect were measured by an adapted version of the PANAS (Watson, Clark, & Tellegen, 1988), a self-administered questionnaire assessing an individual’s immediate (i.e., “in this

moment”) levels of positive and negative affect. At several points throughout the initial assessment, participants were asked to indicate their immediate affective state by circling the appropriate numbers next to each of a list of emotion descriptors. All emotions assessed in this scale are rated on a Likert scale, ranging from 1 (“not at all”) to 9 (“extremely”). Both positive emotions (e.g., “happy,” “joyful”), and negative emotions (e.g., “sad,” “nervous,” “ashamed”) are presented on this scale. Based on previous research indicating that positive and negative emotions appear to be orthogonal constructs (e.g., Watson, Clark & Tellegen, 1988), separate subscales were created for positive and negative emotions. Previous research has indicated that PANAS scales for positive and negative affect are highly internally consistent and largely uncorrelated (Watson, Clark & Tellegen, 1988). Scale analyses for the current study indicated adequate internal consistency for both the negative affect ($\alpha = .72$) and positive affect ($\alpha = .70$) subscales of the PANAS.

Depressive Symptoms. Depressive symptoms were assessed in the current study using the computer-based version of the Diagnostic Interview Schedule for Children (C-DISC-4.0), a structured clinical interview developed for use with children and adolescents ages 6 to 17 years (Shaffer et al., 2000). The C-DISC contains items that assess for the presence of symptoms corresponding to diagnostic criteria from the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (APA, 1994). All interviewers were graduate or doctoral level clinicians who received thorough training in the administration of the C-DISC. Previous studies conducted in community samples of youth have indicated that the C-DISC-IV has adequate test-retest reliability ($Kappa = .55$) for symptom counts on the depression module (Shaffer et al., 1996), which is the most

relevant psychometric property of this instrument for the current study.

Procedure

All Time 1 data were collected in a single laboratory visit, lasting approximately 3.5 hours. All Time 2 data were collected during follow-up phone calls that occurred approximately three and six months after the initial time point, each lasting approximately 45 minutes. The University of North Carolina Institutional Review Board approved all study procedures, and all participants provided informed consent (parents) and assent (adolescents) before participating in the study. Self-injury interviews were administered to adolescents only, and assessed for the presence of both suicidal and non-suicidal thoughts and behaviors. Following administration of the interviews, adolescents engaged in a neutral, non-stimulating activity (watching a nature video) for several minutes, to establish baseline measures of affect (as measured by an adapted version of the PANAS), as well as a variety of baseline physiological measures not included in these analyses. Following this baseline period and related follow-up measures, adolescents engaged in some prompted conversations with a friend, followed by additional measures of affect (i.e., PANAS). Adolescents then completed an initial measure of their problem-solving skills (i.e., SPST, part 1), as well as a measure of their immediate levels of positive and negative affect. After completing part 1 of the SPST, all participants underwent an in-vivo social stressor task (i.e., adapted version of the Trier Social Stress Test, described below), and were then asked to complete another report of their immediate affect (i.e., PANAS) as well as part 2 of the SPST. Participants' friends were not present for any portion of the stressor task or SPST administration. Administration of the SPST directly before and after the in-vivo stressor task allowed for examination of the

influence of distress on interpersonal problem-solving. Similarly, administration of the PANAS directly before and after the stressor task allowed for examination of hypotheses related to negative reactivity among self-injurers.

Stressor Task. The Trier Social Stress Task (Kirschbaum, Pirke & Hellhammer, 1993) is a three-minute speech task in which adolescents are asked to prepare for, and deliver a speech (in this study, to pretend that they are auditioning for a reality TV series about teenagers and their peer relationships). Participants are filmed during this task, and can see a large plasma screen of their face and shoulders while they give the speech. In preparation for this task, the adolescent is given the following instructions: “We would like for you to pretend that MTV is coming up with a new reality TV series about teenagers your age, and that you really want to be on it. The show is going to focus on how teenagers make friends and deal with other teens. You will be giving a three minute audition speech and we want you to tell us about yourself and why you should be picked for the show.” The adolescent is given one minute to prepare for the speech. During the speech task, the adolescent also believes that he/she is being rated by an undergraduate of the opposite sex, who is sitting with the adolescent in the room, pretending to take notes on the adolescent’s performance throughout the speech task. Previous studies have demonstrated the effectiveness of this task in eliciting a meaningful stress response from adolescents (e.g., Kirschbaum, Pirke & Hellhammer, 1993; Harkness, Stewart, & Wynne-Edwards, 2010).

CHAPTER 3

DATA ANALYSES

Preliminary Analyses

Individuals with a history of NSSI at baseline were compared to those with no history of NSSI on several demographic factors, including gender, ethnicity, and age. Means and standard deviations for NSSI, depressive symptoms, various aspects of problem-solving, and positive and negative affect were calculated for Times 1 and 2 to assess for outliers and skewness of the sample. All variables except for NSSI status (which was measured as a binary variable), pre-stressor negative affect, and depressive symptoms approximated a normal distribution. Distributions for depressive symptoms and pre-stressor negative affect were right-skewed because the majority of participants did not endorse any symptoms of depression (N = 42, 69% of baseline sample) and the majority of participants reported the lowest reportable level of negative affect (N = 35, 63% of baseline sample) prior to the stressor task. However, these variables were only entered in analyses as predictors or covariates, and so transformations of these variables were not necessary. Means and standard deviations for each of the key study variables are presented in *Table 1* by self-reported NSSI status at baseline (NSSI history vs. no-NSSI history). Pearson correlations were conducted to examine associations among all study variables (see *Table 2*).

Analyses of sample characteristics revealed significant differences between boys and girls on age, baseline depressive symptoms, and ethnicity. Independent samples t-tests were run to determine whether significant gender differences existed on any primary variables, and revealed no significant differences by gender on any of the interpersonal problem-solving variables (i.e., response generation, response quality, quality of chosen response, and problem-solving self-efficacy), negative or positive affect, or likelihood of a history of NSSI. Therefore, all study hypotheses were run including the full sample. The data were examined for the presence of outliers, and analyses were run with and without outliers included in cases in which outliers were identified. Based on preliminary analyses indicating a significant association between NSSI status and depressive symptoms, all models with significant results were re-run with depressive symptoms entered as a predictor in the model, to determine whether a problem-solving deficits predicted NSSI above and beyond the effect of depressive symptoms. Power analyses were conducted as well, to determine the power of each analysis to detect effects of various sizes in the study sample. Results of power analyses for each hypothesis of the current study are described within the following sections.

Hypothesis Testing

Hypothesis 1 of the current study was that problem-solving abilities (as measured by the SPST) would decrease following the stressor task for all participants in this study. In order to determine the effects of stress on particular aspects of problem-solving, a variety of problem-solving skills were tested. Specifically, the current study examined the impact of the in-vivo stressor task on the *quantity of responses generated* on the SPST, the *quality of responses generated*, the *quality of the response selected*, and the

interpersonal problem-solving *self-efficacy* of participants. In order to test the effects of stress on each of these dimensions of problem-solving, mean group problem-solving scores from before and after the stressor task were compared using paired T-tests. Separate paired T-tests were conducted for each dimension of problem-solving. Power analyses for hypothesis 1 indicated sufficient power to detect medium effects (power = .97) and large effects (power = .99), but insufficient power to detect small effects (power = .33).

Hypothesis 2 of the current study was that individuals who engage in NSSI (as measured during the initial time point) would demonstrate a greater decrement in problem-solving abilities following the stressor task than their non-self-injuring peers. As with the previous hypothesis, problem-solving data included the quantity of responses generated, the quality of responses generated, the quality of the response selected, and the interpersonal problem-solving self-efficacy of participants. NSSI was examined as a between subjects grouping variable, with all participants reporting a history of NSSI included in one group, and all participants with no history of NSSI included in a second group. This hypothesis was examined using a series of within-subjects by between-subjects ANOVAs (i.e., split-plot ANOVAs), with NSSI status as the between subjects variable and the impact of the stressor task as the within subjects variable. This analysis allowed for examination of main effects of time (pre- to post-stressor) and NSSI history, as well as the interaction between the two, on interpersonal problem-solving abilities. Separate analyses were run for each aspect of interpersonal problem-solving.

Power analyses for hypothesis 2 looking at the time x NSSI status interactions in predicting various aspects of problem-solving estimated that these analyses had sufficient

power to detect medium and large effect sizes, but lacked sufficient power to detect small effects. Specifically, Power analyses for hypothesis 2 looking at changes in response generation indicated sufficient power to detect medium (power = .99) and large effects (power = 1.0), but insufficient power to detect small effects (power = .74); Power analyses looking at changes in response quality indicated sufficient power to detect medium (power = .99) and large effects (power > .99), but insufficient power to detect small effects (power = .40); Power analyses looking at changes in the quality of responses chosen indicated sufficient power to detect medium (power = .92) and large effects (power > .99), but insufficient power to detect small effects (power = .27); and power analyses looking at changes in self-efficacy indicated sufficient power to detect medium (power = .98) and large effects (power > .99), but insufficient power to detect small effects (power = .35).

