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How does self-injury feel? Examining automatic positive reinforcement in adolescent self-injurers with experience sampling

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ABSTRACT

One of the most frequently reported, yet understudied, motivations for non-suicidal self-injury (NSSI) involves automatic positive reinforcement (APR), wherein sensations arising from NSSI reinforce and promote the behavior. The current study used experience sampling methodology with a clinical sample of self-injuring adolescents ($N=30$) over a 2-week period during which the adolescents reported NSSI behaviors, and rated if an APR motivation was present, and if so whether that motivation pertained to feeling "pain," "stimulation," or "satisfaction." Over 50% of the sample reported at least one instance of NSSI for APR reasons. No significant differences were found on demographic factors or psychiatric comorbidity for those with and without an APR motivation. However, those with an APR motivation reported elevated NSSI thoughts, longer duration of those thoughts, and more NSSI behaviors. They also reported more alcohol use thoughts, alcohol use, impulsive spending, and binge eating. The most commonly reported sensation following NSSI for APR was "satisfaction." However those endorsing feeling pain reported the most NSSI behaviors. These findings provide new information about the APR motivations for NSSI and shed light on the different sensations felt.

1. Introduction

The most commonly reported motivation for non-suicidal self-injury (NSSI) is an an attempt to reduce or escape from negative emotions and/or thoughts (ANR; Nock and Prinstein, 2004, 2005; Klonsky, 2007). However, a less common but frequently reported motivation for NSSI pertains to automatic positive reinforcement (APR; Nock and Prinstein, 2004), wherein NSSI is used to elicit feelings or sensations that ultimately reinforce and promote the behavior. Despite being a common motivation or function of NSSI, APR motivations have not been well studied in the context of self-injury. Furthermore, although existing studies indicate that APR is often reported as a motivation for NSSI, the percentage of those endorsing this motivation as one of the functions of NSSI varies from study to study. One found that 62% of an adolescent sample endorsed NSSI to "elicit feelings" (Nixon et al., 2002), 92% of an adult sample of women with a history of NSSI endorsed feeling generation as a motivation (Turner et al., 2012), and an epidemiologic study found that up to 36% of self-injurers reported engaging in NSSI "to feel something because you were feeling numb or empty" (Klonsky, 2011). Furthermore, in another adolescent sample approximately 23.5% reported engaging in NSSI "to feel relaxed," while 34% reported using NSSI "to feel something, even if it was pain" (Nock and Prinstein, 2004). Thus, research has yet to clearly establish the rate at which self-injurers report APR motivations.

Difficulty with establishing rates of APR motivations for NSSI may be in part because the descriptions of APR motivations are inconsistent from study to study. As an example, reports on the specific sensation of pain during NSSI are mixed. It is well documented that many self-injurers report pain analgesia during self-injury (Russ et al., 1992; Schmahl et al., 2006), yet there is also evidence that pain might act in some way as an APR function for some self-injurers (Bresin and Gordon, in press; Gordon et al., 2010). One study of adolescent self-injurers found that although many reported feeling no pain during self-injury, over half reported feeling a least some to severe pain (Nock et al., 2006). Thus, it is difficult to determine "what" exactly is being felt during NSSI engaged in for APR reasons, which makes understanding this motivation for NSSI even more complicated.

Perhaps one way to advance the understanding of APR motivations for NSSI may be to recognize that NSSI for APR may elicit different sensations in different people, depending on a variety of factors. Previous studies have examined NSSI to feel "something" with the general assumption that what they are attempting to feel is the same in most cases (e.g., pain). However, there is some evidence that NSSI for APR motivation may at times involve

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sensation seeking, where NSSI is engaged in, in order to generate feelings of excitement or exhilaration in a similar manner as other risky behaviors such as skydiving (Nixon et al., 2002; Osuch et al., 1999; Klonsky, 2007). In line with this possibility, one study of adolescents found that close to 10% of those who engaged in NSSI reported doing so because they thought it would be "fun" (Laye-Gindhu and Schonert-Reichl, 2005) and another study reported that a similar percentage engaged in NSSI for "excitement" (Nixon et al., 2002). Although many self-injurers may be attempting to feel pain at times with NSSI, different people or different NSSI scenarios may involve attempts to elicit other sensations. Thus, in the present study, we define APR in the case of NSSI as an instance of NSSI that was engaged in specifically to "feel" a sensation, such as to feel stimulation, satisfaction, or pain. This is in contrast to engaging in NSSI to escape or remove an unpleasant thought or feeling, instances that would be classified as ANR. This definition of APR is consistent with empirical evidence that motivations such as trying to "feel relaxed" or "trying to feel something, even if it was pain" tend to load onto the same factor (Nock and Prinstein, 2004), suggesting there may be positive reinforcement taking place, regardless of the specific sensation being reported (e.g. pain vs relaxation).

