

Regular Article

The association between nonsuicidal and suicidal self-injurious behaviors: A systematic review and expanded conceptual model

Brooke A. Ammerman¹ , Taylor A. Burke² , Caitlin M. O’Loughlin³ and Rebecca Hammond³

¹University of Wisconsin – Madison, Madison, WI, USA, ²Massachusetts General Hospital, Boston, MA, USA and ³University of Notre Dame, Notre Dame, IN, USA

Abstract

Objectives: Nonsuicidal self-injury (NSSI) is one of the strongest predictors of suicidal behavior. Despite this, the field still has a limited understanding of the mechanisms by which this relationship is conferred.

Method: We conducted a systematic review of the empirical research examining potential factors driving (i.e., moderators, mediators) the relationship between NSSI and suicidal behavior to address this gap in the literature.

Results: We identified only 15 studies examining moderators or mediators of this relationship, examining 40 unique mediators and 22 unique moderators. Three prominent weaknesses were identified in the reviewed literature: (1) limited intersection with existing theoretical models of the NSSI – suicidal behavior relationship, (2) little replication of findings across studies (i.e., only four mediators and four moderators assessed in multiple studies), and (3) only one of the included studies utilized a prospective design. Research to date does little to improve our understanding of the theoretical or prospective relationship between NSSI and suicidal behavior, highlighting a foundational gap in the literature.

Discussion: We propose the Nonsuicidal to Suicidal Self-Injury Pathway Model, a new conceptual model of the relationship between NSSI and suicidal behavior, drawing on extant theory and empirical research; we discuss future directions for work in this area.

Keywords: mechanism; mediators; moderators; NSSI; suicide risk; theory

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Introduction

Nonsuicidal self-injury (NSSI) is the direct and deliberate self-injury of one’s body tissue, enacted without any associated suicidal intent (International Society for the Study of Self-Injury, 2018). It encompasses any behaviors meeting these criteria that are not socially sanctioned. Although related, suicidal self-injury (SSI; which includes suicide attempts and suicide) represents a distinct phenomenon, referring to direct and deliberate self-injury with at least some intent to kill oneself (e.g., Nock & Favazza, 2009). Unfortunately, both forms of self-injurious behavior are relatively prevalent, particularly among adolescents and young adults. Prior work estimates that 19.5% of adolescents, 2.0–3.0% of young adults, and 0.9% of adults have a past-year history of NSSI (Kiekens et al., 2016; Lim et al., 2019; Swannell et al., 2014). Similarly, as many as 10% of adolescents, 1.8% of young adults, and 0.6% of adults (Ivey-Stephenson et al., 2020; National Institute of Mental Health, 2021) report attempting suicide in the past year; there were approximately 46,000 deaths by suicide in the U.S. during 2020 alone (Center for Disease Control, 2020).

Despite being distinct forms of self-injurious behavior, NSSI and SSI have been consistently related and frequently co-occur in both community and clinical samples (Glenn et al., 2017; Klonsky et al., 2013). Indeed, some estimates suggest that in clinical samples, up to 70% of those with an NSSI history also attempt suicide at some point (Nock et al., 2006). Similarly, in a community sample, approximately 40% of individuals with an NSSI history endorsed a history of suicide attempts and 66% of individuals with a suicide attempt history reported NSSI (Voss et al., 2020). Importantly, while not everyone who engages in NSSI will go on to attempt suicide, the association may be stronger than other well-established correlates (i.e., depressive symptoms; Klonsky et al., 2013).

Although both types of self-injurious behaviors represent significant public health concerns that often emerge in adolescence, NSSI onset is typically earlier than that of SSI. A growing body of literature indicates that the average age of NSSI onset is in early adolescence (age 12), peaking at age 14 (i.e., Ammerman et al., 2018), whereas suicide attempts most frequently occur in mid-late adolescence (age 15–16; Kiekens et al., 2018). In a study of undergraduates, after removing participants with SSI age of onset prior to NSSI (6.59% and with the same age of onset (25.75%), the average age difference between retrospective reports of NSSI onset to SSI onset was approximately 3.09 years (SD = 2.55) (O’Loughlin et al., 2021a). This finding has been replicated across samples: NSSI onset was 3.2 years prior to SSI onset in an independent college sample (Kiekens et al., 2018); 1.89 years prior in an adolescent

Corresponding author: Brooke Ammerman; Email: baammerman@wisc.edu

BAA and TAB are contributed equally to this manuscript.

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outpatient sample (Glenn *et al.*, 2017); and 1.28 years prior in an adolescent inpatient sample (Glenn *et al.*, 2017). Given that NSSI most frequently precedes SSI and the elevated rates of suicide attempts among those with a history of NSSI, it has been suggested that NSSI may play a role in the development of SSI (Hamza *et al.*, 2012).

Theoretical models of NSSI – suicidal self-injury association

Meta-analytic evidence indicates that NSSI is one of the strongest prospective predictors of suicide attempts, demonstrating a more robust predictive association than a history of prior SSI itself (Franklin *et al.*, 2017; Ribeiro *et al.*, 2016). Indeed, one meta-analysis of longitudinal studies (median follow-up time = 24 months), found the weighted odds ratio of the prospective relationship between NSSI and SSI to be 4.27, with similar estimates between the general community and clinical samples (Ribeiro *et al.*, 2016). These findings are mirrored in another meta-analysis, noting that prior NSSI was a stronger risk factor for SSI than prior attempted suicide, suicidal ideation, mental disorders (i.e., depression, borderline personality disorder), and psychiatric hospitalization (Franklin *et al.*, 2017; Ribeiro *et al.*, 2016). Although the odds of a suicide attempt are relatively low and the association between NSSI and SSI is complex in nature, the current literature highlights that NSSI is a key prospective predictor of SSI, warranting great theoretical and empirical attention.

Third Variable Theory

One explanation of the NSSI-SSI association is the Third Variable Theory, which suggests that the high degree of co-occurrence between NSSI and suicide attempts is accounted for by the existence of one or more variables that confer risk for both outcomes (e.g., genetic predisposition, depressive symptoms, anxiety symptoms, psychological distress; Hamza *et al.*, 2012). This theory is supported by a body of research identifying numerous shared risk factors of NSSI and suicidal ideation and attempts (e.g., Brausch & Gutierrez, 2010; Whitlock & Knox, 2007). However, NSSI has been shown to be associated with, and prospectively predictive of, SSI, even when accounting for well-established, shared risk factors, including but not limited to borderline personality disorder symptoms, depressive symptoms, anxiety symptoms, and impulsivity (Klonsky *et al.*, 2013). Given this strong evidence, there has been a call for research to identify mechanisms underlying the NSSI – SSI association more specifically. Two theories that answer this call include the Interpersonal Theory of Suicide and Hamza and colleagues' Integrated Model.

Interpersonal Theory of Suicide

The Interpersonal Theory of Suicide (Joiner, 2005) postulates that experiencing both thwarted belongingness and perceived burdensomeness can lead to severe suicidal desire. Notably, it asserts that to facilitate SSI, an individual must also possess the capability to enact SSI to act on one's suicidal desire (i.e., suicide attempt; Joiner, 2005). Work in this area specifies that capability is acquired through life experiences, as well as through genetics (Chu *et al.*, 2017). It is postulated that painful and provocative events (PPEs), such as physical abuse and combat exposure, contribute to the acquired component of suicide capability. Further, the theory suggests that NSSI may serve as a particularly potent PPE: it is hypothesized that engaging in NSSI may influence acquired

capability by increasing one's pain tolerance, as well as decreasing fear related to SSI engagement (via habituation; Chu *et al.*, 2018).

Integrated Theoretical Model

Hamza *et al.*'s (2012) Integrated Model draws from the Interpersonal Theory of Suicide, as well as other extant theories (i.e., Third Variable Theory), to explain the link between NSSI and SSI. First, this model holds that there is a direct pathway between NSSI and SSI. Based on evidence that individuals with a history of both NSSI and suicide attempts report higher levels of psychological distress compared to NSSI alone (e.g., Grandclerc *et al.*, 2016; Hamza *et al.*, 2012; Victor & Klonsky, 2014), the model also asserts this direct relationship is moderated by intrapersonal distress, and that there are shared risk factors for NSSI and SSI which may contribute to their high co-occurrence (i.e., third variables). Finally, the Integrated Model suggests that there is an indirect relationship between NSSI and SSI via acquired capability. The relationship between NSSI and acquired capability is thought to be moderated by the degree of NSSI severity (defined as engaging in more severe NSSI methods, such as cutting), whereas the acquired capability – suicide attempt association is proposed to be moderated by perceived burdensomeness and thwarted belongingness (or the unmet interpersonal needs to belong and for social competence, suggested by the Interpersonal Theory of Suicide as contributing to the development of suicidal desire [Joiner, 2005]) (Hamza *et al.*, 2012).