Hypothesis 3 was that individuals with a history of NSSI (as reported at baseline) would report greater increases in negative affect than their non-self-injuring peers following the stressor task. In order to test this hypothesis, a split-plot ANOVA was conducted, with NSSI status at the between subjects variable, and time (pre- to post-stressor) as the within subjects variable. This analysis allowed for examination of main effects of time (pre- to post-stressor) and NSSI group membership, as well as the interaction between the two, on levels of negative affect. In addition, these same analyses were run with positive affect as the outcome variable, in order to determine whether there is a link between NSSI status and decrements in positive affect. Power analyses for hypothesis 3 looking at the interaction between time (pre-to-post stressor) and NSSI status in predicting negative affect indicated sufficient power to detect medium (power =

.96) and large effects (power > .99), but insufficient power to detect small effects (power = .32). Power analyses for hypothesis 3 looking at the interaction between time and NSSI status in predicting positive affect indicated sufficient power to detect large effects (power = .97), but insufficient power to detect small (power = .16) or medium effects (power = .69).

Hypothesis 4 was that interpersonal problem-solving deficits following the stressor task would be *longitudinally* predictive of NSSI, such that decrements in interpersonal problem-solving following the stressor task would be associated with onset of NSSI at follow-up. Based on the dichotomous nature of the outcome variable, this hypothesis was tested using a series of binary logistic regressions. Separate regressions were conducted for each dimension of interpersonal problem-solving (number of responses generated, quality of responses generated, quality of response selected, and self-efficacy), with pre- to post-stressor difference scores for each aspect of problem-solving entered as the predictor variables. In order to focus on risk factors for the onset of NSSI, a binary (yes/no) follow-up NSSI variable, including only individuals with no reported history of NSSI at baseline, was entered as the outcome variable. This model was intended to provide an initial examination of the longitudinal association between *specific* interpersonal problem-solving deficits under stress and onset of NSSI among adolescents. Unfortunately, given the relatively small sample size available for exploration of longitudinal hypotheses related to the new onset of NSSI (n=35), power to test this model was poor. Power analyses for the logistic regressions conducted to test hypothesis 4 indicated insufficient power to detect small (power = .09), medium (power = .32), or large (power = .65) effects.

Hypothesis 5 was that the longitudinal association between negative reactivity to the stressor task (i.e., pre- to post-stressor change in negative affect) and the onset of NSSI (as measured at time 2) would be partially mediated by decrements in interpersonal problem-solving following the stressor task (i.e., partial mediation hypothesis). As discussed below, mediational analyses were not conducted based on the lack of preliminary support for prerequisite conditions revealed in earlier analyses.

CHAPTER 4

RESULTS

Results of preliminary analyses and hypothesis testing are presented below.

Characteristics of the study sample are first outlined, including between-group differences on all primary study variables (*Table 1*) and details of NSSI reporting within the baseline sample. Next, all significant inter-variable correlations (*Table 2*) are discussed. Finally, results for analyses conducted to test each of the five study hypotheses are presented.

Between-Groups Comparisons on Demographic Factors and Variables of Interest

Participants with a history of NSSI at baseline and those with no history of NSSI at baseline did not differ significantly on age, gender, or ethnicity. Independent Samples t-tests comparing variable means for individuals with a history of NSSI versus individuals with no history of NSSI on several key study variables indicated significant between-group differences. In particular, the NSSI group reported significantly higher levels of depressive symptoms than the non-NSSI group, as well as significantly lower response quality and self-efficacy on the measure of interpersonal problem-solving prior to the stressor task. Means and standard deviations for all study variables are presented in *Table 1* by baseline NSSI status (NSSI history vs. no-NSSI history). Observed effect sizes were calculated for all analyses, in order to provide an estimate of the strength of association between variables that was not influenced by sample size.

Characteristics of NSSI Reporting Within the Sample

Among those who endorsed a history of NSSI at baseline, 86% (n=12) reported engaging in NSSI within the past year, and 43% (n=6) reported engaging in NSSI within the past month. Most frequently cited methods of NSSI in this sample included cutting (n=11; 79% of NSSI group), picking at a wound to the point of drawing blood (n=9; 64% of NSSI group), scraping (n=8; 57% of NSSI group), biting (n=5; 36% of NSSI group), burning (n=4; 29% of NSSI group), and self-hitting (n=3; 21% of NSSI group). The majority (n=11; 79% of NSSI group) of those with a history of NSSI reported engaging in multiple methods of NSSI. Average age of onset for NSSI was 12 ($SD = 2.15$), although there was one outlier who reported engaging in NSSI since age 6. Excluding this participant, average age of onset for NSSI in this sample was 12.46 ($SD=1.3$).

Inter-Variable Correlations

Bivariate correlations between all primary study variables are presented in *Table 2*. Examination of inter-variable correlations revealed a number of concurrent and longitudinal associations between variables. Specifically, baseline NSSI was positively associated with depressive symptoms and negatively associated with pre-stressor response quality and pre-stressor self-efficacy. New onset of NSSI during the follow-up period was positively correlated with depressive symptoms and pre-and post-stressor negative affect and negatively correlated with pre-stressor response generation and post-stressor self-efficacy. Depressive symptoms were positively associated with negative affect following the stressor task, and negatively associated with positive affect following the stressor task. In addition, higher levels of depressive symptoms were significantly

negatively correlated with the quality of responses generated before and after the stressor task, as well as self-efficacy following the stressor task and the quality of responses selected prior to the stressor task. Pre-stressor and post-stressor levels of negative affect were significantly correlated, and pre-stressor negative affect was negatively correlated with pre-stressor positive affect. Negative affect following the stressor task was negatively correlated with both pre-stress and post-stress response generation. Pre- and post-stressor positive affect were significantly correlated with each other, and also both significantly correlated with self-efficacy prior to the stressor task. In addition, positive affect following the stressor task was significantly associated with self-efficacy following the stressor task. Pre- and post-stressor scores for response generation were significantly correlated with each other, and also both significantly *negatively* correlated with the quality of responses generation before and following the stressor task, indicating an inverse relationship between the quantity and quality of responses generated. Response generation prior to the stressor task was also negatively associated with the quality of responses selected prior to the stressor task. Pre-stressor response quality was significantly correlated with pre-stressor quality of selected responses, as well as post-stressor response quality. The quality of responses generated following the stressor task was significantly associated with the quality of chosen responses before and following the stressor task. Self-efficacy before the stressor task was significantly correlated with self-efficacy following the stressor task. Finally, pre- and post-stressor quality of selected responses were significantly associated.

Hypothesis 1: Impact of stress on interpersonal problem-solving skills

The first hypothesis of the current study was that participants would show a decrement in interpersonal problem-solving skills following the stressor task. Consistent with this hypothesis, analyses revealed a significant decrease in the average number of solutions generated from pre-stressor ($M = 3.13$; $SD = 1.14$) to post-stressor ($M = 2.82$; $SD = 1.17$) for the entire sample, $t(59) = 3.44, p < .001 (d = .27)$. Contrary to this initial hypothesis, no significant differences were found in the entire sample from pre- to post-stressor in the quality of responses generated, $t(59) = .35, p = .73 (d = .04)$; quality of the response selected, $t(59) = -.34, p = .74 (d = -.05)$; or problem-solving self-efficacy, $t(59) = .74, p = .46 (d = .09)$.

Hypothesis 2: Impact of stress on interpersonal problem-solving skills of self-injurers

The second hypothesis of the current study was that individuals with a history of NSSI would experience a greater decrement in interpersonal problem-solving following the stressor task than individuals with no history of NSSI. Contrary to this hypothesis, analyses revealed no significant group by time interaction effects for quantity of responses generated, $F(1, 58) = .52, p = .47$ (partial eta-squared = .01); quality of responses generated, $F(1, 58) = 1.94, p = .17$ (partial eta-squared = .03); quality of the response selected, $F(1, 58) = .89, p = .35$ (partial eta-squared = .02); or problem-solving self-efficacy, $F(1, 58) = 1.66, p = .20$ (partial eta-squared = .03). These results indicate that the stressor task did not have a stronger effect on the problem-solving abilities of those with a history of NSSI than it did on those with no history of NSSI.

Although there were no significant interactions between time (pre-to post-stressor) and NSSI status, between-group differences (i.e., main effects) were significant in the expected direction for quality of responses generated, self-efficacy and quality of chosen responses. Individuals who reported a history of NSSI demonstrated significantly lower quality responses ($M=2.29$; $SD=.33$) overall than those with no history of NSSI ($M=2.50$; $SD=.27$), $t(59)=2.34$, one-tailed $p<.05$ (Cohen's $d=.68$). Individuals with a history of NSSI also demonstrated lower interpersonal problem-solving self-efficacy ($M=2.51$; $SD=.45$) than those with no history of NSSI ($M=2.77$; $SD=.50$), $t(59)=1.74$, one-tailed $p<.05$ ($d=.55$). Finally, those with a history of NSSI chose significantly more negative responses ($M=2.53$; $SD=.27$) from among the generated responses than those with no history of NSSI ($M=2.69$; $SD=.27$), $t(59)=1.91$, one-tailed $p<.05$ ($d=.58$). Each of these three between-group differences represents a medium effect size. There were no between-group differences observed for overall number of responses generated on the SPST task, $t(58)= -.71$, one-tailed $p=.25$ ($d=-.23$). Analyses for all significant between-group effects were also conducted controlling for depression. Results indicated that there was no longer a significant between-group difference on self-efficacy ($F(1,50) = .79$, one-tailed $p = .19$, partial eta-squared = .02), quality of selected responses ($F(1,50) = 1.46$, one-tailed $p = .12$, partial eta-squared = .03), or response quality ($F(1, 50) = 2.70$, one-tailed $p = .053$, partial eta-squared = .05) after controlling for depressive symptoms. Means, standard deviations and effect sizes for problem-solving skills before and after controlling for depression are reported in *Table 3*.