The potential distinctions between NSSI for APR motivation, as opposed to NSSI for ANR motivations, are also highlighted in the various theoretical models attempting to explain NSSI functions. Some functional models of NSSI have suggested that it might be used to interfere with dissociative episodes, where the pain or sight of blood in NSSI would "shock" the individual out of a dissociative episode (Gunderson, 1984). Similarly, there are findings that suggest that the sight of blood is a reinforcing aspect of NSSI (Glenn and Klonsky, 2010; Selby and Joiner, 2009), and many self-injurers report that seeing blood during NSSI makes them "feel real" and helps them "focus." However, most affect regulation models of NSSI do not distinguish between aversive and pleasant sensations felt in the process of self-injury and are still limited in their attempts to understand why NSSI is selected over other behaviors as a specific method for emotion regulation.

Another model of NSSI, which may be particularly relevant to understanding sensation seeking or other APR motivations for self-injury, is the opioid hypothesis model (Chapman et al., 2006; Sher and Stanley, 2008). In this view, NSSI may be used to elicit endogenous opioids through deliberate tissue damage, and the release of these opioids may result in pain analgesia and act in some ways like a natural drug that results in feelings of euphoria. The opioid generation model is supported by some findings that self-injures had significantly lower levels of cerebrospinal fluid levels of β-endorphins and met-enkephalin compared to those who did not engage in NSSI (Stanley et al., 2010). However, potential positive APR motivations that might be consistent with the opioid hypothesis of NSSI have not been well examined in relation to other APR sensation motivations, such as feelings of pain.

Finally, although a number of studies have identified multiple APR motivations for NSSI, few studies have examined these motivations in multivariate analyses predicting NSSI frequency. Such analyses may provide more insight into the shared variance between differing APR motivations, potentially highlighting if certain APR motivations are more salient predictors of NSSI frequency than others (e.g., is feeling satisfaction a stronger motivator for NSSI than feeling pain is?). At present, there is little information regarding whether one APR motivation is a more salient predictor of NSSI relative to others, suggesting that further exploration of this issue is needed.

1.1. Current study

One important methodological note with previous studies examining APR motivations for NSSI is that most have examined NSSI using retrospective self-report methods during laboratory assessments, which leaves the report of motivations for self-injury potentially biased by poor recall. One way to diminish the impact of recall bias is through the use of experience sampling, which involves daily assessment over multiple days, allowing participants to report experiences in their natural settings as they occur. Using experience sampling, a more accurate depiction of APR motivations and sensations can be captured, as well as potential associations with frequency of actual NSSI behavior and thoughts.

In the present study, we examined experience sampling data from a group of adolescent self-injurers who were monitored over a period of two-weeks and reported NSSI events as they occurred. Using these data we compared those who reported at least one instance of NSSI for APR motivations during monitoring to adolescents who did not on multiple demographic and psychiatric indices. We also examined group differences in total frequency of NSSI thoughts and behaviors, as well as thoughts about and actual reports of other dysregulated behaviors (e.g. binge eating, alcohol use). To our knowledge, this is the first study to conduct such analyses. Furthermore, in the present study we also examined potential differences between different APR motivations for and sensations felt during NSSI, specifically pain, stimulation, and satisfaction. A better understanding of these specific sensations in the role of NSSI may refine our understanding of what competing sensations are at play in NSSI. In addition to these primary analyses, we also conducted two exploratory multivariate analyses using each of the APR motivations assessed as predictors of total NSSI frequency. The first multivariate analysis examined the specific sensations the participant was attempting to feel, the second examined what sensations were actually felt as a result of NSSI. These analyses allowed for the determination if some APR motivations were more salient predictors of NSSI behavior than others. Finally, examining NSSI in adolescents represents a major advantage for understanding APR motivations, as motivation for and experience of sensations may change over time and following development into an adult, potentially due to factors such as habituation to NSSI sensations (Van Orden, et al., 2010). Thus, fewer confounding factors may be present in an adolescent as compared to an adult sample.

