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EMPIRICAL RESEARCH

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Stressful Experiences, Emotion Dysregulation, and Nonsuicidal Self-Injury among University Students

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Abstract

Developmental theory on nonsuicidal self-injury (NSSI; e.g., self-cutting without lethal intent) underscores that stressful life experiences may lead to heightened risk for NSSI, potentially by undermining individuals' emotion coping capacities. Given that the transition to university is often accompanied by new stressors for emerging adults, it is possible that stressors experienced during the university years may lead to heightened susceptibility for NSSI during this developmental period. Cross-sectional research supports a positive association between stressful experiences and NSSI among students; however, longitudinal research is needed to examine the direction of effects and explore potential mediating factors (i.e., emotion dysregulation). In the present study, university students ($N = 1132$; 70.5% female; $mage = 19.11$) reported on their stressful experiences in university, difficulties in emotion regulation, and NSSI each year for three consecutive years. Path analysis revealed a bidirectional association between stressful experiences and NSSI. Increased stressful experiences predicted increased risk for NSSI through emotion dysregulation, and NSSI predicted increased stressful experiences through emotion dysregulation. Overall, these findings provide new insight into the processes through which NSSI may be initiated and maintained, as well as elucidate the impacts of NSSI on emotion regulation and stressful life experiences in university.

Keywords Nonsuicidal self-injury · Stressful experiences · Emotion regulation · Emerging adults · University students

Introduction

Nonsuicidal self-injury (NSSI) is defined as the direct and deliberate damage or alteration of bodily tissue without lethal intent, and includes behaviors such as self-cutting, self-hitting, or self-burning (American Psychiatric Association 2013). Recent research suggests that NSSI is a widespread mental health concern among emerging adults (ages 18–25 years) on university campuses. As many as 30–40% of emerging adults report lifetime histories of NSSI, and as many as 15–20% of students report engaging in NSSI during their university years (Muehlenkamp et al. 2018; Swannell et al. 2014; Wester et al. 2018). Emerging adults in university are two times more likely to engage in NSSI than their same age peers not in university (Swannell et al. 2014), suggesting that university students may represent a unique at-risk group. Although large-scale longitudinal studies on NSSI among university students are limited, the recent finding that NSSI may be increasing on university campuses (Wester et al. 2018) underscores the need for additional research on NSSI during this sensitive period of development.

Recent theory and research suggest that experiencing stressful events in university may contribute to heightened risk for NSSI during the emerging adult years (Liu et al. 2016; Nock 2010). The early university years involve new stressors and challenges for many emerging adults (e.g., living away from home the first time, navigating new social relationships, increased academic demands and pressures) (Arnett 2000, 2016). For some, it is thought that these challenges may be stressful and overwhelming (Azmitia et al. 2013) leading to NSSI as a form of emotion coping behavior (Klonsky and Glenn 2009). However, there is a lack of longitudinal research on understanding the developmental pathways to NSSI in emerging adulthood. Moreover, recent research suggests that NSSI also may lead

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to increased stressful experiences (Burke et al. 2015), so longitudinal research is necessary to disentangle the nature of association between stressful experiences and NSSI. The present study sought to address these gaps in the literature by examining the longitudinal relations among stressful experiences, emotion dysregulation (one theoretically relevant mediator), and NSSI in a large sample of emerging adults enrolled in university.

The Development and Maintenance of NSSI

Nock's (2009) integrative developmental model of NSSI underscores both distal and proximal processes relevant to engagement in NSSI. In this model, it is thought that early distal risk factors (e.g., childhood maltreatment, familial hostility/criticism, genetic predisposition) lead to emotional and social deficits (e.g., heightened emotional reactivity, poor communication and problem solving). As a result, when an individual experiences stressful life events, they may have difficulty coping with these stressors, which in turn leads to NSSI engagement as a form of coping (i.e., a proximal process) (Nock 2009, 2010). In other words, NSSI functions as a method to regulate negative emotions derived from stressful experiences, and then NSSI is reinforced when the behavior provides relief from distress. Nock's emphasis on NSSI as a form of emotion coping is consistent with other affect regulation models of NSSI (e.g., Chapman et al. 2006; Hasking et al. 2017; Klonsky and Glenn 2009), but Nock's model provides a more comprehensive developmental lens through which NSSI may be initiated and maintained across the lifespan. Although research to date supports the role of early distal risk factors in the prediction of NSSI (Baetens et al. 2015; Buser and Hackney 2012), less research has explored contributing proximal processes, such as the impact of recent stressful experiences in the initiation and maintenance of NSSI, or the process through which difficulties in emotion regulation may mediate this link.

