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Risk for engagement in nonsuicidal self-injury in children and adolescents

A Dissertation

Presented to
the Faculty of Social Sciences

University of Denver

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

by

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Abstract

Although NSSI engagement is a growing public health concern, little research has documented the developmental precursors to NSSI in longitudinal studies using youth samples. This study aimed to expand upon previous research on groups of NSSI engagement in a population-based sample of youth using multi-wave data. Moreover, this study examined whether chronic peer and romantic stress, the serotonin transporter gene (5-HTTLPR), parenting behaviors, and negative attributional style predicted the NSSI group membership as well as the role of sex and grade. Participants were 549 youth in beginning in the 3rd, 6th, and 9th grades at the baseline assessment. NSSI was assessed across 7 waves of data. Chronic peer and romantic stress, 5-HTTLPR, parenting behaviors, and negative attributional style were assessed at baseline. Growth mixture models, conducted to test the latent trajectory of NSSI groups did not converge. Three NSSI groups were manually created according to classifications that were determined *a priori*. NSSI groups included: no NSSI (85.1%), episodic NSSI (8.5%), and repeated NSSI (6.4%). Chronic peer and romantic stress, sex, and grade differentiated the no NSSI vs. repeated NSSI groups and the episodic NSSI vs. repeated NSSI groups. Specifically, higher levels of stress, being female, and being in higher grades related to repeated NSSI. 5-HTTLPR differentiated the no NSSI vs. repeated

NSSI groups, such that carrying the short allele of 5-HTTLPR related to repeated NSSI. Exploratory analyses revealed that the relationship between attributional style and NSSI group was moderated by grade. This study suggests chronic interpersonal peer and romantic stress is an important factor placing youth at greater risk for repeatedly engaging in NSSI.

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Chapter One: Introduction

Self-injurious thoughts and behaviors (SITB; Nock & Favazza, 2009), which includes suicidal and nonsuicidal thoughts and actions, is a serious public health and mental health concern that has gained increasing scientific attention. Nonsuicidal self-injury (NSSI) is defined as the destruction of one's body without the intent to die and is thought to indicate risk for future suicide attempts (Nock et al., 2006), and is a particularly important form of SITB engaged in during the youth years. In community samples, rates of NSSI in children and early adolescents are around 7-8% (Barrocas, Hankin, Abela, & Young, 2012; Hilt, Nock, Lloyd-Richardson, & Prinstein, 2008), and this rises to about 14-21% in high school adolescent samples (Muehlenkamp & Gutierrez, 2004). Until recently, much of the knowledge of NSSI came from case examples and empirical studies of young adults. Not until the past decade have researchers begun to explore NSSI in youth (e.g., Hankin & Abela, 2011; Jacobson & Gould, 2007). Unfortunately, despite these recent efforts there is still very little known about NSSI in youth, and to our knowledge little attempt has been made to establish developmental precursors to NSSI in longitudinal studies using youth samples (for exceptions see Giletta et al., 2013; Hankin & Abela, 2011; Heilbron & Prinstein, 2010; Tatnell, Kaleda, Hasking, & Martin, 2014). Consequently, this study takes a developmental psychopathology approach (Cicchetti, 2006) to understanding the development of NSSI

across childhood and adolescence, including specific risks and vulnerabilities that may suggest greater risk for NSSI engagement.

As important as it is to understand the precursors and predictors of NSSI, it is equally relevant and necessary to attempt to establish what differences might exist in the course of NSSI across development. Until very recently the trajectory of NSSI engagement in youth was completely unstudied. Barrocas, Giletta, Hankin, Prinstein, & Abela (2014) recently showed that NSSI generally declines over the course of a 2-year period in adolescents. In addition, they found 3 specific trajectories of NSSI, a group with chronically high NSSI, a group with moderate engagement, and group with little/no NSSI engagement. The study by Barrocas and colleagues (2014) is limited in the fact that NSSI was assessed over time in a sample of adolescents only, specifically youth starting in the 10th grade. This leaves unanswered what the trajectories of NSSI are over the longer course of the youth years.

The present study takes a developmental psychopathology perspective on risks and vulnerabilities for NSSI engagement by using a sample of youth beginning in the 3rd, 6th, and 9th grades. This paper will outline the importance of attempting to classify NSSI group membership and define specific risk and vulnerability factors for NSSI groups in youth. Since this study was conducted with a sample of youth ranging from age 8-15 at the baseline assessment, next will be a discussion of the importance of assessing the role of sex and grade for associations with NSSI in youth. Finally, methodological concerns for conducting analyses with this sample will be considered.

Developmental Psychopathology and NSSI

In order to best understand the development of NSSI in youth, it is imperative that a developmental psychopathology approach be taken (Cicchetti, 2006; Pickles & Hill, 2006). To date, there has been a paucity of research on NSSI in children younger than age 11. Recent research has shown that the overall rate for NSSI in youth is about 8%, and around the transition to adolescence the rate of NSSI rises to almost 20% in girls, but not in boys (Barrocas et al., 2012). The study by Barrocas and colleagues (2012) was the first to examine NSSI in children as young as age 7. As important as this study was for utilizing a young sample of youth, the design was cross sectional, leaving unanswered what the longitudinal patterns of NSSI may be.

Longitudinal studies with developing youth are greatly needed to better elucidate the mechanisms and risk factors for NSSI as they change across the lifespan. A small, yet important, body of literature has begun to use longitudinal designs (e.g., Giletta et al., 2013; Guan, Fox, & Prinstein, 2012; Hankin & Abela, 2011; Heilbron & Prinstein, 2010; Keenan et al., 2014; Tatnell, Kaleda, Hasking, & Martin, 2014) to begin to move beyond simple descriptions of correlates of NSSI. These projects utilize data collected over time with samples of typically developing youth. Using longitudinal designs, these studies have been able to expand understanding of NSSI risks and vulnerability by suggesting the temporal precedence of these factors to heightened NSSI engagement. In one example, Keenan and colleagues (2014) embrace a developmental psychopathology framework by empirically supporting equifinality in NSSI engagement in youth. In other words, they

suggest that there may be divergent paths (i.e., risks, vulnerabilities, course) for youth who present with the same behavior of NSSI. Moreover, using a longitudinal design, Hankin and Abela (2011) have described several risk and vulnerability factors associated with a first onset of NSSI.

A developmental psychopathology perspective also highlights two important considerations for studying the development of NSSI in youth. First, although research reporting rates of NSSI engagement for different groups of youth provides important basic information, it is possible that different trajectories of NSSI engagement exist. Research on conduct symptoms in youth provides an example of the importance of research examining the different trajectories youth may take. For example, Moffitt (1993) established that trajectories of conduct disorder across development show a group of life-course persistent youth who engage in antisocial behavior consistently and an adolescent limited group who do not perform antisocial behavior in childhood, but do so only during adolescence, and then desist in adulthood. Such research can inform conceptualization of the trajectories of NSSI engagement in children and adolescents. Second, developmental pathways may differ based on specific factors, such as sex or age. Research on depression in adolescence may provide an example of how these third variables may impact NSSI engagement over time in youth. Specifically, literature on sex differences in depression in youth suggests two different perspectives: specific models and general models. Specific models (e.g., Zahn-Waxler, 2000) connote that certain pathways exist for girls and boys

separately, whereas general models (e.g., Hankin & Abramson, 2001) connote that the same pathway exists for both girls and boys, but that levels of risk factors differ.

In an effort to expand upon current knowledge of NSSI in youth, the present study aims to apply these important concepts from developmental psychopathology literature to NSSI engagement.

Latent Group Classification and NSSI

Previous empirical work has demonstrated the existence of distinct groups of individuals engaging in NSSI. First, cross sectional research has identified the difference between episodic and repeated NSSI (Brunner et al., 2007; You, Leung, Fu, & Lai, 2011). Second, several studies (Bjärehed, Wångby-Lundh, & Lundh, 2012; Klonsky & Olino, 2008, Whitlock, Muehlenkamp, & Eckenrode, 2008) have established that NSSI groups, defined by frequency of NSSI, can be differentiated by function or form of NSSI. Third, more recent longitudinal research (i.e., 2 time-points; Andrews, Martin, Hasking, & Page, 2013; Hamza & Willoughby, 2013; Hankin & Abela, 2011) has begun to establish that whereas some you report engaging in NSSI at only one time-point in a research study, others endorse NSSI across time-points, further suggesting the importance of better delineating NSSI severity as a function of engagement over time. Finally, research using longitudinal growth models (Barrocas et al., 2014) has documented the emergence of NSSI groups, which differed by risk/vulnerability factors. Barrocas and colleagues (2014) found three distinct latent trajectory classes of NSSI engagement over the course of 2 years in a sample of adolescents. These classes, or groups, were

differentiated on the severity of NSSI, defined by the number of assessment time-points adolescents reported engaging in NSSI and the frequency of reported NSSI engagement at each of these time-points. This study revealed that 69% of the adolescents were classified as reporting little/no NSSI engagement over the course of the 2-year period, 26% reported moderate NSSI engagement (i.e., engagement at some of the time-points), and 5% reported chronically high levels of NSSI engagement over time. These findings expanded previous research (e.g., Bjärehed et al., 2012; Brunner et al., 2007; Klonsky & Olino, 2008; Whitlock et al., 2008; You et al., 2011) demonstrating subgroups of individuals reporting NSSI engagement with cross-sectional data, which differ based on chronicity of NSSI.