2. Methods

2.1. Participants

This study examined data from 30 adolescents with clinically significant NSSI (ages ranged from 12 to 19 years, $M=17.3$, S.D. $=1.9$), who completed an experience sampling study on the characteristics of self-injurious thoughts and behaviors (Nock et al., 2009). Participants for this study were recruited from the surrounding community of a northeastern university by contacting local treatment centers. Participants were included into the study if they endorsed both of the following criteria: (1) presence of NSSI thoughts in the past 2 weeks and (2) had access to a computer. There were no exclusion criteria. All participants and their parents completed informed consent and assent to participate in the study, and the study was approved by the university IRB board. The sample was 86.7% female, 86.7% European American, 6.7% Hispanic, and 6.7% other race/ethnicity.

2.2. Procedures

Participants first completed a baseline diagnostic interview for history of self-injurious thoughts and behaviors and a psychiatric interview, and then they were trained on the experience sampling protocol. All were provided with personal digital assistants (PDAs) and were trained on how to use the equipment. Participants then engaged in a 14-day assessment protocol, during which the PDAs were programmed to signal participants to complete the experience sampling assessment. Signals alerted participants two times each day, one at midday and the other at end-of-day. Participants were also instructed to complete event-contingent recordings where they initiated a PDA entry whenever they experienced a "self-destructive" thought or behavior. Data from PDAs were uploaded onto a secure server each evening. Participants were compensated upon returning to the lab at

completion of the protocol, and they were provided either $100 or they were allowed to keep the PDA instead ($135 value) if their compliance level was the experience sampling protocol exceeded 80%. During the study, there were 1227 total entries, and 83.3% of the sample completed at least the 28 entries requested of them. Additional details on the study can be found in Nock et al. (2009). Of note, during this study important data were collected on suicide thoughts and behaviors, and more detail on these experiences can be found in the original publication of these data (see Nock et al., 2009).

2.3. Baseline assessment measures

2.3.1. Self-injurious thoughts and behaviors

Prior to the experience sampling part of the study, participants completed a structured interview using the *Self-Injurious Thoughts and Behaviors Interview* (SITBI: Nock et al., 2007). This interview assesses the presence, frequency, and severity of self-injurious and suicidal behaviors. Data on reliability and validity with this interview are well established (Nock et al., 2007). In the current study, only lifetime frequency of NSSI behaviors from this interview was examined.

2.3.2. Psychiatric diagnoses

At baseline all participants completed the Schedule for Affective Disorders and Schizophrenia for School-Aged Children (Kaufman et al., 1997). This was a semi-structured interview administered by one doctoral level psychologist and four graduate research assistants who were trained to reliability and were supervised throughout the study. The average inter-rater reliability score across diagnoses for the interview was excellent ($k=0.93$). In the current study the disorders examined included major depressive disorder (MDD), bipolar disorder, panic disorder, social phobia, specific phobia, generalized anxiety disorder (GAD), obsessive–compulsive disorder (OCD), posttraumatic stress disorder (PTSD), alcohol use disorder, substance use disorder, anorexia nervosa, bulimia nervosa, oppositional defiant disorder, and conduct disorder.

2.4. Experience sampling

2.4.1. NSSI assessment

Participants completed a structured assessment during each data entry period. The assessment began by asking participants if they had experienced a thought of engaging in any self-destructive behavior (currently or since the previous signal). The primary behavior examined in this study was the occurrence of NSSI (harming yourself without wanting to die). If a participant answered in the affirmative for having engaged in a self-injurious or suicidal behavior, then he or she was asked follow-up multiple-choice questions regarding the motivation for or function of the behavior. The stem question was "Indicate why you did the behavior," and choices included, (a) to "rid of the thought/feeling," (b) to "feel something," (c) "to communicate," (d) to "escape task/people," and (e) "other." In the present study we focused primarily on option (b) to examine what feelings may have been motivations for or experienced in NSSI. For those who endorsed motivation (b), they were further asked to report if they were attempting to feel "pain," "stimulation," "satisfaction," or some "other" sensation. Participants were also asked to report the actual consequences experienced (e.g. "Indicate what you felt when you hurt yourself"), allowing us to examine what was felt regardless of motivation.

