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Why Do People Hurt Themselves? A New Conceptual Model of Nonsuicidal Self-Injury

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Abstract
The motivation to avoid pain and injury is a fundamental instinct, crucial to the survival of individuals and species. Yet, each year, millions of people purposefully and directly injure themselves in the absence of suicidal intent. Nonsuicidal self-injury (NSSI) has perplexed psychologists for decades. To advance understanding of NSSI, we present a new model—the benefits and barriers model of NSSI. This model builds on the supported elements of prior models, integrates information from recent experimental and longitudinal NSSI studies, and closely aligns with advances in basic psychological science. The core tenets of this model are that (a) NSSI carries many powerful benefits that are accessible to most people, but (b) most people do not access these benefits because there are several natural or instinctive barriers that motivate them to avoid self-injury. Preliminary work based on this model has produced novel NSSI risk factors and an effective NSSI treatment approach.

Keywords
nonsuicidal self-injury, NSSI, theory, self-criticism, pain, emotion, affect

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Recall the last time that you felt acute physical pain. Perhaps you stubbed your toe, burned your tongue on hot coffee, or bumped your head getting into a car. Whatever the case, you likely regarded it as an unpleasant event, took action to stop the pain, and resolved to avoid similar experiences in the future. This instinctive negative reaction to painful experiences is vital to survival. Without this instinct, we would not be motivated to escape or avoid potentially deadly stimuli. Individuals with congenital insensitivity to pain provide an unfortunate illustration of this point: They often suffer injury-related deaths as children and rarely live beyond age 25 (Daneshjou, Jafarieh, & Raaeskarami, 2012; Protheroe, 1991). Given the evolutionary imperative to avoid pain and injury, how is it possible that millions of people intentionally and directly harm themselves each year?

In this review, we describe a new conceptual model, which we call the benefits and barriers model of nonsuicidal self-injury (NSSI). It provides a preliminary answer to this question and establishes novel directions for future research. But, why is a new model needed? Prior models, which were based on the best evidence available at the time of their proposal, have been crucial in moving the field forward (e.g., Linehan, 1993; Nock & Prinstein, 2004). Some of the mechanisms proposed by these models have received strong empirical support over the past decade; recently, however, it has become increasingly clear that other mechanisms proposed by these models do not play a central role in NSSI. Moreover, treatments based on these models have not produced empirically supported treatments for NSSI (for reviews, see Brausch & Girresch, 2012; Glenn, Franklin, & Nock, 2015; Gonzales & Bergstrom, 2013; Nock, 2010; Washburn et al., 2012), although dialectical behavior therapy and emotion regulation group therapy may lead to modest reductions in NSSI in people who have symptoms of borderline personality disorder (Gratz, Bardeen, Levy, Dixon-Gordon, & Tull, 2015; Kliem, Kröger, &

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Kosfleder, 2010). Other lines of evidence have shown that mechanisms not included in these models may play crucial roles in NSSI (e.g., Fox, Toole, Franklin, & Hooley, 2017; Franklin, Puzia, Lee, & Prinstein, 2014; Hooley & St. Germain, 2014). Our new model integrates these novel mechanisms with the supported elements of existing models to produce a new conceptual approach to NSSI. Of course, research on the benefits and barriers model of NSSI is still in its early phases. Nonetheless, on the basis of the evidence to date, we believe it is timely to present a detailed description of this new model. We hope that this will facilitate its further evaluation and, ultimately, lead to a greater understanding of the nature and treatment of NSSI.

What Is NSSI and Why Is It Important?

NSSI involves the "direct, deliberate destruction of one's own body tissue in the absence of suicidal intent" (Nock & Favazza, 2009, p. 9). Since the first official classification of personality disorders in the third edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM–III*; American Psychiatric Association, 1980), NSSI has been included as a symptom of borderline personality disorder. Although many clinicians and researchers continue to view NSSI only as a symptom of borderline personality disorder, recent studies are changing this perception. This work has shown that NSSI is associated with a range of internalizing, externalizing, and personality disorders and can occur in the absence of psychiatric diagnoses (e.g., Glenn & Klonsky, 2013; Nock, Joiner, Gordon, Lloyd-Richardson, & Prinstein, 2006; Selby, Bender, Gordon, Nock, & Joiner, 2012). Moreover, risk of NSSI does not differ significantly across psychiatric disorders (Bentley, Cassiello-Robbins, Vittorio, Sauer-Zavala, & Barlow, 2015), suggesting that NSSI can be a transdiagnostic phenomenon. In short, there is substantial evidence that NSSI is distinct from borderline personality disorder and all other psychiatric diagnoses. This is reflected in the inclusion of NSSI in the Conditions for Further Study section of the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM–5*; American Psychiatric Association, 2013).

Prevalence estimates for NSSI have a wide range. This likely reflects factors such as the types of behaviors classified as NSSI, method of NSSI assessment, and sample characteristics. Overall, rates appear to be very high in clinical samples (e.g., 30% to 82.4%; DiClemente, Ponton, & Hartley, 1991; Nock & Prinstein, 2004; Penn, Esposito, Schaeffer, Fritz, & Spirito, 2003) and moderately prevalent in nonclinical samples. In a meta-analysis of NSSI prevalence in nonclinical populations, Swannell, Martin, Page, Hasking, and St John (2014) found that methodological factors contributed to wide variation in reports of prevalence. They concluded that rates are approximately 17.2% among adolescents, 13.4% among college-aged adults, and 5.5% among adults older than 25 years. These findings are consistent with a separate review of adolescent NSSI prevalence (18%; Muehlenkamp, Claes, Havertape, & Plener, 2012) and a large study of randomly sampled adults (5.9%; Klonsky, 2011). These results also are in line with evidence that NSSI prevalence in children and young adolescents (third, sixth, and ninth graders) is approximately 8% (Barrocas, Hankin, Young, & Abela, 2012).

NSSI is significantly more prevalent in women than in men, with clinical samples showing the largest gender differences. Women are also more likely to use self-cutting as a method of NSSI (Bresin & Schoenleber, 2015). Many studies report equal rates among ethnicities (e.g., Klonsky, 2011), but other studies have reported that White and multiracial individuals may have higher rates (e.g., Chesin, Moster, & Jeglic, 2013; Kuentzel, Arble, Boutros, Chugani, & Barnett, 2012). Higher rates of NSSI are also found in sexual and gender minorities (e.g., Arcelus, Claes, Witcomb, Marshall, & Bouman, 2016; Batejan, Jarvi, & Swenson, 2015). Finally, most studies find similar prevalence rates across countries (Giletta, Scholte, Engels, Ciairano, & Prinstein, 2012; Plener, Libal, Keller, Fegert, & Muehlenkamp, 2009; Swannell et al., 2014), although Plener et al. (2013) found small but significance differences among Germany, Austria, and Switzerland.

NSSI itself is a dangerous behavior. What makes it most troubling, however, is its strong association with suicidal behavior. Prospective studies demonstrate that NSSI is a risk factor for suicidal behavior, rather than a simple correlate (Asarnow et al., 2011; Cox et al., 2012; Guan, Fox, & Prinstein, 2012; Whitlock et al., 2013; Wilkinson, Kelvin, Roberts, Dubicka, & Goodyer, 2011). Moreover, a recent meta-analysis found that NSSI and prior suicide attempts both predicted future suicide attempts approximately equally well (Ribeiro et al., 2016).

Why Is a New Conceptual Approach Needed?

NSSI is a relatively prevalent and potentially dangerous behavior. Yet, our understanding of NSSI is still rather limited. In the sections below, we consider three different approaches to understanding NSSI, highlighting the strengths and limitations associated with each.

Emotion dysregulation

Emotion dysregulation (often termed *affective dysregulation*) is a broad construct that includes emotion reactivity

and emotion regulation. These are often conflated in discussions of NSSI. Emotion reactivity concerns the threshold, intensity, and duration of experienced emotions (Davidson, 1998), whereas emotion regulation concerns the skills and processes used to modulate emotional states (see Gratz & Roemer, 2004; Gross, 1998). Emotion dysregulation features prominently in most existing models of NSSI (e.g., Chapman, Gratz, & Brown, 2006; Hasking, Whitlock, Voon, & Rose, 2016; Linehan, 1993; Selby & Joiner, 2009). People who engage in NSSI are thought to experience high levels of negative affect and be overreactive to emotional stimuli. This emotional dysregulation drives NSSI. NSSI provides a regulation strategy that provides emotional relief, thus reinforcing the behavior.

Cross-sectional evidence suggests that NSSI is indeed associated with high levels of emotion reactivity. Differences between NSSI and non-NSSI groups tend to be large (e.g., Cohen's *d*s > 1.0) on retrospective self-report measures such as the Emotion Reactivity Scale (e.g., Franklin, Puzia, et al., 2013; Glenn, Blumenthal, Klonsky, & Hajcak, 2011; Nock, Wedig, Holmberg, & Hooley, 2008). However, other methodological approaches yield less clear-cut findings. For example, although daily diary studies show that people who engage in NSSI report more negative mood overall, they do not provide evidence of greater negative affective reactivity or prolonged negative affect in reaction to specific events (Bresin, 2014) outside of the context of samples containing a high level of borderline personality disorder symptoms (Houben et al., 2017; Santangelo et al., 2017). Moreover, much of the negative affect appears to be primarily due to high levels of self-dissatisfaction (Victor & Klonsky, 2014b). In other words, in contrast to retrospective self-report studies, daily diary studies do not demonstrate greater emotional reactivity among people engaging in NSSI. Instead, these studies index higher negative emotionality that may be largely explained by general self-dissatisfaction.

Two laboratory-based, experimental investigations have also found that NSSI is associated with higher overall self-reported negative affect at baseline but not with abnormally increased negative affect before, during, or after a stressful speech task (Franklin et al., 2010; Kaess et al., 2012). Similarly, Weinberg and Klonsky (2012) found that NSSI and control groups displayed similar changes in self-reported affect after an anger induction. Moreover, Bresin and Gordon (2013a) found that, compared with a control group, an NSSI group displayed a smaller increase in self-reported negative affect after a negative mood induction. Several physiological studies found no evidence of more emotional reactivity in NSSI groups across measures of startle eyeblink reactivity during preparation for a stressful speech (Franklin et al., 2010), startle eyeblink reactivity in the context of unpleasant images (Glenn et al., 2011), or cortisol and heart rate measures in reaction to a stressful speech task (Kaess et al., 2012). Nock and Mendes (2008) did report, however, that NSSI was associated with higher physiological arousal during a frustrating task.