This growing body of literature further provides evidence for the need to better understand NSSI from a developmental psychopathology perspective. Based on this empirical support, as well as clinical perspective on NSSI, youth who engage in NSSI on one or few occasions may differ greatly from those who chronically engage in NSSI in both the antecedents and consequences of their NSSI engagement. In summary, there is evidence for distinct subgroups of cross-sectional NSSI engagement and additional emerging evidence that there are subgroups of individuals' NSSI trajectory. However, no research has yet established the course of NSSI over development (i.e., including youth younger than adolescence) and the different trajectory groups that may exist.

Specific Candidate Predictors of NSSI Engagement Group

Numerous candidate factors may predict NSSI engagement groups over time for youth. Theoretical models of NSSI and SITB (e.g., Crowell, Beauchaine, & Linehan, 2009; Nock, 2009) impart that a variety of interrelated and transactional vulnerability factors converge to put individuals, and especially youth, at risk for engaging in NSSI. This study will focus on four specific vulnerability factors as candidate predictors, including both interpersonal (i.e., relationships with others) and intrapersonal (i.e., cognitive and biological) risks and vulnerabilities. Risk/vulnerability factors were chosen for this study based on theoretical importance as well as having an empirical basis.

Nock's (2009) integrated theoretical model of NSSI proposed a behaviorally based explanation for the onset and maintenance of NSSI. The model theorizes that both distal risks and underlying vulnerability factors predispose an individual to heightened risk for NSSI. In the face of stressful life events, these individuals' stress response is theorized to interact with NSSI specific vulnerabilities to lead to NSSI. Distal risks include biological factors, such as genetics, as well as life experiences, such as childhood maltreatment or familial criticism. In this model, underlying vulnerability factors refers to individual interpersonal or intrapersonal traits, such as cognitive vulnerabilities, communication styles, or poor distress tolerance.

The biosocial theory of borderline personality disorder (BPD; Crowell, Beauchaine, & Linehan, 2009; Linehan, 1993) provides additional theoretical support for risks/vulnerabilities of NSSI in youth, given the high incidence of NSSI in this population

as well as the importance of early life experiences and distal vulnerabilities in the theoretical model. Similar to Nock's (2009) model of NSSI, the biosocial theory states that biological risks transact with environmental factors to heighten the likelihood of BPD traits, which includes NSSI. For example, the theory states that an individual who is biologically predisposed to have greater emotional reactivity to stress (e.g., via genes, physiology) and who grows up in a poorly matched environment for this individual (e.g., abuse, chronic invalidation) might result in greater BPD symptoms. Within the context of this example, in an effort to regulate high emotions and more opportunities for emotions to rise, an individual often comes up with maladaptive ways to regulate emotions, such as engaging in NSSI.

In summary, the following factors were chosen for this study based on their theoretical importance as well as having an empirical basis. These include both interpersonal (i.e., relationships with others) and intrapersonal (i.e., cognitive and biological) risks and vulnerabilities, specifically genetics, interpersonal stress, parenting behaviors, and negative attributional style.

Genetics.

The role of genetics is important to explore, as it may play a unique role in the emergence of NSSI. Although specific genes associated with NSSI have not been directly examined, there is a considerable body of research investigating genes associated with related psychiatric traits and risk factors for NSSI. Candidate genes associated with the neurotransmission of serotonin have been widely examined in relation to several traits

related to NSSI behaviors, such as emotion regulation (see Canli & Lesch, 2007 for a review), suicidal behaviors (see Mann, Brent, & Arango, 2001 for a review), and BPD (see Lis, Greenfield, Henry, Guilé, & Dougherty, 2007 for a review). Allelic variation in 5-HTTLPR (i.e. S-allele carriers) has been the focus of numerous investigations related to these traits. For example, the association between 5-HTTLPR and emotion regulation has been seen across developmental stages and measurement type. Consistent with this idea, research has shown an association between the S-allele of the 5-HTTLPR gene and NSSI (Hankin, Barrocas, Young, Haberstick, & Smolen, 2014) and borderline personality traits in youth (Hankin et al., 2011). Hankin and colleagues (2014) specifically found an interaction between 5-HTTLPR and chronic stress in youth, placing youth with the S-allele of 5-HTTLPR and severe chronic stress at greater risk for NSSI engagement.

Chronic peer and romantic stress.

Several theories suggest that relationships during adolescence play an important role in the etiology, maintenance, and exacerbation of NSSI (e.g., Heilbron & Prinstein, 2008, see Prinstein, Guerry, Browne, & Rancourt, 2009). Corresponding with the increase in time spent with peers and expanding social networks (Furman & Buhrmester, 1992; Gavin & Furman, 1989), adolescents generally experience a greater number of interpersonal stressors than younger youth (Hankin, Mermelstein, & Roesch, 2007; Rudolph & Hammen, 1999). Evidence suggests that chronic interpersonal peer and romantic stress may be especially relevant to NSSI. For example, interpersonal peer and romantic problems (e.g., peer conflict, peer rejection, break up with romantic partner) are

concurrently and longitudinally associated with suicidal ideation and behavior and frequently precipitate suicidal behavior (Berman & Schwartz, 1990; Prinstein, Boergers, & Spirito, 2001; Rigby & Slee, 1999). Further, recent longitudinal research on NSSI in a community sample of adolescent girls suggests that among other risk, chronic stress in the childhood years (e.g., peer victimization), as opposed to acute incidents of stress, predicts engagement in NSSI (Keenan et al., 2014). Therefore, it is important to continue to investigate the role of chronic interpersonal, specifically peer and romantic, stress for NSSI in youth.

Parenting behaviors.

Caregivers play a critical role in modulating their children's physiological arousal by providing a balance between soothing and stimulation in the early years of life (van der Kolk, 1996). They teach their children skills for modulating emotional arousal and help children learn to derive comfort from social supports outside of the family system (Yates, 2009). Sensitive and responsive caregivers maintain optimal levels of physiological arousal in their children, whereas parents who are insensitive or inconsistent may promote chronic hyperarousal in their children, adversely affecting the structure, organization, and function of these physiological systems (Yates, 2009). Evidence (Swannell et al., 2012) and theory (Linehan, 1993; Yates, 2009) supports that youth who experience maltreatment, including child physical abuse, are more likely to engage in NSSI in their lifetime. Likewise, children who have experiences with caregivers who are insensitive and inconsistent have more limited opportunities to

develop effective emotion regulation strategies. (Sim, Adrian, Zeman, Cassano, & Friedrich, 2009). As a result, children raised in this type of environment are at a higher risk for engaging in NSSI later in life. In fact, Sim and colleagues (2009) found that adolescents who engaged in NSSI reported experiencing higher levels of invalidation (see Linehan, 1993) from caregivers than adolescents who did not engage in NSSI. Thus, inconsistency in parenting practices and child maltreatment (e.g., corporal punishment) may influence NSSI engagement in youth.

Attributional style.

Prior research on NSSI in youth has shown that a negative attributional style is emerging as an important cognitive vulnerability for NSSI engagement. Negative attributional style is defined as the tendency to think about and describe negative events and/or their consequences as having internal, global, and stable causes and outcomes (Abramson et al., 1989). Hankin and Abela (2011) found that youth who engaged in NSSI 2 ½ years after their baseline assessment were more likely than those who did not report engaging in NSSI to report a negative attributional style at baseline. More recent work by Barrocas and colleagues (2014) found that a negative attributional style predicted adolescent membership in a severe (i.e., chronic) NSSI longitudinal trajectory group as opposed to a moderate or low NSSI trajectory group. Taken together, these two studies suggest that negative attributional style seems to be a salient vulnerability factor for NSSI engagement in youth, and is a cognitive process that warrants future research as it relates to NSSI.

In summary, candidate predictors for NSSI engagement group include theoretically important risks and vulnerabilities, specifically 5-HTTLPR, chronic interpersonal peer stress, parenting behaviors, and negative attributional style.

