ADVANCING THEORY OF SUICIDE AND NON-SUICIDAL SELF-INJURY

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ADVANCING THEORY OF SUICIDE AND NON-SUICIDAL SELF-INJURY

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Editorial: Advancing Theory of Suicide and Non-Suicidal Self-Injury

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Keywords: non-suicidal and suicidal self-injurious thoughts and behaviours, self-harm, suicide, suicidal behaviour, theory, non-suicidal self-injury

Editorial on the Research Topic

Advancing Theory of Suicide and Non-Suicidal Self-Injury

The past decade has seen an explosion of empirical studies devoted to better understanding of self-harm by focusing both on non-suicidal self-injury (NSSI) and on suicide risk outcomes (including non-fatal suicidal thoughts and behaviour), and their key distinctions. Both NSSI and suicide are important public health issues that are associated with psychological distress and impairment (Klonsky et al., 2003; Selby et al., 2012; Brunner et al., 2014; Victor and Klonsky, 2014; Eskin et al., 2016) and significant economic impact worldwide (Sinclair et al., 2011; Florence et al., 2015; Shepard et al., 2015; Kinchin et al., 2017; Doran and Kinchin, 2020; Tsiachristas et al., 2020). Self-injury (including NSSI and past suicidal behaviour) is also an essential risk factor for future suicidal behaviour (Hamza et al., 2012; Ribeiro et al., 2016; Castellví et al., 2017), with suicide being among the top 10 leading causes of death in eastern Europe, central Europe, western Europe, central Asia, Australasia, southern Latin America, and high-income North America (Naghavi, 2019). It is imperative that we continue to develop and refine evidence-based psychological theory so we can better understand, prevent, and treat both NSSI and suicidal behaviour.

In this special issue we therefore showcase papers that advance conceptual and theoretical understandings of NSSI and/or suicide, or which address critical open questions about the nature and operationalisation of these behaviours that must be answered before we put theory to the test and address conceptual gaps in the field. The collection of articles, submitted from across Europe, America, Canada, and Asia, includes: three review papers that inform theory and future research on understanding NSSI and suicide risk outcomes; one conceptual analysis of suicide-specific syndromes; and seven empirical studies. The studies address: operationalisation and stability of NSSI and suicidal behaviour; the relationship between NSSI and suicidality; the co-occurrence of NSSI with other disorders and dysregulated behaviours; and mechanisms, mediators, and moderators underlying NSSI and suicidality.

The first primary theme pertains to "fluctuations in non-suicidal self-injurious and suicidal behaviour." Repetition of NSSI is common, especially among adolescents (Brunner et al., 2007; Hawton et al., 2012; Howe-Martin et al., 2012), leading researchers to identify the mechanisms that might explain why the behaviour is frequent returned to. Repetition of NSSI, for example, is defined

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in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013) as five or more NSSI experiences, and Lee and Hyun's study in University students meeting this threshold suggests that repeat self-injury could be underpinned by general difficulties in behavioural control. Like several other studies in this special issue, this was a cross-sectional one, paving the way for future prospective studies that can identify whether these effects persist over time and simultaneously explain fluctuations in NSSI and suicidality. Indeed, a major takeaway from the special section was that consistency of self-reported NSSI and suicidal behaviour shouldn't be taken for granted. Daukantaite et al., for example, found in psychiatric inpatients that NSSI frequency dropped substantially after the initial assessment (including originally reported lifetime NSSI frequency). Fluctuations were also found in a second potential suicide risk variable, NSSI functions. In our own work with individuals in the community (Gardner et al.), we similarly found changes in functions over time. In addition, intrapersonal (e.g., affect regulatory) functions were a prospective risk factor for repeated future self-harm, and *potentially* suicide attempts. Changes in suicide risk factors were also explored in a University student sample by Law and Anestis; the authors identified changes in suicide capability, which has previously been thought of as a more static trait. Research focusing on suicidal behaviour, especially NSSI, and associated risk variables should be mindful of the variability in patient recalls. Likewise, fluctuations in suicidal ideation and behaviour are likely to dovetail with clinical case conceptualizations of suicidal behaviour as representing acute risk or crisis syndromes characterised by repeated suicidal behaviour (as outlined in the conceptual paper by Voros et al.).

There was also a key theme of better understanding individual perceptual experience in suicidal and NSSI behaviour, and the better we can develop a conceptual theory of mind for such individuals, the better we can tailor our interventions to their needs. In samples of University students Hamza et al. found that exposure to recent stressful experiences was associated with perceived heightened emotional reactivity, which in turn, increased the risk of NSSI; while the Mettler et al. study indicated that those with a history of NSSI may have less accurate perceptions of their emotions and emotion management abilities. The Pollak et al. study of community adolescents identified that a propensity towards imagining more positive future events, especially those less realistic and achievable, was predictive of suicide ideation, possibly because of feeling defeated or trapped by those ambitions. Mental imagery and awareness of future consequences can differentiate individuals who are suicide ideators from attempters, and this is central to the theory outlined by Macintyre et al. which integrates a number of specific concepts into three principles of control, conflict, and awareness.

The social context within which perceptual experiences occur is just as important to understand, and this has also been a focus of empirical studies in the field. The social determinants of behaviour are central to the review by Mueller et al.'s which draws on sociological theories of death by suicide as a basis for recommending that psychology theories place increased emphasis on the external social world that extends beyond individuals' perceptions of it. The theoretical paper by Shafti et al.'s positions social context within their cognitive-emotional model of "*dual harm,*" a concept that accounts for the co-occurrence of non-suicidal self-harm and aggression and can be explained by common proximal and distal risk factors within the individual (e.g., personality) or their environment (e.g., socially adverse situations or events).

The final theme identified in the special issue pertained to placing suicidal behaviours in the greater context of an individual's life and other aspects of mental health. So often suicidal or NSSI behaviours are studied outside the context of comorbid diagnoses that can dramatically affect an individual's symptom severity or prognosis. For example, in their graphical network examination of self-injury symptoms relative to borderline personality disorder symptoms among adolescence, Buelens et al. found that self-injury conceptualised as a disorder was functionally distinct from borderline personality disorder symptoms. There were additional key symptoms that "bridged" the two symptom clusters, namely loneliness, impulsivity, separation anxiety, and self-injury thoughts and affect, which may serve as key early intervention targets in adolescents. Furthermore, suicidal behaviours do not exist isolated from an individual's existential life, experience, and purpose, and yet so much of our assessment and treatment approach is focused solely on symptoms and acute distress. In their study on childhood abuse and spirituality amongst outpatients with suicide attempts, Tae and Chae found that spirituality offered a protective effect against the negative outcomes of childhood abuse and associated suicide risk. There may be room to improve assessments and interventions to incorporate measurement of patient spiritual beliefs or other factors relevant to making meaning out of a difficult life. Doing so is likely to help us reach patients in more personal and possibly more durable ways.

Therefore, as research on suicide risk outcomes and NSSI behaviour continues, we encourage consideration of the key themes identified in this special issue. It is important to recognise suicide risk outcomes and NSSI, and even some key risk factors, as constantly evolving phenomena. Likewise, individual perceptions and the accuracy of those perceptions can influence risk for these behaviours, especially under key social contexts. Finally, suicidal and NSSI behaviour exist as just parts of an individual's life, and better understanding the broader life context surrounding these behaviours may be essential to tailoring and improving current intervention strategies.

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KG and ES led on the initial draft of the editorial. All authors have contributed and approved the final version.

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One-Year Consistency in Lifetime Frequency Estimates and Functions of Non-Suicidal Self-Injury in a Clinical Sample

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Non-suicidal self-injury (NSSI), the direct, deliberate destruction of one's own bodily tissue in the absence of an intent to die, is frequently used for evaluating treatment in clinical care. One instrument for assessing NSSI is the Inventory of Statements About Self-Injury (ISAS). The ISAS is a self-rating measure examining the lifetime frequencies of NSSI behaviors and further exploring NSSI functions. The study aimed to examine the consistency of self-reported lifetime NSSI frequencies and functions (*via* the ISAS) in a clinical sample of individuals with current self-harm and/or recurrent suicidal behaviors over one year. Fifty-two individuals (84.6% women) completed the ISAS three times over 1 year. We found relatively good test-retest stability for most NSSI behaviors and functions, but the correlation coefficients and frequencies of NSSI behaviors varied substantially. Approximately, 50% of participants reported lower lifetime frequencies of NSSI behaviors at the later time points, with approximately 20% reporting a significant reduction in their lifetime frequencies over one year. This unexpected finding raises concerns about the accuracy of reporting lifetime NSSI frequencies among individuals with multiple psychiatric diagnoses and extensive NSSI behaviors across their lives. Further research is needed to determine more reliable ways of collecting data on the lifetime frequency of NSSI in clinical samples and the accuracy of lifetime NSSI frequency estimates in general.

Keywords: self-injury, the Inventory of Statements About Self-Injury (ISAS), self-report measure, lifetime assessment, psychiatric, clinical

INTRODUCTION

Self-injurious behavior, suicidal or non-suicidal, is a common symptom of many different psychiatric disorders (1). Changes in frequency of self-injurious behavior are a common outcome measure in clinical studies and care (2–5). Deliberate self-harm (DSH) is often used as a broader term for self-injurious behavior, describing direct and indirect behaviors that jeopardize the self regardless of

suicidal intent (6, 7). To evaluate treatment or obtain information useful for implementing treatment, a valid and reliable measure of the frequency and/or changes in the frequency of self-injurious behaviors over time is crucial. Over the last few decades, various measurement instruments have been developed to assess different types of DSH. Some instruments {e.g., Suicide Attempt Self-Injury Interview [SASII; (8)]; Self-Injurious Thoughts and Behaviors Interview [SITBI; (9)]} that assess multiple factors related to self-harm and suicide attempts are designed to be administered in a structured interview format, whereas others—which tend to be less comprehensive [e.g., the Self-Injury Questionnaire, (10)]—use a self-report format, require little time to administer, and are used in both clinical and non-clinical research. In this study, we will focus on non-suicidal self-injury (NSSI), a subcategory of DSH that represents the direct, deliberate destruction of one's own bodily tissue (e.g., cutting, burning, carving) in the absence of an intent to die (11). Although the majority of individuals who engage in NSSI lack the intention to die, this behavior remains one of the strongest predictors of attempted and completed suicide (12–17) and is a risk factor for increased all-cause mortality (14). Moreover, NSSI has also been incorporated in the DSM-5, the American Psychiatric Association's diagnostic system (18), as a "condition for further study" (19–21).

Several self-report instruments [e.g., the DSH Inventory (DSHI) (22)]; the Functional Assessment of Self-Mutilation [FASM; (23)]; the Inventory of Statements About Self-Injury [ISAS; (24)]) have been developed to assess NSSI. These instruments ask about specific forms of self-injurious behavior, such as cutting, carving, burning, biting, and punching oneself. While the original DSHI and the ISAS assess lifetime frequency of NSSI behaviors, the FASM requires individuals to report NSSI over the past year. The latter two instruments also evaluate the functions of the NSSI. Although the choice of instrument depends largely on the application of the knowledge of self-injurious behavior, a lifetime assessment of self-injurious behavior is generally of great interest because it enables assessment of the prevalence of NSSI. Furthermore, since lifetime NSSI remains an important risk factor for suicide even if an individual ceases NSSI (25), inaccurate reports of lifetime NSSI or assessing NSSI only in the last year might have decisive consequences for the individual. Inaccurate reports of lifetime NSSI frequencies could also be misleading when evaluating treatment for an individual seeking health care, which, in turn, could lead to inadequate or absent treatment or even incorrect evaluation of a new intervention. However, despite a surge in NSSI studies over the last decades, few examined the longitudinal consistency of lifetime NSSI frequency estimates and functions. Further, most of the research on NSSI has been completed on non-clinical samples. Existing self-report questionnaires might not be suitable for providing valid information on the lifetime nature and frequency of NSSI among individuals with multiple comorbidities, as well as extensive NSSI histories.

The ISAS, one of the most commonly used self-report instruments in self-harm research, comprises two parts: Part 1 assesses the lifetime frequency of 12 predefined NSSI behaviors (e.g., cutting, biting, and burning) and Part 2 assesses two main categories of NSSI functions (intrapersonal and interpersonal). Intrapersonal functions include motivations for NSSI that are independent of the individual's surroundings, such as for regulating emotions, punishing themselves, or reducing suicidality. Conversely, interpersonal functions represent motivations stemming from the individual's surroundings, such as for influencing others, establishing interpersonal boundaries, or bonding with others (24).

While the psychometric properties of the ISAS have been tested cross-sectionally in several countries (e.g., Sweden, Mexico, Spain, Korea, and Turkey) in both non-clinical (26–28) and clinical (29) samples, few studies have examined the consistency and stability of ISAS-measured lifetime frequency estimates and functions of NSSI over a period longer than several weeks or months. To the best of our knowledge, only Glenn and Klonsky (30) established the 1-year test-retest reliability of both parts of the ISAS in a sample of 51 undergraduate students with NSSI. Although the reported frequencies of NSSI behaviors varied substantially between the two measurement points in their study, Glenn and Klonsky (30) did not discuss the trustworthiness of these self-reported frequencies. Instead, they focused on the test-retest correlations between the two measurements of the 12 NSSI behaviors and functions, concluding that both parts of the ISAS demonstrate good stability over one year in a student sample. Expanding on these findings, Victor et al. examined the longitudinal changes in ISAS-measured NSSI functions, among other factors, in a large sample of patients being treated in a partial hospitalization and intensive outpatient treatment program specifically for self-injury and other self-destructive thoughts and behaviors. Victor et al. (31) reported significant but moderate correlations over time for both intrapersonal (r = .53, p <.001) and interpersonal (r = .46, p <.001) functions, significant decreases [with effects sizes varying from very low (Cohen's d = 0.10) to low (Cohen's d = 0.25)] for both functions, and no significant difference in the decrease between functions. The study further supported the relatively good stability of NSSI functions over time in the clinical sample, even though the correlations were lower than were those reported by Glenn and Klonsky (30).

Although the notion of assessing the lifetime NSSI frequency is attractive and important for many researchers and clinicians, the accuracy of such assessments has not been widely discussed. In a study, comparing interview accounts of NSSI behaviors with medical records for incarcerated individuals with a history of self-harm, less than 40% of the participants with self-harm in their medical records disclosed their lifetime self-harm when directly asked (32). To our knowledge, no empirical article has noted the accuracy in discussing the self-reported assessment of lifetime frequencies of NSSI behaviors. However, a number of articles have raised concerns over the reporting of the lifetime prevalence of mental disorders (33–36). While Copeland et al. (35), Moffitt et al. (33), and Takayanagi et al. (34) have found evidence for an underestimation of the lifetime prevalence of mental disorders, Olino et al. (36) found higher lifetime prevalence estimates for several mental disorders. These findings indicate that, in general, lifetime prevalence estimates based on retrospective self-reports are susceptible to recall bias and other memory distortions.

The aim of this paper is to assess the consistency in ISAS-measured lifetime NSSI frequencies and functions in individuals

with current episodes of self-harm and/or recurrent suicidal behavior, who exhibit at least three diagnostic criteria for borderline personality, and who have regular contact with mental health services. Based on previous research [i.e., (30, 31)], we expect that ISAS-measured lifetime frequencies of NSSI behaviors and functions will have a relatively good stability over a year in the clinical sample.

METHOD

Participants

One hundred twenty-five participants with current episodes of self-harm and/or recurrent suicidal behavior, as well as at least three diagnostic criteria for borderline personality disorder (BPD), were recruited from four psychiatric inpatient clinics in Skåne, Sweden, for a project evaluating the effects of Brief Admission to the hospital by self-referral (37). All participants were undergoing treatment at a psychiatric outpatient clinic throughout the study. Of those, 52 individuals (84.6% women) with complete data for the ISAS behavioral section (Part 1) at three time points were included in the study and comprised our analytical sample. An attrition analyses—performed by comparing participants with complete data on the ISAS behavioral scales at all three time points to those with incomplete data—did not show any significant differences in their lifetime frequency of NSSI behaviors and functions at T1, except that the distress function was endorsed by the participants in the analytical sample as more relevant (M = 2.60, SD = 1.60) compared to participants with incomplete data (M = 1.92, SD = 1.63; $t(97) = 2.10$, $p = .039$, Cohen's $d = 0.42$).

Table 1 shows the descriptive statistics of the analytical sample. Participants had up to seven diagnoses (median 3) as assessed by the Mini International Neuropsychiatric Interview (38) and Structured Clinical Interview for DSM-IV Axis II [SCID-II; (39)]. Twenty-four (46.2%) participants reported non-psychiatric disorders, among which hypothyreosis (n = 6) and asthma (n = 4) were the most common. Nine participants reported being diagnosed with attention deficit hyperactivity disorder (ADHD) and four reported an autism diagnosis.

Procedure

This study was carried out in accordance with the latest version of the Declaration of Helsinki, and was approved by the Regional Ethical Board at Lund University (Dnr 2014/570). Participants were recruited from psychiatric in-patient and out-patient units in a region serving 1.3 M inhabitants. After providing informed consent, the participants completed the ISAS, which was administered as a self-report form online. A research assistant or the PI (a psychiatrist) was present during data collection, to answer possible questions or give support. Some participants with more severe difficulties concentrating asked if the forms could be read to them aloud. When requested, this help was provided. Data was collected at baseline (T1) and after 6 (T2) and 12 (T3) months (40).

TABLE 1 | Baseline sociodemographic and clinical characteristics of the participants (N = 52).

Variable	Mean (SD)/No. (%)
Age, mean (SD)	33.2 (9.5)
Female, No. (%)	44 (84.6)
Education, No. (%)	
Elementary school or less	14 (26.9)
High school degree	26 (50.0)
Bachelor's/Master's degree or higher	12 (23.1)
Living alone, No. (%)	25 (48.1)
Living with partner, No. (%)	21 (40.4)
Child (-ren) at home, No. (%)	16 (30.8)
Clinical Characteristics	
Depressive Disorder, No. (%)	24 (46,2)
Suicide ideation, last month No. (%)	50 (96.2)
Suicidal behavior, last year No. (%)	41 (78.8)
Anxiety Disorders, No. (%)	14 (26.9)
Bipolar and related disorders, No. (%)	15 (28.8)
Post-Traumatic Stress Disorder, No. (%)	25 (48.1)
Obsessive-compulsive disorder, No. (%)	10 (19.2)
Eating Disorders, No. (%)	8 (15.4)
Substance-Related Disorders, No. (%)	21 (40.4)
Psychotic Disorders, No. (%)	4 (7.7)
Personality Disorder (Borderline excluded), No. (%)	36 (69.2)

Measures

The ISAS (24, 30) is a self-rating measure of NSSI behavior. This measure contains two parts. Part 1 assesses the frequencies of different forms of self-injurious behavior with the following statement: *"Please estimate the number of times in your life you have intentionally (i.e., on purpose) performed each type of non-suicidal self-harm (e.g., 0, 10, 100, 500)."* This statement is followed by a list of 12 different forms of self-injurious behavior as well as one labeled "other" (see **Table 2** for a complete list of the forms of behavior). The internal consistency values (Cronbach's alpha) of the ISAS behavioral scale were .89 (T1), .88 (T2), and .73 (T3). Responders are also asked to report a number of descriptive and contextual aspects of their behavior. These include the age of onset, whether they experience physical pain from NSSI, whether they are alone or together with others when they injure themselves, the length of time that usually passes between the first impulse to self-injure and performance of the actual act, and whether the individual wants to stop.

Part 2 of the ISAS contains 39 items evaluating 13 different functions of self-harm (i.e., each function is represented by three items; see **Table 3** for a complete list of ISAS functions). Respondents who endorse some form of NSSI are asked to rate the relevance of each item to their experience of self-injury on a three-point Likert scale (*not relevant* = 0, *somewhat relevant* = 1, *very relevant* = 2). Following Klonsky and Glenn (24), the ISAS functions were grouped into two factors representing intrapersonal (e.g., *affect regulation*) and interpersonal (e.g., *autonomy*) functions. These two superordinate function scores were created by averaging the relevant subscales score (which ranged from 0 to 6). The internal consistency values (Cronbach's alpha) of the ISAS functions are presented in **Table 3**.

TABLE 2 | Descriptive statistics and Spearman correlations for the ISAS behaviors across three time points.

NSSI behaviors	T1			T2			T3			Spearman correlations between NSSI behaviors at		
	M (SD)	Median	Range	M (SD)	Median	Range	M (SD)	Median	Range	T1 and T2	T2 and T3	T1 and T3
Cut	477.5 (1445.6)	68.5	10,000	400.9 (1394.7)	100	10,000	411.3 (1411.5)	50	10,000	.76***	.83***	.78***
Bite	133.2 (451.3)	3	2,500	51.60 (156.5)	3	1,000	88.6 (315.1)	5	2,000	.77***	.59***	.60***
Burn	226.1 (1384.9)	1.5	10,000	235.9 (1389.4)	1	10,000	68.6 (210.8)	2	1,000	.83***	.76***	.84***
Carve	366.0 (1402.7)	42.5	10,000	413.8 (1406.6)	72.5	10,000	453.5 (1545.5)	35	10,000	.33*	.61***	.38**
Pinch	197.4 (495.0)	5	2,500	100.7 (267.0)	2.5	1,500	61.4 (172.8)	5	1,000	.82***	.60***	.65***
Pull hair	71.6 (212.0)	0	1,000	226.3 (1385.5)	0	10,000	181.1 (973.4)	0	7,000	.57*	.80***	.59***
Severe scratch	141.3 (325.6)	10	1,700	134.9 (415.2)	7.5	2,500	166.0 (706.6)	10	5,000	.65***	.55***	.56***
Bang/Hit	347.6 (1409.5)	20	10,000	92.2 (179.6)	20	1,000	157.5 (385.3)	20	2,000	.76***	.76*	.79**
Interfere with wounds	408.2 (1441.7)	20	10,000	386.6 (1406.9)	45	10,000	529.1 (1606.2)	50	10,000	.54**	.82***	.56***
Rub skin	68.8 (222.9)	0	1,000	30.4 (142.6)	0	1,000	40.7 (155.2)	0	1,000	.63**	.68***	.59**
Stick self with needles	37.8 (141.2)	0	1,000	27.5 (66.7)	0	300	35.4 (100.1)	0	500	.63***	.71**	.65***
Swallow chemicals	21.6 (71.5)	0.5	500	14.8 (42.3)	0	200	27.1 (98.9)	0	500	.40**	.57***	.52***
Other	263.7 (1394.3)	0	10000	42.6 (118.3)	0	500	243.3 (1008.4)	0	7,000	.32*	.29*	.31*
NSSI behaviors, total	2760.7 (9019.2)	786.5	64181	2158.0 (7142.2)	670	51,628	2463.5 (5479.6)	499.5	33,200	.63***	.82***	.65***

*$p < .05$, **$p < .01$, ***$p < .001$.

TABLE 3 | Means (SDs), Pearson correlations, and Cronbach's alpha values for the ISAS functional scales across three time points.

ISAS function scales	T1		T2		T3		Pearson correlations between function scales at		
	M (SD)	α	M (SD)	α	M (SD)	α	T1 and T2	T2 and T3	T1 and T3
Intrapersonal functions total scale	3.71 (1.04)	.78	3.54 (0.91)	.81	3.59 (0.93)	.74	.67***	.63***	.52***
Affect Regulation	5.06 (0.90)	.12	4.76 (1.45)	.76	4.98 (0.97)	.29	.47***	.57***	.34*
Anti-Dissociation	3.26 (1.95)	.75	3.36 (1.62)	.69	3.23 (1.58)	.63	.60***	.68***	.53***
Anti-Suicide	3.46 (1.99)	.83	3.10 (2.10)	.90	3.29 (1.91)	.85	.56***	.70***	.64***
Marking Distress	2.66 (1.60)	.55	2.52 (1.77)	.68	2.64 (1.70)	.67	.74***	.68***	.54***
Self-Punishment	3.96 (1.84)	.80	3.98 (1.78)	.82	3.71 (1.80)	.79	.66***	.59***	.57***
Interpersonal functions total scale	0.99 (0.65)	.79	0.91 (0.70)	.77	0.88 (0.72)	.82	.69***	.82***	.52***
Autonomy	0.77 (1.38)	.78	0.55 (1.11)[a]	.73	0.91 (1.57)[a]	.85	.59***	.79***	.46***
Interpersonal Boundaries	1.02 (1.44)	.80	0.89 (1.23)	.63	0.98 (1.32)	.62	.61***	.66***	.47***
Interpersonal Influence	1.37 (1.54)	.77	1.35 (1.62)	.81	1.48 (1.62)	.84	.52***	.81***	.62***
Peer Bonding	0.08 (0.34)	.66	0.18 (0.91)	.95	0.10 (0.31)	–.11	.09	.01	.32*
Revenge	0.46 (0.92)	.75	0.38 (1.06)	.84	0.42 (1.07)	.87	.37**	.57***	.16
Self-Care	2.80 (1.73)	.68	2.72 (1.97)	.78	2.65 (1.66)	.72	.70***	.67***	.70***
Sensation Seeking	0.73 (1.25)	.75	0.65 (1.09)	.50	0.47 (1.06)	.72	.64***	.47***	.38**
Toughness	0.85 (1.12)	.48	0.87 (1.24)	.79	0.81 (1.12)	.52	.24	.50***	.46***

[a]*indicates a significant mean difference;* *$p < .05$, **$p < .01$, ***$p < .001$.

Statistical Analyses

All NSSI behavior variables were non-normally distributed (i.e., skewness was clearly above the commonly used cut-point range, between −1 and 1 (41); thus, Spearman correlations were used to calculate the relationships among ISAS behaviors at the three time points, while Friedman tests were performed to examine within-group differences in these ISAS behaviors over the time points. Pearson correlations were used to calculate the relationships between the ISAS functional scales and repeated ANOVAs were performed to study within-group differences on the ISAS functional scales across the three time points.

For the attrition and *post hoc* analyses, between-group comparisons were conducted using the Mann-Whitney *U* test and an independent-samples *t*-test for the ISAS behavioral and functional scales, respectively.

RESULTS

NSSI Characteristics

Participants reported that their age of NSSI onset was between 4 and 45 years old ($M = 14.6$, $SD = 7.8$). Two participants did not report their age of NSSI onset. The time since their last episode of NSSI varied from 1 to 275 days ($M = 41.7$, $SD = 53.3$; $Mdn = 25$) at T1, 0 to 496 days ($M = 81.0$, $SD = 108.1$, $Mdn = 47.5$) at T2, and 1 to 549 days ($M = 102.6$, $SD = 138.1$, $Mdn = 41.5$) at T3.

However, four, eight, and eight individuals at T1, T2, and T3, respectively, did not report or reported that they did not remember the time of their last episode. The vast majority of participants (77.8%, 78.8%, and 92.0% at T1, T2, and T3, respectively) reported engaging in NSSI when alone.

Frequencies of NSSI Behaviors

As **Table 2** shows, individuals reported high lifetime frequencies of NSSI behaviors at all three time points. Although the mean frequencies varied widely for most NSSI behaviors, no significant differences between the time points were found for the whole sample.

When we examined the reported frequencies more closely, we found that a large number of participants reported lower frequencies over time. Specifically, 25 out of the 52 participants (48.1%) reported lower frequencies at T2 as compared to T1 ($M_{\text{DIFF T1-T2}}$ = 1929.6, *SD* = 3530.7; *Mdn* = 450), 27 (51.9%) reported lower frequencies at T3 as compared to T2 ($M_{\text{DIFF T2-T3}}$ = 1178.0, *SD* = 3499.9; *Mdn* =400), and 23 (44.2%) reported lower frequencies at T3 as compared to T1 ($M_{\text{DIFF T1-T3}}$ = 2628.5, *SD* = 6460.8; *Mdn* = 900). Twelve of the 52 participants (21.2%) reported a statistically significant reduction in lifetime frequency of NSSI behaviors across the three time points ($M_{\text{DIFF T1-T2}}$ = 2120.1, *SD* = 3809.5; *Mdn* =670; $M_{\text{DIFF T2-T3}}$ = 1859.4, *SD* = 5246.5; *Mdn* = 92; and $M_{\text{DIFF T1-T3}}$ = 3979.5, *SD* = 8707.1; *Mdn* = 1091.5; χ^2 = 18.0, p <.001).

Table 2 also shows the Spearman correlations among the three time points for the 12 NSSI behaviors. The lowest correlations were found for carving (.33,.61, and.38 between T1 and T2, T2 and T3, and T1 and T3, respectively) and other (.32,.29, and.31 between T1 and T2, T2 and T3, and T1 and T3, respectively), while the highest correlations were found for burning (.83,.76, and.84 between T1 and T2, T2 and T3, and T1 and T3, respectively).

The participants generally reported engaging in several forms of NSSI; on average, they reported engaging in seven forms (*SD* = 3; range: 1–12) at all three time points. The most frequent forms were cutting (88.5% of the sample at all three time points) and carving (86.5% at all three time points). The least frequent forms were hair-pulling and rubbing one's skin (about 35% of participants at one time point at least).

Functions of NSSI

Table 3 shows the descriptive statistics, internal consistency coefficients, and correlations across the three time points for the ISAS functional scale. Participants reported that the intrapersonal functions were more relevant for their NSSI at all three time points compared to the interpersonal functions. Of the intrapersonal functions, affect regulation and self-punishment were the two most commonly endorsed functions; however, affect regulation also showed the lowest test-retest stability among the intrapersonal functions.

Regarding the within-group comparisons, a significant mean difference was found only for the autonomy function. The results showed that individuals endorsed the function significantly less at T2 (*M* = 0.55, *SD* = 1.11) compared to T3 (*M* = 0.91, *SD* = 1.57), although the effect size was low (*Cohen's d* = −0.27).

DISCUSSION

In this study, we aimed to assess the consistency of ISAS-measured lifetime NSSI frequencies and functions in individuals with recurrent self-harm and regular contact with mental health services. To the best of our knowledge, this is the first study to examine both the lifetime NSSI behaviors and functions as measured by the ISAS over a year in a clinical sample.

Regarding the NSSI behaviors, similar to Glenn and Klonsky (30), we found relatively good test-retest stability among the three time points for most NSSI behaviors, even though the correlation coefficients between the different time points for the separate NSSI behaviors varied substantially. The reported frequencies of NSSI behaviors also varied markedly, with about 50% of participants reporting lower frequencies at a later time point and about 20% reporting a significant reduction in their lifetime frequencies across one year. This finding was unexpected given that the actual lifetime frequency of self-harm can only increase over time. The finding therefore raises concerns about the trustworthiness of self-reported lifetime frequencies of NSSI behaviors in a clinical sample.

There are several possible explanations for this finding, with the clinical characteristics of the sample being the most obvious one. On average, our participants had four psychiatric diagnoses and had engaged in NSSI for approximately 20 years. For individuals with several concurrent psychiatric diagnoses and extensive and long-lasting engagement in self-harm, the lifetime prevalence estimates are potentially susceptible to recall bias and other memory distortions (42–46). Moreover, self-injurious behavior can also be cyclic rather than linear; in other words, it can be exhibited for periods of time, stopped, and then resumed (47), making it even more difficult to recall and calculate the lifetime frequency of such behaviors.

Furthermore, confronting individuals who suffer from moderate or severe self-harm with the impossible task of *counting the number of times* they have ever harmed themselves is bound to lead to frustration and other negative emotional responses, thereby potentially worsening their likelihood of recall and potentially causing further harm. A psychiatrist involved in data collection actually noticed that participants in our sample experienced frustration when reporting lifetime frequency of NSSI, feeling that it was an impossible task (i.e., counting something too numerous to count). This is a specific source of frustration for the target group of this study—individuals with extensive and long-lasting NSSI (often with childhood onset). Indeed, even individuals with less intensive self-harm may feel frustrated when confronted with the task of counting lifetime NSSI acts. The enormous range of frequencies of the NSSI behaviors reported at T2 by Glenn and Klonsky (30) may be indicative of such frustration. For instance, the increased range in the frequency of hair pulling from 300 (T1) to 100,000 (T2), may not be realistic. Further, since most individuals who engage in NSSI do so in private, which was also the case in the present study, and only a small proportion of individuals who engage in NSSI present to hospitals or other clinical services (48), it is impossible to validate the self-reported

lifetime frequency of NSSI behavior against medical records or other records. One attempt to do so was made in a study on incarcerated adults, where the registration of self-injurious behaviors is more frequent; in that study, Borschmann et al. (32) found poor agreement between interview accounts of NSSI behaviors and medically verified self-harm. The authors suggested triangulating data from multiple sources to increase the accuracy of self-harm assessments.

It is also possible that the instructions on how to respond to the ISAS could be interpreted differently by different individuals over time. For example, when interpreting the word *frequency*, an individual might count each specific self-injury act as a unique contribution to lifetime frequency; alternatively, they might count only the number of sessions in a day in which one or multiple injuries occurred. These differing interpretations of self-report survey instructions might affect the accuracy of lifetime NSSI reports. Accordingly, the instructions for survey completion should be clarified prior to data collection.

Another possible explanation is an *initial elevation bias*, which was examined recently in four field studies by Shrout et al. (49). Shrout et al. (49) noticed that when making repeated measurements of self-reported symptoms in college students, the initial measurement seems biased toward higher ratings, after which the ratings decrease. Although the initial elevation bias was found in all four field studies, the generalizability of their findings is limited because all participants were students, the assessments were intensive (e.g., twice daily for 44 days), and the main research questions in all these studies pertained to the participants' internal states and behaviors before and after an important exam. By contrast, our sample was clinical, the assessments were much less intensive, and all participants had previously reported self-harming behaviors to their clinicians and the principal investigator. Thus, the first measured assessment in our study was not the first report on self-harming behaviors from participants. Furthermore, as Shrout et al. (49) concluded, internal states, as reported in the field studies, might be more sensitive to the initial elevation bias as compared to behaviors, which were our target in the present study; thus, the initial elevation bias seems less likely in our study. Nevertheless, the initial elevation bias needs more attention in clinical samples.

In none of the studies evaluating ISAS-measured lifetime NSSI behaviors were the raw frequencies discussed extensively. In most cases, the frequencies were further grouped either into "numeric groups" (i.e., 0 times, 1–2 times, 3–10 times, and more than 10 times), as in a study by Klonsky and Olino (50), or into ill-defined categories (i.e., "none", "few", "moderate", and "common") as in the studies by Bildik et al. (26) and Kim et al. (28). These studies again raise the question of the purpose of asking about exact lifetime NSSI frequency estimates. Changing the response format to a set of predefined ranges, for example—as in the aforementioned study by Klonsky and Olino (50) or as suggested by other researchers [e.g., 0, 1, 2–5, 6–20, ≥ 21 NSSI acts; (16, 51) or 0, 1, 2–10, 11–50, ≥ 51 NSSI acts, (52)]—could make respondents' task more realistic. In most cases though, the suggested response formats for non-clinical samples appear to be arbitrary (varying among the studies) and lacking a clear theoretical rationale, which further complicates the validity and generalizability of the results. Furthermore, while this would certainly increase the trustworthiness of the reports, it might fail to capture the lifetime frequencies or changes in frequencies during a specific treatment, as any changes in the frequencies of ≥10, ≥21, or ≥ 51 would be missed, thereby making the instrument less suitable for clinical samples with severe self-injurious behaviors. Moreover, for most clinical samples, including the present sample, this would not be discriminative because the majority of our participants (about 90% of the sample) would be assigned to the highest category (i.e., ≥51 NSSI acts at all three time points). The predefined ranges therefore must be adapted to clinical samples with self-harm. One possible frame would be to use ranges that provide a normal distribution in a representative sample and validate them in relation to levels of psychopathology. Taking all this together, there might be a need for a different theoretical model and accompanying self-report lifetime assessment of NSSI in clinical populations with high frequencies of NSSI.

In line with the findings of Glenn and Klonsky (30) and Victor et al. (31), NSSI functions also showed relatively good stability over a year, with affect regulation being the most often endorsed function at all three time points. This finding is consistent with robust evidence that affect regulation is the most frequently endorsed function of NSSI [for a review, see Klonsky (53)] in both clinical [e.g., (29)] and nonclinical samples [e.g., (26)]. However, the stability of this function measurement was the lowest in Glenn and Klonsky's study (30). It was also the lowest in the present study, among the intrapersonal functions. The recency of NSSI was suggested by Glenn and Klonsky as a possible explanation for this result. However, neither Glenn and Klonsky nor our author group found a clear and significant relationship between affect regulation and the recency of NSSI. Still, it is important to note that in both studies the small sample size did not allow for more extensive investigation. In the present study, there was a large variation in time since participants' last engagement in NSSI (1–275 days at T1, 0–496 days at T2, and 1–549 days at T3), and only five participants reported rather recent (during the last 7 days) engagement in NSSI at all three time points. Although a *post hoc* analysis revealed no significant differences in the endorsement of the affect regulation function between those with recent engagement in NSSI and those with more distal engagement, those with more recent engagement indicated stronger endorsement of affect regulation than did those with more distal engagement. Moreover, the effect sizes were large for differences at T2 (Cohen's d = 0.76) and T3 (Cohen's d = 0.74), but not at T1 (Cohen's d = 0.28) between the two groups. Therefore, the importance of the recency of NSSI for the endorsement of affect regulation remains an open question that needs further consideration in larger clinical and non-clinical samples. Furthermore, while a lifetime period is given for assessing the frequency of NSSI behaviors, no time frame is stipulated for assessing the functions. That is, individuals with rather recent engagement in NSSI could think about the most recent NSSI incident when evaluating the relevance of certain

functions, whereas those with more distal engagement might use a more general evaluation.

In this study, the affect regulation function showed very low internal consistency at both T1 and T3, even though the internal consistency values of the intrapersonal functions in general were acceptable or good at all three time points; this could also be a possible reason for the low test-retest correlations. None of the other reviewed studies, except Lindholm et al. (29), reported Cronbach's alpha values for the 13 functions (they instead reported alpha values only for the total function scales). It is therefore not possible to determine if this is an unexpected result found only in the present study, or if it was the case in other studies. However, the test-retest correlations did not improve even when we re-calculated the correlations after dropping the problematic item and the alpha values for the remaining two items increased at all three time points.

Limitations

First, our results might be confounded by the duration and severity of illness, which over time could influence the motives, cognition, and affect associated with NSSI. Second, the present study can only provide tentative conclusions, given its limited generalizability due to a small sample size and skewed gender representation. The rather small sample size led to less than desirable statistical power to detect some differences (e.g., examining the relationship between affect regulation and the recency of NSSI) and study some effects (e.g., the moderating effect of early onset on changes in lifetime NSSI frequency). Furthermore, although clinical samples of self-harming individuals are predominantly made up of women, research has indicated that NSSI is also a problem among men; however, it might manifest differently in men than in women [see, e.g., (54, 55)].

Conclusions

The results of the current study suggest that the lifetime self-reporting of NSSI behaviors and functions for individuals with a history of extensive self-harm, and perhaps particularly for those with an early onset and who have been diagnosed with several psychiatric disorders, might be of limited accuracy. Taken together, our results imply a need to develop a theoretical framework and accompanying self-report assessment for NSSI with clinically valid numeric categories of NSSI in populations with high frequencies of NSSI. Doing so may help in reliably assessing the lifetime frequency of NSSI behaviors and functions in clinical populations with severe and repeated self-harm.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The Regional Ethical Board at Lund University (Dnr 2014/570). All participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

DD, SL, MH, and SW designed the larger project within which this study was conducted and wrote the protocol for it. SW organized the data collection. DD, RL, and SW conducted literature searches, provided summaries of previous research studies, and formulated the research questions for the present study. DD conducted the statistical analyses. DD, RL, and SW wrote the first full draft of the manuscript. All authors worked on several edits of the paper. All authors contributed to the article and approved the submitted version.

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Comorbidity Between Non-suicidal Self-Injury Disorder and Borderline Personality Disorder in Adolescents: A Graphical Network Approach

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In 2013, DSM-5 urged for further research on non-suicidal self-injury (NSSI) and defined NSSI disorder (NSSI-D) for the first time separate from borderline personality disorder (BPD). However, research on the comorbidity between NSSI-D and BPD symptoms is still scarce, especially in adolescent populations. The current study selected 347 adolescents who engaged at least once in NSSI (78.4% girls, M_{age} = 15.05) and investigated prevalence, comorbidity, gender differences, and bridge symptoms of NSSI-D and BPD. Network analysis allowed us to visualize the comorbidity structure of NSSI-D and BPD on a symptom-level and revealed which bridge symptoms connected both disorders. Our results supported NSSI-D as significantly distinct from, yet closely related to, BPD in adolescents. Even though girls were more likely to meet the NSSI-D criteria, our findings suggested that the manner in which NSSI-D and BPD symptoms were interconnected, did not differ between girls and boys. Furthermore, loneliness, impulsivity, separation anxiety, frequent thinking about NSSI, and negative affect prior to NSSI were detected as prominent bridge symptoms between NSSI-D and BPD. These bridge symptoms could provide useful targets for early intervention in and prevention of the development of comorbidity between NSSI-D and BPD. Although the current study was limited by a small male sample, these findings do provide novel insights in the complex comorbidity between NSSI-D and BPD symptoms in adolescence.

Keywords: non-suicidal self-injury (NSSI), NSSI disorder, adolescence, comorbidity, DSM-5, borderline personality disorder, network analysis

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INTRODUCTION

Non-suicidal Self-Injury (Disorder)

Non-Suicidal Self-Injury (NSSI) is defined as the socially unacceptable, intentional, and direct injury of one's own body tissue without suicidal intent (1). Common methods of NSSI include cutting, burning, or carving one's own skin (2). In community samples, pooled estimates suggest that 17.2% of adolescents, 13.4% of young adults, and 5.5% of adults report a lifetime history of NSSI (3). In clinical samples, lifetime prevalence rises to 60% in adolescence and 65–80% in adulthood (4, 5). The high prevalence rates of NSSI are alarming,

as the behavior has been linked to several mental health conditions. For instance, NSSI is associated with depression, anxiety, rumination, feelings of stigma and shame, and low levels of help seeking (6–8). Moreover, 50–75% of those with a history of NSSI make a suicide attempt at some point in their life (9). Research has shown how NSSI can occur with virtually any mental disorder, although comorbidity rates are particularly high for anxiety and mood disorders, post-traumatic stress disorder, substance use disorder, eating disorders, and personality disorders (10–12). The high prevalence rates and significant mental health implications underscore the necessity for an improved understanding of NSSI (13).

The need for further research on NSSI was formally emphasized with the inclusion of NSSI disorder (NSSI-D) as a "condition requiring further research" in Section III of DSM-5 (14). The newly proposed disorder included six provisional diagnostic criteria (14). First, criterion A specifies that NSSI has to occur for at least 5 days in the past 12 months. Second, criterion B states that the individual must engage in NSSI for one or more of these reasons: to relieve negative thoughts or feelings (B1), to resolve interpersonal difficulties (B2), or to induce a positive state (B3). Third, criterion C indicates that NSSI must be preceded by either negative thoughts or feelings (C1a), conflicts with others (C1b), preoccupation with the behavior that is difficult to resist (C2), or recurrent thoughts about the behavior (C3). Finally, socially acceptable behaviors are excluded (criterion D), the behavior must cause significant distress or interference in the individual's daily life (criterion E), and should not occur solely in the context of another mental disorder (criterion F).

Although research on NSSI has mainly focused on adults and college students, adolescents seem to be particularly at-risk for an NSSI-D diagnosis (3). Based on the limited available data, it has been estimated that 5.6–7.6% of adolescents are eligible for an NSSI-D diagnosis in community samples, compared to 0.2–3% of (young) adults (15–17). Moreover, it has been found that 37.7% of community adolescents with a lifetime history of NSSI meet all six NSSI-D criteria (17). In most studies, the diagnosis was more common in girls than in boys (16). These results may be subject to change, as discussion regarding the exact formulation and clinical relevance of some of the diagnostic criteria and NSSI-D as a separate disorder is still ongoing (17–20). For instance, a recent study suggested that the NSSI-D frequency cut-off should be raised from 5 days to at least 10 days in the past year to clinically meaningful (21, 22). However, a review of 16 empirical studies using the current DSM-5 criteria already found preliminary support for a distinct NSSI-D diagnosis, independent of other closely related mental disorders (16). For instance, in one of the reviewed studies, 80% of adolescents who met the current NSSI-D criteria did not meet criteria for Borderline Personality Disorder (BPD), thus indicating that NSSI-D can occur independently of BPD (23, 24). The distinction between NSSI(-D) and BPD is particularly relevant because NSSI has been historically intertwined with BPD as a prototypical symptom of the disorder (11). More specifically, before the release of DSM-5, NSSI was only mentioned in the DSM as a criterion for BPD.

Borderline Personality Disorder

BPD is a severe mental disorder that is generally typified by four core features: affective instability, identity problems, negative or unstable interpersonal relationships, and impulsivity or recurrent self-harm (14). Individuals diagnosed with BPD tend to experience strong emotions and can be particularly sensitive to rejection (25), they are more likely to suffer from severe psychosocial impairment such as intense conflict and tumultuous relationships (26), and show high mortality rates due to suicide, with up to 10% of BPD patients committing suicide (27). Epidemiological studies have shown that BPD prevalence rates peak in late adolescence and range from 2 to 3.2% in community adolescents (28, 29), 11% in adolescent outpatients, and 33–49% in adolescent inpatients (30–32). In community samples, most studies suggest an equal prevalence in adolescent boys and girls (28, 33). In clinical samples, prevalence rates are typically cited as higher among girls than boys, although it has been argued that this might be an artifact of sampling or diagnostic biases (34, 35). Importantly, adolescents with BPD are more likely than adults to show "acute" BPD symptoms, such as suicidal ideation and recurrent NSSI (36). Around 61% of adolescents with BPD pathology have engaged in NSSI at least once, making "recurrent NSSI and suicidal behavior" the most commonly met diagnostic criterion for BPD in adolescence (34, 37). In this young at-risk age group, the comorbidity between BPD and NSSI is complex (38). For instance, displaying BPD symptoms indicates greater severity of NSSI based on several parameters (36) such as a younger age of NSSI onset (37, 39), more frequent NSSI episodes (40), and a higher likelihood of repetitive NSSI (41). NSSI in adolescence is considered a key precursor for, or even indicator of, BPD, especially when repetitive and long-lasting NSSI is present (42). Severity of NSSI (i.e., earlier age of onset and longer duration of the behavior) is a risk factor for later BPD (43). On the other hand, the majority of adolescents engaging in NSSI do not meet the criteria for BPD (44, 45). To improve our understanding of comorbidity, the field could benefit from adopting a symptom-level approach of the comorbidity between NSSI-D and BPD. This could clarify whether or not NSSI-D and BPD symptoms cluster together and, most importantly, detect which symptoms drive the high co-occurrence between both diagnoses. Network theory offers a compelling new direction because of its clear symptom-level conceptualization of comorbidity and its statistical tools to model and visualize the approach (46).

Network Theory as an Innovative View on Comorbidity of Mental Disorders

In 2013, Borsboom and Cramer introduced network theory, a conceptual framework asserting that mental disorders are networks of symptoms influencing each other, rather than symptom sets being caused by an underlying disease entity (47). The network theory innovated analysis of comorbidity (48), because it states that a symptom can directly activate one or more symptoms in other disorder's network, which thus links disorders to each other without the assumption of a latent comorbidity factor. The accompanying statistical

technique, network analysis, allows researchers to model and visualize these symptom associations to illuminate the nosology and comorbidity of mental disorders (47).

In network analysis, the graphical output represents each symptom by a *node*. Nodes that tend to co-occur in the data are joined together by connecting *edges*, which results in a web-like constellation or *network* (47). If a group of nodes cluster more strongly among each other than with other nodes, that group is defined as a *community* (49, 50). A community structure analysis therefore offers an innovative way of detecting whether or not the symptoms in a network form statistically discernible symptom clusters (i.e., in our study, an NSSI-D community and a BPD community). Interestingly, certain edges can bridge two disorders by running from a node belonging to one theoretically defined cluster (e.g., NSSI-D) to a node belonging to another cluster (e.g., BPD). These between-cluster nodes are aptly referred to as *bridge symptoms* (46). Bridge symptoms are powerful tools in studying comorbidity, as they provide valuable information regarding the spread of activation between disorders. Specifically, the presence of an identified bridge symptom might indicate a heightened risk for the onset of an additional disorder, or, if both disorders are already present, the bridge symptom might play a role in maintaining the spread of activation between them (51). Albeit connections in networks do not necessarily reflect causal structures, edges can be indicative of potential mutual or directed causal relationships (52, 53). If this is the case, "deactivating" a bridge symptom, for instance by intervention or medication, could be regarded as cutting a crucial connection between comorbid disorders. In other words, successfully treating a bridge symptom could result in a decrease in symptom-level associations both within- and between-disorders (46, 51). Up until recently, researchers had to rely on subjective visual inspection of a network to detect bridge symptoms (46). However, in 2019 Jones et al. developed and validated a quantitative index to identify bridge symptoms and to measure their centrality between theoretically defined clusters.

Research Aims and Hypotheses

Embracing these state-of-the-art techniques, the aim of the present study was fourfold: (1) describe prevalence rates of (the comorbidity between) NSSI-D and BPD symptomatology, (2) investigate whether or not NSSI-D and BPD can be distinguished from one another in a network structure, (3) explore potential gender differences in (the comorbidity of) the NSSI-D and BPD network, and (4) identify specific bridge symptoms through which pathology is most likely to spread between NSSI-D and BPD symptom clusters. First, concerning prevalence rates, we tentatively hypothesized that the percentage of individuals scoring above the BPD cut-off in the current sample (i.e., community adolescents engaging in NSSI) would be between percentages found in community adolescents [i.e., 2–3.2%, (28, 29)] and in adolescent outpatients [i.e., 11%, (30)]. Concerning the second research aim, we hypothesized based on a review of the empirical NSSI-D literature (16) that NSSI-D and BPD symptoms (nodes) would split into at least two statistically discernible communities without symptoms from NSSI-D belonging to the BPD community or vice versa. Regarding the third research aim, we expected more girls than boys to be eligible for an NSSI-D diagnosis (16), but we did not expect gender differences in the percentage of boys and girls scoring above the BPD cut-off in this sample (28, 33). To the best of our knowledge, no research is currently available on gender differences in the comorbidity between BPD and NSSI-D symptomatology. Lastly, as no previous research is currently available on potential bridge symptoms between NSSI-D and BPD, no specific hypotheses could be formulated.

MATERIALS AND METHODS

Procedure

The current study is part of a research project in which eight secondary schools took part, all located in Flanders, Belgium (17). Across all eight schools, we contacted the parents of 3,483 students and distributed informed consent forms among them. A total of 2,313 (66.4%) students received active parental consent and were subsequently invited to partake in the study. The 2,162 (93.5%) students who agreed to participate received an assent form, a questionnaire booklet, and an envelope. The data collection took place during school hours, with the researchers present at all time. After signing the assent form and filling out all questionnaires, the students returned these documents in a sealed envelope to the researchers. Students who were absent on the day of assessment were contacted by e-mail to complete an online version of the study. All participants received a movie ticket as compensation, as well as a letter with contact details of the school counselor and several mental health services. The study was approved by the Ethics Committee at the University of Leuven.

Participants

Out of the 2,162 participating students, we selected only those who reported having ever engaged in NSSI (i.e., "I have at least once engaged in self-injury without the intent to die") and who completed the BPD questionnaire. This resulted in a final sample of 347 students (78.4% female) between the ages of 12 and 20 ($M = 15.05$, $SD = 1.83$). The vast majority of students identified as Belgian (93.1%). About half of the students lived with both parents (53.0%, $n = 184$), the remaining students had divorced parents and/or lived in a blended family (40.4%, $n = 132$) or indicated to have another home environment (9%, $n = 31$).