Participants also completed information on the presence or absence of self-injurious or suicidal thoughts. For each of the thoughts, participants rated the intensity of the thought (Rate how intense the urge was to do the self-injurious/self-destructive behavior on a 5-point scale from "not present" to "very severe") as well as the duration of the thought (Indicate how long you thought about doing the behavior you selected above" on a 6-point scale from "< 5 s" to "5 h to 1-day"). A total of 344 NSSI thoughts were reported during the study, and 26 suicidal thoughts were reported.

2.4.2. Dysregulated behaviors

During each self-injurious and suicidal behavior assessment participants rated if they had thought about or engaged in other types of dysregulated behaviors, including alcohol use, substance use, bingeing, unsafe sex, impulsive spending. Although each of these behaviors was examined individually, a total dysregulated behavior variable was generated indicating the total report of all dysregulated behaviors during experience sampling, and combining these behaviors into one index has been done in previous studies (Coifman et al., 2012).

2.5. Data analyses

For the present study, participants were coded as either having reported at least one or more instances of NSSI for the motivation of trying "to feel" something. These participants were then compared on a variety of demographic, psychiatric, and experience sampling indices to determine if those who endorsed APR differed from those who did not. Those reporting APR motivations were further examined to report different types of feeling (e.g. pain, stimulation, satisfaction, other). For the experience sampling variables, for simplicity of presenting results and due to low reports of many behaviors, frequency indices were generated indicating each participant's total number of NSSI thoughts as well as each participant's total number of NSSI behaviors across all observations.

In addition, duration and intensity of NSSI thoughts were aggregated across observations to indicate mean level for each participant. Analyses consisted of chi-square analyses for sex and presence of psychiatric disorders, and Poisson regression analyses for predicting total frequencies of suicidal and self-injurious thoughts and behaviors, as well as for other dysregulated behaviors and thoughts about these behaviors. Poisson regression analyses were used in predicting the experience sampling frequency indices because the outcome variables were count variables rather than continuous (e.g. number of NSSI behaviors reported), and as such they are not normally distributed. By including a Poisson distribution and log link function, the violations of traditional linear regression analyses are accounted for (Dobson and Barnett, 2008). Because this study was exploratory, we did not control for multiple comparisons. Finally, all analyses were reexamined with biological sex as a covariate given the potential differences in behaviors and self-injury for females relative to males.

3. Results

3.1. Characteristics of NSSI for APR

As reported previously, there were a total of 104 NSSI behaviors reported during experience sampling monitoring (Nock et al., 2009). Table 1 displays the percentage of the sample who reported APR motivation for NSSI as well as the percentage of NSSI behaviors that were rated as having APR motivation. Over monitoring 53% of the sample ($N=16$) reported at least one NSSI behavior with APR motivation, and 35% of all NSSI behaviors were reported as having this motivation. The most commonly reported APR motivation among participants was trying to feel satisfaction, with approximately 45% of the sample endorsing this motivation, followed by 31% to feel stimulation and 24% to feel pain. However, of all the NSSI behaviors reported, 20% were to feel satisfaction, followed by 16% to feel stimulation, and 10% to feel pain. Only a minority of the sample (2%) reported attempts to feel some "other" sensation. Of those who reported an APR motivation, 37.5% endorsed one APR motivation only, 37.5% endorsed attempting to feel two motivations, 18.75% endorsed attempted to feel three of

Table 1
Descriptive data on sensation motivations and reported sensations during experience sampling.

	Sample reporting attempting ≥ 1 NSSI behaviors for APR (%)	NSSI behaviors where attempting APR was reported (%)
Motivation for NSSI		
Attempted to feel "something"	53	35
Attempted to feel pain	24	10
Attempted to feel stimulation	31	16
Attempted to feel satisfaction	45	20
Attempted to feel other sensation	7	2
Sensation felt		
Felt any sensation	53	33
Felt pain	31	11
Felt stimulation	31	14
Felt satisfaction	38	13
Felt other sensation	21	9

$N=30$; NSSI = non-suicidal self-injury; APR = automatic positive reinforcement; Note more than one motivation or sensation could be selected for each NSSI behavior. Note: These analyses were descriptive only, and did not involve significance tests.

the four sensations, and 6.25% endorsed attempting to feel all four APR motivations.