Impact of Sex and Age on NSSI

The broader topic of developmental psychopathology places importance on understanding the role of sex. Researchers have long been studying sex differences for psychopathological outcomes in samples of youth, developing an understanding of the role of biological and social-emotional differences that might account of sex differences in these outcomes. For example, it is well established that twice as many girls as boys experience depression starting around puberty (e.g., Hankin et al., 1998). This information is useful to researchers and clinicians. Yet, literature on NSSI engagement in youth samples lacks depth in understanding the role of sex for this specific outcome.

In addition, research on rates of NSSI has shown mixed results for sex differences in NSSI in youth (see Barrocas et al., 2011). In general, the fact that both girls and boys engage in NSSI is not debated. However, although some research suggests NSSI is a behavior that more girls engage in than boys (e.g., Giletta et al., 2012; Muehlenkamp & Gutierrez, 2007; Ross & Heath, 2002), other studies do not support this sex finding (e.g., Muehlenkamp & Gutierrez, 2004; Hilt, Nock, Lloyd-Richardson, & Prinstein, 2008). Furthermore, Barrocas and colleagues (2014) found higher rates of NSSI engagement in Chinese male adolescents than females, which may

be suggestive of an influence of culture on NSSI engagement and the role of sex differences.

The rate of NSSI rises from childhood through adolescence (Barrocas et al., 2012; Whitlock, Eckenrode, & Silverman, 2006). Therefore the role of age for NSSI engagement is another important factor to consider when studying this outcome in youth samples. For example Barrocas and colleagues (2012) found that for older youth, specifically for girls, most youth who reported NSSI engagement used the method of cutting whereas for younger youth reporting NSSI there was no statistical difference in the reported method. Unfortunately, the majority of the research on NSSI has been conducted with adolescents or adults, leaving developmentally sensitive questions on the nature of NSSI (i.e., course, correlates, risks/predictors, etc.) yet to be answered. Understanding of a behavior in post-pubertal youth or adults might not generalize to younger youth samples, as biology, physiology, and social-environmental factors are constantly and quickly changing as youth age.

A developmental psychopathology perspective necessitates understanding outcomes (e.g., behaviors such as NSSI) over development in younger and older youth samples. Therefore sex and age are two important factors to consider when studying the nature and risks and vulnerability factors for NSSI in youth.

Methodological Considerations

One aim of this study was to attempt to empirically establish the course of NSSI across development. This study was designed to better define the course of NSSI from

grade 3 through grade 12 in a sample of youth who originally were recruited in the 3rd, 6th, and 9th grades, and then followed longitudinally for 3 years. The current study was part of a larger project on developmental psychopathology in youth (see Hankin, et al., under review). The project used a cross-sequential, accelerated longitudinal study of 3 cohorts of youth. In other words, the youth who began the study in the 3rd grade overlapped in grade with the youth who begin the study in the 6th grade, and similarly those youth who began the study in the 6th grade overlapped with those beginning in the 9th grade. Therefore, given the design of this study, it seemed plausible that the data would allow modeling of the course of NSSI from grade 3 through grade 12. Yet, due to several methodological considerations, this rigorous study was attempted with the understanding that it may not be statistically possible to test this important question.

The present study attempts to expand upon Barrocas and colleague's (2014) study testing the latent trajectory classes of NSSI. However, there are several differences between the two studies that warrant attention. First, Barrocas and colleagues used a self-report, likert measure of NSSI, allowing for a continuous variable of NSSI. In the current study, NSSI engagement was assessed using a structured interview (Self-Injurious Thoughts and Behaviors Interview; Nock, Holmberg, Photos, & Michel, 2007) yielding only a "yes/no" response (i.e., binary data) from study participants. Second, given the nature of this cross-sequential, accelerated longitudinal study, and our attempt to model across grades 3 through 12, each participant has missing data on at least 2/3 of the time-points, much greater than the study by Barrocas et al. (2014). Third, the rate of NSSI

engagement increases over age, beginning to peak at about 14-15. Therefore, given the age of participants, the rate of NSSI engagement in the present study is lower than in a similar study conducted with adolescents.

Summary and Aims

This study aims to address a gap in the literature on NSSI by attempting to empirically identify different groups of NSSI engagement over time in children and adolescents. The majority of the literature on NSSI across development has been conducted with youth who already engage in NSSI (e.g., Muehlenkamp & Gutierrez, 2004, 2007; Nock et al., 2006). To our knowledge, very little research has used a developmental perspective to assess risks for engagement in NSSI, and none has longitudinally tested the trajectory of NSSI engagement across development in children and adolescents. Barrocas and colleagues (2014) have begun to plot the course of NSSI engagement in a sample of adolescents, finding distinct trajectories of NSSI, which are differentiated by chronicity and several vulnerability factors. Yet, this study is limited in that NSSI was assessed using a sample of Chinese adolescents, making it difficult to generalize to all youth. In addition, NSSI engagement is generally still lacking in conceptual models and theories to drive experimental work in this area, and research employs mainly descriptive and cross sectional studies. Thus, this study is designed to expand the growing body of research on NSSI engagement to younger youth, help better establish the phenotypic profile of NSSI engagement in younger individuals, and utilize a longitudinal design. In other words, the main purpose of the proposed research is to use a

general community sample of youth and longitudinal data to better understand the course of NSSI engagement during youth as well as determine if there are specific risk and vulnerability factors predicting of these trajectories

Aim 1 is to empirically test the latent trajectories of NSSI in youth. It was hypothesized that, similar to findings from previous research (e.g., Barrocas et al., 2014; Klonsky & Olino, 2008) the present study will reveal several distinct trajectory groups of NSSI engagement. Specifically, it was hypothesized that this study will find 3 specific groups of NSSI engagement similar to those found by Barrocas and colleagues (2014); it was predicted that there will be a large percentage of youth who never engage in NSSI, a group of youth who engage in NSSI in an episodic manner, and a final group of youth who engage in NSSI repeatedly.

Conducting GMM, especially with low frequency behavior, is methodologically rigorous. Therefore, it was decided *a priori* that if testing the developmental trajectory of NSSI in youth proves to be unachievable, follow-up analyses of risks and vulnerabilities for NSSI group would still be conducted. To do this, it was decided this study would draw from findings from previous research showing that individuals tend to cluster into 3 NSSI groups. If necessary this study will, therefore, involve creating groups of NSSI severity in youth in order to establish more descriptive data on nature of NSSI longitudinally over development (i.e., number of youth in each group, differences by age, etc.) and to continue to better understand risks and vulnerability factors for NSSI engagement in youth.

Aim 2 will investigate which risk and vulnerability factors, specifically genetics, chronic peer and romantic interpersonal stress, parenting behaviors, and attributional style, predict the developmental course of NSSI in youth (or NSSI group membership). In addition, the role of sex and grade (i.e., age) will be included as important factors relating to NSSI engagement group.

Chapter Two: Method

Sample and Procedures

Youth were recruited by brief information letters sent home directly by the participating school districts to families with a child in 3rd, 6th, or 9th grades. Of the families to whom letters were sent, 1108 parents responded to the letter and called the laboratory for more information. Parent report established that both the parent and child were fluent in English, the child did not have an autism spectrum or psychotic disorder, and had an IQ > 70. Of the families who initially contacted the laboratory, 665 (60% participation rate) qualified as a study participant as they met criteria and arrived at the laboratory for the assessment. The remaining 443 (40%) are considered non-participants for the following reasons: 4 (1%) were excluded because the parent reported that their child had an autism spectrum disorder or low IQ; 13 (3%) were non-English speaking families; 330 (71%) declined after learning about the study's requirements; and 113 (25%) were scheduled but did not arrive for assessment.

At baseline, youth and a parent visited the laboratory for a 3 hour-long assessment and both youth and parents were compensated monetarily. Parents provided informed written consent for their child's participation; youth provided written assent. The Institutional Review Board approved all procedures. Follow-up assessments occurred every 6 months, with families visiting the laboratory again for a 3 hour-long assessment

at the 1.5 and 3 year time-points. At baseline, youth completed interview measures of lifetime history of NSSI, and both youth and parents completed interview measures of chronic stress over the last 18 months of the child's life. In addition, at baseline, youth completed a self-report measure of attributional style and depressive symptoms and parents completed a self-report measure of their parenting behaviors. Finally, at baseline, youth's DNA was obtained. NSSI was additionally assessed via interview with youth every 6 months for the remainder of the longitudinal study, totaling 7 waves of NSSI data.