Measures

Non-suicidal Self-Injury Disorder

Lifetime NSSI was assessed using the single-item screening measure "Have you ever engaged in self-injury without an intent to die?" Those who answered affirmatively responded to follow-up questions regarding frequency and recency of NSSI, current NSSI, age of NSSI onset, and different NSSI behaviors (i.e., scratching, carving, cutting, burning, rubbing the skin, self-hitting, pricking/piercing the skin, and banging the head). Additionally, a set of questions assessing DSM-5 criteria for NSSI-D was included. We used questions that explicitly assessed all NSSI-D criteria (A, B, C, D, E, and F), with the wording of these items matching the DSM-5 criteria as closely as possible

[see Buelens et al. (17) for an overview of the exact questions]. Furthermore, since previous research indicated that criterion C1 contains two elements that are considerably different from each other (17), we additionally split criterion C1 into C1*a* (negative feelings or thoughts) and C1*b* (conflicts with others) to assess this symptom more accurately. We used a dichotomous approach when describing prevalence rates [i.e., fulfilling (1) or not fulfilling (0) the criterion], while we used the continuous scores on each criterion in the network analyses. For all DSM-5 criteria together, a KR-20 reliability coefficient of 0.667 was found, which is close to the 0.7 cut-off for acceptable internal consistency (54).

Borderline Personality Disorder Symptomatology

The brief Borderline Personality Features Scale for Children [BPFSC-11; (55)] was used to assess BPD symptomatology. The questionnaire consists of 11 items scored on a 5-point Likert scale ranging from 0 (*never true for me*) to 4 *(always true for me*) and results in a unidimensional sum score ranging from 0 to 44 or mean score ranging from 0 to 4 (56). A higher mean score indicates more BPD symptomatology. The BPFSC-11 had a Cronbach's alpha of 0.79 in the current study, which is comparable to previous research (56). Next to the continuous mean score, we created a dichotomous cut-off score (1 = above the BPD cut-off, 0 = below the BPD cut-off) as recommended by previous sensitivity and specificity analyses on the BPFSC-11, which indicated the ideal cut-off value to be 34 out of the maximum sum score of 44 (55). We used the dichotomous score when describing percentages of adolescents scoring above and below the cut-off, while we used the continuous BPD score in the network analyses. The BPFSC-11 does not include items assessing NSSI.

Statistical Analyses

To address the first research aim, we used SPSS version 26 (57) to conduct descriptive analyses and compute prevalence rates of (the comorbidity between) NSSI-D and BPD symptoms. Research aims two to four were addressed using R (58) to conduct network analyses. For these analyses, participants who had six or more missing values were removed ($n = 10$) and the remaining 22 missing values out of the 7,751 datapoints were imputed using the *mice* R package (59).

As the second research aim was to investigate whether or not NSSI-D and BPD would occur as statistically discernible clusters of symptoms (nodes), we modeled a weighted, undirected graphical LASSO network using *qgraph* (60). We used the Extended Bayesian Information Criterion (EBIC), with the γ hyperparameter at 0.25, to set the amount of LASSO regularization (61). We then conducted a community structure analysis using the Walktrap algorithm, as implemented in the *igraph* R package (62, 63). Expected influence (EI) was used as a centrality measure, as it accounts for the presence of potential negative edges in the network by not taking the absolute value of edges before summing them (46, 64). The robustness (accuracy and stability) was tested by the bootstrapping procedure in the *bootnet* R package (65, 66). This procedure estimates a 95% confidence interval around the edges to estimate accuracy and provides a correlation-stability (CS) coefficient to assess whether or not the centrality indices (e.g., EI) are stable enough to be interpreted (65, 66). Namely, the CS-coefficient represents the proportion of participants that can be removed from the sample in case-dropping bootstrap resamples, such that the resulting EI indices have a 95% probability to correlate ≥ 0.7 with the original EI index (65). As a rule of thumb, a CS-coefficient below 0.25 indicates insufficient stability and warns against interpreting the centrality indices. A CS-coefficient above 0.50 indicates good stability (66).

To address the third research aim concerning potential gender differences in the network, we used the Network Comparison Test (NCT, $\gamma = 0.25$) from the *NetworkComparisonTest* R package (67) to investigate if the network structure and global strength were significantly different between boys and girls in the sample. The NCT allows us to assess the difference between the male and the female network based on network invariance, global strength invariance, edge invariance and centrality invariance.

Finally, to reach the fourth research aim, we used the *networktools* R package (68) to detect bridge symptoms between NSSI-D and BPD. As we were interested in the comorbidity between these two disorders, we specified to the network model which symptoms belonged to NSSI-D and which symptoms belonged to BPD. We then used bridge EI as a centrality measure to indicate which symptoms operate as bridges between the two theoretically defined symptom sets (64). We computed the CS-coefficient for bridge EI using the same case-dropping bootstrap resample as described above.

RESULTS

Descriptive Statistics

Non-suicidal Self-Injury

At the moment of assessment, 4.6% ($n = 16$) of participants reported having engaged in NSSI that same day and/or the day before, 8.9% ($n = 31$) reported having engaged in NSSI a couple of days ago, 11.8% ($n = 41$) a week ago, 11.5% ($n = 40$) a month ago, 35.2% ($n = 122$) several months ago, and 27.1% ($n = 94$) reported having engaged in NSSI over a year ago. Three participants did not answer this question. A total of 20.7% ($n = 72$) of the participants described themselves as "currently engaging in NSSI." The most common methods of NSSI were cutting and carving one's own skin, with 53.0% ($n = 184$) and 51.0% ($n = 177$) of the sample indicating that they engaged in these behaviors at least once. The other behaviors were hitting (30.8%, $n = 107$), scratching (26.5%, $n = 92$), head banging (25.4%, $n = 88$), pricking/piercing (23.1%, $n = 80$), rubbing (11.8%, $n = 41$), and burning the skin (8.4%, $n = 29$). The mean age of NSSI onset was 12.87 years ($SD = 2.03$), which did not significantly differ between boys ($M_{age} = 12.76$, $SD = 2.23$) and girls [$M_{age} = 12.90$, $SD = 1.98$; $F_{(1,332)} = 1.456$, $p = 0.619$].

Non-suicidal Self-Injury Disorder

Buelens et al. (17) provides more details on the diagnostic NSSI-D criteria in this sample. In short, a total of 37.8% ($n = 131$) of the participants adhered to all DSM-5 criteria for NSSI-D, whereas 59.9% ($n = 208$) was at least one criterion short of being eligible

TABLE 1 | Cross tabulation of NSSI-D and BPD.

	BPD	No BPD	Total
NSSI-D	**14** (2.3)	**117** (−2.3)	131
No NSSI-D	**9** (−2.3)	**198** (2.3)	207
Total	23	315	

NSSI-D, Non-suicidal self-injury disorder; BPD, Borderline personality disorder.
Adjusted standardized residuals are in parentheses.
Number of participants in this category are in bold.

for an NSSI-D diagnosis. 2.3% ($n = 8$) of participants could not be classified on absence of presence of NSSI-D due to missing data on the NSSI-D criteria. When considered dichotomously, criterion A was met by 51.6% of the sample, criterion B by 86.9%, criterion C by 97.9%, criterion D by 100%, criterion E by 78.6%, and criterion F by 99.1% of the sample. Significantly more girls were eligible for an NSSI-D diagnosis ($n = 111$ out of 265 girls, 41.89%) compared boys ($n = 20$ out of 74 boys, 27.03%) according to the assessed DSM-5 criteria [$X^2(1) = 5.39$, $p = 0.020$].

Borderline Personality Disorder

The mean score for BPD symptomatology was 2.16 ($SD = 0.66$) and was significantly higher for girls ($M = 2.22$, $SD = 0.64$) than boys [$M = 1.95$, $SD = 0.70$; $F_{(1,344)} = 1.30$, $p = 0.002$]. There was no significant effect of age [$F_{(8,337)} = 0.709$, $p = 0.684$] on the mean score for BPD symptomatology. We additionally performed analyses using the dichotomous cut-off variable (1 = above the BPD cut-off, 0 = below the BPD cut-off). A total of 6.6% ($n = 23$) of the sample scored above the BPD cut-off, 93.1% ($n = 323$) scored below the cut-off, and 0.3% ($n = 1$) could not be classified due to missing data. Although a higher percentage of girls ($n = 21$ out of 271 girls, 7.75%) scored above the BPD cut-off compared to boys ($n = 2$ out of 75 boys, 2.67%), this difference did not reach statistical significance [$X^2(1) = 2.45$, $p = 0.118$].

Comorbidity

In the cross tabulation of NSSI-D and BPD (**Table 1**), all adjusted standardized residuals exceeded |2|, indicating significant discrepancies between the observed and expected frequencies. Out of the 23 participants who scored above the BPD cut-off, 60.87% ($n = 14$) met the NSSI-D diagnosis as well, the remaining 39.13% ($n = 9$) did not meet the criteria for an NSSI-D diagnosis. Out of the 131 participants who met the NSSI-D diagnosis, 10.68% ($n = 14$) scored above the BPD cut-off as well, while 89.31% ($n = 117$) scored below the BPD cut-off. These differences were statistically significant [$X^2(1) = 5.08$, $p = 0.024$], with a higher probability to observe NSSI-D in the BPD group.

Table 2 shows the Pearson correlations between all NSSI-D criteria and all BPD symptoms.

Graphical Network Analysis

Figure 1 visualizes the EBIC gLASSO network ($\gamma = 0.25$) based on the 12 NSSI-D items (in green) and the 11 BPD items (in pink). Positive regularized edges are depicted in blue, negative regularized edges are in red. The exact values of each edge, as well as the bootstrapped confidence intervals are reported in **Supplementary Table 1**. All 99 edges in this network were positive, with the exception of a small negative edge (−0.09) between B3 (*I engage in NSSI to induce a positive feeling state*) and E1 (*NSSI causes clinically significant distress*), a small negative edge (−0.02) between C1b (*I engage in NSSI to obtain relief from a negative feeling of cognitive state*) and B1 (*interpersonal conflict takes place prior to NSSI*), as well as a small edge (−0.01) between nodes *lonely* and *strong*. Regarding the stability of the centrality measures, the CS-coefficient as calculated by the case-dropping bootstrap resample was 0.65 for EI and 0.401 for bridge EI. Thus, the CS-coefficient for EI stayed above the desired 0.50 threshold and the coefficient for bridge EI remained well-above the lower limit of 0.25, making it justifiable to interpret EI results for this network (66), albeit with some caution in the case of bridge EI. Regarding overall EI, nodes C1a (n*egative feelings prior to NSSI)* C3 (*frequent thinking about NSSI)*, E2 (*NSSI causes interference in interpersonal functioning)*, back (*I go back and forth between different feelings)*, and miss (*I feel that something important is missing about me*) had the highest expected influence in the full network (see the second panel of **Figure 3**). These five symptoms thus had strong and numerous connections to other symptoms and acted as hubs connecting otherwise disparate symptoms to one another (46). The lowest EI was found for mean (*lots of times, my friends and I are really mean to each other)* and E1 (*NSSI causes clinically significant distress*), indicating that both symptoms operated in the periphery of the network, with few and/or weak connections to other symptoms (46).

Community Structure Analysis

Upon visual inspection (**Figure 1**), the NSSI-D items clearly clustered together at the top half of the network while the BPD items clustered together at the lower half of the network. Even though both sets of symptoms were substantially interrelated with each other, no NSSI-D symptoms were nested within the group of BPD symptoms or vice versa.

The results of the community structure analysis (**Figure 2**) corroborated this visual interpretation of the network. Namely, our results showed two communities consisting exclusively of NSSI-D symptoms and two communities consisting exclusively of BPD symptoms, without any overlap (i.e., no NSSI-D symptoms were part of a BPD community or vice versa). For NSSI-D, the E-criteria [*NSSI causes clinical* (E1), *interpersonal* (E2), *academic* (E3), *other* (E4) *distress*], and two of the B-criteria [*engaging in NSSI to resolve interpersonal difficulties* (B2) or *to induce a positive state* (B3)] formed one community (see **Figure 2**, depicted in pink). The remaining criteria [*engaging in NSSI to relieve negative feelings/thoughts* (B1); *number of NSSI days* (A, days); *negative feelings* (C1a), *conflicts* (C1b), *preoccupation with NSSI* (C2), and *frequent thinking about NSSI* (C3)] constituted the third NSSI-D community (depicted in blue). Regarding BPD, the impulsivity symptoms (*I'm careless with things that are important to me* (Careless) and *I get into trouble because I do things without thinking* (nothink) grouped together with *my friends and I are really mean to each other* (mean) into the first BPD community (depicted in purple). The second BPD community (depicted in green) consisted of the remaining BPD symptoms.

TABLE 2 | Correlation coefficients between all study variables.

	Strong	Back	Miss	Leave	Change	Lonely	Hurt	Letdown	Mean	Careless	Nothink
A	**0.136***	**0.219****	**0.230****	**0.188****	**0.134***	**0.261****	**0.172****	**0.148****	0.007	0.046	0.105
B1	0.077	**0.198****	**0.186****	**0.228****	**0.166****	**0.259****	**0.157****	**0.184****	0.071	**0.119***	0.043
B2	0.037	**0.118***	0.058	**0.123***	0.07	0.095	0.014	0.01	0.042	0.026	0.073
B3	0.105	0.074	**0.151****	0.086	0.065	0.065	0.103	0.072	0.074	0.005	**0.123***
C1a	**0.185****	**0.308****	**0.252****	**0.276****	**0.163****	**0.291****	**0.210****	**0.258****	**0.117***	**0.173****	**0.164****
C1b	**0.213****	**0.181****	**0.108***	**0.159****	**0.121***	0.099	**0.168****	**0.194****	0.037	**0.109***	**0.178****
C2	**0.231****	**0.265****	**0.245****	**0.189****	**0.206****	**0.216****	**0.231****	**0.151****	0.079	**0.163****	**0.165****
C3	**0.128***	**0.321****	**0.344****	**0.246****	**0.146****	**0.389****	**0.172****	**0.192****	−0.005	**0.174****	**0.110***
E1	**0.136***	0.096	**0.184****	**0.151****	0.073	**0.116***	**0.119***	**0.121***	0.052	**0.129***	**0.152****
E2	**0.155****	**0.169****	**0.159****	**0.220****	0.077	**0.193****	**0.141****	**0.130***	0.105	**0.163****	**0.251****
E3	**0.125***	**0.119***	**0.152****	**0.147****	0.071	**0.135***	**0.132***	**0.128***	0.099	0.061	**0.195****
E4	**0.164****	0.058	**0.126***	**0.153****	0.043	0.091	0.091	**0.114***	0.05	0.063	0.049

*$p < 0.05$.
**$p < 0.01$.
*Significant correlations are marked in bold. For the full legend, see **Figure 1**.*

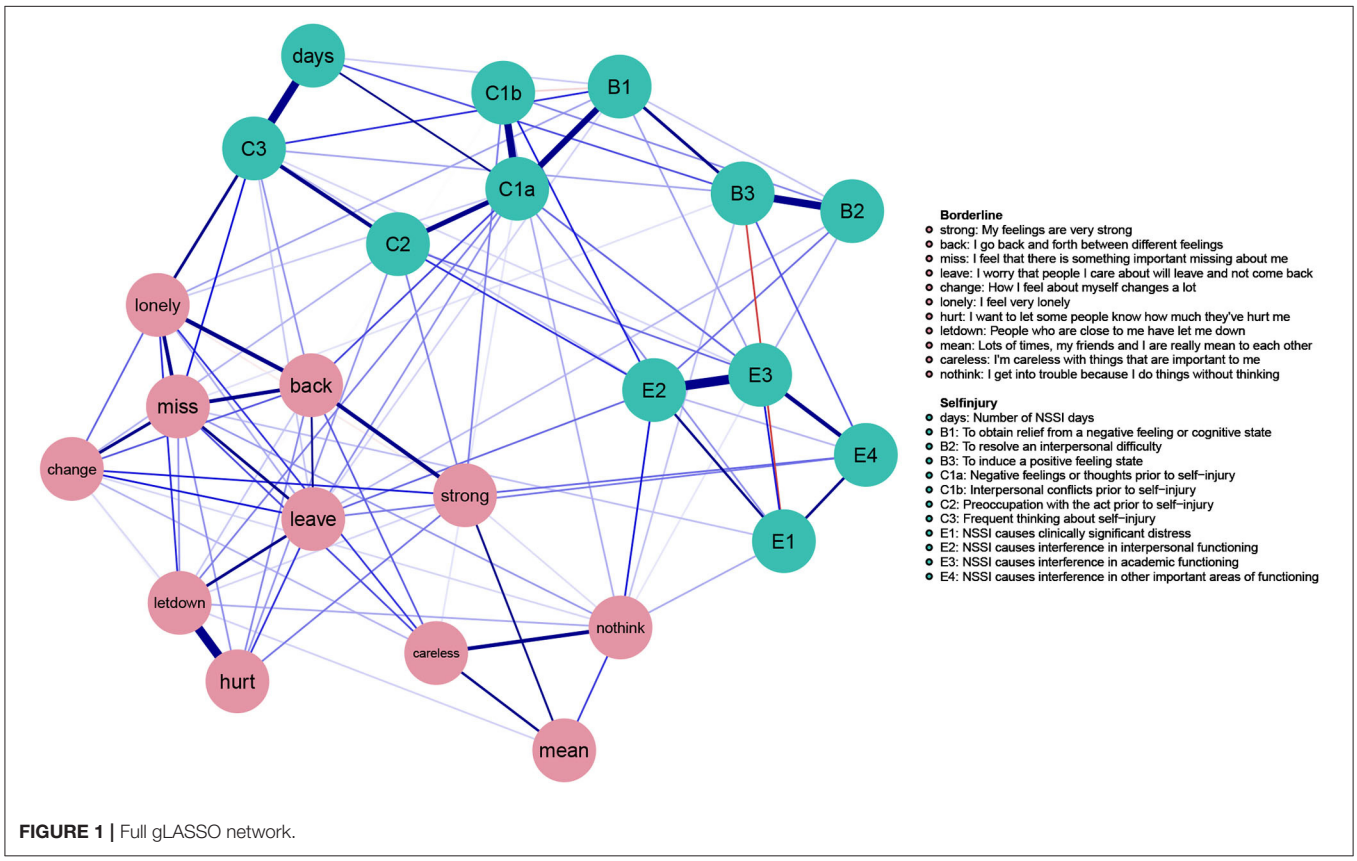

FIGURE 1 | Full gLASSO network.

Gender Differences in the Network

The network invariance test indicated no significant differences in network structure ($M = 0.46$, $p = 0.215$) and no significant differences between girls and boys in global strength across networks (girls: 9.23, boys: 0, $s = 9.23$, $p = 0.243$). However, these results should be interpreted cautiously, as the lack of a significant gender differences might be a result of low power due to the small number of boys in our sample (21.6%, $n = 75$).

Bridge Symptoms

Figure 3 summarizes the standardized centrality measures for each of the 23 symptoms included in the network. For the sake of

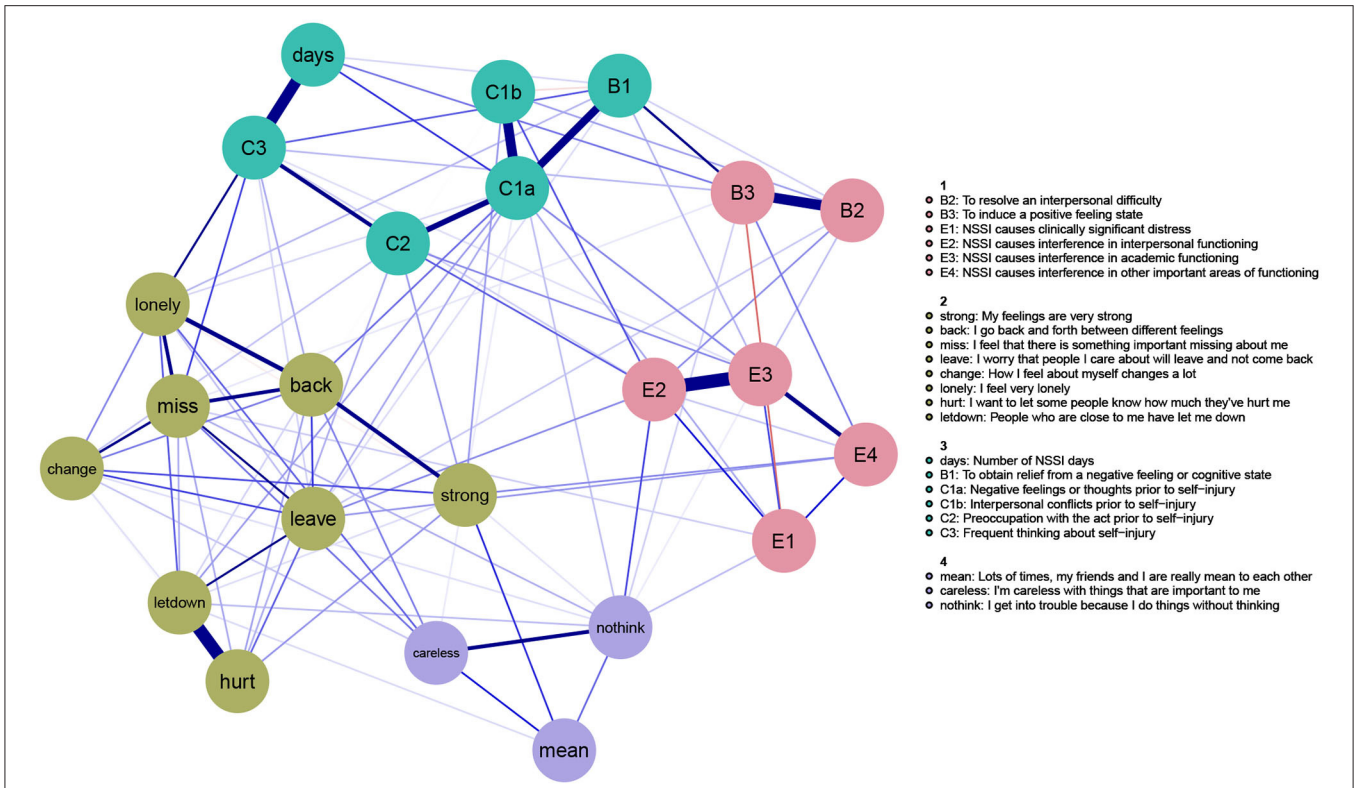

FIGURE 2 | Community structure gLASSO network.

completeness, we included both strength centrality and expected influence (EI). However, because of the small proportion of negative edges in the network, strength centrality and EI were nearly identical for the overall measures ($r_{\text{strngxEI}} = 0.98$) and exactly identical for the bridge measures ($r_{\text{strngxEI}} = 1$), because all negative edges connected nodes within the same cluster. Importantly however, as the CS-coefficient for bridge EI was below the 0.50 threshold, the results below should be interpreted with some caution.

The highest bridge EI was found for C1a (*negative feelings or thoughts prior to NSSI*), C3 (*frequent thinking about NSSI*), leave (*I worry that people I care about will leave and not come back*), lonely (*I feel very lonely*), and nothink (*I get into trouble because I do things without thinking*). This could indicate that these five nodes might have many and/or strong inter-cluster edges bridging the theoretically defined clusters of NSSI-D and BPD symptoms. The lowest bridge EI was found for days (*number of NSSI days*), E4 (*NSSI causes interference in other important areas of functioning*), mean (*my friends and I are really mean to each other*) and careless (*I'm careless with things that are important to me*). This might indicate that these four nodes did not play a significant role in connecting NSSI-D and BPD symptoms. This could either be due to overall low EI (as is the case for *mean*), or to being mainly connected to nodes within the same cluster (as is the case for *careless* in the BPD cluster and *E4* and *days* in the NSSI-D cluster). The latter could indicate that these symptoms are potentially less relevant in the comorbidity between NSSI-D and BPD, even though they could play a considerable role within each disorder.

DISCUSSION

In 2013, DSM-5 urged for further research on NSSI-D and represented NSSI for the first time distinct from BPD (14). However, research on the comorbidity between NSSI-D and BPD symptoms is still scarce, especially in adolescent populations, where the symptoms of both disorders tend to be more acute and more prevalent than in adulthood (36). Therefore, the current study selected 347 adolescents who engaged at least once in NSSI to address four research aims regarding prevalence, comorbidity, gender differences, and bridge symptoms of NSSI-D and BPD.

First, our results showed that 6.6% in this specific sample (i.e., community adolescents with a history of NSSI) scored above the BPD cut-off, which turned out to be higher than the 2–3% previously found in community adolescents (28, 29), but lower than the 11% previously found in outpatient adolescents (30). Regarding the co-occurrence of BPD with NSSI-D, our results showed that 60.87% of adolescents who scored above the BPD cut-off were eligible for an NSSI-D diagnosis as well. To the best of our knowledge, the current study is the first to report the co-occurrence of BPD with NSSI-D in community adolescents. Previous research, however, did already indicate that out of those adolescents who presented with BPD symptomatology, 61% had at least once engaged in NSSI (34, 37). Considering the reverse

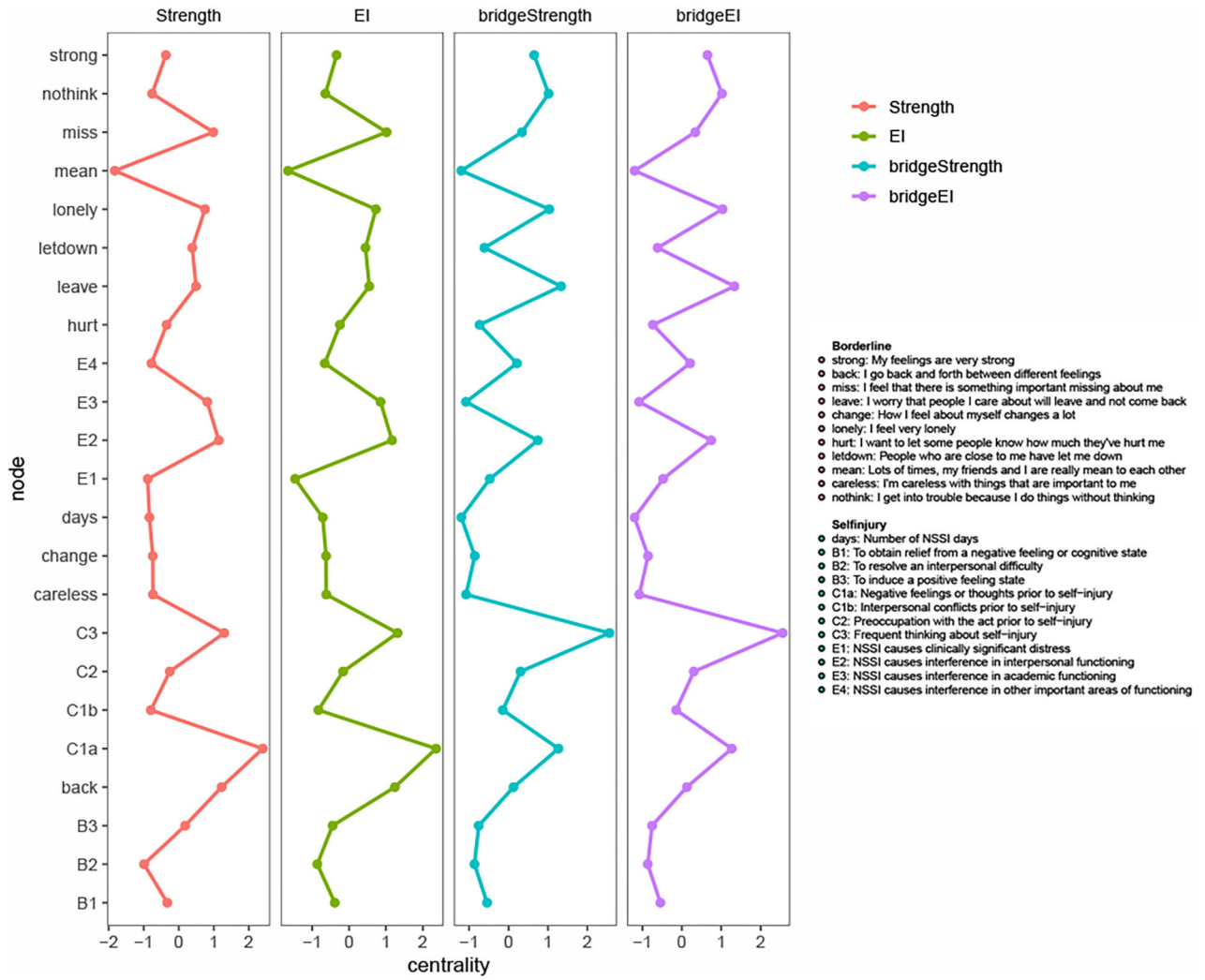

FIGURE 3 | (Bridge) strength and (bridge) expected influence. Centrality measures are visualized using standardized values to facilitate comparison. The x-axis represents standardized centrality values, the y-axis represents each node. The full definition of each node can be found in the legend. *EI,* expected influence.

direction (i.e., the co-occurrence of NSSI-D with BPD), our results showed that 37.14% of adolescents eligible for NSSI-D scored above the BPD cut-off as well. This percentage is just below the 44.4% reported recently by Zetterqvist et al. (69). The slight difference might be due to the fact that our study investigated community adolescents, whereas Zetterqvist et al. studied adolescent outpatients.

Second, to investigate comorbidity in more detail, we modeled the symptoms of NSSI-D and BPD together in one network of inter-symptom relations. The network showed how NSSI-D and BPD symptoms were closely interrelated, with a total of 98 connections running to and from the 23 symptoms included in the network. Despite this interconnectedness, a community structure analysis revealed that NSSI-D and BPD symptoms reliably split into separate communities, where no symptoms from NSSI-D ended up in the BPD community nor vice versa. These results confirm earlier research, which found NSSI-D to occur both together with and independently of BPD (16, 69). As a previous study showed that the overlap between BPD and NSSI-D is similar to the overlap between BPD and other disorders (24), these findings seem to strengthen the validity of distinct, yet related diagnoses (24, 69). Two additional findings emerged from the community structure analysis regarding the clustering of symptoms within NSSI-D. First, criterion B1 (*engaging in NSSI to relieve negative feelings/thoughts*) did not group together with the other B-criteria, but rather formed a community with the A-criterion (*number of NSSI days*) and C-criteria [i.e., *negative feelings* (C1a), *conflicts* (C1b), *preoccupation with NSSI* (C2), and *frequent thinking about NSSI* (C3)]. This could be due to the particularly strong edge connecting *engaging in NSSI to relieve negative feelings/thoughts* (B1) and *experiencing negative thoughts/feelings prior to NSSI* (C1a), which reflects previous research with this sample reporting an almost complete overlap of B1 with C1a (17). Second, criterion A (*the number of days*

one engaged in NSSI in the last year) showed relatively low EI and very low bridge EI. This is likely due to the strong connection of criterion A with C3 (*frequent thinking about NSSI, even when it is not acted upon*): the variance in the number of days seems to be explained to a large extent by the thoughts one has regarding NSSI.

Third, we investigated potential gender differences in (the comorbidity of) NSSI-D and BPD symptoms. Confirming our hypotheses based on previous literature (16, 28, 33), the current study found significantly more girls than boys being eligible for an NSSI-D diagnosis, but no significant gender difference in the BPD cut-off. Moreover, our results showed no significant gender differences in the network of NSSI-D and BPD symptoms. This could indicate that the overall comorbidity structure of NSSI-D and BPD, as well as the strength of the connections between the symptoms, remains alike for boys and girls in a community sample. Thus, even though girls are more likely to meet the NSSI-D criteria, our results tentatively suggest that the manner in which NSSI-D and BPD symptoms are interconnected does not differ between girls and boys. Importantly however, the lack of a significant gender differences in the current study could also be ascribed to the particularly small number of males in our sample.

Fourth, the current study identified the five bridge symptoms through which pathology was most likely to spread to or from NSSI-D and BPD symptoms: negative feelings/thoughts prior to NSSI (C1a), frequent thinking about NSSI (C3), separation anxiety (leave), loneliness (lonely), and impulsivity (nothink). The identification of bridge symptoms can clarify why comorbidities occur in some adolescents, but not in others (70). For instance, our results showed *I feel very lonely* (lonely) to be one of the five main bridge symptoms connecting BPD to NSSI-D symptoms (i.e., high bridge EI). If future research could replicate this finding, it could indicate that an adolescent who feels very lonely would be at greater risk for NSSI-D compared to an adolescent with equally severe BPD features, but who does not feel particularly lonely (70). Loneliness standing out as a potential bridge between BPD and NSSI-D symptoms is supported by earlier work, which reported elevated loneliness in NSSI (71, 72) and BPD (73–75), potentially due to the association of loneliness with depression as a comorbid diagnosis for NSSI and BPD (76). Moreover, previous studies suggested that being alone increases self-reflection (77) which, for at-risk adolescents, could trigger an emotional cascade of rumination, depressive feelings, and potentially NSSI (6).

Relatedly, our results showed that the BPD symptom *I feel very lonely* had its strongest connection to NSSI-D with *frequent thinking about NSSI* (C3), which in itself showed up as one of the five strongest bridge symptoms (i.e., high bridge EI). Thus, *frequent thinking about NSSI* (C3) potentially operates as an important gateway from NSSI-D to BPD. In addition, our results revealed how this symptom was highly influential -and sufficiently stable- in the overall network (i.e., high EI). In other words, *frequent thinking about NSSI* (C3) additionally acted as a central hub in the overall network, with strong and numerous connections to symptoms of both NSSI-D and BPD. Noteworthy, previous research has shown that teaching coping skills to reduce and resist frequent NSSI thoughts and urges is a key component of successful treatment for NSSI (78, 79).

Similarly, *experiencing negative thoughts or feelings prior to engaging in NSSI* (C1a) showed up as one of the five main bridge symptoms (i.e., high bridge EI) as well as one of the most influential symptoms in the overall network (i.e., high EI). This neatly aligns with previous research indicating that, on the one hand, engaging in NSSI to relieve negative thoughts and feelings is the most commonly reported function of NSSI (80, 81) and, on the other hand, adolescents with BPD features tend to report particularly strong negative emotions (25).

Finally, BPD symptoms *I worry that people will leave and not come back* (leave) and *I get into trouble because I do things without thinking* (nothink) showed a different pattern: unlike C1a and C3 these symptoms did not stand out in the overall network (i.e., they showed moderate EI), but they did come up as the final two main bridge symptoms (i.e., high bridge EI) connecting BPD to NSSI-D. These bridge symptoms, BPD symptoms referring to separation anxiety (leave) and impulsivity (nothink), thus could indicate that very anxious or very impulsive adolescents would be at greater risk for NSSI-D, compared to adolescents with equally severe BPD features, but who show less separation anxiety or are less impulsive. This finding extents previous research reporting that separation from parents before the age of 15 increases risk for NSSI and that, among all BPD features, impulsivity showed the strongest association with NSSI frequency (82).

The current study adhered to several recommendations stemming from the extensive discussion on network replicability (83, 84). We provided robustness checks (accuracy and stability) with a bootstrapping procedure and, where necessary, warranted against overinterpreting results with insufficient stability. Despite these precautions, our research was not without limitations. First, our sample size, relatively small considering the high statistical power necessary for these analyses, could have led to increased instability in the LASSO network. Particularly the small number of males in our sample, a common issue when researching both NSSI-D and BPD (34, 35), is likely to be the underlying reason for the insignificant gender differences in the network. Future research with larger sample sizes and more equal numbers of boys and girls should aim to replicate this analysis. Second, NSSI-D showed low internal consistency and measuring NSSI-D and BPD solely with self-report questionnaires is limited and could result in reporting bias (85). However, NSSI is typically secretive (86) and parents or teachers are often unaware of the adolescent's engagement in the behavior (87), which makes NSSI(-D) difficult to assess by other informants. Future research could embrace a multi-method approach and include diagnostic clinical interviews to allow for differential diagnostics and/or behavioral measures to assess NSSI-D and BPD more accurately. Third, our results might not be generalizable to clinical, particularly inpatient, samples. Fourth, both NSSI(-D) and BPD symptoms show high comorbidity with other diagnoses, such as major depressive disorder, substance use disorders, anxiety disorders, and eating disorders (76). Future research could aim to replicate our findings while additionally controlling for other diagnostic comorbidity. Finally, the cross-sectional nature of our data limits the conclusions that can

be drawn. Future longitudinal research will allow us to make stronger assumptions regarding long-term symptom interactions and, noteworthy, directionality and causality. Namely, by using time-series data on a group level or on an individual level, specific nodes could be targeted by experimental manipulations to test for causality in the network (70).

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee at the University of Leuven (G-2017 01 755). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

TB was involved in the conception, design of the study, the acquisition, initial analysis, interpretation of the data, the drafting, and revisions of the manuscript. GC made substantial contributions to the analysis, interpretation of the data, and was involved in the revisions of the manuscript. KL and LC were involved in the funding acquisition, conception and design of the study, and revisions of the manuscript. All authors read and approved the final manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2020.580922/full#supplementary-material

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Task Control Deficit in Individuals With Non-suicidal Self-Injury

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Background: Numerous people in clinical settings who have experienced repeated self-injuries explain their non-suicidal self-injury (NSSI) as "habitual" or due to "difficulty avoiding impulses related to NSSI." Previous studies present retrospective reports, where they experience frequent self-injurious urges and try to resist but fail. However, no study has directly investigated repeated behavioral control problems of people who engage in chronic NSSI through behavioral measurements in an experimental setting. The current study sought to investigate whether people who repeatedly attempt NSSI demonstrate deficiency in task control ability called the object-interference (O-I effect).

Methods: The current study performed object interference tasks on 90 participants, of which 45 were those who reported repeated NSSI while 45 comprised the control group.

Results: We observed delayed reaction times for object stimulus compared to abstract stimulus in the NSSI group, indicative of the object interference effect. This reflects task control deficits and difficulties in NSSI related behavioral control in the repeated NSSI group. When NSSI tools were additionally presented as a target stimulus, longer reaction times and more errors were observed in the NSSI group compared to the control group.

Discussion: The current study discusses the clinical implications of the results from diagnostic point of view and provides suggestions for future research for treatment and prevention.

Keywords: task control, objective-interference effect, non-suicidal self-injury, executive control, non-verbal Stroop task

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INTRODUCTION

Self-injurious thoughts and behaviors (SITBs) can be divided into two main types depending on whether suicidal intentions are present (suicidal thoughts, suicidal plans, suicidal attempts) or not (suicidal gestures, non-suicidal self-injury thoughts and behaviors) (1). However, NSSI has been discussed as strong longitudinal predictors of future suicidal attempts (2) and are related to suicides (3). Around 70% of adolescents who engage in NSSI report experiences of suicidal attempt with clear suicidal intentions (4, 5). Furthermore, 91% of those who exhibit clinically serious levels of self-injuries also show mild levels of self-injury (6). Regardless of presence of suicidal intentions or seriousness, SITBs are significant problems that can lead to death by suicide. In this context, one can easily predict that those who engage in chronic NSSI are vulnerable to life-threatening situations.

When asked as to why they engage in non-suicidal self-injury (NSSI), many individuals in clinical settings who have experienced repeated NSSI explain their early experiences of it with functional factors, such as "to get rid of a bad feeling" or "to feel alive." On the other hand, those with chronic NSSI experiences explain recent NSSI as "as always," "difficulty avoiding impulses (to indulge in NSSI)," or "habitual." Early NSSI experience is related to weakened inhibitory control abilities during negative emotional situations and emotion regulation difficulties (7–10), while chronic NSSI is suggested to be related to problems with controlling repeated behaviors (11). This is known to be a task control ability called the O-I effect (12).

Only a few of those who have experienced NSSI stop after one or two experiences. In many cases, NSSI is repeated and becomes chronic. Furthermore, as behavior repeats over time, it becomes fixed through the reinforcement paradigm, and leads to life-threatening NSSI due to increased frequency and severity (13, 14). A recent cognitive neuroscientific model of NSSI explains the process of chronic stages of NSSI as follows: as NSSI experiences repeat, pain and shame decrease, and changes in neural circuits allow for becoming psychologically, physiologically, and physically accustomed to self-injurious behavior, leading to chronic stages of mechanical repetition (15).

According to Monsell (16), a task is activated in two ways: a top-down approach, where a task is planned by an objective or an instruction, and a bottom-up approach, where an associated specific task is activated due to perceiving a stimulus. Here, the O-I effect is a deficit in executive control ability that inhibits automatic behaviors triggered by environmental cues. From the cognitive neuroscientific perspective, habitual behaviors are not innate, but rather a response triggered by specific situations or stimuli. Furthermore, habitual behaviors become fixed over time, and once acquired, only a small amount of effort is required to produce them (16, 17).

Humans are fundamentally able to directly perceive the behavioral meaning of the object (tool). Therefore, looking at specific objects can produce latent motor responses, even without intentions of action (18, 19). In this context, a recent study on "motor evoked potentials" showed that simply viewing a specific target object through a screen activates related motor planning and relevant brain regions (20).

Objects also act in various ways on human behavior depending on the attached meaning. If NSSI is primed with low pain intensity, the perceived pain during the actual NSSI is reduced. In addition, semantic priming strongly relates to NSSI implicitly or causes attention bias; construal priming induces positive attitudes regarding NSSI, or causes the occurrence of NSSI thoughts; and behavior and goal priming allows individuals to look for, or become involved in self-injurious behaviors. Recent studies suggest the media, Internet, and peer group as priming factors for SITBs (Self-injurious thought and behaviors) (21).

According to Prevor and Diamond (12), task control ability refers to a control mechanism that helps resolve task conflict and successfully achieve goal-oriented behavior by appropriately controlling for the task at hand in a situation where multiple tasks are competing. They found the O-I effect during a development process of non-verbal Stroop variant task for children. This task presents a known, named target picture and an abstract picture in colored forms, and requires verbally naming the color of the picture. The task produced interesting results where children took longer to name the color of the meaningful target with a name, compared to naming the color of an abstract target form. For example, in **Figure 1**, children show slowed response saying "red" when looking at "a red chair" compared to when looking at "a red abstract figure." This is called the O-I effect (22, 23).

This phenomenon is observed before the age of 6.5 (age 3.5∼6.5), and older children or adults can quickly resolve task conflict through maturation of executive control process (22). Children usually exhibit color preference during ages 2–3, and form preferences until the age of 9. Therefore, as age increases, the tendency to recognize the object increases, but the form preference is offset by the increase in the effectiveness of the frontal lobe executive control (23). Therefore, the O-I effect in adults is an abnormal phenomenon, and is strong evidence to indicate low levels of task control.

There are a variety of phenomena of "Stroop-like paradigms," such as picture-word, or color-word interference effect, etc. The O-I effect is seemingly similar to the original Stroop interference effect, but it is explained by another factor (24). It is not simply a matter of word selection due to lexical interference, but a conflict between task sets of processing color vs. processing object.

La Heij et al. (23) performed several variants of object-interference tasks to identify distinct characteristics of the O-I effect in children. Repeated verification was made in many ways, such as naming the object's color rather than their location, or presenting objects where children recognize their functions but have difficulty naming (e.g., contrabass, monkey-spanner, etc.). The results showed a consistent O-I effect when the color-naming task was changed to a location-naming task, or when the lexical difficulty increased, or even when objects that could not be named were presented. In addition, when required to produce non-verbal responses such as pressing buttons during the original Stroop task, the effects of verbal interference disappear, suggesting a differentiation with simple word selection problems due to verbal interference. In other words, the O-I effect is not simply a semantic priming effect or a word selection problem, but rather the ability to control for the fundamental confusion of task selection between processing either the color or the object, a more comprehensive concept.

The previously mentioned behavioral meaning and motor execution induced by an object have important implications not only for NSSI, but also for mental illness involving repeated behaviors such as obsessive-compulsive behaviors. A recent study on obsessive-compulsive disorder (OCD) patients identified abnormalities in executive control abilities (19). An example is an OCD patient whose main symptom of checking behaviors is repeatedly locking the doorknob. When the patient tries to open the doorknob to go outside, the doorknob triggers the checking behavior of repeatedly locking it. In this situation, the goal-oriented behavior of going outside and the checking behavior triggered by the doorknob cause a "task competition." In other words, environmental cues trigger behaviors that are repeatedly habituated, which hinder goal-oriented behaviors. This creates difficulties in task control that requires executive control.

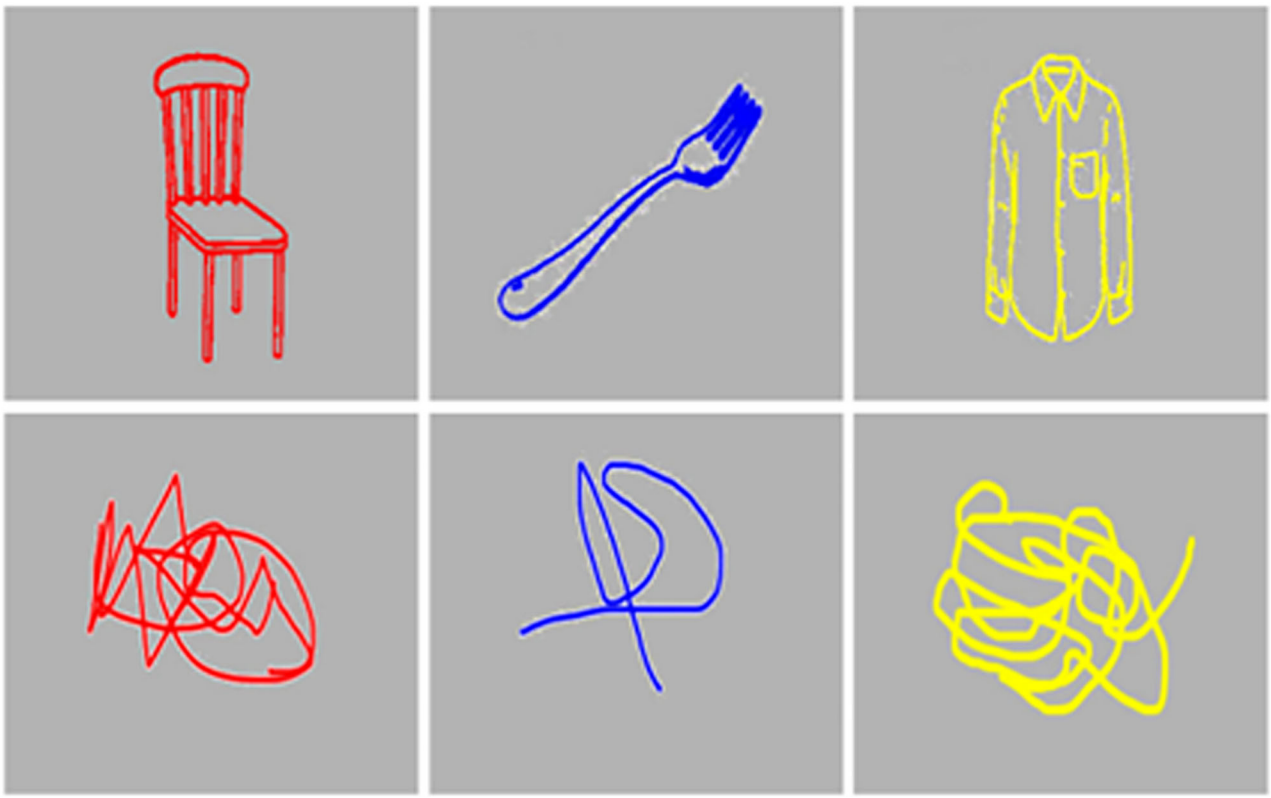

FIGURE 1 | An example of object stimuli and abstract stimuli used in the current study.

Such challenges also apply to repeated NSSI patients. Repeated NSSI patients in clinical settings report that looking at frequently used self-injury tools triggers self-injurious behavior. Furthermore, they state that it is difficult to control NSSI impulses because many objects around them are seen as self-injury tools. In other words, daily goal-oriented activities compete with self-injurious behaviors triggered by objects, thus leading to situations where controlling repeated, habituated self-injurious behaviors is difficult. These fixated NSSI behaviors hinder functional performance in important aspects of life as they are triggered by various target objects met in everyday lives, thus gradually deepening adaptive problems. It is therefore important to remove self-injury tools from those with dangers of self-injury. One study showed that the most effective way of resisting impulses of self-injury is to remove the means of self-injury (tools) used frequently at home (11). However, there is insufficient direct evidence explaining this phenomenon. Hence, repeated NSSI behaviors as an executive control problem of habituated behaviors triggered by objects should be objectively measured. This will allow for the presentation of clear evidence for a treatment protocol to prevent NSSI relapses.

Therefore, the current study aims to see whether participants who report repeated NSSI experience object-induced task conflict to produce the O-I effect, compared to the control group. In Blocks 1 and 2, it can be hypothesized that the NSSI group, compared to the healthy control group, will report longer reaction times to object stimuli than abstract stimuli. It can also be expected that both NSSI group and healthy control group will report relatively higher number of errors to object stimuli than abstract stimuli. Additionally, exploratory attempts were made, where self-injury tools were presented as object stimuli in Block 3, to compare any differences between results from Blocks 1 and 2.

METHODS

Participants

From March to July 2019, participants were invited from three universities located in Seoul, through both online and offline notifications. The selection criterion was adults who are 18 or older reporting repeated NSSI, and 48 individuals participated. The participants were administered the Self-Injurious Thoughts and Behaviors Interview- Korean (SITBI-K). Those who reported serious NSSI that required medical treatment in the last month were considered high-risk, and were removed as per research ethics. Also, those with formal thought disorder, intellectual disability, and organic mental disorder, etc. who are unable to report reliable self-reports were excluded. Participants in the healthy control group were matched for age and sex with the NSSI group.

Measures

Non-suicidal Module From the SITBI-K

The NSSI module from the SITBI (25) was translated into Korean by the researcher, and was used in the current study (26). Study participants' selection criteria were identified using items for NSSI experience and frequency.

Object-Interference Task

The Object-Interference task was computerized by a PhD in electrical engineering using WPF (Window Presentation Foundation) C#, and the program was implemented in Visual Studio 2017 (NET Framework 4.5.2) and was run on a 14-inch laptop. Voice Key (SV-1, cedrus) connected to a headset was used to measure speech production. Verbal responses are suggested to reflect cognitive processing speed more accurately, unlike the motor response (measured with keyboard or keypad) (27, 28).

The Object-Interference task was constructed using the Experiment 1 paradigm from the La Heij et al. (23) study. The target stimuli were selected from Snodgrass and Vanderwart's (29) A Standardized Set of 260 Pictures (line pictures). Targets were selected in order of the following standards: ease of labeling, high level of familiarity, and consistency between targets and pictures. Consequently, 28 target stimuli were selected. To formulate abstract stimuli to use with the object stimuli, the complexity of the lines was divided into three levels and the abstract stimuli were created accordingly. The final object targets were colored red, yellow, blue, and green using Portable Photoshop 8 CS. In addition, seven self-injury tools were separately presented in Block 3 for further analysis. Among the line pictures of seven self-injury tools, three were selected from the previously mentioned papers and four were selected through an internet search.