Current review

The Interpersonal Theory of Suicide and Integrated Model outline potential underlying mechanisms between NSSI and subsequent SSI. Yet, our empirical understanding of the theoretical association has remained relatively stagnant. For example, while evidence continues to mount, strongly suggesting that NSSI prospectively predicts suicide attempts, there has been a more limited research agenda aimed at directly testing the theoretically implicated mechanisms underlying this association. Indeed, in Hamza *et al.*'s (2012) meta-analytic review on the NSSI – SSI relationship, authors focused on identifying studies that examined NSSI as a predictor of SSI, as well as those that compared individuals who engaged in NSSI versus SSI across risk factors but did not systematically examine potential drivers of the association.

It has been over a decade since the Interpersonal Theory of Suicide and Integrated Model were put forth, and yet there is no systematic review of moderating and mediating mechanisms of the association between NSSI and SSI. As the NSSI – SSI association is currently well-established, it is now imperative to understand the underlying mechanisms to not only advance our theoretical understanding of this association but also to inform empirically-supported models of risk and preventative measures to reduce suicidal behaviors among those with a history of NSSI. It is necessary to identify the underlying mechanisms, or mediators, of the relationship between NSSI and SSI, as well as factors that impact, or moderate, the association as a way to identify risk and protective factors for the transition from NSSI to SSI and guide future mechanistic work. Thus, we set forth to conduct the first comprehensive systematic review of the empirical research examining mediators and moderators of the relationship between NSSI and suicidal behavior (i.e., suicide attempts, suicide).

Method

This systematic review was not pre-registered. Study materials are available from the corresponding author upon request. This review was conducted following PRISMA guidelines (Moher et al., 2009). Our electronic search targeted papers published between January 1, 2000 and July 31, 2024 in the following databases: PsycINFO, ERIC, and MEDLINE. See Supplemental Figure 1 for search terms and inclusion flow.

Inclusion and exclusion criteria

Studies were required to be in English and meet the following criteria: (a) explicit definition of NSSI as occurring in the absence of suicidal intent; (b) NSSI was statistically examined as the independent variable; (c) suicide attempts (SA) and/or suicide was examined as the dependent variable(s); (d) use of mediation or moderation to examine the relationship(s) between NSSI and suicidal behavior; (e) sample was not specific to those with intellectual disabilities, autism spectrum disorder, or traumatic brain injury; (f) inclusion of original empirical data (i.e., could not be a review article or study protocol); and (g) peer-reviewed (i.e., could not be a published dissertation study). Of note, pertaining to inclusion criterion (b) articles were included in the current review if NSSI was examined as a moderator, even if not hypothesized as the independent variable, given the statistically identical nature of the two models. Exclusion criteria included: (a) if NSSI was not assessed or the definition of NSSI was ambiguous in nature (i.e., did not clearly distinguish the absence of suicidal intent in their operationalization of NSSI, or did not utilize a validated measure that assesses NSSI as being absent of suicidal intent); (b) if NSSI was not examined as the independent variable (i.e., mediator); (c) if SA was not assessed or the definition of SA was ambiguous in nature (i.e., not clearly distinguished from suicidal thinking, planning, or preparatory behavior); (d) if NSSI or a variable other than SA or suicide was the dependent variable; and (e) if the model did not specify a mediator or moderator. All articles were independently reviewed by the co-first authors to determine inclusion.

Results

Data extraction

Of the 4248 articles produced by the search, 15 met inclusion criteria. The reference sections of these articles were examined, as were relevant articles in the literature, for potentially pertinent articles not identified in the initial electronic search (see Supplemental Figure 1). The final sample (15 articles) was then analyzed and the following data were extracted: (a) recruitment site; (b) sample size and sample characteristics (i.e., age, percent female, number of participants with NSSI history, number of participants with suicidal behavior history); (c) operationalization of NSSI and suicide behavior variables; (d) type of model (i.e., mediation vs. moderation); (e) construct(s) assessed as mediators/moderators; (f) strengths of relationships (i.e., odds ratios, standardized beta weights, partial eta squared), if available (see Supplemental Table 2); and (g) covariates included in the primary analysis. See Supplemental Table 1.

Included articles were then characterized based on the mediator or moderator evaluated, resulting in five primary categories (a single study may belong to more than one category if multiple constructs were examined across models; for Supplemental Table 1, if multiple constructs were examined in a single model, study was

categorized based on majority, however, when categorizing articles in text, articles may be counted within more than one category): (a) articles assessing constructs related to the Interpersonal Theory of Suicide (Joiner, 2005) (five studies); (b) articles assessing NSSI characteristics (four studies); (c) articles assessing cognitive and affective factors (i.e., intrapersonal factors; six studies); and (d) articles assessing suicidal thoughts and planning (two studies). Primary findings for included articles are synthesized below.

Studies related to the Interpersonal Theory of Suicide

Five articles (one longitudinal and four cross-sectional) assessed constructs related to the Interpersonal Theory of Suicide, each examining the role of suicide capability (defined broadly) in the NSSI and suicidal behavior relationship, with one article also considering the role of thwarted belongingness and perceived burdensomeness. Of these articles, 11 unique mediators and 8 unique moderators were examined; only two mediators related to the Interpersonal Theory of Suicide, self-reported fearlessness about death (Gratz et al., 2020; Harris and Ribero, 2021) and acquired capability for suicide (Chu et al., 2018; Gratz et al., 2020), were examined in more than one study and only three moderators related to the Interpersonal Theory of Suicide, pain persistence, pain tolerance, and pain threshold (Law et al., 2017), were examined in more than one study.

Across the two articles that examined fearlessness about death and the one study that examined fearlessness about death *by suicide*, findings are mixed. For example, Gratz et al. (2020), failed to demonstrate a mediating effect for self-reported fearlessness about death, a specific aspect of acquired suicide capability, in the relationship between lifetime NSSI frequency and lifetime SA presence. In contrast, in a more nuanced examination among an undergraduate/young adult sample, higher NSSI frequency predicted number of SAs via reduced fear of death *by suicide*, as well as via higher mental rehearsal of suicide plans, but this was not the case for pain tolerance (Moseley et al., 2022). The potential mediating effect of fearlessness about death in the relationship between lifetime NSSI frequency and SAs has also been examined longitudinally (i.e., 28-days and two-years later). Despite utilizing three hypothesized metrics of fearlessness about death (i.e., self-report, explicit affective suicide image ratings, implicit affective suicide image ratings), only explicit affective ratings (ratings of images on a Likert-type scale from extremely unpleasant to extremely pleasant) of suicide images demonstrated significant mediation. There was a significant indirect effect of NSSI on SAs through changes in explicit affective rating at the 28-day, but not two-year, follow-up (Harris & Ribeiro, 2021).

Researchers have also considered constructs theorized to be linked to suicide capability (Van Orden et al., 2010). For example, pain persistence, defined as an individual's willingness to persist from pain onset to the maximum tolerated pain intensity, as well as pain threshold and tolerance, each significantly moderated the lifetime NSSI frequency – lifetime SA history association in an undergraduate sample (Law et al., 2017). Interestingly, however, these findings were not replicated in a community sample: distress persistence (i.e., one's willingness to persist through subjective distress *and* pain), but not pain persistence, threshold, or tolerance alone, moderated the NSSI – SA association (Law et al., 2017).

Examining a more holistic view of the Interpersonal Theory of Suicide, Chu et al. (2018) investigated acquired capability for suicide as a moderator of the mediating effects of thwarted

belongingness and perceived burdensomeness within the lifetime NSSI presence - SA history relationship: the interaction of thwarted belongingness and perceived burdensomeness was only significantly associated with the number of lifetime SAs at high levels of acquired capability (Chu *et al.*, 2018). Together, support for the constructs central to the Interpersonal Theory of Suicide in the relationship between NSSI and SAs has been mixed. While a few cross-sectional studies found that aspects of acquired capability mediated the NSSI frequency - SA relationship (Law *et al.*, 2017; Mosely *et al.*, 2022), these have only been replicated in a longitudinal framework in one study, albeit with partial support (Harris *et al.*, 2021).