Participants with at least five out of seven follow-up measure of NSSI were included in the analyses ($n = 549$; 83% of sample). Of the 549 youth in the analytic sample, 71.8% had data for all seven waves of follow-up (see Table 1 for more details). General descriptive characteristics of the sample can be found in Table 3. The sample is comparable to the community and school districts from which it was recruited. The sample is also generally comparable to the ethnicity and race characteristics of the overall population of the United States around the time of data collection (US Census Bureau Population Division, 2000-2009), yet is made up of less Caucasian participants (80%) and less Latino/a participants than the overall population of the United States (18%).

Measures

Nonsuicidal self-injury.

NSSI was measured using the Self-Injurious Thoughts and Behaviors Interview (SITBI; Nock, Holmberg, Photos, & Michel, 2007), a structured clinical interview that

assesses the presence and frequency of NSSI engagement. NSSI was assessed at baseline and every six months thereafter totaling 7 waves of NSSI engagement data, and youth were interviewed via the SITBI in person at the first, fourth, and last assessments and over the phone for all others. Youth were asked, “Have you done anything to purposely hurt yourself without wanting to die (for example cutting or burning your skin)?” Youth were considered NSSI engagers for each time frame if they reported engaging in NSSI at one or more occasion in the specified time frame and a dichotomous variable was created. The SITBI has excellent inter-rater reliability and test-retest reliability ($\kappa_s = 1.00$) and validity ($\kappa_s \geq 0.74$; Nock et al., 2007).

Predictors of NSSI trajectories.

Chronic peer and romantic stress. The Youth Life Stress Interview (YSLI; Rudolph & Flynn, 2007), a revised version of the UCLA Child Episodic Life Stress and Chronic Stress Interview (Rudolph & Hammen, 1999; Hammen et al., 1987), is a semi-structured contextual stress interview and assessed youths’ ongoing stress. For this study, the interpersonal domains were used to create an index for chronic interpersonal peer and romantic stress. These domains assess the quality of the youths’ relationship with their friends and other same-age peers as well as romantic partners (i.e., boyfriend, girlfriend, crush). Interviewers ascertained from youth the duration, or length of time, that the quality of the relationships had been as described. Severity and duration information are presented to a team of 3 or more blind raters, who evaluated these chronic stress domains on a scale from 1 (little/no stress) to 5 (severe stress) using detailed behavioral anchors

and a chronicity score from 1 (less than 6 months) to 5 (18 months or more). These severity and chronicity scores were recoded (0 to 3) multiplied together to create a composite stress score which weights each severity score by duration of the stress (Badanes, Watamura, & Hankin, 2011). The YLSI is a reliable, valid, semi-structured contextual stress interview used to assess youths' ongoing stress level. The YLSI has demonstrated excellent reliability and validity (e.g., Conley & Rudolph, 2009; Rudolph & Flynn, 2007).

Genotyping. Saliva samples were obtained from all study participants with Oragene™ (DNA Genotek, Ontario, Canada) collection kits, and DNA was extracted using standard salting-out and solvent precipitation methods at the Institute of Behavioral Genetics's molecular genetics lab. The method for *5-HTTLPR* and SNP rs25531 is detailed in Whisman, Richardson, and Smolen (2011). The successful call-rate was 97.5% for *5-HTTLPR*. *5-HTTLPR* was in Hardy-Weinberg Equilibrium. The *5-HTTLPR* alleles were modified by using primers reported by Hu et al. (2005). The rs25531 SNP genotypes (LA vs. LG) were obtained by incubating the PCR products with MspI.

Negative attributional style. The Adolescent Cognitive Style Questionnaire (ACSQ; Hankin & Abramson, 2002) was used to assess attributional style. Participants were presented with a total of 6 hypothetical *negative* scenarios involving achievement and interpersonal events. For each scenario adolescents reported to what extent they attributed the negative event to internal (versus external), stable (versus unstable) and

global (versus specific) causes on a scale from 1 to 7. The ACSQ has been shown to have good reliability and validity (see Hankin & Abramson, 2002).

Parenting behaviors. The Alabama Parenting Questionnaire (APQ; Frick, 1991), a measure of parenting behaviors commonly given to parents of children and adolescents, was used in this study. The APQ is a 42-item self-report questionnaire that can be broken down into five dimensions: positive reinforcement, parental involvement, inconsistent discipline, poor monitoring and supervision, and corporal punishment (Essau, Sasagawa, & Frick, 2006). The corporal punishment and inconsistent discipline dimensions were used for this study. The APQ has been shown to have good reliability and validity (Shelton, Frick, & Wootton, 1996).

Control variable.

It was determined *a priori* that if NSSI groups were to be manually created to test the association of hypothesized risk and vulnerability factors for NSSI engagement groups, analyses would include a control variable of depressive symptoms. Depressive symptoms have been shown to strongly relate to and predict NSSI in youth (Giletta et al., 2015; Guerry & Prinstein, 2010; Hankin & Abela, 2011; Nock et al., 2006). Commonly, research on internalizing pathology, including research on NSSI, controls for depressive symptoms. This is done to account for the variance in associations between measured factors and NSSI group membership that is attributable to the role of depressive symptoms. In doing this, any findings for NSSI and predictors will be above and beyond the association between NSSI and depressive symptoms or risk/vulnerability factors and

depressive symptoms. Doing this makes for stringent and conservative tests and is an established precedent used in previous research on NSSI.

Depressive symptoms. The Children's Depression Inventory (CDI; Kovacs, 1981) is a 27-item self-report measure that was used to assess depressive symptoms in youth. Each item of the CDI is rated on a 0-2 Likert scale, with a higher score indicating greater symptom severity. The CDI has been shown to have good reliability ($\alpha = .89$) and validity (Kazdin, French, & Unis, 1983) as a measure of general depression in youth and is commonly used in research on depressive symptoms with children and adolescents.

Statistical Analysis Plan

The percent of youth who reported engaging in NSSI in the current sample was 8% at the baseline assessment (see Barrocas et al., 2012), and it was assumed *a priori* that this total lifetime rate of NSSI would increase by the end of the study, as the youth age. Since it was speculated that the GMM analyses in this study would yield NSSI engagement classes with low N's, power was important to take into account before conducting analyses. In this study $N = 549$. Muthén and Curran (1997) have used Monte Carlo simulations to show that with a sample size of about 550 a latent analysis model with two classes testing mean and variance has a power of greater than 0.96.

First, for aim 1, the developmental course of NSSI was tested using Growth Mixture Modeling (GMM; see Muthén & Muthén, 2000) in MPlus (Muthén & Muthén, 1998-2001). GMM empirically tests for latent classes with different growth trajectories, from longitudinal data. This procedure allows for modeling the data taking

into account the mean growth curve for each class and individual variation around the curves. This study used GMM to empirically determine the different growth trajectory groups of NSSI engagement in youth. Since NSSI engagement was not evenly distributed in the sample (i.e., a low-frequency behavior) Zero-Inflated Poisson (ZIP) models (Lambert, 1992) were used. ZIP adjustments are used when modeling data with a large amount of zeros (i.e., “no” or not engaging in a behavior) while conducting a mixture model (Atkins & Gallop, 2007; Muthen & Shedden, 1999). In order to conduct GMM analyses, the data were first restructured in SPSS and data imputation was conducted using MPlus. Data restructuring was used to create a dataset combining grade cohorts into one large sample of youth with assessments from age 8 through 18 at regular measurement intervals every 6 months instead of starting at baseline every 6 months for 3 years. The goal of this was to enable modeling of NSSI starting in childhood through adolescence.

The design of the study, specifically a cross-sequential, accelerated longitudinal study of 3 cohorts of youth, yielded a large amount of planned missingness per participant since the design only allowed for observed data across about 3 years of time. Literature on missing data suggests using imputation to handle missing data when it is not possible to be completely sure that the data are missing completely at random (MCAR; see, Enders (2013). Although it may have been possible to conduct GMM analyses without imputing the data, the decision was made to impute data due to the combined cohort dataset including individuals with greater than 2/3 missing data. This

was because the dataset initially combined grade cohorts in an effort to model the course of NSSI from age 8-17. The IMPUTE command in MPlus uses multiple imputation (MI) and Bayesian estimation. Finally, following successful data imputation, GMM were conducted to test the course of NSSI engagement over development.