After the participant sits down in front of the computer and wears the headset, verbal measurement sensitivity (delay & threshold) is tested using Voice Key. A fixation cross is then presented in a gray rectangular box (dimensions 14.37 cm × 8.54 cm) in the middle of a black screen, followed by random presentation of the object or abstract stimuli. The stimuli disappear when the first verbal syllable is recognized. When no speech is recognized, the stimuli are presented for up to 2,000 ms and disappear. The inter-stimulus interval is 500 ms, and the fixation cross is presented during the interval. Practice trials include 16 trials (8 object stimuli, 8 abstract stimuli), and experimental trials consist of two blocks, each block comprising 56 trials (28 object stimuli, 28 abstract stimuli). In the additional Block 3, the self-injury tools are presented as object stimuli. To reduce fatigue during experiment, there is a 10 s break between each block, and when the participant presses the space bar, the next block begins. When calculating for the mean reaction time per block, responses below 300 ms or above 1,500 ms were considered as errors (noise or omission error) and were excluded. In the practice trial stage, participants' sight problems (e.g., color-blindness) were identified, and correct/incorrect responses during performance were double checked using manual recording by the experimenter and screen and voice recording using the Open Broadcaster Software program.

Data Analysis

Object-interference tasks were performed on 48 participants who reported repeated NSSI. In object-interference tasks, neurocognitive process affects speech production speed, producing difference under 200 ms. Therefore 3 cases showing outlier values larger than 2SDs were excluded for analysis, leaving a total of 25 people. Participants in the healthy control group were matched for age and sex with the NSSI group. Statistical analyses were performed using IBM SPSS Statistics 23. Descriptive analyses were performed on participants' demographic information and NSSI related characteristics. To identify for O-I effect between groups, mixed 2-way ANOVA of 2 between subjects (Groups) × 2 within subjects (Stimulus) was conducted. In addition, a 1 way-ANOVA was conducted to specifically examine the effects of stimulus type.

RESULTS

Demographics and Clinical Characteristics

The prior homogeneity test confirmed homogeneity of gender and age by group in the sample (gender $X^2 = 0.303$, $p = 0.581$; age $X^2 = 1.63$, $p = 0.204$). The mean age of participants was 21.86 ($SD = 2.62$), and 82.2% were females. Based on the frequency of occurrence "within the last year" on the SITBI-K, 23 (51.5%) reported 5 or more NSSI experiences, satisfying satisfies diagnostic criterion A of NSSI in *Diagnostic and Statistical Manual of Mental Disorders (DSM)*-5. Based on 2 or more years as a standard for chronic NSSI, 33 (73.3%) reported chronic NSSI, which includes current remission as well as partial remission. This confirmed the appropriateness of the sample to test for O-I effect in repeated NSSI experiences.

O-I Effect Between NSSI and Control Groups

The mean and standard deviations of O-I task performance for the NSSI and control groups are presented in **Table 1**. When analyses were performed on the basis of response times, significant main effect of stimulus condition was relatively greater [$\eta^2 = 0.38$, $F_{(1, 88)} = 33.34$, $p = 0.000$], and the main effect of group [$\eta^2 = 0.09$, $F_{(1, 88)} = 7.90$, $p = 0.006$] and interaction effect between group and stimulus condition [$\eta^2 = 0.09$, $F_{(1, 88)} = 10.22$, $p = 0.002$] were also significant. Specifically, compared to reaction time difference between the object and abstract stimulus in the healthy control group [$F_{(1, 44)} = 4.84$, $p = 0.033$], the difference in the NSSI group was remarkably larger [$F_{(1, 44)} = 30.61$, $p = 0.000$]. Furthermore, reaction times were delayed for object stimulus compared to abstract stimulus (**Figure 2**). These results support the hypothesis, providing evidence of the O–I effect in repeated NSSI group.

Analyses performed based on error rates revealed non-significant results for the main effects of group, stimulus types, as well as interaction between group and stimulus types. The NSSI group had a slightly greater mean number of errors but this was not statistically significant [$F_{(1, 88)} = 0.291$, $p = 0.591$].

TABLE 1 | Results of object-interference task of NSSI and control group.

	NSSI ($n = 45$)				NC ($n = 45$)			
	Object stimulus		Abstract stimulus		Object stimulus		Abstract stimulus	
Reaction	***M***	**±*SD***	***M***	**±*SD***	***M***	**±*SD***	***M***	**±*SD***
Time (msec)	864.67	125.57	760.65	81.03	774.60	119.23	744.89	83.31
Error (n)	0.27	0.54	0.18	0.32	0.21	0.33	0.17	0.28

NSSI, non-suicidal self-injury; NC, normal control; M, mean; SD, standard deviation.

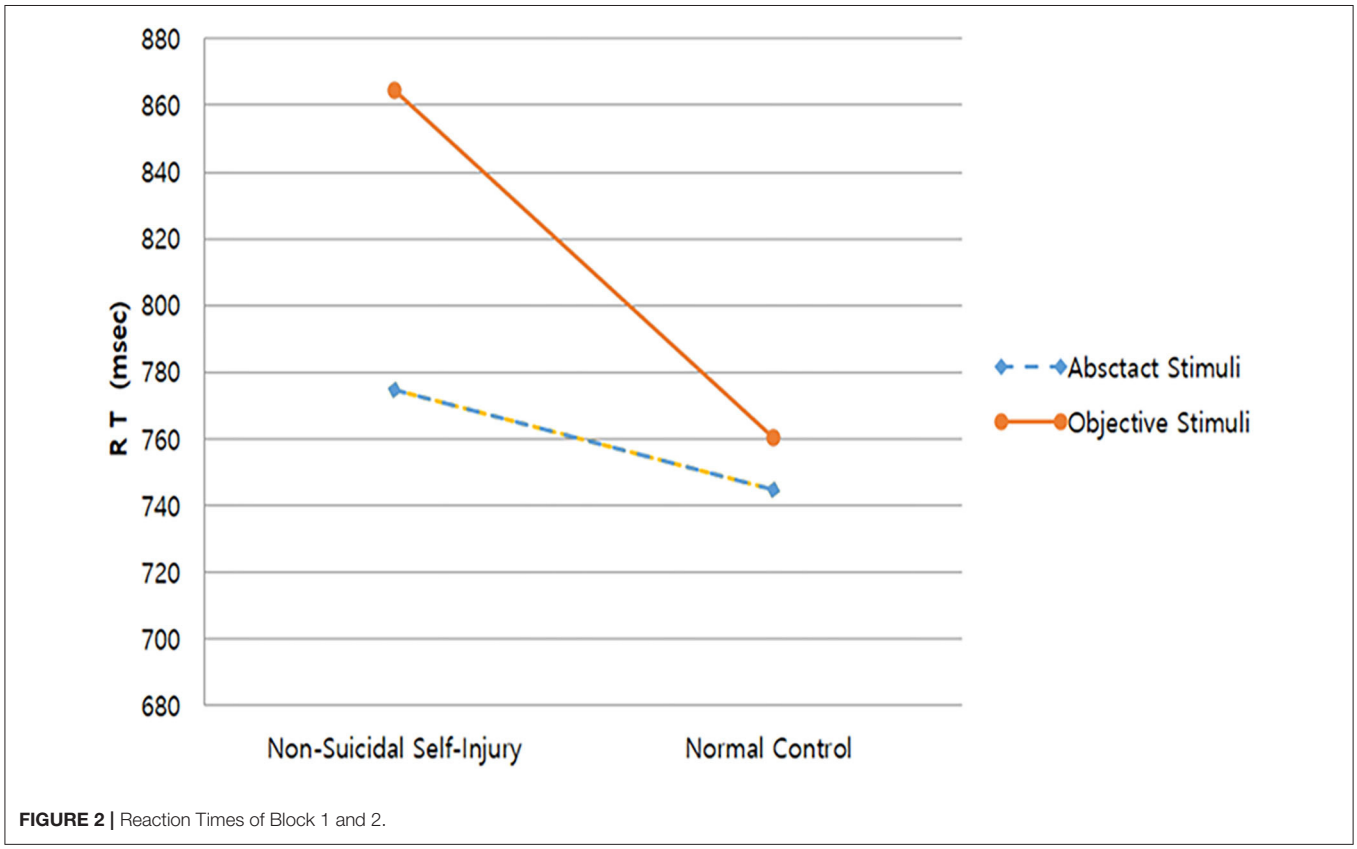

FIGURE 2 | Reaction Times of Block 1 and 2.

NSSI Tools Interference Task Effect on NSSI and Control Groups

In Block 3, NSSI tools were presented as object stimuli. The means and standard deviations of the NSSI tools interference task for the NSSI and control groups are presented in **Table 2**.

Based on the reaction times, the main effect of group [$\eta^2 = 0.14$, $F_{(1, 88)} = 12.33$, $p = 0.001$], main effect of stimulus [$\eta^2 = 0.05$, $F_{(1, 88)} = 4.15$, $p = 0.045$], and interaction effect between group and stimulus [$\eta^2 = 0.06$, $F_{(1, 88)} = 5.01$, $p = 0.028$] were all significant. As for the NSSI group, the difference in reaction times between NSSI tool stimuli and abstract stimuli were not significant [$F_{(1, 44)} = 0.02$, $p = 0.893$]. On the other hand, reaction times were relatively longer for the abstract stimulus compared to NSSI tool stimuli in the control group [$F_{(1, 44)} = 10.28$, $p = 0.003$]. This is an unusual result, because the control group showed relatively healthier executive control abilities in Blocks 1 and 2 compared to the NSSI group. What is more noteworthy is that reaction times were delayed overall for the NSSI tools stimuli compared to reactions times in Blocks 1 and 2, for both groups (**Figure 3**).

In terms of the number of errors, the main effect of group was significant [$\eta^2 = 0.10$, $F_{(1, 88)} = 8.51$, $p = 0.004$] but the main effect of stimulus conditions and the interaction effect between group and stimulus conditions were not. For the NSSI group, reaction times were significantly delayed without deviation for both the NSSI tool stimuli and abstract stimuli compared to the control group but had relatively higher errors (**Figure 4**).

DISCUSSION

This study attempted to investigate whether the O-I effect was present in those who have experienced repeated NSSI. Unlike the reaction times of the control group, the NSSI group displayed O-I effect characterized by longer reaction times for object stimuli

TABLE 2 | Results of NSSI tools interference task in NSSI and control group.

	NSSI ($n = 45$)				NC ($n = 45$)			
	Object stimulus (NSSI tools)		Abstract stimulus		Object stimulus (NSSI Tools)		Abstract stimulus	
Reaction	***M***	**±*SD***	***M***	**±*SD***	***M***	**±*SD***	***M***	**±*SD***
Time (msec)	906.69	147.64	903.38	142.34	785.00	117.95	855.33	144.82
Error (n)	0.42	0.62	0.33	0.56	0.18	0.39	0.13	0.41

NSSI, non-suicidal self-injury; NC, normal control; M, mean; SD, standard deviation.

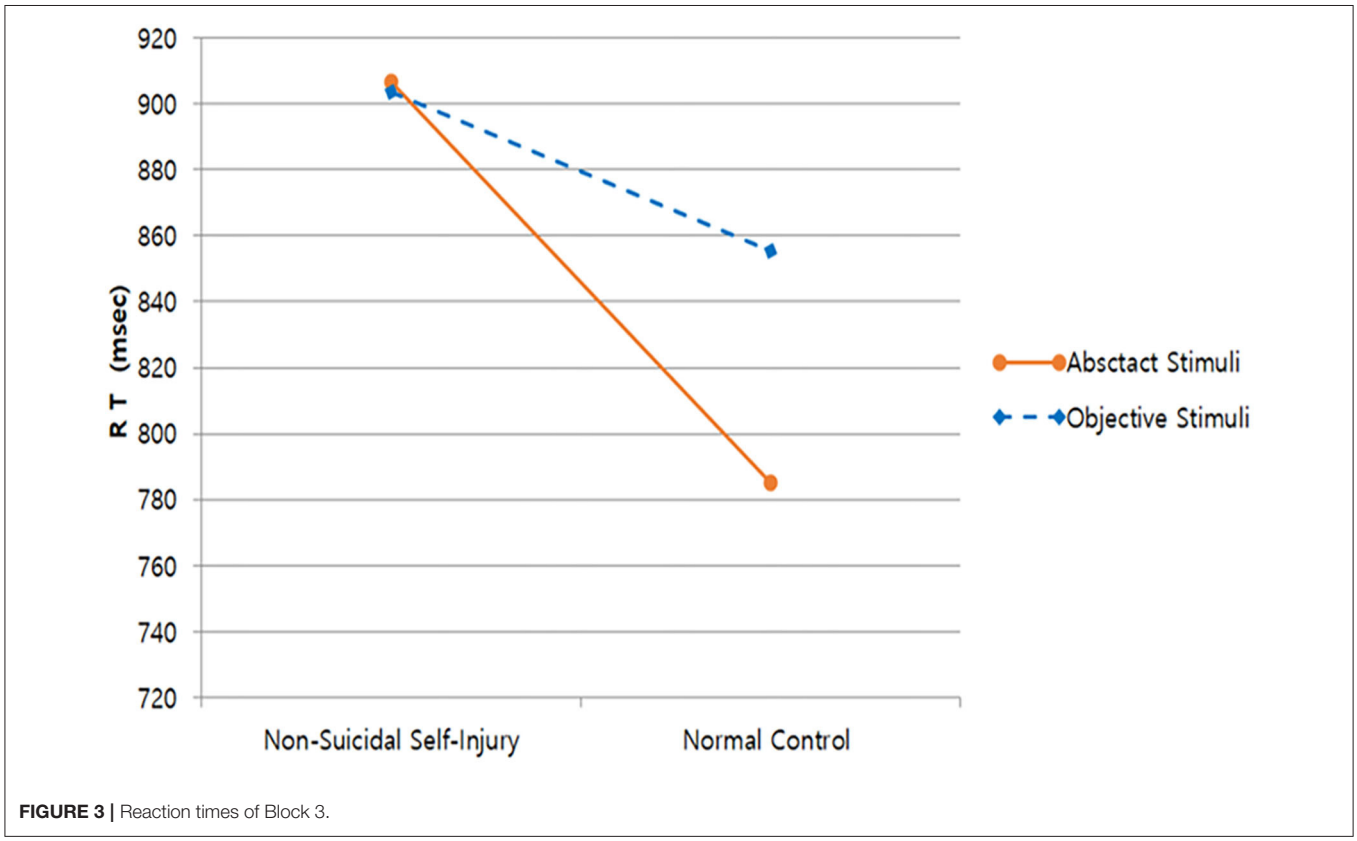

FIGURE 3 | Reaction times of Block 3.

compared to abstract stimuli. These results show a similar pattern with results found in previous research on children younger than 6.5 years with immature frontal lobe executive function development and OCD patients (19, 23). On the other hand, there was no significant difference for error rate. O-I effect affects neurocognitive processing, which manifests as a small difference of up to 200 ms in speech production speed. In other words, the O-I task is not difficult enough to show errors by participants with good neurocognitive abilities.

This study has the following clinical significance and treatment implications. Firstly, repeated NSSI experience is a type of habitual behavioral control problem, which can cause task confusion between object-induced behavior and goal-oriented behavior in everyday life. In the proposed NSSI diagnostic criteria for future study in the DSM-5 (30), diagnostic criterion A "In the last year, the individual has, on 5 or more days, engaged in intentional self-inflicted damage" is stated. This also leads to diagnostic criterion C "thinking about NSSI that occurs frequently, even when it is not acted upon" and diagnostic criterion E "the behavior or its consequences cause clinically significant distress or interference in interpersonal, academic, or other important areas of functioning." The above criteria clearly relate to problems associated with repeated NSSI and not with NSSI as a one-off experience. The O-I effect in the NSSI group suggests deficits in task control abilities, as this group found it difficult to suppress the pressure induced from external objects found during daily goal-oriented behaviors, and experienced task confusion which hinders the original goal-oriented activities. This is in line with previous studies (7, 31), and thus, NSSI can be interpreted as a kind of behavioral addiction or compulsive behavior control problem.

Secondly, in the past DSM-IV-TR (32), OCD was classified as an anxiety disorder; trichotillomania (hair-pulling disorder) and excoriation disorder (skin-picking) as impulse control disorders;

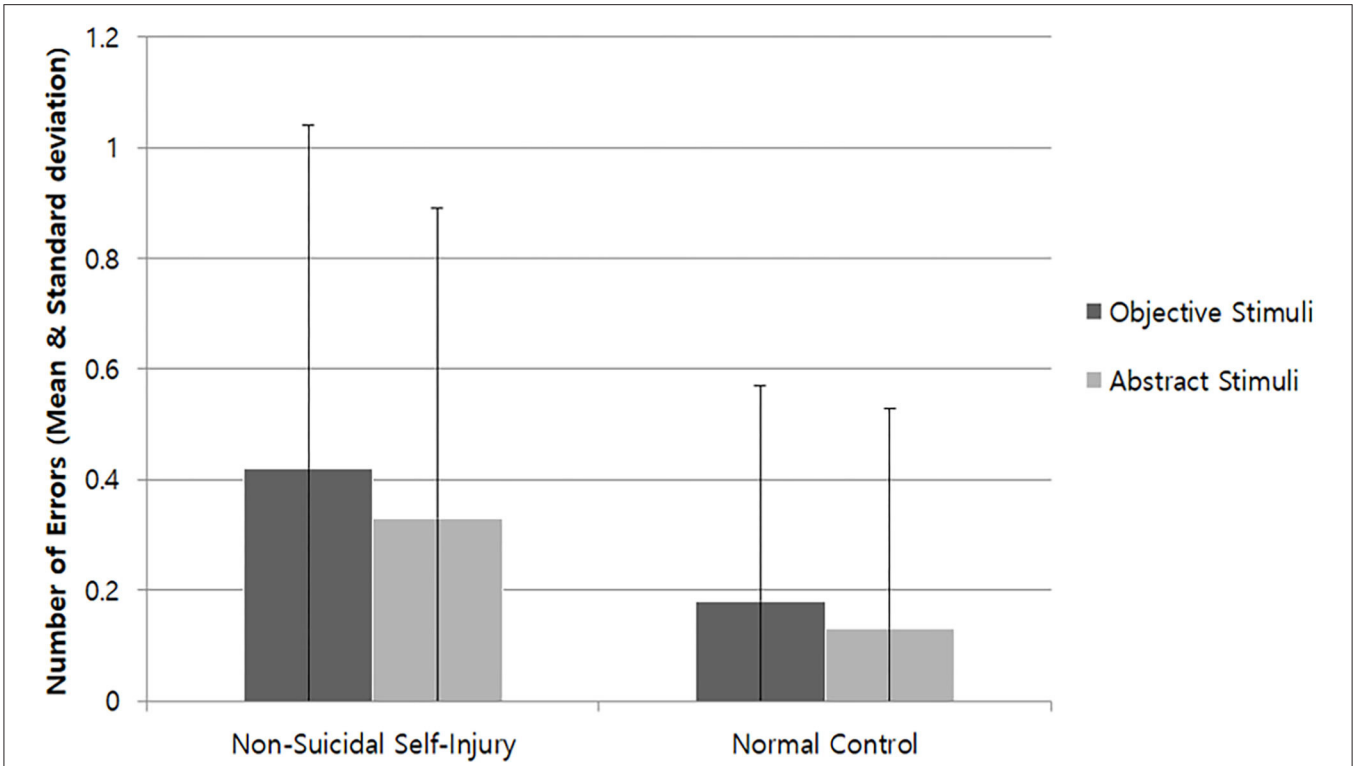

FIGURE 4 | Number of Errors of Block 3.

and NSSI behaviors as one of the symptoms for borderline personality disorder. However, during the transition to DSM-5 (30), disorders were re-classified based on accumulated findings, in consideration of clinical utility. OCD became independent from anxiety disorders to form obsessive-compulsive and related disorders, and trichotillomania and excoriation disorder were included here. This indicates grouping together of disorders characterized by "preoccupations and repetitive behaviors or mental acts in response to the preoccupations." Furthermore, NSSI was newly added under "conditions for further study," and it is mentioned that "when the behavior occurs frequently, it might be associated with a sense of urgency and craving, the resultant behavioral pattern resembling an addiction." Therefore, with reference to this study's results, it is appropriate to suggest that NSSI will be incorporated into obsessive-compulsive and related disorders that are mainly characterized by preoccupations and pressure of repeated behaviors, or into non-material related disorders in substance-related or addiction disorders, characterized by repeated behaviors and cravings.

With regards to treatment, Klonsky and Glenn (11) has suggested that the most effective method to resist NSSI impulses is to remove the means of NSSI (tools) frequently used at home. This of course makes it physically impossible to self-injure but can also serve to prevent task confusion between automatic NSSI impulses triggered by related objects from surroundings and ongoing everyday tasks. Those who engage in repeated NSSI often report that merely keeping self-injury tools within reach is enough to feel comfort, as they are related to functional factors of self-injury (reinforcing factors). However, keeping self-injury tools close will increase the risk of self-injurious behaviors. Of course, it is impossible to remove all objects that can be used for self-injury from patients (in absence of frequently used tools, they may break objects such as plastic to create new tools), and external control by family, etc. is not a fundamental method to stop and change self-injurious behaviors (33). Although, in early stages of treatment where it is difficult to control urges to repeat self-injury, it is necessary to guide the patients to understand that removing self-injury tools is effective in preventing self-injurious behaviors.

Furthermore, recent studies consider the media, the Internet, peer group, etc., as priming factors for SITBs (21, 34), which trigger pain perception, attention bias, attitudes, and acting out related to NSSI. Therefore, it is imperative to prioritize removal of e means of NSSI (tools) in the treatment of NSSI, as well as deliberation regarding dealing with NSSI related information on the Internet and the media.

NSSI tools were also presented in Block 3 as object stimulus for additional analyses, which was expected to cause greater task confusion. As a result, while the difference between the object stimulus and abstract stimulus for NSSI group was not significant, reaction times for the abstract stimulus were significantly longer than for the object stimulus in the control group. There was also an unusual number of errors which was more than twice as high for the NSSI group compared to the control group. As mentioned previously, error number is not a sensitive measure for reaction times in individuals with good

neurocognitive abilities, which was confirmed via non-significant error numbers for Blocks 1 and 2. Furthermore, it is notable that the overall reaction times in Block 3 were longer than Blocks 1 and 2. In this regard, considerations should be made to investigate how using NSSI tool stimulus in Block 3 may have affected the participants.

While objects such as a fruit knife, cutter knife, awl, scissors, etc., were presented as NSSI tool object stimuli, line pictures were used. This may have caused difficulties in perceiving the stimuli as threats or experiencing disgust on a conscious level. While it is difficult to predict the type of emotion induced from the object, it can be assumed that the stimuli may have had different emotional valence for the NSSI and control groups. In addition, since both participant groups were informed regarding the current study, it is possible that NSSI tools were perceived by similar attributes and functions, interfering with the performance due to ideological thinking.

As a result, both groups were hindered by neurocognitive performance, resulting in significantly longer reaction times. The unusual number of errors shown by the NSSI group reflects obvious cognitive mistakes, suggesting that the stimuli may have caused strong cognitive confusion in some way. Furthermore, the NSSI group showed significantly delayed reaction times for both NSSI tools and abstract stimuli, which may be due to strong cognitive confusion. For the control group, reaction times were unusually longer for abstract stimuli compared to NSSI stimuli, which is contrary to the O-I effect. This could be because there was a carry-over effect during a fast and simultaneous presentation of NSSI stimuli and abstract stimuli, producing mixed results. Of course, the NSSI tool stimuli in Block 3 is more of an exploratory investigation rather than based on sufficient theoretical background, therefore a more controlled research paradigm should be examined in the future, while supplementing for theoretical evidence.

The limitations of the current study are as follows. First, there is a sample limitation. The participants for this study were sampled through promoting the research in three universities in Seoul, therefore it is a somewhat limited representation of the entire population who experience NSSI. This study had the advantage of being able to achieve a homogeneous cognition level among participants as their neurocognitive abilities were measured. However, the participants are students from leading universities, who are presumably highly educated with high cognitive functioning limiting generalization. In addition, "those who reported serious NSSI that required medical treatment in the last month" were removed as per research ethics during sampling. This may limit generalization of the current results to those who experience serious levels of self-injury. Also, while most participants were experiencing repeated self-injury at the time, 12 participants were in full or partial remission (last NSSI within 4 years). Those currently repeating self-injuries and those who stopped self-injuries may create differences in their results. As it was difficult to compare their differences in the current study due to limited sample size, it needs to be considered in future studies.

Another limitation is that of the appropriateness of the NSSI tool stimulus used in Block 3. NSSI methods and tools that were used in the NSSI group were selected from previous studies (1, 11, 14), and this was not different from what the participants in the current study reported. For example, "cutting using a sharp object," "burning" were reported as the highest rate, therefore a cutter knife, scissors, awl, lit cigarette, etc., were used as object stimulus. However, individuals who experience NSSI have different methods and tools for frequent NSSI. Therefore, the specific NSSI tools presented may hold a special significance for certain participants compared to a general object stimulus, but this may not be true for other participants, thus obscuring the results. The results of this study show that the response patterns of the two groups in Blocks 1 and 2 compared to Block 3 were quite different, leaving much room for discussion. If NSSI tools familiar to each individual were selectively presented, or selectively used during result analyses, they would have had a more accurate interpretive meaning, which should be supplemented in subsequent studies.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Chung-Ang University Institution Review Board (No. 1041078-201801-HRSB-019-01K). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

SL: conceptualization, methodology, validation, formal analysis, investigation, data curation, writing-original draft. MH: supervision, project administration, writing-review, and editing. Both authors contributed to the article and approved the submitted version.

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HYPOTHESIS AND THEORY
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The Co-occurrence of Self-Harm and Aggression: A Cognitive-Emotional Model of Dual-Harm

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There is growing evidence that some individuals engage in both self-harm and aggression during the course of their lifetime. The co-occurrence of self-harm and aggression is termed dual-harm. Individuals who engage in dual-harm may represent a high-risk group with unique characteristics and pattern of harmful behaviours. Nevertheless, there is an absence of clinical guidelines for the treatment and prevention of dual-harm and a lack of agreed theoretical framework that accounts for why people may engage in this behaviour. The present work aimed to address this gap in the literature by providing a narrative review of previous research of self-harm, aggression and dual-harm, and through doing so, presenting an evidence-based theory of dual-harm – the cognitive-emotional model of dual-harm. This model draws from previous studies and theories, including the General Aggression Model, diathesis-stress models and emotional dysregulation theories. The cognitive-emotional model highlights the potential distal, proximal and feedback processes of dual-harm, the role of personality style and the possible emotional regulation and interpersonal functions of this behaviour. In line with our theory, various clinical and research implications for dual-harm are suggested, including hypotheses to be tested by future studies.

Keywords: dual-harm, co-occurrence, Suicide, self-injury, self-harm, assault, violence, aggression

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INTRODUCTION

Self-harm is an umbrella term that encompasses both suicidal behaviours (self-injury behaviour with intent to end one's life) and non-suicidal self-injury (NSSI; self-injury without intent to die). There is much debate in the literature as to whether it is meaningful to make a distinction between suicidal and non-suicidal forms of self-injury (Butler and Malone, 2013; Kapur et al., 2013). As with self-harm, aggression is variably defined within the literature. Aggressive behaviour may range in severity from minor acts (e.g., verbal aggression) to more serious acts (e.g., stabbing and killing).

While self-harm and aggression may initially seem distinct, research has consistently shown that these behaviours co-occur across various populations. The co-occurrence of self-harm and aggression during the course of an individual's lifetime has been termed "dual-harm" (Slade, 2019). There is emerging evidence to suggest that, compared to those who engage in self-harm alone or aggression alone ("sole-harm"), individuals who dual-harm may have distinct characteristics. These include greater levels of contextual and personal risk, and a riskier pattern

of harmful behaviours (Bortolato et al., 2013; Tang et al., 2013; O'Donnell et al., 2015; Terzi et al., 2017; Harford et al., 2018; Kottler et al., 2018; Slade, 2018; Richmond-Rakerd et al., 2019; Steeg et al., 2019; Carr et al., 2020; Slade et al., 2020). Such evidence has led researchers to hypothesise that, rather than self-harm and aggression simply co-occurring, dual-harm may be an independent construct that stands separate from sole-harm behaviour.

Despite empirical support for dual-harm, little research has investigated this construct. At the time of writing, there is a lack of an agreed theory that explains why individuals may engage in both self-harm and aggression. Given the high-risk profile shown by those who dual-harm, it is important that we develop our theoretical understanding of this behaviour. Doing so may provide support for considering dual-harm as a unique and independent clinically valid entity.

The present article aims to address the gaps in the literature by presenting a theoretical model of dual-harm, focusing on the cognitive and emotional aspects of this behaviour. First, we will provide a narrative review of previous research of self-harm, aggression and dual-harm, with a particular focus on psychological factors. Subsequently, the paper will draw from this review to propose a cognitive-emotional model of dual-harm that accounts for why individuals may engage in both aggression and self-harm during the course of their lifetime.

To provide a comprehensive review of self-injury behaviour, and given that much research has not identified suicidal intent, the present paper will draw from the broader self-harm literature (i.e., self-injury irrespective of intent to end life). Furthermore, we will define aggression according to its most common definition within social psychology and aggression research: "any behaviour directed toward another individual that is carried out with the proximate (immediate) intent to cause harm. . .the perpetrator must believe that the behaviour will harm the target, and that the target is motivated to avoid the behaviour" (Anderson and Bushman, 2002, p. 28). The above definition encapsulates all forms of aggression, regardless of severity of intent. This definition will be adopted given its demonstrated utility in the development and testing of aggression theories, as well as evidence that similarly defined behaviours have comparable aetiologies (Allen and Anderson, 2017). Our work will inform future research of dual-harm by providing testable hypotheses for further investigation and therefore, help to extend our understanding of this behaviour.

SELF-HARM

Emotional Regulation

Emotional dysregulation has gained great support as a core component of self-harm. This construct has been defined differently across the literature, reflecting its various conceptualisations. Our paper will adopt Gratz and Roemer's (2004) definition which highlights the functionality of all emotions. According to Gratz and Roemer, emotional regulation is the "(a) awareness and understanding of emotions, (b) acceptance of emotions, (c) ability to control impulsive behaviours and behave in accordance with desired goals when experiencing negative emotions, and (d) ability to use situationally appropriate emotional regulation strategies flexibly to modulate emotional responses as desired in order to meet individual goals and situational demands" (Gratz and Roemer, 2004, p. 42). The absence of any of these components would indicate emotional dysregulation (Gratz and Roemer, 2004). The above definition has been shown to be clinically useful, with research demonstrating a relationship between the emotional regulation components and harmful behaviours (Gratz, 2007; Peh et al., 2017; Velotti et al., 2020; Yeo et al., 2020).

Studies have consistently found that individuals who engage in self-harm have greater levels of emotional dysregulation compared to those who do not (Weiss et al., 2015; Taylor et al., 2018). Taylor et al. (2018) conducted a meta-analysis of 46 studies investigating the functions of NSSI, including emotional regulation. The review found that emotional regulation was the most common function of NSSI, with 63–78% of participants reporting it as the function of their behaviour. The role of emotional dysregulation in self-harm has been demonstrated across community, clinical and forensic samples, providing strong support for the generalisability of findings (Dixon-Gordon et al., 2012; Andover and Morris, 2014). For example, Borderline Personality Disorder (BPD) is characterised by instability in interpersonal functioning, cognitions, affect, and impulsivity (American Psychiatric Association, 2000). It has been suggested that emotional regulation is a central component of self-harm in BPD (Putnam and Silk, 2005). The above hypothesis may be supported by findings that interventions targeting emotional regulation in BPD reduce the frequency of self-harm (Rizvi et al., 2016; Sahlin et al., 2017a; Wetterborg et al., 2020). Such research suggests that emotional dysregulation may be a key causal pathway underlying self-harm in those with psychopathology.

Given the strong evidence, the most recognised theories of self-harm highlight emotional regulation as the core function of this behaviour (Hasking et al., 2017). The exact mechanism of how emotional regulation operates in self-harm varies across theories. For example, Hasking et al. (2017) suggested a cognitive-emotional model of NSSI, where individuals with emotional dysregulation and maladaptive cognitions are more likely to use NSSI to modulate emotionally negative situations. Alternatively, Chapman et al.'s (2006) experiential avoidance theory (**Figure 1**) suggests that emotional dysregulation, combined with a negative emotional experience, may lead to the use of self-harm as temporary relief from undesired situations or emotions. This relief may reinforce self-harm behaviour, causing the development of self-harm into a repeated classical conditioned response to negative emotions. While the exact processes in the above theories may vary, their shared conclusion remains: emotional regulation is a key function of self-harm, used as a response to negative feelings.

Adverse Events

Research has provided evidence for the role of early environmental mechanisms in self-harm. These include

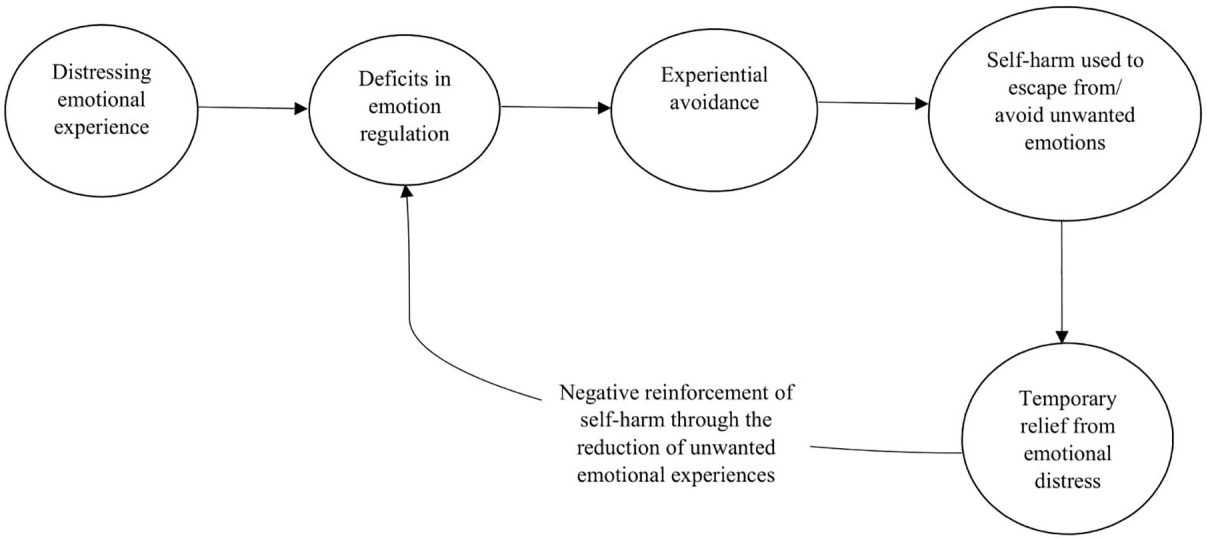

FIGURE 1 | Experiential avoidance theory of self-harm. This figure provides a simplified illustration of the experiential avoidance theory of self-harm. As highlighted, deficits in emotional regulation may contribute to an individual using experiential avoidance as a response to distressing emotional experiences. Here, experiential avoidance refers to attempts to avoid distressing emotions, even when such attempts may cause harm to the individual. According to the theory, the individual may use self-harm as an experiential avoidance strategy to escape from or avoid their unwanted emotions. Self-harm may provide the individual with temporary relief from their emotional distress, thus leading to negative reinforcement of their self-harm. This negative reinforcement feeds back into the person's emotional regulation deficits, thus repeating the cycle of experimental avoidance and maintaining the use of self-harm.

bullying, familial dysfunction and peer rejection, and most notably, negative childhood experiences within the family, such as emotional neglect and abuse (Fliege et al., 2009; Di Pierro et al., 2012; Swannell et al., 2012; Esposito et al., 2019). For example, Fliege et al. (2009) systematically reviewed 59 studies examining the distal and proximal risk-factors of NSSI. The most frequently reported risk-factor was childhood trauma, including emotional neglect and psychological and physical abuse.

To account for how early adverse factors may lead to self-harm, diathesis-stress models suggest that they interact with biological factors to develop certain personality traits and cognitive styles, including impaired self-regulation and decision-making (Brodsky, 2016). These increase an individual's risk of engaging in self-harm in response to a stressor (Brodsky, 2016). On the other hand, the Interpersonal Theory of Suicide (Joiner, 2007; Van Orden et al., 2010) proposes that the desire to engage in suicidal behaviours occurs when an individual experiences perceived burdensomeness and thwarted belongingness. An individual acts on this desire when they have the capability to engage in suicidal behaviour. It has been suggested that adverse childhood events (e.g., physical or sexual abuse) may lead to both the desire and capability to engage in suicidal behaviour, therefore increasing the risk of self-harm (Van Orden et al., 2010).

Interpersonal Functions

Although intrapersonal functions, such as emotional regulation, are the most frequently reported reason for NSSI (Klonsky, 2009; Saraff and Pepper, 2014; Taylor et al., 2018), there is evidence that this harmful behaviour may also serve interpersonal functions (e.g., establishing autonomy, communicating distress; Hilt et al., 2008; Muehlenkamp et al., 2013; Sadeh et al., 2014; Gardner et al., 2016; Taylor et al., 2018). For example, Gardner et al. (2016) examined NSSI in offenders and found that 73% of individuals reported an interpersonal function for their NSSI, such as creating a boundary from others and seeking help. Such findings highlight that theories should consider the interpersonal and intrapersonal motivations of self-harm, as well as the social context in which they occur.

AGGRESSION

Adverse Events

As with self-harm, a range of environmental factors have been associated with aggression (Mendes et al., 2009). Mendes et al.'s (2009) systematic review revealed that familial dysfunction, poverty, family criminality, and educational underachievement are significant risk-factors for aggression. Studies have particularly provided support for the role of negative childhood experiences within the family, such as abuse, harsh discipline and early neglect, in aggression (Lansford et al., 2007; Duke et al., 2010; Topitzes et al., 2012; Milaniak and Widom, 2015). Duke et al.'s (2010) prospective study of 135,549 students found that early adverse experiences (e.g., physical abuse, sexual abuse, and household dysfunction) were significantly associated with aggression in adolescence. For each type of adverse event reported by participants, the estimated risk of violence increased from 35 to 144% (Duke et al., 2010).

Numerous processes, in particular, biological mechanisms, have been proposed to underlie the pathway from early aversive experiences to aggression. These experiences have been

suggested to interact with genetic predisposition to increase an individual's vulnerability to aggression (Byrd and Manuck, 2014). For example, the MAOA gene has been found to moderate the influence of childhood maltreatment on aggression, suggesting that gene-environment interactions play a role in this behaviour (Byrd and Manuck, 2014). Furthermore, diathesis-stress models suggest that early adverse events interact with genetic mechanisms to develop an antisocial personality style. This personality style increases an individual's risk of using aggression in response to a stressor (Ferguson et al., 2008). As well as influencing personality, researchers have highlighted the effect of negative childhood experiences on emotional functioning. Such experiences have been shown to be significantly associated with impairments in emotional processes, including emotional regulation, emotional reactivity and emotion recognition (Pechtel and Pizzagalli, 2011). These impairments may increase the likelihood of engaging in aggression in response to stressful stimuli (Fox et al., 2015).

Personality

Personality traits, including emotional reactivity, impulsivity and neuroticism, have been significantly linked to aggression (Ramirez and Andreu, 2006; Jones et al., 2011). Psychopathy is a personality style characterised by interpersonal, affective, behavioural, and antisocial characteristics, as well as a disregard for other people's rights and societal norms (Hare, 1996). Psychopathy has been found to be one of the strongest dispositional factors associated with aggression, including its most stable and violent patterns, across community, clinical and forensic populations (Neumann and Hare, 2008; Forsman et al., 2010; Blais et al., 2014; McCuish et al., 2015; Gray and Snowden, 2016). A meta-analysis of 53 studies found that psychopathy was significantly associated with instrumental and reactive violence, with moderate effect sizes ($r = 0.36$, $r = 0.35$, respectively; Blais et al., 2014). Furthermore, biological studies have demonstrated that individuals with psychopathy show unique neurobiological patterns associated with persistent aggression, including differences in their brain's function and structure (Gregory et al., 2012). Given the consistent evidence for psychopathy as a key mechanism for aggression, measures of this personality are often utilised in risk-assessments for violence and recidivism within forensic settings (Viljoen et al., 2010).

Emotional Regulation

Emotional regulation has been argued to be a function of aggression, with significant positive associations reported between emotional dysregulation and aggression amongst adults and adolescents (Davidson et al., 2000; Cohn et al., 2010; Roberton et al., 2012). Moreover, individuals who engage in aggression have been found to show differences in their brain's central circuitry that is responsible for emotional regulation (Davidson et al., 2000). Roberton et al. (2012) suggested that emotional regulation may lead to aggression due to either under-regulation or over-regulation. Under-regulation refers to when an individual fails to sufficiently contain their difficult emotional experience and prevent impulsive behaviours. Such under-regulation may occur through increased negative affect and physiological arousal, decreased inhibitions against harmful behaviours and impaired decision-making, causing the individual to be aggressive. Alternatively, over-regulation occurs when regulation strategies are used to stop an emotional experience from occurring. An individual may use aggression to suppress and avoid their own emotional experience by directing harm toward others.

Individuals with psychopathy have been shown to have high levels of emotional dysregulation (Casey et al., 2013; Donahue et al., 2014; Garofalo et al., 2018). Donahue et al. (2014) investigated emotional regulation in 119 adults, comprised of undergraduate students and offenders referred to outpatient anger management programmes. Psychopathy scores in participants were significantly associated with subscales within the Difficulties in Emotion Regulation Scale ($r = 0.30$, $p < 0.01$), including non-acceptance of emotions ($r = 0.23$), impulse control difficulties ($r = 0.35$) and lack of emotional clarity ($r = 0.26$). Such findings highlight the importance of investigating the position of emotional dysregulation upon the causal pathway to aggression in personality styles such as psychopathy.

General Aggression Model

One of the most widely accepted theories of aggression is the General Aggression Model (GAM; 15; **Figure 2**). The GAM is predominantly a social cognitive theory that divides the pathway to aggression into two processes: proximal factors (i.e., those that operate in the current state) and distal factors (i.e., those that occur over a long period of time). Distal factors, specifically, biological and environmental modifiers, combine to influence proximal factors. These proximal factors then lead to aggression through three stages: inputs, routes, and outcomes. These stages highlight the role of personal and situational related factors, as well as emotional and cognitive processes. The GAM highlights that the behavioural outcome of aggression impacts the environmental response and feeds back into the person and situation related factors through learning mechanisms, thus perpetuating the model's process (Anderson and Bushman, 2002). According to the model, each stage may be considered a learning trial in which aggression-related knowledge structures are reinforced.

Although there is wide support for the GAM, the model has been subject to criticism (Ferguson and Dyck, 2012). The GAM focuses on the role of cognitive processes in aggression, in particular knowledge structures (Anderson and Bushman, 2002). Whilst the model includes the role of evidence-based biological, environmental, social, affective, and personality related factors, these are largely discussed in relation to how they link to cognitive mechanisms. Consequently, the GAM may be considered to be an inadequate or incomplete account as it views aggression through a particular lens. To provide a comprehensive framework for aggression, a more integrated understanding of this behaviour may be required.

Diathesis-Stress Theories

Diathesis-stress theories of aggression may address some limitations of the GAM. These theories emphasise that individual

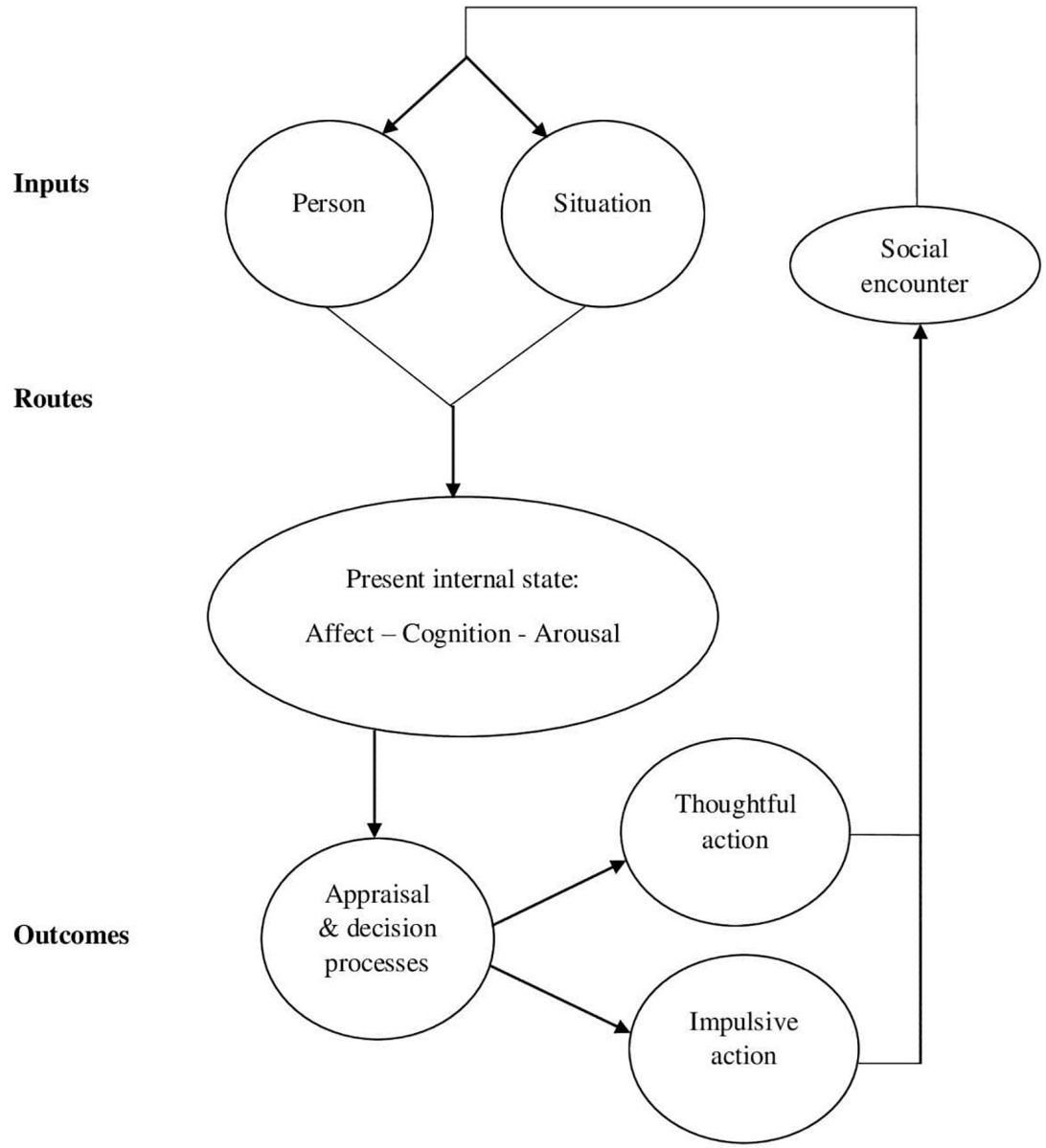

FIGURE 2 | General Aggression Model. This figure highlights the proximal process of aggression in the General Aggression Model. The proximal process occurs in three stages: Inputs, routes, and outcomes. First, in the input stage, person-related factors and situations act as inputs which, in the routes stage, activate certain emotions, cognitions and arousals in the individual. The person's internal state then affects appraisal and decision-making processes in the outcome stage, leading to them engaging in either a thoughtful action or impulsive action, such as aggression. This behavioural outcome impacts the individual's social encounter and feeds back into person and situation related factors through learning mechanisms, thus perpetuating the model's process.

differences in biological, personality and environmental related factors combine to lead to aggression. For example, the Catalyst Model (Ferguson et al., 2008) proposes that if an individual has been exposed to early adverse environmental factors, their genetic predisposition to aggression is more likely to lead to an aggressive personality style. The Catalyst Model highlights that individuals with such personality styles are then more likely to engage in aggression when they experience environmental stress. Support for the Catalyst model is provided by evidence for the role of stress and gene × environmental interaction effects on aggression, as well as findings that this model is a stronger predictor of aggression than the GAM (Ferguson et al., 2008; Ferguson and Dyck, 2012).

Social Determinants

Despite evidence for the diathesis-stress model and GAM, these theories do not elaborate on the specific social contextual mechanisms that may provoke or minimise aggression. Situational and social contextual factors, such as social threat, social identity, peer status, and nature of the perpetrator's

and target's relationship, have been found to be associated with aggression (Prinstein and Cillessen, 2003; Goldstein and Tisak, 2004; Coccaro et al., 2007; Richardson and Hammock, 2007; Faris and Ennett, 2012; Graham et al., 2013). Given such findings, researchers have highlighted that aggression may be interpersonally motivated and it is imperative that we consider this behaviour in the social context within which it is perpetrated (Prinstein and Cillessen, 2003; Richardson and Hammock, 2007).

DUAL-HARM

Research has widely distinguished self-harm from aggression, approaching these behaviours as two distinct constructs. Such separation may be a reflection of the contrasting perceptions surrounding harmful behaviours. Aggression is often seen as an unreasonable act in which an individual offends against others, consequently leading to a reactive response, typically in the form of containment and punishment orientated strategies (Slade, 2019). In contrast, self-harm is perceived as a sign of distress and an act against the self, which is more likely to elicit a care-giving response (Slade, 2019). Despite their historic separation, there is increasing evidence that self-harm and aggression are linked and co-occur. Furthermore, research has found that these behaviours are associated with common risk-factors, such as negative childhood experiences, impulsivity, impairments in emotional functioning, and genes related to dysfunctional serotonergic systems (Boxer, 2010; Bortolato et al., 2013; O'Donnell et al., 2015; Jordan and Samuelson, 2016; Sahlin et al., 2017b; Terzi et al., 2017).

The co-occurrence of self-harm and aggression, and the link between these two behaviours, has consistently been shown within community, clinical, forensic, adult, and adolescent samples. O'Donnell et al.'s (2015) systematic review of 23 studies found that the prevalence of aggression in those who had self-harmed exceeded 20% in most studies, with the highest reported prevalence rate being 74%. Moreover, in 23 studies that examined the association between harmful behaviours, most reported a significant positive correlation between self-harm and aggression ($r = 0.12$–0.62). The researchers also reviewed 24 studies that had not selected their sample for either harmful behaviour. In most studies, the prevalence rate of co-occurring self-harm and aggression exceeded 15%, with the highest prevalence rate being 47%. Furthermore, individuals who engaged in one of the harmful behaviours were significantly more likely to engage in the other behaviour (*odds ratio* = 1.05–38.55). Given that O'Donnell et al. (2015) reviewed studies across various populations, settings, designs, measurements, and data, their findings suggest that self-harm and aggression co-occur and are linked independently of methodological differences.

Richmond-Rakerd et al.'s (2019) 20-year cohort study of 2,049 twins within the general population in the United Kingdom provided further support for the co-occurrence of self-harm and aggression. 4.7% of participants reported to have previously engaged in both self-harm and violent crime. Furthermore, the risk of committing a violent crime was more than three times greater in those who had engaged in self-harm, compared to those who had not (*odds ratio* = 3.50). This association remained significant when only police records (*odds ratio* = 3.26) and only self-reports of violent crime (*odds ratio* = 3.50) were used, suggesting that the association between self-harm and aggression is not simply a reflection of assessment methods.

To date, the largest population-based investigation of dual-harm is Sahlin et al.'s (2017b) longitudinal cohort study of 1,850,525 individuals from the general population. During the average follow-up time of 8.1 years, 0.4% of the total sample had been in contact with healthcare due to self-harm and convicted of a violent crime. Specifically, 14.8% of self-harming patients had previously been convicted of a violent crime. After adjusting for psychiatric comorbidity, this represented a two-fold risk of having a conviction of violent crime amongst self-harm patients, in comparison to those who had not been in contact with healthcare due to self-harm.