Regarding actual feelings, as displayed in Table 1, more of the sample reported actually feeling pain (31%) than attempted to feel it (24%), the rates for feeling stimulation (31%) were consistent with those attempting to feel stimulation (31%), and fewer reported actually feeling satisfaction (38%) than attempted to feel satisfaction (45%). Although few in the sample were attempting to feel some "other" sensation, over 20% of the sample and 7% of all NSSI behaviors were rated as having felt another sensation than the three primary ones examined here.

3.2. Group differences on demographic variables

Demographic characteristics and psychiatric comorbidity rates for the sample can be found in the original publication involving these data (Nock et al., 2009). In this study, there were no significant group differences between those who reported at least one instance of NSSI for APR reasons and those who did not on sex, age, or any of the psychiatric disorders assessed (MDD, bipolar disorder, panic disorder, social phobia, specific phobia, GAD, OCD, PTSD, alcohol use disorder, substance use disorder, anorexia nervosa, bulimia nervosa, oppositional defiant disorder, or conduct disorder). There were still no significant group differences on any of these variables when the sex covariate was included in analyses.

3.3. Differences in NSSI thoughts and behaviors

Differences between the APR and non-APR groups on frequencies of self-injurious thoughts and behaviors are displayed in Table 2. Those who endorsed at least one ARP NSSI behavior reported more lifetime NSSI behaviors as assessed by the SITBI ($B=1.19$, SE$=0.01$, $P<0.001$, RR$=3.30$), and they also reported more NSSI behaviors during the experience sampling protocol ($B=0.46$, SE$=0.21$, $P<0.05$, RR$=1.58$). They had more frequent NSSI thoughts ($B=0.46$, SE$=0.12$, Wald$=15.74$, $P<0.001$, RR$=1.58$), with longer average duration of thoughts about engaging in NSSI prior to doing so (APR $M=3.51$ duration, S.D.$=1.18$, non-APR M$=2.65$, S.D.$=1.18$; $B=0.28$, SE$=0.09$, $P<0.01$, RR$=2.32$). This finding indicated that the APR group tended to think about NSSI for 1–30 min prior to engaging in the behavior in most cases, while the non-APR group more frequently thought about NSSI for under a minute before engaging in it. There were no group differences on average intensity of NSSI thoughts ($B=0.03$, SE$=0.09$, $P>0.05$) or frequency of suicide thoughts ($B=-0.08$, SE$=0.40$, $P>0.05$). Analyses remained the same when including biological sex as a covariate.

3.4. Differences in other dysregulated behaviors

Table 2 displays the frequency of different dysregulated behaviors and thoughts about those behaviors as a function of those endorsing APR as a motivation for NSSI. Those in the APR group reported more thoughts about using alcohol ($B=0.85$, SE$=0.22$, Wald$=14.85$, $P<0.001$, RR$=2.34$), but not more thoughts about other behaviors. Regarding discrete behaviors reported, those in the APR group reported more of the following behaviors reported during experience sampling: alcohol uses ($B=0.67$, SE$=0.33$, $P<0.01$, RR$=1.95$), binge eating episodes ($B=2.07$, SE$=0.47$, Wald$=19.30$, $P<0.001$, RR$=7.92$), and impulsive spending ($B=1.60$, SE$=0.78$, Wald$=4.20$, $P<0.01$, RR$=4.95$). No group differences were found on drug use or risky sex. The APR group also reported more total dysregulated behavior during monitoring ($B=0.75$, SE$=0.16$, Wald$=22.00$, $P<0.001$, RR$=2.11$).

3.5. Specific feelings and NSSI frequency

In order to explore the potential influence of sensation motivations for NSSI and report of sensations during NSSI on frequency of NSSI during experience sampling, two multivariate Poisson regression models were generated. The first model simultaneously examined those reporting sensation motivations in predicting total NSSI behaviors reported, and the second model examined those who reported feeling actual sensations during at least one NSSI behavior during monitoring. In the first model (Table 3), those who reported attempting to feel pain ($B=0.68$, SE$=0.23$, Wald$=8.69$, $P<0.001$, RR$=1.97$) and stimulation ($B=0.85$, SE$=0.28$, Wald$=9.22$, $P<0.001$, RR$=2.34$) during monitoring had elevated levels of NSSI behavior relative to those who did not. In contrast, those who reported trying to feel satisfaction during NSSI reported significantly less NSSI behavior than those who did not ($B=-0.84$, SE$=0.30$, Wald$=8.08$, $P<0.001$, RR$=0.43$). Those who reported trying to feel an "other" sensation did not engage in significantly different levels NSSI than those without APR motivations.