Stressful Experiences, Emotion Dysregulation, and NSSI

Cross-sectional research suggests that stressful experiences and NSSI are positively associated (Baetens et al. 2011; Cerutti et al. 2011; Manca et al. 2014), and that individuals who engage in NSSI report more frequent stressful experiences than individuals without a history of NSSI (Liu and Miller 2014; O'Connor et al. 2012). Individuals who engage in NSSI also show higher physiological reactivity in distressing tasks, and a reduced ability to tolerate this distress compared to those who do not engage in NSSI (Nock and Mendes 2008). That said, longitudinal examinations on stressful experiences and NSSI are lacking. In a published review of the literature (Liu et al. 2016), it was found that only three studies included longitudinal assessments of the impact of stressful experiences on NSSI over time, but none of these studies specifically focused on the period of emerging adulthood. In one study of clinically referred adolescents, stressful experiences predicted increased NSSI engagement at 9, 15, and 18 months follow-up among those with a negative attribution style (Guerry and Prinstein 2010). Similarly, in two other studies of community-based adolescents, stressful experiences at baseline predicted increased risk for NSSI at one-year follow-up (Hasking et al. 2013), as well as onset of NSSI across a two-year follow-up (Voon et al. 2014). Although this research suggests that stressful experiences may heighten risk for NSSI over time, none of these studies specifically sought to examine the process through which stressful experiences may lead to NSSI. This led Liu et al. (2016) to conclude that there is a need to move beyond stress exposure models to a consideration of potential mediators to more fully elucidate the mechanisms through which stressful experiences may impact NSSI engagement.

According to Nock's (2009) developmental model of NSSI, stressful experiences may undermine an individual's ability to cope with distress, leading to NSSI as a form of emotion coping behavior. It follows then that emotion dysregulation may be a key mediator in the relation between stressful events and NSSI. In support of this contention, research has shown that stressful experiences can lead to heightened negative affect (Brose et al. 2017; Denovan and Macaskill 2017; Stutts et al. 2018), as well as emotion dysregulation (Herts et al. 2012; McLaughlin and Hatzenbuehler 2009). Moreover, there is accumulating evidence that NSSI serves to function as an emotion regulation strategy; for example, university students self-report that NSSI leads to decreased stress, anxiety and frustration (Batejan et al. 2015; Klonsky and Glenn 2009; Taylor et al. 2018). Negative affect also has been shown to increase prior to NSSI (Bresin and Gordon 2013; Muehlenkamp et al. 2009), and decrease following the act (Armey et al. 2011; Nock et al. 2009) in daily diary and ecological momentary assessment studies (which often require participants to complete multiple assessments in vivo to capture thoughts, feelings, and behaviors in real time) (Armey et al. 2011; Trull and Ebner-Priemer 2009). These findings indicate that NSSI may serve to regulate aversive emotions triggered by stressful experiences, but multi-wave longitudinal research is needed to explicitly test this hypothesis (i.e., research that includes more than two assessment waves).