While aggression is present amongst a third of those who have engaged in self-harm in community samples (O'Donnell et al., 2015), this figure has been reported to rise to over half within clinical and forensic samples (Plutchik et al., 1989; Slade, 2018; Slade et al., 2020). Slade et al. (2020) investigated harmful behaviours in 965 male prisoners in England using official HM Prison Service data. Results revealed that 11% of prisoners had engaged in dual-harm. Furthermore, there was a significant positive correlation between self-harm and aggression ($r = 0.258$), with 60% of those engaging in self-harm, having also engaged in aggression. This represented an almost fourfold increased risk of aggression for those with a history of self-harm, compared to those who had not engaged in self-harm (*odds ratio* = 3.81, $p < 0.001$). In another study of 326 prisoners from two prisons in England, it was found that up to 42% of prisoners who had engaged in aggression, had also engaged in self-harm (Slade, 2018). Moreover, Daffern and Howells (2009) examined harmful behaviours in 41 patients within a high-security personality disorder hospital. Results revealed that 46% of patients engaged in dual-harm during their stay at the hospital. The above studies suggest that rather than engaging in sole-harm behaviour, many high-risk individuals within forensic and clinical populations will engage in dual-harm.

A Unique Clinical Construct?

There is growing evidence that compared to those who engage in sole-harm, individuals who dual-harm may be distinguished by unique characteristics and show a riskier pattern of harmful behaviours (**Figure 3**). For example, Slade et al.'s studies (Slade, 2018; Slade et al., 2020) found that offenders with a history of dual-harm spent a significantly longer time in prison (on average, 40% longer) than those who had sole-harmed. This group also contributed to a higher rate and wider range of aversive prison incidents (e.g., arson and property damage) and were more likely to use a wider range and more lethal methods of self-harm (e.g., overdose).

Such unique characteristics have further been shown within community and clinical samples (Tang et al., 2013; O'Donnell et al., 2015; Harford et al., 2018; Carr et al., 2020). Boxer (2010) investigated dual-harm amongst 476 inpatients in a secure youth mental health service. Compared to the sole-harm group,

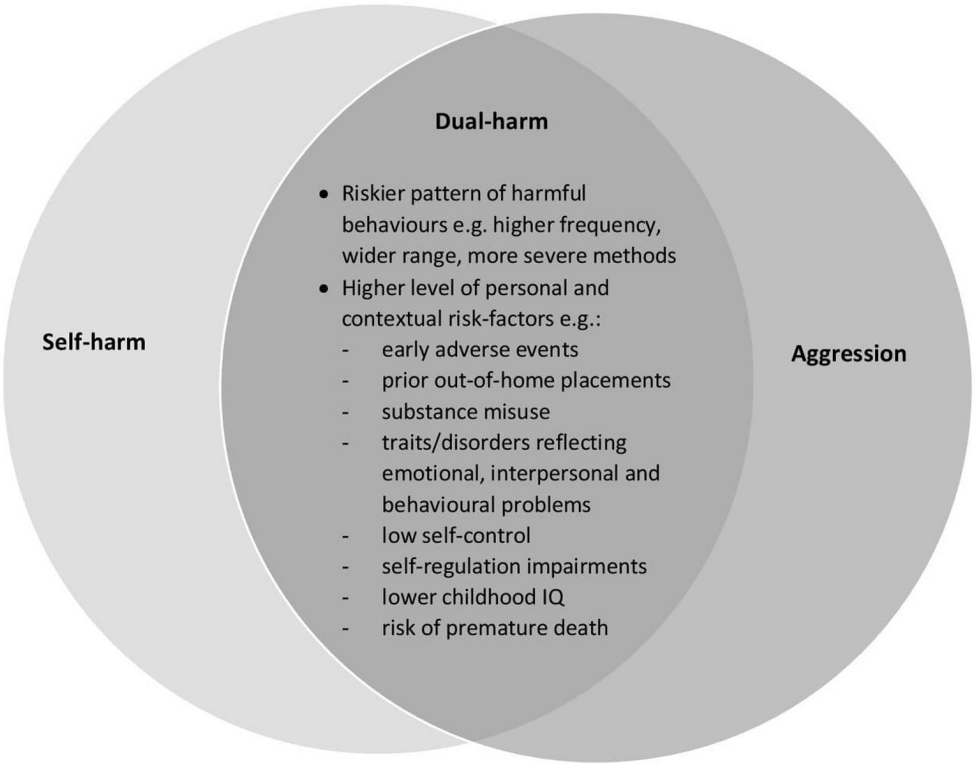

FIGURE 3 | Potential distinct profile of dual-harm. This Venn diagram highlights the potential mechanisms that may distinguish dual-harm as a separate clinical entity from the behaviours of self-harm alone and aggression alone. According to previous research, compared to those who engage in sole-harmful behaviours, individuals who have a history of dual-harm are significantly more likely to engage in a higher frequency of harmful behaviours, as well as a wider range and more severe methods of risky behaviours. Furthermore, these individuals have been found to have higher levels of personal and contextual risk-factors. Such higher levels of risk in those who dual-harm may be an important factor that distinguishes dual-harm from the sole-harm behaviours of self-harm and aggression.

the dual-harm group were significantly more likely to show personal and contextual risk across different factors, including physical, sexual and emotional abuse, neglect, age of aggression onset, prior out-of-home placements (e.g., hospitalisation and foster care), and emotional and behavioural disorders. Finally, the dual-harm group showed high continuity in their harmful behaviours from before treatment to during treatment, with 74% exhibiting both self-harm and aggression during treatment, and 97% showing either self-harm or aggression. Boxer (2010) outlined the potential importance of such findings, highlighting that harmful behaviours shown by those with a history of dual-harm may persist over time. As such, clinicians may be able to predict with greater certainty that individuals who enter mental health treatment with a history of dual-harm will likely engage in harmful behaviours during their stay.

Richmond-Rakerd et al.'s (2019) study demonstrated that individuals with a history of dual-harm may have a distinct personality style. Compared to those who had a history of sole-harm, individuals who had dual-harmed were significantly more likely to have traits relating to emotional and interpersonal liability ($d = -0.15$ to -0.06), as well as problems with self-control and self-regulation (*odds ratio* = 1.82). They were also more likely to have lower childhood IQ, which the researchers suggested indicates impairments in executive functioning. Additionally, the dual-harm group were more likely to have experiences of childhood maltreatment (*odds ratio* = 2.46) and adolescent victimisation (*odds ratio* = 2.40). As with Slade et al.'s (Slade, 2018; Slade et al., 2020) research, these individuals also demonstrated more lethal self-harm (e.g., hanging) and aggressive behaviours. The above studies are supported by findings that, in comparison to sole-harm, individuals who dual-harm are significantly more likely to exhibit traits reflecting emotional and interpersonal liability, self-regulation impairments, substance misuse disorders, greater risk of premature death (*incidence rate ratio* = 29.37), have experienced early adverse events, and show a more severe, frequent and wider range of harmful behaviours (Bortolato et al., 2013; Tang et al., 2013; O'Donnell et al., 2015; Terzi et al., 2017; Harford et al., 2018; Kottler et al., 2018; Slade, 2018; Steeg et al., 2019; Carr et al., 2020; Slade et al., 2020).

In the context of dual-harm, it may be that, rather than only co-occurring, self-harm and aggression possess common vulnerabilities, causal pathways and functionality. If this is the case, individuals who engage in harmful behaviours may be categorised into the following groups: *self-harm alone, aggression alone,* and *dual-harm*, each with a distinct risk-profile and patterns of behaviour. Accordingly, management of dual-harm may benefit from tailored approaches that address

the distinct needs of this potentially unique high-risk group. Nevertheless, there is currently no national clinical guidelines for the prevention, management and treatment of dual-harm, reflected by the lack of literature in this area. The National Institute of Health and Care Excellence (NICE) provides separate guidance for aggression and self-harm, with no guidelines for those who engage in both behaviours (National Institute of Health Care Excellence, 2011; National Institute of Health Care Excellence, 2015). For example, within the NICE guideline for aggression (National Institute of Health Care Excellence, 2015), self-harm is only mentioned to highlight the lack of evidence of this behaviour as a risk-factor for aggression.

Although evidence points to the notion that those who dual-harm represent a unique high-risk group, we still have limited understanding of this behaviour. There is a need to investigate whether dual-harm should be considered and treated separately from sole-harm behaviours. Furthermore, previous literature has not offered a definition of dual-harm that specifies how close in time self-harm and aggression must co-occur (Slade, 2018, 2019; Slade et al., 2020). According to working definitions, an individual may self-harm and be aggressive at different points during their lifetime, and this would be considered dual-harm. However, should an individual who has repeatedly self-harmed and been aggressive throughout their lifetime be categorised in the same group as someone who has self-harmed once during adolescence and then been aggressive years later? It may be appropriate to suggest that self-harm and aggression should co-occur within a certain window of time for the behaviour to be considered as dual-harm. Research should explore the impact of adopting different criteria for the definition of dual-harm in order to identify a clinically useful assessment of this behaviour.

A COGNITIVE-EMOTIONAL MODEL OF DUAL-HARM

Based on our narrative review of previous literature, we propose a cognitive-emotional model of dual-harm (**Figure 4**). This model draws from components of the GAM and diathesis-stress theories by highlighting the potential distal, proximal and feedback processes of dual-harm, as well as the key role of personality. Furthermore, we propose that emotional regulation and interpersonal motivations are the main functions of this behaviour. The different mechanisms of our cognitive-emotional model of dual-harm are summarised below.

Distal Processes

Akin to the GAM, our model comprises two main processes: distal and proximal. While the distal processes indirectly inform a vulnerability toward dual-harm over a period of time, proximal processes more directly lead to the occurrence of this behaviour.

Personality

Personality-related factors, specifically, traits associated with emotional and interpersonal liability, have been shown to be distinguishing features in those who dual-harm (Richmond-Rakerd et al., 2019). Furthermore, research has shown that personality is associated with distinct levels of stress and coping strategies. For example, those with maladaptive personality traits, such as neuroticism, are more likely to use avoidant coping strategies (e.g., escape avoidance or self-blame), which may often lead to harmful behaviours (Afshar et al., 2015; Zainah et al., 2019). Individuals with maladaptive traits have also been shown to be more likely to experience stress and negative emotions (Vollrath and Torgersen, 2000; Zainah et al., 2019). Such findings suggest that an individual's personality is linked to the level of emotional distress they experience, as well as the strategies they use to respond to such distress. Accordingly, in line with the GAM and diathesis-stress theories that highlight the important role of personal-related factors, our model proposes that a personality style that predisposes individuals to emotional and interpersonal liability, maladaptive coping strategies and harmful behaviours, may be a key distal component of dual-harm.

Secondary psychopathy may be a personality style that increases the likelihood of an individual engaging in dual-harm. This construct is a variant of psychopathy (the other being primary psychopathy), characterised by traits associated with an antisocial and unstable lifestyle (Hare, 2016). These include high impulsivity, poor anger control, sensation seeking, irresponsible behaviour, emotional instability, and antisocial behaviours (Hare, 2016). When conceptualised into its two variants, secondary psychopathy, but not primary psychopathy, has been linked to both self-harm and aggression (Douglas et al., 2006; Hicks et al., 2010; Smith et al., 2014; Pennington et al., 2015). Such findings may be attributed to the traits of secondary psychopathy that may make individuals more vulnerable to both harmful behaviours. For example, compared to primary psychopathy, individuals with secondary psychopathy have been found to have significantly higher levels of emotional distress, impulsivity, violent and criminal behaviour, mental health problems, substance abuse, victimisation, and poorer levels of behavioural control and interpersonal functioning (Skeem et al., 2007; Vaughn et al., 2009; Hicks et al., 2010). In our cognitive-emotional model, we suggest that personality style may be a key distal pathway to dual-harm. This is due to the emotional, cognitive and arousal characteristics of the personality, such as those of secondary psychopathy, which may form a predisposed vulnerability to both self-harm and aggression.

While we specify the role of secondary psychopathy, our model may be extended to other personality styles that are vulnerable to harmful behaviours and possess similar traits. For example, many characteristics of secondary psychopathy overlap with BPD symptoms, including impulsivity, emotional distress and low behavioural control. Research has also shown that these constructs are significantly linked to one another (Skeem et al., 2007; Miller et al., 2010). Therefore, our model may apply to other personality constructs, such as BPD, that relate to its various theoretical components.

Biological and Environmental Factors

Compared to those who sole-harm, individuals who engage in dual-harm have been found to be significantly more likely to have experienced early adverse life experiences (Richmond-Rakerd et al., 2019; Carr et al., 2020). Studies have also found that those with a history of dual-harm engaged in their first act of

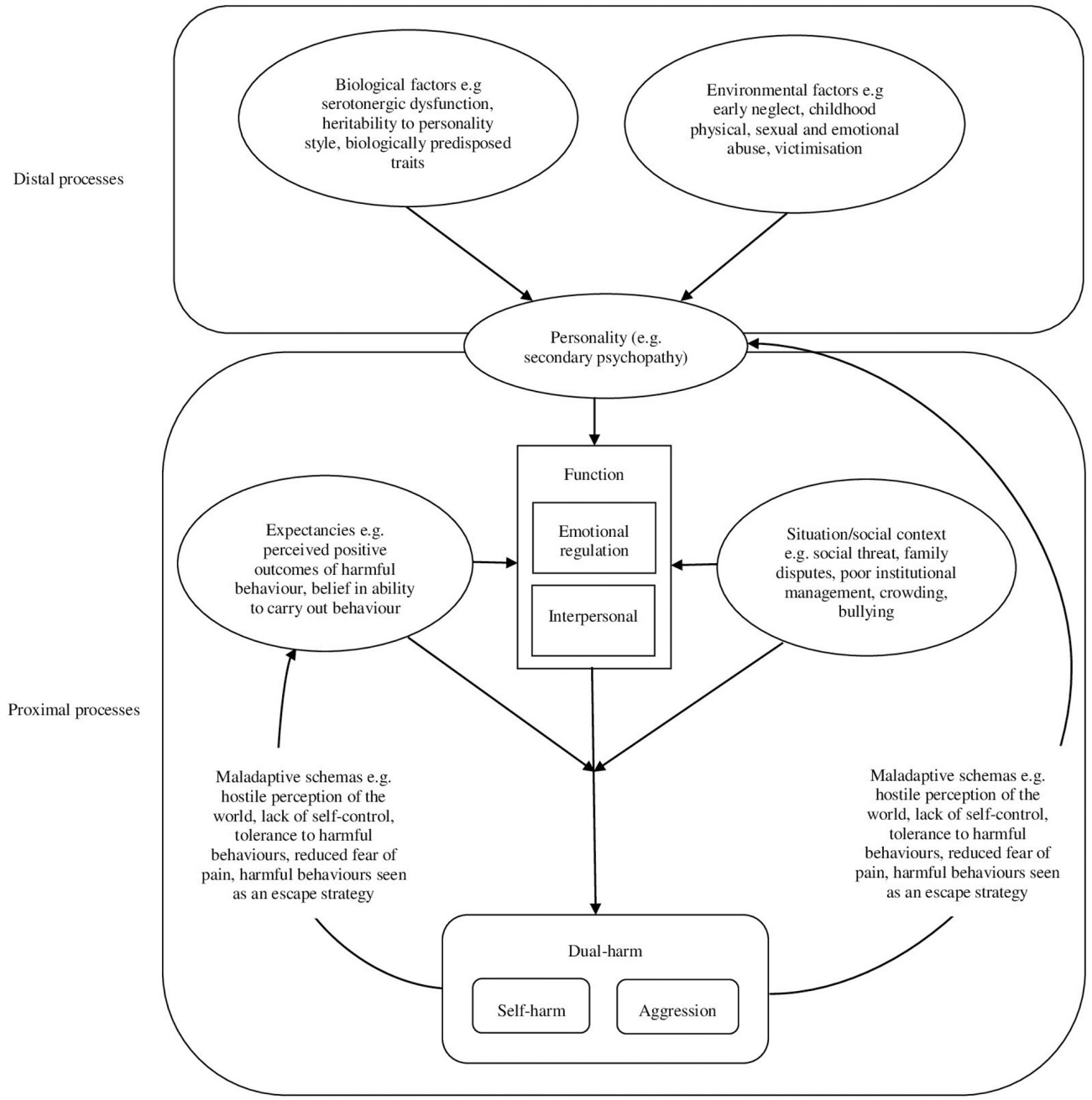

FIGURE 4 | The cognitive-emotional model of dual-harm. This figure illustrates the cognitive-emotional model of dual-harm. Here, the causal pathways to dual-harm are divided into two main processes: distal and proximal. In the distal processes, biological and environmental factors combine to develop a certain personality style. Through its effects on cognition, arousal and affect, this personality style facilitates the proximal processes of dual-harm by predisposing the individual to harmful behaviours. In the proximal processes, the social context/situation the individual is in and their expectancies of harmful behaviours influences the function of their dual-harm behaviour (i.e., emotion regulation or interpersonal motivation), as well as the specific harmful behaviour that they choose to engage in (i.e., self-harm or aggression). Specifically, the individual may choose to engage in dual-harm as an emotional regulation response to their distressing negative emotions. Alternatively, they may choose to engage in dual-harm to fulfil an interpersonal function. Finally, the outcome behaviour affects the environmental response and individual's experience. Through learning processes, this response may reinforce the individual's maladaptive schemas and feed back into their personality traits and expectancies, thereby repeating the process of dual-harm.

harmful behaviour earlier than those who engaged in sole-harm (Slade et al., 2020). These findings have been attributed to the notion that initiation of harmful behaviours may begin at an earlier stage for those who dual-harm, given that they are more likely to have experienced early adverse life events (Slade et al., 2020).

In consideration of such findings, our cognitive-emotional model of dual-harm suggests that in addition to personality, biological and environmental factors may also underpin the distal process of this behaviour. Similar to the GAM and diathesis-stress theories, we propose that adverse environmental factors, notably negative childhood experiences, interact with predisposed biological factors to develop a personality style that is vulnerable to dual-harm. Support for the above notion may be provided by research that has shown that a combination of early aversive environmental and genetic factors interact to develop harmful behaviours and personality style, including secondary psychopathy (Bakermans-Kranenburg and Van Ijzendoorn, 2006; Beaver et al., 2011; Belsky and Beaver, 2011; Althoff et al., 2012; Waldman et al., 2018). Additionally, biologically predisposed traits that are linked to harmful behaviours, such as irritability, have been proposed to only result in aggression prone personality styles when the individual is exposed to early aversive environments (Beauchaine et al., 2009). These findings suggest that biological and environmental factors may combine to influence each other's pathway to a personality style that is vulnerable to harmful behaviours, such as secondary psychopathy.

Proximal Processes

Emotional Regulation

While personality may cause a predisposition to dual-harm, it is important to consider why an individual may choose to engage in this behaviour. As mentioned, self-regulation may be a distinctive characteristic in those with self-harm and aggressive behaviours (Tang et al., 2013; Richmond-Rakerd et al., 2019). Therefore, it could be that emotional dysregulation theories of self-harm may be extended to dual-harm. In the context of dual-harm, self-harm and aggression may be utilised interchangeably as an emotional dysregulation response to negative emotions. This may occur through over-regulation, in which an individual suppresses their emotional experience by engaging in dual-harm to provide themselves with more perceived tolerable emotions and sensations. Alternatively, emotional dysregulation may occur through under-regulation, in which the individual is unable to use the necessary regulation strategies to sufficiently contain their intense emotional experiences and control their behaviour. Consequently, they fail to inhibit impulsive behaviours and to engage in goal-directed behaviour, thereby leading to dual-harm.

Emotional dysregulation has been implicated in the relationship between psychopathy and harmful behaviours (Long et al., 2014). Therefore, our model suggests that personality constructs that are vulnerable to emotional dysregulation and harmful behaviours, such as secondary psychopathy, may increase an individual's risk of using dual-harm as an emotional regulation response to their negative emotions. This response may occur through under-regulation or over-regulation of emotional experiences.

Interpersonal Functions

In certain situations, it may be that dual-harm serves an interpersonal function. As previously mentioned, harmful behaviours have been found to be influenced by social contextual factors and motivated by interpersonal reasons, such as establishing autonomy or responding to grievance. Furthermore, previous research has demonstrated that self-harm and aggression are associated with increased reactivity to socially adverse situations and impaired value-based decision-making (Coccaro et al., 2007; Richard-Devantoy et al., 2014; Olié et al., 2015). Such impairments have especially been found in personality styles prone to harmful behaviours, including psychopathy. For example, von Borries et al. (2012) found that compared to controls, individuals with psychopathy showed lack of avoidance in response to social threat and were more reactive to such stimuli. Due to the characteristics of secondary psychopathy, such as emotional reactivity, individuals may be more likely to engage in self-harm and aggression in response to distressing social contexts in order to fulfil an interpersonal function. Consequently, our model suggests that, in addition to being utilised as an emotional regulation strategy, dual-harm may also be recognised as a response to interpersonal motivations.

Situation/Social Context

While individual related risk-factors, such as personality, are emphasised within our cognitive-emotional model, it is also important to consider the influence of situational and social contextual factors. Situational stressors, including social threat, institutional factors (e.g., crowding and poor management in prisons), family disputes, and bullying, have been shown to be associated with self-harm and aggression (Webb, 2002; Gadon et al., 2006). Given such evidence, researchers have argued that harmful behaviours do not take place in a "vacuum of internal drives and motivations" (Johnstone and Cooke, 2010, p. 182). Rather, situational determinants play an important role. In line with social-cognitive (Hasking et al., 2017) and diathesis-stress theories (Ferguson et al., 2008), we propose that personality traits, such as impulsivity and emotional reactivity in secondary psychopathy, may be triggered into action by an emotionally strenuous situation or social context. The greater the distress caused by this proximal stressor, the more likely the individual is to respond with harmful behaviours.

Expectancies

There is a lack of literature that has investigated why individuals may engage in self-harm at one point and aggression at another. Sahlin et al.'s (2017b) study found that self-harm and aggression had a bidirectional relationship. To account for this, the authors suggested that rather than there being a causal unidirectional relationship between self-harm and aggression, where one behaviour leads to another, these behaviours may develop from common vulnerabilities. Therefore, in the context of dual-harm, it may be that individuals engage in self-harm and aggression interchangeably to fulfil a shared function (e.g., emotional regulation or interpersonal motivations).

The behaviour that an individual chooses to engage in at one point in time may be dependent upon the specific situation they are in and their expectations. The above notion

is outlined by Hasking et al.'s (2017) cognitive-emotion model which highlights the importance of outcome expectancies and self-efficacy expectancies in NSSI. Outcome expectancies are the expected consequences of a behaviour. Individuals may be more likely to engage in and repeat a behaviour that is linked to positive outcomes (e.g., emotional relief, social attention). Meanwhile, self-efficacy expectancy is an individual's belief in their ability to successfully carry out the behaviour in a particular context. For example, an offender may believe that the outcome expectancy of self-harm is more positive than that of aggression as they are less likely to receive punishment. Consequently, they may be more likely to self-harm as a way to regulate their emotions. The above notion may account for the proportionally higher rates of self-harm amongst male prisoners in comparison to males within the community (Fazel et al., 2016). Self-efficacy and positive expectations regarding the outcome, emotional regulation and interpersonal functions of harmful behaviours has been found to be associated with increased self-harm and aggression (Smithmyer et al., 2000; Pornari and Wood, 2010; Hasking, 2017; Brausch and Muehlenkamp, 2018; Dawkins et al., 2019a,b,c). Such findings may provide evidence for the influence of expectancies on harmful behaviours.

The role of expectancies may be further highlighted by Daffern and Howells (2009) study of mental health inpatients. Those who engaged in dual-harm tended to perpetrate aggression before self-harm. Moreover, the likelihood of self-harm increased during later stages of the inpatients' hospital stay. The authors accounted for such findings by suggesting that individuals may have learned over time that aggression does not function well for its expected purpose in the acute mental health ward environment. Accordingly, they include or change to other behaviours, such as self-harm, which may be more appropriate to their particular context. Nijman and à Campo's (2002) study of dual-harm in mental health inpatients revealed that certain situational factors were distinctively associated with self-harm and aggression. For example, self-harm was more likely to occur in the evening and in private within the patient's room. These findings were attributed to the notion that patients believe they will be more likely to successfully self-harm during the evening when there are no activities in place and they are able to retreat in the privacy of their rooms where no one can stop them (Nijman and à Campo, 2002).

In light of the above research, our cognitive-emotional model suggests that in the context of dual-harm, self-harm and aggression may be used interchangeably to serve the same purpose (e.g., emotional regulation or interpersonal goals). The specific behaviour the individual chooses to engage in and its function could be influenced by situational determinants and outcome and self-efficacy expectancies. Such expectancies may account for why not all individuals with secondary psychopathy will dual-harm. In that, if an individual has negative self-efficacy or outcome expectancies about self-harm and aggression, they may be less likely to dual-harm as a way to regulate their emotions or for interpersonal reasons (Hasking et al., 2017).

Feedback Processes

The association between harmful behaviours and personality styles, such as secondary psychopathy, has been argued to be maintained by maladaptive knowledge structures, or cognitive schemas (Anderson and Bushman, 2002; Crawford and Wright, 2007; Gilbert and Daffern, 2011). Schemas are interconnected patterns of thoughts, beliefs, behaviours, and affective states regarding various phenomena (Anderson and Bushman, 2002). These guide cognitive processes and responses to situations (Anderson and Bushman, 2002). Maladaptive schemas are suggested to be formulated and reinforced through repeated exposure to aversive experiences, which give the individual the capability to engage in harmful behaviours. This notion is in line with the Interpersonal Psychological Theory of Suicide (Joiner, 2007; Van Orden et al., 2010) which proposes that the desire and capability to self-harm occurs due to consistent exposure to painful and fearful experiences, such as child abuse. Such exposure leads to an enhanced tolerance to pain and a decreased fear of death or bodily harm. These experiences may also increase the likelihood of aggression, in which witnessing or being a victim of violence increases the capability to engage in aggression (DeWall et al., 2011).

The Schematic Appraisals Model of Suicide (Johnson et al., 2008) further highlights how schema may lead to harmful behaviours. This model suggests that activation of suicide schema leads to thoughts and plans of engaging in suicide as an escape strategy (Johnson et al., 2008). Suicidal schemas may strengthen through repeated experience of volatile emotional states. Moreover, suicidal schemas are suggested to drive, and be reinforced by, situational appraisals (e.g., perception of poor social support) and self-appraisals (e.g., negative perceptions of personal attributes and abilities). This suggests that schemas may influence and be influenced by an individual's expectancies regarding harmful behaviours.

Young et al.'s (2003) cognitive theory highlights the role of maladaptive schemas in harmful behaviours and personality. The researchers propose that maladaptive schemas develop from a combination of negative childhood experiences and temperamental disposition. Harmful behaviours in personalities, such as psychopathy, are said to mainly be a result of ineffective coping responses to such schemas (Chakhssi et al., 2014a). Research has provided evidence for the association between maladaptive schemas, such as a hostile perception of the world, lack of self-control and low tolerance to frustration, and secondary psychopathy in those with a history of aggression (Chakhssi et al., 2014a).

Our cognitive-emotional model draws from the above theories, the GAM and social-cognitive theories of harmful behaviours to highlight the effect of maladaptive schemas on dual-harm. We suggest that an individual's adverse experiences, including witnessing or engaging in harmful behaviours, may increase their likelihood of dual-harm through the reinforcement of maladaptive schemas. The above proposal is supported by research that has demonstrated a strong association between perpetrating and/or being a victim of aggression with later self-harm (*odds ratio* = 3.68) (Jordan and Samuelson, 2016; Daukantaitë et al., 2019). Furthermore, studies have found that past self-harm behaviour is the strongest predictor of future self-harm (Beghi et al., 2013). Considering the great likelihood of exposure to aggression within prisons and forensic mental

health services, the above notion may account for the high prevalence of dual-harm within forensic settings (Slade, 2018). Moreover, akin to the GAM, our model highlights that when an individual engages in dual-harm, the environmental response and their experience may feed back into their personality, thereby reinforcing their maladaptive schemas. In line with the Interpersonal Theory of Suicide and Schematic Appraisals Model of Suicide, we suggest that such schemas may also influence self-efficacy and outcome expectations regarding harmful behaviours. The above feedback processes increase the risk of endured dual-harm by reinforcing and repeating the model's process.

In accordance with the Interpersonal Theory of Suicide (Van Orden et al., 2010), within a dual-harm context, individuals may be more likely to engage in NSSI and less severe methods of self-harm at earlier stages as they have not yet acquired the capability to engage in more harmful self-harm behaviours. Due to feedback processes that reinforce and increase tolerance to harmful behaviours, an individual's capability for more severe methods of self-harm (e.g., overdose and self-immolation) may increase the more they engage in this behaviour. Hence, it may be that the greater the frequency and severity of an individual's dual-harm, the more likely they are to engage in suicidal behaviour, rather than NSSI, over time, as well as more severe self-harm methods. The above notion may be supported by research that has consistently found NSSI to be a risk-factor for suicidal behaviour and that severity of self-harm positively predicts future suicidal behaviour (Young et al., 2003; Beckman et al., 2018; Olfson et al., 2018; Knorr et al., 2019). Moreover, researchers have suggested that those with emotional regulation impairments gain the capability and desire to engage in suicidal behaviours through the repeated use of other risky behaviours, such as NSSI and aggression (Law et al., 2015). Hence, our model suggests that the frequency and severity of past harmful behaviours perpetuates and reinforces the cycle of dual-harm.

Model Summary

To summarise, our cognitive-emotional model divides the causal pathways to dual-harm into two main processes: distal and proximal. In the distal processes, biological factors combine with adverse environmental factors to develop a personality style that may predispose an individual to harmful behaviours. In this paper, we focus on secondary psychopathy, though our theory may extend to other personality styles. Through its effects on cognition, arousal and affect, personality traits facilitate the proximal processes of dual-harm by predisposing the individual to both self-harm and aggression, as well as emotional and interpersonal liability, such as emotional dysregulation and emotional reactivity. Consequently, the individual is more likely to engage in dual-harm as an emotional regulation response to their distressing negative emotions. Alternatively, they may engage in dual-harm to serve an interpersonal function. As such, dual-harm may be perceived as a response to internal threat (i.e., regulating intense negative emotions) or external threat (e.g., creating boundaries or communicating distress). The social context and situation the individual is in and their expectancies regarding harmful behaviours combine to lead to the specific function and behaviour they choose to engage in. Finally, the outcome behaviour impacts the individual's experience and environmental response. This response reinforces maladaptive schemas and feeds back to their personality and expectancies through learning processes, thereby repeating and reinforcing the process of dual-harm.

DISCUSSION

Our cognitive-emotional model may provide various implications for the development of clinical interventions that aim to target dual-harm. The characteristics in secondary psychopathy have been understood to be developed due to emotional adaption to negative early experiences (e.g., abuse or neglect), and these are perceived to be amenable to treatment (Skeem et al., 2007). Hence, in accordance with our model, interventions aiming to target these traits (e.g., impulsivity, emotional distress, and low behavioural control), as well as emotional dysregulation, may reduce dual-harm in individuals with secondary psychopathy and other related personality styles, such as BPD. This idea may be supported by findings that interventions targeting emotional dysregulation and maladaptive characteristics are effective in reducing the occurrence of self-harm and aggression, including in those with BPD (Castillo et al., 2013; Gratz et al., 2014).

As highlighted by our model, schemas may perpetuate the cycle of dual-harm by reinforcing maladaptive traits and expectancies, leading to repeated engagement with this behaviour. Maladaptive schemas have been shown to be amenable with treatment (Giesen-Bloo et al., 2006; Farrell et al., 2009). For example, schema therapy has been associated with improvements in schemas and traits associated with harmful behaviours, as well as reducing risky behaviours in psychopathy (Chakhssi et al., 2014b). It may be that interventions addressing maladaptive schemas and positive expectations regarding harmful behaviours could reduce dual-harm.

The cognitive-emotional model presented in this report may highlight the potentially limited effectiveness of current strategies in addressing dual-harm. Clinical (e.g., mental health inpatient settings) and forensic (e.g., forensic mental health settings and prisons) services tend to conceptualise and respond to self-harm and aggression separately. Aggression is mostly perceived as unreasonable behaviour and the key focus of responses is to protect other individuals. Consequently, strategies of management tend to be reactive, typically in the form of punishment, restraint or seclusion (Slade, 2019). Conversely, self-harm is perceived as an indication of distress and is treated with care and compassion, with the aim of understanding the individual's behaviour (Slade, 2019). Our model suggests that, in the context of dual-harm, individuals may use self-harm and aggression interchangeably to fulfil the same function. Therefore, by managing self-harm and aggression separately, services may inadequately recognise the co-occurrence, potential interchangeability and shared function of these behaviours in those who dual-harm.

Previous research has shown that reactive strategies of violence management within clinical and forensic settings, for example placing offenders on a basic regime or solitary confinement, increase the risk of future antisocial behaviour and self-harm (Duxbury and Whittington, 2005; Kenning et al., 2010; Kaba et al., 2014). Our cognitive-emotional model may account for such findings. The model suggests that an individual's negative experience in response to their dual-harm (e.g., punishment and containment management strategies) strengthens their maladaptive schema and expectancies, thereby reinforcing dual-harm behaviour. This may lead to a coercive cycle of harmful behaviour-aversive response, in which harmful behaviours are met with an aversive response, which in turn, leads to future harmful behaviours, and so on. Despite the potential risk associated with using reactive approaches with those who dual-harm, offenders who dual-harm have been reported to spend a longer time in prison and twice as much time in segregation and other restrictive programmes compared to offenders who engage in aggression alone (Slade, 2019). Such findings suggest that current management approaches may be ineffective in reducing self-harm and aggression in those who dual-harm, and could in fact increase their risk of these behaviours.

Individuals who dual-harm represent a high-risk group, and control and punishment-orientated strategies are often necessary to protect others from dangerous situations posed by these individuals. Consequently, those who dual-harm may not be able to access certain interventions due to the risk they present to others (Slade, 2019). To address this, it may be important for services to adopt an integrated approach that considers an individual's history of both aggression and self-harm on a case-by-case basis, as well as the risk they pose to themselves and others. This may allow the development of more effective risk-assessment, intervention and management strategies that are tailored to the individual's particular risk profile. Evaluating the effectiveness of different management strategies on a case-by-case basis may also allow better identification of approaches that are in the best interest of the individual. This may help break the suggested harmful behaviour-aversive response cycle by taking into account the duality of an individual's harmful behaviour and utilising strategies that inhibit the reinforcement of both their self-harm and aggression. To guide such evaluations, future research should aim to investigate the effect of various management approaches on dual-harm.

The inadequate research investigating dual-harm is reflected in the lack of guidance for the effective care of those who engage in this behaviour. Harmful behaviours are systematically perceived and managed separately from the top (e.g., distinct government areas and policies) to ground level (e.g., society, healthcare, and forensic services). Nevertheless, this paper and previous research highlight that such a separation between self-harm and aggression may be insufficient, and even unhelpful. Our work supports a shift from exclusively approaching self-harm and aggression separately, to considering these behaviours together in the context of dual-harm and the possible unique needs of those who engage in this behaviour. To implement such a major shift, it is necessary to adapt our perceptions of harmful behaviours as a potential false dichotomy, to a more unified construct. This may be achieved by expanding the literature on the aetiology, function, and characteristics of dual-harm. Our cognitive-emotional model informs such research by providing various testable hypotheses regarding the causal pathways and motivations of this behaviour. These include the association between personality and dual-harm, and the role of emotional regulation, distal biological and environmental factors, situational factors, expectancies, and feedback processes in this behaviour.

LIMITATIONS

It is important to note the limitations of our cognitive-emotional model. Dual-harm is yet to be established as a separate, clinically valid construct, and it is unclear how this behaviour should be meaningfully defined. There is a need for research that tests the hypotheses presented by our model and investigates the impact of adopting various definitions of this behaviour. Moreover, the model we have presented draws from our narrative review of the literature of harmful behaviours. While a systematic review was beyond the scope of this paper, future systematic reviews should be conducted that evaluate previous research in-depth to provide evidence for the various components of our theory.

In this article, we have considered self-harm more broadly by not distinguishing between suicidal and non-suicidal behaviours, or different methods of self-harm. Additionally, research has shown an association between self-harm/suicidal ideation and aggression (Hill et al., 2020; Koyama et al., 2020). It may be important to differentiate between NSSI, suicidal behaviours and ideation in order to identify their distinct and shared causal mechanisms in dual-harm.

While the cognitive-emotional model includes distal biological factors, it does not consider the potential role of proximal biological mechanisms. This is because our theory intended to focus on the evidence-based cognitive and emotional aspects of harmful behaviours. There is currently a lack of evidence that supports the inclusion of proximal biological mechanisms as a central component of dual-harm. Nevertheless, there may be important biological factors that contribute to this behaviour. For example, research has implicated impairments in prefrontal areas of the brain in emotional dysregulation (Beauchaine and Cicchetti, 2019). Therefore, this factor could play a role in those who may dual-harm as an emotional dysregulation response. Research should investigate the role of biological factors in dual-harm to provide a more comprehensive biopsychosocial theory of this behaviour.

Finally, the theory proposed in this report is not intended to be an exhaustive account of dual-harm. Given the early stage in which the literature of dual-harm is currently in, we did not intend to provide a comprehensive model that includes all potential causal pathways. Our model may not generalise to all who dual-harm, and not everyone who engages in this behaviour will do so for emotional regulation and interpersonal reasons or have a personality style that is vulnerable to harmful behaviours. Future research should test the proposed model and other

theories of dual-harm across different groups of individuals, including those with secondary psychopathy, BPD diagnoses and other personality styles, in order to assess its generalisability.

CONCLUSION

To the best of our knowledge, our cognitive-emotional model provides one of the only theoretical frameworks for dual-harm. This work encourages research and practice to move toward an integrated approach that considers the duality of self-harm and aggression and the possibility that these behaviours may have common causal pathways in the context of dual-harm. To achieve this, there is a need for robust research that will help us better understand, predict and treat this behaviour. Our model provides various hypotheses that can be tested with such research. Further investigations could establish dual-harm as a unique construct, that should be understood as being separate from sole-harm behaviour. This may help us address challenges in current policy and practice by facilitating the development of more integrated and focused assessment, management and treatment strategies for dual-harm.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

MS wrote the manuscript. AF, DP, and PJT contributed to manuscript revision, read, and approved the submitted version. All authors contributed to the article and approved the submitted version.

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Perceived vs. Actual Emotion Reactivity and Regulation in Individuals With and Without a History of NSSI

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Non-suicidal self-injury (NSSI) has consistently been associated with self-reported difficulties in emotion reactivity and the regulation of negative emotions; however, less is known about the accuracy of these self-reports or the reactivity and regulation of positive emotions. The present study sought to investigate differences between women with and without a history of NSSI on: (a) self-reported general tendencies of negative and positive emotion reactivity, (b) self-reported general tendencies of negative and positive emotion regulation, and (c) emotion regulation reported in response to a positive and negative mood induction. The sample consisted of 36 women with a recent history of NSSI within the last 2 years (*Mage* = 20.06; *SD* = 1.51) and a comparison group with no history of NSSI (*n* = 34; *Mage* = 20.15; *SD* = 1.54). Participants completed self-report measures of negative and positive emotion reactivity and regulation. In a separate session, participants underwent both a negative and positive mood induction using a counterbalanced design and reported their experienced emotions. Results from two-way MANOVAs and ANOVAs revealed those with a history of NSSI reported significantly greater difficulties in negative emotion reactivity and regulation than the no-NSSI comparison group; however, no group differences emerged in self-reported reactivity or regulation of positive emotions. In contrast, repeated measures ANOVAs on data from the mood induction task found no group differences in reactivity or regulation for either negative or positive emotions. These findings highlight the possibility that although individuals with a history of NSSI evaluate their ability to manage negative emotions as significantly worse than individuals with no history of self-injury, this may not reflect their actual emotion regulatory processes.

Keywords: differences in experimental vs. *in vivo*, emotion reactivity, emotion regulation, positive emotions, negative emotions

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INTRODUCTION

Non-suicidal self-injury (NSSI) is the deliberate damaging of body tissue without the intent to die and for purposes not socially sanctioned (International Society for the Study of Self-Injury, 2007; Nixon and Heath, 2009). According to the International Society for the Study of Self-Injury (ISSS) and researchers in the field, NSSI includes behaviors such as cutting, scratching, self-hitting, and

burning, but excludes extreme tattooing or body piercing (International Society for the Study of Self-Injury, 2007; Nock and Favazza, 2009). Although NSSI prevalence rates seem to vary according to age groups, they are consistently high amongst university students, with rates ranging from 15 to 39%, thus making the study of NSSI behaviors in this age group particularly important (e.g., Swannell et al., 2014; Cipriano et al., 2017). Interestingly, NSSI is also a prevalent behavior within both community and clinical populations, typically emerging in adolescence and associated with an increased risk of suicide and mental health difficulties such as depression and anxiety (e.g., Klonsky et al., 2003; Muehlenkamp and Gutierrez, 2007; Swannell et al., 2014).

The present study was conducted to investigate differences in self-reported and actual emotion regulatory processes for both negative and positive emotions between those with and without a history of NSSI engagement. Indeed, one of the most commonly endorsed motivations for engaging in NSSI is to regulate negative emotions [e.g., see review by Taylor et al. (2019)]; therefore, most of the existing literature has focused on investigating the role of negative emotions in the development and maintenance of NSSI and there is much less research investigating the role of positive emotions in NSSI engagement (e.g., Adrian et al., 2011; Jenkins and Schmitz, 2012). However, investigating the influence of positive emotions provides a new lens for NSSI research given that positive and negative emotions have been shown to be differentially associated with mental health, well-being, and health outcomes (e.g., Moskowitz et al., 2019; Pressman et al., 2019). Specifically, within the field of NSSI research, recent evidence suggests that positive emotions are differentially associated with NSSI engagement depending on the degree to which negative affect is also reported (e.g., Hasking et al., 2018). These findings are in line with Frederickson's broaden-and-build theory of positive emotions, which suggests that the presence of positive emotions can in and of itself be protective and functions differently from negative emotions (e.g., Fredrickson, 2013). Thus, further research is needed to investigate the role of positive emotions in NSSI engagement. Finally, beyond being focused on negative emotions, almost all research on emotion reactivity and regulation has relied on self-report methods that may be influenced by a recall bias rather than assessing actual regulatory processes. Therefore, there is a need to extend NSSI research to investigate positive emotions and to compare self-report with *in vivo* emotion regulatory processes.

One of the factors that may influence an individual's ability to regulate emotions is emotion reactivity, which is defined as individual differences in the intensity and temporal nature of behavioral or physiological responses to emotional stimuli (Chapman et al., 2006; Rothbart et al., 2011). It comprises 3 components: (a) the extent to which an individual experiences emotions in response to stimuli (i.e., emotion sensitivity), (b) how strongly or intensely the emotional experience is (i.e., emotion intensity), and (c) the period of time needed to return to a baseline level of arousal (i.e., emotion persistence; Nock et al., 2008). Furthermore, emotion reactivity is believed to be stable across emotional valence: thus, according to theory, individuals who experience strong positive emotions will also experience strong negative emotions (Larsen and Diener, 1987).

Past research suggests that individuals who engage in NSSI report higher levels of emotion reactivity for negative emotions (e.g., Nock et al., 2008; Jenkins and Schmitz, 2012). For example, a study conducted by Baetens and colleagues (Baetens et al., 2011) revealed that adolescents who engage in NSSI are more likely to report greater levels of negative affect and frustration compared to individuals who do not engage in NSSI. Similarly, Anderson and Crowther (2012) found that undergraduate students who had a history of NSSI had more intense negative emotional experiences compared to those who had never engaged in NSSI.

Beyond emotion reactivity, it is also important to consider how individuals regulate their emotions in order to manage their emotion reactivity (e.g., Gross and John, 2003). Research is consistent in suggesting individuals with a history of engaging in NSSI have difficulties regulating their negative emotions (e.g., Richmond et al., 2015; Nicolai et al., 2016; Zelkowitz et al., 2017). Furthermore, research shows the NSSI engagement is itself often used as a means of down-regulating negative emotions and up-regulating positive emotions (e.g., Klonsky, 2009; Claes et al., 2010).

Although most research has focused on the association between NSSI and challenges in emotion reactivity and regulation of negative emotions (e.g., Adrian et al., 2011; Turner et al., 2012), much less has focused on examining the association between positive emotions and NSSI engagement. Further, the few studies that have investigated the role of positive emotions in NSSI engagement focused on the general experience of positive emotions, such as the frequency with which positive emotions occur (e.g., Victor and Klonsky, 2014), and the removal of negative emotions (i.e., calm and relief) following engagement in NSSI (e.g., Klonsky, 2009; Claes et al., 2010). Interestingly, recent evidence suggests that the emotion regulatory function of NSSI for negative emotions may depend on the frequency with which individuals experience positive emotions. Specifically, experiencing positive emotions may be protective against NSSI when experiencing intense negative emotions but may lead to increased NSSI engagement when experiencing low negative affect (Hasking et al., 2018). Accordingly, further research is warranted to investigate the unique influence of positive and negative emotions on NSSI engagement in terms of the experience of emotions as well as their reactivity and regulation.

Moreover, much of the research on NSSI engagement and emotion reactivity and regulation has been conducted either through retrospective reports or diary studies where individuals answer questions pertaining to their emotional experiences as soon as they are able to following the event (e.g., Adrian et al., 2011; Victor and Klonsky, 2014). Unfortunately, these studies very rarely target emotions as the individual is actively experiencing them. Nevertheless, efforts have been made to examine individuals' current mood state in order to identify potential differences between the emotional experiences of those with and without a history of NSSI. Here, mood induction techniques have shown utility as they account for emotions in real time (e.g., Bresin and Gordon, 2013; Arbuthnott et al., 2014).

Overall, very few studies have used mood induction to examine the reactivity and regulation of emotions compared to individuals without a history of NSSI but findings so far have been mixed. Specifically, Davis and colleagues (Davis et al., 2014) conducted a negative mood induction using a sad movie clip and did not find significant differences in reports of negative emotion reactivity between individuals with a history of NSSI, a clinical control group without a history of NSSI matched on symptoms of anxiety and depression, and a control group with no history of anxiety, depression, or NSSI. In contrast, another study found different results indicating that individuals with a history of NSSI self-reported significantly greater emotion reactivity than those without such a history (Glenn et al., 2011). However, unlike Davis and colleagues (Davis et al., 2014), Glenn and colleagues (Glenn et al., 2011) used a mood induction combining negative, neutral, and positive images rather than a negatively valenced video clip. Therefore, further research is needed to investigate the unique outcomes from either negative or positive mood inductions.

Furthermore, there is a paucity of mood induction studies assessing both negative and positive emotions as outcomes in NSSI research. Using a rumination induction, Arbuthnott and colleagues (Arbuthnott et al., 2014) assessed both negative and positive affect and found that individuals with a history of NSSI reported significantly greater increases in negative affect during the task when compared to a comparison group of individuals with eating disorders, whereas the comparison group reported greater decreases in positive emotions than those with a history of NSSI. These results suggest that positive and negative emotions may be differentially affected by a negative emotional situation for individuals with distinct difficulties (such as those who engage in NSSI compared to those with an eating disorder).

In a related study, Boyes and colleagues (Boyes et al., 2020) used both a negative and a positive mood induction and found that individuals with a history of NSSI displayed significantly less emotion reactivity for both negative and positive emotions than those without such a history following the mood inductions. However, the authors did not investigate group differences for both negative and positive emotions within each mood induction valence type. Rather, only negative emotions were assessed during the negative mood induction and only positive emotions were assessed during the positive mood induction. Given that positive and negative emotions have been shown to be non-mutually exclusive and to have differential outcomes and mechanisms, there is a need for a more in-depth investigation of how positive and negative emotions are affected within each valence of mood induction.

Therefore, the present study seeks to address the lack of research on self-reported positive emotion reactivity and regulation for individuals with a history of NSSI engagement and the promising findings in the area of mood induction research for NSSI. The objectives of the current study were to investigate differences between individuals with and without a history of NSSI engagement in terms of (a) self-reported emotion reactivity, (b) self-reported emotion regulation, and (c) actual emotion regulatory processes in response to negative and positive mood inductions. Each of these objectives will be examined first with a focus on negative emotions and then with a focus on positive emotions.

The first objective was to investigate differences in self-reported emotion reactivity. It was hypothesized that individuals engaging in NSSI would self-report significantly greater difficulty with emotion reactivity for both negative (H1a, i.e., report greater reactivity to negative emotions) and positive (H1b, i.e., report less reactivity to positive emotions) emotions than the non-NSSI group.

The second objective was to investigate differences in self-reported emotion regulation. It was hypothesized that the NSSI group would self-report significantly less success in emotion regulation in response to negative (H2a; i.e., less ability to down regulate negative emotions) and positive (H2b; i.e., less ability to up regulate positive emotions) emotions compared to the non-NSSI group.

Finally, the third objective was to investigate actual emotion regulatory processes in response to both a negative and a positive mood induction. Based on previous findings by Arbuthnott and colleagues (Arbuthnott et al., 2014), it was hypothesized (H3) that individuals with a history of NSSI would report higher levels of negative affect in response to both the negative and positive mood induction than individuals who have never engaged in NSSI. In terms of positive affect, it was hypothesized (H4) that individuals with a history of NSSI would report significantly less positive affect than those without a history of NSSI in response to both the negative and positive mood inductions. Interactions were also expected (H5) such that individuals with a history of NSSI would require significantly more time to recover (i.e., return to baseline) from negative emotions in response to the negative mood induction and less time to return to baseline from positive emotions in response to the positive mood induction than individuals in the non-NSSI group.

MATERIALS AND METHODS

Participants

Participants were female undergraduate students ($N = 74$) recruited from a large urban Canadian university using two recruitment methods. First, following IRB approval, a research team database was used to contact individuals who had agreed to be contacted about participation in studies on stress and coping and who had previously completed a screening questionnaire pertaining to their NSSI engagement. Participants were also recruited from an advertisement posted on the university's online classifieds and social media pages.

As a result of data cleaning, 4 participants had to be removed from the study (details are provided in the Result section below); thus, the final sample consisted of 36 female participants who reported a history of NSSI engagement over the past 2 years ($Mage = 20.06$ years; $SD = 1.51$), as well as a comparison group consisting of 34 female participants with no history of NSSI engagement ($Mage = 20.15$ years; $SD = 1.54$). **Table 1** presents the sample's demographic information.

Measures

NSSI Screening Questionnaire

A self-report researcher-designed questionnaire assessing stress and coping in university students was administered campus-wide as part of a previous study. NSSI is included as one of the listed

TABLE 1 | Sample demographics.

Ethnicity ($N = 70$)		NSSI Frequency ($n = 36$)	
Caucasian	57.1%	Once	5.6%
Asian	28.6%	2–4 times	11.1%
Other	8.6%	5–10 times	8.3%
Mixed	5.7%	11–50 times	50%
		51–100 times	8.3%
		100 times or more	16.7%

coping behaviors that participants have the option to choose from (i.e., "physically hurt myself on purpose without wanting to die"). This screener questionnaire also included a question asking whether participants were interested in being contacted again about future studies with our team. Therefore, the NSSI engagement item was used to provide preliminary information to identify a subsample of individuals who may either be currently engaging in NSSI or have a history of NSSI engagement and these people were sent the invitation email to participate in the present study.