Studies related to NSSI characteristics

Four articles, all with a cross-sectional design, examined the role of specific NSSI characteristics in the association between NSSI and SA history. Of these studies, 30 unique mediators and 2 unique moderators were examined; subjective pain during NSSI was examined in two articles as a mediator (Moseley *et al.*, 2022; O'Loughlin *et al.*, 2021b) and number of NSSI methods was examined in two articles as a moderator (Ammerman *et al.*, 2016; Anestis *et al.*, 2015). Two articles focused on a commonly assessed NSSI behavioral feature - number of NSSI methods. Anestis *et al.* (2015) found that among a large sample of emerging adults, as well as a subsample of participants with at least one prior SA, a greater number of NSSI methods strengthened the lifetime NSSI frequency - lifetime SA relationship (Anestis *et al.*, 2015). In contrast, in a large sample of undergraduates with a history of NSSI, number of NSSI methods did not moderate the association between lifetime NSSI frequency and SA history. Researchers have also focused on experiential or functional aspects of NSSI behavior. In a large sample of undergraduates, the lifetime NSSI frequency - SA history association was stronger among individuals who experienced greater (versus lesser) subjective pain during NSSI engagement (Ammerman *et al.*, 2016).

Another article simultaneously examined several NSSI characteristics as mediators in the relationship between lifetime NSSI frequency and SA. More specifically, authors demonstrated mediating roles of age of NSSI onset; the NSSI methods of burning self, wound interference, pinching self, swallowing dangerous substances, and cutting self; and the anti-suicide, anti-dissociation, affect regulation, autonomy, toughness, and sensation seeking functions of NSSI (O'Loughlin *et al.*, 2021b). Similar to this work, Moseley *et al.* (2022) considered different types and features of NSSI in the relationship with SA. They examined three specific NSSI methods - scratching, cutting, and self-hitting - in addition to the number of NSSI methods as predictors of SA, while considering pain during NSSI, habituation to NSSI (i.e., cutting self more deeply or severely to get the same effect), and acquired capability as serial mediators of this relationship. Across all models there was a significant indirect effect of acquired capability; however, it was also found that there was a significant serial indirect effect on SA via habituation to NSSI and acquired capability for models examining cutting, self-hitting, and number of methods.

Studies related to cognitive and/or affective factors

Six articles with cross-sectional designs included in the review studied affective, cognitive, and/or cognitive-affective experiences. A total of 3 unique mediators and 10 unique moderators were examined; only one mediator related to cognitive and/or affective

factors, emotion regulation self-efficacy, was examined in two studies (Gratz *et al.*, 2020). Spanning both cognitive and affective symptomatology, prior research has also considered the impact of depressive symptoms. Researchers investigated the moderating effect of major depressive disorder diagnostic status in the association between presence of lifetime NSSI and lifetime SA. A significant interaction was found, such that those with both a history of NSSI and lifetime major depressive disorder were most likely to have an SA history (Knorr *et al.*, 2016). Anestis *et al.* (2013) found that higher (versus lower) levels of distress tolerance strengthened the relationship between lifetime NSSI frequency and suicide potential (operationalized as a continuum ranging from no prior SSI to SSI with minimal bodily harm to highly lethal SSI); however, this relationship did not hold when examining number of NSSI methods utilized as opposed to NSSI frequency. Results were replicated in a subsample of individuals with a lifetime SA history (Anestis *et al.*, 2013). Researchers have also tested the mediating role of emotion regulation self-efficacy. In a model that simultaneously examined the mediating effects of emotion regulation self-efficacy and fearlessness about death, emotion regulation self-efficacy significantly mediated the relationship between lifetime NSSI frequency and presence of lifetime SA; this was replicated across an online community sample and among participants receiving substance use treatment (Gratz *et al.*, 2020). Anestis *et al.* (2015) have examined the role of grit and perseverance, finding that each moderates the NSSI - SA relationship. Indeed, the magnitude of the relationship between lifetime NSSI frequency and lifetime SA increased as individuals exhibited greater ability to persist toward long-term goals (i.e., higher grit) and ability to persist during tasks that become difficult or boring (i.e., higher perseverance; Anestis & Selby, 2015). Finally, cognitive flexibility has been investigated as a potential moderator of the relationship between NSSI and lifetime SA. It was found that cognitive flexibility moderated the relationship between number of NSSI methods and SA, but not between NSSI frequency and SA. More specifically, individuals scoring higher on overall cognitive flexibility, as well as the alternatives subscale, have a stronger relationship between NSSI methods and SA history (Park & Ammerman, 2023).

Several additional salient cognitive-affective constructs (i.e., resilience, life satisfaction, and subjective happiness) have also been explored as potential protective factors in the NSSI - SA association. However, these constructs did not moderate the relationship between past-year NSSI frequency or past-year number of NSSI methods and past-year SA, demonstrating no protective role (Muehlenkamp & Brausch, 2019).

Studies related to suicidal thoughts and planning

Two articles with cross-sectional designs examined the moderating role of the presence of suicidal thinking and planning, respectively, on the NSSI - SA relationship; neither moderator was examined in more than one study. Focusing on the interaction between past-year NSSI frequency and suicidal ideation in predicting frequency of lifetime SA, Brackman *et al.* (2016) demonstrated elevated lifetime SA risk when a participant reports both greater suicidal ideation frequency and a greater past-year NSSI frequency. Similarly, Sellers *et al.* (2021) aimed to reconstruct the temporal relationship between NSSI, suicidal planning, and SA leading up to a psychiatric hospitalization among adolescents utilizing a timeline follow-back interview. They found that while the presence of NSSI and suicidal planning independently increased the likelihood of

same-day SA, the interactive effect did not impact same-day SA likelihood.

Discussion of review findings

We identified a dearth of studies examining moderators or mediators of the relationship between NSSI and suicidal behavior, with only 15 articles in this area; no studies examined death by suicide as an outcome. Further, only one study was published in the prior two years. We consider three prominent weaknesses in the reviewed literature: (1) the mediators and moderators examined had a limited intersection with existing theoretical models of the NSSI – SSI relationship, (2) little replication of findings across studies, and (3) only one of the included studies utilized a prospective design. These weaknesses severely limit our ability to evaluate existing theoretical models of the risk relationship between NSSI and SSI.

As noted, one of the key limiting factors of the reviewed literature is the considerable variability in the studied mechanisms, with 40 unique mediators and 22 unique moderators examined across the 15 articles. Four mediators were examined in more than one study: acquired capability for suicide (Chu et al., 2018; Gratz et al., 2020); fearlessness about death (Gratz et al., 2020; Harris and Ribeiro, 2021); subjective pain during NSSI (Moseley et al., 2022; O’Loughlin et al., 2021b) and emotion regulation self-efficacy (two studies presented in the same manuscript; Gratz et al., 2020). Four moderators were examined in more than one study: pain persistence, pain threshold, and pain tolerance were examined in two studies, presented in the same manuscript (Law et al., 2017), and number of NSSI methods were examined in two studies (Ammerman et al., 2016; Anestis et al., 2015). Given the variability in evaluated mediators and moderators across studies, there is not adequate replicability in constructs assessed. Only 13 studies (across 10 articles) concurrently assessed multiple mediators and/or moderators within a given model, limiting the conclusions that can be drawn about the cumulative or interactive roles across theorized constructs. While expanded upon below, these limitations prohibit evidentiary conclusions regarding existing theoretical models from being drawn. As several constructs not included in established theoretical models demonstrated a significant role in the NSSI – SSI relationship (i.e., rumination, emotion regulation processes), this strongly casts doubt as to whether the current theoretical frameworks are able to capture the complexity of the relationship between NSSI and SSI.

Our systematic review also highlights that the vast majority of the extant research has been limited by the employment of cross-sectional designs. Only three studies considered the temporal sequence of NSSI and suicide-related outcomes in their investigation (Brackman et al., 2016; Chu et al., 2018; O’Loughlin et al., 2021a, 2021b) and only one conducted a longitudinal investigation (Harris & Ribeiro, 2021). Notably, the longitudinal investigation examined *lifetime* NSSI as the independent variable in the risk relationship between NSSI and SSI. This is problematic as the impact of recency of NSSI behavior, or behavior onset, in relation to the proposed mechanisms has yet to be established. Moreover, the majority of studies examining mediators of the NSSI – SSI relationship identified in the review were cross-sectional, which is inherently limiting as such models are unable to adequately account for temporality or control for plausible confounds and may not be replicable in longitudinal designs (Maxwell et al., 2011). Nevertheless, cross-sectional mediation can lay the groundwork for the development of meaningful theoretical contributions.