Exploring Reciprocal Relations

Although stressful experiences may lead to heightened NSSI engagement through emotion dysregulation, it also is

possible that this indirect relation may be bidirectional. According to Hammen's (1991, 2006) stress generation hypothesis, individuals are active, rather than passive, players in their environment and, as such, stressful events are dependent on an individual's characteristics, beliefs, and behaviors. In this sense, an individual may react not only to environmental stressors, but also may select, process, and contribute to their own social contexts (Sameroff and Mackenzie 2003). Although research exploring the reciprocal nature of NSSI and stressful experiences is limited, in one study Burke and colleagues (2015) examined whether NSSI increased the risk of experiencing stressful events, specifically interpersonal life stress. The authors found that frequency of lifetime and past year NSSI predicted occurrence of interpersonal stressful events among late-adolescent females, but not among males. As suggested by Burke et al. (2015), this sex difference may be a result of findings that NSSI is predictive of psychological and social difficulties more strongly for adolescent females than males (Lundh et al. 2011; Lundh et al. 2011), and these difficulties may uniquely account for the occurrence of interpersonal life stress. Indeed, there is evidence that NSSI may impact stressful experiences through heightened emotion dysregulation; for example, Liu and Kleiman (2012) found that heightened negative urgency, one aspect of emotion dysregulation, predicted more frequent negative events (i.e., interpersonal events) over a four-week period in their study of undergraduate students. Given that individuals who engage in NSSI have a more difficult time regulating their emotions (Hasking et al. 2017; Zelkowitz et al. 2016), consequential behaviors associated with emotion regulation difficulties (i.e., impulsivity, aggressiveness), may lead to the occurrence of more stressful experiences.

Current Study

Despite increased research on the link between stressful experiences and NSSI in recent years, there are a number of important limitations of the literature. First, much of the research to date has been cross-sectional, and longitudinal research is lacking. Additionally, there is a paucity of multi-wave longitudinal research, which includes assessments of constructs over multiple time points that can be used to explore the mechanism through which stressful experiences may increase risk for NSSI engagement (Liu et al. 2016), or vice versa. Although recent theory (i.e., Nock's theoretical model) and findings seem to support emotion dysregulation as a potential mechanism, this relationship has not been empirically tested over time. Second, given the lack of longitudinal research on stressful experiences and NSSI, it also is difficult to determine the nature of this relation. The findings of Burke et al. (2015) suggest this relation may be bidirectional, underscoring the necessity of examining the direction of effects between stressful experiences and NSSI. Third, little research on the link between stressful experiences and NSSI has focused on emerging adults, but the university years represent a period of significant transition, characterized by unique stressors such as moving away from home for the first time, increased financial and career related pressures, and navigating new social relationships (Arnett 2000, 2016). Given findings that emerging adulthood also may represent a sensitive period for the onset of NSSI behavior (Swannell et al. 2014), it is important to consider the role of developmentally relevant stressors in NSSI, as well as the impact of NSSI on stressful experiences, specifically during this period of development.

In the present study, associations among stressful experiences, emotion dysregulation, and NSSI among emerging adults in university were examined using a large-scale longitudinal research design. Based on Nock's (2009) theoretical model, it was hypothesized that emotion regulation would mediate the relationship between stressful experiences and NSSI engagement, such than an increase in stressful events would lead to heightened emotion dysregulation, and, subsequently, to increased NSSI engagement. Further, based on the findings of Burke et al. (2015), it also was hypothesized that this would be a bidirectional relationship such that increased NSSI engagement also would lead to heightened emotion dysregulation, and in turn to more frequent stressful experiences. Given that there is mixed evidence regarding sex differences in NSSI prevalence (e.g., Bresin and Schoenleber 2015; Laye-Gindhu and Schonert-Reichl 2005; Swannell et al. 2014), and that Burke et al. (2015) found that the association between stressful life events and NSSI held only for females, sex also was explored as a possible moderator of the indirect link between stressful experiences and NSSI.

Methods

Participants

In the present study, 1132 emerging adults in university (70.5% female, $mage = 19.11$, $SD = 1.05$) completed a survey as part of a five-year longitudinal research project at a mid-sized Canadian university. Students completed the survey in February or March of their first, second, and third year of university and all assessments were completed one year apart. Consistent with the demographics for the region, 87.5% of participants were born in Canada and reported a Canadian ethnic background. Other ethnic backgrounds included British (19%), Italian (17%), French (10%), and German (9%). Most participants (76%) lived in campus residence, 15% lived at home with one or both parents, and

9% lived off-campus with roommates. For paternal education, 10% did not finish high school, 22% finished high school, 13% finished some college, university, or apprenticeship program, 22% completed a college/apprenticeship diploma, 19% completed a university undergraduate degree and 14% completed a professional degree. For maternal education, 5% did not finish high school, 22% finished high school, 17% finished some college, university, or apprenticeship program, 22% completed a college/apprenticeship diploma, and 22% completed a university undergraduate degree and 12% completed a professional degree.