Non-suicidal Self-Injury

The Inventory of Statements about Self-Injury (ISAS; Klonsky and Glenn, 2009) is a self-report measure that assesses various aspects of NSSI, with sections assessing the frequency and functions of NSSI. For the purpose of this study, only information relating to the frequency of NSSI was used. This measure was only administered to individuals who indicated that they had ever engaged in NSSI on the NSSI screening questionnaire described above, in order to confirm NSSI engagement and specifically identify individuals who had engaged in NSSI over the past 2 years.

Emotion Reactivity

All participants completed the Emotion Reactivity Scale (ERS; Nock et al., 2008), a 21-item questionnaire developed to assess how individuals experience emotions. In particular, the ERS assesses 3 aspects of emotion reactivity including: (a) sensitivity (e.g., "even the littlest things make me emotional"), (b) intensity (e.g., "when I experience emotions, I feel them very strongly/intensely"), and (c) persistence (e.g., "when something happens that upsets me, it's all I can think about for a long time"). For the purpose of this study, the ERS was also adapted to assess positive emotions by adding questions that are the positive emotion equivalents for each item (e.g., "when something happens that makes me happy, it's all I can think about for a long time"). In the present study, the internal consistency of the ERS was good both for negative (Cronbach's α: sensitivity = 0.92; intensity = 0.92; persistence = 0.80) and positive (Cronbach's α: sensitivity = 0.86; intensity = 0.84; persistence = 0.77) emotion reactivity.

Emotion Dysregulation

The Regulatory Emotional Self-Efficacy scale (RESE; Caprara and Gerbino, 2001) is a well-validated 12-item self-report measure designed to assess one's efficacy in regulating negative (despondency and anger) and positive (including happiness, joy, and contentment) affect (Alessandri et al., 2015). In the current study, the Cronbach's alphas were 0.68 for despondency, 0.65 for anger, and 0.67 for positive emotions, which are deemed acceptable for research (Meyers et al., 2013).

Positive and Negative Emotional Experiences

The Positive and Negative Affect Scale (PANAS; Watson et al., 1988) is a self-report measure designed to assess the frequency with which an individual has experienced negative and positive emotions in the past day or week. Responses for each emotion are rated on a five-point Likert scale ranging from "very slightly or not at all" to "extremely." The PANAS demonstrates good internal consistency, test-retest reliability, as well as convergent and divergent validity (Watson et al., 1988; Jenkins and Schmitz, 2012). Unfortunately, the internal consistency of the PANAS within this study could not be calculated due to corruption of the raw data for this instrument. For the purposes of this study, the intensity of state-level emotions was measured by looking at the change in responses from baseline to post-task intensity, which will be interpreted as reactivity. Recovery time was measured by assessing emotions at 1- and 2-min post video clip.

Procedure

The study was conducted in 2 parts. First, participants completed an online survey including the measures described above, following which they received $10 as well a list of resources should they require additional support. Participants with a history of NSSI were subsequently emailed and asked if they would be interested in participating in an in-person follow up study on emotions. Individuals matched on age but with no history of NSSI were also invited to participate as a comparison group.

Immediately prior to completing the mood induction task, participants were asked to complete the PANAS (Watson et al., 1988) to assess their baseline emotions and their relative intensities. Participants underwent a positive and negative mood induction, using a randomized counterbalanced design whereby they were either presented with a negative video (in which a cat was trying to revive another cat lying motionless on the ground with sad background music) or a positive video (in which a young boy humorously reports on "10 things that we should say more often"). These videos were chosen in the present study based on findings from Zhang and colleagues (Zhang et al., 2014) where videos containing both affectively-congruent images and music were the most effective out of 4 types of mood inductions at inducing either a positive or negative mood. Both negative and positive video clips (each about 3 min long) had been piloted with research team volunteers prior to starting data collection to ensure the appropriate mood was induced and to determine the typical timeframe for a return to baseline for both positive and negative emotions.

Immediately following the first mood induction, participants were asked to complete the PANAS again, wait 2 min, and complete the PANAS once more. Participants then underwent a distractor task consisting of simple math problems to be solved without a time limit before completing another baseline

assessment of their emotions using the PANAS prior to the second mood induction. Then, participants viewed their second mood induction video followed by a repeat of the PANAS at a 2-min interval, a distraction task, and a final completion of the PANAS to ensure a return to baseline. If a participant's mood was worse than it was at baseline (i.e., they felt more negative affect or less positive affect), they watched a humorous clip from the television show "Friends" before completing the PANAS again. The session concluded when the participant's mood was comparable to their baseline negative and positive affect.

Analytic Plan

The first objective was to investigate differences in self-reported emotion reactivity for both negative (H1a) and positive (H1b) emotions between individuals with and without a history of NSSI. Given that the ERS (Nock et al., 2008) has 3 subscales, separate one-way MANOVAs were used with negative and positive emotion reactivity as outcomes, respectively.

The second objective was to investigate differences in self-reported emotion regulation for both negative (H2a) and positive (H2b) emotions between individuals with and without NSSI engagement. Given that the RESE (Caprara and Gerbino, 2001) has 2 subscales assessing negative emotion regulation and 1 subscale assessing positive emotion regulation, differences in regulation of negative emotions were assessed with a one-way MANOVA while differences in regulation of positive emotions were assessed with a one-way ANOVA.

Finally, the third objective was to compare differences in actual emotion regulatory processes in response to mood inductions in individuals with and without a history of NSSI. Given that each participant underwent two mood inductions (one negative and one positive) and that both negative and positive emotions were assessed before and after each mood induction, 4 separate 2 (Group: NSSI vs non-NSSI) X 4 (Time: pre, post, 1 min post, 2 min post) repeated measures ANOVAs were conducted.

RESULTS

All analyses were conducted using SPSS version 24. Prior to the main analyses, we evaluated patterns of missingness and cleaned the data. One participant was removed from the sample given that NSSI status had not been reported. As per recommendations by Tabachnick and Fidell (2012), the data were assumed to be missing completely at random (MCAR) given that <5% of data points were missing per variable. Therefore, the expectation maximization procedure was used to impute missing values within each measure or subscale of both the NSSI and non-NSSI groups separately to increase the accuracy of the prediction. Following imputation, 1 participant in the non-NSSI group was identified as an outlier on emotion reactivity (i.e., more than 3 SDs from the mean) and was thus excluded from the final sample. Given that all other participants were women, a participant in the non-NSSI group who reported being male was also excluded from final analyses along with a randomly selected age-matched participant in the NSSI group. Therefore, the final sample consisted of 36 female participants with a history of NSSI over the past 2 years (*M*age = 20.06 years; *SD* = 1.51) and 34 female participants without a history of NSSI (*Mage* = 20.15 years; *SD* = 1.54).

TABLE 2 | Means and standard deviations for negative and positive emotion reactivity and regulation.

	NSSI		Non-NSSI	
	M	***SD***	***M***	***SD***
Negative emotion reactivity				
Sensitivity	24.26	9.96	15.53	8.92
Intensity	16.38	8.23	10.65	6.80
Persistence	9.56	4.14	6.35	3.53
Positive emotion reactivity				
Sensitivity	15.72	8.18	14.82	7.59
Intensity	9.97	5.83	9.65	5.41
Persistence	6.08	4.11	5.62	2.83
Emotion regulation				
Despondency	4.78	2.83	6.47	2.97
Anger	5.28	3.08	7.12	2.69
Positive emotions	10.47	3.08	10.85	3.05

The first objective was to compare women with and without a history of NSSI in terms of their self-reported reactivity to positive and negative emotions. Separate one-way MANOVAs were conducted to test whether women with a history of NSSI would report greater difficulties with emotion reactivity for negative emotions (H1a) and positive emotions (H1b) than those without a history of NSSI. **Table 2** presents the means and standard deviations for emotion reactivity of positive and negative emotions. Consistent with H1a, women with a history of NSSI reported significantly greater difficulties with emotion reactivity for negative emotions compared to those without a history of NSSI, Wilk's $\Lambda = 0.81$, $F_{(3, 66)} = 5.15$, $p = 0.003$, $\eta_p^2 = 0.19$. Specifically, they reported higher levels of sensitivity, $F_{(1,68)} = 14.87$, $p < 0.001$, $\eta_p^2 = 0.18$, intensity, $F_{(1,68)} = 10.03$, $p = 0.002$, $\eta_p^2 = 0.13$, and persistence, $F_{(1,68)} = 12.07$, $p = 0.001$, $\eta_p^2 = 0.15$, for negative emotions. However, contrary to H1b, no significant differences were found when a separate MANOVA was conducted for positive emotion reactivity, Wilk's $\Lambda = 0.99$, $F_{(3,66)} = 0.15$, $p = 932$, $\eta_p^2 = 007$. Further, partial eta-squared suggested a moderate to large effect size for negative emotion reactivity and a small to moderate effect size for positive emotion reactivity.

The second objective of the present study was to investigate group differences in terms of self-reported emotion regulation for negative and positive emotions between women with and without a history of NSSI. Similarly to the first objective, a one-way MANOVA was conducted to test H2a that women with a history of NSSI would report worse emotion regulation for negative emotions. **Table 2** also presents the means and standard deviations for emotion regulation of positive and negative emotions. Results revealed significant group differences at the multivariate level, Wilk's $\Lambda = 0.88$, $F_{(2, 67)} = 4.46$, $p = 0.015$, $\eta_p^2 = 0.746$. Specifically, women with a history of NSSI reported worse negative emotion regulation for both despondency, $F_{(1, 68)}$

TABLE 3 | Means and standard deviations for negative and positive emotions across time points (pre, post, 1 min post, 2 min post) for NSSI and non-NSSI groups within the negative and positive mood inductions.

		NSSI		Non-NSSI	
		M	*SD*	*M*	*SD*
Negative mood induction	**Negative affect**				
	Pre	15.08	6.71	13.62	2.94
	Post	17.89	7.02	16.91	4.27
	1 min post	16.08	6.35	15.68	4.41
	2 min post	14.89	6.20	13.35	3.05
	Positive affect				
	Pre	23.50	7.28	25.65	6.94
	Post	17.94	5.94	19.94	5.44
	1 min post	16.94	5.57	19.91	6.47
	2 min post	17.50	6.22	20.21	6.67
Positive mood induction	**Negative affect**				
	Pre	14.22	4.46	13.21	3.04
	Post	12.22	2.71	11.97	2.50
	1 min post	12.36	3.14	11.82	2.52
	2 min post	12.58	3.38	12.35	2.91
	Positive affect				
	Pre	22.47	7.40	25.24	6.18
	Post	26.67	9.90	27.91	7.90
	1 min post	23.19	9.03	24.38	7.24
	2 min post	20.67	8.65	22.15	6.43

TABLE 4 | Results of 2 (Group: NSSI vs. non-NSSI) X 4 (Time: pre, post, 1 min post, 2 min post) repeated measures ANOVAs for negative and positive affect following a negative and positive mood induction.

Negative affect—negative mood induction	
Mauchly's test of sphericity—Time	χ^2 (5) = 46.71, $p < 0.001$
Interaction—*Greenhouse-Geisser*	$F_{(3, 204)} = 0.675$, $p = 0.527$, $\eta_p^2 = 0.010$, $1–\beta = 0.17$
Main effect of Time (within)—*Greenhouse-Geisser*	$F_{(2.24,204)} = 22.94$, $p < 0.001$, $\eta_p^2 = 0.252$, $1–\beta = 1$
Main effect of Group (between)	$F_{(1, 68)} = 0.886$, $p = 0.350$, $\eta_p^2 = 0.013$, $1–\beta = 0.15$
Positive affect—negative mood induction	
Mauchly's test of sphericity–Time	χ^2 (5) = 37.53, $p < 0.001$
Interaction—*Greenhouse-Geisser*	$F_{(3, 204)} = 0.419$, $p = 0.676$, $\eta_p^2 = 0.006$, $1–\beta = 0.12$
Main effect of Time (within)—*Greenhouse-Geisser*	$F(2.18, 204) = 68.26$, $p < 0.001$, $\eta_p^2 = 0.501$, $1–\beta = 1$
Main effect of Group (between)	$F_{(1, 68)} = 3.13$, $p = 0.081$, $\eta_p^2 = 0.044$, $1–\beta = 0.42$
Negative affect—positive mood induction	
Mauchly's test of sphericity–Time	χ^2 (5) = 63.02, $p < 0.001$
Interaction—*Greenhouse-Geisser*	$F_{(3, 204)} = 0.838$, $p = 0.436$, $\eta_p^2 = 0.012$, $1–\beta = 0.19$
Main effect of time (within)—*Greenhouse-Geisser*	$F_{(2.03,204)} = 14.75$, $p < 0.001$, $\eta_p^2 = 0.178$, $1–\beta = 1$
Main effect of group (between)	$F_{(1, 68)} = 0.579$, $p = 0.449$, $\eta_p^2 = 0.008$, $1–\beta = 0.12$
Positive affect—positive mood induction	
Mauchly's test of sphericity–Time	χ^2 (5) = 35.23, $p < 0.001$
Interaction—*Greenhouse-Geisser*	$F_{(2.4,204)} = 0.89$, $p = 0.431$, $\eta_p^2 = 0.013$, $1–\beta = 0.22$
Main effect of time (within)—*Greenhouse-Geisser*	$F_{(2.4,204)} = 37.88$, $p < 0.001$, $\eta_p^2 = 0.358$, $1–\beta = 1$
Main effect of group (between)	$F_{(1, 68)} = 0.88$, $p = 0.351$, $\eta_p^2 = 0.013$, $1–\beta = 0.15$

$= 5.97$, $p = 0.017$, $\eta_p^2 = 0.08$, and anger, $F_{(1, 68)} = 7.05$, $p = 0.01$, $\eta_p^2 = 0.09$, compared to women without a history of NSSI, with a moderate effect size. A one-way ANOVA was then conducted to test H2b that women with a history of NSSI engagement would report worse emotion regulation for positive emotions than those without. However, contrary to H2b, no significant differences were found between those with and without a history of NSSI for emotion regulation of positive emotions, $F_{(1, 68)} = 0.27$, $p = 0.605$, $\eta_p^2 = 0.004$.

The third objective aimed to compare negative and positive emotions for women with and without a history of NSSI in response to a negative and positive mood induction. Four separate 2 (Group: NSSI vs non-NSSI) × 4 (Time: pre, post, 1 min post, 2 min post) repeated measures ANOVAs were conducted: one for each type of negative and positive emotion within each condition (negative vs. positive mood induction). **Table 3** presents the means and standard deviations of negative and positive affect across all time points for the NSSI and non-NSSI groups within both the negative and positive mood inductions. Additionally, results for the repeated measures ANOVAs are presented in **Table 4** and **Figure 1**. No significant interactions were found in any of the 4 repeated measures ANOVA analyses across the negative or positive affect and mood induction tasks.

However, significant main effects of Time were found for each repeated measures ANOVA across negative and positive affect for both types of mood induction task, thus indicating that the respective mood inductions had the expected overall effects (i.e., the negative induction induced negative emotions and the positive induction induced positive emotions). Specifically, as expected, in the negative mood induction negative affect significantly increased post-induction and then gradually returned to baseline levels while positive affect significantly decreased. The opposite pattern was found with regards to the positive mood induction. **Table 5** presents the results from pairwise comparisons for both negative and positive mood inductions using the Bonferroni correction.

Meanwhile, in terms of main effects for Group (NSSI vs. non-NSSI), women with a history of NSSI did not report significantly different positive or negative affect compared to their non-NSSI peers in either mood induction task. Thus, although the respective mood inductions functioned as expected in terms of eliciting positive and negative affect, participants followed a similar pattern of response within each mood induction regardless of NSSI engagement.

DISCUSSION

The purpose of the present study was to investigate differences between individuals with and without a history of NSSI engagement on the experience of positive and negative emotions

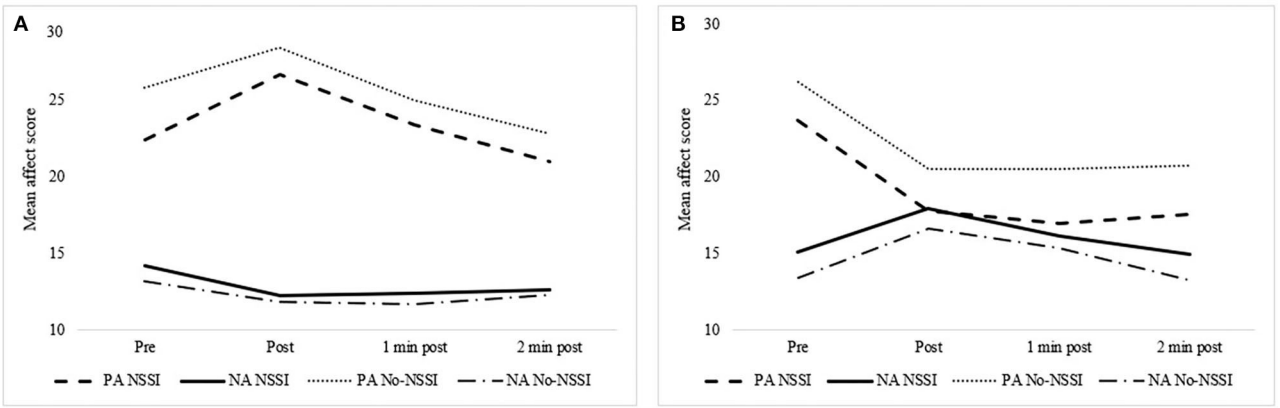

FIGURE 1 | (A) presents the results for the positive mood inducement pre- and post-mean negative (NA; blue lines and positive (NA; orange lines) affect scores for women with and without a history of NSSI. **(B)** presents the results for the negative mood inducement pre- and post-mean negative (NA; blue lines) and positive (PA; orange lines) affect scores for women with and without a history of NSSI.

TABLE 5 | Results of pairwise comparisons of time based on estimated marginal means for 2(Group: NSSI vs. non-NSSI) X 4(Time: pre, post, 1 min post, 2 min post) repeated measures ANOVAs for negative and positive affect following a negative and positive mood induction.

	M	*SD*
Negative affect—negative mood induction		
Pre	14.35[a]	0.63
Post	17.40[b]	0.70
1 min post	15.88[c]	0.66
2 min post	14.12[a]	0.59
Positive affect—negative mood induction		
Pre	24.57[a]	0.85
Post	18.94[b]	0.68
1 min post	18.43[b,c]	0.72
2 min post	18.85[b,c,d]	0.77
Negative affect—positive mood induction		
Pre	13.71[a]	0.46
Post	12.10[b]	0.31
1 min post	12.09[b,c]	0.34
2 min post	12.47[b,c,d]	0.38
Positive affect—positive mood induction		
Pre	23.85[a]	0.82
Post	27.29[b]	1.07
1 min post	23.79[a]	0.98
2 min post	21.41[c]	0.92

Significant differences in reports of affect over time points, as found using pairwise comparisons of estimated marginal means with the Bonferroni correction, are indicated by superscript letters within the column for means. Time points with the same superscript letter are not significantly different from one another.

in terms of: (1) self-reported emotion reactivity, (2) self-reported emotion regulation, and (3) in-person experience of emotions in response to both a positive and negative mood induction. In what follows, the study's findings, limitations, and implications will be discussed.

Consistent with previous studies, the present results revealed that participants with a history of NSSI reported significantly greater difficulties in negative emotion reactivity than the comparison group on the self-report questionnaires (e.g., Gratz, 2006; Najmi et al., 2007; Jenkins and Schmitz, 2012). A similar pattern was found with respect to individuals' ability to regulate their negative emotions. Specifically, those with a history of NSSI reported significantly greater difficulties in regulating their negative emotions than those without such a history. These findings are consistent with previous studies examining the emotion reactivity and regulation of negative emotions in individuals with and without a history of NSSI (e.g., Gratz and Roemer, 2008; Heath et al., 2008; Peh et al., 2017; You et al., 2018).

However, contrary to hypotheses, no differences were found for self-reported reactivity or regulation of positive emotions between participants with and without a history of NSSI. Previous studies have examined the experiencing of positive emotions among individuals who engage in NSSI, with findings suggesting those who engage in NSSI report experiencing less positive emotion; however, results have been mixed (e.g., Bresin and Gordon, 2013; Arbuthnott et al., 2014; Santangelo et al., 2017). The present findings build on previous literature by going beyond the frequency of experiencing positive emotions, which is only one aspect of emotion reactivity, to establish a more comprehensive understanding of reactivity as it relates to NSSI. Specifically, in the present study, the *Emotion Reactivity Scale* (Nock et al., 2008) was adapted to assess positive emotions for a more complex assessment of emotion reactivity through individuals' sensitivity to emotions, their perception of emotion intensity, and the rate at which they experience persistence of emotions. Surprisingly, when using this more complex assessment, no differences in reactivity to positive emotions were found between women with and without engagement in NSSI on their perception of their emotion reactivity to positive emotions.

The discrepancy between self-reported positive and negative emotion reactivity and regulation is particularly interesting given

that these assessments were conducted during the same session. This discrepancy suggests that women who engage in NSSI may perceive a difference in their tendency to react to or regulate positive vs. negative emotions. Specifically, although there are significant differences in the self-reported response to negative emotions between women with and without a history of NSSI engagement, there seem to not be significant differences when it comes to responding to positive emotions. These findings highlight the need to actively compare both positive and negative emotions when conducting research on NSSI. Additionally, further research is needed to assess self-reported positive emotion reactivity in both complex and simple ways in order to deepen our understanding of why individuals who self-injure report experiencing less frequent positive emotion when only assessing frequency of positive emotions (e.g., Victor and Klonsky, 2014) but report a comparable positive emotion reactivity when using a more complex assessment.

Uniquely, the current study simultaneously measured emotion reactivity and regulation through self-report and *in vivo* mood inductions of emotions with both valences. Contrary to what was hypothesized, results from the mood induction task indicated that, although the mood inductions functioned as expected for both women with and without a history of NSSI, no group differences emerged in reactivity or regulation for either negative or positive emotions as a function of NSSI engagement. Although theoretically this lack of significant differences may have been due to low power, this is unlikely given how similar the means are between the NSSI and no-NSSI groups for both types of affect in both mood inductions. Furthermore, this lack of group differences in response to the mood inductions was particularly surprising given the consistent findings of group differences in self-reports of negative emotion reactivity and regulation between individuals with and without a history of NSSI (e.g., Jenkins and Schmitz, 2012).

A potential explanation for this finding may be that self-reported differences in negative emotion reactivity and regulation are not reflective of actual differences in the regulatory processes of women with a history of NSSI. This would suggest that self-report assessments may be biased representations of what some women who engage in NSSI are actually experiencing emotionally. For example, some women who engage in NSSI may be particularly sensitive to the experience of a typical negative emotional response to stimuli and their sensitivity to that experience may cause them to feel that it is extremely intense when in fact it is comparable to their non-NSSI peers' experience. Therefore, their subjective interpretation of their negative emotional experience may be what is driving the self-reported differences in negative emotion reactivity and regulation.

Alternatively, the type of mood inductions selected may have had an impact on participants' response. Indeed, Arbuthnott and colleagues (Arbuthnott et al., 2014) found results conflicting with the current study's but used a rumination induction in which participants were asked to think about a personal experience that was upsetting to them and to describe why they felt the way they did about that situation. However, there may be a lack of standardization in this type of experimental task since it is possible that the personal experiences recalled by those with a history of NSSI in the induction were actually far more negative than those recalled by the non-NSSI comparison group. Meanwhile, the present results are consistent with Davis and colleagues (Davis et al., 2014) findings and both studies used mood inductions that were not related to participants' personal experiences (e.g., video clips were used). Thus, more research is needed to determine the potential impact of the type of mood induction used.

Interestingly, a recent mood induction study by Boyes and colleagues (Boyes et al., 2020) found that individuals with a history of NSSI did not report differences in self-reported negative emotion reactivity but reported significantly lower self-reported positive emotion reactivity when compared to those with no history of NSSI. Furthermore, when looking at positive and negative emotion reactivity in response to both a positive and a negative mood induction, individuals with a history of NSSI displayed lower emotion reactivity for both negative and positive emotions than those without a history of NSSI engagement.

However, a number of factors may account for the discrepancy between Boyes and colleagues' (Boyes et al., 2020) study and the current study. Most importantly, the measure of emotion reactivity for positive and negative emotions used by Boyes and colleagues (Boyes et al., 2020), the *Emotion Reactivity Intensity and Perseverance Scale* (Ripper et al., 2018), relied heavily on social comparison (i.e., "When exposed to a situation that would make the 'average' person experience this feeling, how likely is it that you will experience this particular feeling?") whereas the Emotion Reactivity Scale (Nock et al., 2008) used in the current study focused solely on participants' own experiences of positive and negative emotion reactivity. Therefore, future studies may need to simultaneously assess both self-focused experience of positive and negative emotions and other-focused experience based on social comparison.

Furthermore, differences in sample demographics may also account for this discrepancy in findings. Specifically, although the present study had an exclusively female sample of participants, Boyes and colleagues (Boyes et al., 2020) only had a majority of female participants (73.8%), which may have influenced findings given that studies have demonstrated potential gender differences in the experience of NSSI (e.g., Sornberger et al., 2012).

Finally, Boyes and colleagues (Boyes et al., 2020) chose to recruit participants with a lifetime history of NSSI while controlling for their history of mental illness; meanwhile, the present study focused on women who had engaged in NSSI over the past 2 years. This is particularly important because research shows that emotion reactivity and regulation may differ as a function of the recency of NSSI engagement (i.e., lifetime vs. current); therefore, this may have contributed to the differences in results obtained across both studies.

Despite differences in findings, these two recent mood induction studies strongly highlight the need for further research in the field of NSSI to better understand the differences between self-reported and *in vivo* emotion reactivity and regulatory processes while also clearly differentiating between positive and negative emotions. Overall, the results of the current study suggest that women who engage in NSSI may (a) interpret their self-reported emotion reactivity and regulation to be worse for negative emotions and comparable for positive emotions when compared to their non-NSSI peers; and (b) experience negative

and positive emotions comparably to their non-NSSI peers in response to both a negative and positive mood induction. This suggests that women who engage in NSSI may be less reactive to negative situations and may be better at regulating their emotions (negative and positive) than they believe.

Limitations and Future Directions

The current study is limited in the generalization of its findings to the investigation of emotion reactivity and regulation in female university students due to the insufficient number of men who engage in NSSI who volunteered to participate in this study. However, this is unfortunately a common limitation in NSSI research [e.g., see review by Cipriano et al. (2017)]. Future research is needed to investigate gender differences in NSSI research, which is particularly important given that findings show marked gender differences in preferred method of NSSI engagement with women engaging more in self-cutting and men engaging in self-hitting or burning (Sornberger et al., 2012). Similarly, the sample in the present study consisted of undergraduate students; therefore, further research on emotion reactivity and regulation for positive and negative emotions is needed to extend beyond using university samples.

Although the PANAS was used in the present study as a highly validated measure of emotional experiences, future studies should incorporate validity scales as well as a broader variety of assessments of state emotional experiences including visual analog scales and objective measures of mood reactivity. Similarly, although the videos for the current mood inductions were found to be effective and standardizable, they may not be generalizable to the same degree within clinical samples. Most importantly, future studies need to replicate the present study using autobiographical mood induction techniques given that, as noted in the discussion, a study by Arbuthnott and colleagues (Arbuthnott et al., 2014) using autobiographical mood induction techniques found significant differences based on NSSI engagement.

Finally, although the positive and negative mood inductions used in the current study functioned in the expected manner, with the positive induction eliciting positive emotions and vice versa, there was an unexpected yet interesting lack of significant group differences in response to the mood inductions between individuals with and without a history of NSSI engagement. In light of these findings, it may be of interest for future studies to replicate this design with a larger sample size to account for low power. Furthermore, future research should ask participants at the end of the mood induction task whether they felt that they reacted more or less strongly compared to others. This would allow for the assessment of participants' subjective experience of their emotional states in the same moment and on the same task as opposed to having a more generalized self-report assessment that was completed prior to the mood induction tasks. Additionally, a potential confound to be considered is alexithymia, which has been associated with NSSI engagement and may have led the NSSI group to have experienced different physiological reactions without being able to label them as such (e.g., Greene et al., 2020).

CONCLUSION

Despite some limitations, the current study presents novel findings with important implications for future research and clinical practice in the area of NSSI. In particular, this study is an important first step in investigating the differences in emotion reactivity and regulation for both negative and positive emotions using self-report measures as well as *in vivo* mood induction. The findings of the current study suggest that, despite self-reported differences, individuals with a history of NSSI may not differ from individuals who have not engaged in NSSI when experiencing negative and positive stimuli. Consequently, these results suggest implications about the need to consider that the focus in a clinical context should be less on changing emotion regulatory processes and more on accepting or tolerating emotional responses. Future research is needed to replicate these findings and extend our understanding of positive and negative emotion reactivity and regulation for individuals who engage in NSSI.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by McGill University Research Ethics Board Office. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

MS and NH designed the study and organized the data collection. JM, MS, and NH conducted literature searches and formulated the research questions for the study. JM conducted the statistical analyses. MS, JM, SL, and NH contributed to the first full draft of the manuscript. JM and NH completed subsequent numerous edits and revisions. All authors contributed to the article and approved the submitted version.

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Defeat, Entrapment, and Positive Future Thinking: Examining Key Theoretical Predictors of Suicidal Ideation Among Adolescents

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Adult-based suicide theories have determined much of what we know about suicidal ideation. Here, we investigate the extent to which elements of the *Integrated Motivational-Volitional* (IMV) model generalize to adolescence, a period when rates of suicidal ideation increase dramatically. In a sample of community-based adolescents (n = 74), we tested whether defeat and entrapment related to suicidal ideation, and whether poor positive future thinking abilities exacerbated this association. Consistent with the IMV model, we found that defeat/entrapment was associated specifically with history of suicidal ideation, and not with history of suicide attempt. Defeat/entrapment was related to baseline suicidal ideation severity above and beyond depressive symptoms. While defeat/entrapment predicted future suicidal ideation controlling for history of ideation, it did not do so controlling for depressive symptoms. Counter to the IMV model, we initially found that the association between defeat/entrapment and suicidal ideation was strongest among adolescents with *greater* positive future thinking abilities. This was driven by the tendency to imagine more positive future events, particularly those that are less realistic and achievable. These findings call for a more nuanced understanding of defeat/entrapment and positive future thinking among adolescents, particularly in how they interact to predict recurrent suicidal ideation.

Keywords: suicide, defeat, entrapment, future thinking, integrated motivational-volitional model, adolescence

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INTRODUCTION

Approximately 16–18% of adolescents report experiencing suicidal ideation each year (Centers for Disease Control and Prevention, National Center for Health Statistics, 2015, Ivey-Stephenson et al., 2020), and approximately one-third of suicidal adolescents go on to attempt suicide (Nock et al., 2013). Despite the prevalence and severity of these outcomes, our understanding of why suicidal thoughts and behaviors (STBs) emerge and persist during adolescence is limited. One cited reason for this is that suicide research to date has largely examined the same narrow set of risk factors—most of which show small effect sizes for prediction of STBs (Franklin et al., 2017). Further, adult samples account for a majority of the risk factor literature over the past 50 years (Franklin et al., 2017). This discrepancy is puzzling, given that rates of suicidal ideation escalate dramatically between the ages of 12

and 17 (Nock et al., 2008, 2013), and suicidal thoughts may transition quickly to behaviors among this age group (Glenn et al., 2017a). Adolescence represents a high-risk period for onset of STBs, yet these outcomes are notably understudied in this population.

In addition to a relative lack of empirical work on adolescence compared to adulthood, there currently exist no adolescent-specific theories of suicide. In the past decade, researchers have posited several theories to explain development of suicidal ideation, and who will transition from suicidal thoughts to action (e.g., *Interpersonal Psychological Theory of Suicide*; Joiner, 2005; Van Orden et al., 2010; *Three-Step Theory*; Klonsky and May, 2015). However, these and most suicide theories are age-agnostic, or else allude to—rather than center around—developmental considerations germane to adolescence. Further, leading theories are infrequently tested among youth. For example, a 2017 meta-analysis of research on the Interpersonal Psychological Theory of Suicide found that fewer than 5% of studies were conducted among youth under 18 years (Chu et al., 2017). There is a need to test the extent to which prevailing theories generalize to adolescence, and if needed, pursue more developmentally sensitive explanations for suicidal ideation earlier in life.

Among existing suicide theories, the *Integrated Motivational-Volitional* model (IMV; O'Connor, 2011) may be a particularly promising framework to explain suicidal ideation among adolescents. The IMV not only offers one of the most detailed explanations for the emergence of suicidal ideation but also incorporates constructs that may be especially relevant to adolescence. The IMV adopts an "ideation-to-action" framework to explain development of suicidal ideation, and the transition from suicidal thoughts to behaviors. It posits that experiences of *defeat* (i.e., failed social struggle and feelings of being brought down), triggered by stressful life events or other environmental precipitants, lead to *entrapment* (i.e., perceived inability to escape or be rescued from aversive situations)—and ultimately suicidal ideation (O'Connor and Kirtley, 2018). Indeed, defeat and entrapment have been linked with suicidal ideation in some prior work (for overviews, see O'Connor and Kirtley, 2018; O'Connor and Portzky, 2018); however, most of these studies have involved adult samples (e.g., O'Connor et al., 2013; Owen et al., 2018). Empirical studies involving youth are limited and have yielded mixed findings. In one of the few studies among adolescents, entrapment was associated cross-sectionally with suicidal ideation (Park et al., 2010), and one prior study with young adults showed mixed findings, suggesting that defeat but not entrapment predicts future suicidal ideation (Taylor et al., 2011). The impact of defeat and entrapment on suicidal ideation warrants clarification, as well as further replication, in younger populations.

A critically understudied component of the IMV model is moderators that may either enhance or mitigate the effects of defeat and entrapment on suicidal ideation. Among the moderators proposed by the IMV model, *positive future thinking* is an especially promising cognitive process that may mitigate risk for suicidal ideation. Moderators such as positive future thinking, or the ability to imagine desirable events that may occur in one's life, can help mitigate "setting conditions" for transitioning into suicidal thoughts and behaviors (O'Connor, 2011). Adult-based studies suggest the potential importance of positive future thinking in relation to suicidal ideation: distinguishing it from negative future thinking in suicidal individuals (MacLeod et al., 1993, 1997, 1998, 2005; Hunter and O'Connor, 2003), and demonstrating its prediction of suicidal ideation above and beyond hopelessness[1] (O'Connor et al., 2008). Despite these intriguing theoretical bases, no studies to our knowledge have examined associations between positive future thinking, defeat, and entrapment in predicting future suicidal ideation. Moreover, work exploring future thinking and suicidal ideation (i.e., independent of defeat and entrapment) has been largely limited to adult samples.

It is especially important to explore future thinking in adolescence for two reasons. First, there is a notable improvement in this cognitive ability during this developmental period. Numerous studies suggest that children and adolescents become more oriented toward the future, rather than the present, across development (e.g., Steinberg et al., 2009). Adolescents in particular, relative to children, have been shown to provide more episodic and semantic details when generating future events (Gott and Lah, 2014); this may help prepare them for key developmental tasks of adolescence into early adulthood, including formulation of values, identity, and goals (Marcia, 1980; Nurmi, 1991). Second, future-oriented cognitions have been shown to moderate the association between other psychological traits (e.g., impulsivity) and self-harming behaviors in adolescents (e.g., Chen and Vazsonyi, 2011). Future thinking thereby shows promise as a way to modulate risk for self-injurious thoughts and behaviors, potentially extending to suicidal ideation as the IMV model would predict. Given the developmental salience of future thinking, there is reason to hypothesize that this cognitive process may play a role in modulating risk for suicidal ideation among adolescents, specifically.

Building on prior work, the present study marks the first investigation of how defeat/entrapment, positive future thinking, and their interaction may prospectively predict suicidal ideation during adolescence. We explored the combined construct of *defeat/entrapment* in light of more recent findings suggesting that defeat and entrapment are best captured as a single factor (Griffiths et al., 2015). Specifically, we pursued two aims. First, we aimed to test the strength and specificity of the proposed defeat/entrapment-to-suicidal ideation pathway in adolescents, among whom empirical tests of this association—and suicide theory generally—are lacking. In pursuit of this aim, we directly tested cross-sectional and prospective associations between defeat/entrapment and suicidal ideation among adolescents, and between nonsuicidal and suicidal adolescents. Specifically, we tested

[1]As a conceptual aside, positive future thinking is distinct from constructs such as hopelessness not only in emotional valence, but also in scope. Positive future thinking captures a more discrete cognitive ability, whereas hopelessness captures a broader attitude or outlook (i.e., hopelessness about the future, self, and the world; Beck et al., 1974) that may not only recruit future thinking but other psychological processes (e.g., problem-solving abilities, fixed mindset, and low self-efficacy; Millner et al., 2020). Indeed, feelings of defeat and entrapment without promise of future relief may render death an appealing option.

whether: (1) defeat/entrapment predicts suicidal ideation cross-sectionally; (2) defeat/entrapment distinguishes between adolescents along the continuum of STBs (i.e., suicidal ideation vs. suicide attempt); and (3) defeat/entrapment prospectively predicts suicidal ideation at two follow-up time points (i.e., 3 and 6 months). We hypothesized that greater defeat/entrapment would distinguish suicidal ideation from no suicidal ideation history, but would not distinguish suicidal ideation history from suicide attempt history. We further hypothesized that greater defeat/entrapment would correspond with greater suicidal ideation at baseline, as well as 3- and 6-months later. Second, we aimed to explore how poor future thinking abilities may alter the association between defeat/entrapment and suicidal ideation. In pursuit of our second aim, we tested whether positive future thinking moderates the association between defeat/entrapment and suicidal ideation. Given prior work linking deficits in *positive* future thinking and suicidal ideation, we hypothesized that greater positive future thinking abilities would mitigate the association between defeat/entrapment and suicidal ideation.

MATERIALS AND METHODS

Participants

Participants were adolescents (n = 74) recruited from the community to participate in a larger study examining cognitive deficits in suicidal adolescents. Participants ranged from 12 to 19 years (M = 16.27, SD = 2.21) and were racially diverse (25.7% White; 21.6% Black; 21.6% Asian; 29.7% other; and 1.4% unknown) and majority non-Hispanic (70.3%; 29.7% Hispanic).

The study recruited adolescents with a past-year history of suicidal ideation, as well as adolescents who had never experienced suicidal thoughts or behaviors. Across the final sample included in this investigation, 41.9% (n = 31) of participants endorsed history of suicidal ideation (i.e., with or without suicide attempt history), and 10.8% (n = 8) endorsed history of suicide attempt. Of note, we distinguish between "history of ideation" and "history of ideation *only*." In the following sections, "history of ideation" refers to adolescents with *any* history of suicidal ideation, who may or may not also have a history of suicide attempt. However, "history of ideation only" refers to adolescents with a history of suicidal ideation but not suicide attempt. These distinctions are especially pertinent to Aim 1 data analyses and results, described below.

Measures

Short Defeat and Entrapment Scale

The Short Defeat and Entrapment Scale (SDES; Griffiths et al., 2015) is an 8-item self-report measure assessing feelings of defeat and entrapment over the past week. Participants indicate the extent to which they identify with eight statements on a 5-point Likert scale (i.e., 0 = *Not at all like me* to 4 = *Extremely like me*). Items assessing defeat include "I feel defeated by life" and "I feel that there is no fight left in me," while those assessing entrapment include "I can see no way out of my current situation" and "I would like to escape from my thoughts and feelings." The SDES has demonstrated excellent internal consistency (Griffiths et al., 2015).

Suicidal Ideation Questionnaire

The Suicidal Ideation Questionnaire (SIQ; Reynolds, 1988) is a 30-item self-report measure assessing frequency of suicidal thoughts over the past month. Items are scored on a 7-point Likert scale (i.e., 0 = *I never had this thought* to 6 = *Almost every day*) and assess frequency of both passive (e.g., "I thought about death") and active (e.g., "I thought about how I would kill myself") suicidal thoughts. The SIQ has been shown to have very strong psychometric properties (Reynolds, 1988).

Self-Injurious Thoughts and Behaviors Interview-Revised

The Self-Injurious Thoughts and Behaviors Interview-Revised (SITBI-R; Fox et al., 2020) is a semi-structured interview assessing presence and frequency of suicidal and nonsuicidal thoughts and behaviors across various time frames (e.g., lifetime, past year, past week, etc.). This investigation relied on participants' answers to two questions on the SITBI-R: one question assessing lifetime history of suicidal ideation (i.e., "Have you ever had thoughts of killing yourself?") and one question assessing lifetime history of suicide attempts (i.e., "Have you ever tried to kill yourself?"). This has been validated in adolescents, and modules for suicidal ideation and attempt reveal perfect inter-rater reliability for lifetime presence of suicidal ideation and attempt, as well as excellent convergent validity with the SIQ (Fox et al., 2020; Gratch et al., in press).

Quick Inventory of Depressive Symptomatology-Self Report

The Quick Inventory of Depressive Symptomatology-Self Report (QIDS-SR; Rush et al., 2003) is a 16-item self-report measure assessing depressive symptoms aligned with the nine symptom criteria domains of Major Depressive Disorder, including sad mood, sleep disturbance, and changes in appetite and weight. The QIDS-SR has been shown to have strong psychometric properties, including concurrent validity with other measures of depression (Reilly et al., 2015) and reliability when used with adolescents (αs $\geq$ 0.80; Bernstein et al., 2010). In this investigation, total QIDS-SR scores were calculating excluding item 12 (assessing suicidal ideation).

Future Thinking Task

The Future Thinking Task (FTT; MacLeod et al., 1998) assesses participants' ability to generate and list anticipated future events in their lives across distinct future time frames. In this investigation, we assessed three time periods: the next week, next 3 months (i.e., to fit the 3-month follow-up time frame), and next 5–10 years. Participants are asked to separately generate positive and negative events for each future time period, for a total of six sets of events. For each set, participants were specifically instructed to "think of potential events that may occur in your future" within the given time frame and were provided 1 min to speak aloud as many positive events and, in separate sets, negative events as they could. This study examined positive events, defined as "things you are looking forward to that you think you would enjoy if they did occur."

Events could be trivial or important and planned or unplanned, but participants were asked to generate specific, realistic events that might reasonably happen and would last just a few minutes or hours. Additionally, participants rated the emotional valence (i.e., "What are the types of emotions associated with this event?") and likelihood (i.e., "How likely is it that this event will occur?") of each event on 5-point Likert scales (i.e., valence: 0 = *Very negative* to 5 = *Very positive*; likelihood: 0 = *Not at all* to 5 = *Extremely*). Interviewers recorded participants' event descriptions and valence and likelihood ratings. Following conventional FTT scoring procedures (MacLeod et al., 1998, 2005), a composite positive FTT score (i.e., FTT-Pos) was calculated by multiplying the total number of positive events generated across the three positive event sets; the mean valence rating across all positive events; and the mean likelihood rating across all positive events.

Procedure

Adolescent participants were recruited from New York City and the broader tristate area *via* flyers, community fairs, and online advertisements. After completing a phone screen to determine study eligibility (12–19 years, English proficiency, and no high/imminent suicide risk), participants completed an in-person laboratory visit. Participants under 18 years of age were accompanied by a parent or guardian, who provided informed consent for their child's participation. Adolescents completed study self-report measures (i.e., SDES, SIQ, and QIDS-SR) privately on a computer. The FTT and SITBI-R were administered by trained interviewers. Adolescent participants were compensated with a $40 Amazon.com gift card. Adolescents were sent follow-up surveys *via* email 3 and 6 months after their lab visit to assess suicidal ideation (i.e., SIQ). At 3-month follow-up, participants were also provided a list of the positive and negative events they had generated in the FTT during the baseline lab visit—specifically, those events generated for the "next three months" time frame set—and were asked to indicate whether the events had actually occurred in the 3 months prior.

Data Analyses

Analyses were conducted with the SPSS statistical package (IMB SPSS Statistics, version 25.0). SDES, SIQ (i.e., baseline, 3-month follow-up, and 6-month follow-up), QIDS-SR, and FTT-Pos composite scores were transformed to satisfy assumptions of normality prior to further analyses. Additionally, missing data were observed for follow-up SIQ variables (i.e., 3-month and 6-month). Little's Missing Completely at Random (MCAR) test was not significant and supported the MCAR assumption, $\chi^2(18) = 19.21$, $p = 0.38$, supporting the handling of missing data *via* pairwise deletion. Further diagnostic analyses using independent samples *t*-tests revealed no significant differences in any study variables (i.e., SDES, baseline SIQ, QIDS, and Pos-FTT) between those who did vs. did not have 3-month SIQ data, $t(72) = -0.69$ to 0.45, ps = 0.49–0.71, and 6-month SIQ data, $t(72) = -1.35$ to 1.75, ps = 0.09–0.53. There was also no correlation between history of suicidal ideation at baseline and completion of 3- or 6-follow-ups ($\chi^2 = 0.01$–0.03, ps = 0.87–0.94), suggesting that adolescents with a history of suicidal ideation were not more or less likely to complete follow-ups than controls.

To test our first aim, we conducted a linear regression testing the cross-sectional association between defeat/entrapment and suicidal ideation, with SDES scores as the independent variable and baseline SIQ scores as the dependent variable. *Post-hoc* analyses also controlled for depressive symptoms (QIDS-SR) as a covariate. Additionally, we compared defeat/entrapment across three mutually exclusive groups: nonsuicidal adolescents (i.e., no history of suicidal ideation or attempt); adolescents with a history of suicidal ideation only (i.e., history of suicidal ideation but not attempt); and adolescents with a history of suicide attempt (i.e., history of suicidal ideation and attempt), using one-way ANOVA. For this analysis, adolescents were classified into the category of STBs reflecting the greatest level of severity endorsed, based on lifetime history of suicidal ideation and suicide attempt(s) assessed in the baseline lab visit using the SITBI-R.

In pursuit of our second aim, we tested the association between defeat/entrapment and suicidal ideation across two follow-up time points (i.e., 3-month and 6-month) *via* multiple linear regression models, with SDES scores as the independent variable and SIQ scores as the dependent variable. Prospective models predicting follow-up SIQ (i.e., at 3- and 6-months) also included baseline SIQ as a covariate. *Post-hoc* analyses also controlled for depressive symptoms (QIDS-SR) as a covariate.

Thirdly, to test positive future thinking as a moderator, defeat/entrapment (i.e., SDES) and positive future thinking (i.e., FTT-Pos) variables were centered and multiplied to create an interaction term. Linear regressions were conducted with SDES, FTT-Pos, and (for analyses predicting follow-up SIQ) baseline SIQ entered in the first step. The interaction term was entered in the second step. *Post-hoc* probing analyses were conducted following guidance on testing moderation (Aiken and West, 1991; Holmbeck, 2002). Results of these *post-hoc* analyses were graphed at low (−1 SD below the mean) and high (+1 SD above the mean) levels of positive future thinking. Similar to Aims 1 and 2, additional *post-hoc* analyses explored baseline depressive symptoms (i.e., QIDS-SR) as a covariate in moderation models that significantly predicted suicidal ideation.

RESULTS

Descriptive statistics and Pearson's *r* correlations for SDES, SIQ (i.e., baseline and 3- and 6-month follow-ups), FTT-Pos, and QIDS-SR are presented in **Table 1**. On average, participants generated between 17 and 18 positive future events across the three FTT positive event sets ($M = 17.63$, $SD = 5.97$, *range*: 6–35). Across participants, positive events tended to be rated as moderately likely to occur ($M = 3.82$, $SD = 0.55$) and fairly positive in valence ($M = 4.42$, $SD = 0.29$). Positive events generated included things such as desired activities (e.g., "go to the Museum of Natural History"); anticipated accomplishments (e.g., "get 100% on vocab test"); receipt of gifts, toys, or other

possessions (e.g., "Mom buys me a new game"); and completion of, or relief from, unwanted tasks or responsibilities (e.g., "be done with all my appointments").

Aim 1

In linear regression analyses, SDES significantly predicted baseline SIQ scores. SDES remained predictive of baseline SIQ in multiple linear regression models controlling for depressive symptoms (**Table 2**).

Short Defeat and Entrapment Scale scores significantly differed across groups, $F(2, 71) = 14.34$, $p < 0.001$ (**Figure 1**). Specifically, adolescents with a history of ideation only endorsed greater feelings of defeat/entrapment ($M = 11.35$, $SD = 7.67$) compared to nonsuicidal adolescents ($M = 3.74$, $SD = 5.29$; $p < 0.001$, $d = 1.16$). There was no difference in defeat/entrapment between adolescents with a history of ideation only and those with a history of attempts ($M = 11.63$, $SD = 7.65$; $p = 1.00$, $d = 0.04$).

Additional *post-hoc* analyses explored the defeat and entrapment subscales of the SDES to determine whether these two constructs showed differential associations with suicidal ideation and attempts. Both defeat scores, $F(2, 71) = 13.69$, $p < 0.001$, and entrapment scores, $F(2, 71) = 12.06$, $p < 0.001$, significantly differed across groups. Group differences mirrored those for SDES total scores. Adolescents with a history of ideation only endorsed significantly higher defeat ($M = 4.52$, $SD = 4.02$) and entrapment ($M = 6.83$, $SD = 4.24$) scores compared to nonsuicidal adolescents ($Ms = 1.23$–2.51, $SDs = 2.73$–2.93; $ps < 0.001$, $ds = 1.16$–1.25), even after applying Bonferroni corrections to adjust for multiple comparisons. Neither defeat nor entrapment scores differed between adolescents with a history of ideation only and those with a history of attempts ($ps = 1.00$, $ds = 0.02$–0.03).

TABLE 1 | Bivariate correlations and descriptive statistics.

	1.	2.	3.	4.	5.	6.
1. SDES	--					
2. SIQ (baseline)	0.71**	--				
3. SIQ (3-month)	0.64**	0.71**	--			
4. SIQ (6-month)	0.53**	0.50**	0.72**	--		
5. FTT-Pos	−0.06	−0.16	−0.01	−0.20	--	
6. QIDS-SR	0.77**	0.60**	0.64**	0.59**	−0.15	--
Mean	6.96	18.89	24.50	23.71	299.18	7.50
Standard deviation	7.35	24.92	29.64	31.90	119.27	4.43

*Table presents Pearson's r values. SDES, Short Defeat and Entrapment Scale; SIQ, Suicide Ideation Questionnaire; FTT-Pos, Positive Future Thinking Task (composite score for positive trials); QIDS-SR, Quick Inventory of Depressive Symptoms-Self Report (excludes item 12 assessing suicidal ideation). **p <0.01.*

TABLE 2 | Cross-sectional and prospective linear regression analyses predicting suicidal ideation by defeat/entrapment and depressive symptoms.

	Model 1			Model 2		
	Baseline SIQ	3-mo SIQ	6-mo SIQ	Baseline SIQ	3-mo SIQ	6-mo SIQ
R^2	0.50	0.68	0.54	0.51	0.68	0.55
SDES (β)	0.70**	0.23*	0.12	0.58**	0.17	0.04
Baseline SIQ (β)	--	0.65**	0.64**	--	0.63**	0.62**
QIDS-SR (β)	--	--	--	0.17	0.08	0.55

*SDES, Short Defeat and Entrapment Scale; SIQ, Suicide Ideation Questionnaire; QIDS-SR, Quick Inventory of Depressive Symptoms-Self Report (excludes item 12 assessing suicidal ideation). 3-mo and 6-mo SIQ refer to suicidal ideation severity at 3-month follow-up and 6-month follow-up, respectively. Model 1 includes baseline SIQ as a covariate. Model 2 includes depressive symptoms and baseline SIQ as covariates. R^2, model explained variance, β, standardized beta. *p < 0.05; **p < 0.01.*

Aim 2

Baseline SDES predicted 3-month SIQ in prospective models controlling for baseline SIQ (**Table 2**, Model 1). SDES did not predict 6-month SIQ in prospective models controlling for baseline SIQ. After controlling for baseline depressive symptoms, SDES was no longer predictive of 3- or 6-month SIQ (**Table 2**, Model 2).