As previously stated, however, it was also a potential that it would not be possible to conduct these GMM analyses. In this case, I planned to create NSSI groups in order to continue to test aim 2. It was determined that empirical and theoretical evidence (Andrews et al., 2013; Barrocas et al., 2014; Brunner et al., 2007; Bjärehed et al., 2012; Hamza & Willoughby, 2013; Hankin & Abela, 2011; Klonsky & Olino, 2008, Whitlock et al., 2008; You et al., 2011) point toward the likelihood of 3 NSSI groups. For example, Barrocas et al. (2014) found three NSSI groups: 1) no/little NSSI, 2) moderate NSSI engagement, and 3) repeated NSSI engagement. In line with these findings, it was planned *a priori* to manually create 3 similar NSSI groups if the GMM analyses did not converge; however, given the age-range of the youth in this study being much younger than those in the Barrocas et al. paper and subsequently the lower rate of NSSI in younger youth, group membership was planned to differ slightly. In this study, group membership was to be created as follows: 1) no NSSI, defined as no NSSI at any time-point in the longitudinal study, 2) episodic NSSI, defined as evidence of NSSI at one time-point but no evidence of repeated NSSI across time-points, and 3) repeated NSSI,

defined as evidence for NSSI engagement at more than one time-point in the course of the study.

Second, for aim 2, empirical tests of the association between specific risk/vulnerability factors and the developmental course of NSSI as well as the role of sex and age on the course of NSSI were conducted. If the initial GMM worked, a second GMM would be conducted in which factors were allowed to differentiate trajectory groups, thus predicting the longitudinal course of NSSI for each NSSI group. If it were found that I had to create NSSI groups manually due to an inability to empirically test the developmental trajectory of NSSI in our sample, I would continue to test the relationship between risk/vulnerability factors and quasi-latent class NSSI groups. In this case, longitudinal data analysis would be used to differentiate researcher-created group membership instead of empirically derived NSSI group membership.

When testing the predictive ability of risks or vulnerabilities, there are several options for analyses (e.g., linear regression, binary logistic regression, multinomial logistic regression, survival analysis). The dependent variable to be created, NSSI group, consisted of groups best defined as categorical data with 3 group options. Multinomial logistic regression is used when the dependent variable is a categorical variable with 3 or more options (e.g., 3 groups). Multinomial logistic regression assumes lack of multicollinearity among independent variable and independence of irrelevant alternatives (IIA; McFadden, 1973), or independence among dependent variable choices. There was no evidence of multicollinearity among independent variables (see Table 2). Tests for

violation of IIA are thought to provide inconsistent results (see Long & Freese, 2006), therefore the recommendation for dealing with the IIA assumption is to consider the possibility that dependent variables cannot logically be substitutes for one another.

Chapter Three: Results

Descriptive Statistics

Table 1 reports rates and frequencies of NSSI across the seven waves for the whole sample and by sex. Overall 7.4% (N = 50) of youth in this sample had a lifetime history of NSSI engagement at the baseline assessment (see Barrocas et al., 2012 for more information about NSSI at this assessment).¹ NSSI engagement since the previous assessment (i.e., in the past 6 months) ranged from 2.9-5.3% in the overall sample across the other 6 assessments. Over the 7 assessments, 15.3% (N = 104) of youth reported at least one NSSI episode.

Descriptive statistics of all variables used in analyses (means, standard deviations, and correlations) are presented in Table 2.

Data Imputation

Data imputation followed standard imputation techniques (Asparouhov & Muthen, 2010) in MPlus, which uses MI and Bayesian estimation (Muthén & Muthén, 1998-2001). MPlus failed to complete imputation analyses for the large dataset. It remains unclear why this was the case. In an effort to better understand this, at the

¹ Although both studies utilize data from the same larger study the current project found 7.4% of youth reported NSSI at baseline and in the Barrocas et al., (2012) study the rate reported is 8.0% of youth reporting NSSI at the same time-point. The current study has a smaller sample size due to the exclusion of individuals who provided data on less than 5 of 7 time-points throughout the longitudinal study, which occurred in an effort to have the most accurate data possible.

suggestion of a statistical consultant (Dr. Galena Rhoades), a small subset of participants (N = 20) were selected and the imputation model was conducted again; the data imputation completed. This was done in order to confirm that the script for the IMPUTE command in MPlus was written correctly and could converge with less data, and thus less missing data. Imputation analyses with this smaller subset of data completed. After further discussion with this statistical consultant, it was hypothesized that the large amount of missing data and binary outcome data were making the feasibility of imputing the data low, and a decision was made to not impute data to conduct GMM models.

Growth Mixture Modeling by Grade

A Zero Inflated Poisson (ZIP) GMM was conducted for each grade cohort. MPlus would not converge when testing the models for the 6th and 9th grade cohorts. It was decided that understanding the role of risks and vulnerabilities for NSSI severity in youth was to be best understood by manually creating NSSI groups due to the inability of the data imputation and GMM to converge.

Descriptive Data About Self-Injury Groups

The next step in testing hypotheses, planned *a priori*, was to manually create NSSI groups. In line with these findings of empirically derived NSSI group membership (Barrocas et al., 2014), the current study involved manually created 3 NSSI groups. The 3 NSSI groups were: 1) No NSSI group, which was comprised of youth with no NSSI engagement over the course of the study, 2) episodic NSSI group, which was comprised

of youth who reported engaging in NSSI at one time-point during the course of the study, and 3) repeated NSSI group, which was comprised of youth who reported engaging in NSSI at least 2 time-points over the course of the study. Data from youth who completed at least 5 of the 7 time-points were used.

Descriptive statistics (i.e., including sex, grade, age) of these youth and group membership are shown in Table 3. The no NSSI group included 85.1% of youth in the sample (N = 467), the low NSSI group included 8.6% of sample (N = 47), and the repeated NSSI group was comprised of 6.4% (N = 35) of youth in the sample.

Group Membership Predictors

Multinomial logistic regressions were conducted in SPSS to test for predictors of NSSI group membership. Youth report of depressive symptoms at baseline was controlled for in all analyses. Results from group membership predictors can be found in Table 4.

No NSSI vs. episodic NSSI.

There were no significant predictors of group membership in the no NSSI group vs. the episodic NSSI group.

No NSSI vs. repeated NSSI.

There were several significant predictors of group membership in the no NSSI group vs. the repeated NSSI group. High-risk 5-HTTLPR gene carriage ($p \leq .05$, OR = 0.43, CI 0.19, 0.98) and chronic peer and romantic stress ($p \leq .001$, OR = 2.26, CI 1.55, 3.30) significantly related to membership in the repeated vs. no NSSI group after

controlling for depressive symptoms. Specifically, youth who carry the high-risk 5-HTTLPR gene were more likely to be in the repeated NSSI group than the no NSSI group and youth with greater chronic peer and romantic stress were more likely to be in the repeated NSSI group than the no NSSI group. On the other hand, youth with negative attributional style, greater corporal punishment, and more inconsistent discipline were equally likely to belong in either the repeated vs. no NSSI group. Further, both sex ($p \leq .05$, OR = 0.35, CI 0.15, 0.84) and grade ($p \leq .05$, OR = 0.23, CI 0.07, 0.71) significantly related to membership in the repeated vs. no NSSI group after controlling for depressive symptoms. Specifically, girls as well as 6th and 9th grade youth were more likely to be in the repeated NSSI group than the no NSSI group.

Episodic NSSI vs. repeated NSSI.

There were two significant predictors of group membership in the episodic NSSI group vs. the repeated NSSI group. Chronic peer and romantic stress ($p \leq .05$, OR = 1.61, CI 1.02, 2.55) significantly related to membership in the repeated vs. episodic NSSI group after controlling for depressive symptoms. Specifically, youth with greater chronic peer and romantic stress were more likely to be in the repeated NSSI group than the episodic NSSI group. In addition, youth grade significantly related to membership in the episodic vs. repeated NSSI group ($p \leq .05$, OR = 0.15, CI 0.04, 0.55) after controlling for depressive symptoms. Specifically, youth in the 6th and 9th grade were more likely to be in the repeated NSSI group than in the episodic NSSI group. There was no significant effect of grade for youth in the 6th or 9th grades in regard to

membership in the episodic NSSI vs. repeated NSSI groups. Further exploratory analyses were conducted to better understand these significant associations.

Exploratory Analyses: Moderation of Attributional Style and Parenting Behaviors

Moderation analyses were used to test if the association between attributional style or parenting behaviors (corporal punishment and inconsistent discipline) and NSSI group was moderated by grade. These analyses were conducted in order to better understand why hypothesized risk factors did not relate to NSSI group, and specifically to understand the impact of development on these relationships.

Moderation was tested using the SPSS macro PROCESS (Hayes, 2013) to test if youth grade impacted the relationship from attributional style or parenting behaviors to NSSI group. Using PROCESS, the indirect effect is estimated by multiplying *a* by *b*, and in these analyses grade was the moderating variable. For categorical outcomes variables PROCESS uses logistic regression. A 95 percent bias-corrected bootstrapping confidence interval based on 1000 bootstrap samples was calculated to determine the significance of the indirect effect. Youth report of depressive symptoms at baseline was controlled for in all analyses.