Procedure

Students in first-year university were invited to complete a survey examining stress and coping in university through posters, classroom announcements, website postings, and residence visits. Any student enrolled in first-year university at the university in which data was collected was eligible to participate in the present study (regardless of academic discipline). The survey was completed in-person at Time 1 and Time 2, and at Time 3 the survey was completed online. Only participants who previously completed the study at Time 1 were eligible to participate at Time 2 and Time 3. Participants who completed the first-wave of the project were given either monetary compensation ($10) or a course credit, at Time 2 participants received $20, and at Time 3 participants received $30. The study was approved by the University Research Ethics board prior to survey administration at all three assessments, and active informed consent was obtained from all individual participants included in the study. Although asking emerging adults about self-injury does not have iatrogenic effects (Whitlock et al. 2013), to ensure the safety of participants a full debrief was provided at the end of each survey, and all participants were given a list of mental health supports and the contact information of researchers. Participants also were given the option of providing their contact information so that they could be contacted by a mental health professional if they were experiencing any distress.

Missing data analysis

Missing data occurred because some participants did not complete the entire questionnaire at each of the three waves (average missing data = 3.5%), and because not all participants completed the survey at all three waves. At Time 2, 73% of participants from Time 1 completed the survey, and at Time 3, 72% of participants from Time 1 completed the survey. Results from an independent samples t-test revealed that compared to participants who completed the survey at all three waves, participants who did not complete the survey at Time 2 and/or 3 were more likely to be male ($p < 0.01$), but did not significantly differ on any of the other study variables. Missing data analysis revealed that the probability of missingness on a given variable was not significantly related to any variable scores (i.e., $p > 0.01$, data were missing at random; Enders 2010). Thus, missing data for the main model were estimated using the full information maximum likelihood (FIML) estimation method. FIML retains cases that have missing data, thus avoiding the biased parameter estimates that can occur with pairwise or listwise deletion (Schafer and Graham 2002).

Measures

Demographics

A demographic questionnaire was administered at Time 1 to assess participant age, sex (1 = male, 2 = female), ethnicity, whether the individual was born in Canada, and parental education. Parental education was assessed with one item per parent, on a scale of 1 = did not finish high school to 6 = professional degree.

Nonsuicidal self-injury

At Times 1, 2, and 3, participants completed a shortened version of the Inventory of Statements about Self-injury (ISAS) (Klonsky and Glenn 2009). A list of seven self-injurious behaviors that involved direct tissue damage (e.g., self-cutting, self-burning, head banging, biting, severe scratching to the point of bleeding, preventing wounds from healing, and rubbing skin against a rough surface) was provided. Participants were asked to indicate how many times in their life they had intentionally engaged in each of the behaviors listed without suicidal intent. In line with other longitudinal research on NSSI, lifetime NSSI behavior was assessed (Daly and Willoughby 2019; Voon et al. 2014; Xavier et al. 2017). The ISAS was chosen because it has been shown to produce reliable retrospective reports of NSSI engagement in longitudinal research on emerging adults (Glenn and Klonsky 2011). To create a normalized measure of NSSI frequency, participant responses were collapsed into six categories: 1 incident, 2–4 incidents, 5–10 incidents, 11–50 incidents, 51–100 incidents, more than 100 incidents (see Heath et al. 2008 for a similar categorization). The ISAS has good internal consistency, structural and construct validity (Klonsky and Glenn 2009), and test-retest reliability (Glenn and Klonsky 2011) among university undergraduate populations.