Longitudinal NSSI studies cast further doubt on a central role for emotion reactivity and suggest that increased negative emotionality may be a strong correlate of NSSI (at least in terms of retrospective self-report inventories) but not a strong risk factor for NSSI. For example, Franklin, Puzia, et al. (2014) found that self-reported emotion reactivity powerfully distinguished between NSSI and non-NSSI groups at baseline but did not predict NSSI over the ensuing 6 months. Several other studies have found that constructs related to dysregulated emotionality (e.g., anxiety, depression, impulsivity) do not longitudinally predict NSSI (e.g., Glenn & Klonsky, 2011; Tuisku et al., 2014). Reflecting this, a recent meta-analysis, which reported that affect dysregulation (primarily meaning negative affect/emotional reactivity) was a significant predictor of NSSI, yielded a surprisingly weak weighted odds ratio of 1.05 (Fox et al., 2015).

Taken together, there is strong evidence for increased emotion reactivity in NSSI based on retrospective self-reports but weak evidence based on daily diary, experimental, physiological, and longitudinal studies. Moreover, although retrospective self-report evidence and evidence from ecological momentary assessment studies support the idea that elevated negative affect precedes most episodes of NSSI (Armey, Crowther, & Miller, 2011; Klonsky, 2007; Muehlenkamp et al., 2009; Nock, Prinstein, & Sterba, 2009), this elevated negative affect may be within the bounds of a normative reaction to a stressor. In other words, there is no evidence of abnormally intense negative affect indicative of affect dysregulation (cf. Bresin, 2014). For example, Muehlenkamp et al. (2009) found that, across the 4 hours preceding an NSSI event, negative affect ratings increased from 27 to 30 on the Positive and Negative Affect Schedule, which has a range of 10 to 50. Armey et al. (2011) obtained similar results. Although experiencing intense negative emotions plays a central role in several NSSI theories, our review of this literature leads us to suggest that the importance of this may be overstated. High negative emotionality appears to play a more limited and indirect role.

In contrast, there is good support for the emotion regulation function of NSSI. Emotion regulation is commonly endorsed as a primary motivation for engaging in NSSI (Klonsky, 2007), and people who engage in NSSI score higher on the Difficulties in Emotion Regulation Scale (e.g., Franklin et al., 2010; Franklin, Hessel, & Prinstein, 2011; Franklin, Puzia, et al., 2013). In a sample

of college students, Whitlock et al. (2011) noted that 81% of those who reported NSSI endorsed that their NSSI served an emotion regulation function. Although we recognize that people may not always be fully aware of the motives behind their behavior (Nisbett &Wilson, 1977), retrospective self-report and ecological momentary assessment studies further support the idea that mood improves after engaging in NSSI (Armey et al., 2011; Klonsky, 2007; Muehlenkamp et al., 2009; Nock et al., 2009). It is important that laboratory NSSI studies also show that mood improves after painful stimuli in NSSI groups across a range of self-report and physiological measures (Bresin & Gordon, 2013a; Franklin et al., 2010; Franklin, Puzia, et al., 2013; Russ et al., 1992; Schoenleber, Berenbaum, & Motl, 2014; Weinberg & Klonsky, 2012). With few exceptions, however, these studies also found that pain-induced mood regulation in NSSI groups was not significantly different from that observed in the control groups. This is a critical observation that has long been overlooked. It presents a challenge to the assumptions of some researchers and clinicians who believe that feeling better after pain is a unique feature of people who engage in NSSI.

In summary, recent empirical tests of emotion dysregulation models show that small increases in negative affect tend to precede NSSI. Marked emotional reactivity, however, does not appear to play a direct and central role in NSSI. Research further demonstrates that NSSI tends to improve affect in most people. This supports the emotion regulation aspect of NSSI. The question of why NSSI is selected over other methods of emotion regulation remains, however. If the negative emotions experienced by people who engage in NSSI are not especially intense or extreme, why do they engage in NSSI? Why do they select such an extreme method of emotion regulation?

Four-function model

Another approach to understanding NSSI is reflected in the four-function model. This model was introduced to the NSSI literature by Nock and Prinstein (2004). The core of the model has remained the same across subsequent articulations (Bentley, Nock, & Barlow, 2014; Nock, 2008, 2009, 2010). Specifically, the model has two main tenets: (a) Difficulties regulating affective or cognitive states and/or social dysregulation increase risk for NSSI and (b) NSSI modifies affect and the social environment.

In many ways, the four-function model subsumes the affect or emotion regulation model while also broadening the scope to include the social regulation functions of NSSI. Whereas the emotion regulation model posits that affect dysregulation precedes NSSI and NSSI leads to affect regulation, the four-function model proposes that affect dysregulation or social dysregulation (disturbances or demands in the person's social environment) may precede NSSI and NSSI may bring about affect regulation or social regulation. In addition, whereas the emotion regulation model focuses on negative reinforcement (i.e., negative affect reduction), the four-function model includes both negative (relief) and positive (reward) reinforcement. Hence, the four functions are social positive and negative reinforcement and intrapersonal positive and negative reinforcement.

As we have already noted, experimental, physiological, and longitudinal evidence indicate that marked emotional dysregulation (specifically, the emotion reactivity component of emotional dysregulation) does not play a central role in NSSI. Accordingly, this aspect of the four-function model does not appear to be well supported. However, there is good evidence that NSSI results in decreased negative affect (e.g., Bresin & Gordon, 2013a; Franklin et al., 2010; Klonsky, 2009) as well as increased positive affect (e.g., Franklin, Lee, Hanna, & Prinstein, 2013; Muehlenkamp et al., 2009; Selby, Nock, & Kranzler, 2014). As such, there is support for the affective regulation component of the four-function model. With regard to social dysregulation in NSSI, there are few empirical studies, and experimental and longitudinal research is needed to more directly investigate this aspect of the model. Several studies do indicate that social factors such as highly aversive parent-child relationships, intimate partner violence, and general interpersonal difficulties are all associated with increased NSSI (e.g., Adrian, Zeman, Erdley, Lisa, & Sim, 2011; Levesque, Lafontaine, Bureau, Cloutier, & Dandurand, 2010; Martin et al., 2016), but these studies typically implicate affective functions rather than social functions. In other words, such studies suggest that interpersonal events may increase negative affect, which may generate NSSI episodes to reduce negative affect rather than to regulate the social environment (e.g., by reducing demands or decreasing family stress). That said, some people do report that they engage in NSSI to get attention or to influence others (Klonsky & Glenn, 2009; Nock & Prinstein, 2004). Longitudinal studies also provide indirect evidence for a social positive reinforcement function (Giletta, Burk, Scholte, Engels, & Prinstein, 2013; Prinstein et al., 2010; You, Lin, Fu, & Leung, 2013). It is notable, however, that most episodes of NSSI occur in private (Klonsky & Olino, 2008; Nock et al., 2009) and are not disclosed (Turner, Cobb, Gratz, & Chapman, 2016). This suggests that NSSI is not typically performed with an eye toward regulating the social environment. Nonetheless, potential social benefits warrant consideration in any new conceptual approach to understanding NSSI.

Opioid homeostasis model of NSSI

There are a few variants of the opioid homeostasis model (Bresin & Gordon, 2013b; Sher & Stanley, 2009; Stanley et al., 2010). Their core tenets are that (a) individuals who engage in NSSI have low baseline opioids, (b) the body has a set point for opioids and deviations from this may motivate behaviors that restore opioid homeostasis, and (c) NSSI restores opioid homeostasis. Essentially, this model is similar to the affect regulation model, except that it is expressed in biological terms. Very little direct empirical work has tested this model, but the model suggests two valuable points. First, as with all psychological and behavioral phenomena, there are biological correlates of NSSI, and these may be important for improving the understanding of NSSI. Second, the well-known associations among pain, opioids, and elevated affect are a natural starting point for a biological model of NSSI, given that NSSI is a painful behavior that improves affect. It is unfortunate that there are several issues that reduce enthusiasm for this particular model of NSSI.

First, this model reduces NSSI to a biological phenomenon whereby NSSI is motivated by low opioid levels and serves the function of returning opioids to a set point. Similar chemical imbalance models have been proposed for schizophrenia, depression, anxiety, and many other types of psychopathology. Although such models are intuitively appealing, historical and empirical reviews indicate that there is no evidence for such imbalances (e.g., Bowers, 1974; Haracz, 1982; Kendler, 2005; Kirsch, 2010; Mendels & Frazer, 1974; Whitaker, 2012).

In addition, the concept of homeostasis proposed by this model may not reflect the nature of physiological homeostasis. The popular understanding of homeostasis is intuitive and heavily influenced by engineering principles, but it is not consistent with how physiological systems actually work (Ramsay & Woods, 2014). There is no evidence for physiological set points, error detection mechanisms, or a centralized physiological command center (Berridge, 2004; Carpenter, 2004; Ramsay & Woods, 2014). Rather, robust and stable states of variables (e.g., consistent opioid levels) are better accounted for by mechanisms such as settling-point regulation, which Berridge (2004) defined as "a stable state caused by a balance of opposing forces, but without any setpoint or error detection" (p. 182). Similarly, it is unlikely that the body has a teleological set point for opioids or error detection/correction mechanisms to maintain this set point. Furthermore, stress is associated with increased opioid activity (see Butler & Finn, 2009). Given that stress often precedes NSSI, this also suggests that NSSI typically occurs in states of elevated opioids rather than diminished opioids. This pattern is the inverse of the opioid homeostasis model and suggests that the function of NSSI is not therefore to increase low levels of opioids.

Some have proposed that evidence for the opioid homeostasis model is provided by studies showing that opioid antagonists may reduce stereotypic self-injury in some individuals with developmental disabilities (e.g., Symons, Thompson, & Rodriguez, 2004). However, such evidence may actually represent evidence against this model because, according to this model, lower opioid activity should be associated with more NSSI, not less. A potential explanation for these findings is that opioid antagonists tend to induce amotivational states (e.g., Crowley, Wagner, Zerbe, & Macdonald, 1985; Mendelson, Ellingboe, Keuhnle, & Mello, 1978) that reduce all behaviors, not just NSSI.