Grade as a moderator of attributional style and NSSI group.

Youth grade significantly moderated the association between attributional style and NSSI group (see Table 5). Simple slope analyses in PROCESS indicated that at 1 SD below the mean (youth in the 3rd grade at baseline), there was no association between attributional style and NSSI group (effect = .03, *p* =.34). However, at the

mean (youth in the 6th grade at baseline) and at 1 SD above the mean (youth in the 9th grade at baseline), there was a significant negative association between attributional style and NSSI group (effect = .10, $p \leq .001$ and effect = .17, $p \leq .001$ respectively), suggesting that as youth age attributional style plays a role in youth's NSSI engagement.

Grade as a moderator of parenting behaviors and NSSI group.

Youth grade did not significantly moderate the association between corporal punishment and NSSI group (see Table 5). Simple slope analyses in PROCESS indicated that at the mean as well as 1 SD above and below the mean the association between corporal punishment and NSSI group was not significant. Additionally, youth grade did not significantly moderate the association between inconsistent discipline and NSSI group. Simple slope analyses in PROCESS indicated that at the mean as well as 1 SD above and below the mean the association between inconsistent discipline and NSSI group was not significant.

Chapter Four: Discussion

NSSI engagement in youth warrants greater empirical attention given that youth who engage in this maladaptive behavior experience high levels of other psychiatric conditions and symptoms (e.g., Nock, 2009; Nock et al., 2006). In recent years more research has been conducted to better understand NSSI in youth, yet the majority of this work has been conducted with data employing cross sectional designs (see Giletta et al., 2013; Guan, Fox, & Prinstein, 2012; Hankin & Abela, 2011; Heilbron & Prinstein, 2010; Keenan et al., 2014; Tatnell, Kaleda, Hasking, & Martin, 2014 for exceptions). Most recently, however, Barrocas and colleagues (2014) studied the developmental course of NSSI in a sample of adolescents in China, finding 3 distinct trajectory groups of adolescents engaging in NSSI. The present study aimed to expand upon previous cross-sectional research and Barrocas et al.'s longitudinal work in an attempt to better understand the developmental patterns of NSSI across childhood and adolescence as well as elucidate some important risks and vulnerabilities for youth at risk for greater NSSI engagement. Moreover, this study utilized multi-wave data and a gold-standard assessment of NSSI. Although statistical modeling did not converge, impeding the ability to specifically add to understanding of the developmental course of NSSI across the childhood and adolescence years, important findings emerged for other patterns of NSSI engagement in youth. Information about individuals in NSSI groups yielded

important descriptive data not yet published and which provides an expanded understanding of the phenotypic profile of youth who engage in NSSI. Further, several important factors, specifically greater chronic peer and romantic stress, the short allele of 5-HTTLPR, being in the 9th grade, and being female differentiated NSSI groups in this sample of children and adolescents, adding to the literature on risks and vulnerabilities for NSSI engagement in the youth years. Finally, exploratory analyses suggest that the association from negative attributional style, a vulnerability emerging in literature as being important for NSSI, to NSSI group was moderated by youth grade such that older youth with a more negative attributional style were more likely to report greater NSSI engagement, suggesting implications for association for NSSI changing over development.

Interpretation of Results

This study yielded important descriptive data about youth NSSI engagement over time. Of the youth in the study, 85.1% did not report engaging in NSSI at any wave of data collection, 8.6% reported engaging in NSSI at one wave (i.e., episodic), and another 6.4% reported engaging in NSSI at more than one wave, constituting those youth with repeated NSSI engagement. Most importantly, the 35 youth in the repeated NSSI group were mostly female (about 77%) and half were in the 9th grade (about 51%). Those who reported NSSI engagement at only one wave were about evenly split across grade and sex. These findings naturally build upon previous research, including data published from the same data at baseline (see Barrocas et al., 2012), suggesting that in samples of youth

in the US older youth in their adolescence and females tend to have higher rates of NSSI engagement. This study suggests, importantly, that the majority of the youth who self-injure at a more chronic and repeated manner are older females. Although this is not surprising given previous findings as well as clinical observations, it is important to document this finding empirically.

At the same time, there are a small number of younger youth who report engaging in NSSI, and the youth who engage in this behavior are not only female. Further, these results add to literature describing likely features of individuals engaging in repeated NSSI (e.g., Bjärehed, Wångby-Lundh, & Lundh, 2012; Klonsky & Olino, 2008, Whitlock, Muehlenkamp, & Eckenrode, 2008) adding to a phenotypic profile of NSSI engagers.

Findings from regression analyses identified several specific factors for risk of repeated NSSI engagement. Having a history of greater chronic peer and romantic stress related to youth being in the repeated NSSI group when compared to the no NSSI group and the episodic NSSI group, and carrying the high-risk serotonin transporter gene related to youth being in the repeated NSSI group when compared to the no NSSI group. These results are consistent with previous research; yet little research has examined these factors for NSSI risk. Chronic stress has long been theorized to relate to NSSI engagement (e.g., Heilbron & Prinstein, 2008), and Keenan and colleagues (2014) have empirically shown that chronic interpersonal stress longitudinally relates to NSSI in youth. Giletta and colleagues (2015) have also found that support from peers

and reciprocity in friendships are protective for NSSI engagement in adolescence. Interpersonal relationships are salient for youth across development, and the present study suggests that high and chronic levels of difficulty in peer and romantic interpersonal relationships in youth increase the chance of youth engaging in NSSI.

Previous studies have linked the serotonin transporter gene (i.e., 5-HTTLPR) and interpersonal stress with NSSI in youth (Hankin et al., 2014), borderline personality traits in youth (Hankin et al., 2011), and suicidal behaviors in adults (see Mann, Brent, & Arango, 2001 for a review). It has been hypothesized that 5-HTTLPR puts youth at risk for NSSI engagement via its robust link with emotion regulation difficulty (see Barrocas et al., 2011). Although the specific mechanism by which the serotonin transporter gene relates to NSSI engagement is not understood, this study contributes to the literature establishing this important link. Namely, this study adds that carrying the short allele of the 5-HTTLPR gene relates to repeated (i.e., chronic) NSSI at a young age.

Demographic factors were found to differentiate NSSI group as well, as expected. Youth reporting repeated NSSI were more likely to be female than youth who did not engage in NSSI over the course of the study. Given that the role of sex for NSSI continues to be defined by mixed findings in the literature (see Barrocas et al., 2011; see Whitlock & Selekman, 2014), this study provides valuable data. Findings suggest that although youth engaging in episodic NSSI might not differ by sex, the group of youth engaging in repeated NSSI are much more likely to be female than male. In

addition, grade differentiated both the no NSSI from the repeated NSSI group and the episodic NSSI from the repeated NSSI group, suggesting that as youth age, the rate of NSSI increases. Further, older youth are more likely to have engaged in NSSI repeatedly. Together these findings are not surprising; findings build upon previous research from our group showing that youth of all ages report engaging in NSSI but a higher rate of older youth, and specifically females, engage in NSSI (Barrocas et al., 2012) than do younger youth and older teenage males.

This study additionally suggests that older youth and females not only are more likely to engage in NSSI but also do so repeatedly. Recent work by Klonsky, May, and Glen (2013) has shown that greater level of NSSI (i.e., either frequency or method of NSSI) suggests greater risk for suicide attempts in youth and adult samples. The association between interpersonal stress and NSSI found in the present study is specific for the repeated NSSI group, which is suggestive of greater general psychiatric severity in this group, and possibly greater risk for these youth attempting suicide. Clinical literature (see Holander, 2008; Linehan, 1993; Miller, Muehlenkamp, & Jacobson, 2009) has long implied that teenage girls and young women are at the greatest risk for NSSI engagement. This study is in line with these clinical observations. Furthermore, this study adds a nuanced perspective; these older girls and young women who report engaging in NSSI repeatedly are at greatest risk for a more severe psychiatric course.

Despite expectations that attributional style and parenting behaviors would differentiate NSSI groups, neither factor did when conducting the planned analyses.

Negative attributional style has emerged as a promising risk linking to NSSI engagement in adolescent samples (Barrocas et al., 2014; Hankin & Abela, 2011), therefore it was expected that attributional style would relate to NSSI group in the current study. This sample utilized a sample younger than previous studies looking at the relationship between attributional style and NSSI engagement. As such, it was thought that attributional style as a vulnerability factor for NSSI emerges as youth age, and might not confer risk for NSSI in younger youth. In order to better understand if there might be developmental implications for this relationship, further *post-hoc* exploratory analyses were conducted to test if grade moderated the association from attributional style to NSSI group. In fact, findings revealed that there was an effect of grade, such that although for younger youth (i.e., in the 3rd grade at baseline) a negative attributional style did not impact likelihood of being placed in any of the NSSI groups, for older youth (i.e., in the 6th and 9th grades at baseline) having a more negative attributional style related to increased risk for NSSI. This highlights the importance of assessing NSSI, a behavior not only affecting adolescents but also younger youth, over the course of development.