Table 2
Poisson regression analyses predicting total dysregulated thoughts and behaviors reported during experience sampling.

Total reported	Attempting APR present ***M*** **(S.D.)**	Attempting APR not present ***M*** **(S.D.)**	***B***	**SE**	**Wald**	**RR**
Thoughts						
NSSI thoughts	14.19 (10.01)	8.62 (9.29)	0.46	0.12	15.74**	1.58
Suicide thoughts	0.88 (1.15)	0.92 (2.25)	−0.08	0.40	0.04	–
Alcohol use thoughts	4.44 (4.95)	2.38 (3.88)	0.85	0.22	14.85**	2.34
Drug use thoughts	0.42 (0.51)	0.45 (0.52)	0.06	0.65	0.01	–
Food binge thoughts	0.25 (0.45)	0.18 (0.40)	0.39	0.93	0.18	–
Impulsive spending thoughts	0.17 (0.39)	0.00 (0.00)	0.20	0.10	3.66	–
Risky sex thoughts	0.08 (0.29)	0.00 (0.00)	0.12	0.07	3.10	–
Behaviors						
Baseline total lifetime NSSI behaviors	2158.06 (8021.13)	600.15 (1302.49)	1.19	0.01	8956.81**	3.30
Experience sampling NSSI behaviors reported	4.25 (2.96)	2.62 (4.21)	0.46	0.21	4.69*	1.58
Alcohol binges reported	1.67 (2.36)	1.15 (2.11)	0.67	0.33	4.03*	1.95
Drug use reported	0.08 (0.29)	0.30 (0.48)	1.42	1.15	1.51	–
Eating binges reported	3.19 (5.31)	0.38 (0.77)	2.07	0.47	19.30**	7.92
Impulsive spending reported	0.69 (1.14)	0.15 (0.38)	1.60	0.78	4.20*	4.95
Risky sex reported	0.31 (0.79)	0.15 (0.38)	0.61	0.84	0.53	–
Total dysregulated behaviors reported	11.83 (8.73)	5.70 (4.85)	0.75	0.16	22.00**	2.11

NSSI = non-suicidal self-injury.

* $P<0.05$.

** $P<0.01$.

Table 3
Multiple Poisson regression analyses predicting total NSSI behaviors reported during experience sampling as a function of specific APR motivations and feelings.

NSSI Sensation	*M* (S.D.)	B	SE	Wald	RR
Model 1 – experience sampling NSSI behaviors reported					
Attempted to feel pain	5.71 (3.20)	0.68	0.23	8.69**	1.97
Attempted to feel stimulation	4.89 (2.67)	0.85	0.28	9.22**	2.34
Attempted to feel satisfaction	3.46 (2.50)	−0.84	0.30	8.08**	0.43
Attempted to feel other sensation	4.50 (2.12)	−0.21	0.38	0.30	–
Model 2 – Experience sampling NSSI behaviors reported					
Felt Pain	5.11 (3.01)	0.48	0.23	4.37*	1.62
Felt stimulation	4.44 (2.79)	0.40	0.22	3.19	–
Felt satisfaction	3.27 (2.28)	−0.39	0.23	2.91	–
Felt other sensation	4.67	0.17	0.25	0.45	–

NSSI=non-suicidal self-injury.
* $P<0.05$.
** $P<0.01$.

In the second model, when entered into the model simultaneously, only those who reported actually feeling pain reported more NSSI behavior during monitoring than the other three motivations ($B=0.48$, SE=0.23, Wald=4.37, $P<0.01$, RR=1.62). Those who reported actually feeling stimulation, satisfaction, or some other sensation during NSSI did not report significantly different levels of NSSI during monitoring than those who did not. Both models were essentially unchanged when biological sex was included as a covariate in the models.

4. Discussion

APR is a common motivation for NSSI, yet it has not been well studied. The primary purpose of the current study was to examine APR motivations, as well as actual APR sensations felt, during reported NSSI episodes in a sample of adolescents who completed an experience sampling protocol. Findings from this study indicated that APR motivations for NSSI were common, with over half of the sample reporting at least one NSSI behavior with an APR motivation, and of those over half reported attempting to feel more than one APR sensation. The findings of the current study indicated that there were no significant demographic or psychiatric differences between those who endorsed APR motivations and those who did not. However, those who endorsed at least one APR motivation reported more NSSI and alcohol thoughts, more NSSI behaviors, and more dysregulated behaviors such as impulsive spending, alcohol use, and binge eating. Findings of a high percentage of this sample engaging in NSSI for APR, and that those who did so reporting elevated levels of self-injury, were consistent with previous studies examining rates of NSSI according to APR motivation (Lloyd-Richardson et al., 2007).