Another concern, as noted by Bresin and Gordon (2013b), is that most studies relevant to this model have major limitations in terms of their samples and methods. In particular, most studies include samples of nonhuman primates or individuals with developmental disabilities who engage in stereotypic self-injury. In addition, some of these studies used blood plasma levels of opioids as their major outcome variable; it is unfortunate that these levels are not correlated with central opioid activity (e.g., De Riu et al., 1997).

Finally, even if we assume that some individuals have low opioids and that self-injury is motivated by opioid homeostasis, it is unclear why such a system would produce NSSI behaviors such as self-cutting or burning. Instead, one might posit that such a system may be more likely to produce the types of injury commonly found in individuals with congenital insensitivity to pain, such as intense chewing of the tongue, cheeks, and fingertips (Daneshjou et al., 2012). Compared with NSSI, such injuries are more easily (e.g., no instruments needed), quickly, and privately performed. We are unaware of any reports of these behaviors in people who engage in NSSI.

In summary, although opioids provide a natural starting point for investigating the biology of NSSI, the opioid homeostasis model does not appear to be viable because of several conceptual and empirical limitations. However, tests of the affect regulation models have produced two extremely valuable insights: (a) Small increases in negative affect tend to precede NSSI, and (b) NSSI improves affect. Research on these models has also revealed four other findings that future models should consider: (a) Marked emotional reactivity does not play a central role in NSSI, (b) extremely intense negative affect is not necessary to produce NSSI, (c) NSSI is associated with impairments in affect regulation, and (d) the affect regulation properties of NSSI are universal. As described below, our new model integrates each of these key facts.

The Benefits and Barriers Model of NSSI

Fundamental to our approach are two key questions: Why do so many people find NSSI to be a useful behavior? What separates people who engage in NSSI from people who do not? Correspondingly, two ideas are central to this model. First, consistent with research on the affective and social functions of NSSI (Bentley et al., 2014; Nock & Prinstein, 2004), we posit that there are several factors that entice people to engage in NSSI; we consider these to be benefits of NSSI. We propose that these benefits transform NSSI into a useful behavior for many people. Second, we hypothesize that there are many factors that naturally dissuade most people from engaging in NSSI; we consider these to be barriers to NSSI. We propose that differences in these barriers separate people who engage in NSSI from people who do not engage in NSSI. Overall, the core tenets of the benefits and barriers model are that (a) NSSI has the potential to provide a range of benefits for nearly everyone but that (b) most people do not access the benefits that result from NSSI because certain physiological, psychological, and social barriers disincline them from doing so. We also wish to make it clear that our use of the term *benefits* should not be taken to mean that we regard NSSI as a beneficial behavior. Although NSSI provides affective benefits, it is a behavior with considerable physical and psychological costs.

What Are the Benefits of NSSI?

Consideration of the benefits of NSSI helps to explain why NSSI makes sense for some individuals in certain circumstances. This work has been the focus of much prior research, although most of this research has been cross-sectional, retrospective, and/or self-reported and has centered on the affect regulation and four-function models. Below, we describe a broader array of NSSI benefits and propose the mechanisms that govern these benefits, noting current research.

Before describing each of these benefits, however, we note that our model makes several general predictions about the benefits of NSSI that diverge from most traditional models. First, we suggest that the affective benefits of NSSI play a minor role in the initial selection of NSSI as a behavior but a major role in continuing NSSI thereafter; the opposite pattern should exist for nonaffective benefits (cf. Muehlenkamp, Brausch, Quigley, & Whitlock, 2013). Second, the benefits of NSSI are universal processes available to most people (and species). Accordingly, compared with NSSI barriers, NSSI benefits weakly distinguish between NSSI and non-NSSI individuals at baseline (cf. Franklin, Puzia, et al., 2013). Third, compared with the erosion of NSSI barriers, the intensities of NSSI benefits are weak retrospective and prospective predictors of NSSI frequency within NSSI groups (cf. Franklin, Lee, Puzia, & Prinstein, 2014; Franklin, Puzia, et al., 2013; Franklin, Puzia, et al., 2014). Fourth, compared with NSSI barriers, NSSI benefits are relatively poor treatment targets. In sum, the benefits of NSSI are vital for understanding how NSSI works, but NSSI barriers are more important for NSSI assessment, prediction, and treatment.

Benefit 1: NSSI improves affect

Researchers have long noted that NSSI improves affect, and this remains one of the most popular topics in NSSI research. Most theoretical models have focused on the ability of NSSI to reduce negative affect (Chapman et al., 2006; Linehan, 1993; Selby & Joiner, 2009). However, recent work has demonstrated that NSSI also increases positive affect (Muehlenkamp et al., 2009; Selby et al., 2014). In fact, as mentioned earlier, experimental evidence indicates that NSSI may simultaneously reduce negative affect and stimulate positive affect (Franklin, Lee, et al., 2013). It should also be noted that factor analytic studies such as that by Nock and Prinstein (2004) show that negative affect reduction subsumes emotional numbness alleviation as a function of NSSI. Engaging in NSSI to "feel something" would therefore be another example of NSSI reducing negative affect. Although these affective benefits play only a minor role in the initiation of NSSI, we suggest that they play a major role in its maintenance. They are also associated with a higher frequency NSSI trajectory (Klonsky & Olino, 2008; Muehlenkamp et al., 2013; Whitlock, Muehlenkamp, & Eckenrode, 2008). In other words, most people may not initially recognize the affective benefits of NSSI, but once they do (generally after multiple NSSI episodes), they view NSSI as an effective way to improve affect.

How does NSSI improve affect? At least three potential mechanisms are relevant here. These mechanisms are not mutually exclusive; they may combine to produce improved affect. First, the gratification of self-punishment desires may have many effects, including improved affect. As we note in a later section, there is now empirical support for this idea (Fox et al., 2017). Second, NSSI may serve as a potent distractor from cascades of negative thoughts and emotions (Linehan, 1993; Selby & Joiner, 2009). Several non-NSSI studies suggest that distractors can reduce negative thoughts and emotions (e.g., Bastian, Jetten, & Fasoli, 2011; Lyubomirsky, Caldwell, & Nolen-Hoeksema, 1998; McRae et al., 2010; Nolen-Hoeksema & Morrow, 1993). Most people find pain to be highly distracting. It is

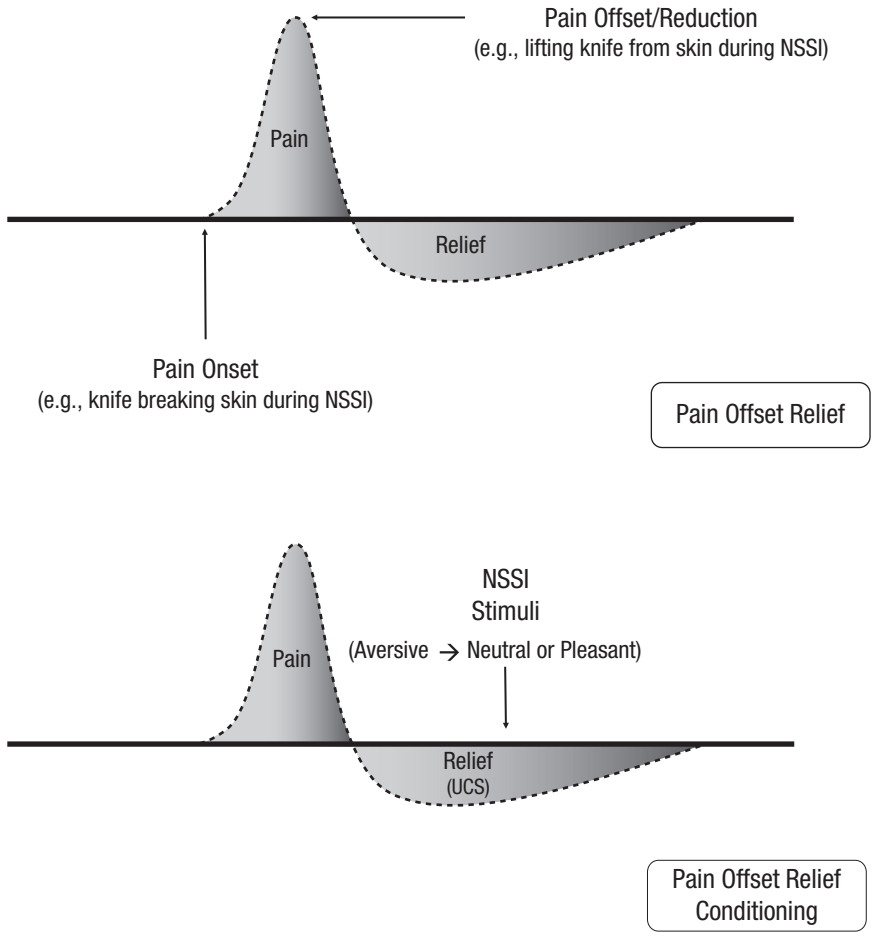

Fig. 1. Pain-offset relief (top); pain-offset relief conditioning (bottom). The actual act of injury during nonsuicidal self-injury is painful, but the removal or reduction of the painful stimuli prompts a powerful state of relief (top); stimuli present during this relief period become paired with relief and gain a more positive valence.

therefore reasonable to expect that distraction could provide a mechanism through which NSSI impacts negative mood. However, contrary to the pain-as-distraction hypothesis, a recent empirical study found no evidence that experiencing pain repairs negative mood (see Fox et al., 2017). This suggests that the affective benefits of NSSI may not be attributable to the distracting properties of pain.