It was also hypothesized that parenting behaviors, specifically inconsistent parenting and corporal punishment, would differentiate NSSI groups, given theoretical literature (e.g., Yates, 2009) and empirical studies (Sim et al., 2009) suggesting that the parenting system, especially when considered an invalidating environment (Linehan, 1993), can play a role in youth's emotional dysregulation and subsequently NSSI

engagement. Unexpected non-significant findings from this study revealed that parenting behaviors, specifically the use of corporal punishment and inconsistent discipline, did not relate to NSSI group and exploratory analyses showed that grade did not impact these non-significant relationships. Recent research by Baetens and colleagues (2014) found that the parenting factors of parent support/control and parent stress did not relate to NSSI in a sample of youth. Although the constructs measured by Baetens and colleagues (2014) differ from those measured in the present study, taken together these studies suggest that although theory and some empirical work might suggest a link from parenting to NSSI this does not seem to be supported at least in the younger youth years. It is also plausible that the theoretical construct of an invalidating environment is not captured by the items used to measure harsh parenting and inconsistent discipline used in this study.

Developmental Considerations

Findings from this study are important to consider within a developmental framework. As youth grow older, they are faced with social developmental changes (Habermas & Bluck, 2000) including greater changes in the social networks they live in (Furman & Buhrmester, 1992). Many youth are able to move through their changing environment and demands smoothly; however, some are either faced with more challenges or at greater risk for struggling emotionally. This study fits within this developmental picture, showing that specific risks and vulnerabilities emerge for repeated NSSI engagement as youth age. Further, that a history of chronic

interpersonal peer and romantic stress not only puts youth at greater risk but also accounts for the link from grade (i.e., a proxy for age) to greater NSSI engagement is supported by known social transitions that occur over development. In addition, youth with a more negative attributional style were shown to be more likely to engage in NSSI, but only at more advanced grades at the beginning of the teenage years. Why youth choose this maladaptive coping mechanism to regulate heightened emotions (Nock & Prinstein, 2004, 2005) is still unknown. Yet, the profile of who is at greater risk for engaging in this behavior is becoming better understood and as is the timing of which risks and vulnerabilities emerge for NSSI.

Discussion of Trajectory Analyses

One main aim of this study was to test for latent trajectory groups of NSSI engagement over development using growth modeling in this rich longitudinal sample of youth. It was hypothesized that the present study would replicate findings from Barrocas and colleagues (2014) and yield developmental trajectory groups that emerged in a sample spanning a greater period of development. Unfortunately, it was not possible to conduct the GMM analyses to test this aim. It is possible that if NSSI engagement were measured using a continuous variable, like the data used by Barrocas and colleagues (2014), rather than a dichotomous categorical variable it may have been feasible to conduct the planned analyses. Likewise, other factors (e.g., younger youth, low rates of NSSI) may have additionally played a role in the difficulty conducting the planned analyses. Despite being unable to test for latent groups of NSSI engagement

over development, valuable information was gained in this study by creating NSSI engagement groups that were modeled after the empirically driven NSSI groups (Barrocas et al., 2014; Klonsky & Olino, 2008). Creating these groups, which were *a priori* determined, allowed for testing of questions on vulnerability for repeated NSSI in youth.

Although this study could not empirically test the latent trajectories of NSSI across the youth years in order to better understand differences in NSSI engagement severity, findings remain valuable in conceptualizing the different groups of youth NSSI engagers. Creating groups of NSSI engagement in youth based on suggestions from previous empirical literature proved to be salient for determining important demographic variables and risk/vulnerability factors. Descriptively, this study imparts that across grades, a small percentage of youth engage in NSSI only once. These youth seem to look different in the risks and vulnerabilities (including demographic variables) than those who end up engaging in NSSI repeatedly. Further, although not empirically derived, the repeated NSSI group seemed to be made up mostly of individuals with a specific profile, especially as it relates to demographic factors.

Given the convergence of an empirical basis for NSSI groups, that risks and vulnerabilities differentiated them, and that findings overlap with clinical assumptions, this study is suggestive of the possibility that several different pathways (or courses) of NSSI engagement for youth exists. To be more specific, it seems plausible that the three

NSSI groups (no NSSI, episodic NSSI, repeated NSSI) used to test for risks and vulnerabilities in this study overlap greatly with clinical implications.

Often, youth come to treatment in the teenage years when external stress and pressure, regularly in the peer and romantic domains, leading to an increase in psychiatric symptoms and the impairment these are having on their lives. Anecdotally, the majority of youth presenting with these problems that, either initially or eventually, report NSSI are teenage youth. This study suggests that some of these youth are able to desist in their use of NSSI as a behavior to turn to when faced with increased stress, whereas others continue to engage in NSSI. On the other hand, it is rare to see youth in treatment for one episode of NSSI. It might be that these youth are not presenting in treatment due to discontinuation of NSSI and/or the life stressors leading to choosing to engage in NSSI in the first place.

In summary, although empirically testing the latent trajectory of NSSI in youth was not feasible, this study yielded important results allowing for inferences to be drawn about the course of NSSI engagement for different groups in youth.

Why Might Youth Engage in NSSI?

Researchers and clinicians alike have been asking the question, ‘why do people self-injure’ for some time (see Favazza, 2009; Nock, 2009; Nock & Prinstein, 2004). Although this study was not designed to answer this question, some relevant inferences can be drawn. It has been widely accepted and established that one reason individuals engage in NSSI to regulate emotions (Klonsky, 2007). It is theorized that for some

individuals, when they experience low tolerance of a high level of emotional arousal (Linehan, 2003), they use NSSI as a coping behavior to decrease their arousal. Recent findings from experimental studies support this notion (e.g., Franklin, Lee, Hanna, & Prinstein, 2013; Franklin et al., 2013). In the present study, there is no direct measure of emotion regulation; however, 5-HTTLPR has been described as a genetic vulnerability for stress reactivity, which is a construct that includes heightened emotions in the face of stress. Therefore, this study might imply that through 5-HTTLPR short-allele carriage, some youth experience greater heightened emotional arousal. When considering that the episodic and repeated NSSI groups were differentiated by chronic peer and romantic stress, it additionally seems plausible that youth who face high levels of unremitting peer and romantic stress learn that turning to NSSI as an emotion regulation coping behavior works, albeit a maladaptive one. These youth might then learn to continue this process, not turning to more adaptive coping mechanisms. This hypothesis should be considered lightly given this study did not empirically test this process, yet clinical experience and anecdotes, as well as theory from the BPD literature (Linehan, 1993), would support the hypothesis.

Implications for Treatment

Implications for clinical practice can be drawn from findings as well. Like previous work from my colleagues and me (e.g., Barrocas et al., 2012), this study continues to expand the phenotypic profile of which youth engage in NSSI, adding new information about who does so repeatedly – i.e. chronically or in a more severe manner –

than their peers. Emerging research suggests that more chronic NSSI might precede more severe suicidal gestures and actions (Giletta et al., 2015). Therefore, youth who are female, older, have a history of severe peer and/or romantic stress (e.g., bullying, isolation, romantic relationship problems), and a negative attributional style might warrant early intervention for how to cope with any increasing interpersonal stress (i.e., peer conflict, romantic relationships) and emotion dysregulation. This study suggests that targeting interpersonal stress specifically, and doing so early, might be important for treatment, and possibly prevention, of NSSI engagement as youth age. Additionally, findings indicate that attributional style, a common focus in cognitive behavioral therapy (CBT) techniques, may be an additional therapy target with youth in the teenage years who engage in NSSI. When considering clinical implications, it is relevant to note that although findings from the present study and previous work consistently show *these* risks and vulnerabilities for NSSI engagement, other youth report NSSI as well.

In clinical settings, psychoeducation and skills training are often utilized in treatment, especially with individuals who engage in NSSI. This study is important and clinically relevant in that it can aid in treatment providers offering empirical backing for psychoeducational use in their practice. For example, when working with youth and their parents, a clinician could utilize findings from this study to educate patients on the risks and vulnerability, including demographic factors, that have collectively led to an individual turning to, and continuing to use, NSSI as a coping mechanism. Often patients and their families find comfort in knowing that a behavior like NSSI is somewhat

common and treatable. Further, once understood that NSSI engagement serves a meaningful and understandable function, the next step in treatment would be to help a patient understand why they initially and repeatedly use NSSI engagement. This study imparts that youth engaging in NSSI experience chronic (long-term) stress with friends and romantic partners. This offers a place for intervention. These youth are likely to continue to face stressful events, which – if the hypothesis that they have learned to engage in NSSI because it works to decrease emotional arousal is accurate – would offer them opportunities to attempt to use skills learned in treatment. Clinicians can build rapport and offer validation around how difficult continued stress is and empower youth to choose a skill instead of NSSI when faced with stressful events. In summary, this study can aid treatment providers in talking with their patients, especially those in youth who face chronic peer and romantic stress, and their parents about what is known about NSSI during their developmental period to lead to conversations around when and how to eliminate the pattern or repeated NSSI.