Emotion dysregulation

At each assessment point, participants completed six-items from the Difficulties with Emotion Regulation Scale

(DERS) (Gratz and Roemer 2004). Participants were asked to rate the frequency that each of the six different emotion regulation strategies were applicable to them (e.g., "When I am upset or stressed, I have difficulty thinking about anything else"). Responses ranged from 1 (almost never) to 5 (almost always). Higher scores indicated more difficulties with emotion regulation. The DERS has been shown to have high internal consistency, test-retest reliability, and construct validity (Gratz and Roemer 2004; Neumann et al. 2010), and convergent and divergent validity among university students (Ritschel et al. 2015).

Stressful experiences

To assess subjective stressful experiences, at each time point participants completed a 26-item measure of Daily Hassles adapted from Willoughby (2008). Participants were asked to indicate the frequency of being bothered by daily hassles with friends, peers, and university work (e.g., "What I am going to do after my undergraduate degree is done," "problems with roommates"). Responses ranged from 1 (almost never bothers me) to 3 (often bothers me). Responses were averaged such that higher scores represented higher perceived stressful experiences. In past research, this measure has demonstrated good internal consistency among undergraduate students (Hamza and Willoughby 2013).

Results

Preliminary Analyses

Prior to running the primary analyses, descriptive analyses were explored for all variables (Table 1), and a test for multivariate outliers was conducted (no multivariate outliers were identified). Frequencies were examined to obtain demographic information across scales (e.g., sex proportion, age frequencies). Skewness and kurtosis were examined to test assumptions of normality, and variables were normally distributed. In the present sample, 35.6% reported NSSI at Time 1, 40.1% of students reported NSSI at Time 2, and 43.8% reported a history of NSSI at Time 3.

Table 1 Descriptive statistics

Variable	*M (SD)*
NSSI1	1.18 (1.78)
NSSI2	1.53 (1.94)
NSSI3	2.01 (1.70)
HASSLES1	1.96 (0.32)
HASSLES2	1.96 (0.29)
HASSLES3	1.95 (0.29)
DERS1	2.79 (0.74)
DERS2	2.85 (0.69)
DERS3	2.84 (0.69)

DERS difficulties in emotion regulation, *HASSLES* daily hassles

Primary Analyses

Path analysis in MPlus 7 (Muthén and Muthén 2012) was used for the primary analysis. An autoregressive cross-lagged model was tested with stressful experiences, emotion dysregulation, and NSSI assessed at each of the three time points. The model included stability paths within variables across time (i.e., autoregressive paths), concurrent associations among variables within each assessment wave, and associations between variables across time (i.e., cross-lagged paths). Age, sex, place of birth, and parental education for both parents assessed at Time 1 were included as covariates, with paths to each of the variables at each assessment point. Overall model fit was evaluated using the χ^2 test of model fit, the comparative fit index (CFI), the root-mean-square error of approximation (RMSEA; Bentler 2006; Kline 2015) and the Square Root-Mean Square residual (SRMR). As recommended by Hu and Bentler (1999) and Kline (2015), CFI values greater than .95, RMSEAs less than 0.06, and SRMR values less than 0.10 simultaneously, were used to indicate good model fit.

In order to identify the best fitting overall model, it was first tested whether the pattern of results was invariant over time by comparing a model in which all cross-lagged paths were constrained to be equal across time, to an unconstrained model in which all cross-lagged paths were free to vary. The χ^2 Difference Test of Relative Fit indicated that the unconstrained model was not a significantly better fit than the constrained model, χ^2 diff (6) = 7.10, $p > 0.05$. All further interpretations were based on the constrained model, as this model was more parsimonious and had good model fit, $\chi^2(12) = 15.59$, $p > 0.05$, RMSEA = 0.020, CFI = 0.999, and SRMR = 0.01. As the pattern of associations were invariant across time, the regression coefficients presented below refer only to results from Time 1 to Time 2, as the pattern of results were the same from Time 2 to Time 3. The standardized paths estimates are provided in Table 2. As can be seen in Table 2, autoregressive paths were significant for all study variables.