Further, many of the studies examining moderators of the NSSI – SSI relationships utilized lifetime SSI as the outcome; of the 12 cross-sectional studies examining moderators of the NSSI – SSI relationship, only two (Muehlenkamp & Brausch, 2019; Sellers et al., 2021) utilized SSI occurring in a shorter timeframe (i.e., past-year, past 90 days, respectively). While these studies have provided preliminary information that can inform future research, they do not provide insight into the temporal ordering of these relationships. Unfortunately, consistent with the current theoretical frameworks, research to date has not allowed for the capture of, what we expect to be, the temporal and dynamic associations between NSSI and SSI. Acknowledging the significant limitations noted above, we summarize the empirical evidence and evaluate it through the lens of extant theoretical models.

Integration of findings into theoretical models

Despite the prominence of suicide capability in the theorized relationship between NSSI and SSI within the Interpersonal Theory of Suicide (Van Orden et al., 2012), only five articles directly examined this relationship (Chu et al., 2018; Gratz et al., 2020; Harris & Ribeiro, 2021; Law et al., 2017; Moseley et al., 2022). While the cross-sectional findings generally support the proposed relationship, the single longitudinal study examining this association offers limited empirical support (Harris & Ribeiro, 2021). Longitudinal findings are in line with recent suicide capability literature, which fails to demonstrate significant associations between suicide capability and SA over time (Ribeiro et al., 2021) and argues against the significance of suicide capability in SSI due to limited empirical support (Chu et al., 2017; Huang et al., 2021; Ribeiro et al., 2020). It is possible that mixed findings in the current review may be due to varying approaches to assessing suicide capability. For example, some researchers utilized a common self-report measure and iterations of this measure (i.e., Acquired Capability for Suicide Scale (ACSS), ACSS-FAD; Chu et al., 2018; Gratz et al., 2020), whereas others employed theoretically linked behavioral measures (e.g., affect misattribution, pain persistence, distress persistence; Harris & Ribeiro, 2021; Law et al., 2017). Further, two of the studies in this review conceptualized NSSI features as indicators of suicide capability (i.e., Ammerman et al., 2016; Anestis et al., 2015; subjective pain during NSSI and number of NSSI methods used), blurring the distinction between NSSI severity operationalization and suicide capability. Additionally, despite the likely dynamic nature of capability (Smith & Cukrowicz, 2010; Spangenberg et al., 2019), it is often assessed in a trait-like manner (e.g., via a single self-report measure; Rogers & Joiner, 2019). Finally, and perhaps most importantly, despite the fact that suicide capability is one of the most broadly discussed mechanisms of the NSSI – SSI relationship, and is central to both Joiner’s and Hamza’s NSSI-SSI models, our review identified only five empirical studies that have tested this mechanism in a mediation framework (Chu et al., 2018; Gratz et al., 2020; Harris and Ribeiro, 2021; Moseley et al., 2022). Thus, the real possibility of publication bias should be considered when evaluating this small and mixed body of empirical evidence.

Paralleling the lack of empirical literature evaluating the Interpersonal Theory of Suicide, few studies have examined the additional theorized associations outlined in Hamza et al.’s (2012) Integrated Model, including the likely effect of intrapersonal distress on the NSSI – SSI association. The few studies identified in the review (i.e., Anestis et al., 2013; Knorr et al., 2016) suggest that, in line with the Integrated Model, several constructs related to

intrapersonal distress serve to strengthen the role between NSSI and suicide-related outcomes. However, research has yet to replicate any given association (i.e., only one study examined the role of distress tolerance), limiting the generalizability of these findings.

One aspect of the Integrated Model that has received more attention in the empirical literature reviewed is the role of NSSI severity. The Integrated Model suggests that suicide capability may mediate the association between NSSI and SSI, and, more specifically, that NSSI severity (as defined in the model as engaging in more severe methods of NSSI) may moderate the association between NSSI and suicide capability within this relationship (Hamza *et al.*, 2012). Findings included in the current review underscore that specific characteristics of NSSI, including NSSI methods utilized (O'Loughlin *et al.*, 2021b), do play a role in the NSSI – SI relationship as hypothesized in The Integrated Model. Notably, however, the definition of NSSI severity employed in The Integrated Model is limited. It is worthwhile to note that other features of NSSI often considered to be indicators of greater severity, including frequency (Brackman *et al.*, 2016) and number of NSSI methods utilized (Anestis *et al.*, 2015), were demonstrated in the review to also have an impact on the NSSI – SSI relationship. Yet, despite providing general support for the role of NSSI severity, the operationalization of NSSI severity and the nature of the relationship (i.e., mediator vs. moderator) have yet to be fully articulated or explored.

Taken together, our review highlights a foundational gap in the current state of the literature on the NSSI – SSI relationship. Not only has the existing literature been limited in providing the necessary empirical foundation for current theoretical models, but it has also highlighted that several constructs potentially central to the NSSI – SSI relationship have been overlooked. Further, the intricacies of the temporal relationship between NSSI, SSI, and the drivers of this relationship have not been fully accounted for and are rarely directly examined. Consequently, our theoretical frameworks (and accordingly, our empirical investigations) as they currently exist, are hampered in their ability to capture the complexity of the relationship between these two behaviors. Thus, there is a critical need to put forth an empirically supported theoretical framework that incorporates a broader range of factors that have been demonstrated as potential drivers of the NSSI – SSI association.

Proposing a new conceptual model: The Nonsuicidal to Suicidal Self-Injury Pathway Model

To address the gaps in prior theoretical models outlining the role of NSSI as a risk factor for subsequent SSI, we propose a new conceptual framework, the Nonsuicidal to Suicidal Self-Injury Pathway Model. We highlight a comprehensive set of factors that have garnered empirical support and their proposed role in a new elaborated conceptual model. This model considers the presence of NSSI / NSSI engagement (i.e., any lifetime NSSI history, inclusive of a singular NSSI act), rather than other metrics of NSSI severity (i.e., number of NSSI acts) as the primary independent variable, given the literature highlighting that *any* history of NSSI elevates one's risk of suicidal behavior (e.g., Franklin *et al.*, 2017; Ribeiro *et al.*, 2016). Indeed, we intend for this model to specifically address the pathways by which SSI risk is facilitated *among those with a history of NSSI*. We also believe that this model may be most relevant for those with recent NSSI onset, which is most likely to occur in early adolescents (i.e., 12–14 years old; Ammerman *et al.*,

2018), given the progression from NSSI to SSI ranges from 1 to 3 years (Glenn *et al.*, 2017; Kiekens *et al.*, 2018; O'Loughlin *et al.*, 2020).

Briefly, in the proposed model, we put forth several novel categories of mediators in the NSSI – SSI relationship (i.e., intrapersonal distress, cognitive and affective regulation, interpersonal factors, self-view, suicide capability), secondary (serial) mediators (i.e., suicidal ideation/planning), as well as model moderators (i.e., NSSI severity, NSSI public stigma). Additionally, the model considers an array of important third variables. Our hope is that this model can serve as an expanded, although preliminary, framework through which to view the NSSI – SSI relationship, as well as a model to guide avenues of future between- and within-person research. We also hope that this model can be useful to guide clinicians in their approach to the assessment of, and intervention upon, risk factors when working with those engaging in NSSI. See Figure 1 for a graphical representation of the Nonsuicidal to Suicidal Self-Injury Pathway Model and Table 1 for an overview of the included theoretical constructs.

Mediators

Building on the Integrated Model, we maintain the role of suicide capability and we propose four additional categories of potential mediators of the NSSI – SSI association: intrapersonal distress, cognitive and affective regulation, interpersonal factors, and self-view. Indeed, we posit that NSSI may directly affect each domain of risk factors, and in turn, each domain of risk factors may directly increase suicidal ideation/planning (i.e., serial mediation), and thus influencing risk for future SSI. The primary exception to this pathway is suicide capability: we propose NSSI directly increases suicide capability, which, in turn, influences SSI risk.

Intrapersonal distress

Within the Integrated Model, intrapersonal distress is hypothesized as a moderator of the association between NSSI and SSI. Instead, we offer the perspective that it serves as a mediator. Although ample evidence indicates aversive intrapersonal states precede and predict NSSI, and that engagement in NSSI may lead to immediate relief (e.g., Hepp *et al.*, 2020), there is some evidence that NSSI may increase negative affective states over extended periods (Buelens *et al.*, 2019; Burke *et al.*, 2019; Houben *et al.*, 2017). Indeed, engaging in NSSI prospectively predicts an increase in negative emotionality on the timescale of hours (Houben *et al.*, 2017). Results over longer-term follow-up periods are mixed. Some evidence suggests that NSSI predicts increases in depressive symptoms over the following months (Burke *et al.*, 2019) and years (Mars *et al.*, 2014), and more general psychological distress in the following three years (Buelens *et al.*, 2019). However, other evidence has shown null effects over similar periods (Burke *et al.*, 2019; Marshall *et al.*, 2013). Despite some mixed findings, accumulating evidence indicates it is plausible that engaging in NSSI may lead to increases in intrapersonal distress, across a wide range of constructs (i.e., depression, negative emotionality, and general distress), and across various time frames.