Aim 3

Positive future thinking (FTT-Pos) did not moderate the association between defeat/entrapment and SIQ scores from baseline or the 6-month follow-up ($\beta s = -0.01$ to 0.03, $ps = 0.75$–0.96). The interaction between defeat/entrapment and FTT-Pos was, however, significant for prediction of 3-month follow-up SIQ ($\beta = 0.17$, $p = 0.04$). Contrary to hypothesis, results showed that defeat/entrapment was associated with 3-month SIQ among those with *greater* positive future thinking abilities ($\beta = 0.36$, $p = 0.02$), but not among those with lower positive future thinking abilities ($\beta = 0.11$, $p = 0.37$; **Figure 2**). The interaction between defeat/entrapment and FTT-Pos predicted 3-month SIQ at a marginally significant level after controlling for depressive symptoms ($\beta = 0.17$, $p = 0.051$).

Post-hoc analyses further explored elements of FTT-Pos scores to understand exactly which feature of positive future thinking accounted for this significant interaction. We repeated moderation analyses predicting 3-month SIQ using, in separate models, the three values comprising the composite FTT-Pos score: total number of positive events generated across the FTT, mean likelihood of positive events, and mean valence of positive events. The interaction of SDES with total number, but not mean likelihood ($\beta = -0.01$, $p = 0.86$) or mean valence ($\beta = -0.03$, $p = 0.73$), of positive future events significantly predicted 3-month follow-up SIQ ($\beta = 0.20$, $p = 0.01$). Specifically, defeat/entrapment predicted 3-month follow-up SIQ among those who generated more, but not fewer, positive future events ($\beta = 0.41$ $p = 0.003$). The interaction term remained significant after controlling for depressive symptoms ($\beta = 0.19$, $p = 0.02$).

We conducted additional *post-hoc* analyses addressing how positive future thinking may have been maladaptive in nature. Imagining many positive future events that are, for instance, detached from reality and unlikely to occur would presumably not be helpful. To determine how realistic adolescents' imagined positive events were, we assessed whether those events listed

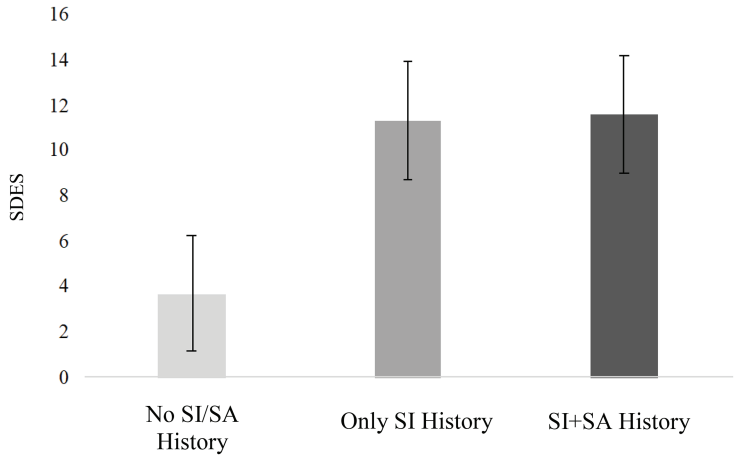

FIGURE 1 | Differences in defeat/entrapment across suicidal and nonsuicidal adolescents. SDES, Short Defeat and Entrapment Scale; No SI/SA History, no history of suicidal ideation or attempt; Only SI History, history of suicidal ideation but not attempt; SI+SA History, history of suicidal ideation and suicide attempt. Error bars represent standard error.

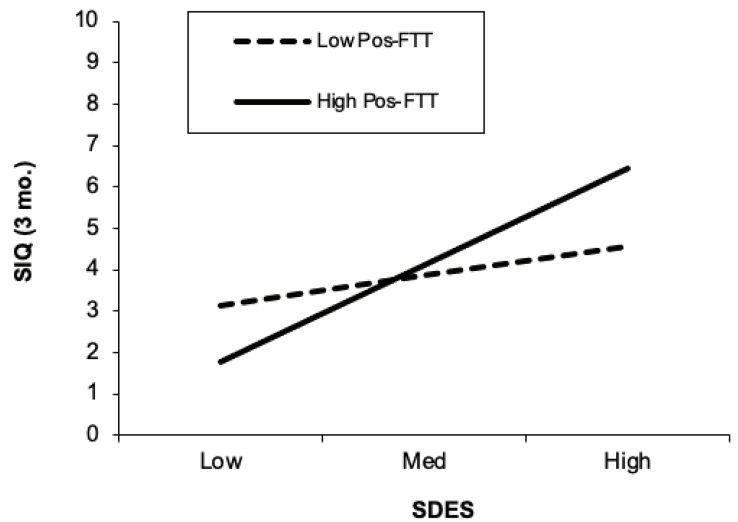

FIGURE 2 | Positive future thinking moderates the association between defeat/entrapment and future (3-month) suicidal ideation. SDES, Short Defeat and Entrapment Scale; SIQ, Suicide Ideation Questionnaire. Greater and lower levels of positive future thinking were defined as +1 SD and −1 SD, respectively. The SIQ scale reflects values of the transformed variable, and not raw scores.

from baseline occurred over the next 3 months and calculated what proportion of them did *not* occur (i.e., unrealistic positive future thinking index). Indeed, the proportion of unrealistic positive future thinking moderated the association between defeat/entrapment and suicidal ideation 3 months later ($\beta = 0.17$, $p = 0.03$). We probed this result at higher (+1 SD above the mean) and lower (−1 SD below the mean) levels of unrealistic future thinking (i.e., proportion of unrealized positive events) and found that defeat/entrapment predicted 3-month SIQ among those with less realistic future thinking (i.e., higher proportions of unrealized positive events; $\beta = 0.42$, $p = 0.004$), but not among those with more realistic future thinking (i.e., lower proportions of unrealized positive events; $\beta = 0.12$, $p = 0.38$; **Figure 3**). The interaction term between defeat/entrapment and unrealistic positive future thinking remained significant after controlling for depressive symptoms ($\beta = 0.16$, $p = 0.045$).

DISCUSSION

This investigation yielded three main findings. First, defeat/entrapment was associated with history of suicidal ideation, as

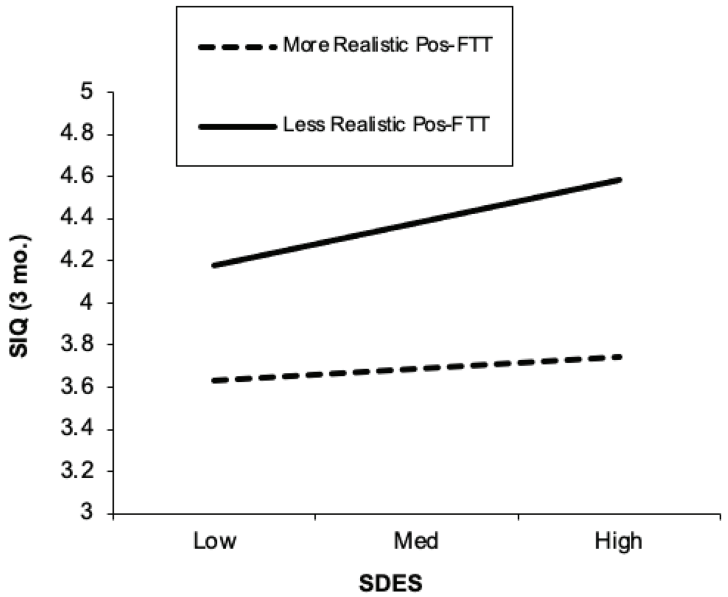

FIGURE 3 | Degree of realistic positive future thinking moderates the association between defeat/entrapment and future (3-month) suicidal ideation. SDES, Short Defeat and Entrapment Scale; SIQ, Suicide Ideation Questionnaire. More vs. less realistic positive future thinking levels (i.e., less unrealistic vs. more unrealistic) were defined as −1 SD and +1 SD, respectively. The SIQ scale reflects values of the transformed variable, and not raw scores.

demonstrated by a significant cross-sectional association between defeat/entrapment and ideation severity, and differences in defeat/entrapment between adolescents with and without a history of suicidal ideation. Moreover, this association was not accounted for by depressive symptoms. These cross-sectional findings align with the IMV model's emphasis on the role of defeat/entrapment in explaining suicidal ideation (vs. suicide attempt), and shows that such associations exist in adolescence. Consistent with the IMV model, defeat/entrapment was specific to history of suicidal ideation: defeat/entrapment distinguished adolescents who had considered suicide from those who had not, but did not distinguish adolescents who had considered suicide from those who had attempted suicide. Indeed, adolescents' experience of defeat/entrapment may help distinguish between absence vs. presence of suicidal thoughts, but may not offer unique predictive validity in distinguishing ideators who have also engaged in suicidal behaviors (i.e., suicide attempts). Additionally, while some studies show differential associations of defeat vs. entrapment with suicidal ideation (e.g., Taylor et al., 2011; O'Connor et al., 2013), we found that ideators showed elevated scores on both defeat and entrapment subscales, suggesting that both constructs may distinguish adolescents who have previously considered suicide from those who have not.

Second, defeat/entrapment was not a robust predictor of future suicidal ideation among adolescents. Defeat/entrapment predicted 3-month follow-up suicidal ideation controlling for baseline ideation, but did not do so controlling for depressive symptoms. This is inconsistent with prior evidence that defeat can predict future suicidal ideation above and beyond depressive symptoms (Taylor et al., 2011). This may be accounted for by the exceptionally strong association between baseline defeat/entrapment and depressive symptoms observed in our sample. Depressive symptoms and defeat/entrapment may reinforce one another; prior work has shown that while defeat/entrapment predicts depressive symptoms, the reverse is also true (Griffiths et al., 2014). This is also in keeping with concepts of "arrested flight" and certain models of depression (e.g., social rank and arrested defenses models; see Carvalho et al., 2013), which link feelings of defeat and entrapment with depressive symptoms (Gilbert and Allan, 1998). Our results may suggest a similar pattern, such that defeat/entrapment increases ideation severity, and suicidal ideation exacerbates feelings of defeat/entrapment.

Third, we found that positive future thinking moderated the association between defeat/entrapment and suicidal ideation at 3-month follow-up. Contrary to hypotheses, greater positive future thinking abilities exacerbated the association between defeat/entrapment and suicidal ideation three months later. When examining components of the positive future thinking score, it was the number of positive events generated, rather than the perceived likelihood or emotional valence of positive events, that drove this moderating effect. These findings initially appear to contradict the IMV model and other research connecting *low* levels of positive future thinking and suicidal ideation (e.g., MacLeod et al., 1997; Hunter and O'Connor, 2003; O'Connor et al., 2004, 2007, 2008). However, this is not the only case of maladaptive positive future thinking: O'Connor et al. (2015) found that high positive intrapersonal future thinking predicted suicidal behaviors among adults. There are several possible explanations for this unexpected pattern. For instance, such a pattern would emerge if adolescents' positive future thoughts

pertained to maladaptive outcomes that would yield negative consequences if they occurred (e.g., risky behaviors). Similarly, suicidal adolescents could experience suicide-related mental imagery when prompted to imagine positive future events (e.g., flash-forwards and day dreams; Holmes et al., 2007; Selby et al., 2007). These possibilities, while interesting, are unlikely, as our cursory review of event content revealed no such thematic patterns. An additional consideration, albeit tentative, is that similar cognitive processes may underlie thoughts of positive future events and thoughts of death or suicide. Other work shows that suicide-related thoughts or mental imagery are future-oriented, often rated as comforting (Holmes et al., 2007; Crane et al., 2012, 2014), and associated with increases in positive affect (Kleiman et al., 2018). That more severely suicidal adolescents may be better at, or more practiced in, engaging in positively valenced, future-oriented mental imagery—in the form of suicidal thoughts or otherwise—presents an intriguing hypothesis. However, this hypothesis is speculative and inconsistent with a majority of prior findings showing weaker positive future thinking among suicidal adults. Nevertheless, future work might explore differences in cognitive processes underlying future-oriented thoughts and mental imagery between suicidal and nonsuicidal adolescents.

Instead, *post-hoc* analyses revealed an alternative explanation: that adolescents' positive future thoughts may be unrealistic, such that they do not attain anticipated positive events and thereby experience greater entrapment and ultimately suicidal ideation. In support of this "unachievability hypothesis," the tendency to imagine less realistic positive future events significantly and robustly moderated the effects of defeat/entrapment on suicidal ideation, such that this association was stronger among adolescents with more unrealistic positive future thinking (i.e., greater proportions of unrealized positive events). Taken together, results suggest that positive future thinking, particularly *unrealistic* positive future thinking, may not always be protective. This finding provides nuance to prior literature largely showing associations between *low* levels of positive future thinking and suicidal outcomes. Future work might attend to characteristics of positive future thinking (e.g., thematic content; perceived likelihood vs. actual occurrence) to further understand how, and under what circumstances, positive future thinking mitigates or heightens risk for suicidal ideation.

Our findings should be interpreted in light of several study limitations. First, the present sample featured a small sample size. This would have increased the risk of Type II error in the case of small effects. Additionally, sample size was further limited by missing follow-up data for prospective analyses. While diagnostic analyses revealed no biases in data missingness, further limiting of sample size represents a notable limitation. Second, we did not assess for verbal fluency. Given the 1 min time limit of the FTT, those who generated higher numbers of positive future events may have done so in part because of greater verbal fluency abilities, thus yielding higher positive FTT scores. Future work should control for general cognitive or verbal fluency in order to remove this potential confound. Third, we did not account for the potential effects of mood on FTT performance. One study assessing the effect of mood on positive future thinking found that positive future thinking decreased following a negative mood induction (O'Connor and Williams, 2014). As we assessed positive future thinking only once, adolescents' FTT performance could have been influenced by mood during the lab visit, and may therefore not accurately measure general future thinking ability across time and mood states. Fourth, our "unrealistic positive future thinking index" may be driven by factors other than the perceived achievability of events listed at baseline. Finally, the present investigation did not test other critical elements of the IMV model, including the transition from suicidal ideation to attempt. Prospective studies featuring larger and more clinically severe samples would be better suited to explore the transition to suicide attempt.

In sum, we have tested elements of the IMV model explaining suicidal ideation and found that not all aspects of the model can be assumed to generalize to adolescence. We encourage future work to carefully consider age differences in theoretical predictors of suicidal ideation in order to better understand this developmental period. We also encourage further examination of future thinking, including different types of positive future thoughts or differences in positive vs. negative future thinking, among suicide researchers. Examining variability in future thinking is aligned with trends in suicide research toward identifying dysfunctional patterns in basic processes, including those normally considered adaptive, that may characterize suicidal individuals (e.g., Glenn et al., 2017b; Millner et al., 2020). Identifying which protective processes to enhance—and how—will help inform future efforts to disrupt patterns of recurrent suicidal ideation.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Teachers College, Columbia University IRB. For minors, written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

OP: conceptualization, formal analysis, and writing – original draft. EG: conceptualization and writing — review and editing. KS: methodology and writing — review and editing. CC: conceptualization, methodology, project administration, and writing — review and editing. All authors contributed to the article and approved the submitted version.

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HYPOTHESIS AND THEORY
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The Psychological Pathway to Suicide Attempts: A Strategy of Control Without Awareness

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Objectives: This paper aims to identify potential areas for refinement in existing theoretical models of suicide, and introduce a new integrative theoretical framework for understanding suicide, that could inform such refinements.

Methods: Literature on existing theoretical models of suicide and how they contribute to understanding psychological processes involved in suicide was evaluated in a narrative review. This involved identifying psychological processes associated with suicide. Current understanding of these processes is discussed, and suggestions for integration of the existing literature are offered.

Results: Existing approaches to understanding suicide have advanced the current knowledge of suicide in various ways. They have guided valuable research in the following areas: motivations for suicide and the psychological distress which influences suicide attempts; ambivalence about suicide; suicidal individuals' focus of attention; and ways in which individuals who contemplate suicide differ from individuals who attempt suicide. We outline a new theoretical framework as a means to integrating all of these concepts into the three principles of control, conflict, and awareness. Within this framework, suicide is regarded as occurring due to a long standing conflict between an individual's personal goals, culminating in an episode of acute loss of control. The new framework posits that the individual then strives to regain control through the means of suicide because of a narrowed awareness of consequences of their actions on other valued goals. This psychological mechanism of limited awareness is posited to be the common pathway by which individuals make a suicide attempt, regardless of which risk factors are present.

Conclusion: This article introduces a theoretical framework that generates several hypotheses for future research, and focuses on psychological processes occurring during immediate crisis. One of the key hypotheses resulting from our predictions on how individuals progress from contemplating to attempting suicide will be tested in

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an ongoing program of research: Individuals who attempt suicide have a significantly reduced awareness of consequences of suicide, which would negatively impact on their important life goals, values, principles, or ideals, compared to individuals who contemplate suicide. Therapy guided by the new framework may be more flexible, immediate, and client-focused than other therapies for suicidal individuals.

Keywords: suicide, suicidal ideation, suicide attempts, prevention, control, awareness

INTRODUCTION

Suicide is a leading cause of death worldwide (World Health Organization, 2016), and more research is needed on arguably the most important factor for intervention - the mechanism which causes individuals to make a suicide attempt (Klonsky and May, 2014). Theoretical models of suicide have made significant progress toward understanding suicide, including the circumstances when individuals attempt suicide (Klonsky et al., 2018). There is currently no common pathway to understanding the multiple types of interventions for suicide and their various mediating mechanisms. Current psychological interventions for suicidal individuals, which are informed by existing theoretical models, have limitations. Since they aim to address multiple risk factors for suicide such as entrapment and perceived burdensomeness, as recommended by existing models (Joiner, 2005; Rudd, 2006; Klonsky and May, 2015; O'Connor and Kirtley, 2018), this often entails a structured approach involving multiple sessions (Linehan et al., 1991; Jobes, 2006; Stanley et al., 2009; Tarrier et al., 2013). Subsequently, clients may have fewer opportunities to speak freely about their problems, and the adaptation of these interventions to settings where time and resources are limited, such as inpatient ward and prisons, may pose challenges. Lastly, existing theoretical models include risk factors which are not directly modifiable in treatment, such as family history of suicide and pain sensitivity (Klonsky and May, 2015; O'Connor and Kirtley, 2018).

This article will review the contributions of various theoretical models to the current understanding of suicide. It will also introduce a new theoretical framework to understanding suicide from ideation-to-action, as recommended in previous literature (May and Klonsky, 2016), and describe how the new framework can integrate the contributions of recent theoretical models. Lastly, we discuss ways in which this theoretical framework may be helpful in informing future research on understanding suicide; in particular, the mechanism underlying suicide attempts and in informing psychological interventions. Our theoretical framework is intended to complement and extend existing models of suicide, and therefore some of its constructs map onto theoretical concepts which are explained in existing theoretical models of suicide using other terms. However, the new integrative theoretical framework has a novel focus on a single pathway to suicide which is mediated by striving for control and goal conflict awareness, both of which will be explained in detail in Sections "A Framework for Understanding Suicide Informed by Perceptual Control Theory", "Predisposing to a Crisis", "Precipitating a Crisis", and "Mediating Suicide Behaviors". Foremost, this theoretical framework focuses on an important niche of when the client is in immediate crisis, and intervention around this time. A simple and effective intervention for crisis periods may be highly beneficial for suicidal individuals, and such an intervention could be informed by this new framework. Once this immediate crisis has been addressed, other more complex theoretical approaches involving risk factors such as perceived burdensomeness could be applied in the longer term. Furthermore, our theoretical approach provides a clearer treatment target which may underlie risk factors such as entrapment and hopelessness, thereby addressing the mechanism underlying suicidal behavior more directly in therapy. This may also enable therapists to use a more client-centered and flexible approach, which could be more suitable for adaptation to challenging settings. Method of Levels (MOL) (Carey, 2006), a therapeutic application of our theoretical approach, shows evidence of promise across mental health settings (Tai, 2009, 2016; Bird et al., 2013; Carey et al., 2013; Griffiths et al., 2019a,b; Grzegrzolka et al., 2019). Our claims about the theoretical approach will be discussed in detail in the narrative review in Sections, "Predisposing to a Crisis", "Precipitating a Crisis", and "Mediating Suicide Behaviors", and a detailed section on the implications for psychological interventions will be provided in Section "Clinical Implications" of the article.

The purpose of introducing the new theoretical framework is to set the stage for a new program of research which aims to test its hypotheses. For the purpose of this article we provide a narrative overview of previous theoretical literature as opposed to an exhaustive review of all theories of suicide (more extensive reviews of theoretical suicide literature can be found elsewhere, Barzilay and Apter, 2014; Gunn and Lester, 2014; Klonsky et al., 2018; Millner et al., 2020). The overview will evaluate theories that follow an ideation-to-action framework, since this framework is recommended for new models of suicide (Klonsky and May, 2014; May and Klonsky, 2016). In addition, it will include existing theories which are most consistent with our theoretical approach. Since the focus of this article is on understanding and explaining suicide from a psychological perspective, only brief reference will be made to existing treatments and/or risk assessments. Throughout the article, our definition of a suicidal crisis is consistent with the original definition provided by Hendin et al. (2007), i.e., "a time-limited psychological state that signifies acute danger of suicide," which can occur as close as minutes before an attempt (Deisenhammer et al., 2009). We agree with previous literature that it involves intense affect (Hendin et al., 2001, 2007) which is elevated from the individual's baseline level of affect, and involves suicidal

ideation and behaviors that indicate an intent to end one's life (Wenzel and Beck, 2008).

WHAT IS SUICIDE?

In summarizing how existing theoretical models have contributed to current understanding of suicide, it is necessary to consider the key psychological processes which may occur during suicide. This includes psychological processes that may occur before an individual becomes suicidal, while they are contemplating suicide, and immediately prior to a suicide attempt. A large number of risk factors have been identified that predispose individuals to becoming suicidal through various mechanisms (O'Connor and Nock, 2014). For example, social risk factors include family history of suicide, whereas others are emotional, such as depression, or cognitive, such as experiences of hopelessness (O'Connor and Nock, 2014). Regardless of which risk factors are present, for many individuals who consider suicide, it is a response to physical or psychological pain and distress, accompanied with an unmet need to escape (Williams, 2014; Calati et al., 2015; Verrocchio et al., 2016).

When a suicidal individual is in crisis, intent to die and a motivation for ending their life act as precipitating mechanisms (Silverman et al., 2007; May and Klonsky, 2013). Individuals who both contemplate suicide (ideators) and make a suicide attempt (attempters) can experience ambivalence about suicide, if they have motivations for suicide and reasons for staying alive (Bryan et al., 2016). In addition, individuals who are in crisis can experience imagery related to suicide, such as images of desired outcomes or unwanted consequences (Hales et al., 2011).

Only a third of people who contemplate suicide make an attempt (Nock et al., 2008), which suggests that there may be critical differences between ideators and attempters (Klonsky and May, 2014). Ideators and attempters have been found to differ in terms of environmental, social, and physiological factors, such as sensitivity to pain and access to means of suicide (Klonsky and May, 2015). In addition, there is evidence that ideators and attempters differ in terms of the psychological processes underlying their experiences leading up to and during suicidal crises. For example, attempters demonstrate an increased focus on suicide-related stimuli (Cha et al., 2010) and reduced fear of death (Smith et al., 2016), relative to ideators. An individual's suicide risk can fluctuate over a period of days or even hours (Bryan et al., 2016), and the period of time between considering suicide and making an attempt can be as short as ten minutes (Deisenhammer et al., 2009). It may be, therefore, that these fluctuations in suicide risk and rapid transitions from contemplating suicide to making an attempt are due to psychological processes, which might be different for ideators and attempters (Rudd, 2006; Bryan et al., 2016, 2019).

The new theoretical framework for understanding suicide will be introduced in the following sections. Perceptual Control Theory (Powers, 1973), the transdiagnostic framework guiding our theoretical approach, will be described. An overview will then be provided of how theoretical models have contributed to our understanding of the psychological processes which may occur during each stage of the progression from psychological distress to a suicide attempt, from distal to proximal processes. These will be grouped into the following three main headings: predisposing to a crisis, precipitating a crisis, and mediating suicide behaviors. The first heading, predisposing to a crisis, refers to psychological processes which increase individuals' vulnerability toward experiencing a mental health problem and potentially becoming suicidal. The second heading, precipitating a crisis, refers to psychological processes which are instrumental in triggering and exacerbating a suicidal crisis. The third heading, mediating suicide behaviors, refers to psychological processes which lead an individual to attempt suicide during a suicidal crisis. For each of these headings, we will explain ways in which the new theoretical framework could potentially address unanswered questions in the existing theoretical literature. A summary of the key elements used in Sections "Predisposing to a Crisis", "Precipitating a Crisis", and "Mediating Suicide Behaviors" is provided in **Table 1**.

A FRAMEWORK FOR UNDERSTANDING SUICIDE INFORMED BY PERCEPTUAL CONTROL THEORY

We present a new framework for understanding suicide, which guides our current and future research, including qualitative and quantitative focus on people with lived experience of suicide attempts. The new framework is informed by the principles of Perceptual Control Theory (PCT) (Powers, 1973), a transdiagnostic framework for understanding psychological well-being and distress (Mansell et al., 2012; Alsawy et al., 2014). PCT has already been applied with good effect to various areas of mental health, including psychosis, bipolar disorder, and phobias (Mansell, 2007; Mansell et al., 2014; Healey et al., 2017; Morris et al., 2018; Griffiths et al., 2019a,b). Studies on these mental health problems have supported hypotheses guided by PCT, that loss of control and goal conflict increase individuals' distress. These theoretical constructs will be explained in the following paragraphs. Since suicide is a transdiagnostic problem, PCT may provide useful contributions to the current understanding of suicide. Explanations of terms used by the framework are provided in **Table 2**.

People as Controllers

From a PCT perspective, all behavior, including suicidal behavior, is an attempt to act on the environment in order to achieve and

TABLE 1 | Key elements of suicide which are described in the current article.

	Heading	
Predisposing to a crisis	**Precipitating a crisis**	**Mediating suicide behaviors**
Cognitive-affective states which increase suicidality	Motivations and direct drivers for suicide	Capability for suicide and access to means
Responses to stressful life events and negative emotions	Ambivalence or internal conflict about suicide	Narrowing of attention
Factors which increase dispositional vulnerability	Suicide imagery	Differences in ability to imagine consequences and make decisions

TABLE 2 | Definition of terms (adapted from Powers, 1973; Mansell, 2005).

Term	Definition
Reference value	A "just right" state in which no action is required. This is an internal standard which is set by genetic disposition or past experience. A reference value can also be described as a goal, personal value, ideal, or principle.
Control system	A homeostatic system which acts to maintain the perception of a particular reference value.
Goal hierarchy	The structure in which personal goals are organized, ranging from abstract higher-level goals to more concrete lower-level goals.
Conflict	The experience of wanting to achieve two incompatible goals at the same time. This results from two control systems with two different reference values attempting to control the same perception. Unresolved conflict can lead to psychological distress.
Error	The discrepancy experienced when one's current experiences do not match the way they want that experience to be (their reference value for that experience).
Awareness	The focus of an individual's attention. An individual's awareness moves around their goal hierarchy, although it is possible to have awareness of more than one goal at the same time.
Limited awareness	A state in which an individual is only aware of one of their goals, and is unaware of how the striving for and achievement of that goal would affect their other goals.
Awareness of the impact of suicide on one's goals	Awareness of how one's other higher-level goals would be adversely affected by suicide.

maintain one's desired experiences (perceptual states) (Powers, 1973, 1998). This process can be described as a dynamic process of control whereby the perceived effects of one's own actions are monitored and adjusted, based on perceptual input, in a negative feedback loop (Powers, 1973). The control of these perceived effects enables an individual to match their perceptual input to a desired *reference value*, or "just right" state, and can be carried out automatically without the need for conscious awareness (Carey et al., 2015). Due to this negative feedback loop, in contrast with theories which view human experiences as resulting from cause and effect on a linear pathway, PCT views individuals as controllers of their experiences and environment (Powers, 1973; Carey, 2018).

The "just right" states that individuals control, which could also be termed as goals, values, principles, or ideals, are structured in a hierarchy ranging from higher-level goals to lower-level goals (Powers, 1973, 1998; Mansell et al., 2015). Throughout this article, in line with the PCT definition, the term *goals* includes values, principles, self-concepts, and ideals, and also refers to the concept of shared systems that an individual belongs to, such as their family, school, country, and community (Powers, 1973). Higher-level goals represent more abstract perceptions, whereas lower-level goals, further down the hierarchy, involve controlling more concrete sensory perceptions (Powers, 1973, 2005; Mansell et al., 2015). For example, a suicidal individual may have a higher-level goal to experience a sense of peace away from their current psychological distress. If they have developed a plan to attempt suicide, they may also have a corresponding lower-level goal specifying a method. Whether goals are considered to be values, principles, self-concepts, ideals, or shared systems depends on the level of the hierarchy where they are situated (Powers, 1973). However, regardless of a goal's level or the term used to describe it, it is the *reference value* for the state that the individual would like to experience. The individual controls their perceptual input to reduce the discrepancy between their current experience and this reference value (Powers, 1973). This dynamic process of control is explained in greater detail in other literature (Powers, 1973, 1998, 2005; Mansell, 2005, 2015; Morris et al., 2016). In order to illustrate our framework, we apply it to the anonymized clinical example of Lucy.

> *Lucy was a 17-year-old British female who was in her final year of school when she attempted suicide. She had struggled with mental health issues over the years following a difficult, traumatic childhood and had a history of close family members experiencing severe mental health problems. Her background and circumstances were predisposing factors for suicidality since they increased her vulnerability toward experiencing psychological distress. Before her attempt, Lucy had had aspirations to go to university and fulfill her ambition of becoming a speech therapist. Her group of friends in school were also very important to her since she found it difficult to make new friends. However, these friends began to take drugs, and pressured Lucy into joining in. Lucy experienced intense anxiety from worrying that taking drugs would affect her studies and her ability to achieve her ambitions, but also worrying that if she did not join in, her friends would reject her and she would become isolated. Lucy experienced feelings of hopelessness and despair for several months, since she could not find a solution which would enable her to achieve her ambitions without being rejected by her friends. The possibility of rejection by her friends and difficulties with fitting in with their group may have led to feelings of thwarted belongingness or perceived burdensomeness. These feelings were a consequence of conflict between Lucy's goals (i.e., the underlying problem) preventing her from achieving either of those goals. When Lucy's feelings of hopelessness and despair became unbearable, they acted as precipitating processes and she attempted suicide. Lucy's experience will be referred to throughout the rest of the article and is illustrated in* ***Figure 1****.*

Reduced Control of Experiences Increases Psychological Distress

People have an intrinsic need to control their perceptions of themselves and the world (Powers, 1973; Grawe, 2006), such as maintaining a sense of safety and relationships with others (Mansell et al., 2015), and this control gives individuals a sense of purpose (Mansell and Carey, 2009). Normal human functioning is described as a state when individuals have as much control as they would like over the experiences that are most important to them (Carey, 2006). Powers (2005) states that when individuals do not have sufficient control over their experiences, they experience *error*, which is defined as a sense of discrepancy between their current experiences and the experiences they would like to have. This sense of discrepancy can result in psychological distress that may manifest in various ways, depending on the individual's goals (Mansell et al., 2012).

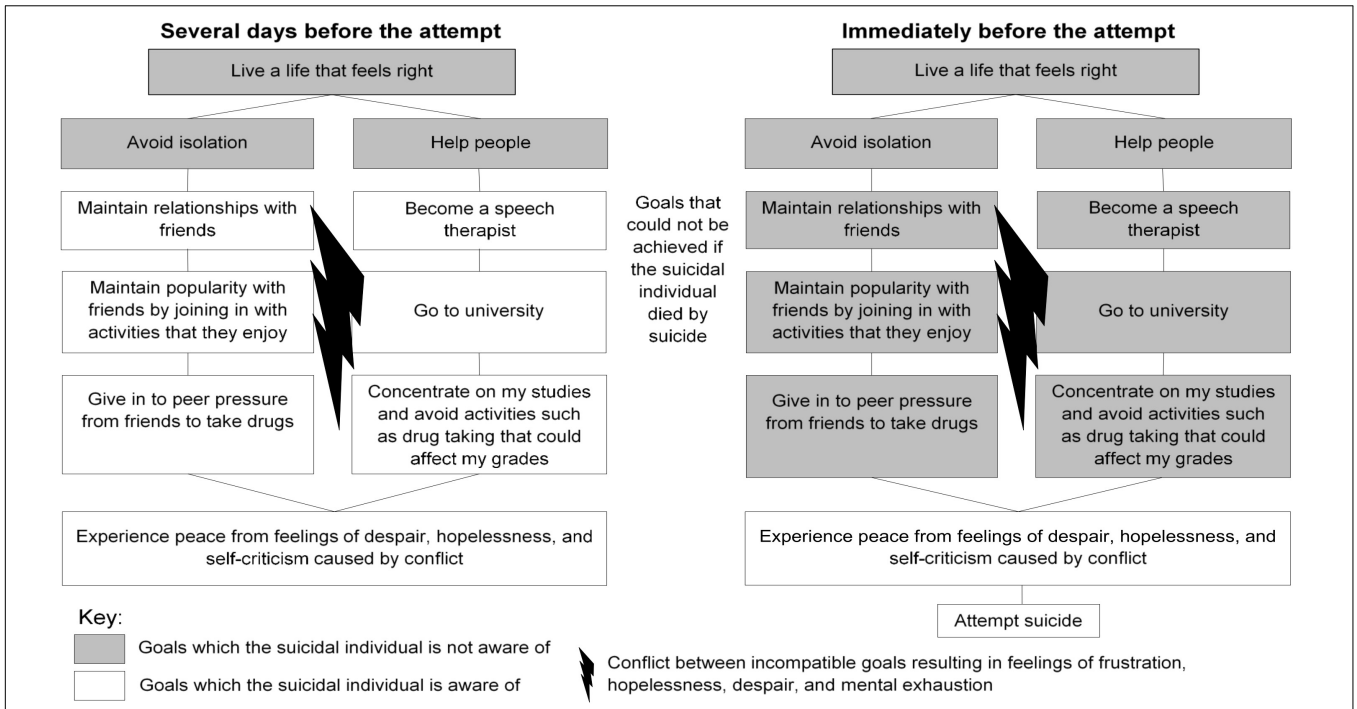

FIGURE 1 | Awareness of goals at different times before a suicide attempt. This example has been adapted from clinical case material.

For example, individuals with spider phobia prefer to maintain a certain distance between themselves and any spiders, and if a spider comes within this preferred distance, they move away (Healey et al., 2017). If they are unable to move away, either due to environmental circumstances, or because they have reasons not to move away (e.g., wanting to appear capable of facing their fears), they experience psychological distress (Powers, 1973; Healey et al., 2017).

Existing literature has highlighted numerous other examples of psychological distress which result from difficulties in controlling one's experiences. For example, individuals may experience negative thoughts or emotions as uncontrollable, or experience difficulties in controlling impulses to gamble or engage in binge eating (Tull et al., 2007; Ehring and Watkins, 2008; Fernández-Aranda et al., 2008). Furthermore, since control is so integral to individuals, in many people without mental health problems, there are times when their higher-level goals over-ride the importance of the intrinsic goals people are born with (Powers, 1973; Mansell et al., 2012). For example, individuals may have an intrinsic goal to avoid experiencing pain, but athletes participating in certain sports, such as marathon runners, willingly endure pain in order to achieve their goals, such as completing a marathon (Powers, 1973; Masters and Ogles, 2008).

Certain circumstances can affect an individual's ability to control their experiences, such as natural disasters, or if the individual develops a serious illness, and this loss of control is often distressing (Powers, 2005; Mansell and Carey, 2009; Mansell et al., 2012). PCT proposes that there is also a more subtle way in which an individual's control over their experiences can be reduced, which is when they try to control two incompatible experiences simultaneously (Powers, 1973). This results in conflict between the individual's goals, which is often outside of their awareness (Carey, 2006). As a result, this conflict can remain unresolved and consequently, the individual is unable to achieve control over either goal, which may lead to ongoing psychological distress (Powers, 1973; Kelly et al., 2011b, 2015; Gray et al., 2017). *Goal conflict* can occur at times in an individual's life when either their goals change, or their life circumstances change so that their goals are no longer compatible (Powers, 1973; Mansell et al., 2012; Carey et al., 2015). For example, if an individual becomes a parent, the newly developed goal to look after the child could cause conflict if they were also very focused on achieving their career goals and had limited time.

According to PCT, any areas of discrepancy between a current and desired experience automatically attracts an individual's attention (Powers, 1973). By focusing on the discrepancy (problem), they may gain new insights into ways of resolving it through a process known as reorganization (Mansell et al., 2012). Reorganization describes the way in which individuals develop new ways of achieving their goals through trial and error (Powers, 1973; Carey, 2006; Mansell et al., 2012). However, if goal conflict remains outside of an individual's awareness, and not resolved, it can become chronic goal conflict (Carey, 2006).

In the clinical example of Lucy, she experienced chronic goal conflict, which led to her attempting suicide. Specifically, she experienced peer pressure from her friends to take drugs and perceived that she would be rejected by them and become isolated if she did not join in. She also believed that taking drugs would affect her studies and her ability to get into university which, from her perspective, would mean that she is a failure.

It was important for her to resolve the conflict between wanting friendships (avoiding rejection and isolation) and wanting to pursue her studies (avoiding being a failure), in order to reach satisfaction with her life. She described the process of constantly trying to find a solution to the conflict as agony, which was when the idea of suicide occurred to her as a means of ending this "agony."

PREDISPOSING TO A CRISIS

This section will discuss psychological processes which may increase an individual's likelihood of contemplating suicide, including psychological risk factors and ways in which individuals respond to distressing emotions. It will then explain how the new theoretical framework can be used to explain these psychological processes. Our definition of processes which predispose individuals to suicide is in line with the definition of predisposing factors used in case formulations in clinical practice (Macneil et al., 2012). This refers to any processes which may increase the individual's vulnerability toward developing a mental health problem that may eventually result in suicide.

Cognitive-Affective Factors Which Increase Suicidality

Previous theoretical models of suicide have highlighted the importance of specific psychological states in increasing suicidality, such as defeat, entrapment, hopelessness, perceptions of burdensomeness, thwarted belongingness, and pain, e.g. (Williams and Williams, 1997; Joiner, 2005; Johnson et al., 2008; Klonsky and May, 2015; O'Connor and Kirtley, 2018). This has provided valuable insight into the kinds of psychological distress that predispose individuals toward experiencing a suicidal crisis. Many of these theoretical models have hypothesized that the simultaneous experience of some of these cognitive-affective states increases an individual's suicide risk. Indeed, when individuals experience some of these states simultaneously, such as defeat and entrapment, or pain and hopelessness, there is an accumulative effect, and they are more likely to contemplate suicide (Dhingra et al., 2015; Klonsky and May, 2015). However, currently known risk factors and cognitive-affective states are inaccurate at predicting suicide attempts and often result in false positive predictions (Franklin et al., 2017). Furthermore, the interactions between large numbers of risk factors and/or cognitive-affective states are difficult to comprehend due to the complexity of these interactions, and therefore do not provide a clear target for intervention (May and Klonsky, 2016; Franklin, 2019). Conversely, when interactions between small numbers of risk factors are analyzed, they have low explanatory power in understanding suicide attempts (Franklin, 2019).

Recent theoretical suicide literature has proposed that since the interplay between risk factors for suicide is so complex, it may be more useful to understand suicide in terms of psychological primitives (Franklin, 2019). Psychological primitives are defined as the "fundamental (i.e., do not rely on anything else psychological to exist) and irreducible (i.e., cannot be reduced to anything else psychological) psychological entities from which all psychological phenomena emerge" (Ortony and Turner, 1990; Russell, 2003; Barrett, 2009, 2012; Barrett and Satpute, 2013; Franklin, 2019). More specifically, according to Franklin (Franklin, 2019), psychological phenomena emerge when individuals interpret internal stimuli (e.g., their experience of affect) and external stimuli using their conceptual knowledge. Franklin (2019) suggested that explaining suicide in terms of this kind of core psychological process may be more beneficial than investigating complex interactions between risk factors. Indeed, progress has been made in understanding the pathways to mental health problems and reduced well-being using similar approaches, such as examining psychological processes which determine response to various factors, such as past experiences of trauma and socio-economic status (Kinderman et al., 2015). Therefore, an approach which focuses on basic psychological processes may provide a more in-depth understanding of a common pathway to suicide attempts than investigating the interplay between specific risk factors. One potential area for refinement would be to identify common psychological mechanisms, by which interactions between these cognitive-affective states (e.g., perceived burdensomeness and thwarted belongingness), might increase and maintain individuals' psychological distress, thereby increasing their likelihood of contemplating suicide.

The PCT Concept of Chronic Goal Conflict Integrates Risk Factors From the Existing Literature

Our new theoretical framework has potential to address the unanswered questions in existing literature which we have highlighted so far by providing an explanation of basic psychological processes that maintain distress. Our framework integrates and potentially explains states such as thwarted belongingness, psychological pain, perceived burdensomeness, hopelessness, defeat, and entrapment, which are predicted to be instrumental in suicide by other recent theories (Joiner, 2005; Johnson et al., 2008; Klonsky and May, 2015; O'Connor and Kirtley, 2018), as arising due to goal conflict. It is clear that these states of mind, such as hopelessness and entrapment, commonly have a crucial role in suicide (Hendin et al., 2007; De Beurs et al., 2019). However, from a PCT perspective, these emotional states are all examples of the *result* of chronic unresolved conflict between goals, and it is the chronic unresolved conflict which is the *mechanism* underlying the distress (Carey, 2006). For example, it is likely that a sense of entrapment is experienced when an individual has attempted many different solutions to resolve a particular conflict, none of which have been successful (Gilbert and Allan, 1998). This conflict between goals, which remains unresolved, is likely to lead to the sense of entrapment, whilst having many unsuccessful attempts at resolving the problem is likely to accompany a sense of defeat, i.e., the failed struggle (Gilbert and Allan, 1998; Taylor et al., 2010). This is consistent with evidence that internal entrapment, defined as a sense of being trapped by one's own thoughts and feelings (Gilbert and Allan, 1998), is more strongly associated with suicidal ideation than external entrapment, defined as being trapped by external circumstances (Gilbert and Allan, 1998; Rasmussen et al., 2010; Owen et al., 2018; De Beurs et al., 2019).

Furthermore, there is growing evidence that defeat and entrapment both reflect a transdiagnostic psychological mechanism which underlies suicidal ideation (Griffiths et al., 2015; Owen et al., 2018), and we suggest that this underlying mechanism is goal conflict. In the case of perceived burdensomeness, if one of an individual's higher-level goals involves trying not to be a burden to other people, they will take steps to maintain this. However, they may also have reasons to avoid taking these steps, such as if they need social support in order to manage the distress arising from a traumatic life event or symptoms of a mental health problem. These reasons for both avoiding being a burden to others and seeking help or support from others will entail conflict between the two incompatible goals. As a result of this conflict, neither "just right" state is achieved (Powers, 1973; Carey, 2006), and so the individual is unable to adequately control their experience of not being a burden. If such a conflict remains unresolved, the individual will experience chronic loss of control of this important higher-level goal, which is likely to cause psychological distress (Mansell et al., 2012). Therefore, the emotional states that play key roles in other models are integrated and explained as arising due to conflict between important life goals, and the way in which this conflict is experienced depends on individual circumstances (Carey, 2006; Mansell et al., 2012, 2015; Mansell and McEvoy, 2017). Indeed, there is evidence that goal conflict underlies psychological distress and reduced wellbeing (Kelly et al., 2011a, 2015; Gray et al., 2017).

Moreover, we posit that the reason the *combination* of thwarted belongingness and perceived burdensomeness leads so many individuals to consider suicide (Joiner, 2005) is due to goal conflict. The conflict most likely includes a goal to not feel like a burden to other people and a goal to feel a sense of belongingness, both of which are likely to come from a more general higher-level goal to connect to other people, which may be further up in the goal hierarchy (Mansell et al., 2015). If an individual feels that they may be a burden to other people, the steps they take to reduce their perceived burdensomeness may also decrease their sense of belongingness, resulting in feelings of thwarted belongingness. If they take steps to increase their sense of belongingness, such as relying on other people for social support, they may begin to perceive themselves as being more of a burden, thereby increasing their feelings of perceived burdensomeness. The chronic unresolved conflict which, for that individual, may arise from incompatibility between these goals (Carey, 2006) may lead to the kind of ongoing psychological distress that causes some individuals to consider suicide. We agree with theories which postulate that psychological pain plays an important role in suicide (Klonsky and May, 2015), but we posit that the mechanism underlying the psychological pain is chronic goal conflict. Therapeutic applications of this theoretical approach to understanding psychological distress would aim to target the underlying mechanism, i.e., goal conflict, rather than the array of outcomes that are generated by it, such as entrapment or hopelessness. We posit that if goal conflict is the key target for intervention in therapy, psychological states such as feelings of entrapment, hopelessness, or perceived burdensomeness will reduce; whereas targeting these states (e.g., perceived burdensomeness) in therapy addresses the problem less directly. From this perspective, suicidal individuals' problems may be resolved less efficiently or may not be fully resolved, and they may be more likely to continue experiencing suicidal thoughts than if the goal conflict was addressed directly.

Responses to Stressful Life Events and Negative Emotions

Cognitive behavioral models of suicide posit that the way in which individuals respond to stressful life events and negative emotions can increase their likelihood of experiencing suicidal crises, such as rumination over negative experiences or feelings of thwarted belongingness (Johnson et al., 2008; Wenzel and Beck, 2008; Williams et al., 2016). There is evidence that responses such as rumination, experiential avoidance, or avoidance-based coping attempts, are associated with increased distress (Penley et al., 2002; O'Connor et al., 2007; Karekla and Panayiotou, 2011). A large study involving 32,827 participants from the general population demonstrated that these kinds of psychological processes mediate the impact of life events, risk from familial mental health history, and social circumstances, such as income, on mental health (Kinderman et al., 2013). Since none of these psychological processes reliably differentiate between ideators and attempters (May and Klonsky, 2016; Franklin et al., 2017), they may increase some individuals' vulnerability towards experiencing mental health problems, but are unlikely to be involved in the final common pathway to suicide attempts.

Responses to Stressful Life Events and Negative Emotions From a PCT Perspective

Our theoretical framework has potential to explain how psychological processes such as rumination and experiential avoidance can exacerbate distress which may cause an individual to consider suicide. From a PCT perspective, the process of reorganization is necessary to resolve goal conflict, but for this process to occur, the individual needs to focus their awareness on the level above the conflicting goals within their goal hierarchy (Carey, 2006). Awareness of higher-level goals which are above the level of the goal conflict is necessary to enable the individual to identify the underlying purposes of the conflicting goals, and consequently re-evaluate new ways of achieving those goals (Mansell et al., 2012; Carey et al., 2014a). For example, a case study (Grzegrzolka and Mansell, 2019) described a client who was in conflict, but who experienced therapeutic change by focusing his awareness on the level above the conflicting goals. The client wanted to change his principles of overworking and socializing by frequently drinking at the pub, in order to feel less tired throughout the week. He was in conflict since he did not want to change these principles, since he values his work and his social life. Therapy helped him to focus his awareness above the level of these conflicting principles, and he had a realization regarding his own identity which appeared to be at higher level. This realization was that being a mental health professional himself, he should be willing to make changes necessary for his own well-being. This realization enabled him to make changes to his principles, such as how much he prioritized his work or social life, so that they were no longer in conflict with each other.

However, if the individual only focuses their attention on the level of the two conflicting goals, they may not reach a solution to their problem (Carey, 2006; Mansell et al., 2012; Carey et al., 2015), and the resulting distress may increase their risk of suicide. This exclusive focus on the level of the conflicting goals and subsequent distress is reflected in the descriptions of various transdiagnostic strategies which have been examined in other literature (Williams et al., 2016; Mansell and McEvoy, 2017). These strategies include thought suppression, worrying, self-punishment, experiential avoidance, and substance misuse, and are used as a means of controlling one's experiences (Carver et al., 1989; Hayes et al., 1996; Purdon and Clark, 1999; Moore and Abramowitz, 2007). However, since many of these strategies are associated with increased distress (Hayes et al., 1996; Purdon and Clark, 1999; Penley et al., 2002; Moore and Abramowitz, 2007; Karekla and Panayiotou, 2011) and do not address the underlying goal conflict, they exacerbate the problem further and the individual remains in chronic conflict (Mansell, 2011a). For example, instead of talking through her problems with family members or friends, Lucy tried to suppress thoughts that she might fail at her exams whenever they came into her awareness.

Factors Which Increase Dispositional Vulnerability

While the primary focus of this section is on psychological processes that increase individuals' likelihood of contemplating suicide, the role of dispositional vulnerability factors such as genetics, biological circumstances, and an individual's personality and psychological characteristics must be acknowledged (Wenzel and Beck, 2008; Brodsky and Mann, 2017). The Stress-diathesis model of suicide (Brodsky and Mann, 2017) posits that trait factors such as lower serotonin function, genetics, and the impact of childhood experiences increase individuals' vulnerability towards suicide. When these trait factors interact with state factors, such as symptoms of psychosis, or negative life events such as losing one's job, individuals may experience suicidal ideation which could lead a suicide attempt (Brodsky and Mann, 2017). Wenzel and Beck's cognitive model of suicidal behavior (Wenzel and Beck, 2008) holds similar assumptions but from a cognitive perspective. It proposes that suicidal individuals have psychological characteristics, such as overgeneral memory, problem-solving deficits, maladaptive cognitive styles, and personality traits such as neuroticism, which predispose these individuals to becoming suicidal in the presence of severe life stressors (Wenzel and Beck, 2008).

A PCT Understanding of Dispositional Traits

From our theoretical perspective, all dispositional factors which increase vulnerability to mental health problems are integrated using the concepts of control and conflict (Carey et al., 2014a,b; Mansell et al., 2015; Mansell, 2016). According to PCT, genetic traits, biological circumstances, psychological characteristics, and environmental factors impact on individuals' ability to control aspects of their lives which are important to them, potentially leading to poorer wellbeing and mental health (Mansell et al., 2012, 2015; Carey et al., 2014a,b; McEvoy et al., 2016). For example, Alzheimer's disease, which occurs partly due to genetic factors (Moreno-Gonzalez et al., 2020), can negatively impact on individuals' mental health and lead to suicide in some cases (Purandare et al., 2009; Seyfried et al., 2011; Cui et al., 2019). The disease affects individuals' ability to maintain their sense of self and function in their daily lives, by reducing their ability to concentrate, communicate, and complete tasks such as making tea (Bastin et al., 2010; McEvoy et al., 2016). This lack of control over their lives can lead to psychological distress and reduced wellbeing (McEvoy et al., 2016). Similarly, some individuals have personality traits that predispose them towards hypomanic experiences, which in some cases lead to a diagnosis of bipolar disorder, a risk factor for suicide (Kwapil et al., 2000; Brodsky and Mann, 2017). From a PCT perspective, it is not the hypomanic experiences which directly cause mental health problems, but resulting chronic conflict between important life goals of these individuals (Mansell, 2016). Lastly, PCT posits that environmental factors, such as experiences of trauma, impact on mental health when they result in chronic conflict between an individual's goals, thereby reducing their control over their experiences (Carey et al., 2014b). One example of goal conflict underlying trauma is someone wanting to forget their experiences of abuse so that they can move on, but wanting to keep remembering their abuser in order to continue hating them (Carey et al., 2014b). Our theoretical framework posits that all dispositional trait and state factors, such as biological, environmental, psychological, and neurocognitive factors (Wenzel and Beck, 2008; Brodsky and Mann, 2017), can increase vulnerability towards suicide by reducing individuals' control over their experiences.