Strengths, Limitations, and Future Directions

It is important to consider strengths and limitations of this study. This study is among very few testing associations for NSSI in samples of youth extending downward to elementary age children. We utilized a sample of 549 youth starting the study in the 3rd, 6th, and 9th grades and assessed NSSI engagement every six months for three years, totaling seven waves of NSSI engagement data. In addition, NSSI was assessed using a gold-standard interview method, the Self-Injurious Thoughts and Behaviors Interview

(SITBI; Nock, Holmberg, Photos, & Michel, 2007). Moreover, this study used theoretically driven and empirically supported risk and vulnerability factors for NSSI over time in this sample of youth. Overall, this study utilized rigorous methods and included younger youth than most studies on NSSI. Despite these strengths, some limitations must be considered. First, NSSI rates are lower in the younger youth, and the amount of youth engaging in repeated NSSI is low as well. Findings on grade associations for NSSI group place importance on the impact of grade. These findings, therefore, are only suggestive until replicated. Research on NSSI engagement with younger youth is gravely needed, and this study adds to literature beginning to document NSSI in youth. Second, this study initially aimed to increase understanding of the developmental course and latent trajectories of NSSI. Despite the longitudinal design of the study GMM analyses did not converge, necessitating the use of manually created NSSI groups. Doing this condensed many waves of data into a single variable. As a result, the richness of modeling NSSI engagement over time could not be achieved. Third, findings from this study are specific to youth starting in the 3rd, 6th, and 9th grades, and it is unknown if the associations significant in the current study would expand to older individuals engaging in NSSI. Fourth, the finding with chronic peer and romantic stress should be considered within the context of development. As youth age, peer and romantic relationships increase in salience. Thus, there may be a bias in the importance given to this construct in the youth report, biasing findings. Fifth, in order to attempt to rigorously test associations as well as use analyses that are in line with current practices in the NSSI literature, it was chosen to

control for CDI in all analyses. This choice was made intentionally, yet there may be unintentional downsides to doing this. For example, if NSSI leads to increases in depressive symptoms, controlling for CDI may eliminate some potentially important findings. Finally, recent literature suggests that repeated NSSI engagement confers greater risk for more serious, and sometimes lethal, suicidal thoughts and behaviors, yet this study did not measure these constructs. Therefore, links from risk for repeated NSSI in this sample to risk for more serious suicidal thoughts and behaviors are hypothetical and an area for future research to explore.

Summary

Findings from this study revealed important novel and valuable information on youth's NSSI engagement over development. Descriptive information obtained about the NSSI engagement groups, which were determined *a priori*, aids in a better understanding of the phenotypic profile of youth who engage in NSSI. Further, several important factors differentiated NSSI engagement group; most importantly, youth who are older, female, carry the short-allele of the serotonin transporter gene, and who have a history of severe chronic interpersonal peer and romantic stress are more likely to engage in repeated NSSI, a course that is hypothesized to be more serious and relate to greater mental health problems, specifically suicidal thoughts and behaviors. In addition, grade was found to moderate the association from attributional style to NSSI group, suggesting the importance of development for risks and vulnerabilities for NSSI engagement.

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Appendix A: Tables

Table 1.

Rate of NSSI at Each Follow-up Assessment in the Total Sample and by Sex.

Follow-up	Boys	Girls	Total
	% (N)	% (N)	% (N)
Baseline	6.3 (19)	8.3 (31)	7.4 (50)
6 month	1.6 (4)	7.4 (24)	4.8 (28)
12 month	1.9 (5)	4.3 (14)	3.3 (19)
18 month	3.3 (8)	6.3 (19)	4.9 (27)
24 month	2.2 (5)	4.8 (14)	3.7 (19)
30 month	1.3 (3)	4.2 (12)	2.9 (15)
36 month	2.6 (6)	7.4 (22)	5.3 (28)

Note. NSSI = Nonsuicidal self-injury; Follow-ups occurred every 6 months. The % of the total sample is represented. For each sex (boys and girls) the % represents the % of boys or girls, respectively, reporting NSSI engagement.

Table 2.

Means, standard deviations, and correlations

	1	2	3	4	5	6	7	8	9
1. NSSI									
2. 5-HTTLPR	.08								
3. Chronic Peer and Romantic Stress	.32**	.10							
4. Attributional Style	.17**	.03	.17**						
5. Corporal Punishment	-.02	.06	-.02	-.002					
6. Inconsistent Discipline	.04	-.01	.18**	.08	.17*				
7. Sex	.11*	-.03	.05	-.01	-.01	-.04			
8. Grade	.12**	.05	.20**	.18**	-.23**	-.01	.02		
9. Depressive Symptoms	.35**	.03	.29**	.40**	-.01	.14**	.06	.15**	
<i>M</i>	0.21	0.21	3.25	2.87	6.36	13.55	1.56	5.97	6.57
<i>SD</i>	0.54	0.41	0.98	0.88	1.64	3.76	0.50	2.37	5.60

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

Table 3.

Descriptive statistics for NSSI group membership

Variable	No NSSI	Episodic NSSI	Repeated NSSI
	N (%)	N (%)	N (%)
Total in Group	467 (85.1%)	47 (8.6%)	35 (6.3%)
Sex			
Female	252 (54.0)	27 (57.4)	27 (77.1)
Male	215 (46.0)	20 (42.6)	8 (22.9)
Grade at BSL			
3 rd Grade	152 (32.5)	18 (38.3)	4 (11.4)
6 th Grade	180 (38.5)	16 (34.0)	11 (31.4)
9 th Grade	135 (29.0)	13 (27.7)	20 (57.1)
Age - Mean (SD)	11.9 (2.3)	11.7 (2.4)	13.1 (2.0)

Table 4.

Multinomial logistic regressions examining the difference of NSSI group membership by risk and vulnerability factors

Variable	No Vs. Episodic NSSI ^a		No Vs. Repeated NSSI ^a		Episodic Vs. Repeated NSSI ^b	
	OR (CI 95%)	<i>p</i>	OR (CI 95%)	<i>p</i>	OR (CI 95%)	<i>p</i>
Chronic Stress	1.40 (0.98-2.01)	<i>NS</i>	2.26 (1.55-3.30)	≤0.001	1.61 (1.02-2.55)	0.04
5-HTTLPR	0.98 (0.45-2.13)	<i>NS</i>	0.43 (0.19-0.98)	0.04	0.44 (0.16-1.25)	<i>NS</i>
Attributional Style	1.17 (0.80-1.70)	<i>NS</i>	1.17 (0.75-1.83)	<i>NS</i>	1.17 (0.75-1.83)	<i>NS</i>
Parenting Behaviors						
Corporal Punishment	1.07 (0.88-1.31)	<i>NS</i>	0.92 (0.71-1.20)	<i>NS</i>	0.86 (0.63-1.18)	<i>NS</i>
Inconsistent Discipline	1.01 (0.93-1.11)	<i>NS</i>	0.98 (0.88-1.10)	<i>NS</i>	0.97 (0.85-1.11)	<i>NS</i>
Sex	0.94 (0.51-1.75)	<i>NS</i>	0.35 (0.15-0.84)	0.19	0.38 (0.14-1.03)	<i>NS</i>
Grade						
3 rd	1.54 (0.71-3.37)	<i>NS</i>	0.23 (0.07-0.71)	0.01	0.15 (0.04-0.55)	0.004
6 th	1.24 (0.56-2.77)	<i>NS</i>	0.70 (0.31-1.61)	<i>NS</i>	0.56 (0.19-1.67)	<i>NS</i>
9 th	Ref					

a. Reference is No NSSI Group. b. Reference group is Episodic NSSI Group.

Table 5.

Regression coefficients for exploratory analyses: Moderation of attributional style and parenting behaviors by grade

Predictor	Outcome					
	Attributional Style		Corporal Punishment		Inconsistent Discipline	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Outcome	-.068	.069	.021	.047	-.022	.019
Grade	-.061	.034	.051	.050	-.035	.042
Outcome X Grade	.028	.011	-.003	.008	.005	.003