Cognitive and affective regulation

A mounting body of literature implicates cognitive and affective regulation in the etiology of NSSI; individuals engage in NSSI, in part, to regulate labile cognitive-affective experiences such as through distraction or the interruption of ruminative or self-critical processes (i.e., Hooley & Franklin, 2018; Selby *et al.*, 2013).

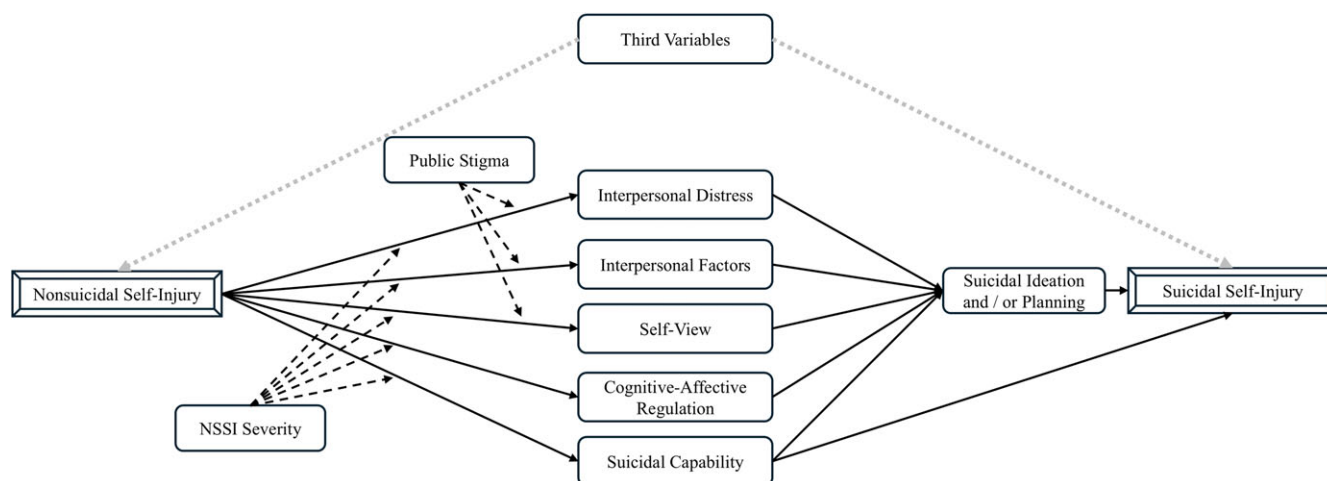


Figure 1. Nonsuicidal to Suicidal Self-Injury Pathway Model. *Note:* Gray dotted lines represent variables impact both nonsuicidal self-injury and suicidal self-injury; dashed lines represent moderating variables; solid lines represent mediating variables; all mediating variables are assumed to have cross-sectional and prospective bidirectional associations with one another; the heterogeneity in the suicidal ideation to action process is beyond the scope of this model, however, the proposed model relies on empirical work suggesting that suicidal ideation most often precedes suicidal behavior.

While NSSI may be effective at regulating such processes in the short-term, repeatedly relying on NSSI as a coping strategy may result in poorer cognitive-affective regulation over time. For example, a lack of self-efficacy in one's emotion regulation skills (i.e., lacking the belief that one is capable of changing their current emotional state; Tamir & Mauss, 2011) may be reinforced through one's environment (i.e., others may begin to fragilize those with repetitive NSSI), thus reducing opportunities to experience distress and practice adaptive emotion regulation skills (Robinson et al., 2019). Furthermore, by continually engaging in NSSI to avoid highly aversive emotions, individuals may begin to find these emotional experiences more intolerable as opportunities for habituation become less frequent (Robinson et al., 2019). Indeed, individuals who repeatedly engage in NSSI may experience reductions in emotion regulation self-efficacy over time (Robinson et al., 2019). In line with this conjecture, a longitudinal, bidirectional relationship between NSSI and emotion regulation difficulties among university students (Ewing et al., 2019) and community adolescents (Robinson et al., 2019) has been demonstrated. Similarly, research has suggested a prospective association between past 12-month NSSI and rumination (Buelens et al., 2019). This may be explained through research highlighting that thought suppression may actually increase the aversive thoughts that one is attempting to suppress (e.g., Abramowitz et al., 2001). Thus, for individuals who use NSSI to disrupt ruminative processes or to suppress thoughts, NSSI may serve to inadvertently increase aversive thought patterns and rumination over time (Buelens et al., 2019). Further, like the proposed effects of continual reliance on NSSI to cope with negative emotions, relying on rumination (and thus, NSSI to disrupt this process) may lead to reduced opportunities to practice more adaptive cognitive coping strategies (e.g., problem-solving) (Buelens et al., 2019).

Ample evidence supports the notion that maladaptive cognitive-affective regulatory processes, including poor emotion regulation skills, elevated levels of rumination, and low emotion regulation self-efficacy, may increase the risk of suicidal ideation (Hatkevich et al., 2019; Heffer & Willoughby, 2018; Miranda et al., 2013). We therefore posit that cognitive and affective regulation may serve as mediators for the relationship between NSSI and SSI. Although limited by a cross-sectional design, a study by Gratz et al.

(2020) provides initial direct evidence of this mechanism in two separate samples, focusing specifically on the construct of emotion regulation self-efficacy as a mediator of the relationship between NSSI and SA.

Interpersonal factors

While most individuals report emotional motivations for engaging in NSSI, social or interpersonal motivations are endorsed among approximately 33–65% of individuals (Heath et al., 2009; Taylor et al., 2018). Notably, negative affect that precedes NSSI may result from interpersonal distress (Ammerman et al., 2021), with elevated interpersonal stress often preceding acts of NSSI (Turner et al., 2017; Victor et al., 2019). While NSSI may serve to reduce interpersonal stress both directly and indirectly, there is evidence that NSSI may also inadvertently *increase* interpersonal stress.

The stress generation hypothesis purports that individuals may engage in certain behaviors as a result of psychopathology that may, in turn, directly generate stress (Conway et al., 2012). Extending this to the NSSI literature, Burke et al. (2015) found preliminary support for greater NSSI engagement predicting the occurrence of interpersonal stress. Moreover, NSSI may contribute to chronic interpersonal stress, even after adjusting for levels of prior interpersonal stress (Miller et al., 2018). Longitudinal research has also shown that stressful experiences, including interpersonal events, are bidirectionally related to NSSI among university students (Ewing et al., 2019) and community adolescents (Baetens et al., 2021). With mounting evidence underscoring the central role of stress in SSI (Franklin et al., 2017), and particularly interpersonal stress (e.g., Ammerman et al., 2021), we suggest that interpersonal distress may function as one mechanism underlying the prospective relationship between NSSI and SSI.

Beyond the hypothesized role of NSSI in eliciting interpersonal distress, NSSI may contribute to other interpersonal factors that also increase risk for SSI. One of the reported interpersonal functions of NSSI is the facilitation of group bonding (e.g., Nock & Prinstein, 2005). Prior research suggests individuals who engage in NSSI are more likely to have friends who self-injure (Nock & Prinstein, 2005) and to befriend individuals similar to themselves

Table 1. Nonsuicidal to suicidal self-injury pathway model example constructs

Variable category	Example constructs
Third Variables	Psychopathology; Interpersonal factors; Intrapersonal distress; Cognitive-affective regulation factors; Neurocognitive factors; Biological factors; Suicidal ideation
Mediators	
Intrapersonal distress	General negative affect / emotionality; General distress; Shame; Guilt; Depression; Other psychopathology
Interpersonal factors	Interpersonal stress; Exposure / contagion to NSSI
Self-view	Self-criticism; Low self-esteem; Self-disgust; Self-stigma; NSSI-related identity
Cognitive and affective regulation	Emotion (dys)regulation; Emotion regulation self-efficacy; Rumination; Thought suppression
Suicide capability	Exposure to painful and provocative events; Pain tolerance / sensitivity; Fearlessness about death; Lethal means knowledge; Access to means
Suicidal ideation/ planning	Suicidal ideation, suicide planning
Moderators	
NSSI severity	NSSI frequency; Number of NSSI methods; NSSI scarring; Medical attention due to NSSI
Public stigma	Stereotypes; Negative attitudes towards those with NSSI history

Note: NSSI = nonsuicidal self-injury.