Hypothesis 3: Emotional reactivity to stress among self-injurers

The third hypothesis of the current study was that individuals with a history of NSSI would experience more negative emotional reactions to the stressor task than individuals with no history of NSSI. In particular, it was predicted that individuals with a history of NSSI would experience greater increases in negative affect, and greater decreases in positive affect following the stressor task, relative to individuals with no history of NSSI. Analyses revealed a significant main effect of time (pre- to post-stressor) on both negative affect and positive affect, indicating that the entire sample experienced significantly higher levels of negative affect, $t(59) = -5.11, p < .001$ ($d = -.84$), and lower levels of positive affect, $t(59) = 9.86, p < .001$ ($d = 1.0$), following the stressor task. These findings represent large effect sizes. Analyses of interaction effects indicated a significant group by time interaction for levels of negative affect, with individuals with a history of NSSI (change in negative affect $M = .96, SD = .83$) demonstrating significantly greater increases in negative affect following the stressor task than individuals with no history of NSSI (change in negative affect $M = .70, SD = 1.24$), $F(1, 57) = 3.64$, one-tailed $p = .03$ (partial eta-squared = .06, $d = .25$). This same interaction was non-significant for levels of positive affect, $F(1, 58) = .01, p = .92$ (partial eta-squared = .00, $d = -.04$). These results suggest that individuals with a history of NSSI were more negatively affected by the stressor task than individuals with no history of NSSI, and that both groups were similar in the decreases in positive affect experienced as a result of the stressor task. When the analyses examining negative affect were conducted controlling for depression, the main effect of the stressor task ($F(1, 49) = 13.41; p < .001$) on negative affect remained, but the main effect of NSSI status ($F(1, 49) = .16$, one-tailed $p = .35$) and the interaction between

the stressor task and NSSI status ($F(1, 49) = .46$, one-tailed $p = .25$) were non-significant (see *Table 4 and Figure 1*).

Longitudinal Analyses

The fourth and fifth hypotheses of the current study relate to the prediction of new cases of NSSI over the follow-up period, and therefore were examined among the sample that had no history of NSSI at baseline *and* had full baseline and follow-up data available ($N=35$). Given the very small number of participants who reported initial onset of NSSI between baseline and 6-month follow-up ($N=5$), variable means and standard deviations observed in this sample may not be representative of the population from which the sample is drawn. Results reported below therefore must be interpreted very cautiously. Longitudinal hypotheses tested in the current study are intended to provide pilot data only. Replication of these results in a larger sample is needed before any meaningful conclusions can be drawn regarding the generalizability of these findings.

Hypothesis 4: Decrements in Interpersonal Problem-Solving Skills Predict Onset of NSSI

The fourth hypothesis of the current study was that, among the group who reported no history of NSSI at baseline, decrements in social problem solving following the stressor task would predict the onset of NSSI over time. Although this analyses lacked sufficient power to detect a significant effect, results indicated that there was a strong effect pre- to post stressor change in self-efficacy on the onset of NSSI over time ($\beta = -3.10$, $p = .09$, odds ratio=.05). Of note, this odds ratio indicates that for every one unit increase in pre- to post-stressor self-efficacy, there is a 95% decrease in the risk of

engaging in NSSI during the follow-up period. There were no significant associations revealed between post-stress deficits in response generation ($\beta = -.57, p = .21$, odds ratio = .43), response quality ($\beta = .15, p = .92$, odds ratio = 1.16), or selected response quality ($\beta = -.8, p = .58$, odds ratio = .45) and onset of NSSI over time.

Hypothesis 5: Association Between Negative Emotional Reactivity and Longitudinal NSSI Mediated by Interpersonal problem-solving Deficits

The final hypothesis of the current study was that the association between negative emotional reactivity to stress and new onset of NSSI would be mediated by the presence of decrements in problem-solving skills following the stressor task. That is, it was expected that decrements in problem-solving would partially account for the longitudinal association between heightened negative reactivity to stress and new engagement in NSSI. This hypothesis was tested using Baron and Kenny's (1986) guidelines for testing mediation using multiple regression, in which mediation is established by a three-step regression process. Each step of this model must be significant for the mediation model to be significant. Therefore, results are reported for the first non-significant step only.

Step 1: Change in negative affect significantly predicts new onset NSSI at follow-up.

Results indicated a non-significant association between baseline increases in pre- to post-stressor negative affect and new onset of NSSI at follow-up ($\beta = 1.17, p = .09$, odds ratio = 3.21). Results also revealed a non-significant association between pre- to post-stressor decreases in positive affect and new onset of NSSI over time ($\beta = -.46, p = .11$, odds ratio = .63). Results indicate that emotional reactivity to stress did not predict new

onset of NSSI over time. Steps 2 and 3 of the mediation model were not conducted because the first step failed to yield significant results, and therefore results could not meet the conditions for presence of a mediation effect.

CHAPTER 5

DISCUSSION

Adolescence is developmental period marked by increased exposure to stressors, particularly in the interpersonal domain (e.g., Ge et al., 1994). It is also a time in which many high-risk behaviors, including self-injurious behaviors, emerge as strategies for coping with the experience of stress and its physiological and emotional sequelae (Hilt, Nock, Lloyd-Richardson & Prinstein, 2008). One of the most pressing goals of research examining NSSI among adolescents is to determine what factors are associated with increased risk for engaging in NSSI, and to do so in a way that is sensitive to the developmental context of adolescence. The current study provides a valuable contribution to the literature by examining potential risk factors for adolescent NSSI as they relate to the developmentally salient experience of interpersonal stress.

This study tested five hypotheses examining the associations among emotional reactivity to stress, interpersonal problem-solving skills, and NSSI. All study hypotheses reflect specific elements of the integrated biopsychosocial model of NSSI presented earlier in this paper and draw on a multitude of previous research in this domain. This study was conducted with the aim of replicating and extending the findings of prior literature linking negative emotional reactivity and problem-solving deficits with NSSI. In particular, concurrent hypotheses positing an association between interpersonal problem-solving and NSSI were tested with the intention of replicating the findings of a

recent study (e.g., Nock & Mendes, 2008) that demonstrated initial evidence for an association between interpersonal problem-solving deficits and self-injury among adolescents. Additional aims of the current study were to examine the roles of negative reactivity to stress and problem-solving deficits as risk factors for the *onset* of NSSI over time, and to test the possibility that problem-solving deficits mediate the longitudinal association between negative emotional reactivity and NSSI. This study sought to address several major limitations of previous research by including an established in-vivo social stressor task, by examining self-injury in a mixed sample of both high-risk and normative adolescents, and by examining NSSI longitudinally, allowing for the analysis of factors that may contribute to the onset of NSSI in adolescence. The inclusion of an in-vivo stressor task was a particular strength of this study, as it allowed for the examination of emotional and social-cognitive consequences of interpersonal stress on adolescents' risk for NSSI, both concurrently and longitudinally.

Support for the Integrated Model

The integrated biopsychosocial model of adolescent NSSI presented at the beginning of this paper proposed several complementary hypotheses related to the associations between negative reactivity to stress, problem-solving skills, and NSSI. Specifically, this model suggested that heightened negative emotional reactivity to stress would be associated with both impaired interpersonal problem-solving and engagement in NSSI, and that relative deficits in problem-solving would be associated with engagement in NSSI, both concurrently and longitudinally. In addition, the mediation model included in this larger model suggested that problem-solving deficits would mediate the association between negative emotional reactivity to stress and onset of NSSI

over time. Results from this study supported several aspects of the proposed model, by providing evidence for increased emotional reactivity to stress among adolescents with a history of NSSI; worse performance on several *specific* aspects of problem-solving among individuals with a history of NSSI, compared to their non-self-injuring peers; and preliminary evidence of a *longitudinal* association between the decrements in self-efficacy following the experience of stress and new onset of NSSI. A discussion of the implications of these findings in explaining who is at risk for NSSI is presented below, along with a discussion of limitations of the current study and suggestions for future research in this domain.

Concurrent Association between Interpersonal Problem-Solving Deficits and NSSI

Consistent with a recent study conducted by Nock and Mendes (2008), the current study provided evidence of interpersonal problem-solving deficits among self-injurers. In particular, individuals with a history of NSSI provided poorer-quality responses to interpersonal problem-solving scenarios, self-reported lower confidence in their ability to enact effective solutions to social problems (i.e., interpersonal problem-solving self-efficacy), and selected more negative responses from among those generated than their peers with no history of NSSI. These findings suggest that relative deficits in the ability to generate and carry out effective solutions to problems, as well as relative deficits in adolescents' beliefs about their ability to successfully solve interpersonal problems, are associated with increased risk for engaging in NSSI. Results also indicated that individuals with a history of NSSI were equally able to generate an adequate number of solutions to social problems, compared to their non-self-injuring peers, and that there was an inverse association between the quality and quantity of responses generated on the

SPST. In combination, these findings provide evidence for the proposed association between problem-solving deficits and NSSI, but suggest that certain aspects of problem-solving may be more relevant than others in understanding who is at risk for engaging in NSSI. These results also suggest that treatments aimed at improving the interpersonal problem-solving abilities of adolescents who engage in NSSI (e.g., DBT; Linehan, 1993) are warranted, and may be particularly effective if they focus on quality over quantity of solutions and on increasing adolescents' problem-solving self-efficacy.