Third, a phenomenon called pain-offset relief may play a major role in improving affect as a result of NSSI (see Fig. 1). Several basic studies have shown that, compared with pre-pain levels, the removal of pain significantly increases positive affect and reduces negative affect and physiological arousal (Bastian, Jetten, Hornsey, & Leknes, 2014; Franklin, Puzia, et al., 2013; Gerber et al., 2014). Similar findings have been reported in laboratory NSSI studies (Bresin & Gordon, 2013b; Franklin et al., 2010; Franklin, Lee, et al., 2013; Russ et al., 1992; Weinberg & Klonsky, 2012). Pain-offset relief may occur in part because of a common neural overlap between physical and emotional pain (see Franklin, Puzia, et al., 2013). Specifically, both types of pain activate the anterior cingulate cortex and the anterior insula (see Eisenberger, 2012, 2015), which function in part to sense and integrate visceral information into conscious experience (Lindquist, Wager, Kober, Bliss-Moreau, & Barrett, 2012). Because visceral information is a key ingredient of affective experience (Lindquist et al., 2012), these areas are active during most affective experiences, including the experience of pain. Given this overlap, factors that affect physical pain incidentally affect emotional pain (see Eisenberger, 2012, 2015). For example, proinflammatory cytokines (e.g., endotoxins) have long been known to increase sensitivity to physical pain, but Slavich, Way, Eisenberger, and Taylor (2010) have demonstrated that they also increase emotional pain and that this effect is mediated in part by anterior cingulate and anterior insula activity. Similarly,

the physical pain-killer acetaminophen reduces emotional pain in response to a social exclusion manipulation, and this is mediated in part by anterior cingulate and anterior insula activity (DeWall et al., 2010).

In line with the foregoing evidence, the removal (or even slight reduction in the intensity; see Grill & Coghill, 2002) of a physically painful stimulus is also associated with reduced emotional pain (Bastian et al., 2014; Gerber et al., 2014), possibly due in part to changes in anterior cingulate and anterior insula activity. In short, the removal of emotional pain is difficult, but the removal of self-induced physical pain is simple and easy to control (e.g., removing a knife from skin). Individuals who engage in NSSI may incidentally reduce emotional pain (or induce positive affect) as a result of the common neural overlap between physical and emotional pain. The incidental nature of this effect is consistent with patterns of NSSI motivation. It is counterintuitive that self-injury would improve affect; correspondingly, the initial episodes of NSSI typically are motivated by self-punishment or social reasons (Muehlenkamp et al., 2013). After multiple episodes of NSSI, however, the affective benefits of NSSI likely become more salient. As a result, later episodes of NSSI primarily are motivated by obtaining affective benefits (Muehlenkamp et al., 2013).

The pain-offset relief mechanism we are proposing is supported by several lines of evidence from both basic and applied research; it does not require biological reductionism, chemical imbalances, or homeostatic mechanisms. This mechanism is also distinct from the self-punishment motive mechanism because it operates in healthy individuals with no such motive (e.g., Franklin, Puzia, et al., 2013).

Benefit 2: NSSI gratifies self-punishment desires

Several retrospective self-report studies and theoretical speculations have suggested that the desire for self-punishment often motivates NSSI (Hooley, Ho, Slater, & Lockshin, 2002, 2010; Menninger, 1938; St. Germain & Hooley, 2012). On the basis of factor analyses, self-punishment has often been subsumed by the positive reinforcement function of NSSI (e.g., Nock & Prinstein, 2004). We similarly propose that the gratification of self-punishment motives is reinforcing, but we emphasize that this benefit is separate from the improved affect benefit of NSSI. In other words, we posit that this is a major cognitive benefit of NSSI.

Laboratory studies have shown that factors such as self-criticism or self-punishment motivations instantiate the desire for pain and punishment (Hamza, Willoughby, & Armiento, 2014; Hooley et al., 2010). Because of NSSI's painful and punishing nature, some individuals may regard it as a viable method of self-punishment; upon engaging in NSSI, the desire for pain and punishment accordingly may be satisfied. Self-injurers who report self-punishing motivations for NSSI rate pain as less aversive than self-injurers without self-punishing motivations (Hamza et al., 2014). Moreover, Bastian et al. (2011) found that, in healthy individuals primed to feel guilty, a laboratory pain induction significantly reduced self-reported guilt. Schoenleber et al. (2014) similarly found that a laboratory pain induction significantly reduced self-reported shame in women with and without a history of NSSI who had been primed to feel shame. As with the affective benefits of NSSI, these preliminary studies are consistent with the notion that the gratification of self-punishment desires is a benefit of NSSI accessible to all members of the population. However, unlike the affective benefits of NSSI, which should be present in all NSSI episodes, this cognitive benefit (and any subsequent affective benefits that derive from it) may occur only when NSSI is motivated by self-punishment desires.

Recent research supports this idea. Fox and colleagues (2017) exposed self-injuring participants to a negative mood induction. They then randomly assigned some participants to an experimental condition that involved a pain induction (pressure algometer). Mood measures taken at regular intervals before, during, and after experiencing pain showed that pain itself did not lead to changes in mood; in contrast, a neutral distraction task did significantly decrease negative mood. This suggests that pain does not bring about mood changes through simple distraction. However, there was an interaction with self-criticism such that participants who scored high on self-criticism felt better during the experience of pain. More specific, they showed a reduction in negative mood and an increase in positive mood. This was not the case for participants who scored lower on self-criticism. During pain, these participants showed an increase in negative mood and a decrease in positive mood. Following the removal of the painful stimulus, however, mood in these participants improved. In other words, for participants low on self-criticism, it was the benefits of pain-offset relief that were most significant. Taken together, the findings of this study support the importance of both pain-offset relief and the gratification of self-punishing motivations in providing affective benefits to those who engage in NSSI.

Benefit 3: NSSI provides peer group affiliation

Some individuals may engage in NSSI to attain, increase, or affirm their affiliation with a peer group (Prinstein,

Guerry, Browne, & Rancourt, 2009). In other words, if someone's desired peer group engages in NSSI, that person may also engage in NSSI to improve or maintain their affiliation with this group. Both retrospective (see Prinstein et al., 2009) and longitudinal (e.g., Giletta et al., 2013; Prinstein et al., 2010) studies have found evidence for this benefit, but little direct work has been conducted. Evidence further suggests that peer affiliation may be a relatively uncommon benefit. Muehlenkamp et al. (2013) found that the reasons related to this benefit were rarely endorsed as a motivation for either initiating NSSI (e.g., 5.9% endorsed "wanting to fit in with others"; 2.7% endorsed "friend suggested it") or repeatedly engaging in NSSI (e.g., 4.3% endorsed "because my friends do it"; 1.6% endorsed "to be part of a group"). Accordingly, this benefit may play a more minor role compared with other factors.

How does peer affiliation affect NSSI? Prinstein et al. (2009) suggested two types of socialization effects that may partially explain how peers influence NSSI engagement. First, if an individual admires a person or group who engages in NSSI, they may emulate this behavior to maintain a positive self-image (Cohen & Prinstein, 2006). Second, NSSI may be influenced by peer deviancy training (Granic & Dishion, 2003). Research on this mechanism has shown that deviant peers tend to positively reinforce communications of deviant behaviors (e.g., expressing approval, laughing, or nodding after a description of binge drinking); a similar mechanism may influence NSSI engagement among some social groups (Prinstein et al., 2009). Consistent with these ideas, in a cross-sectional study, Claes, Houben, Vandereycken, Bijttebier, and Muehlenkamp (2010) found that, compared with adolescents with no history of NSSI, adolescents who engaged in NSSI reported knowing more self-injuring peers. Students with lower self-esteem also reported knowing more peers who engaged in NSSI. Claes and colleagues (2010) suggested that adolescents with self-esteem problems may be attracted to peers who self-injure and who have similar problems with feelings of self-worth. Alternatively, it may be that adolescents with low self-esteem are more inclined to imitate NSSI in others, perhaps to enhance their social status in such a group.

Benefit 4: NSSI can communicate distress or strength

A final potential benefit of NSSI concerns its ability to act as a potent form of communication (see Nock, 2008). In some cases, this may involve the communication of distress. When less intense forms of distress communication (e.g., talking, yelling, crying) are ineffective, NSSI may serve to capture the attention of others and to elicit care. In other cases, NSSI may involve the communication of strength. As noted by Zahavi (1975), some animals engage in behaviors that increase their risk of injury or otherwise handicap themselves as a means of signaling their physical condition and quality (e.g., stotting in gazelles). In a similar vein, some individuals may display wounds and scars from NSSI to communicate strength to others (Nock, 2008). This may be especially evident in prison populations (Gambetta, 2009).

Very few studies have directly examined this potential benefit. Nonetheless, reasons related to this benefit are commonly endorsed as motivators for initial episodes of NSSI (Muehlenkamp et al., 2013). One longitudinal study has also demonstrated that NSSI (but not other maladaptive behaviors) was associated with adolescents reporting improved relationships with their fathers over a 1-year period (Hilt, Nock, Lloyd-Richardson, & Prinstein, 2008). Yet, a different study found that NSSI actually predicted interpersonal stressors 6 months later among female participants (Burke, Hamilton, Abramson, & Alloy, 2015). Using an experience sampling diary approach, Snir, Rafaeli, Gadassi, Berenson, and Downey (2015) found that, although participants with borderline personality disorder did not explicitly identify interpersonal communication as a motive for engaging in NSSI, such acts did tend to be preceded by perceived feelings of rejection and social isolation. Moreover, these feelings decreased after an act of NSSI. Finally, again using a daily diary study, Turner and colleagues (2016) were able to show that NSSI acts that were revealed to others were followed by increased perceived social support the following day (although next-day interpersonal conflict did not decline). Although the majority of acts of self-injury are not revealed to others (and the response of others may depend of the nature and type of NSSI), increased social support does appear to be a benefit of NSSI in some cases. That said, more research is needed to advance knowledge about this potential benefit of NSSI.