(i.e., friends with past or present NSSI; Prinstein *et al.*, 2010). This phenomenon has been regularly referred to as the “contagion effect,” wherein an individual’s engagement in NSSI is associated with others’ later engagement in NSSI, even among those with no prior history of NSSI (Taiminen *et al.*, 1998). Notably, this association may be bidirectional. Researchers found significant reciprocal associations between perceptions of friends’ self-injury and adolescents’ own NSSI engagement, such that adolescents’ NSSI was longitudinally associated with higher levels of perceptions of friends’ self-injury nine months later (Prinstein *et al.*, 2010). These findings are consistent with theory related to peer selection effects, by suggesting that engagement in NSSI may lead to greater exposure to others’ self-injury over time and vice versa. We therefore suggest that engaging in NSSI may increase exposure to others’ self-injury, which may, in turn, increase risk for suicide-related outcomes, thus serving as a mediator.

Self-view

Distinct from the above intrapersonal and cognitive and affective regulation, self-view is characterized as a self-directed cognitive process (e.g., James *et al.*, 2015; Verplanken *et al.*, 2007). NSSI engagement is associated with several markers of negative self-view, including greater negative self-talk (Wolff *et al.*, 2014), increased self-critical thoughts (Burke *et al.*, 2021), lower self-esteem (Forrester *et al.*, 2017), and greater feelings of worthlessness (Chapman *et al.*, 2006), self-disgust (Smith *et al.*, 2015), and self-dissatisfaction (Victor & Klonsky, 2014). Several theoretical models have underscored the role of negative self-view in the development and maintenance of NSSI (i.e., Hooley & Franklin, 2018; Nock, 2009), supported by meta-analytic evidence

demonstrating the longitudinal relationship between specific forms of negative self-view (i.e., self-criticism) and NSSI engagement (Zelkowitz & Cole, 2020). Although most frequently conceptualized as a precipitant of NSSI, mounting evidence indicates many individuals report negative self-view as a direct result of engaging in NSSI (Burke *et al.*, 2017). While there is a bidirectional longitudinal relationship between NSSI and negative self-view (i.e., self-criticism; Daly & Willoughby, 2019), there have been mixed findings on the prospective relationship between NSSI and self-criticism (e.g., Burke *et al.*, 2019), highlighting the need for greater research.

There is evidence that NSSI may also negatively influence self-view via self-stigma (i.e., the agreement with and application of public stigma to the self; Corrigan & Rao, 2012). There is a high degree of public stigmatization of NSSI (Burke *et al.*, 2019), which is often internalized. Indeed, research leveraging both explicit and implicit assessment methods demonstrates high levels of self-stigma among individuals with an NSSI history (Piccirillo *et al.*, 2020). Individuals with an NSSI history often report experiencing shame and embarrassment as a direct result of their self-injurious behaviors, an emotional consequence that may be exacerbated for individuals who bear physical scarring from NSSI (e.g., Burke *et al.*, 2017; Burke *et al.*, 2020). Not surprisingly, the internalization of stigmatization has been associated with reductions in self-esteem and self-efficacy (Corrigan & Rao, 2012).

Under the umbrella of self-view, we also propose that engagement in NSSI may lead to the development of an identity associated with self-injury. Accumulating evidence indicates those with a history of NSSI demonstrate greater associations between NSSI and the self (Cha *et al.*, 2016; Glenn *et al.*, 2017). These effects were also sensitive to both severity and recency of NSSI behavior (Glenn *et al.*, 2017) and a reciprocal relationship between NSSI frequency and self-injury implicit association task performance over one year has been observed (Glenn *et al.*, 2016). Importantly, the average age of NSSI onset coincides with a normative phase of identity development, adolescence (e.g., Erikson, 1968), highlighting the potential pertinence of NSSI in the formation of one’s identity (i.e., viewing oneself as a “self-injurer”; Breen *et al.*, 2013). Supporting this notion, adolescents with greater identity confusion and lower identity synthesis are found to be at greater risk for NSSI (Claes *et al.*, 2014). Evidence also suggests this relationship may be bidirectional, such that NSSI prospectively relates to delays in identity formation (Gandhi *et al.*, 2017; Luyckx *et al.*, 2015), potentially attributed to, or contributing to, increased identification with NSSI. This may also increase the likelihood of affiliation with peers who also engage in NSSI. For example, by identifying as a “self-injurer”, an adolescent may be more likely to be exposed to others who engage in NSSI through online message boards or communities (Lewis *et al.*, 2012).

Evidence suggests that the aforementioned forms of self-view are predictive of suicide-related outcomes. Negative self-view has been linked to SSI through theoretical models (i.e., O’Connor, 2011) and empirical literature, including elevated self-criticism, lower self-esteem, and increased negative self-statements (even after accounting for other key risk factors; i.e., depression) (Butter *et al.*, 2019; Campos *et al.*, 2013). Further, these associations prospectively predict SAs (Wichstrom, 2000) and are likely independent of other emotional consequences (such as those resulting from NSSI), as changes in self-criticism predict changes in suicidal ideation, after controlling for changes in distress

(Campos et al., 2018). Further underscoring the relevance of self-view, identification with NSSI differentiates individuals with vs. without suicidal ideation and SA history, as well as predicts suicidal ideation six-months later (Nock & Banaji, 2007), even when controlling for demographics, psychiatric risk factors, and prior suicidal ideation and SA. Taken together, it is possible that, while various aspects of one's self-view may lead to NSSI engagement, NSSI itself may further perpetuate negative self-views through increasing self-criticism, self-stigma, and one's self-association with NSSI, potentially serving to increase risk for SSI.

Capability

In line with past models, we propose that the relationship between NSSI and SSI is mediated by capability for suicide; in contrast to other mediators in our model, however, we propose a direct relationship from suicide capability to SSI, rather than through suicidal ideation/planning. Further, we specify that capability not only encompasses the constructs that are hypothesized to be (in part) acquired through repeated exposure to experiences that increase pain tolerance and decrease fearlessness about death but also incorporates practical factors that contribute to capacity to enact SSI. Such factors include lethal mean knowledge or familiarity and access to means, all of which may be acquired through NSSI engagement (Joiner, 2005; Klonsky & May, 2015). Accumulating cross-sectional evidence indicates greater self-reported suicide capability amongst those with a history and greater frequency of NSSI (Matney et al., 2018; Willoughby et al., 2015), and that there may be a prospective unidirectional relationship between NSSI frequency and acquired capability (Willoughby et al., 2015). Furthermore, individuals with a history of NSSI and SSI (vs. without) exhibit greater experimentally assessed pain tolerance and lower pain sensitivity (e.g., Koenig et al., 2016); but it's unclear if NSSI leads to changes in pain sensitivity over time (Koenig et al., 2017). Finally, there are mixed findings on the relationship between NSSI and fearlessness about death, (e.g., Gratz et al., 2020) with little direct research regarding the practical aspects of suicide capability. However, indirect evidence highlights that greater frequency of NSSI is associated with utilizing more NSSI methods (e.g., Ammerman et al., 2020), which may increase one's access to, familiarity with, and knowledge of potentially lethal methods to enact SSI (e.g., cutting, ingesting poisonous substances).

There is evidence that facets of capability are associated with SA, although findings are limited and mixed (Bauer et al., 2019; Bryan et al., 2010). In a meta-analysis of the Interpersonal Theory of Suicide, findings supported a modest significant interaction between capability, thwarted belongingness, and perceived burdensomeness in association with SA history (Chu et al., 2017). However, in the only longitudinal study on the association between the specific suicide capability facet of fearlessness about death and SA, findings indicated no main effect on future SA risk, as well as no interactive effect with suicidal desire (Ribeiro et al., 2020).

Taken together, while there is some mixed evidence regarding the association between the NSSI – suicide capability – SSI relationships, given the theoretically plausible role of capability as a mechanism underlying the association between NSSI and SSI, we include capability as a mediator in our model to encourage advances in its assessment and a more rigorous investigation of its role in the NSSI-SSI association.