Contrary to study hypotheses, individuals with a history of NSSI were not *more* impaired by the stressor task (i.e., did not experience greater decrements in problem-solving) than individuals with no history of NSSI in this study. This finding raises the possibility that the relative interpersonal problem-solving deficits observed among self-injurers may not be exclusively linked to the experience of stress. That is, the relative social cognitive deficits observed among individuals who engage in NSSI may be observable even in the absence of acute stress. In additional support of this possibility, adolescents with a history of NSSI demonstrated significantly poorer response quality, quality of chosen responses, and self-efficacy than those with no history of NSSI *prior* to the stressor task.

A related link of the broader conceptual model that was not supported by the results of this study was the proposed association between the experience of stress and decrements in interpersonal problem-solving. The only significant effect of the stressor task on problem-solving in the full sample was a decrease in response generation from pre-stressor to post-stressor, which is likely accounted for by the cognitive load imposed by participation in the stressor task. The stressor task did not lead to any significant

changes in the quality of responses generated by participants, the quality of responses chosen, or the self-reported self-efficacy of participants. Furthermore, exploratory analyses indicated that there was no significant relationship between increases in negative affect following the stressor task, and decrements in problem-solving following the stressor task. Together, these findings indicate that the experience of stress, and greater levels of negative emotional reactivity to stress were not associated with decrements in problem-solving skills. These findings raise the possibility that interpersonal problem-solving deficits represent a relatively stable social-cognitive variable, perhaps more closely related to distal risk factors for NSSI (e.g., negative cognitive style) than to the immediate experience of more transient stressors. Another possibility is that only very salient stressors (e.g., termination of romantic relationships, fight with friends and family members, etc.) elicit strong enough levels of negative reactivity to interfere with social-cognitive processes. If this is the case, it is still possible that individuals who engage in NSSI would show greater decrements in problem-solving following the occurrence of more severe stressors, and that cognitive and emotional reactivity to these more extreme stressors is still relevant for understanding who is at risk for engaging in NSSI following the experience of stress. However, this latter explanation is unlikely given evidence that this stressor task in this study elicited significant changes in both negative and positive affect, as well as evidence that this task has historically been very effective in eliciting strong stress reactions among adolescents (e.g., Kirschbaum, Pirke & Hellhammer, 1993; Harkness, Stewart, & Wynne-Edwards, 2010).

With one exception, discussed below, the findings of this study related to problem-solving deficits among self-injurers replicate the results of the only other study

that has examined stress reactivity and problem-solving among adolescents using the SPST. Nock and Mendes (2008) examined performance on the SPST among individuals with and without a history of NSSI, and observed greater problem-solving deficits among those with a history of NSSI on the quality of chosen responses and on self-efficacy, but did *not* observe between-group differences on the quality of solutions generated. By contrast, the current study found greater problem-solving deficits among self-injurers on the quality of solutions generated, the quality of solutions chosen, and interpersonal problem-solving self-efficacy. The most likely explanation for this discrepancy relates to a change in the operationalization of “response quality” between the original study conducted by Nock and Mendes (2008) and the current study. Specifically, Nock and colleagues reformulated the coding scheme for response quality to include only the *quality* of responses (i.e., negative, neutral, or positive), and separated the behavioral content of each response (e.g., assertive versus passive behavior) into a distinct aspect of the behavioral coding scheme for the SPST (M. Nock, personal communication, March 31, 2011). It is likely that this change in variable definition accounts for the observed difference in results between the original study conducted by Nock and Mendes (2008) and the current study. An alternate explanation for this difference in findings is that the sample included in the study by Nock and Mendes (2008) varied in several important ways from the sample included in the current study. Specifically, the current study examined a younger sample, included a much lower proportion of self-injurers, and included many individuals with clinical diagnoses in the “control” (i.e., no NSSI history) group.

Increased Negative Emotional Reactivity to Stress among Self-Injurers

Findings from the current study indicated that the stressor task resulted in significantly higher levels of negative affect and lower levels of positive affect for the entire sample, suggesting that the stressor task was effective in eliciting emotional reactivity among adolescents. Of particular relevance for the proposed model, individuals with a history of NSSI reported greater increases in negative affect in response to the stressor task than individuals with no history of NSSI. This finding indicates that negative emotional reactivity to stress is associated with increased risk for engaging in NSSI. This finding is also consistent with previous evidence that adolescents who engage in self-injury experience greater emotion dysregulation in response to stress than their non-self-injuring peers (e.g., Nock, Wedig, Holmberg & Hooley, 2008; Glenn, Blumenthal, Klonsky & Hajcak, 2011), and parallels physiological evidence that self-injurers are more reactive to the experience of stress than non-self-injurers (e.g., Haines et al., 1995; Nock & Mendes, 2008).

Longitudinal Association between Problem-Solving Deficits and NSSI

Examination of the longitudinal association between problem-solving and NSSI revealed an almost significant association between decreases in problem-solving self-efficacy following the stressor task and the onset of NSSI over time. That is, individuals who felt less capable of carrying out effective solutions to social problems following the stressor task were more likely to begin engaging in NSSI over the 6-month follow-up period. While the generalizability of this finding is limited by the relatively small size of the longitudinal study sample, the presence of a very large effect suggests that there may be value in further exploring the longitudinal association between low problem-solving self-efficacy and NSSI. Replication of this finding in a larger sample would indicate that

low problem-solving self-efficacy under stress is a substantial risk factor for the onset of NSSI among adolescents, whereas other aspects of problem-solving do not predict the onset of NSSI over time. This possibility raises an important distinction between concrete problem-solving skills deficits and a negative problem-solving orientation (i.e., cognitive, behavioral and emotional variables related to how one approaches problems, as well as a belief in one's ability to manage problems effectively). Whereas the ability to generate effective responses to social scenarios and the ability to indicate which solutions to problems are most "objectively" effective may be seen as basic problem-solving abilities, adolescents' beliefs surrounding their ability to carry out effective solutions, and subsequent willingness to attempt effective solutions, may be seen as more closely related to their problem-solving orientation (D'Zurilla, 1986; Kuperminc & Allen, 2001). In support of the possibility that self-efficacy is the most relevant aspect of problem-solving for understanding risk for self-injury, a recent study conducted by Becker-Weidman and colleagues (2010) found that adolescents' perceived problem-solving ability (i.e., self-efficacy) and problem-solving orientation were more salient than adolescents' actual problem-solving abilities in explaining adolescent's levels of depression and suicidality. Similarly, multiple studies have demonstrated associations between low problem-solving self-efficacy and engagement in maladaptive behaviors among adolescents (e.g., Bandura, 1980; Kuperminc & Allen, 2001). Such findings raise the possibility that clinical treatments among self-injurious adolescents should focus on adolescents' problem-solving self-efficacy and problem-solving orientation over more concrete problem-solving skills. The scenario of an adolescent who is perfectly capable of generating and role-playing effective solutions, but continues to engage in self-

destructive behaviors in the face of social stress, is all too familiar for many clinicians. This study adds to a growing body of literature suggesting that a lack of perceived ability to carry out effective solutions may be central to predicting whether adolescents choose adaptive or maladaptive strategies for managing interpersonal distress.

Depressive Symptoms

Another finding of the current study that warrants further discussion relates to the role of depressive symptoms in explaining the observed associations between negative emotional reactivity, problem-solving deficits, and NSSI. While the current study did not explicitly test hypotheses related to the role of depression in predicting NSSI, preliminary analyses indicated that individuals who engaged in NSSI were significantly more depressed than those with no history of NSSI and that the experience of negative emotions following the stressor task was significantly linked to depressive symptoms. In fact, depression explained 22% of the variance in NSSI status at baseline in the current study. Based on these preliminary findings, all significant models were re-run with depression as a covariate, allowing for examination of the role of depressive symptoms in accounting for the associations between primary study variables. The inclusion of depressive symptoms in these models altered the significance of findings for all group by stressor interaction effects, a finding that warrants further discussion.

The relative problem-solving deficits observed among adolescents with a history of NSSI were no longer significant after controlling for depression. Similarly, the observation of greater negative reactivity to stress among those with a history of NSSI disappeared when depression was entered as a covariate in the model. Together, these findings call into question the role of depressive symptoms, which are significantly

correlated with engagement in NSSI, in explaining the increased emotional reactivity to stress seen in the NSSI group, as well as between-group differences in problem-solving. The finding that the inclusion of depressive symptoms alters the association between problem-solving deficits and self-injury in this study is consistent with previous research examining problem-solving and repetition of self-injury among suicidal adolescents (Hawton, Kingsbury, Steinhardt, James & Fagg, 1999) Further research is needed to elucidate the exact nature of the associations between depressive symptoms, negative reactivity to stress, problem-solving deficits and NSSI. For example, further research is needed to determine whether depression impairs problem-solving because of affective interference with cognitive processes, or because it is associated with a more negative problem-solving orientation. Similarly, further research is needed to explore processes that may confer increased risk for both depression and NSSI. Paralleling diathesis-stress models of depression, a recent study provided initial evidence that a negative cognitive style and the experience of stress may interact in producing higher risk for engagement in NSSI (Guerry & Prinstein, 2010). In addition, recent research conducted by Hankin and colleagues (2011) provided initial evidence that the presence of a “negative cognitive style,” which has historically been associated with depression (Abramson et al., 1989), was predictive of new onset NSSI among adolescents over the course of the study. To the extent that a negative cognitive style extends to youths’ problem-solving orientations, this finding may help to explain one mechanism by which depressive symptoms lead to impaired problem-solving and increased risk for NSSI among youth. That is, due to the presence of a negative cognitive style that includes negative views of the self, the world and the future (Beck, 1976), depressed youth may be more likely to approach

interpersonal problems with a negative problem-solving orientation (i.e., lower self-efficacy, distorted beliefs about their ability to solve social problems, etc.), leading to less effective problem-solving and higher likelihood of selecting ineffective responses to problems (including the use of NSSI as a coping mechanism).