Barriers to NSSI

If the benefits of NSSI are natural, universal, and potent, why do most people not engage in NSSI? On the basis of recent research, we propose that there are at least five barriers that deter most people from engaging in NSSI (see Fig. 2). These are (a) a lack of exposure or awareness about NSSI, (b) feelings of self-worth or a positive association with the self, (c) a desire to avoid physical pain, (d) an aversion to NSSI stimuli, and (e) social norms. We propose that any single barrier is sufficient to prevent an episode of NSSI. For example, an individual may be familiar with NSSI as a behavioral

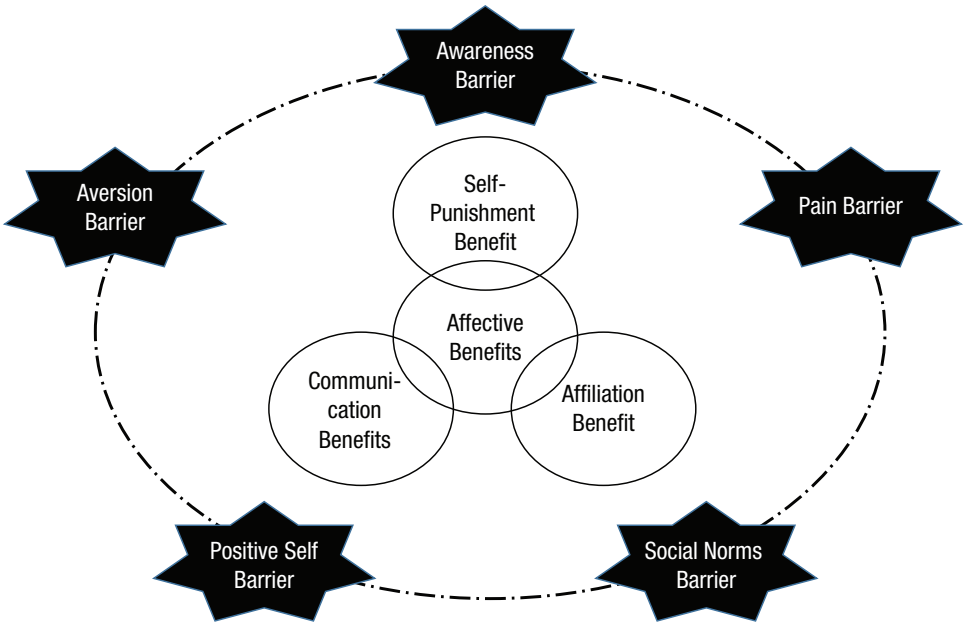

Fig. 2. Overview of the basic components of the benefits and barriers model. There are at least four types of nonsuicidal self-injury (NSSI) benefits: self-punishment, affective, affiliation, and communication. Most NSSI episodes carry multiple benefits, and all NSSI episodes carry affective benefits. The reason that most people do not access these benefits with NSSI is that there are several major barriers that dissuade individuals from engaging in NSSI. These barriers include lack of awareness about NSSI, aversion to NSSI stimuli, a positive association with the self, dislike of physical pain, and concern about social norms. Each of these barriers must be overcome for NSSI to occur. In a given episode of NSSI, all barriers must be overcome: Some may be lowered (e.g., an individual may be aware of NSSI and may like images of NSSI stimuli) and others may be sidestepped (e.g., an individual may reason that the affiliation benefits of NSSI are worth the physical pain involved in NSSI).

option, not mind physical pain or NSSI stimuli, and have privacy to side-step social norms about NSSI. Nonetheless, if the individual has a positive association with the self (and this barrier remains intact), our model predicts that he or she is not likely to engage in NSSI.

We note that some of these barriers are conceptually similar to the construct of suicide capability first discussed by Joiner (2005). In particular, barriers (b) and (c) above are similar to Joiner's (2005) definition of suicide capability as fearlessness about death and heightened pain tolerance. As we have noted elsewhere (e.g., Franklin et al., 2016), this overlap may play an important role in the substantial link between NSSI and suicidal behaviors. Nonetheless, much remains unknown about the nature of these barriers, suicidal capability, and the link between NSSI and suicidal behaviors.

Below, we describe how each barrier may contribute to NSSI selection and discuss relevant research.

Barrier 1: Lack of awareness about NSSI

It is perhaps self-evident that people who have never been exposed to the idea of self-injurious behavior are unlikely to consider it as a behavioral option. Accordingly, a lack of exposure to or general awareness of NSSI (either the concept of NSSI or the actual behavior) can be considered to be a barrier to engaging in NSSI. Yet, this is a barrier that is easily overcome. Although NSSI is not an especially new behavior (see Hooley, 2008), it has only relatively recently begun to attract so much attention. It is now extremely difficult to avoid exposure to NSSI in some form. In recent decades, NSSI has been depicted in movies, in songs, and on television, and several celebrities have disclosed their NSSI histories (Trewavas, Hasking, & McAllister, 2010; Whitlock, Purington, & Gershkovich, 2009). Linking this to NSSI engagement, Radovic and Hasking (2013) found that exposure to NSSI in film was associated with a history of NSSI, especially when this exposure was combined with strong identification with the self-injuring character portrayed in the film. There is also an increasingly large online NSSI presence. Millions of people now share descriptions, pictures, and videos of their NSSI through social media and YouTube (Baker & Lewis, 2013; Duggan, Heath, Lewis, & Baxter, 2012; Lewis, Heath, Sornberger, & Arbuthnott, 2012).

In addition to such media-based exposure, peers also may be a common source of NSSI exposure. For example, Heath, Ross, Toste, Charlebois, and Nedecheva

(2009) found that 65% of an adolescent NSSI sample reported talking to their friends about self-injury, 58.8% reported that their friend engaged in NSSI before they did, and 17.4% reported that they had engaged in NSSI in front of their friends. Suggesting that this peer exposure may have a direct effect on NSSI engagement, multiple longitudinal studies have found that exposure to peer NSSI is associated with greater risk for later NSSI (Hasking, Andrews, & Martin, 2013; Prinstein et al., 2010; You et al., 2013).

Awareness of NSSI establishes NSSI as a potential behavioral option. In the absence of such knowledge, even individuals with high levels of many NSSI risk factors would be unlikely to engage in NSSI. For example, Hasking et al. (2013) found that exposure to peer NSSI moderated the association between stressful life events and NSSI. Consistent with the findings of Radovic and Hasking (2013), exposure may be a particularly potent influence on the selection of NSSI if the exposure involves an admired character, celebrity, or friend. These preliminary findings suggest that exposure to NSSI may represent a general risk factor for NSSI, but recent evidence indicates that exposure to NSSI-related surveys does not have an acute "triggering" effect. Muehlenkamp, Swenson, Batejan, and Jarvi (2014) found that answering survey questions about NSSI was not associated with a significant increase in NSSI behaviors or urges. Similarly, exposing research participants to NSSI-related stimuli does not appear to increase desire to engage in NSSI (Cha et al., 2016). It remains possible that graphic NSSI images and videos, depictions of NSSI in movies, and peer NSSI do have a triggering effect. Although qualitative evidence supports this possibility (Baker & Lewis, 2013), we are unaware of any experimental or longitudinal studies of this widely discussed phenomenon.

Barrier 2: Positive view of the self

All individuals have a representation of themselves or a self-identity, and most people have a positive association with the self (e.g., Koole, Dijksterhuis, & van Knippenberg, 2001). As a result, neutral objects tend to gain a positive valence when paired with the self (e.g., Gawronski & LeBel, 2008). We propose that it is difficult to deliberately self-injure under these conditions. Indeed, if you regard yourself favorably, you protect your body rather than harm it deliberately. In contrast, for people who have a highly negative view of the self, NSSI becomes an option that can be considered rather than immediately dismissed. Correspondingly, NSSI should be associated with a negative view of the self.

Research supports this hypothesis. Levels of self-criticism are higher in people who engage in NSSI than they are in people who do not engage in NSSI (Glassman, Weierich, Hooley, Deliberto, & Nock, 2007; Hooley et al., 2010; Hooley & St. Germain, 2014; St. Germain & Hooley, 2012). NSSI has also been linked to self-blame (Swannell et al., 2012), self-dissatisfaction (Victor & Klonsky, 2014a), self-disgust (Smith, Steele, Weitzman, Trueba, & Meure, 2015), shame (Schoenleber et al., 2014), negative self-views (Weismoore & Esposito-Smythers, 2010), negative body image (Duggan et al., 2012), criticism-related aspects of perfectionism (Claes, Soenens, Vansteenkiste, & Vandereycken, 2012; Hoff & Muehlenkamp, 2009), and a lack of self-forgiveness (Westers, Rehfuss, Olson, & Biron, 2012). We suggest that this negative association with the self not only removes a key barrier to NSSI but also specifically motivates individuals to engage in directly self-injurious behaviors over less direct or less self-focused behaviors. To further clarify, if you view yourself as bad, toxic, worthless, or similar, you are likely to care little about your body. Harming it in an effort to feel better or to atone for being bad thus becomes a viable and potentially appealing option. As noted earlier, there is also evidence that, for people who are highly self-critical, the experience of pain is associated with improvement in mood.

Accordingly, we propose that a negative association with the self plays a central role in the selection of NSSI as a behavior and in the acute motivation for NSSI (see Fig. 3). This is consistent with evidence that factors such as self-anger are the most commonly reported reasons for initially engaging in NSSI (Muehlenkamp et al., 2013). A negative association with the self creates a state where the individual (a) feels unpleasant and wants to escape (see Study 5 of Chatard & Selimbegović, 2011); (b) believes that he or she deserves pain and punishment (Hooley et al., 2010; Hooley & St. Germain, 2014); and (c) more readily accesses and implicitly identifies with self-injurious concepts (Chatard & Selimbegović, 2011; Tang, Wu, & Miao, 2013). In short, a negative association with the self creates the necessary conditions for selecting NSSI over many other helpful (e.g., exercise) or not so helpful (e.g., substance abuse) approaches that carry the same affect regulation benefits as NSSI.

Of course, having a highly negative sense of self does not occur in a vacuum. High levels of self-criticism are correlated with other aspects of negative emotionality such as depression or high trait negative affect. However, there are reasons to believe that self-criticism may play a particularly important role. For example, Hooley et al. (2010) found that scores on a measure of hopelessness did not predict how long self-injuring participants were willing to endure physical pain. The same was true for scores on a measure of depression.