Indirect Effects

First, a model was run using only stressful experiences and NSSI. There was a significant direct effect from NSSI at Time 1 to stressful experiences at Time 2 ($B = 0.36$, $SE =$

Table 2 Path coefficients for autoregressive and cross-lagged paths

Path	*B*	*SE*	*p*	*95% CI*
HASSLES1 → HASSLES2	0.522	0.027	0.000	[0.448, 0.568]
DERS1 → HASSLES2	0.137	0.023	0.000	[0.039, 0.077]
NSSI1 → HASSLES2	0.026	0.018	0.148	[−0.002, 0.011]
SEX → HASSLES2	0.051	0.030	0.086	[−0.005, 0.075]
AGE → HASSLES2	−0.009	0.028	0.752	[−0.022, 0.016]
BORN → HASSLES2	0.056	0.028	0.041	[0.002, 0.108]
EDU_M → HASSLES2	0.053	0.030	0.079	[−0.001, 0.024]
EDU_D → HASSLES2	−0.009	0.031	0.780	[−0.014, 0.010]
HASSLES1 → DERS2	0.106	0.025	0.000	[0.135, 0.361]
DERS1 → DERS2	0.511	0.028	0.000	[0.453, 0.577]
NSSI1 → DERS2	0.060	0.018	0.001	[0.010, 0.041]
SEX → DERS2	0.018	0.031	0.567	[−0.071, 0.130]
AGE → DERS2	−0.030	0.029	0.302	[−0.071, 0.022]
BORN → DERS2	0.018	0.029	0.526	[−0.090, 0.175]
EDU_M → DERS2	0.002	0.031	0.939	[−0.030, 0.033]
EDU_D → DERS2	0.002	0.032	0.947	[−0.029, 0.031]
HASSLES1 → NSSI2	0.002	0.013	0.885	[−0.144, 0.167]
DERS1 → NSSI2	0.030	0.012	0.015	[0.016, 0.145]
NSSI1 → NSSI2	0.863	0.009	0.000	[0.925, 0.999]
SEX → NSSI2	−0.055	0.018	0.003	[−0.398, −0.082]
AGE → NSSI2	0.003	0.018	0.866	[−0.068, 0.080]
BORN → NSSI2	−0.008	0.017	0.633	[−0.263, 0.160]
EDU_M → NSSI2	0.015	0.019	0.430	[−0.031, 0.072]
EDU_D → NSSI2	0.002	0.020	0.919	[−0.046, 0.051]

B standardized coefficient, *SE* standard error, *DERS* difficulties in emotion regulation, *HASSLES* daily hassles, *BORN* birth place, *EDU_M* maternal education, *EDU_D* paternal education

Numbers after construct names indicate Time 1 or Time 2—only two time points are provided as cross-lagged paths were invariant across Time

0.18, $p < 0.05$) and a trend from stressful experiences at Time 1 to NSSI at Time 2 ($B = 0.018$, $SE = 0.011$, $p = 0.097$). Next, the full model was run, including emotion dysregulation. Specifically, it was assessed whether: (1) stressful experiences predicted NSSI engagement through emotion dysregulation, and (2) NSSI engagement predicted stressful experiences through emotion dysregulation. Analyses of indirect effects indicated a significant indirect path from stressful experiences to NSSI through emotion dysregulation over time, $B = 0.003$, $SE = 0.001$, $p < 0.05$, 95% CI [.000, .006], as well as a significant indirect path from NSSI to stressful experiences through emotion dysregulation over time, $B = 0.008$, SE = 0.003, $p < 0.05$, 95% CI [0.003, 0.014]. It also is important to note that the model was re-run using sex as a moderating variable, rather than a covariate. The χ^2 difference test revealed that sex did not significantly moderate the pattern of associations among variables, X^2diff (6) = 5.467, $p > 0.05$.