Suicidal ideation and/or planning

The final specified mediator of the proposed model is a serial mediator, suicidal ideation (SI) and/or suicidal planning (SP). As previously noted, we propose that the above mediators, with the exception of suicide capability, do not have a direct effect on SSI. Rather, we suggest these parallel mediators lead to elevated SSI risk by increasing the likelihood of experiencing SI and/or SP. Although previously acknowledged that SI likely serves as a risk factor for both NSSI and SSI (thus meets criteria to be considered a third variable), we assert that engagement in NSSI may also increase risk for SI and/or SP. Indeed, NSSI has been demonstrated to onset prior to SI (Kiekens et al., 2018) and SP (Glenn et al., 2017; Kiekens et al., 2018). Furthermore, NSSI is predictive of SI (e.g., Kiekens et al., 2018) and SP (Muehlenkamp et al., 2022). We posit that this is due, at least in part, to NSSI's impact on intrapersonal distress, cognitive and affective regulation, self-view, and interpersonal factors. Supporting this postulation, prior research has highlighted that factors falling under the umbrella of each mediator category are associated with, or even prospectively predict, SI and/or SP. For example, high levels of intrapersonal distress (i.e., hopelessness, internalizing psychopathology) are prospectively predictive of SI (Franklin et al., 2017), and factors influencing one's ability to regulate these negative intrapersonal experiences, such as distress tolerance, emotion (dys)regulation, and rumination (e.g., Law et al., 2015; O'Connor & Noyce, 2008), are associated with SI, and may even serve as a pathway between NSSI and SSI (Anestis et al., 2013). Further, poorer self-view (i.e., lower self-esteem, greater self-criticism) has also been linked to SI (O'Connor & Noyce, 2008). Finally, meta-analytic evidence underscores the role of interpersonal distress in predicting longer-term, as well as proximal, risk for SI (Chu et al., 2017; Kyron et al., 2018). Although the literature on SP is much more limited, there is support for intrapersonal distress indicators (i.e., depressive symptoms; Borges et al., 2008; Nock et al., 2008) and greater cognitive-affective regulatory deficits (e.g., Knorr et al., 2019) as predictive of SP. Given that SI and SP are well-established predictors of SSI (e.g., Franklin et al., 2017; Ribeiro et al., 2016), we theorize SI/SP serve a central role in the NSSI – SSI association. While the role of SI/SP as a serial mediator may not be pertinent for all individuals who engage in NSSI, the proposed pathways are likely still applicable in understanding the NSSI – SSI association, even in the absence of SI or SP.

Relationships between proposed mediators

We hypothesize transactional relationships between all proposed mediators, as well as with NSSI (e.g., Sameroff & Mackenzie, 2003). For example, NSSI's role in generating interpersonal stress may reduce opportunities to observe and practice the use of healthy emotion regulatory strategies, both of which may exacerbate intrapersonal distress and negative self-view (e.g., Robinson et al., 2019). Further, associations among proposed mediators may interact over time to ultimately exponentially amplify risk for SI/SP (e.g., Campos et al., 2018) and SSI (Ribeiro et al., 2016).

Moderators

We highlight two key moderators that may strengthen the relationship between NSSI and the proposed mediators: NSSI severity and the experience of NSSI-specific public stigma. We propose the impact of NSSI severity may be broader reaching, impacting each of the mediators, whereas the experience of NSSI

public stigma may be more likely to impact associations with intrapersonal distress, interpersonal factors, and one's self-view.

NSSI severity

While there is no single agreed-upon definition of NSSI severity, we operationalize NSSI severity as the *physical* severity of the behavior, or the extent to which tissue is affected. We assert NSSI severity, thus, has a range of indicators including greater NSSI frequency, number of NSSI methods used, need for medical attention secondary to NSSI, and physical scarring due to NSSI (i.e., Ammerman *et al.*, 2018, 2020; Burke *et al.*, 2016). Ample research has evidenced that greater NSSI severity is associated with poorer mental health outcomes, including a greater risk for SSI (Ammerman *et al.*, 2016; Anestis *et al.*, 2015; Victor & Klonsky, 2014). The relationship between NSSI severity indicators and SSI may be impacted by the association between NSSI and other intermediate factors (i.e., hypothesized mediators). For example, more frequent NSSI has been associated with poorer coping skills (Hasking *et al.*, 2008), increased intrapersonal distress, greater psychiatric symptoms (i.e., Hasking *et al.*, 2008; Paul *et al.*, 2015), poorer self-view (e.g., Zerkowitz & Cole, 2020), and greater interpersonal conflict (Adrian *et al.*, 2011). Similarly, employing a greater number of NSSI methods has been associated with greater intrapersonal distress (Paul *et al.*, 2015; Turner *et al.*, 2013; Victor & Klonsky, 2014) and poorer emotional and behavioral control (Adrian *et al.*, 2011; Turner *et al.*, 2013). While less often studied, other indicators of NSSI severity, such as scarring as a result of NSSI (e.g., Burke *et al.*, 2016) and the need for medical attention due to NSSI (i.e., Chartrand *et al.*, 2015), have also been associated with poorer mental health outcomes. Finally, as discussed above, greater NSSI severity may contribute to increased capability for suicide (Joiner *et al.*, 2012; Matney *et al.*, 2018; Willoughby *et al.*, 2015). Given this evidence, it is anticipated that NSSI severity will serve to strengthen the relationship between NSSI and the proposed mediators in the path to SSI.

Of note, we suggest that not only does greater NSSI severity strengthen the association between NSSI and the proposed mediators, but that greater severity also increases the strength of the downstream effects of NSSI and the subsequent impact on risk for SSI, as each mediator may serve to drive repeated NSSI engagement and increased NSSI severity. As a review of the functional properties of NSSI is beyond the scope of the proposed model, we draw readers' attention to Hooley and Franklin's Benefits and Barriers Model of NSSI (2018) and depiction of the "Affective Engine" of repeated NSSI for additional detail on the reinforcing properties (or benefits) of NSSI, as well as NSSI engagement's weakening of barriers to enacting SSI, both of which also serve to reinforce NSSI itself.

NSSI public stigma severity

Public stigma involves agreeing with a stereotype about a specific population or group of individuals (i.e., a harmful, public belief about a group of individuals; Corrigan *et al.*, 2011), which can lead to harmful cognitions (i.e., prejudice) and behaviors (i.e., discrimination; Corrigan *et al.*, 2011). There is an empirical base supporting the widespread presence of public NSSI stigma. NSSI is often misunderstood, ranging from misconceptions that NSSI is used for attention or to be manipulative (Lewis *et al.*, 2014) and that it is superficial or transitory (Mitten *et al.*, 2016) to the belief that NSSI is present only among teens (Hughes *et al.*, 2017) or girls (Lewis *et al.*, 2014). Oft, these misconceptions

result in prejudice and discrimination, as well as cognitive and behavioral biases that contribute to, or result from, public stigma (Corrigan & Shapiro, 2010). Public NSSI stigma is, unfortunately, relatively ubiquitous. Negative attitudes toward NSSI have been reported by medical staff (Saunders *et al.*, 2012), psychologists (Gagnon & Hasking, 2012), parents (Hughes *et al.*, 2017), and peers (Burke *et al.*, 2019) of those who self-injure. Prior research suggests that individuals who are stigmatized based on their mental health suffer a variety of adverse effects, such as social withdrawal, low self-esteem, self-deprecation, negative affect, and shame, as well as increased psychiatric symptoms (Stier & Hinshaw, 2007).

Thus, it is anticipated that greater public stigma of NSSI in one's environment (e.g., family, peers, school, state, country) will exacerbate the relationship between NSSI and several of the proposed mediators, including interpersonal stress, intrapersonal distress, and negative self-views (including NSSI-specific self-stigma; Burke *et al.*, 2019), thus having a downstream effect on risk for SI/SP, and SSI.

Third variables

We assert that third variables account for significant shared variance between NSSI and SSI. We specifically highlight psychopathology, interpersonal factors, intrapersonal distress, cognitive and affective regulation, neurocognitive factors, and biological factors (among numerous others) to likely have a direct effect on both NSSI and SSI. As with many other third variables (i.e., intrapersonal distress), we highlight that in addition to SI/SP being a candidate (serial) mediator, they are also likely third variables. Evidence suggests that SI and SP may not only be longitudinal predictors of SSI (Franklin *et al.*, 2017), but SI also may predict NSSI (Burke *et al.*, 2023; Kyron *et al.*, 2018). Indeed, a commonly cited function of NSSI, the anti-suicide function, is to respond to SI without engaging in SSI (e.g., Burke *et al.*, 2018; Kraus *et al.*, 2020; Park *et al.*, 2024), highlighting the role of SI as a risk factor for subsequent NSSI for some individuals. While there has been less research related to SP, there are similarities in the NSSI – SI and NSSI – SP associations (e.g., Burke *et al.*, 2018), suggesting SP may also serve as a predictor of NSSI. Given this, we view the specification of third variables, including SI/SP, as essential in understanding the complexity of the NSSI – SSI relationship. Finally, we suggest that NSSI and SSI may share similar motivations or functions, which may also serve as third variables. We direct the reader to review the four-function model of NSSI (Nock & Prinstein, 2004; Nock, 2009), which suggests that NSSI is reinforced and maintained via four functional reinforcement processes (i.e., automatic [i.e., intrapersonal] negative reinforcement, automatic positive reinforcement, social [i.e., interpersonal] negative reinforcement, social positive reinforcement). There is evidence that many of the functions of NSSI also serve as functions for SSI (Brown *et al.*, 2002).