The theoretical framework we present, as applied to suicide, has important advantages over theoretical models such as the Stress-diathesis model of suicide (Brodsky and Mann, 2017) and a cognitive model of suicidal behavior (Wenzel and Beck, 2008). Firstly, as previously mentioned, it offers an explanation of core psychological processes which underlie all dispositional trait and state factors, therefore providing an account which does not rely on analyses of interactions between risk factors. Secondly, both of these models assume linear cause and effect, but there is evidence that suicide risk fluctuates and does not necessarily follow a linear pathway (Bryan et al., 2016, 2019; Klonsky et al., 2018). In contrast, our theoretical framework, by understanding human functioning as a negative-feedback process by which individuals continually attempt to control their experiences (Carey et al., 2014b), provides a more dynamic way of understanding fluctuations in suicide risk. Thirdly, these models describe fewer details on how individuals move from suicidal ideation to making an attempt, whereas our theoretical framework provides an in-depth explanation of psychological mechanisms by which individuals attempt suicide. The latter two points will be explained in greater detail in the "Precipitating a Crisis" and "Mediating Suicide Behaviors" sections.

PRECIPITATING A CRISIS

This section will describe psychological processes which may trigger a suicidal crisis, including individuals' motivations for

suicide. The potential roles of ambivalence about suicide and suicide imagery before and during suicidal crises will also be considered. Our definition of processes which precipitate a crisis is consistent with definitions of precipitating factors within the literature on clinical case formulations (Macneil et al., 2012), i.e., processes which precede the onset of a suicidal crisis. We consider processes which predispose individuals to suicide to be distinct from precipitating processes, since the former increase an individual's general vulnerability towards mental health problems, whereas the latter occur more specifically and immediately before the onset of a suicidal crisis.

Motivations and Direct Drivers for Suicide

It is vital to understand suicidal individuals' motivations for suicide, in order to address these motivations within psychological interventions (May and Klonsky, 2013). This is particularly crucial since individual circumstances can affect the influence of risk factors on suicidal behavior (Pompili, 2018), and the relationship between risk factors and suicidal behavior is complex (Pompili et al., 2010). Reviews of existing evidence indicate that certain biological risk factors and cognitive processes are only problematic in particular contexts (Carey et al., 2014b).

There have been few studies on direct drivers of suicide or motivations for suicide which have been guided by theoretical models (May and Klonsky, 2013). Direct drivers of suicide are defined as the thoughts, feelings, and behaviors which lead to the individual becoming suicidal, but which are more specific to the person's individual circumstances than emotional states, such as hopelessness or entrapment (Jobes, 2006; Tucker et al., 2015). They include an individual's internal experiences and what makes specific emotional states, such as thwarted belongingness, problematic for them (Tucker et al., 2015). Tucker and colleagues (Tucker et al., 2015) give the example of a man who wants to end his life because he perceives himself to be a burden to others (the direct driver), which are due to his inability to keep a job, bad financial circumstances, and mental health problems (indirect drivers). An increased theoretical focus on drivers or motivations for suicide may be helpful in future research, particularly given the limitations of risk factors in providing a greater understanding of suicide (Franklin et al., 2017). Tucker and colleagues emphasized the importance of understanding the idiosyncratic direct driver for each suicidal individual, whether that driver is perceived burdensomeness, impulsivity, or interpersonal isolation (Ellis et al., 2012; Tucker et al., 2015), such as what makes a particular individual feel like a burden. However, a theoretical framework hypothesizing a common psychological process that motivates individuals to consider suicide, regardless of their idiosyncratic experiences and individual drivers, may provide a clearer target for psychological interventions. It may also provide insight beyond what is currently known from research on emotional states or risk factors.

Loss of Control Precipitates Suicidal Crises

The new theoretical framework for understanding suicide offers the explanation that loss of control is the common psychological process underlying motivations for suicide regardless of individuals' idiosyncratic experiences. We posit that if goal conflict remains unresolved, individuals may experience an acute loss of control as a result of neither goal being achieved (Mansell, 2005), potentially resulting in sufficient psychological distress for the individual to experience a suicidal crisis. This is consistent with previous theoretical claims that individuals experience the greatest distress when they perceive a discrepancy between their perception of their current experiences and the states they would like to experience (Williams et al., 2016).

However, there are subtle differences in the way in which our account conceptualizes these ideas. Some accounts postulate that distressing emotions trigger a sense of discrepancy (Williams et al., 2016). In contrast, we posit that anyone who is unable to control the experiences which are most important to them will experience a prolonged sense of discrepancy or loss of control (Carey, 2006). We posit that the distressing emotions arise when individuals become aware of this discrepancy, and that the emotional state an individual experiences will depend on which kinds of goals they are unable to achieve (Mansell et al., 2015). For example, an individual who feels unable to achieve their goal of feeling a sense of belonging with other people may experience feelings of thwarted belongingness.

If the use of strategies to cope with this loss of control, such as taking drugs, drinking alcohol, or engaging in experiential avoidance, reduce an individual's distress on a short-term basis, they may continue using these strategies (Mansell and McEvoy, 2017). However, since these strategies prevent the individual's awareness from focusing on the level of the goal hierarchy where it needs to be, i.e., the level above the conflicting goals, reorganization cannot take place (Mansell et al., 2012, 2015; Mansell and McEvoy, 2017). Therefore, the continued sense of loss of control arising from the conflicting goals (Mansell et al., 2012) may result in individuals becoming more likely to experience a suicidal crisis. This loss of control can involve an individual feeling unable to make decisions, not knowing what they want, or experiencing a loss of sense of identity, depending on which level of the goal hierarchy the loss of control occurs (De Hullu, 2020). For example, when Lucy initially suppressed thoughts that she might fail at her exams, this redirected her attention away from the goal conflict, and she felt less distressed temporarily. However, the more she suppressed these thoughts, the more often they returned to her awareness, making her experience an even greater sense of loss of control. This led to a chronic and overwhelming sense of loss of control and as a result, she began to frequently experience severe psychological distress, which eventually led to a suicidal crisis.

Suicide as a Means of Controlling Perceptual Experiences

According to our framework, individuals' motivations for suicide occur as a result of having a specific higher-level goal which they believe could be achieved by suicide. For example, Lucy believed that the distressing emotions she was experiencing, including a feeling of "agony," would end if she died by suicide. We postulate that in many cases these higher-level goals involve ending or

escaping from physical or psychological pain, but that this is not necessarily the case.

Since control is a dynamic process (Powers, 1973), this may explain fluctuations in suicide risk (Bryan et al., 2016); it is posited that individuals' desire to attempt suicide at any given moment depends on their control over goals which could be achieved by suicide. For example, during moments when Lucy experienced less distress, she was less motivated to attempt suicide. This dynamic process of control is explained and illustrated in other literature (Powers, 1973, 2005; Mansell and Huddy, 2018), including mental health literature (Mansell, 2005; Morris et al., 2016), and from 3.00 min onward in a video explaining PCT (Mansell, 2011b).

Ambivalence or Internal Conflict About Suicide

Feelings of ambivalence or internal conflict are common in the build up to and during suicidal crises. In a sample of 888 attempters, 85.4% experienced ambivalence about whether they wanted to die (Kim et al., 2018). Clinicians are advised to explore ambivalence about suicide (Berman and Silverman, 2014) in assessments such as the Collaborative Assessment and Management of Suicidality (CAMS) (Jobes, 2006). Furthermore, ambivalence towards suicide plays a crucial role, on an ongoing basis, for multiple suicide attempters, both causing them distress and keeping them alive (Bergmans et al., 2017). Investigating psychological processes involved in ambivalence about suicide may lead to a greater understanding of the mechanisms underlying suicide attempts, particularly since ambivalence can deter individuals from attempting suicide (Jobes, 2006; Bryan et al., 2016).

The role of ambivalence about suicide has been acknowledged by some suicide theorists (Shneidman, 1964; Stengel, 1964; Linehan et al., 1983; Jobes, 2006) and theoretical models, such as the Fluid Vulnerability Theory (FVT) (Rudd, 2006) of suicide. However, a limitation of existing literature is that few theoretical models which follow an ideation-to-action framework include ambivalence about suicide as a key concept, despite its important role in suicide (Jobes, 2006; Bryan et al., 2016). The FVT is the only model following an ideation-to-action framework which fully considers the role of ambivalence (Bryan, 2020). Although the FVT offers a useful approach to understanding fluctuations in individuals' wish to live and wish to die, it provides fewer details on the psychological processes which may underlie these fluctuations. A theoretical framework which provides a more in-depth understanding of ambivalence than previous theoretical models may be useful in guiding future research. Specifically, a theoretical framework specifying the psychological processes involved in the balance between one's reasons for wanting to live and wanting to die in greater detail would expand on previous theoretical accounts. This could include mechanisms by which individuals' focus on these reasons varies over time.

Ambivalence About Suicide Reflects Internal Conflict Between Goals

The new theoretical framework for understanding suicide expands on accounts from previous literature by providing a deeper explanation of the psychological processes involved in the balance between one's reasons for living and reasons for wanting to die. From a PCT perspective, the reasons for living and reasons for wanting to die which are referred to in previous literature (e.g., Jobes, 2006) are conceptualized as higher-level goals. Individuals may experience ambivalence about suicide when they have awareness of the higher-level goal motivating them to end their lives but are also aware of higher-level goals or ideals which would be negatively impacted on if they died by suicide. Since both types of goal are incompatible, this is another example of goal conflict, which can become chronic if it remains unresolved (Carey, 2006; Mansell et al., 2012). We posit that ambivalence about suicide can be distressing because chronic unresolved conflict prevents individuals from having enough control over their experiences (Powers, 1973; Carey, 2006; Carey et al., 2014a).

However, ambivalence about suicide can also be protective against suicide attempts (Bergmans et al., 2017), since an awareness of goals which would be negatively impacted on by suicide may deter individuals from attempting suicide (Tarrier et al., 2013). We agree with Klonsky and May (Klonsky and May, 2015) that connectedness is a major protective factor, but we conceptualize it as the amount of control an individual has over the perceptual state of feeling connected. We posit that greater awareness of a higher-level goal to feel connected is likely to be protective against suicide. Our theoretical account is consistent with findings that ambivalence can be both distressing and protective in suicidal individuals (Bergmans et al., 2017). However, it goes beyond recent theoretical accounts of ambivalence about suicide (Linehan et al., 1983; Jobes, 2006; Rudd, 2006), since we posit that one's combined reasons for living and reasons for dying are simultaneously associated with distress, due to the loss of control they may entail.

Suicide Imagery

Mental imagery plays a role in suicide, particularly during suicidal crises, since it is essential for planning, goal setting, and choosing between options, and enables individuals to rehearse events in their minds (Schacter et al., 2008; Crane et al., 2012). Individuals experience mental imagery when thinking about potential consequences of their actions (Gilbert and Wilson, 2007), and imagery influences future behavior (Hales et al., 2011). Suicidal individuals can experience "flash-forward" images of their potential suicide, containing images of methods and potential desired and undesired consequences, such as family members' reactions (Hales et al., 2011). The role of these images may be complex in suicide, since both ideators and attempters experience suicide imagery, and imagery deters some individuals from engaging in self-harm and attempting suicide (Hales et al., 2011; McEvoy et al., 2017). Therefore, experiences of suicide imagery may be linked to individuals' reasons for wanting to die and for wanting to live, and may affect or be influenced by the balance between these reasons.

In addition, addressing the content of mental imagery in therapy can reduce psychological distress (Holmes et al., 2007a) and reduce suicidal ideation in suicide attempters (Rahnama et al., 2013). For example, the Broad Minded Affective Coping

(BMAC) task (Tarrier, 2010), a key component of Cognitive Behavioral Therapy for Suicide Prevention (CBSP) (Tarrier et al., 2013), uses mental imagery to reconstruct positive memories, thereby increasing access to their associated positive emotions. Therefore, the images which suicidal individuals experience warrants further investigation which is guided by theoretical hypotheses.

Currently, models such as the Integrated Motivational-Volitional Model of suicide (IMV) (O'Connor and Kirtley, 2018) explain the role of suicide imagery as a form of cognitive rehearsal of suicide. However, this does not account for the role of imagery in cases when it deters individuals from engaging in self-harm or attempting suicide (Hales et al., 2011; McEvoy et al., 2017). A more in-depth explanation of suicide imagery is needed, which explains the mechanisms by which imagery both deters individuals from and influences individuals to attempt suicide, and how these mechanisms relate to ambivalence about suicide.

Suicide Imagery Reflects Individuals' Goals

Our framework for understanding suicide offers a theoretical explanation of the mechanisms by which images of potential consequences influence whether individuals will attempt suicide, and their relationship with ambivalence about suicide. The PCT explanation of mental imagery is consistent with previous cognitive literature stating that imagery is a means of rehearsing future actions and simulating potential consequences (Gilbert and Wilson, 2007; Schacter et al., 2008). According to our framework, individuals experience "flash-forward" suicide imagery when they have a higher-level goal which could be achieved by suicide that has come into their awareness. This enables individuals to imagine how the goal of ending their life could be achieved, so this aspect of our account is consistent with theoretical accounts conceptualizing suicide imagery as a form of cognitive rehearsal for suicide (O'Connor and Kirtley, 2018). For example, prior to making a suicide attempt, Lucy imagined herself cycling in front of cars on the road as a means of ending her life.

Our account also differs from some previous theoretical accounts, such as the IMV (O'Connor and Kirtley, 2018), since our account also emphasizes a potentially protective aspect of suicide imagery. We postulate that some suicide imagery occurs due to the individual becoming aware of higher-level goals which would be negatively impacted on by suicide. Therefore, some imagery may enable individuals to become more aware of potential negative consequences of suicide which are linked to their reasons for living, and thus have a positive impact (Tarrier, 2010; Tarrier et al., 2013). For example, after Lucy had survived a suicide attempt, she experienced images of her family's reaction if she had died, and felt acute sadness and regret that her actions could have had these consequences. This account is consistent with existing therapeutic techniques which utilize protective aspects of mental imagery in clinical practice. For example, the BMAC (Tarrier, 2010; Tarrier et al., 2013) aims to support suicidal individuals' imaginal rehearsal of key positive memories, which are typically key social events, such as their wedding day, one of their children being born, or a family holiday.

MEDIATING SUICIDE BEHAVIORS

The following section will discuss psychological processes which may cause individuals to attempt suicide during a suicidal crisis.

Capability for Suicide and Access to Means

Recent theoretical models of suicide which follow an ideation-to-action framework, including the IMV (O'Connor and Kirtley, 2018), 3-Step Theory (3ST) (Klonsky and May, 2015), and Interpersonal Theory of Suicide (IPTS) (Joiner, 2005), posit that individuals progress from suicidal ideation to suicide attempt if they have sufficient capability for suicide. Joiner (2005) argues that for evolutionary reasons, people avoid threats such as the risk of injury or death, and therefore, the act of attempting suicide involves overcoming one's fear of death or sensitivity to pain. Through the process of habituation, individuals' fear of death and pain sensitivity decrease, and consequently, these individuals are more capable of making a suicide attempt (Joiner, 2005).

The 3ST and IMV have expanded on these ideas by proposing that environmental and social factors, such as access to means of suicide and exposure to suicide attempts made by family members, also influence whether individuals attempt suicide (Klonsky and May, 2015; O'Connor and Kirtley, 2018). These ideas have been supported by recent empirical evidence (Klonsky and May, 2015; Smith et al., 2016). However, while knowledge of these factors is important for suicide prevention strategies on a societal level (Zalsman et al., 2016), it does not highlight a clear treatment target which is amenable to psychological interventions. Furthermore, it does not explain fluctuations in individuals' ambivalence about attempting suicide (Bryan et al., 2016; Bergmans et al., 2017). Therefore, a further refinement to these theoretical ideas could be to specify precise psychological processes occurring during a suicidal crisis that contribute to an individual's decision to make a suicide attempt. This would guide further research on these psychological processes, thereby informing ways in which psychological interventions could be refined to directly address such processes.

Narrowing of Attention

Theorists have postulated that some individuals experience a narrowing of attention (or "cognitive constriction"), only focusing on certain aspects of their experiences when they are feeling suicidal (Shneidman, 1964; Johnson et al., 2008; Wenzel and Beck, 2008; Williams et al., 2016). Indeed, suicide-specific rumination, defined as a fixation on one's suicide-related thoughts and plans (Rogers and Joiner, 2017), predicts attempts over and above other risk factors (Rogers and Joiner, 2018). In addition, individuals at high risk of suicidal behavior experience difficulties in controlling the focus of their attention, and attempters demonstrate reduced cognitive inhibition compared to ideators (Richard-Devantoy et al., 2015; Thompson and Ong, 2018). However, an explanation of these differences in focus of attention and attentional control between ideators and attempters is not included in theoretical models which fit the recommended ideation-to-action framework (Klonsky and May, 2014), such as

the IMV, 3ST, and IPTS. Furthermore, no theoretical models currently exist which attempt to integrate these related but separate constructs. Therefore, further refinements to the existent theoretical literature could integrate these findings and explain how these psychological processes influence whether individuals attempt suicide.

Narrowing of Attention and Limited Awareness: The Common Pathway From Ideation to Suicide Attempts From a PCT Perspective

The core predictions of our framework for understanding suicide, which will now be outlined, have the potential to integrate these findings on attentional control and narrowing of attention using the concept of limited awareness. Our framework proposes that limited awareness is the final common psychological pathway underlying suicide attempts, regardless of which risk factors are present in an individual's life. Even though the loss of control resulting from goal conflict automatically attracts an individual's attention, for many people, their attention is naturally drawn away from any prolonged focus on the problem to other more wide-ranging priorities in their lives (Mansell et al., 2012; Kelly et al., 2013). People vary in their propensity to balance focusing on pursuing particular goals with being flexible enough to shift their attention to wider issues in their lives (Kelly et al., 2013).

Limited awareness occurs when individuals become focused on the pursuit of one particular goal to the extent that they lose sight of how this might impact upon other goals (Powers, 1973; Mansell, 2005). This can include a limited awareness of both concrete lower level-goals and more existential higher-level goals or values, such as goals specifying the sort of person they want to be or principles they prefer to follow. This psychological process is theorized to occur across a range of psychological difficulties (Mansell et al., 2015) and is posited to be the psychological mechanism by which individuals attempt suicide. We posit that limited awareness occurs when suicidal individuals become exclusively focused on suicide as a goal, in an attempt to avoid experiencing memories and feelings that are part of their important life goals. For example, they may have an important life goal to maintain a close relationship with their children, in which case memories of spending time with their children and the associated feelings would remind them of this goal. They may avoid experiencing these memories or feelings if they are experiencing loss of control in these areas of their lives, which could trigger overwhelming and extreme distress whenever their focus of awareness is placed upon them. Therefore, we conceptualize suicide as a means by which individuals attempt to increase their sense of control, whilst concurrently avoiding the experience of memories or reminders of their important life goals.

In reality, if an individual ends their life, it would have a negative impact on the achievement of their other goals, thus bringing about consequences which conflict with the achievement of these goals. However, our framework posits that an individual contemplating suicide can become so focused on the goal of ending their life, in order to regain control, that the consequences of suicide which conflict with other important life goals remain outside of their current awareness. This exclusive concentration upon ending one's life occurs when suicide as a means of regaining control becomes the focus of attention, often due to the chronic error arising from lost control of other goals (Powers, 2005; Carey, 2006; Mansell et al., 2012).

The process of focusing on the goal to end one's life and having limited awareness of other goals may explain what is referred to as "tunnel vision" in anecdotal accounts of suicide attempts (Wenzel and Beck, 2008). During this process, individuals may experience imagery of methods of suicide, enabling them to mentally simulate a suicide attempt (Hales et al., 2011), and imagery of outcomes they want to achieve by ending their life, such as an end to their suffering (Crane et al., 2012). For example, Lucy imagined being hit by a car and the overwhelming stress that she was experiencing ending very suddenly. An individual's limited awareness makes them less likely to imagine consequences which they would prefer to avoid, such as upsetting their family. As a result, they are not deterred from attempting suicide and remain focused upon this goal.

The theoretical idea of limited awareness is consistent with findings from cognitive psychology literature that individuals have goals which they are not consciously aware of, and that these unconscious goals can conflict with each other (Bargh et al., 2001). One of these conflicting unconscious goals can become more dominant than another (Moskowitz et al., 1999; Bargh et al., 2001), thus preventing the individual from becoming aware of the less dominant goal (Moskowitz et al., 1999). Therefore, if a goal to end one's life is more dominant than other goals, the individual is prevented from becoming aware of their other goals associated with reasons for living.

In the clinical example, after a prolonged period of despair and ambivalence about suicide, Lucy became completely focused on ending her agony and despair. Due to the "agony" she was experiencing, she found it difficult to envisage achieving any other goal unless the agony went away. She became so focused on the goal of "ending my agony" that she was no longer attentive to any of her other goals, which obviously would not be achieved if she died by suicide, despite these goals underlying her conflict. This exclusive focus upon the "ending my agony" goal also occurred since Lucy was already experiencing a loss of control and, in order to consider her other goals, she would have had to confront her fears of being rejected or being a failure more directly. Confronting these fears, and the resulting loss of control, would feel overwhelming. As such, Lucy was conscious of not wanting to perceive the feeling of intense anxiety associated with these fears, which she would have experienced if she became more aware of these goals. However, she was not fully conscious of wanting to avoid thinking about the negative consequences of suicide for these life goals. These other goals included maintaining contact with her friends and pursuing a career as a speech therapist. Limited awareness of these other goals meant that Lucy did not have to imagine any negative consequences of ending her life (e.g., no further contact with friends) and consequently attempted suicide.

Responses to Ambivalence About Suicide Affect Awareness of Goals

Ambivalence about suicide can be distressing (Bergmans et al., 2017), and we posit that this is due to the underlying goal

conflict between one's reasons for living and reasons for dying, since conflict leads to loss of control (Powers, 1973; Mansell et al., 2012). Individuals may avoid focusing their awareness on the conflicting goals, since memories and reminders of these goals may lead to an even greater and overwhelming loss of control. This is reflected in strategies which have been investigated in the transdiagnostic literature, such as thought suppression, experiential avoidance, or drinking alcohol to block out unwanted thoughts and feelings (Carver et al., 1989; Hayes et al., 1996; Purdon and Clark, 1999). Similarly, individuals may use appraisals which minimize their perception of the impact of suicide on their life goals, such as telling themselves that others will not miss them (Tarrier et al., 2013). We posit that these strategies are all means of avoiding placing a focus of awareness upon one's goals which are in conflict (Mansell et al., 2015; Mansell and McEvoy, 2017). We also suggest that doing so can impede an individual's access to potentially distressing memories or reminders of goals that may underlie their reasons for living. This prevents individuals from remaining aware of goals which would be negatively impacted by a death from suicide.

For example, an individual who is experiencing feelings of perceived burdensomeness may feel that others would be better off without them. Even if they are fully aware of how upset their family and friends might be should they take their own life, they may still feel that in the long term it is better to prioritize reducing the burden they place upon others. As a result, the individual may wish to avoid feeling any guilt associated with thoughts that their death could upset others. When they are considering suicide, they may become aware of this guilt, since we posit that individuals automatically become aware of valued goals if they are about to engage in behavior which would prevent the achievement of these goals. The individual may employ strategies such as thought suppression or drinking alcohol in order to avoid experiencing the guilt about the pain caused to their family as a result of their death. If the person frequently uses strategies to avoid distress associated with these other goals, this is likely to result in limited awareness of how their other goals (such as to avoid upsetting their family) would be negatively impacted upon by suicide.

We also posit that the limited awareness resulting from moving one's awareness towards less distressing goals, such as by distracting oneself using alcohol, may be experienced as feelings of emotional numbing or dissociation (Holmes et al., 2005; Mansell and Carey, 2012). These theoretical ideas are consistent with evidence from existing literature that high levels of dissociation are associated with an increased number of suicide attempts, regardless of an individual's ability to tolerate pain (Rabasco and Andover, 2020). Furthermore, emotional numbing is associated with suicidal ideation, and suicide plans and attempts among ideators (Afzali et al., 2017).

In contrast, some individuals allow themselves to experience reminders of goals that would be negatively impacted upon by their death from suicide (Hales et al., 2011; Crane et al., 2012). We posit that these individuals are more likely to maintain a greater awareness of these goals and are less likely to attempt suicide. This is consistent with psychological interventions that aim to increase suicidal individuals' awareness of their reasons for living. For example, clinicians using the Cognitive Behavioral Prevention of Suicide (CBPS) (Tarrier et al., 2013) explore the meaning and emotions associated with the client's negative beliefs about suicide. This has the aim of encouraging ambivalence and ensuring that the client maintains a full awareness of the negative impact of suicide on their other goals, especially when the client is in crisis (Tarrier et al., 2013). Similarly, Method of Levels therapy (MOL) (Carey, 2006) aims to increase clients' sense of control by helping them to explore and increase their awareness of both sides of an internal conflict. This may increase suicidal clients' awareness of goals underlying their reasons for living if the conflict which they explore is their ambivalence about suicide.

Our theoretical framework is also consistent with theoretical literature on schemas (Fredrickson, 2004; Johnson et al., 2008; Tarrier et al., 2013) which suggest that the activation of schemas related to "suicide as a means of escape" inhibits schemas containing more positive memories, thoughts, or emotions. Our framework conceptualizes this inhibition as an exclusive focus on the goal of ending one's life, and narrowed awareness of memories, thoughts, and emotions related to one's other goals. The BMAC task (Tarrier, 2010; Johnson et al., 2013; Tarrier et al., 2013), which was developed from cognitive models of suicide, is also consistent with our approach. The aim of the BMAC is to strengthen and build content of and access to positive schemas, so that clients become more aware of these experiences, appraisals, and coping strategies, and then are more able to access such schemas when experiencing a suicidal crisis (Johnson et al., 2013; Tarrier et al., 2013). The BMAC achieves this by encouraging clients to hold positive memories in their minds and explore and re-experience these positive memories and associated emotions (Johnson et al., 2013; Tarrier et al., 2013). The rationale for the BMAC is that if clients become able to access some positive material when in crisis, this initial activation will then enable the client to subsequently be able to access further positive material, since the triggering and content of the positive schema has been strengthened (Johnson et al., 2013). Our theoretical framework would interpret this as increasing clients' awareness of goals other than death from suicide, and posits that once clients have a greater awareness of these other goals, they become less likely to avoid thinking about them.

Differences in Ability to Imagine Consequences and Make Decisions

Suicide ideators and attempters differ in their ability to think through consequences of their actions and make decisions (Klonsky and May, 2010; Saffer and Klonsky, 2018), both of which involve mentally simulating future events (Gilbert and Wilson, 2007). Suicide attempters have a less specific memory retrieval style than non-attempters, and also demonstrate reduced specificity compared to non-attempters when imagining future events (Williams et al., 1996). This reduced ability to generate specific details when imagining future events may result in less specific content of "flash-forward" suicide imagery, since suicide imagery occurs by the same process by which individuals imagine future events (Williams et al., 1996; Holmes et al., 2007b). This in turn may influence whether individuals attempt suicide (Holmes et al., 2007b; Hales et al., 2011). Similarly, it may account

for difficulties in solving problems which have been observed in suicidal individuals (Schotte and Clum, 1987). However, few of these findings have been replicated, which is partly due to the small number of studies comparing ideators with attempters, and inconsistency in their methods resulting from the use of different measures to assess the same constructs (Saffer and Klonsky, 2018). Moreover, existing theoretical models do not provide an explanation of the relationship between these psychological processes in terms of a common pathway, or outline a mechanism by which this common pathway could lead to suicide attempts. Refinements to the theoretical literature could provide a more in-depth explanation integrating these findings and specifying a common mechanism by which these psychological processes lead to suicide attempts. This would enable the development of a psychological tool to assess this mechanism, which could lead to greater consistency in future research on differences between ideators and attempters.

Psychological Differences Between Ideators and Attempters Reflect Limited Awareness

Our theoretical framework has potential to explain psychological differences which have been observed between ideators and attempters in existing literature. Firstly, reduced attentional control, including the ability to inhibit responses (Richard-Devantoy et al., 2015; Thompson and Ong, 2018), would be interpreted from a PCT perspective as a reduced ability to sustain or shift awareness between goals (Mansell et al., 2012). Consequently, individuals with reduced attentional control are likely to have more limited awareness of how suicide might negatively affect their other goals. In addition, differences in how ideators and attempters imagine events or consequences (Williams et al., 1996; Klonsky and May, 2010) are consistent with our hypotheses, since the ability to simulate future events would affect individuals' awareness of the impact of suicide on their goals. These findings may also be linked to differences in ability to make decisions and solve problems (Schotte and Clum, 1987; Saffer and Klonsky, 2018), since both of these processes are likely to involve imagining future events (Gilbert and Wilson, 2007; Schacter et al., 2008, 2012; Schacter, 2012), and therefore may also affect awareness of consequences. In some cases, fearlessness about death observed in attempters (Smith et al., 2016) may also be due to limited awareness, since if individuals have limited awareness of goals which would be negatively affected by suicide, this may reduce their fear of death. Furthermore, there is emerging evidence from ongoing work to support the possibility of the new framework having validity (Wynford-Thomas et al., in preparation). When interviewed, individuals who had attempted suicide described having no awareness of potential consequences at the time of the attempt. In contrast, individuals who had only contemplated suicide were deterred by awareness of other goals, such as a desire to avoid upsetting family members.

Fluctuations in Awareness of Goals

Because awareness of goals fluctuates (Carey, 2006), individuals may experience more limited awareness of their goals on some days, yet have greater awareness on others. Therefore, our framework does not consider the process by which individuals attempt suicide to be a linear transition. Conversely, it predicts that individuals who experience suicidal ideation are most likely to attempt suicide at times when their awareness of how death from suicide would affect their higher-level goals is limited.

In some cases, individuals can swiftly move into a state of heightened shame and regret soon after a non-fatal suicide attempt (Wiklander et al., 2003), due to an increased awareness of the potential impact on their goals following the attempt. This may occur if the realization that they almost died leads the individual to imagine the consequences of their suicide that would have negatively impacted upon their personal goals. Conversely, individuals who go on to attempt suicide on multiple occasions would still have limited awareness following the initial attempt and consequently would not have imagined how suicide would affect their other goals.

Limited awareness depends on an individual's mental flexibility; in other words, their ability and willingness to shift their awareness to and sustain their attention on other goals (Mansell et al., 2012). Mental flexibility can be affected by variables that impact on cognitive functioning, such as substance abuse or certain physiological states (Pompili et al., 2010). Following a suicide attempt, when the individual's cognitive abilities are no longer affected by such variables, they may become more aware of consequences of suicide which would negatively impact upon their achievement of other goals. In addition, awareness of these negative consequences of suicide could be affected by the extent to which an individual believes that suicide will enable them to achieve the goal they have become focused on, and the importance of that goal. For example, Lucy became so focused on ending her life because she no longer felt able to tolerate the psychological distress she was experiencing, and believed that suicide would end this distress. This focus on suicide as a means of ending one's distress is likely to be strengthened the more an individual tries but fails to find an alternative solution. However, the core prediction of our model is that regardless of the reason for the individual's limited awareness, which vary with individual circumstances, it is always limited awareness that causes individuals to make a suicide attempt.

CONCLUSIONS OF THE REVIEW

We have described several ways in which existing theoretical ideas could be refined to integrate explanations of psychological processes that occur when individuals become suicidal and attempt suicide. These psychological processes can be grouped together into the broad headings of psychological processes which predispose individuals to suicidal crises, psychological processes which precipitate suicidal crises, and psychological processes which mediate suicide attempts. We have also introduced a new theoretical framework, and outlined the ways in which these existing theoretical concepts are integrated by the new framework. Lastly, we explained how, according to our theoretical framework, the concepts of control and goal conflict mediate a common pathway to suicide that underlies the psychological processes and risk factors which are included in previous theoretical models. This common pathway may provide

a clearer treatment target, thereby allowing for the use of a more flexible, client-centered psychological intervention which can be used during immediate suicide crises. These claims will be discussed in the "Clinical Implications" section. The following section will propose novel hypotheses for future research.

HYPOTHESES

According to our framework, we hypothesize that: (1) Individuals who contemplate and/or attempt suicide significantly differ from individuals who are not suicidal in terms of the level of goal conflict they report; (2) High levels of reported goal conflict predict psychological distress in individuals who contemplate and/or attempt suicide; (3) A reduction of goal conflict in suicidal individuals predicts a reduction in psychological states which are important components in recent theoretical models of suicide (e.g., perceived burdensomeness, thwarted belongingness, defeat, and entrapment); (4) Individuals who attempt suicide have a significantly reduced awareness of consequences of suicide which negatively impact on their important life goals, values, principles, or ideals, compared to individuals who contemplate suicide; (5) An intervention that increases suicidal individuals' awareness of the impact of suicide on their goals will decrease the occurrences of suicide behaviors.

Hypotheses 1 and 2 could be tested using methodologies which have tested similar hypotheses on goal conflict in other clinical populations (Kelly et al., 2011a,b, 2013). A study which recruited individuals with depression (Kelly et al., 2011a) used the Strivings Instrumentality Matrix (SIM, 10 × 10 version) (Emmons and King, 1988) to assess conflict between their goals over time. The same measure and method could be used in suicidal individuals. Alternatively, Lauterbach's Computerised Intrapersonal Conflict Assessment (CICA) (Lauterbach and Newman, 1999) could be used to assess conflict between individuals' goals (Kelly et al., 2015). Further details on these methodologies for assessing goal conflict have been described elsewhere (Kelly et al., 2015). To test hypothesis 3, goal conflict could be assessed in a longitudinal study using one of these measures in addition to standardized measures of other key components of theoretical models of suicide, such as the Interpersonal Needs Questionnaire (INQ) (Orden et al., 2012), which assesses perceived burdensomeness and thwarted belongingness. The association between scores on these measures and goal conflict at various time points could be analyzed.

In order to test hypotheses 4 and 5, it would be necessary to develop and validate a tool for assessing individuals' awareness of the impact of suicide on their goals. Ideators' awareness of these consequences, as assessed by this tool, would then need to be compared with attempters' awareness, in order to ascertain whether the two groups significantly differ. Lastly, it would be necessary to test the effect of an intervention that aims to increase suicide attempters' awareness of the impact of suicide on their goals. A new program of research is currently ongoing, which aims to develop the tool for assessing awareness and test these hypotheses. During this program, data from cognitive interviews will be used to develop a clinical interview for assessing awareness (i.e., the awareness assessment tool), which can be scored quantitatively. This clinical interview will then be tested for reliability and validity among individuals who have contemplated or attempted suicide, and the two groups will be compared using the clinical interview once it has been developed. Once this research has been conducted, the clinical interview can be used to assess suicidal individuals' awareness before and after an intervention that aims to increase awareness of their goals, such as Method of Levels therapy (Carey, 2006).

LIMITATIONS OF A PCT-INFORMED THEORETICAL FRAMEWORK FOR UNDERSTANDING SUICIDE

While the new theoretical framework has distinct strengths, it also has limitations. Firstly, since its theoretical constructs of control, conflict, and awareness are very broad, further work is needed to develop, refine, and adapt methodologies of testing hypotheses that are driven by these theoretical constructs. Previous research involving other clinical populations has made progress in developing and applying these methodologies (Kelly et al., 2011a,b, 2013, 2015), thereby contributing to an emerging evidence-base for the principles of PCT and their use in clinical populations. Furthermore, some methods will be adapted and tested in a suicidal population in an ongoing program of research. However, further work will be needed to provide further support for the application of these PCT principles and their associated methodologies in a suicidal population. Some of this work, in particular the development of accurate and useful assessments of these theoretical constructs in suicidal individuals, may be challenging since these theoretical constructs are so broad. For example, accurately assessing conflicting goals outside of individuals' awareness may prove to be an empirical challenge. Secondly, since our theoretical approach is so novel, a substantial amount of research will be needed to establish its utility in a suicidal population. As part of this research, it will be necessary to rigorously test the effectiveness of interventions which are informed by this theoretical framework in larger scale studies with suicidal participants. Lastly, in cases when researchers are particularly interested in the relationship between specific risk factors and suicide attempts, the use of other theoretical approaches may be more appropriate, since our theoretical framework does not focus on the impact of specific risk factors.

CLINICAL IMPLICATIONS

Our framework has direct clinical implications for treatment and risk assessment, and recommends the use of a therapy which has some distinct features. Firstly, our framework recommends the use of psychological interventions which specifically aim to reduce goal conflict and increase individuals' awareness of their goals. This is distinct from interventions which target psychological states that are posited to arise due to goal conflict

in our theoretical framework, such as perceived burdensomeness or hopelessness. We posit that the treatment targets of goal conflict and suicidal individuals' awareness of their goals address their problems more directly than treating specific psychological states such as perceived burdensomeness. We also propose that simple and effective interventions which directly address these treatment targets may be particularly useful when suicidal clients are in immediate crisis. Furthermore, we posit that the distressing feelings (e.g., perceived burdensomeness) that are targeted by other interventions would be reduced as a result of resolution of the goal conflict. Since our framework emphasizes the importance of control of one's experiences, this is also most consistent with therapeutic approaches which facilitate exploration of clients' higher-level goals at their own pace. One such therapy which is specifically appropriate from the basis of this model, and already uses the questioning style which we suggest, is Method of Levels therapy (MOL) (Carey, 2006).

Method of levels is a transdiagnostic therapy which has been used with good effect with a variety of clinical populations, including individuals who have contemplated or attempted suicide (Bird et al., 2013; Carey et al., 2013; Griffiths et al., 2019a,b; Grzegrzolka et al., 2019). MOL is unique due to its focus on helping clients shift and sustain awareness to the source of goal conflicts, and its emphasis on facilitating clients' control over the therapy session and their experiences (Carey, 2008). The approach used in MOL aims to directly address the problems of loss of control of one's experiences and limited awareness which are described in this model, by increasing clients' control and awareness of their goals. There is a variety of literature available elsewhere on how MOL achieves these aims, including concrete examples of its questioning style and the format of a therapy session (Carey, 2006; Mansell et al., 2012; Carey et al., 2015; Tai, 2016).

Several treatments currently exist which are specifically intended to reduce suicide risk and suicidality (Jobes et al., 2015), such as Dialectical Behavior Therapy (DBT) (Linehan et al., 1991), Cognitive Behavioral Therapy for Suicide Prevention (CBSP) (Tarrier et al., 2013), and the Collaborative Assessment and Management of Suicidality (CAMS) (Jobes, 2006). Brief interventions also exist, such as Motivational Interviewing for Suicidal Ideation (MI-SI) (Britton et al., 2012), the Teachable Moment Brief Intervention (TMBI) (O'Connor et al., 2015), and the Safety Planning Intervention (SPI) (Stanley and Brown, 2012). When compared with DBT, CBSP, and CAMS, MOL is a briefer, less structured intervention (Griffiths et al., 2019a,b), and does not involve multiple structured clinical assessments or skills training (Carey, 2006). This has the distinct advantages that it is efficient and can be adapted for use in challenging settings where there is limited time and resources, such as mental health wards, prisons, and A&E departments (Tai, 2009, 2016). Therefore, it is more similar to MI-SI, another brief less structured intervention which only requires one or two sessions (Britton et al., 2012). However, MOL has the advantage over MI-SI of having a more in-depth transdiagnostic theoretical basis which has been tested in other clinical populations (Kelly et al., 2011a; Mansell et al., 2014; Healey et al., 2017). Kovacs and Beck's internal struggle hypothesis (Kovacs and Beck, 1977), which is the theoretical basis for MI-SI, posits that individuals attempt suicide when their wish to die is greater than their wish to live. PCT, the theoretical basis for MOL, expands on this account by conceptualizing an individual's wish to die and wish to live as being affected by their higher-level goals and awareness of those goals (Powers, 1973).

Since MOL aims to be more flexible in its delivery than interventions such as DBT, CBSP, CAMS, the TMBI, and the SPI, this may facilitate suicidal individuals having more opportunities to speak freely about their problems at their own pace. This is an aspect of MOL which clients experiencing psychosis have reported to be helpful (Griffiths et al., 2019b). In addition, suicidal patients have expressed a need for more opportunities to speak freely about their problems, and benefitted from therapy which enables them to do so (Britton et al., 2012; Hagen et al., 2018). MOL also has similar advantages to CAMS of being individualized to that specific client and non-judgmental about their problems, since its curious questioning style facilitates an exploration of clients' idiosyncratic problems, and discovery of solutions which are most suited to them (Mansell et al., 2012; Jobes, 2017). This meets the need expressed by suicidal patients on inpatient wards for more time spent by staff on exploring their individual problems in a non-judgmental way (Hagen et al., 2018). Lastly, individuals who make multiple suicide attempts have described surviving as an ambiguous state of indecision between wanting to die and wanting to live, and have benefitted from an increased sense of personal control (Bergmans et al., 2017). MOL has the potential to directly address this by enabling them to resolve this internal conflict by becoming more aware of goals related to their reasons for living, and increase their sense of control (Carey et al., 2015).

The use of our theoretical framework would also change how clinicians interpret the psychological processes underlying clients' suicide risk. Clinicians already ask clients about their reasons for living (Berman and Silverman, 2014), but our framework would interpret this as assessing their awareness of how their other goals would be affected by suicide. For example, if a client's reason for living is that they would no longer be able to look after their children if they died, this would be interpreted as the higher-level goal of "looking after my children."

In contrast to therapeutic approaches that involve developing more reasons for living (e.g., Wenzel and Jager-Hyman, 2012), an approach to risk assessment and/or treatment based on our framework would involve enabling clients to become more fully aware of, and to more fully access the imagery, feelings and memories involved in, their existing higher-level goals. For example, the therapist could ask the client questions to explore thoughts and imagery they experience about suicide. If the client described imagery related to consequences which would negatively impact on their goals, the therapist would ask questions that encourage the client to focus on these consequences and explore what they mean from that client's perspective. For example, if the client mentioned experiencing images of their family looking upset while they are feeling suicidal, the therapist might ask "What is it that bothers you about that?" or "What do you make of that?". They might also ask the client about specific details of that mental image, such as which family members are present, what else is happening in the

image, and whether that image is at the forefront or back of their mind. This has the aim of encouraging the client to focus on and become more aware of the higher-level goals which are related to that image, thus becoming more aware of consequences of suicide which would negatively impact upon that client.

Lastly, clinicians may wish to use structured risk assessments, such as ratings of reasons to die and reasons for living in CAMS (Jobes, 2006), or interventions such as the SPI, in addition to MOL. We do not believe this is necessary for therapeutic change to occur, since MOL aims to target a core process of therapeutic change (Griffiths et al., 2019a), thereby reducing distress and decreasing suicidality. However, some clinicians may prefer to do this or it may be necessary to meet the requirements of their service. In these cases, these assessments and/or interventions would not occur during an MOL session, and instead would either take place on a separate occasion or immediately prior to or after the MOL session.

CONCLUSION

A more refined approach is needed to fully understand suicide, in particular the mechanism underlying suicide attempts. We propose that the common pathway underlying suicide attempts is an acute loss of sense of control of one's experiences, combined with limited awareness of one's personal goals, both of which are specific treatment targets. The application of this theoretical framework to the treatment of suicidal individuals involves the use of a brief, flexible, client-centered therapy with distinct advantages, which aims to directly address these treatment targets. Our theoretical framework offers potential refinements to existing theoretical literature and suggestions for integration of existing findings.

AUTHOR CONTRIBUTIONS

VM led the conceptualization of the theoretical ideas expressed in this article under the supervision of ST, WM, and DP. VM drafted the original manuscript with input from ST, WM, and DP. All authors contributed to the revision of the manuscript. All authors read and approved this final version of the manuscript.

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CONCEPTUAL ANALYSIS
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Crisis Concept Re-loaded?—The Recently Described Suicide-Specific Syndromes May Help to Better Understand Suicidal Behavior and Assess Imminent Suicide Risk More Effectively

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Background: Despite of the decreasing suicide rates in many countries, suicide is still a major public health concern worldwide. Traditional suicide risk factors have limited clinical predictive value, as they provide little reliable information on the acute psychological processes leading to suicide.

Aims: The aim of this analysis is to describe and compare the recently introduced two suicide-specific syndromes [*Acute Suicidal Affective Disturbance (ASAD)* and *Suicidal Crisis Syndrome (SCS)*] with the classic psychological features of pre-suicidal crisis and also to assess the clinical utility of the new suicide prediction scales in contrast to classical risk factors.

Method: Conceptual analysis.

Results: Suicide-specific syndromes are not novel in terms of symptomatology or dynamics of symptom onset, but in their use of well-defined diagnostic criteria. In addition to symptomatic classification, they also provide an opportunity to objectively measure the current pre-suicidal emotional and mental state by validated tools.

Limitations: Future studies need to be completed to prove the reliability and predictive validity of suicide-specific diagnostic categories and the related suicide risk assessment tools.

Conclusion: Clinical use of suicide-specific syndromes is suggested. This transdiagnostic approach not only enables a more accurate and objective assessment of imminent suicide risk, but also facilitates research in neuroscience, which represent a major step forward in managing and complex understanding of suicidal behavior.

Keywords: suicide-specific syndromes, acute suicidal affective disturbance, suicidal crisis syndrome, suicide risk factors, suicide prediction, suicide prevention

INTRODUCTION

Despite of the decrease in the overall global suicide rates in recent decades, suicide is still a common cause of death, especially among younger people. Furthermore, in some countries, for example in the United States an increase of suicide was reported across all age groups (1). Therefore, intense neuroscientific research (including genetic, neurobiological, functional imaging and cognitive research) has begun to more accurately identify the underlying factors for suicidal behavior. For now, a number of characteristics are proved to be associated with suicidal behavior. However, the multicausality of suicidal behavior and the complex development of suicide risk, involving biological, psychological, clinical, social and environmental factors predicts the difficulty of suicide risk assessment (2). Furthermore, risk factors need to be considered at the population and individual levels, and also predisposing and precipitating factors have been distinguished (3).

From a clinical perspective, the hierarchical classification of risk factors (4) differentiates between primary (mental disorders, previous suicide attempt, low serotonin activity, etc.), secondary (early trauma, negative life-events, smoking, etc.) and tertiary (male gender, periods of developmental crises, vulnerable periods, etc.) risk factors. This classification may help to determine the targets and methods of intervention. However, traditional suicide risk factors have only limited clinical predictive value (5), because they provide little reliable information on the acute psychological processes leading to suicide and on imminent suicide risk assessment. According to some researchers, studies on the subjective aspects of suicidal behavior would help to clarify the emotional and psychological background ("psychache") of suicidal behavior and may lead to a paradigm-shift in suicide risk assessment (1).

Because only weak evidence supports the routine use of currently available assessment tools, new risk assessment models with high negative predictive value should be developed to support clinical decision-making and preserve resources (3). Therefore, the use of structured suicide prediction tools as adjuncts to an individual psychiatric assessment is recommended by the European Psychiatric Association (6). As the lack of precise recognition of acute suicide risk limits the ability to provide adequate care, more research has begun to develop methods for a better risk assessment and complex risk analysis that may provide more accurate predictions (7, 8).

For this reason, many researchers have advocated for the introduction of a suicide-specific diagnostic category in the psychiatric nomenclature and in the diagnostic classification systems for mental disorders (5, 9, 10). The Section III of the Diagnostic and Statistical Manual of Mental Disorder, Fifth Edition (DSM-5) already includes *Suicidal Behavior Disorder* (SBD) among Conditions for Further Study (9, 11) (**Table 1**). According to the currently proposed criteria, it is defined as an attempted suicide within 24 months. The diagnosis is not applied to suicidal ideation or to preparatory acts, and if the act was initiated during a state of delirium or confusion, and if the act was undertaken solely for a political or religious objective. Other specifiers of suicidal behavior according to the DSM-5 refer to the violence (violent or non-violent) and the lethality (high or low lethality) of the method, and the dynamics (planned or impulsive) of the attempt (11) (**Table 1**). While these are clinically important features, they alone provide little useful information on the background of suicidal behavior (e.g., mental disorder, crisis situation, etc.) and do not help to identify warning signs or acute risk and to predict future suicidal behavior (12, 13). Because acute suicide risk usually develops rapidly (up to some days or hours) (14), it would be necessary to introduce a category that emphasizes the characteristics of this life-threatening pre-suicidal state of mind requiring urgent intervention (15, 16). Furthermore, in the recent, 11th Revision of the International Classification of Diseases (ICD-11), suicidal behavior is also listed outside the chapter on mental, behavioral, or neurodevelopmental disorders (10). In ICD-11, the different forms of self-injuries, self-harming and suicidal behavior are listed in different chapters, such as External Causes of Morbidity or Mortality, or Symptoms, Signs, and Clinical Findings not Elsewhere Classified (10).

TABLE 1 | The diagnostic criteria for suicidal behavior disorder (SBD), according to the DSM-5 (Section III, Conditions for Further Study) (11).

A. Within the last 24 months, the individual has made a suicide attempt.
   Note: A suicide attempt is a self-initiated sequence of behaviors by an individual who, at the time of initiation, expected that the set of actions would lead to his or her own death. The "time of initiation" is the time when a behavior took place that involved applying the method.)
B. The act does not meet criteria for non-suicidal self-injury — that is, it does not involve self-injury directed to the surface of the body undertaken to induce relief from a negative feeling/cognitive state or to achieve a positive mood state.
C. The diagnosis is not applied to suicidal ideation or to preparatory acts.
D. The act was not initiated during a state of delirium or confusion.
E. The act was not undertaken solely for a political or religious objective.

Specify if:
   Current: Not more than 12 months since the last attempt.
   In early remission: 12–24 months since the last attempt.

Other specifiers of suicidal behavior are the violence of the method (violent or non-violent), the lethality (high or low) and the dynamics (planned or impulsive) of the attempt.

However, in recent years, two complex, specific syndromes have been described that may assist in a more accurate assessment of pre-suicidal psychopathology and thus in the prediction of suicidal behavior. Researchers recommended the introduction and—after a predictive validation process—the clinical use of two suicide-specific syndromes, the *Acute Suicidal Affective Disturbance (ASAD)* (13, 17) and *Suicidal Crisis Syndrome (SCS)* (5, 18) (**Table 2**). These newly described syndromes deserve attention because the well-known, classical theory of suicidal crisis by Caplan and the presuicidal syndrome, described by Ringel (Ringel's Triad), as well as other related phenomena, such as "psychic pain," "cry-for-help," or "cry-of-pain" have been already known for decades (20) (**Table 3**). This classical description of suicidal crisis forms basis of understanding the subjective experiences of patients with suicidal behavior, that need to take into account when planning effective risk assessment and suicide prevention methods (1). The concept of suicide-specific syndromes combines this traditional crisis

TABLE 2 | Proposed brief diagnostic criteria for suicide-specific syndromes by Joiner (acute suicidal affective disturbance (ASAD) and Galynker (suicide crisis syndrome (SCS) (19).