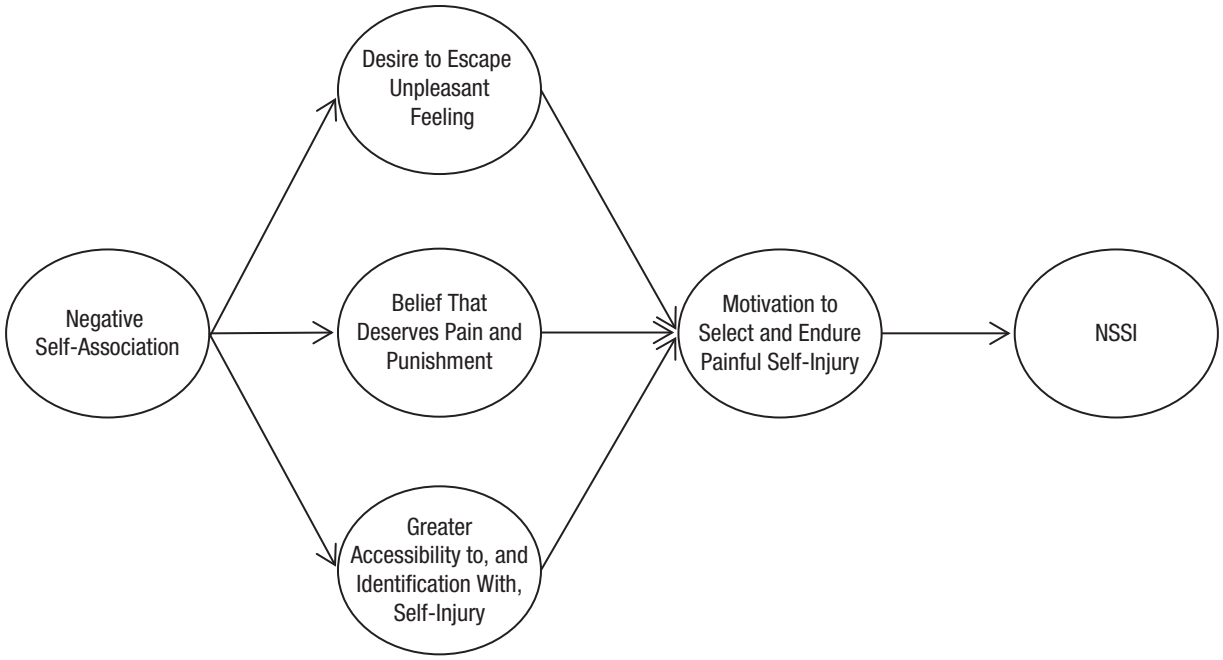

Fig. 3. Negative association with the self, physical pain, and nonsuicidal self-injury (NSSI). A highly negative association with the self can generate (a) the desire to escape this unpleasant affective state, (b) the belief that one deserves pain and punishment, and (c) a greater accessibility to and identification with self-injury. In turn, these factors engender the motivation to select and endure painful self-injury, which leads to NSSI behaviors. In effect, a negative association with the self removes both the positive self-association barrier and the physical pain barrier of NSSI and motivates the selection of NSSI over behaviors that carry similar benefits (e.g., alcohol use).

Only self-criticism was significantly associated with pain endurance. Moreover, in a subsequent study, St. Germain and Hooley (2012) found that, aside from suicidality history, high self-criticism was the only factor that distinguished between people who engaged in NSSI and those who engaged in more indirect forms of self-injury such as abusing substances, depriving themselves of food, or engaging in risky behaviors. Factors such as negative temperament, impulsivity, depressive symptoms, aggression, dissociation, and borderline personality disorder symptoms did not distinguish between these two groups. Experimental research further suggests that changing self-criticism changes pain endurance in people who engage in NSSI (Hooley & St. Germain, 2014). However, no changes in pain endurance were apparent in participants who engage in NSSI who experienced a (noncognitive) positive mood induction. In addition, Smith and colleagues (2015) have reported that self-disgust, which is a form of self-criticism, fully mediated the association between depressive symptoms and NSSI in a sample of college students. Taken together, these data highlight the central role of negative views of the self in understanding NSSI.

Where might such highly negative views of the self originate? Factors such as maltreatment, abuse, and parental criticism may be important here. Several studies have shown that a negative association with the self mediates the relationship between NSSI and factors such as childhood maltreatment (Glassman et al., 2007; Swannell et al., 2012), childhood trauma (Muehlenkamp, Claes, Smits, Peat, & Vandereycken, 2011), childhood emotional abuse (Buser & Hackney, 2012), adverse childhood experiences (Kaess et al., 2012), sexual abuse (Smith et al., 2015), and perceived parental criticism (Baetens et al., 2015). These findings may also help to explain why family, peer, and relationship problems all tend to be associated with NSSI (e.g., Adrian et al., 2011; Di Pierro, Sarno, Perego, Gallucci, & Madeddu, 2012; Levesque et al., 2010). High levels of perfectionism (Claes et al., 2012; Hoff & Muehlenkamp, 2009) may also facilitate high levels of self-criticism. Perfectionism may be especially important in cases in which there is no history of abuse or childhood maltreatment.

In a more transient way, simply experiencing or thinking about failure or criticism from others may temporarily cause a highly negative association with the self, thereby generating a mindset where self-injury becomes more accessible, possible, and desirable. Supporting this view, across several studies, Chatard and Selimbegović (2011) prompted healthy participants to think about various scenarios related to failure and disappointment. Compared with control participants,

these participants displayed a significantly greater accessibility to suicide-related thoughts as measured by an implicit word completion task. Tang, Wu, and Miao (2013) conducted a similar study with the death/suicide implicit association test as the dependent variable. Results indicated that, compared with control participants, participants prompted to think about failure showed significantly stronger implicit identification with death/suicide. Although these studies focused on suicide, it is likely that NSSI is associated with a similar process (see Study 6 of Chatard & Selimbegović for preliminary evidence of the generalizability of this effect). Particularly striking, these studies included only healthy control individuals, suggesting that this may be a normative response to failure and criticism. This may help to explain why NSSI tends to occur in reaction to acute stressors.

A negative association with the self may also play a key role in the trajectory of NSSI. Specifically, individuals with a trait-like negative association with the self are likely to have a high frequency trajectory. In contrast, individuals with lower trait levels may primarily engage in NSSI after acute failure- or criticism-related stressors (e.g., failing a test, argument with family). Consistent with this hypothesis, Schoenleber et al. (2014) found that shame-proneness was strongly correlated with NSSI frequency (r = .58), and Fox et al. (2017) found that self-criticism was moderately correlated with past week, month, and year and life NSSI frequency (rs = .23–.30).

Barrier 3: Physical pain

Physical pain signifies potential or actual tissue damage, which could jeopardize the life of an organism and, ultimately, a species. As a result, organisms evolved an aversion to and a strong motivation to avoid or escape pain. NSSI requires that an individual overcome this powerful evolutionary instinct. Supporting this view, several laboratory studies have found that NSSI is associated with increased latency to report pain, increased pain tolerance, or longer pain endurance (e.g., Franklin, Aaron, Arthur, Shorkey, & Prinstein, 2012; Franklin et al., 2011; Glenn, Michel, Franklin, Hooley, & Nock, 2014; Hooley et al., 2010; Schmahl et al., 2006; St. Germain & Hooley, 2013).

There are several potential mechanisms that may explain increased pain endurance (i.e., the duration of willingness to experience pain) among people who engage in NSSI. Some researchers have proposed that this reflects a biological abnormality by which, via genetics or the effects of stress on neurodevelopmental processes, central and peripheral pain perception are altered (e.g., Ballard & Bosk, 2010; Schmahl et al., 2006; Sher & Stanley, 2009). Although these hypotheses are interesting, few studies have directly investigated them and evidence is inconsistent with these proposed mechanisms. For example, Pavony and Lenzenweger (2014) found that a sample of people diagnosed with borderline personality disorder (many of whom engaged in NSSI) displayed increased pain endurance but did not show more generalized exteroceptive or proprioceptive deficits. This indicates that sensory deficits among people who engage in NSSI may be specific to pain, which suggests a psychological rather than biological mechanism.

Consistent with this view, recent laboratory studies have shown that self-criticism (or, more generally, a negative association with the self) is a psychological mechanism that may play a substantial role in pain perception (Fox et al., 2017; Franklin et al., 2012; Hooley et al., 2010; Hooley & St. Germain, 2014). Hooley et al. (2010) found that self-critical beliefs were strongly associated with pain endurance among NSSI participants. Powerfully demonstrating a causal role for self-criticism, Hooley and St. Germain (2014) have shown that a brief cognitive intervention targeting self-criticism normalized pain endurance among NSSI participants. These findings suggest that many people who engage in NSSI believe that they deserve pain, and they endure pain longer because of this belief rather than a biological mechanism (see also Hamza et al., 2014). This psychological mechanism also helps to reconcile laboratory-based NSSI pain findings (which indicate greater endurance) with retrospective self-report studies, which find that more frequent NSSI is associated with reports of greater pain during NSSI (e.g., Klonsky & Olino, 2008; Lloyd-Richardson, Perrine, Dierker, & Kelley, 2007; Nock et al., 2006). Specifically, people who engage in NSSI experience pain during NSSI (cf. self-reports), but they believe that they deserve this pain, so they willingly endure it (cf. laboratory NSSI pain studies).

Finally, mechanisms such as pain-offset analgesia, placebo analgesia, and stress-induced analgesia may also help individuals overcome the physical pain barrier (see Heilbron, Franklin, Guerry, & Prinstein, 2014). In other words, pain perception during NSSI may be altered by the effects of pain offset (see Grill & Coghill, 2002), expectations of little pain (see Price et al., 1999), or increased stress (see Butler & Finn, 2009). It is unfortunate that there are no empirical studies, in our awareness, that have evaluated these hypotheses in the context of NSSI.

Overall, we maintain that physical pain plays a secondary and paradoxical role in the selection of NSSI as a behavior. For most people, physical pain serves as a potent deterrent against NSSI. However, for individuals who hold profoundly negative associations with the

self or who wish to self-punish, the fact that NSSI causes physical pain makes it an appealing behavioral option (see Hamza et al., 2014; Hooley et al., 2010; Hooley & St. Germain, 2014). Accordingly, high pain endurance in itself is not a direct risk factor for NSSI (cf. St. Germain & Hooley, 2013). Instead, the painful qualities of NSSI attract highly self-critical individuals to these behaviors (Fox et al., 2017; St. Germain & Hooley, 2012).