We also examined the different APR motivations for NSSI, as well as the actual sensations felt during NSSI. The most widely reported APR motivation was to feel “satisfaction,” although attempting to feel “pain” and “stimulation” were commonly reported motivations as well. However, what was meant by feeling sensations of “satisfaction” and "stimulation" was somewhat ambiguous. Reports of actual feeling of sensations were consistent with the frequency of APR motivations for NSSI, indicating that if an adolescent engaged in NSSI to feel a particular sensation that sensation was likely felt. Finally, when the different APR motivations and sensations were used to predict NSSI frequency, pain motivations and sensations were associated with the highest NSSI frequency, while satisfaction motivations were associated with lower NSSI frequency. Thus, these results provide novel findings on the different APR sensations that may be associated with NSSI.

To our knowledge, this is the first study to compare self-injurers who reported having an APR motivation for NSSI to those who did not report such motivations. Although we did not find group differences in demographic variables or psychiatric comorbidity, key differences were observed between the groups. One particularly salient difference was that those in the APR group reported more NSSI thoughts, and that NSSI thoughts had a longer duration in those endorsing an APR motivation. Although there may be many different interpretations for why there were more NSSI thoughts in this group, one possible explanation may be that those in the APR group find the sensations experienced during NSSI particularly reinforcing. In line with this explanation, those in the APR group also endorsed more alcohol use thoughts, and it may be that they were contemplating the reinforcing sensations they would receive from either NSSI and/or alcohol use.

The finding in this study that APR motivations were associated with higher levels of other dysregulated behaviors was also interesting, and has not been previously documented in other experience sampling studies on NSSI. One potential explanation for this relationship is that those seeking APR for NSSI may also be seeking APR from these other dysregulated behaviors. It has been noted that many distinct dysregulated behaviors may share common reinforcing properties, perhaps involving sensations, and two separate studies have found that reports of multiple dysregulated behaviors load well onto a single latent variable (Selby et al., 2008, 2009). Thus, sensations felt during these various dysregulated behaviors may be reinforcing of the behavior in a similar manner for some, and those who seek NSSI for a particular sensation may be more likely to seek another behavior for similar sensations as well.

One of the most interesting findings from the current study was that the most widely reported APR motivation for NSSI was for feeling “satisfaction.” This issue highlights the paradoxical nature of NSSI in that physical harm to one's body could result in positive sensations. One potential explanation for this finding may be that endogenous opioids are involved in maintaining NSSI behavior (Nock, 2009). The opioid hypothesis of NSSI suggests that during the act of NSSI endogenous opiates may be released in response to tissue damage, and the result of these opioids being released is sensations of euphoria. These positive sensations then result in feelings of satisfaction and reinforce future NSSI. However, the additional finding in this study was that when all APR motivations for NSSI were simultaneously entered into a model predicting NSSI frequency, satisfaction motivations predicted lower NSSI frequency. If opioids were resulting in sensations of satisfaction, then it would seem that satisfaction would predict higher NSSI frequency, similar to the positive reinforcing aspects of substance use. Because of this inconsistency other issues may be involved, such as semantics as to what some adolescents meant by trying to feel “satisfaction.” It is possible that many of the self-injurers interpreted relief from upsetting emotions as feeling satisfaction, or perhaps satisfaction was achieved in some other way than with opioids, such as through social reinforcement arising from the behavior. These findings highlight that discrete positive sensations in NSSI are in need of further examination, as are the potential causes of APR sensations arising from NSSI.