As evidence accumulates for a high degree of overlap between risk factors for depression and NSSI, a promising possibility concerning treatment is raised. Namely, if the same cognitive risk factors confer vulnerability for both depression and NSSI, then treatments that target this negative cognitive style could be effective in both treating depressive symptoms and ameliorating risk for engaging in NSSI. Given the substantial comorbidity of depression and self-injurious behaviors, the possibility of a shared treatment strategy is very appealing. Further treatment outcome research is needed to determine whether treatment that focuses on depression and its cognitive correlates is effective in treating individuals who engage in NSSI, or if NSSI itself needs to be identified and treated as a primary focus of intervention. In addition, further research is needed to determine whether a depressogenic cognitive style (Abramson et al., 1989) confers greater risk for a negative problem-orientation, and whether a negative problem-orientation increases the likelihood that adolescents will select NSSI and other maladaptive coping strategies as a means of responding to stressors. A longitudinal study examining negative problem orientation as a mediator of the association between depression and NSSI would be a valuable first step in answering this question.

Limitations and Future Directions

The current study provided several valuable contributions to the NSSI literature, including replication of findings related to problem-solving deficits among self-injurers,

evidence of increased negative reactivity to stress among self-injurers, and an initial exploration of the longitudinal association between specific problem-solving deficits and NSSI. Despite these strengths, this study suffered a number of limitations. Each of these limitations is discussed below, and suggestions for overcoming these limitations in future research are presented.

Perhaps the most salient limitation of the current study was the use of a relatively small sample of adolescents. While the number of participants included at the baseline phase of this study ($N = 60$) was adequate for examining cross-sectional study hypotheses, the small number of participants available at follow-up ($N = 35$) substantially limited the examination of longitudinal hypotheses. Considering the relatively small proportion of individuals who engaged in NSSI for the first time between baseline and the 6-month follow-up period ($N = 5$), a much larger sample would be needed to adequately test hypotheses related to the prediction of new NSSI onset. In addition, a longer follow-up period would likely have resulted in observation of more cases of NSSI onset and future studies may benefit from the examination of self-injury over a longer period of time. Also due to the small sample size, the current study was unable to formally examine gender, age and ethnicity as covariates in the models tested. Ideally, future research in this domain will include large enough samples to examine sophisticated longitudinal models with the power to test the multiple mediation and moderation effects currently thought to play a role in risk for NSSI. In addition, the ability to examine potential differences in NSSI risk by gender, ethnicity, and developmental phase would contribute greatly to the literature in this domain, and will only be possible in large, heterogeneous samples.

An additional factor that may limit the interpretation of results is the examination of NSSI as a binary variable. NSSI was examined as a dichotomous (yes/no) variable in the current study to increase the reliability of adolescents' self-report, based on evidence from preliminary analyses indicating that some individuals reported lower levels of *lifetime* NSSI at follow-up than at baseline. However, examining NSSI in this manner precluded investigation of differences among individuals with varying frequency or intensity of NSSI. It is possible, for example, that adolescents who engage in more intense or more frequent acts of NSSI are also those who demonstrate greater emotion dysregulation under stress. It is also possible that individuals who have only engaged in NSSI once are clinically more similar to individuals who have never engaged in NSSI than to individuals who engage in NSSI frequently. In order to explore the associations between negative reactivity to stress, problem-solving deficits and NSSI more comprehensively, valid continuous (i.e., frequency) and categorical (i.e., type) assessment of NSSI is needed. One recent development in the NSSI literature that provides a promising means of collecting more valid data on the frequency and intensity of NSSI episodes is the use of ecological momentary assessment (EMA) methods (e.g., Arney, Crowther & Miller, 2011; Muehlenkamp, 2009; Nock, Prinstein & Sterba, 2009). Because EMA methods allow for real time reporting of NSSI and its correlates, self-reports collected using this method allow for investigation of multiple aspects of each incident of NSSI and provide a substantially more reliable picture of the frequency and intensity of NSSI over time, compared to retrospective reporting of NSSI that may have occurred months prior to the reporting period. Furthermore, because individuals in EMA studies are typically reacting to real-life events rather than lab-based stressors, this

method circumvents ethical issues related to stress inductions among clinical populations and is able to provide evidence for the types of stressors and levels of affect that immediately precede acts of self-injury.

Another aspect of this study that may limit the interpretation of results is the lack of a true “baseline” measure of negative affect. Because the current study was nested within a larger study of adolescent behaviors and relationships, performance on the social stressor task and measures of problem-solving and affect on either side of this task may have been impacted by unrelated aspects of the baseline laboratory visit. For example, directly prior to the “pre-stressor” measure of negative affect in this study, adolescents participated in a conversation with a friend about their peer group. While it is certainly reasonable to claim that talking about ones peers represents a fairly “typical” (i.e., baseline) adolescent behavior, it is also possible that pre-stressor levels of affect and interpersonal problem-solving were affected by engagement in these other pre-stressor task activities. In order to maximize the ecological validity of these results, future studies may benefit from some method of assessing the extent to which adolescents are functioning at their baseline prior to the induction of stress in a laboratory setting (e.g., a self-report scale assessing the extent to which adolescents report feeling the way they “typically” feel, to be given prior to the stressor task).

An additional significant limitation of the current study was the inability to make inferences about the direction of the association between variables. This is a limitation of all concurrent research, and one that the current study sought to overcome by examining longitudinal hypotheses as well. However, as previously discussed, the limited longitudinal sample size resulted in insufficient power to adequately test prospective

models. Therefore, the direction of the observed association between negative reactivity to stress and NSSI, as well as the observed associations between NSSI and various aspects of problem-solving, remain speculative.

A final limitation of the current study relates to the limited set of constructs examined. The current study examined two constructs thought to be relevant to risk for engaging in NSSI – namely, negative reactivity to stress and interpersonal problem-solving deficits. As illustrated by the integrated biopsychosocial model of NSSI presented in this paper, these constructs represent only a small subset of the distal and proximal risk factors thought to play a role in putting adolescents at risk for self-injury. Furthermore, the models of problem-solving and negative reactivity to stress tested in this study did not address the possibility that certain types of stressors (e.g., peer versus family versus achievement-related) may be more relevant for understanding risk for NSSI, or that the relevance of certain types of stress may vary by gender, ethnicity, or developmental phase. Investigation of variability in the salience and predictive value of different stressors, various types of stress reactivity (i.e., emotional, physiological, behavior), and approaches to problem-solving across different demographics of adolescents is essential to making informed treatment recommendations.

Brief Summary and Proposed Revisions to the Integrated Model of Adolescent NSSI

In summary, the current study provided support for several pieces of a model linking negative emotional reactivity and interpersonal problem-solving deficits to NSSI among adolescents. Despite the limitations discussed, this study provides several valuable contributions to the NSSI literature. First, this study replicates the findings of recent research indicating the presence of specific problem-solving deficits among adolescents

who engage in NSSI (Nock & Mendes, 2008). Second, the current study provides evidence of increased negative emotional reactivity to stress among adolescents who engage in NSSI, compared to non-self-injuring adolescents. Third, the current study is the first of its kind to provide preliminary evidence for a *longitudinal* association between low interpersonal problem-solving self-efficacy and the onset of NSSI among adolescents. Finally, the current study provides additional evidence that depressive symptoms (or the cognitive and emotional correlates of depression) may play a substantial role in explaining the associations between various cognitive and emotional variables and engagement in NSSI.

Taken together, these findings point to the need for several modifications to the proposed integrated model of adolescent NSSI. Specifically, indicated revisions to this model include the following: First, results from the current study indicate that problem-solving deficits associated with previous and current engagement in NSSI may differ from those that are prospectively associated with the onset of NSSI. While relative deficits in the quality or responses generated, quality or responses chosen, and self-efficacy are all concurrently associated with increased risk for engagement in NSSI, only post-stress decrements in self-efficacy seem to be pose increased risk for the *onset* of NSSI over time. If these results are replicated in future studies with larger longitudinal samples, a model that better differentiates between risk factors for the onset versus maintenance of NSSI may be warranted. Second, the proposed association between negative emotional reactivity to stress and decrements in interpersonal problem-solving was not supported in the current study, indicating that other risk factors in the model (e.g., a negative cognitive style) may better account for impaired problem-solving among

self-injurers. Further research is needed to test the viability of other, more distal risk factors in explaining the relative problem-solving deficits among individuals who engage in NSSI. A third recommended change to the integrated model of adolescent NSSI relates to better specifying the types of problem-solving deficits that are relevant for understanding who is at risk for engaging in NSSI, such that the relative deficits in the quality of potential responses generated by adolescents, the quality of responses actually selected by adolescents, and adolescents' perceived ability to carry out effective solutions are all concurrently related to risk for engaging in NSSI, while adolescents who become less self-efficacious under stress are proposed to be at increased risk for the onset of NSSI over time. A fourth proposed change to the integrated model relates to the relative salience of positive versus negative reactivity to stress in understanding who is at risk for NSSI. Based on the findings of the current study, it appears that greater increases in negative affect following the experience of interpersonal stress may provide valuable information about who is at increased risk for engaging in NSSI, while decreases in negative affect following the occurrence of stress are not specifically related to risk for NSSI. Finally, further studies are needed to determine which risk factors for NSSI confer risk above and beyond the risk conferred by higher levels of depressive symptoms (and the social, cognitive, and emotional correlates of depression) among individuals who engage in NSSI. If problem-solving deficits that pose increased risk for NSSI have substantial enough overlap with risk factors for depression, it is possible that future models would be better able to explain risk for NSSI via the creation of a latent variable that represents a shared set of risk factors for depression and NSSI (e.g., negative

cognitive style, including depressogenic cognitions and a negative problem-solving orientation).