Barrier 4: Aversion to NSSI stimuli

There is a powerful evolutionary advantage to avoiding stimuli associated with injury (e.g., blood, wounds). In healthy individuals, these stimuli tend to evoke the most negative responses across a range of self-report and physiological measures (e.g., Bradley, Codispoti, Sabatinelli, & Lang, 2001; Schupp et al., 2004). Given that these stimuli are components of NSSI, individuals who engage in NSSI must overcome this instinctive aversion to self-injury stimuli. Consistent with this possibility, several studies have shown that NSSI is associated with diminished aversion to self-injury stimuli across explicit (Franklin, Lee, et al., 2014; Glenn & Klonsky, 2010), implicit (Franklin, Lee, et al., 2014), and biological (Brain, Haines, & Williams, 1998; Franklin, 2014; Haines, Williams, Brain, & Wilson, 1995; Plener, Bubalo, Fladung, Ludolph, & Lulé, 2012; Welch, Linehan, Sylvers, Chittams, & Rizvi, 2008) measures.

We propose three mechanisms for overcoming this aversion barrier. First, the mere exposure effect (Zajonc, 2001) may gradually erode the aversion to NSSI stimuli across repeated exposures. Supporting this hypothesis, preliminary experimental evidence indicates that aversion to NSSI stimuli decreases significantly across repeated exposures to these stimuli during a 3-hour laboratory session (Franklin, Puzia, et al., 2013). Consistent with this hypothesis, diminished aversion to NSSI stimuli is strongly correlated with greater lifetime NSSI frequency (Franklin, Lee, et al., 2014).

We suggest an additional mechanism on the basis of recent evidence: This diminished aversion is not present in individuals who have abstained from NSSI in the past year, regardless of their lifetime NSSI frequency (Franklin, Lee, et al., 2014). Pain-offset relief conditioning (see Fig. 1) may explain this pattern (Bastian et al., 2014; Gerber et al., 2014). As described above, the offset of pain generates a powerful state of relief; stimuli present during this state become paired with relief. During an NSSI episode, this would mean that stimuli such as blood, knives, wounds, and so forth would become paired with relief, gradually eroding the instinctive aversion to these stimuli. After a prolonged period of NSSI abstinence, this association would likely weaken and the instinctive aversion to these stimuli would return. Preliminary experimental evidence supports this possibility. In healthy individuals, pain-offset relief conditioning significantly reduces the physiological aversion to NSSI stimuli (Franklin, 2014).

A third potential mechanism is that some individuals simply sidestep the aversion barrier under stressful, self-punishing, or socially pressured conditions. In other words, at times, the motivation to engage in NSSI may exceed the aversion-based motivation to avoid NSSI. We are not aware of any direct empirical tests of this possibility. However, Bastian and colleagues (2011) have shown that when people were made to feel guilty (by writing about a time they behaved unethically), they were willing to endure pain for a longer period than were people who wrote about an everyday interaction.

Although diminished aversion to NSSI stimuli may facilitate NSSI, it may not play a central role in the selection of NSSI as a behavior. If this were the case, we might expect that emergency medical personnel, trauma surgeons, phlebotomists, and others who routinely encounter blood or tissue damage in their daily lives would be at elevated risk of NSSI. However, as noted above, it is possible that NSSI stimuli may directly trigger NSSI in some cases (see qualitative evidence in Baker & Lewis, 2013, but see contrary empirical evidence in Cha et al., 2016; Muehlenkamp et al., 2014). Another prediction from this aspect of our model is that blood injury phobia may serve as a protective factor, creating a high barrier to cutting and so reducing the likelihood of selecting this as a method of NSSI.

Barrier 5: Social norms

In most cultures, it is not acceptable to engage in NSSI. Such behaviors are often met with alarm, fear, and revulsion (Muehlenkamp, 2005). For an individual seeking to reduce distress via NSSI, such a negative reaction from the social environment would be counterproductive and possibly lead to increased distress. For many individuals who want to engage in NSSI, social norms accordingly represent a major barrier.

There are at least three potential mechanisms for overcoming the social norms barrier. First, an individual may sidestep this barrier by privately engaging in NSSI. This appears to be a particularly common mechanism for individuals who engage in high frequency NSSI (Klonsky & Olino, 2008). Second, individuals may overcome this barrier by joining a subculture that accepts NSSI. Supporting this mechanism, a subset of individuals engages in NSSI with friends (Heath et al., 2009), and many people who engage in NSSI report having friends who also engage in NSSI (Claes et al., 2010; Heath et al., 2009; Whitlock et al., 2008). In addition,

as mentioned above, online forums dedicated to NSSI are increasingly popular and appear to socially reinforce these behaviors via encouraging comments on pictures and videos depicting NSSI (Baker & Lewis, 2013; Lewis et al., 2012). Third, some individuals may purposely violate social norms about NSSI as a powerful means of communicating distress or strength (Gambetta, 2009; Nock, 2008).

Social reasons are commonly endorsed as contributors to NSSI initiation but may play a more minor role in maintaining NSSI (Muehlenkamp et al., 2013; Turner et al., 2016) relative to other factors such as self-criticism. There are at least two ways that social norms may influence the selection of NSSI as a behavior. First, a subculture may introduce and positively reinforce NSSI via a range of socialization effects (see Baker & Lewis, 2013; Prinstein et al., 2009; Radovic & Hasking, 2013). In other words, social influence may lead an individual to view NSSI as an accepted and attractive behavior that signifies membership in a desired social group. Consistent with this effect, multiple longitudinal studies have shown that peer engagement in NSSI may directly or indirectly influence one's own future engagement in NSSI (Giletta et al., 2013; Hasking et al., 2013; Prinstein et al., 2010; You et al., 2013). Second, some individuals may seek to find a shocking way to communicate strength or distress and may reason that violating the social norms against NSSI is an effective method (cf. Nock, 2008).

Summary of the Benefits and Barriers Model of NSSI

NSSI is a prevalent and dangerous behavior with many counterintuitive features: It requires that individuals intentionally self-administer pain, it necessitates that individuals display a motivational approach toward extremely unpleasant stimuli such as blood and wounds, it places individuals at risk for receiving social disapproval, and it demonstrates that pain somehow makes people feel better. Prior theoretical models made great strides toward providing insight into NSSI, but a full understanding of these behaviors has remained elusive. Drawing on basic psychological science and recent experimental and longitudinal NSSI studies, we have crafted a new model of NSSI. This model reconciles the supported features of prior models with more recent evidence and, in the process, shifts NSSI from an affect dysregulation/regulation paradigm to a benefits and barriers paradigm. The core tenets of our new model are that (a) NSSI has potent benefits that are accessible to most people, and (b) most people do not access these benefits of NSSI because there are powerful barriers that motivate them to avoid self-injury. This model provides plausible and highly testable explanations for many previously unexplained features of NSSI. Highlighting the potential promise of this new approach, preliminary evidence is consistent with these novel explanations (e.g., the roles of self-criticism, diminished aversion to NSSI stimuli, pain endurance, and pain-offset relief; Fox et al., 2017; Franklin et al., 2010; Franklin, Lee, et al., 2014; Franklin, Puzia, et al., 2013; Franklin, Puzia, et al., 2014; Hooley et al., 2010; Hooley & St. Germain, 2014). Most critically, however, three recent randomized controlled trials have shown that interventions based on this new model significantly reduce NSSI (Franklin et al., 2016).

We do not regard our model as explaining animal models of self-injury. Nonhumans are unlikely to have a level of cognition that would allow them to have self-punishment desires as we conceptualize those here. Nor do we see our model as capable of explaining self-injury in people with genetic disorders such as Lesch-Nyhan or Prader-Willi syndromes. For those with neurodevelopmental disorders, dopamine insufficiency may be a major factor (Devine, 2012). Animal models also suggest that idiopathic self-injury can be induced through the administration of pemoline, a dopamine agonist, with self-injury being further enhanced in the context of cortical damage (Cromwell, Levine, & King, 1999; Muehlmann, Brown, & Devine, 2008). Chemically induced lesions of the dopaminergic system in newborn rodents also lead to self-injurious behavior when the adult rats are subsequently challenged by administration of L-dopa, which increases dopamine availability (Breese et al., 2005). Other factors such as social and environmental stress have been linked to self-injurious behaviors in captive rhesus monkeys with some genetic polymorphisms perhaps conferring increased vulnerability (Novak, El-Mallah, & Menard, 2014). Common elements linking human and animal models may therefore include tension reduction as well as reward responsivity. Nonetheless, we believe that understanding NSSI in normative human populations requires more nuanced considerations than animal-based approaches are currently able to offer.

Figure 4 provides an overarching view of how the benefits and barriers model of NSSI applies to the initiation and maintenance of NSSI. NSSI and the processes that produce it are complicated, and the model reflects this. The model allows for a broad range of distal risk factors. Some of these, such as abuse, maltreatment, and victimization, reflect extreme childhood adversity. Other risk factors, such as parental criticism or exposure to peer NSSI, may be characteristic of more ordinary developmental circumstances. Regardless, our model proposes that these factors typically generate initial NSSI episodes via one of three proximal risk factors. The most common of these is a negative self-association, followed