Less commonly reported than satisfaction, but still frequently reported, were feelings of stimulation and pain. However, unlike sensations of satisfaction, those who reported feeling pain or stimulation at least once during the experience sampling protocol reported a higher frequency of NSSI. This suggests that something about these two sensations may be reinforcing. This paradoxical response is still not well understood, although both biological and psychological models have attempted to explain this process (Franklin et al., 2013; Selby et al., 2009). One possible explanation is that for some who self-injury, both APR and ANR motivations

may be simultaneously involved in maintaining NSSI. In fact, some studies have found a strong correlation between both APR and ANR in NSSI (r=0.51–0.71; Nock and Prinstein, 2005; Hilt et al., 2008), suggesting that people may engage in NSSI for both of these reasons or that both reasons may have something in common. Another view of NSSI that attempts to reconcile APR and ANR motivations is that the feeling sensations of NSSI (e.g., pain) may serve to distract from upsetting thoughts and emotions and that this distraction may then result in subsequent feelings of relief (Selby and Joiner, 2009). In this sense, NSSI for APR vs ANR may be just a matter of perspective, with some self-injurers focusing on the sensation aspect and others focusing on the associated relief aspect of the sensation.

The findings of the current study may also elucidate the relationship between NSSI and suicidal behavior. There is some evidence that those who self-injure may have been exposed to multiple previous physically painful events, potentially making them fearless regarding the use of NSSI for emotion regulation purposes (Selby et al., 2010). Similarly, there is evidence that repeated NSSI may also result in gradual habituation to pain, which may further decrease fear of pain, ultimately eroding fear of pain as a barrier to suicidal behavior (Anestis et al., 2011). Given our findings that those who engaged in NSSI for APR motivations tended to report more frequent NSSI, individuals self-injuring for APR motivations may habituate to those sensations over time, and in the process develop more fearlessness, particularly if they are self-injuring to feel pain and experiencing habituation to pain over time. Further support for this hypothesis can be found in the exploratory analyses in this study, which found that those who reported feeling pain during NSSI also reported the most frequent NSSI, relative to those who endorsed feeling satisfaction or stimulation.

There were some important strengths with the current study, the most salient being the use of experience sampling derived data on NSSI motivations and sensations. Most other studies on APR motivations for NSSI involved retrospective self-report data, while these data were captured in the real life circumstances of those who self-injure, when they are attempting to actually feel sensations. Another strength was that the sample consisted of adolescents with clinically significant self-injurious behavior, increasing the generalizability of these findings to other clinical settings. The use of an adolescent sample may also be beneficial in studying APR motivations for NSSI, as those motivations may change during transition into adulthood or over longer periods of time.

There were a few limitations to note. The primary limitation with the current study was the somewhat small sample size, which may have reduced statistical power for detecting effects between groups, particularly for the finding of no group differences on demographic and psychiatric variables. However, despite this concern there were a number of significant findings worthy of note. Another limitation of this study was that some sensations may have been ambiguous when interpreted by the adolescent participants. For example, many endorsed NSSI to feel "satisfaction," leaving open to interpretation what was meant in terms of actual positive sensations or reduction of negative sensations. This ambiguity is a direct result of experience sampling methodology, however, where small digital screens are used to display questions, which are required to be brief to fit on the screen. More precise definitions and understanding of APR motivations in NSSI are also needed, which may further help to distinguish APR motivations from ANR motivations and better understand where the two motivations may overlap. Better understanding the role of opponent-processes (Solomon and Corbit, 1974) in self-injury may also help to address these two motivations. In addition, while the current study assessed for several psychiatric disorders, Borderline Personality Disorder (BPD) was not assessed, precluding the examination of group differences between those who reported at least one instance of NSSI for APR reasons and those who didn't on symptoms of BPD, and this remains an important question for future research. Finally, although these data were collected in real world environments, they are still correlational in nature, thus causal relations between NSSI and the reported sensations felt cannot be made.

This study is one of the first to explore APR motivations and sensations in NSSI in depth, and a number of clinically useful findings were generated. For example, for many self-injurers it may be important to explore APR motivations along with ANR motivations, and to determine what about the specific sensations of NSSI may be reinforcing. Along these lines, if alternative healthy behaviors can be identified that might induce a similar reinforcing sensation, then those healthy behaviors may be able to be harnessed as more effective alternatives to NSSI. For example, if one purpose of NSSI is to derive pain, then exercise might function as an effective alternative as moderate levels of exercise might have a similarly painful or distracting effect that can help cope with upsetting emotions (Wallenstein and Nock, 2007), or exercise might also be involved in opioid release (Thoren et al., 1990). Future studies should continue to examine APR motivations for NSSI, as although they are not the most common reasons for NSSI, they may have a dramatic impact on the behavior.

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