Table 1. Means (and standard deviations) for Primary Variables at Time 1 (n=60) by lifetime NSSI status.

	Baseline NSSI group	Baseline No NSSI group	<i>t</i> (58)
Time 1			
Depressive symptoms	4.21(3.56)	1.04(2.32)	-3.14**
Pre-Stressor Negative Affect	1.18(.38)	1.17(.25)	.05
Post-Stressor Negative Affect	2.13(.85)	1.89(1.31)	-.65
Pre-Stressor Positive Affect	5.79(2.15)	6.03(2.02)	.39
Post-Stressor Positive Affect	3.53(2.26)	3.94(1.95)	-.69
Pre-stressor Response Generation	3.41(1.54)	2.97(1.08)	-.98
Post-stressor Response Generation	2.99(1.38)	2.72(1.17)	-.75
Pre-stressor Response Quality	2.25(.40)	2.52(.29)	2.73**
Post-stressor Response Quality	2.33(.31)	2.47(.33)	1.44
Pre-stressor Self-Efficacy	2.45(.51)	2.83(.49)	2.42*
Post-stressor Self-Efficacy	2.57(.51)	2.72(.64)	.42
Pre-stressor Response Selection	2.48(.44)	2.70(.32)	1.98
Post-stressor Response Selection	2.58(.28)	2.69(.32)	1.09

* $p < .05$; ** $p < .01$ (significance values are 2-tailed)

Table 2. Bivariate Associations among Primary Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Time 1															
1. NSSI	-	.46**	-.01	.21	-.05	-.08	.14	.08	-.34**	-.19	-.30*	-.11	-.25	-.14	n/a
2. Depressive Symptoms		-	.09	.44**	-.04	-.30*	.14	.11	-.41**	-.39**	-.16	-.33*	-.30*	-.15	.41*
3. Pre-Stressor Negative Affect			-	.47**	-.29*	-.21	-.18	-.14	.14	.09	-.17	-.05	.12	.02	.65**
4. Post-Stressor Negative Affect				-	.07	-.17	.26*	.29*	-.21	-.08	-.13	-.09	-.16	.09	.56**
5. Pre-Stressor Positive Affect					-	.69**	.10	.08	.00	.04	.35**	.24	.02	.01	.06
6. Post-Stressor Positive Affect						-	.11	.12	.08	.10	.27*	.27*	.06	.12	-.19
7. Pre-stressor Response Generation							-	.83**	-.54**	-.37**	-.03	.20	-.27*	-.02	-.43**
8. Post-stressor Response Generation								-	-.47**	-.42**	.02	.14	-.25	.01	-.27
9. Pre-stressor Response Quality									-	.61**	-.01	.06	.69**	.13	.13
10. Post-stressor Response Quality										-	.13	.21	.45**	.54**	.02
11. Pre-stressor Self-Efficacy											-	.53**	.05	.17	.01
12. Post-stressor Self-Efficacy												-	.15	.20	-.41*
13. Pre-stressor Response Selection													-	.36**	-.14
14. Post-stressor Response Selection														-	-.09
Time 2															
15. New Onset NSSI															-

* p < .05; ** p < .01

Table 3. Means and standard deviations of problem-solving (across time) by NSSI status, before and after controlling for depressive symptoms

Mean problem-solving abilities by group

	NSSI History	No NSSI History	<i>d</i>
Avg. Response Generation	3.20 (1.44)	2.91(.99)	.23
Avg. Response Quality	2.29 (.33)	2.49 (.27)	-.66
Avg. Selected Response Quality	2.53 (.27)	2.69 (.27)	-.59
Avg. Self-Efficacy	2.51 (.45)	2.77 (.50)	-.55

Mean problem-solving abilities by group, after controlling for depressive symptoms (tested for significant group differences only)

	NSSI History	No NSSI History	<i>d</i>
Avg. Response Quality	2.34 (.62)	2.50 (.31)	-.32
Avg. Selected Response Quality	2.56 (.64)	2.69 (.33)	-.25
Avg. Self-Efficacy	2.57 (1.09)	2.72 (.56)	-.17

Table 4. Estimated marginal means of pre-stressor and post-stressor positive affect and negative affect by NSSI status, before and after controlling for depressive symptoms

Positive Affect

NSSI Status x Stressor Task interaction, prior to controlling for depressive symptoms

<u>Group</u>	<u>Mean Pre-Stress Positive Affect (SD)</u>	<u>Mean Post-Stress Positive Affect (SD)</u>	<u><i>d</i></u>
NSSI History	5.79 (2.15)	3.71 (2.23)	.95
No NSSI History	6.03 (2.02)	4.01 (1.94)	1.01

Negative Affect

NSSI Status x Stressor Task interaction, prior to controlling for depressive symptoms

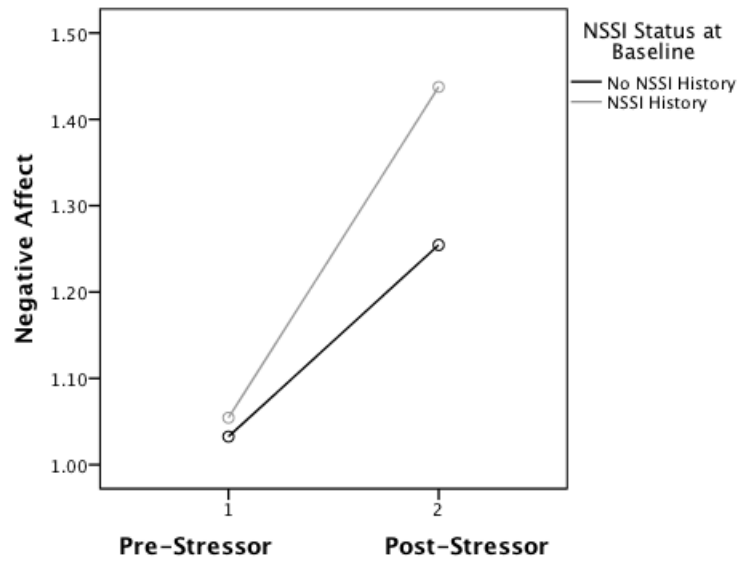
<u>Group</u>	<u>Mean Pre-Stress Negative Affect (SD)</u>	<u>Mean Post-Stress Negative Affect (SD)</u>	<u><i>d</i></u>
NSSI History	1.17 (.25)	2.13 (.85)	-1.53
No NSSI History	1.18 (.38)	1.72 (.79)	-.87

NSSI Status x Stressor Task interaction, after controlling for depressive symptoms

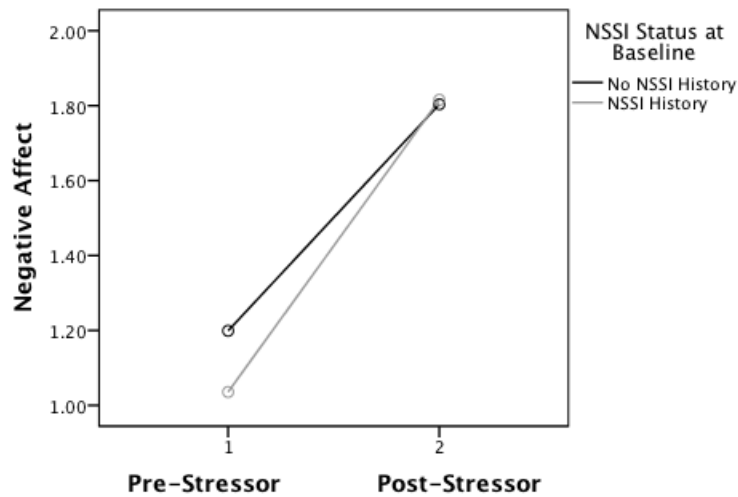
<u>Group</u>	<u>Mean Pre-Stress Negative Affect (SD)</u>	<u>Mean Post-Stress Negative Affect (SD)</u>	<u><i>d</i></u>
NSSI History	1.04 (.81)	1.82 (1.83)	-.55
No NSSI History	1.20 (.41)	1.80 (.94)	-.83

Figure 1: Estimated marginal means of pre-stressor and post-stressor negative affect by NSSI status, before and after controlling for depressive symptoms

NSSI Status x Stressor Task interaction, prior to controlling for depressive symptoms



NSSI Status x Stressor Task interaction, prior to controlling for depressive symptoms