Discussion

Although there has been increasing interest regarding the relation between stressful experiences and NSSI (Liu et al. 2016), there has been little longitudinal research examining the nature of the association, or the process through which stressful experiences and NSSI may be associated. However, understanding the relation between developmentally relevant stressful experiences and NSSI may be especially important in emerging adulthood, given that this is a period of marked stress and transition for some individuals (Arnett 2000, 2016), as well as a period of increased risk for NSSI (Swannell et al. 2014; Wester et al. 2018). To address this gap in the literature, the present study examined associations among stressful experiences, emotion dysregulation, and NSSI among university students using a multi-wave longitudinal research design. Consistent with study hypotheses, stressful experiences significantly predicted NSSI engagement through emotion dysregulation over time. It also was found that this relationship was bidirectional such that NSSI engagement predicted stressful experiences through emotion dysregulation over time.

Indirect Effect of Stressful Experiences on NSSI

In the integrated model on the development and maintenance of NSSI, Nock (2009) underscores the impact of stressful experiences on the onset and maintenance of NSSI, suggesting that exposure to stressors may lead to NSSI through increased emotion dysregulation. The early adult years are a sensitive period of development, characterized by frequent transitions and changes that some individuals find stressful and/or overwhelming (Arnett 2000, 2016). Therefore, one reason university students may be particularly susceptible to NSSI (Muehlenkamp et al. 2018; Swannell et al. 2014) is because the early university years represent a period of heightened stress, leading to NSSI as a form of emotion coping. In support of this contention, and consistent with previous research (Wester et al. 2018), it was found that NSSI was a widely occurring mental health concern among university students in the present study. Additionally, as predicted, increased stressful experiences in university predicted increased risk for NSSI engagement over time indirectly through emotion dysregulation. The present findings are consistent with cross-sectional findings that exposure to stressful experiences is associated with increased risk for NSSI (Cerutti et al. 2011; Liu and Miller 2014; Manca et al. 2014; O'Connor et al. 2012; Zetterqvist et al. 2013), and extend limited longitudinal research by

elucidating one mechanism through which stressful experiences may lead to NSSI, particularly among emerging adults in university.

The present findings also suggest that NSSI may not be a direct product of exposure to stressful experiences, but rather a result of the impact that stressful experiences have on one's ability to regulate their emotions. It is well established that emotion regulation is a key function of NSSI (Batejan et al. 2015; Klonsky and Glenn 2009; Taylor et al. 2018) and that individuals who engage in NSSI have more difficulties regulating their emotions than individuals who do not engage in NSSI (Hasking et al. 2017; Zelkowitz et al. 2016). As such, the presence of stressful life events may undermine emotion regulation capacities among a group of individuals who already have a limited coping repertoire (Aldao et al. 2010; Andrewes et al. 2017; Kranzler et al. 2018). The present findings extend the results of Liu et al. (2016) and suggest that emotion dysregulation is a key mediator in the link between stressful experiences and NSSI. Thus, equipping students with strategies to manage their emotional responses to stressors in university may help to prevent use of NSSI as a primary emotion coping strategy.

Indirect Effect of NSSI on Stressful Experiences

On the basis of previous research (Burke et al. 2015), a reciprocal relationship was tested to explore the possibility that NSSI also may lead to increased stressful experiences through emotion dysregulation. It was found that NSSI predicted increased emotion dysregulation over time, which in turn, predicted more stressful experiences. Although NSSI is a well-established emotion regulation strategy in that participants report that it reduces negative emotions in the short-term (Armey et al. 2011; Bresin and Gordon 2013; Klonsky and Glenn 2009; Nock et al. 2009) there is some evidence that the behavior may lead to an increase of negative emotions in the long-term (Nixon et al. 2002; also see Laye-Gindhu and Schonert-Reichl 2005). For example, Favazza and Conterio (1989) found that while majority of females in their sample reported an increase in positive emotions immediately following NSSI, 50% reported feeling worse a few days following engagement. It is possible that NSSI is effective in reducing negative emotions in the short-term, but repetitive use of NSSI may undermine the development of other coping mechanisms and emotion regulating strategies. In line with this hypothesis, there is evidence that individuals who engage in NSSI employ fewer problem solving and more avoidance coping strategies than those who do not engage in NSSI (Chapman et al. 2006; Heath et al. 2008; Nielsen et al. 2017; Silverman et al. 2018). The results of the present study suggest that difficulties in emotion dysregulation may then lead to experiencing more stressful life events, in accordance with Hammen's (1991, 2006) stress generation hypothesis (i.e., that individuals are active participants, and may evoke stressful experiences in their environments). Findings suggest that interventions aimed at reducing NSSI behavior is important, given that repetitive engagement in NSSI may undermine an individual's emotion coping strategies, making them vulnerable to additional stressful experiences while in university.