Outcome

Our model is intended to encompass both non-lethal and lethal suicidal behaviors. We recognize that the correlates of non-lethal suicide attempts and dying by suicide may differ significantly (Beghi *et al.*, 2021; Reutfors *et al.*, 2021). Given we identified no studies in the present systematic review examining mechanisms underlying the association between NSSI and suicide death, this is an important area for future research to address.

Considerations for collecting data needed to evaluate the Nonsuicidal to Suicidal Self-Injury Pathway Model

The current review highlights notable methodological limitations of the literature to date, which will be necessary to address in testing the Nonsuicidal to Suicidal Self-Injury Pathway Model and alternative theoretical models. Below, we outline the methodological considerations we view as most pertinent to evaluating the model's hypotheses, necessary to provide initial support for the overall model. We also recognize the complexity of the proposed model. While it is our hope that this model can serve to guide avenues of future between- and within-person research, thus allowing for increased specificity, it may be most beneficial to examine the current model utilizing research methodologies that can harness such complexity (i.e., multi-wave, multi-modal data collection; also see Sameroff & Mackenzie, 2003), paired with statistical techniques best suited for such data (e.g., dynamic system modeling, machine learning).

Model timescale

To date, the temporal course of NSSI onset and subsequent effect on distress (i.e., intrapersonal, interpersonal) and cognitive-affective factors have not been mapped with any granularity, nor has research considered the impact of NSSI onset timing or behavior trajectory in the NSSI – SSI association. We suggest that the greatest amount of change in the proposed mechanisms occurs shortly after the behavior onset, but that these experiences may become increasingly salient as an individual continues to engage in NSSI. Consequently, it will be necessary to capture the period of time before and immediately after NSSI onset, as well as the months and years to follow. For example, utilizing only short follow-up periods or intensive longitudinal designs (i.e., daily diaries; experience sampling) may be insufficient to observe change in the mechanisms underlying the risk pathway from NSSI to SSI. While prior research has demonstrated that the time from NSSI onset to SSI onset ranges from days to years (with the average duration of time to transition between two to three years; Glenn et al., 2017; Kiekens et al., 2018; O'Loughlin et al., 2021a), research has also highlighted that aspects of the proposed model (i.e., cognitive-affective factors; NSSI-related experiences) can vary across a few months to a year (i.e., Victor et al., 2016; Voon et al., 2014). Consequently, studies designed to capture NSSI onset that also offer regular assessment windows (i.e., a few months) over multiple years post-onset may be best suited to examine mechanisms that underlie the NSSI – SSI relationship. For instance, in considering the proposed mediator of self-view, we might see that as an individual engages in NSSI over a longer period of time, one's self-view may become increasingly negative as a result of their continued NSSI behavior and resulting permanent physical scarring (e.g., Burke et al., 2017); concurrently, they may develop greater identification with the behavior (i.e., Glenn et al., 2017), which may further reinforce their negative self-view, increasing their risk for further NSSI and SSI (i.e., Butter et al., 2019).

Our model posits that some variables can serve as both third variables and mediators. Specifically, factors such as intrapersonal distress may function in both roles (see Table 1). To address this, it is crucial to examine these factors for their direct and mediating effects, ideally measuring them both before and after the onset of NSSI. We recommend using advanced statistical techniques like structural equation modeling and conducting longitudinal studies to effectively observe these complex temporal sequences.

Developmental considerations

The developmental stages at which the onset of NSSI and its transition to SSI occur will also be crucial to consider in future research. The importance of NSSI age of onset in the trajectory of NSSI behavior and its association with SA has already been demonstrated (i.e., Ammerman et al., 2018), underscoring a potentially sensitive period of risk based on age. A core tenet of developmental psychopathology is that risk factors can influence how youth function in distinct ways according to their developmental phase (Cicchetti & Rogosch, 2002). Thus, the developmental timing of third variables, NSSI onset, proposed mediators, and proposed moderators may all affect the transition to SSI. For example, several of the proposed mediators (e.g., self-view, including identity development) may be more salient during specific stages of development (e.g., adolescence, early adulthood; e.g., Claes et al., 2014; Erikson, 1968). Similarly, the proposed moderator of stigma may vary based on key developmental factors, such as peer and familial attachments (e.g., Hasking et al., 2015; Henshaw et al., 2024). Our model suggests that self-view and identity can be strongly impacted by NSSI. Data have also suggested that susceptibility to peer influences may peak during adolescence (Berndt, 1979), exacerbating the impacts of peer perceptions and the affiliation with peers who engage in NSSI. Given these notable developmental changes coincide with the typical age of NSSI onset, it is likely that the developmental stage in which NSSI is initiated impacts the pathway from NSSI to SSI, as well as the timescale of the pathway. Yet, only one of the studies included in the current review examined the (cross-sectional) NSSI – SA relationship among adolescents (Sellers et al., 2021), and neither of these studies examined the developmental timing of NSSI or its risk factors in modeling.

Demographic factors

While often acknowledged as being associated with key differences in self-injurious behavior presentations, sociodemographic factors, such as gender (Bresin & Schoenleber, 2015) and racial identities (Bridge et al., 2018), require additional study in the context of the NSSI – SSI association. Evidence suggests that characteristics, correlates, and antecedents of NSSI, SI/SP, and SA may vary based on demographics (e.g., Ammerman et al., 2020; Polanco-Roman et al., 2014; Victor et al., 2018). These differences may impact aspects of the relationship between NSSI and SSI. For example, certain NSSI characteristics, including some specific NSSI methods utilized, are found to exhibit gender-based patterns (i.e., Andover et al., 2010). Distinctions in NSSI methods have also been reported by race, suggesting White youth may engage in cutting more frequently than African American youth (Gratz et al., 2012). The use of certain NSSI methods is indicative of NSSI severity, likely having downstream effects on several of the mediators proposed in the Nonsuicidal to Suicidal Self-Injury Pathway Model (i.e., suicide capability, self-view, etc.). Consequently, it will be necessary to consider the relationship between NSSI and SSI in the context of sociodemographic factors.

Conclusion

NSSI is one of the strongest prospective predictors of SSI (Franklin et al., 2017; Ribeiro et al., 2016). We conducted a systematic review to identify empirical studies examining mediators and moderators of the relationship between NSSI and suicidal behavior. Overall, we found a dearth of literature rigorously testing the tenets of extant theoretical models of this association. Further, we found that

current literature suggests a range of potential mechanisms that are not included in previous theoretical models. Although prior theories have aided our understanding of the underlying mechanisms between NSSI and subsequent SSI, there remains an incomplete conceptualization of NSSI's complex and pernicious downstream effects on SSI risk. The Nonsuicidal to Suicidal Self-Injury Pathway Model draws on former models and extant cross-sectional and longitudinal research to outline a more comprehensive set of domains of mediators and moderators of this risk relationship. This newly developed model aims to advance our current theoretical framework of the NSSI – SSI relationship by offering concrete and promising avenues for future researchers to explore.

Not all individuals who engage in NSSI go on to engage in SSI and it is our hope that our model will shed light on this subset of individuals. For those in which NSSI precedes SSI, it is important not only for researchers but also for clinicians to have an understanding of the underlying pathways between these behaviors to identify and intervene with those at greatest risk. The proposed model may offer a framework from which psychoeducation can be provided, facilitating conversations regarding the impact of NSSI on suicidal behavior, a gap in many clinical contexts that clients often wish to be addressed (Awenat et al., 2018) and can have positive downstream effects on many of the identified mechanisms in the proposed model (i.e., Cook et al., 2014; Griffiths et al., 2014). Additionally, the proposed model may help improve clinicians' understanding of the sequelae of NSSI (which may serve to maintain NSSI itself), potentially guiding assessment and intervention to reduce the recurrence of NSSI and the emergence of SSI. With the goal of guiding future research on the NSSI – SSI relationship, we encourage future researchers to engage in hypothesis testing regarding components of, or multiple pathways purported in, our model. We believe that the proposed Nonsuicidal to Suicidal Self-Injury Pathway Model should be evaluated with rigorously designed studies, using psychometrically sound assessment methods across multiple units of analysis and employing evidence-based sample selection and assessment timing. Such future research is critically important to conduct as the prevalence of both NSSI and SSI has continued to rise.

Supplementary material. For supplementary material accompanying this paper visit <https://doi.org/10.1017/S095457942500001X>

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