REFERENCES

- Adrian, M., Zeman, J., Erdley, C., Lisa, L., & Sim, L. (2010). Emotional dysregulation and interpersonal difficulties as risk factors for nonsuicidal self-injury in adolescent girls. *Journal of Abnormal Child Psychology*, *39*(3), 389-400. doi:10.1007/s10802-010-9465-3
- American Psychiatric Association. (2000). *Borderline Personality Disorder. Diagnostic and Statistical Manual of Mental Disorders* (4th ed. text revision). Washington, D.C.: Author.
- Bandura, A. (1980). Gauging the relationship between self-efficacy judgment and action. *Cogn. Therapy Res.*, *4*: 263-268. doi:10.1007/BF01173659
- Becker-Weidman, E.G., Jacobs, R.H., Reinecke, M.A., Silva, S.G. & March, J.S. (2010). Social problem-solving among adolescents treated for depression. *Behav. Res. Ther.*, *48*(1), pp. 11-18. doi:10.1016/j.brat.2009.08.006
- Biggam, F. H., & Power, K. G. (1999). Suicidality and the state-trait debate on problem-solving deficits: A re-examination with incarcerated young offenders. *Archives of Suicide Research*, *5*(1), 27-42. doi:10.1080/13811119908258313
- Brown, M. Z., Comtois, K. A., & Linehan, M. M. (2002). Reasons for suicide attempts and nonsuicidal self-injury in women with borderline personality disorder. *Journal of Abnormal Psychology*, *111*, 198-202. doi:10.1037/0021-843X.111.1.198
- Chapman, A. L., Gratz, K. L., & Brown, M. Z. (2006). Solving the puzzle of deliberate self-harm: The experiential avoidance model. *Behaviour Research and Therapy*, *44*(3), 371-394. doi:10.1016/j.brat.2005.03.005
- Cohen, J., Cohen, P., West, S.J., Aiken, L.S. (2003). *Applied multiple regression/ correlation analysis for the behavioral sciences*, (3rd edition) Hillsdale, NJ: Lawrence Erlbaum Associates.
- Crick, N. R., & Dodge, K. A. (1994). A review and reformulation of social information-processing mechanisms in children's social adjustment. *Psychological Bulletin*, *115*, 74-101. doi:10.1037/0033-2909.115.1.74
- Crowell, S. E., Beauchaine, T. P., McCauley, E., Smith, C. J., Stevens, A. L., & Sylvers, P. (2005). Psychological, autonomic, and serotonergic correlates of parasuicide among adolescent girls. *Development and Psychopathology*, *17*(4), 1105-1127. doi:10.1017/S0954579405050522
- Diehl, A.S. & Prout, M.F. (2002). Effects of posttraumatic stress disorder and child sexual abuse on self-efficacy development. *American Journal of Orthopsychiatry*, *Vol. 72* (2), 262-265. doi:10.1037/0002-9432.72.2.262

- Forgas, J.P. (1995). Mood and judgment: The affect infusion model (AIM). *Psychological Bulletin* 117, pp. 39–66. doi:10.1037/0033-2909.117.1.39
- Franklin, J.C., Hessel, E.T., Aaron, R.V., Arthur, M.S., Heilbron, N., & Prinstein, M.J. (2010). The functions of nonsuicidal self-injury: Support for cognitive-affective regulation and opponent processes from a novel psychophysiological paradigm. *Journal of Abnormal Psychology*, 119(4):850-62. doi: 10.1037/a0020896
- Fredrickson, B.L. (1998). What good are positive emotions? *Review of General Psychology*, 2, 300-319. doi:10.1037/1089-2680.2.3.300
- Fredrickson, B.L. (2001). The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *American Psychologist*, 56, 218-226. doi:10.1037/0003-066X.56.3.218
- Fredrickson, B.L. & Branigan, C. (2005). Positive emotions broaden the scope of attention and thought-action repertoires. *Cognition and Emotion*, 19 (3), 313-332. doi:10.1080/02699930441000238
- Garrison, C. Z., Addy, C. L., McKeown, R. E., Cuffe, S. P., Jackson, K. L., & Waller, J. L. (1993). Nonsuicidal physically self-damaging acts in adolescents. *Journal of Child and Family Services*, 2, 339-352. doi:10.1007/BF01321230
- Ge, X., Lorenz, F. O., Conger, R. D., Elder, G. H., & Simons, R. L. (1994). Trajectories of stressful life events and depressive symptoms during adolescence. *Developmental Psychology*, 30, 467-483. doi:10.1037/0012-1649.30.4.467
- Glassman, L. H., Weierich, M. R., Hooley, J. M., & Nock, M. K. (2007). Child maltreatment, non-suicidal self-injury, and the mediating role of self-criticism. *Behaviour Research and Therapy*, 45, 2483–2490. doi:10.1016/j.brat.2007.04.002
- Glenn, C.R., Blumenthal, T.D., Klonsky, D.E. & Hajcak, G. (2011). Emotional reactivity in nonsuicidal self-injury: Divergence between self-report and startle measures. *International Journal of Psychophysiology*, Vol. 80 (2), 166-170. doi:10.1016/j.ijpsycho.2011.02.016
- Guerry, J.D. & Prinstein, M.P. (2010). Longitudinal Prediction of Adolescent Nonsuicidal Self-Injury: Examination of a Cognitive Vulnerability-Stress Model. *Journal of Clinical Child & Adolescent Psychology*, 39(1), 77–89. DOI: 10.1080/15374410903401195
- Haines, J., Williams, C. L., Brain, K. L., & Wilson, G. V. (1995). The psychophysiology of self-mutilation. *Journal of Abnormal Psychology*, 104, 471-489. doi:10.1037/0021-843X.104.3.471.

- Harkness, K.L., Stewart, J.G. & Wynne-Edwards, K.E. (2010). Cortisol reactivity to social stress in adolescents: role of depression severity and child maltreatment. *Psychoneuroendocrinology*, 36(2):173-81. doi:10.1016/j.psyneuen.2010.07.006
- Hawton, K., Kingsbury, S., Steinhardt, K., James, A. & Fagg, J. (1999) Repetition of deliberate self-harm by adolescents: The role of psychological factors. *Journal of Adolescence*, Vol. 22 (3), 369-378. doi:10.1006/jado.1999.0228
- Herpertz, S. C., Werth, U., Lukas, G., Qunaibi, M., Schuerkens, A., Kunert, H. J., et al. (2001). Emotion in criminal offenders with psychopathy and borderline personality disorder. *Archives of General Psychiatry*, 58(8), 737–745. doi:10.1001/archpsyc.58.8.737
- Hilt, L.M., Nock, M.K., Lloyd-Richardson, E.E. & Prinstein, M.J. (2008). Longitudinal Study of Nonsuicidal Self-Injury Among Young Adolescents: Rates, Correlates, and Preliminary Test of an Interpersonal Model. *Journal of Early Adolescence*, Vol. 28 (3), pp. 455-469. doi:10.1177/0272431608316604
- Hooley, J.M., Ho, D.T., Slater, J. & Lockshin, A. (2010). Pain Perception in Nonsuicidal Self-Injury. *Personality Disorders: Theory, Research, and Treatment*, Vol 1(3),170-179. doi: 10.1037/a0020106
- Kleindienst, N., Bohus, M., Ludaescher, P., Limberger, M.F., Kuenkele, K., Ebner-Priemer, U.W., Chapman, A.L., Reicherzer, M., Stieglitz, R.D., & Schmahl, C. (2008). Motives for non-suicidal self-injury among women with Borderline Personality Disorder. *Journal of Nervous and Mental Disease*, 196: 230–236. doi:10.1097/NMD.0b013e3181663026
- Klonsky, D.E. & Muehlenkamp, J.J. (2007). Self-Injury: A Research Review for the Practitioner. *Journal of Clinical Psychology: In Session*, Vol. 63(11), 1045-1056. doi: 10.1002/jclp.20412
- Kuperminc, G.P. & Allen, J.P. (2001). Social Orientation: Problem Behavior and Motivations Toward Interpersonal Problem Solving Among High Risk Adolescents. *Journal of Youth and Adolescence*, 30(5): 597–622. doi:10.1023/A:1010452705746
- Laye-Gindhu, A. & Schonert-Reichl, K.A. (2005). Nonsuicidal self-harm among community adolescents: Understanding the ‘whats’ and ‘whys’ of self-harm. *Journal of Youth and Adolescence*, 34, 447-457. doi:10.1007/s10964-005-7262-z
- Linehan, M. M. (1993). Cognitive–behavioral treatment of borderline personality disorder. New York: Guilford Press.
- Linehan, M. M., Camper, P., Chiles, J. A., Strohsahl, K. & Shearin, E. N. (1987). Interpersonal problem solving and parasuicide. *Cognitive Therapy and Research* 11, 1-12.