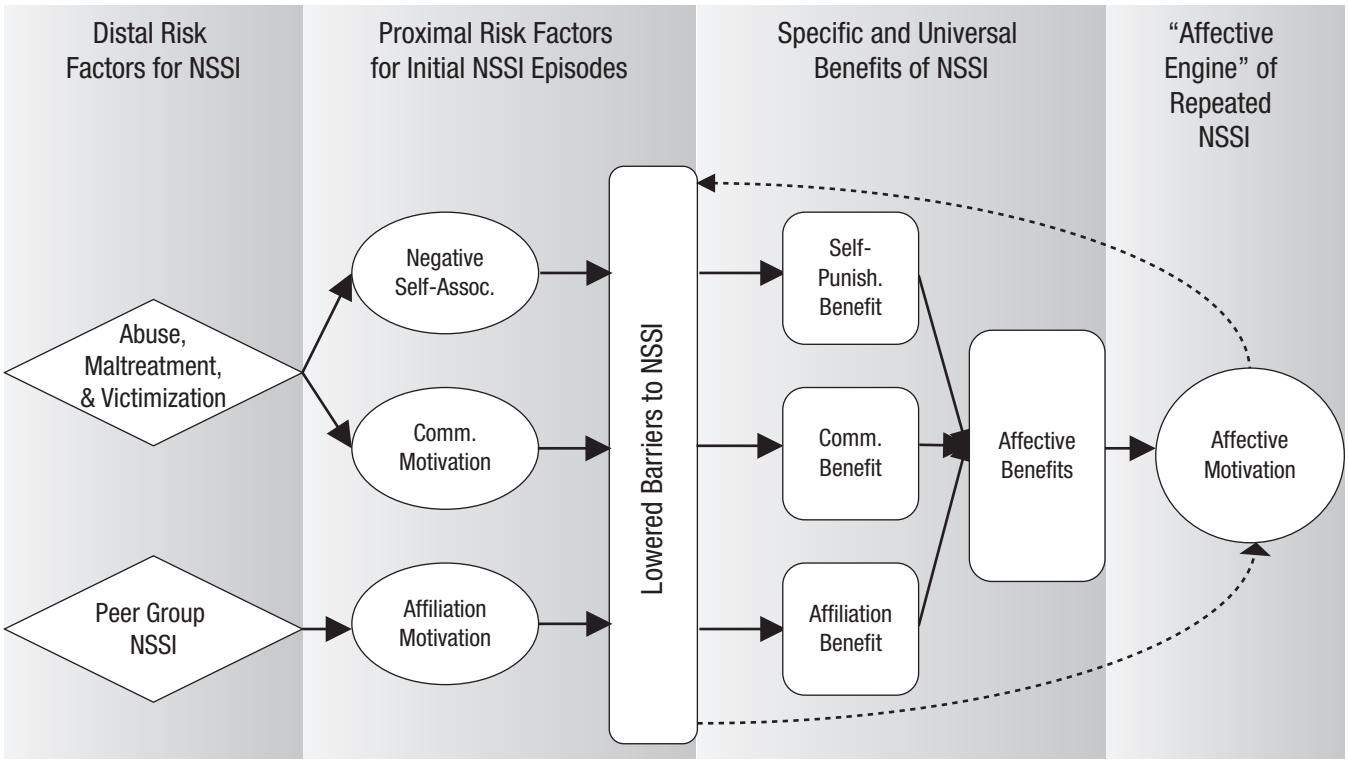

Fig. 4. How the benefits and barriers model applies to the initiation and maintenance of nonsuicidal self-injury (NSSI). In most (but not all) initial episodes of NSSI, a broad range of distal risk factors generates one of three major proximal risk factors for initial NSSI episodes. Each of these proximal factors lowers the barriers to NSSI and carries a specific benefit; however, all episodes of NSSI carry affective benefits. Over time, this "affective engine" of NSSI further lowers the barriers to NSSI and becomes the primary motivator of NSSI episodes. Given its role as perhaps the most common motivator of initial NSSI episodes, a negative association with the self should be a primary treatment target. Similarly, given its role as a primary barrier to NSSI, diminished aversion to NSSI stimuli should also be a primary treatment target.

by a desire to communicate either distress or strength with NSSI, and the motivation to affirm or increase affiliation with NSSI (cf. Muehlenkamp et al., 2013). Each of these proximal factors reduces the barriers to NSSI either directly (e.g., see Fig. 3) or indirectly by motivating the individual to sidestep certain barriers (e.g., one might decide that the physical pain involved in NSSI is worth peer affiliation). Each proximal factor carries a unique benefit (e.g., communication benefits when NSSI is motivated by communication), but all NSSI episodes carry affective benefits. Not all benefits are required to reinforce NSSI behavior.

It is interesting that approximately 50% of individuals who engage in NSSI behaviors appear to rarely or never engage in NSSI again (cf. Klonsky, 2011; Klonsky & Olino, 2008; Lloyd-Richardson et al., 2007; Tang, Ma, et al., 2013; Whitlock et al., 2008). This suggests that, for some people, the affective benefits of NSSI may be less marked and/or that the barriers to NSSI may become quickly reestablished (perhaps because a transient stressor is removed or because a new and rewarding relationship develops, etc.). The remaining 50%, however, may be subject to what we term an "affective engine" that drives repeated NSSI. Via several mechanisms noted above, this affective engine may further reduce the barriers to NSSI and shift individuals toward NSSI episodes primarily motivated by potential affective benefits rather than by social benefits or a negative association with the self (although repeated engagement in NSSI may increase shame and self-criticism and so contribute to the maintenance of the behavior by this route). For example, pain-offset relief conditioning likely occurs during each episode of NSSI; over time, this conditioning may reduce the instinctive aversion to NSSI stimuli (see Franklin, Lee, et al., 2014; Franklin, Puzia, et al., 2014; Fig. 1). In addition, affective benefits may generate heightened awareness of the affective benefits of NSSI (further reducing the lack of awareness barrier) and of placebo analgesia (further reducing the physical pain barrier), among other effects. Regardless of initial motivation for NSSI, after several NSSI episodes, this affective engine should lead to high frequency NSSI motivated primarily by potential affective benefits. Several studies are consistent with this hypothesis (e.g., Klonsky & Olino, 2008; Muehlenkamp et al., 2013; Whitlock et al., 2008).

Primary Implications

The benefits and barriers model makes a number of unique predictions, most of which can be subsumed under the following general corollaries:

(a) The benefits of NSSI are natural and they are relatively poor treatment targets. The benefits of NSSI are not biological aberrations (i.e., some people are not "wired differently" to enjoy pain); they are natural processes that can be experienced by nearly everyone. Our proposed benefits draw on some of the affective and social benefits proposed in the four-function model (Nock & Prinstein, 2004). Extending this work, our model expresses these benefits in NSSI-specific terms, includes additional benefits (e.g., gratification of self-punishment desires), and proposes mechanisms of action. Moreover, we emphasize that altering these benefits may be impossible, extremely difficult, and/or much less effective than modifying the barriers to NSSI. Accordingly, diverging from the predictions of most other NSSI models, we predict that interventions that target NSSI benefits will have limited success, especially compared with barriers-focused interventions.

(b) To engage in NSSI, an individual must overcome all of the barriers to NSSI. This could be accomplished by the gradual erosion of a barrier over time, state-based lowering of a barrier, and natural individual differences that produce relatively low barriers in some members of the population. Whatever the mechanisms, all barriers must be lowered for an episode of NSSI to occur. Individuals with chronically lowered barriers are more likely to follow a high-frequency NSSI trajectory; individuals with state-based (transient) lowering of barriers are more likely to follow an episodic NSSI trajectory.

(c) Diminished barriers to NSSI represent novel and important treatment targets. In this respect, our model differs greatly from traditional models, which have prompted interventions that target factors such as affect dysregulation, contingencies surrounding NSSI, and restoration of hypothesized chemical imbalances. Given that barriers serve to discourage most people from engaging in NSSI, it is likely that building or reestablishing these barriers will reduce these behaviors among people who engage in NSSI. Barriers such as a positive association with the self and the aversion to NSSI stimuli may be particularly important treatment targets.

Preliminary studies based on our model support this idea. Hooley and St. Germain (2014) demonstrated that a brief cognitive intervention focused on increasing positive associations with the self resulted in NSSI participants being less willing to endure physical pain. In addition, in a laboratory study, Franklin (2014) tested the benefits and barriers model prediction that increasing the aversion to NSSI stimuli would reduce the rate of NSSI. In a subsample of individuals with a history of NSSI (i.e., the treatment group), NSSI stimuli were paired with shock onset. In another subsample of individuals with a history of NSSI (i.e., the control group), the same number of shocks and NSSI stimuli were presented but there was no contingency between these stimuli. Compared with the control group, the treatment group displayed more than a 50% reduction in NSSI during a 6-month period when controlling for NSSI rates during the 6 months before the laboratory visit. Moreover, this treatment effect was partially mediated by an increase in the aversion to NSSI stimuli.

Extending these findings, we recently tested a novel intervention that targeted both diminished aversion to NSSI stimuli and self-criticism (Franklin et al., 2016). This intervention was a mobile app that employed evaluative conditioning to alter associations with NSSI stimuli and the self. A control group received a similar mobile app that included only neutral stimuli. In two of the three tests of this intervention, participants had engaged in self-cutting at least twice in the prior month. In the third test of the intervention, all participants had made a suicide attempt in the past year, and many had recently engaged in NSSI as well. Across studies, the treatment group displayed significant reductions (i.e., 35%–45%) in NSSI compared with the control group over the course of 1 month, even after controlling for prior month NSSI, emotion dysregulation, internalizing symptoms, desire to engage in NSSI, and treatment history. This treatment effect was associated with both increased aversion to NSSI stimuli and increased positive associations with the self. It is notable that this app-based treatment for NSSI also significantly reduced suicide plans and suicidal behaviors, suggesting a possible "capability" (for NSSI and for suicidal behaviors) link between NSSI and suicidal behaviors (Franklin et al., 2016; cf. Franklin, Lee, et al., 2014; Joiner, Ribeiro, & Silva, 2012).

Future Directions

Although preliminary tests of the benefits and barriers model of NSSI are promising, more future studies are needed to test all aspects of this model and to further clarify the nature of NSSI. Many key questions remain. Do the benefits and barriers related to NSSI change over the course of development? Is self-hatred an "entry ticket" to self-injury? What factors determine individual differences in self-worth? How do cultural and subcultural

factors influence both the benefits and barriers associated with NSSI? Are certain events, such as failure- and criticism-related events, more likely than other types of events to generate a negative association with the self? Does growing up in a critical family environment play an especially important role? Might opposing factors, such as narcissism, be protective?

Another specific prediction from our model is that an improved (more favorable) association with the self should promote NSSI cessation. This may occur naturalistically through the removal of the stimulus that prompted the negative association (e.g., school pressure, bullying, abusive relationship) or the addition of a stimulus that reduces the negative association (e.g., a helpful teacher, a supportive partner, a caring therapist). Components of traditional therapies (e.g., self-validation and self-care in dialectical behavior therapy or acceptance-focused approaches) as well as compassion-based approaches may hold considerable promise in this regard. Finally, intervention efforts would also do well to focus on building or rebuilding the aversion to NSSI by employing various aversive conditioning techniques. We hope that continued clarification of aspects of the benefits and barriers approach with regard to the onset and maintenance of NSSI will further advance the ability to treat these dangerous and damaging behaviors.

Author Contributions

J. M. Hooley and J. C. Franklin developed the ideas, drafted the manuscript, and provided critical revisions. Both authors approved the final version of the manuscript for submission.

Declaration of Conflicting Interests

The author(s) declared that there were no conflicts of interest with respect to the authorship or the publication of this article.

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