Sex Effects

In contrast to the findings of Burke et al. (2015), the present results suggest that there is no sex difference in the bidirectional relation among stressful experiences, emotion dysregulation, and NSSI. The present study utilized a general measure of stressful experiences that did not differentiate between interpersonal and intrapersonal stress, while Burke et al. (2015) focused on interpersonal stressful experiences specifically. It may be that sex differences emerge for specific types of stressful experiences dependent on NSSI functions and motivations and the context in which life stress is situated. However, the current sample was much larger than that of Burke and colleagues (2015), so having an increased sample of males may have provided greater statistical power for testing differences in the pattern of associations between males and females.

Limitations and Future Directions

Despite the many strengths of the present study, including the use of a multi-wave longitudinal design, the present study is not without limitations. First, although the present study included a large sample representative of the university in which the data was collected, the majority of the participants were white and middle-class; therefore, findings may not generalize to other geographic regions, specifically those with different ethnic and demographic backgrounds. Second, although the use of a large-scale longitudinal approach allows for modelling of developmental processes over time, relying on retrospective reports of NSSI behaviors may have led to recall errors (e.g., forgetting NSSI incidents). It would be useful for future research to assess the relationship among stressful experiences, emotion dysregulation, and NSSI using shorter assessment intervals, as well as ecological momentary sampling techniques, to capture more recent NSSI events. It also is important to note that although the lifetime prevalence of NSSI in the present study was comparable to other studies (Cerutti et al. 2011; Wester et al. 2018), it also is on the higher side. Research suggests that studies that use checklist measures of NSSI, and allow for self-administration of NSSI questions, do tend to yield higher response rates than studies that involve

recall, and in-person interview questions (Muehlenkamp et al. 2012; Swannell et al. 2014). Third, the study utilized a subjective measure of stressful experiences, designed to assess the participants' specific perceptions around the stressfulness of particular events. The measure used provides strength due to its incorporation of personal and contextual factors in addition to event occurrence (Folkman 2013; Roberti et al. 2006). However, it is important for future research to consider inclusion of other measures of stressful experiences in order to differentiate the impact subjective and objective stressful events.

Conclusion

NSSI is a widely occurring mental health concern among emerging adults in university. Although theoretical models on the development of NSSI underscore the importance of stressful experiences in the prediction of NSSI, longitudinal research on stressful experiences and NSSI, or the mechanism through which stressful experiences may lead to NSSI, are lacking. Moreover, there is a paucity of research on the impact of developmentally relevant stressful experiences on NSSI behaviors among emerging adults in university, but research suggests this may be a unique at-risk group (Swannell et al. 2014). The present study addressed these gaps in the literature by examining the associations among stressful experiences, emotion dysregulation (one theoretically relevant mediator), and NSSI among emerging adults over the first three years of university. It was found that the relation between stressful experiences and NSSI through emotion dysregulation was bidirectional. This result suggests that stressful experiences may lead not only to increased risk for NSSI engagement among emerging adults as proposed by Nock (2009), but that repetitive engagement in NSSI may undermine an individual's ability to cope with distress, and lead to increased stressful experiences. This study's findings contribute a more nuanced understanding of the link between stressful experiences and NSSI, elucidating emotion regulation as a crucial pathway through which a bidirectional relationship between stressful experiences and NSSI may exist.

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Data Sharing and Declaration The manuscript's data will not be deposited.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval The present study involved the use of human participants. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standard.

Informed consent Informed consent was obtained from all individual participants included in the study.

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