- doi:10.1007/BF01183128
- Lloyd, E. E., Kelley, M. L., & Hope, T. (1997, April). *Self-mutilation in a community sample of adolescents: Descriptive characteristics and provisional prevalence rates*. Poster session presented at the annual meeting of the Society for Behavioral Medicine, New Orleans, LA.
- Lloyd-Richardson, E.E. (2008). Adolescent nonsuicidal self-injury: Who is doing it and why? *Journal of Developmental & Behavioral Pediatrics, Volume 29(3)*, pp. 216-218. doi:10.1097/DBP.0b013e318173a5c1
- Lloyd-Richardson, E. E., Nock, M. K. & Prinstein, M. K. (2009). Functions of adolescent nonsuicidal self-injury. In M. K. Nixon & N. Heath (Eds.), *Self-injury in youth: Essential guide to assessment and intervention*.
- Lloyd-Richardson, E., Perrine, N., Dierker, L., & Kelley, M. L. (2007). Characteristics and functions of non-suicidal self-injury in a community sample of adolescents. *Psychological Medicine, 37*, 1183–1192. doi:10.1017/S003329170700027X
- Malouff, J.M., Thorsteinsson, E.B. and Schutte, N.S. (2007). The efficacy of problem solving therapy in reducing mental and physical health problems: A meta-analysis. *Clinical Psychology Review, 27*, pp. 46–57. doi:10.1016/j.cpr.2005.12.005
- McAuliffe, C., Corcoran, P., Keeley, H., Arensman, E., Bille-Brahe, U., De Leo, D. et al (2006). Problem solving ability and repetition of deliberate self-harm: A multicentre study. *Psychological Medicine, 36*, 45-55. doi:10.1017/S0033291705005945
- McEwen, B.S. (2007). Physiology and Neurobiology of Stress and Adaptation: Central Role of the Brain. *Physiol. Rev. 87*: 873-904. doi:10.1152/physrev.00041.2006
- Miller, A. L., Rathus, J. H., & Linehan, M. M. (2007). *Dialectical behavior therapy with suicidal adolescents*. New York: Guilford Press.
- Miller, A.L., Wyman, S.E., Huppert, J.D., Glassman, S.L., & Rathus, J.H. (2000). Analysis of behavioral skills utilized by suicidal adolescents receiving dialectical behavior therapy. *Cognitive & Behavioral Practice, 7*, 183-187. doi:10.1016/S1077-7229(00)80029-2
- Muehlenkamp, J. J. (2006). Empirically supported treatments and general therapy guidelines for nonsuicidal self-injury. *Journal of Mental Health Counseling, 28*, 166-185.
- Muehlenkamp J.J., Engel, S.G., Wadson, A., Crosby R.D., Wonderlich, S.A., Simonich, H., & Mitchell, J.E. (2009). Emotional states preceding and following acts of nonsuicidal self-injury in bulimia nervosa patients. *Behavior Research and Therapy, 47*:83–87. doi:10.1016/j.brat.2008.10.011

- Muehlenkamp, J.J. & Gutierrez, P.M. (2004). An investigation of differences between self-injurious behavior and suicide attempts in a sample of adolescents. *Suicide and Life-Threatening Behavior*, *34*, 12-23. doi:10.1521/suli.34.1.12.27769
- Muehlenkamp, J.J. & Gutierrez, P.M. (2007). Risk for suicide attempts among adolescents who engage in non-suicidal self-injury. *Archives of Suicide Research*, *11*, 69-82. doi:10.1080/13811110600992902
- Nixon, M.K., Aulakh, H., Townsend, L. & Atherton, M. (2009). Psychosocial Interventions for Adolescents. In M.K. Nixon & N.L. Heath (Eds), *Self-Injury in Youth: The Essential Guide to Assessment and Intervention*. New York, NY: Routledge.
- Nixon, M. K., Cloutier, P. F., & Aggarwal, S. (2002). Affect regulation and addictive aspects of repetitive self-injury in hospitalized adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry*, *41*, 1333-1341. doi:10.1097/00004583-200211000-00015
- Nock, M. K. (2006). *Social Problem Solving Skills Test: Administration and coding manual*. Unpublished manuscript, Harvard University, Cambridge, MA.
- Nock, M.K. (2009). Why do people hurt themselves? New insights into the nature and functions of self-injury. *Current Directions in Psychological Science*, *Vol. 18* (2), 78-83. doi:10.1111/j.1467-8721.2009.01613.x
- Nock, M. K., & Cha, C. B. (2009). Psychological models of nonsuicidal self-injury. In M. K. Nock (Ed.), *Understanding nonsuicidal self-injury: Origins, assessment, and treatment* (pp. 65-78). Washington, D.C.: American Psychological Association. doi:10.1037/11875-004
- Nock, M.K., Joiner, T.E., Gordon, K.H., Lloyd-Richardson, E., & Prinstein, M.J. (2006). Non-suicidal self-injury among adolescents: Diagnostic correlates and relation to suicide attempts. *Psychiatry Research*, *144*, 65-72. doi:10.1016/j.psychres.2006.05.010
- Nock, M. K., Holmberg, E. B., Photos, V. I., & Michel, B. D. (2007). The Self-Injurious Thoughts and Behaviors Interview: Development, reliability, and validity in an adolescent sample. *Psychological Assessment*, *19*, 309–317. doi:10.1037/1040-3590.19.3.309
- Nock, M.K. and Mendes, W.B. (2008). Physiological arousal, distress tolerance, and social problem-solving deficits among adolescent self-injurers. *Journal of Consulting and Clinical Psychology*, *76*, 28–38. doi:10.1037/0022-006X.76.1.28
- Nock, M.K. & Prinstein, M.J. (2004). A functional approach to the assessment of self-mutilative behavior. *Journal of Consulting and Clinical Psychology*, *72*, 885-890.

doi:10.1037/0022-006X.72.5.885

- Nock, M. K., & Prinstein, M. J. (2005). Contextual features and behavioral functions of self-mutilation among adolescents. *Journal of Abnormal Psychology, 114*, 140-146. doi:10.1037/0021-843X.114.1.140
- Nock, M. K., Wedig, M. M., Holmberg, E. B., & Hooley, J.M. (2008). The Emotion Reactivity Scale: Development, evaluation, and relation to self-injurious thoughts and behaviors. *Behavior Therapy, Vol. 39 (2)*, 107-116. doi:10.1016/j.beth.2007.05.005
- Orbach, I., Rosenheim, E., & Hary, E. (1987). Some aspects of cognitive functioning in suicidal children. *Journal of the American Academy of Child and Adolescent Psychiatry, 26(2)*, 181–185. doi:10.1097/00004583-198703000-00010
- Prinstein, M.J., Nock, M.K., Hastings, P., Rudolph, K., & Bauer, D.J. (2010). Stress Responses as Prospective Predictors of Girls' Suicidality and Self-Injury. Grant proposal submitted to National Institute of Health (NIH).
- Quiggle, N.L., Garber, J., Panak, W.F., Dodge, K.A. (1992). Social Information Processing in Aggressive and Depressed Children. *Child Development, Vol. 63 (6)*, pp. 1305-1320. doi:10.2307/1131557
- Ross, S. & Heath, N. (2002). A study of the frequency of self-mutilation in a community sample of adolescents. *Journal of Youth and Adolescence, 31*, 67-77. doi:10.1023/A:1014089117419
- Sadowski, C., & Kelley, M. L. (1993). Social problem solving in suicidal adolescents. *Journal of Consulting and Clinical Psychology, 61(1)*, 121–127. doi:10.1037/0022-006X.61.1.121
- Saigh, P.A., Mroueh, M., Zimmerman, B.J., & Fairbank, J.A. (1995). Self-efficacy expectations among traumatized adolescents. *Behavior Research & Therapy, 33*, 701-706. doi:10.1016/0005-7967(94)00092-X
- Scheel, K.R. (2000). The empirical basis of dialectical behavior therapy: summary, critique, and implications. *Clinical Psychology Science and Practice, 7*, 768–786. doi:10.1093/clipsy.7.1.68
- Schotte, D. E., Cools, J., & Payvar, S. (1990). Problem-solving deficits in suicidal patients: Trait vulnerability or state phenomenon? *Journal of Consulting and Clinical Psychology, 58(5)*, 562–564. doi:10.1037/0022-006X.58.5.562
- Shaffer, D., Fisher, P., Dulcan, M.K., et al. (1996). The NIMH Diagnostic Interview Schedule for Children, Version 2.3 (DISC-2.3): description, acceptability, prevalence rates, and

- performance in the MECA study. *Journal of the American Academy of Child and Adolescent Psychiatry* 35:865-877. doi:10.1097/00004583-199607000-00012
- Shaffer D., Fisher P., Lucas, C.P., Dulcan, M.K., Schwab-Stone, M.E. (2000). NIMH Diagnostic Interview Schedule for Children Version IV (NIMH DISC-IV): description, differences from previous versions, and reliability of some common diagnoses. *Journal of the American Academy of Child and Adolescent Psychiatry*, 39: 28–38. doi:10.1097/00004583-200001000-00014
- Speckens, A. E. M., & Hawton, K. (2005). Social problem solving in adolescents with suicidal behavior: A systematic review. *Suicide and Life-Threatening Behavior*, 35, 365–387. doi:10.1521/suli.2005.35.4.365
- Steinberg, L. (2004). Risk Taking in Adolescence: What Changes, and Why? *Annals of the New York Academy of Sciences*, 1021: 51-58. doi:10.1196/annals.1308.005
- Townsend, E., Hawton, K., Altman, D. G., Arensman, E., Gunnell, D., Hazell, P., House, A. & Van Heeringen, K. (2001). The efficacy of problem-solving treatments after deliberate self-harm: meta-analysis of randomized controlled trials with respect to depression, hopelessness and improvement in problems. *Psychological Medicine*, 31, 979-988. doi:10.1017/S0033291701004238
- Watson, D., Clark, L.A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology* 54(6), 1063-1070. doi:10.1037/0022-3514.54.6.1063
- Webb, L. (2002). Deliberate self-harm in adolescence: A systematic review of psychological and psychosocial factors. *Journal of Advanced Nursing*, 38, 235-244. doi:10.1046/j.1365-2648.2002.02174.x
- Whitlock, J. & Knox, K.L. (2009) Intervention and Prevention in the Community. In M.K. Nixon & N.L. Heath (Eds), *Self-Injury in Youth: The Essential Guide to Assessment and Intervention*. New York, NY: Routledge.