ASAD	SCS
A. A drastic increase in suicidal intent over the course of hours or days, as opposed to weeks or months B. One (or both) of the following: marked social alienation (e.g., social withdrawal, disgust with others, perceptions that one is a liability on others) and/or self-alienation (e.g., self-hatred, perceptions that one's psychological pain is a burden) C. Perceptions that one's suicidality, social alienation, and self-alienation are hopelessly unchangeable D. Two (or more) manifestations of overarousal (i.e., agitation, irritability, insomnia, nightmares)	A. Persistent or recurring feeling of entrapment and urgency to escape or avoid a perceived inescapable and unavoidable life situation. Although death may appear as the only escape, explicit suicidal ideation need not be (though may be) present B. Affective, behavioral, and cognitive changes associated with the experience of entrapment, including at least 1 item from a to d: a. Affective disturbance b. Loss of cognitive control c. Disturbance in arousal d. Social withdrawal

theory with the structured diagnostic concept of the recently used major diagnostic and classification systems, such as the DSM-5 (**Figure 1**).

We present the most important features of these newly described suicide-specific syndromes, the experience with their clinical application and the major research findings. Then these syndromes are compared with each other and with the classical psychological features of pre-suicidal crisis to find out whether these are new interpretations of suicidal behavior or those are merely the well-known classical symptoms with new terminology ("old wine in new bottles").

ACUTE SUICIDAL AFFECTIVE DISTURBANCE AND SUICIDAL CRISIS SYNDROME

Acute Suicidal Affective Disturbance (ASAD) is based on empirical pre-suicidal clinical features and theory-driven predictors (13, 17, 19) (**Table 2**). This concept emphasizes that symptoms develop very quickly. Its main components are: drastic increase in suicidal intents over the course of hours or days; marked social alienation (e.g., social withdrawal, disgust with others, perceived burdensomeness) and/or self-alienation (self-hatred, perceptions that one's psychological pain is a burden); the above mentioned are hopelessly unchangeable; and over-arousal (agitation, irritability, insomnia, nightmares) (12). A 28-item clinical scale (ASADI-L) was also developed to assess lifetime ASAD symptoms (17). The validity of these symptoms and their distinction from other psychiatric disorders have been demonstrated in numerous studies, including healthy population and people with different mental disorders (16, 23, 24). The construct validity of ASAD as a unified entity was first demonstrated by Tucker et al. (17) in a sample of undergraduate students. A confirmatory factor analysis with 1,442 psychiatric in-patients replicated previous results and confirmed the factor structure of ASAD in a large sample (16). Later, the unidimensional nature, and also the convergent and discriminant validity of ASAD were demonstrated in a large sample of out-patients with mental disorders (23). According to these studies, ASAD seems to be a unified construct that may predict suicidal behavior and can be clearly differentiated from other mental disorders, including major depressive disorder. Moreover, ASAD not only significantly predicted a past suicide attempt (16), but also differentiated multiple attempters, single attempters and non-attempters as well as attempters, ideators, and non-suicidal patients (23).

Suicidal Crisis Syndrome (SCS) (18) is a presuicidal mental state with affective and cognitive dysregulation and behavioral changes in response to a real or perceived threat (19, 25) (**Table 2**). The symptoms occur unexpectedly when the individual is unable to cope with a situation, which is unacceptable, intolerable and unescapable (such as loss of a job or love relationships, etc.). The key symptoms of SCS are the persistent or recurring feeling of entrapment and urgency to escape from a perceived unavoidable life situation (12, 25). Thus, death may appear as the only escape, however explicit suicidal ideation need not be (though may be) present. Other diagnostic criteria include affective symptoms (affective disturbances as manifested by emotional pain, rapid spikes of negative emotions, extreme anxiety, acute anhedonia); cognitive impairments (loss of cognitive control as manifested by rumination, cognitive rigidity, ruminative flood/cognitive overload, repeated unsuccessful attempts to suppress negative or disturbing thoughts); and behavioral changes [as manifested by disturbance in arousal (agitation, hypervigilance, irritability, insomnia) and/or social withdrawal (reduction in social activity, evasive communication)] associated with the experience of entrapment (12). These symptoms develop rapidly and may last minutes to days, and then may persist or recur. As the condition progresses, symptoms may either increase in their intensity or fluctuate rapidly, or the two types may mix. Social isolation is often associated with the syndrome, which further increases the risk of suicide. The coherence and predictive validity of these symptoms have also been confirmed by numerous studies (25). Galynker et al. (5) also developed an assessment tool, the Suicide Crisis Inventory (SCI) to measure SCS. The SCI had significantly more pronounced predictive value for suicidal behavior in high-risk psychiatric patients after discharge from the hospital than traditional, classical suicide risk factors (5, 18). In this respect, the subscale of "feeling of entrapment" had the most powerful predictive value (5). The clinical utility of SCI is strongly supported by the evidence, that SCI was predictive of future suicidal behavior after discharge, thus it may help clinicians in their decision-making regarding the termination of the hospitalization (5). In addition to this clinical benefit, the use of SCI may have a positive impact on the related potential legal and economic conditions.

TABLE 3 | Comparison of the newly described suicide-specific syndromes [acute suicidal affective disturbance (ASAD) and suicidal crisis syndrome (SCS)] with suicidal behavior disorder (SBD) included in DSM-5 and with the classical suicidal crisis concept.

	Suicide-specific syndromes		DSM-5 category	Classical crisis concept
	ASAD	**SCS**	**SBD**	**PSS**
Term	Acute Suicidal Affective Disturbance	Suicidal Crisis Syndrome	Suicidal Behavior Disorder	Pre-Suicidal Syndrome (Suicidal Crisis)
References	Tucker et al. (17)	Galynker (18)	DSM-5 (11)	Ringel (21) and Caplan (22)
Key-symptom	- Drastic increase in suicidal intent over the course of hours or days	- Persistent or recurring feeling of entrapment	- Suicide attempt within the last 24 months	- Ringel-triad: - Constriction - Inhibited aggression turned toward the self - Suicidal fantasies
Other major characteristics	- Social and self-alienation - Hopelessness - Hyperarousal	- Affective and cognitive dysregulation with behavioral symptoms: - Affective disturbance - Loss of cognitive control - Disturbance in arousal - Social withdrawal	- Not applied: - To suicidal ideation or preparatory acts - If initiated during delirium or confusion - If undertaken solely for political or religious objective	- Caplan's crisis concept: - Perceive an event as being threatening - Unable to modify or lessen the impact - Increased fear, tension, confusion - High level of discomfort - State of disequilibrium - Other symptoms: - Regression - Autonomic symptoms - Insomnia - Psychomotor symptoms - Behavior changes
Course, dynamics	- Rapid (up to hours or days) - Spike-like (brief and intense) - Time-limited	- Persistent or recurring	- Planned (chronic) or impulsive (acute) - 24 months	- Fluctuating - Vortical

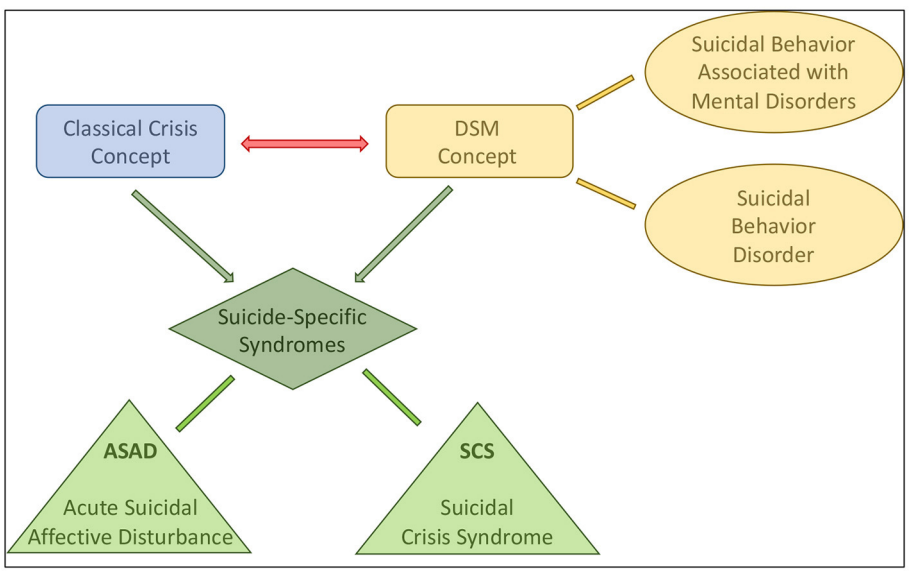

FIGURE 1 | Concept and development of the newly described suicide-specific syndromes [acute suicidal affective disturbance (ASAD) and suicidal crisis syndrome (SCS)]. The DSM-5 involves suicidal behavior disorder in its Appendix. Suicidal behavior may also be associated with different mental disorders, such as major depressive disorder, borderline personality disorder, etc. In contrast, the classical crisis theory, as a transdiagnostic concept, focuses on the emotional and psychological aspects of suicidal behavior, regardless of their potential association with mental disorders. Suicide-specific syndromes integrate these two major concepts with establishing well-defined diagnostic criteria, but also consider the acute psychological and psychopathological changes during the pre-suicidal period. Two different forms of suicide-specific syndromes were described recently, the ASAD and the SCS.

COMPARISON OF THE SUICIDE-SPECIFIC SYNDROMES

The two suicide-specific syndromes show a number of similarities, particularly in terms of their concept of the dynamics of suicidal behavior, as the symptoms are acute and rapidly worsening and precede suicidal behavior in both cases (**Table 3**). They are also characterized by hyperarousal, hopelessness and social withdrawal (12), all contributing to an increase in acute suicide risk (25). ASAD is characterized by rapid and extreme increase of conscious suicidal intents, accompanied by social withdrawal, hopelessness, and hyperarousal, while the key symptom of SCS is the feeling of entrapment, even without direct suicidal intents (19, 25, 26). In SCS, the loss of cognitive control results in the impairment of the executive functions, leading to a further deterioration of the problem-solving and coping capacity. This is the background to the dynamically occurring mental process in which suicide may seem to be the only possible solution. While ASAD is characterized by a rapid escalation of the basic symptoms, in SCS the progressive or fluctuating course of the associated affective, cognitive and behavioral symptoms and hyperarousal are highlighted. Furthermore, social withdrawal and isolation are key symptoms in ASAD, whereas in SCS those are only considered as accessory phenomena. Similarly, hopelessness, which creates an intense desire to escape the situation at all costs is in the focus of SCS, whereas in ASAD, in this respect is only incidental. Hyperarousal plays an important role in both syndromes, but in ASAD nightmares are more prominent, whereas in SCS, hypervigilance is emphasized (**Table 3**).

Based on the above, it can be concluded that there are many overlaps between the two new suicide-specific syndromes and also with the symptoms of the classical suicidal crisis. Cognitive (e.g., feeling of being unable to cope, cognitive distortions, futility, hopelessness); affective (e.g., depression, anxiety, emotional instability); behavioral (e.g., narrowing of the repertoire of actions, inadequate problem-solving capacity); vegetative (e.g., insomnia, somatic complaints associated with anxiety); psychomotor (e.g., regression or agitation) symptoms and social characteristics (reduced social relationships) show that most of the features of ASAD and SCS are also found in the classical description of the pre-suicidal syndrome (**Table 3**).

DISCUSSION

As with the classical crisis paradigm (20, 27), new suicide-specific syndromes have the great advantage that the detailed assessment of the characteristics and dynamics of symptom presentation may provide a basis for a more accurate risk assessment and intervention. Accurate and routine implementation of a scientifically proven risk assessment is the best way to effectively evaluate and manage suicide risk. Applying and adequately documenting these methods as the "gold standard" can also prevent possible negative legal consequences (12).

Before suicide-specific syndromes are considered as clinically useful and validated diagnostic entities included in the diagnostic systems of mental disorders, future studies need to be completed to prove their reliability and predictive validity. It is also an important goal for future research to find out whether these syndromes are independent from other mental disorders and from each other. As these two clinical entities capture different aspects of the pre-suicidal process, further clinical use and research may lead to the description of an integrated syndrome, whose statistically validated criteria combine the symptoms of the two separate suicide-specific syndromes (12). Further research is also needed to identify the symptoms with the best prognostic value and to describe the dynamics of the symptoms more accurately (26). To reach this goal, it is essential to accurately describe the precipitating factors, the clinical features (e.g., suicide-specific rumination), the underlying neurobiological and neuropsychological factors (increased attention to negative emotional stimuli, impaired problem-solving and decision-making, decreased verbal fluency, etc.) in suicidal behavior. Numerous studies have already demonstrated the role of the prefrontal cortex (especially dorsal regions), the anterior cingulate cortex, and the amygdala in the development of suicidal behavior. Neuroscientific research has increasingly outlined the components of neurobiological dysregulation underlying ASAD (28). Based on these findings, certain elements of these syndromes may represent endophenotypic domains that provide a more accurate understanding of the neurobiological background of the complex pre-suicidal emotional state. Furthermore, the application of the Research Domain Criteria (RDoC) approach in suicidology can also help to integrate research results and clarify their clinical relevance (29).

Thus, the description of suicide-specific syndromes may represent a paradigm-shift in the psychological-psychiatric interpretation of suicidal behavior (**Figure 1**). Previously, in case of many non-fatal or fatal suicide attempts, no mental disorder was identified in the background of the suicidal act, but those were conceptualized as psychological-emotional crisis, based on the traditional crisis theory. However, suicide-specific syndromes condense the complex psychological and psychopathological state and the behavior associated with the suicidal act into a diagnostic category, defining it as a mental disorder. Thus, a significant proportion of suicidal behaviors may still be interpreted as symptoms associated with other major mental disorders (e.g., depression, bipolar disorder, borderline personality disorder, schizophrenia, etc.), but another significant proportion now may be interpreted not only in the framework of the traditional crisis concept, but as the leading symptoms of suicide-specific syndromes. At the same time, suicide-specific syndromes, whether ASAD or SCS, form the basis of a clinically useful transdiagnostic algorithm for detecting imminent suicidal threat. Thus, suicide-specific syndromes may help in a more accurate assessment of suicidal risk, in a more effective prediction of suicidal behavior, and may provide a basis for more effective interventions (12, 13, 19, 26, 30, 31).

As suicidal behavior is a multicausal phenomenon, an integrated approach and modern tools need to be applied for complex risk assessment on a population level (2). These novel methods may include genetic testing, digital phenotyping, data-driven machine learning approach, machine-learning

of electric health records, or Computerized Adaptive Testing (CAT) (2, 3, 15, 32). Although, preliminary results with these new strategies on suicide risk assessment and prediction are promising, further testing and randomized controlled trials are needed to assess their effect and clinical validity (2). The suicide-specific syndrome concept may be successfully integrated in this complex approach. Furthermore, the validated factors and clinical tools developed in the framework of the suicide-specific syndrome research may be used not only in the clinical practice, but also in future clinical trials.

In conclusion, compared to the traditional crisis theory, suicide-specific syndromes are not novel in terms of symptomatology or dynamics of symptom onset, but in their use of more well-defined diagnostic criteria. In addition, past suicide attempts and other classical suicide risk factors provide only marginal improvement of diagnostic accuracy and minimal incremental prediction of future suicide attempts (19, 33), but suicide-specific syndromes may also provide an opportunity to objectively measure the current pre-suicidal emotional and mental state by validated clinical tools. Furthermore, as researchers suggest, suicidal behavior (as a suicide-specific syndrome) should be officially recognized in psychiatric nosology, as an independent, codable entity and as a distinct diagnostic category in the major diagnostic and classification systems, such as DSM or ICD (10). This transdiagnostic approach not only enables a more accurate assessment of suicide risk and prediction of suicide, but also facilitates clinical and neuroscientific (neurobiological and neurocognitive studies) research and also the psychological and narrative interpretations of suicidal behavior, which represent a major step forward in managing and complex understanding of suicidal behavior.

AUTHOR CONTRIBUTIONS

VV and PO designed and wrote the manuscript. TT raised the concept and reviewed the manuscript. AN and SF helped with the concept and completing the paper and reviewed the manuscript. All authors contributed to the article and approved the submitted version.

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Factors Related to Suicide Attempts: The Roles of Childhood Abuse and Spirituality

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Objectives: The purpose of this article was to identify independent factors associated with suicide attempts in patients with depression and/or anxiety.

Background and Aims: This study was conducted in order to examine whether risk and protective psychological factors influence the risk of suicide attempts among outpatients with anxiety and/or depressive disorders. In this regard, explanatory models have been reported to detect high-risk groups for suicide attempt. We also examined whether identified factors serve as mediators on suicide attempts.

Materials and Methods: Patients from 18 to 65 years old from an outpatient clinic at Seoul St. Mary's Hospital were invited to join clinical studies. From September 2010 to November 2017, a total of 737 participants were included in the final sample. The Beck Depression Inventory (BDI), State-Trait Anxiety Inventory (STAI), Childhood Trauma Questionnaire (CTQ), Functional Assessment of Chronic Illness Therapy-Spiritual Well-being Scale (FACIT-Sp-12), and Functional Social Support Questionnaire (FSSQ) were used to assess psychiatric symptoms. An independent samples *t*-test, a chi-square test, hierarchical multiple regression analyses, and the Baron and Kenny's procedures were performed in order to analyze data.

Results: Young age, childhood history of emotional and sexual abuse, depression, and a low level of spirituality were significant independent factors for increased suicide attempts. Depression was reported to mediate the relationship between childhood emotional and sexual abuse, spirituality, and suicide attempts.

Conclusions: Identifying the factors that significantly affect suicidality may be important for establishing effective plans of suicide prevention. Strategic assessments and interventions aimed at decreasing depression and supporting spirituality may be valuable for suicide prevention.

Keywords: suicide attempts, depression, childhood sexual abuse, childhood emotional abuse, spirituality

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INTRODUCTION

Approximately 90% of people who commit suicide are considered to have at least one psychiatric disorder at the time of death (1, 2). Of these psychiatric disorders, mood and anxiety disorders have been particularly identified as critical determinants of suicide (3–6). In addition, sociodemographic factors, such as being male, unmarried, and unemployed (7), as well as exposure to childhood

trauma (8) are recognized as independent risk factors for suicide. Earlier studies have showed that childhood abuse is an important risk factor for violent behaviors toward the self and a key factor to consider for the effective prevention of suicide (9–11). Several studies have also suggested that childhood abuse is related to internalizing (depression and anxiety) and externalizing (substance abuse and antisocial behavior) dimensions underlying psychiatric disorders, and that both of these dimensions are related to suicide attempts (12, 13).

Although there is a substantial amount of literature on suicide risk factors (14, 15), much less is known about the protective factors for suicide (16). In recent decades, some researchers have started to recognize the importance of identifying these protective factors (17, 18). Several studies have reported that spirituality is associated with lower suicide risk and better mental health (19, 20). Spirituality has been defined as "the personal search for understanding life's meaning and the goal of life" (21). Koenig et al. (21) reported that spiritual belief and practices such as meditation, prayer, and communal worship tend to arouse positive and supportive emotions from participants. Other studies have also indicated that the protective effect of spiritual values might be affected by the influence of social support (22). The presence of social support may increase feelings of belongingness, which are negatively associated with suicide risk within Joiner's Interpersonal Theory of Suicide (23, 24). Given the importance of mental illness in the context of suicide (25), it is important to understand the relationship between spirituality, social support, and suicide attempts in populations of people with depression.

Regardless of the agreement among the empirical studies on whether the presence of spiritual beliefs and social support is related to increased resiliency to suicide, the majority of previous studies have not considered both spirituality and social support for suicide. Therefore, studies which examine both factors affecting suicide would be meaningful for suicide protection. In particular, spirituality has some characteristics such as social practices similar to social support. To differentiate both positive factors, we considered spirituality as spiritual beliefs, an affective aspect of spirituality and a cognitive aspect of spirituality. The spiritual practices including communal worship were excluded to differentiate the other positive factor such as social support. Therefore, we identified both relationships between spirituality and suicide attempts, and between social support and suicide attempts, respectively.

The purpose of this study was to examine whether risk and protective factors influence the risk of suicide attempts among outpatients with anxiety and/or depressive disorders. First, we classified patients with anxiety and/or depressive disorder into two groups by the presence or absence of a history of suicide attempts. Then, both groups were compared in terms of sociodemographic factors, psychiatric symptoms, histories of childhood trauma, and positive psychological factors such as spirituality and social support. We used suicide attempts as an outcome variable because suicide attempts are a definite indicator of suicidality (26). We then evaluated the effects of the positive and negative factors which were considered to be related to suicide attempts. Finally, we examined whether the identified significant factors served as mediators on the risk of suicide attempts. According to the prior research findings described above, we formulated three hypotheses: that childhood abuse among different types of childhood maltreatment would be related to the increased suicide attempts, that positive factors such as spirituality and social support would be related to the decreased suicidal behavior, and that depression would mediate the relationship between significant positive/negative factors and suicide attempts.

METHODS

Participants and Procedures

Treatment-seeking patients from 18 to 65 years old from the Mood and Anxiety Disorders Clinic at Seoul St. Mary's Hospital, The Catholic University of Korea were invited to join clinical studies. From September 2010 to November 2017, the participants underwent an assessment that comprised several health and behavioral aspects as well as a psychological evaluation at their first visit before treatment. Patients who met the DSM-IV criteria for depressive and/or anxiety disorders were included in this study. Relevant diagnoses were made by a psychiatrist using structured interviews of the Mini-International Neuropsychiatric Interview (M.I.N.I) (27). A lifetime diagnosis of psychotic disorder, bipolar disorder, intellectual disability, current substance abuse, any mental disorder due to another medical condition as well as medical problems affecting study participation were exclusion criteria. A total of 751 outpatients who met the inclusion criteria participated in the study and were administered a battery of self-report psychiatric questionnaires. Excepting analyses of those who had not completed all measures, the final sample included 737 patients. This investigation was carried out in accordance with the latest version of the Declaration of Helsinki. This study was approved by the Institutional Review Board of the Ethics Committee of Seoul St. Mary's Hospital at The Catholic University of Korea (KC09FZZZ0211). Written informed consent was obtained from all subjects after providing them with a complete description of the study.

Measurements

Sociodemographic, Clinical Information, and Suicide Attempts

Sociodemographic and clinical information were acquired from medical charts and interviews with patients and their caretakers. Data on age, gender, education, marriage status and employment status were obtained in the study. Education was estimated by the years of formal education. Marital status was categorized as married and unmarried (including single, divorced, and widowed). Employment status was categorized as employed (including permanent and precarious employment) and unemployed. In this study, the definition of unemployed included all subjects who were without work regardless of whether they were looking for work or not. Suicidality was assessed according to the following question: "Have you ever attempted suicide in the past?" There is supporting evidence that past suicide attempt is a leading risk factor for future attempts

and death by suicide (28, 29). Positive responses were confirmed by follow-up questions that assessed the number, method, and subjective seriousness of these attempts.

Psychiatric Symptoms

The Beck Depression Inventory (BDI) was used to assess depressive symptoms. The BDI consists of 21 items on a 4-point scale from 0 (symptom absent) to 3 (severe symptoms) and is a self-report inventory for evaluating the severity of depression. The BDI evaluates depressive symptoms within the preceding week, with high scores reflecting a greater severity of depressed mood (range = 0–63) (30). The Korean version of BDI used here has been validated (31–33).

Anxiety was evaluated by the State-Trait Anxiety Inventory (STAI). The STAI consists of two scales, each containing 20 items using a 4-point Likert scale. First, the State Anxiety Scale (S-Anxiety) assesses the current state of anxiety, asking how respondents feel "right now," including subjective feelings of apprehension, tension, nervousness, worry, and activation/arousal of the autonomic nervous system. The Trait Anxiety Scale (T-Anxiety) assesses relatively stable aspects of "anxiety proneness" using items that measure general states of calmness, confidence, and security. When the scores on each item are added up, a total summed score is obtained. We used a total summed score to assess anxiety. The range of scores for each subtest is 20–80, with a higher score implying greater anxiety (34). Validation of the Korean version of STAI has proven its reliability and sensitivity in the measurement of anxiety (35).

Childhood Trauma

Childhood trauma was measured using the short form of the Childhood Trauma Questionnaire (CTQ). The CTQ yields scores for childhood physical neglect, emotional neglect, physical abuse, emotional abuse, and sexual abuse, as well as a total score. The short version of CTQ is a 5-item Likert scale on which the respondents rate the frequency of 28 sentences about childhood trauma experiences (36–38). The CTQ measures the severity of symptoms as none, low, moderate, or severe, and we used a moderate-to-severe cutoff point (39). Validation of the Korean version of CTQ has proven its reliability and sensitivity (40).

Positive Psychological Factors

Spiritual well-being was assessed using the Functional Assessment of Chronic Illness Therapy-Spiritual Well-being Scale (FACIT-Sp-12) (41). This scale is divided into three factors: faith (spiritual beliefs), peace (an affective aspect of spirituality), and meaning (a cognitive aspect of spirituality) (42, 43). The FACIT-Sp-12 has a 5-point Likert-style response scale (0 = not at all, 1 = a little bit, 2 = somewhat, 3 = quite a bit, 4 = very much), and when the scores on all the items are added up, a total summed score is obtained (two items are reverse-scored). The Korean version has not been officially validated, but it has been used in a domestic study. In that study, Cronbach alpha was 0.751, and spiritual well-being correlated negatively with anxiety ($r = -0.613$) and depression ($r = -0.526$, all $p < 0.05$), attesting to the concurrent validity of the FACIT-sp (44). The internal consistency of our study as measured by the Cronbach's alpha coefficient was been found to be 0.76 for the Spiritual Well-being subscale.

Social support was measured by the Functional Social Support Questionnaire (FSSQ), an eight-item questionnaire which assesses the strength of one's social network. It consists of two domains: confidential social support and affective social support. The score of the scale ranges from 11 to 55, where 55 indicates the highest levels of social support. Validation of the Korean version of FSSQ has proven its reliability and sensitivity in the measurement of social support (45).

Data Analysis

Participants were classified into either the suicide attempt group or the no suicide attempt group based on the responses of a self-report form assessing suicidality. The characteristics of the participants were reported as means (standard deviation [SD]) for continuous variables, and as numbers (%) for categorical variables. Two-tailed tests were used in all instances, and statistical significance was defined as $p < 0.05$ with confidence intervals at 95%. In order to identify the relationship between each of these variables and suicide attempts, an independent samples *t*-test was performed for each continuous variable and a chi-square test was performed for each categorical variable.

Hierarchical multiple regression analyses were performed in order to evaluate whether each positive and negative factor is related to suicide attempts or not. The principle of "factors coming earlier in the series can affect other factors coming later, but not vice versa" was used to decide the order of the included variables (46). In the four-block model, we initially included demographic data to adjust for the effects of demographic differences. Then, childhood trauma, positive psychological factors, and clinical symptoms were entered into blocks 2, 3, and 4, respectively, according to the guidelines. Because childhood trauma is known as one of the distal factors which affect suicide risk (4), we entered this variable into block 2. Next, positive factors such as spirituality and social support have long been regarded as mitigating distress (47, 48). Social support has been found to be inversely related to depression and anxiety (49). Moreover, spirituality plays a key role in helping depressive patients cope with stress (50, 51). Because protective factors have been known to decrease psychiatric symptoms such as depression and anxiety, positive factors and clinical symptoms were included in blocks 3 and 4. A forward selection method was used in the multiple regression analyses because intercorrelations between variables were expected.

In the final part of the study, we performed mediating analysis in order to understand the relationship between significant factors and suicidal ideation. Baron and Kenny's procedures were used to examine the mediating effect of depression (52). Past studies have shown that the association between childhood abuse and suicidal behaviors was mediated by mental disorders such as depression (53–55). In addition, other studies have described that spirituality and social support provide protective effects regarding suicide attempts (56) and are associated with decreased rates of depression (57). According to these previous studies, we confirmed a relationship between each independent variable (i.e., childhood trauma and positive factors)

TABLE 1 | Demographic and psychiatric characteristics, childhood trauma, and positive factors of subjects with anxiety and/or depression by suicide attempt history.

Variable	No suicide attempt history (*n* = 554, 75.2%)	Suicide attempt history (*n* = 183, 24.8%)	*p*[a]
DEMOGRAPHIC CHARACTERISTICS			
Age, years, mean ± SD	38.3 ± 13.4	30.7 ± 11.1	<0.001**
Gender (female), no. (%)	305 (55.5)	97 (53.3)	0.668
Education, years, mean ± SD	14.3 ± 2.8	13.6 ± 2.4	0.002**
Marriage status (Unmarried), no. (%)	278 (50.2)	119 (76.5)	<0.001**
Employment status (no), no. (%)	244 (44.0)	108 (59.0)	0.001**
PSYCHIATRIC CHARACTERISTICS			
Depression (BDI), mean ± SD	21.8 ± 10.9	31.0 ± 10.7	<0.001**
Anxiety (STAI), mean ± SD	115.4 ± 23.9	130.4 ± 19.6	<0.001**
CHILDHOOD TRAUMA (CTQ)			
Emotional abuse (yes), no. (%)	8.2 (4.5)	11.6 (5.8)	<0.001**
Physical abuse (yes), no. (%)	8.6 (4.5)	10.8 (5.5)	<0.001**
Sexual abuse (yes), no. (%)	6.1 (2.6)	7.5 (4.3)	<0.001**
Emotional neglect (yes), no. (%)	12.5 (5.4)	15.1 (5.9)	<0.001**
Physical neglect (yes), no. (%)	8.0 (3.3)	8.7 (3.6)	0.035*
POSITIVE FACTORS			
Spirituality (FACIT-Sp-12), mean ± SD	22.1 ± 10.0	13.7 ± 9.4	<0.001**
Social support (FSSQ), mean ± SD	40.3 ± 11.6	35.2 ± 12.0	<0.001**

BDI, Beck Depression Inventory; STAI, State-Trait Anxiety Inventory; CTQ, Childhood Trauma Questionnaire; FACIT-Sp-12, Functional Assessment of Chronic Illness Therapy-Spiritual Well-being Scale; FSSQ, Functional Social Support Questionnaire; SD, standard deviation.

[a]*Statistical significance from independent t-tests or chi-square tests.*

**p < 0.05, **p < 0.01.*

and the dependent variable (i.e., suicide attempts) in the logistic regression analysis in Step 1. In Step 2, simple linear regression analysis was conducted in order to confirm a relationship between the independent variables and the mediator variable (i.e., depression). In Step 3, logistic regression analysis was used to confirm relationships between the mediator and the dependent variable after controlling for the predictor variables. Then, we confirmed the relationships between the independent variables and the dependent variable after controlling for the mediator in Step 4. The Sobel test (58) was then employed in order to determine the indirect effects of the mediator variable on the association between predictor variables and the outcome variable. All analyses were conducted with SPSS version 21.0 for Windows (SPSS, Inc., and IBM Company, Chicago, IL, USA).

RESULTS

Demographic Characteristics, Related Risk, and Positive Factors With Suicide Attempts

Sociodemographic and psychiatric characteristics, childhood trauma history, and positive psychological factors of subjects in the two groups (having a history of suicide attempts and having no history of suicide attempts) are shown in **Table 1**. Approximately two-thirds (75.2%) of participants were classified with no suicide attempt history while approximately one-third (24.8%) of participants were classified with suicide attempt history. Five hundred and fifty-four participants without suicide attempt history had a mean age of 38.3 (±13.4) years with 305 females (55.5%) and 245 males (44.5%). The mean years of education was 14.3(±2.8) years. Half of them were unmarried (50.2%) and majority of them were employed (56.0%). On the other hand, 183 participants with a history of suicide attempts had a mean age of 30.7 (±11.1) years with 97 females (53.3%) and 85 males (46.7%). The mean years of education was 13.6 (±2.4) years. Majority of them were unmarried (76.5%) and unemployed (59%). Comparing sociodemographic factors between the two groups according to suicide attempt history, subjects with a history of suicide attempts tended to be younger ($p < 0.001$), less educated ($p = 0.002$), be less employed ($p = 0.001$), and live alone ($p < 0.001$). There were no significant gender differences between the two groups.

The mean BDI and STAI scores of participants with a history of suicide attempts were 31.0 (±10.7) and 130.4 (±19.6) which belong to the ranges of severe depression and anxiety (45, 59–61). These scores were significantly higher than the scores of participants with no history of suicide attempts ($p < 0.001$). People with a history of suicide attempts had significantly higher scores in all areas of childhood trauma questionnaires than those without a history of suicide attempts ($p < 0.001$). Considering positive factors, subjects with suicide attempt history tended to have lower FACIT-Sp-12 ($p < 0.001$) and FSSQ ($p < 0.001$) scores than those without suicide attempt history. In other words, participants with a history of suicide attempts had lower spirituality and social support than those with no history of suicide attempts.

TABLE 2 | Results of hierarchical logistic regression model to identify factors related to suicide attempts.

Block no., variable	Results of each step using forward stepwise method in blocks 2–4						Last step results	
	OR (95%CI)	*p*	OR (95%CI)	*p*	OR (95%CI)	*p*	OR (95%CI)	*p*
CONSTANT								
1. Covariates								
Age, years	0.97 (0.95–0.99)	0.001**	0.97 (0.95–0.99)	0.001**	0.98 (0.96–0.10)	0.027*	0.97 (0.95–1.00)	0.017*
Gender (female)	0.76 (0.52–1.12)	0.164	0.90 (0.60–1.35)	0.625	0.89 (0.58–1.35)	0.571	0.98 (0.64–1.50)	0.914
Marriage status (Unmarried)	0.44 (0.26–0.74)	0.002**	0.53(0.31–0.91)	0.022*	0.68 (0.39–1.19)	0.176	0.65 (0.37–1.14)	0.135
Education, years	0.96 (0.89–1.03)	0.208	0.97 (0.90–1.05)	0.476	0.98 (0.90–1.06)	0.556	0.98 (0.91–1.07)	0.680
Employment status (no)	0.68 (0.47–0.99)	0.043*	0.71 (0.48–1.05)	0.085	0.76 (0.50–1.14)	0.182	0.78 (0.51–1.18)	0.239
2. Childhood trauma								
Emotional abuse (yes)			1.07 (1.02–1.12)	0.011*	1.07 (1.02–1.13)	0.010*	1.06 (1.01–1.12)	0.028*
Physical abuse (yes)			1.02 (0.97–1.07)	0.465	1.02 (0.97–1.07)	0.497	1.01 (0.96–1.06)	0.611
Sexual abuse (yes)			1.09 (1.03–1.16)	0.005**	1.09 (1.03–1.17)	0.007**	1.09 (1.02–1.17)	0.012*
Emotional neglect (yes)			1.03 (0.98–1.07)	0.242	1.00 (0.96–1.05)	0.966	1.01 (0.96–1.06)	0.665
Physical neglect (yes)			0.98 (0.92–1.05)	0.616	0.99 (0.92–1.06)	0.737	0.98 (0.91–1.06)	0.628
3. Positive factors								
Spirituality (FACIT–Sp-12)					0.93 (0.90–0.96)	<0.001**	0.94 (0.91–0.98)	0.001**
Social support (FSSQ)					1.01 (0.99–1.03)	0.562	1.01 (0.99–1.03)	0.344
4. Psychiatric characteristics								
Depression (BDI)							1.05 (1.02–1.08)	0.001**
Anxiety (STAI)							0.10 (0.98–1.01)	0.693
MODEL FIT								
Hosmer and Lemeshow test	$\chi^2 = 5.694$, $p = 0.681$		$\chi^2 = 1.842$, $p = 0.985$		$\chi^2 = 2.223$, $p = 0.973$		$\chi^2 = 8.080$, $p = 0.426$	

BDI, Beck Depression Inventory; STAI, State–Trait Anxiety Inventory; CTQ, Childhood Trauma Questionnaire; FACIT-Sp-12, Functional Assessment of Chronic Illness Therapy-Spiritual Well-being Scale; FSSQ, Functional Social Support Questionnaire.
Hierarchical multivariate logistic regression analysis was performed.
*$p < 0.05$, **$p < 0.01$.*

Independent Effect of Negative and Positive Factors on Suicide Attempts

Table 2 shows the results of a hierarchical multivariate logistic regression analysis examining the factors related to suicide attempts. After controlling for demographic covariates, a high grade of childhood trauma, low spirituality, low social support, and high levels of depression and anxiety symptoms were included in the model step by step. In the final model, being of a young age [adjusted [adj.] OR = 0.97 (0.95–1.00)] and having experienced a high level of emotional abuse [adj. OR = 1.06 (1.01–1.12)] and a high level of sexual abuse [adj. OR = 1.09 (1.02–1.17)], as well as low spirituality [adj. OR = 0.94 (0.91–0.98)] were all independently associated with suicide attempts. In particular, a high grade of childhood sexual abuse was the most influential variable on suicide attempts. The overall model fits the data well (Hosmer and Lemeshow test of goodness-of-fit $\chi^2 = 8.08$, $p = 0.426$).

Mediating Effects of Depression on Patients' Suicide Attempts

All four steps of Baron and Kenny's analysis were performed in order to examine the mediating roles of depressive symptoms in the relationships between childhood emotional abuse, childhood sexual abuse, spirituality, and suicide attempts. As shown in **Table 3**, the results of mediation analyses showed that the total effect of childhood emotional abuse on suicide attempts was significant ($\beta = 0.121$, SE = 0.016, $p < 0.001$). The significant coefficient of path a ($\beta = 0.238$, SE = 0.988, $p < 0.001$) and path b ($\beta = 0.064$, SE = 0.009, $p < 0.001$) indicated positive associations of childhood emotional abuse on depression, and depression on suicide attempts. Besides, the indirect effect of childhood emotional abuse on suicide attempts through depression was statistically significant ($\beta = 0.092$, SE = 0.017, $p < 0.001$). Therefore, depression significantly mediated the effect of childhood emotional abuse on suicide attempts (see **Figure 1**).

TABLE 3 | Mediating effects of depression on patients' suicide attempts.

	β	*SE*	*p*	Exp(B)	Adjusted R^2
Model 1					
Emotional abuse → Suicidal attempt	0.121	0.016	<0.001	1.129	0.110
Emotional abuse → Depression	0.238	0.988	<0.001		0.055
Depression → Suicidal attempt	0.064	0.009	<0.001	1.066	0.216
Emotional abuse → Suicidal attempt excluding Depression	0.092	0.017	<0.001	1.097	
Sobel test $z = -4.36$, $p = <0.001$					
Model 2					
Sexual abuse → Suicidal attempt	0.116	0.025	<0.001	1.123	0.044
Sexual abuse → Depression	0.138	1.092	<0.001		0.018
Depression → Suicidal attempt	0.069	0.008	<0.001	1.072	0.186
Sexual abuse → Suicidal attempt excluding Depression	0.087	0.027	0.001	1.091	
Sobel test $z = -2.35$, $p = 0.001$					
Model 3					
Spirituality → Suicidal attempt	−0.094	0.011	<0.001	0.910	0.187
Spirituality → Depression	−0.492	0.740	<0.001		0.241
Depression → Suicidal attempt	0.044	0.010	<0.001	1.045	0.220
Spirituality → Suicidal attempt excluding Depression	−0.065	0.012	<0.001	0.938	
Sobel test $z = -3.31$, $p = <0.001$					

Baron and Kenny's procedures were used to examine the mediating effects of depression.

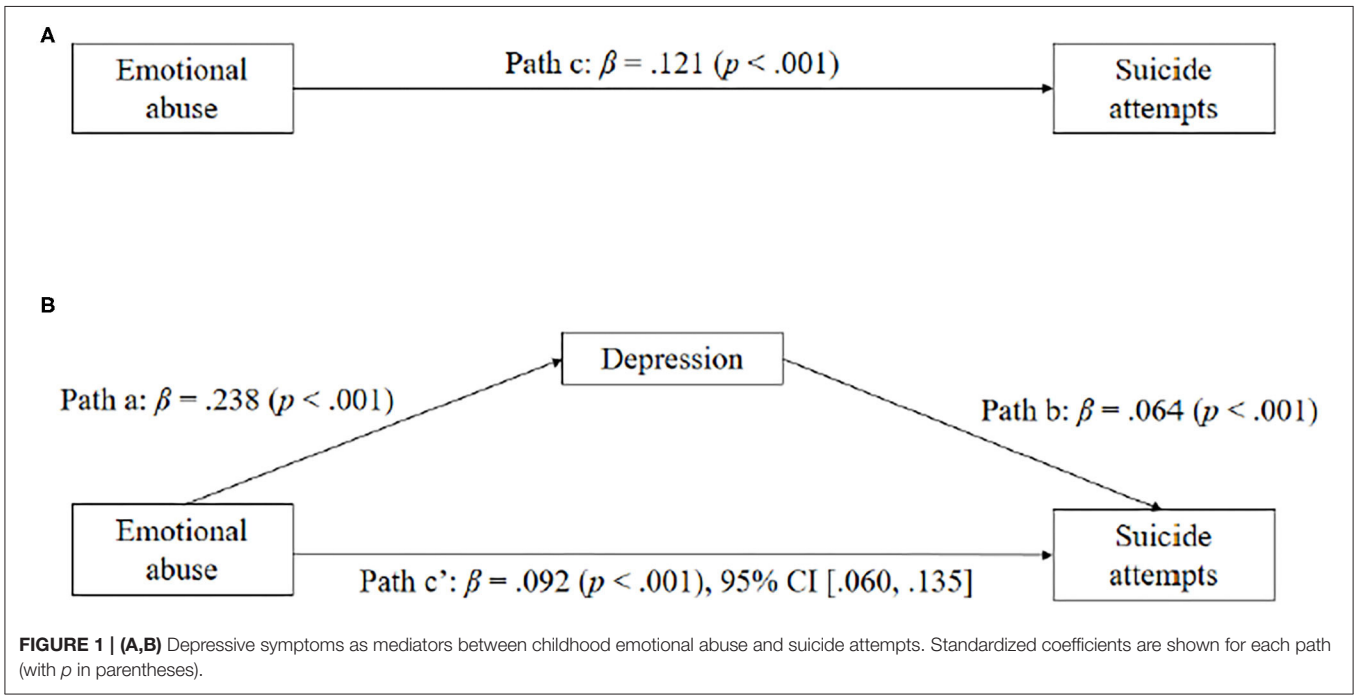

FIGURE 1 | (A,B) Depressive symptoms as mediators between childhood emotional abuse and suicide attempts. Standardized coefficients are shown for each path (with *p* in parentheses).

Significant effects were also observed for childhood sexual abuse on depression ($\beta = 0.138$, SE = 1.092, $p < 0.001$), depression on suicide attempts ($\beta = 0.069$, SE = 0.008, $p < 0.001$), and childhood sexual abuse on suicide attempts ($\beta = 0.116$, SE = 0.025, $p < 0.001$). Notably, the indirect effect of childhood sexual abuse on suicide attempts through depression was significant ($\beta = 0.087$, SE = 0.027, $p = 0.001$). The pattern of the mediating effects of depression between childhood sexual abuse and suicide attempts is depicted in **Figure 2**.

Figure 3 displays the model of spirituality as a predictor of suicide attempts, mediated by depression. When depression was excluded in the model, spirituality significantly predicted suicide attempts ($\beta = -0.094$, SE = 0.011, $p < 0.001$). The simple mediation analysis with suicide attempts as the outcome indicated that spirituality significantly predicted depression (β

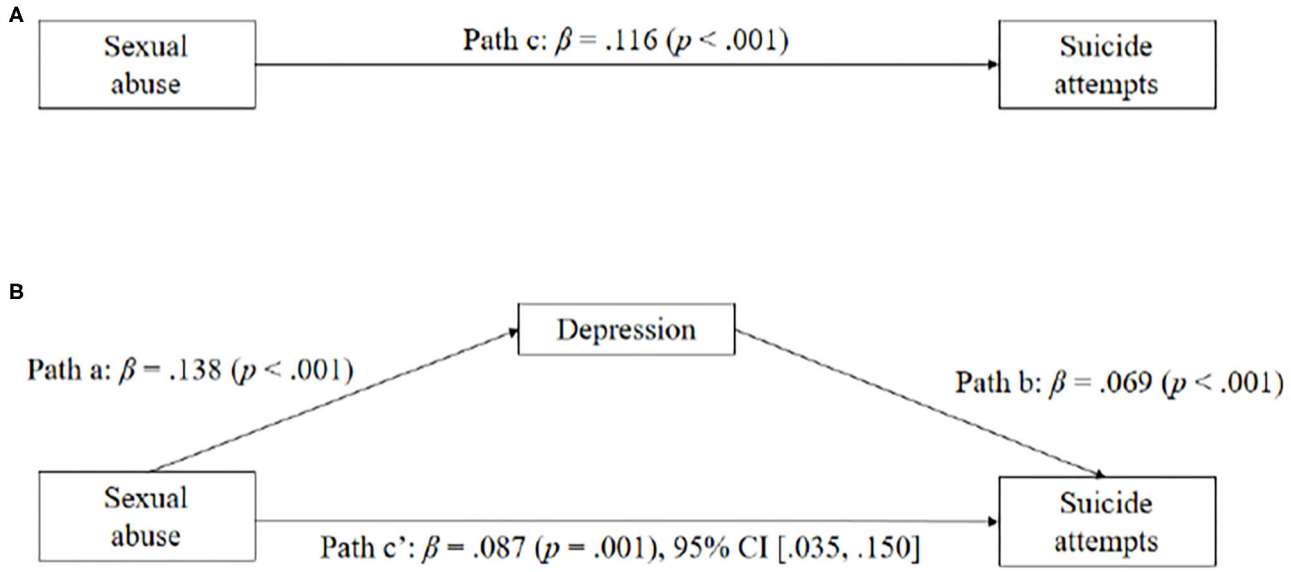

FIGURE 2 | (A,B) Depressive symptoms as mediators between childhood sexual abuse and suicide attempts. Standardized coefficients are shown for each path (with p in parentheses).

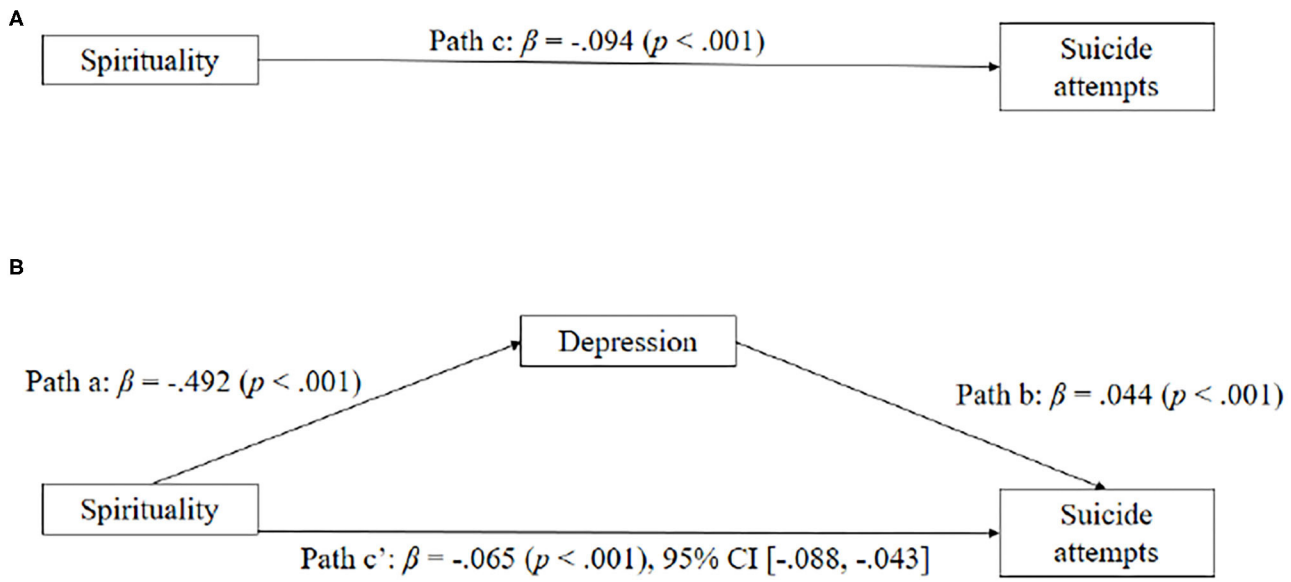

FIGURE 3 | (A,B) Depressive symptoms as mediators between spirituality and suicide attempts. Standardized coefficients are shown for each path (with *p* in parentheses).

= −0.492, SE = 0.740, $p < 0.001$). The association was negative: as spirituality increased, depression severity declined (and vice versa). Spirituality significantly predicted suicide attempts even with relationship depression in the model (β = −0.065, SE = 0.012, $p < 0.001$) and depression also significantly predicted suicide attempts ($\beta = 0.044$, SE = 0.010, $p < 0.001$). As depression severity increased, suicide attempts increased as well (and vice versa), and as spirituality increased, suicide attempts decreased. Consistent with our hypothesis, depression significantly mediated the effect of spirituality on suicide attempts.

DISCUSSION

In the present study on patients with depression and/or anxiety disorders, being young, having experienced a high level of childhood emotional and sexual abuse, and having a

high level of depression and low level of spirituality were all significant independent factors for increased suicide attempts after controlling for sociodemographic factors, childhood trauma history, positive psychological factors, and psychiatric symptoms. In particular, depressive symptoms were identified as partially mediating the relationships between childhood emotional and sexual abuse, spirituality, and suicide attempts.

The findings of our study were consistent with those of previous studies that depression was significantly related to suicidality (62–64). It is therefore important to identify the close relationship between suicide and depression distinct from anxiety. The first possible connecting link between these two factors is hopelessness. Wolfe et al. (65) reported that hopelessness is a mediator of suicidal ideation in depressive adolescent youth. A strong relationship among depression, suicide, and hopelessness as a mediator was demonstrated in a non-clinical sample in another study (66). The second factor affecting suicidality was identified as anhedonia. Research has suggested that anhedonia may be a unique symptom of depression associated with thoughts of suicide (63). Those who have suicidality are less interested in experiencing pleasure and try to avoid intolerable psychological pain, which motivates them to think about suicide (64). In other words, hopelessness and anhedonia, which are intimately related with depression other than anxiety, are important factors associated with suicide.

Several studies have reported that sexual abuse history in particular has a noticeable effect on the risk of suicide (67–69). Brown et al. proposed that, among various types of childhood trauma, sexual abuse alone was the strongest independent risk factor for suicide (70). Ryan demonstrated that those who had a history of childhood sexual trauma may respond to anger, even if there is no danger related to the traumatic experience (71). The effects of traumatic events and depression on anger, particularly internal hostility, are related to suicide risk, suggesting a potential mechanism of childhood sexual trauma and suicide linkage (72). On the other hand, childhood emotional abuse is an independent risk factor of suicide with its effects on interpersonal relationships (73). Emotional difficulties arousing from negative relationships between the exploiter caregiver and the abused child may be internalized and responsible for long-term effects on negative cognitions (74). Those with a history of emotional abuse may have schemas of deficiency, shame, and self-sacrifice, which may induce emotional problems and depression (75). Therefore, it was concluded that sexual and emotional abuse was a significant determinant of predisposition to suicide.

As our study has shown, spirituality was a significant factor having a meaningful protective effect on suicide. It has been reported that spirituality may increase senses of intimacy as well as enhance a feeling of comfort and relief (76), provide hope in one's life (77, 78), and decrease physical, psychological, and social difficulties (76, 79, 80). High spirituality helps individuals apply a positive coping style against stress (81) and decrease suicide in various populations (82–84). Wu et al. (85) has shown that religion is a positive factor against completed suicide in a majority of settings where suicide research is conducted using a meta-analysis. Thus, taking a spiritual history is not only necessary to identify spiritual resources that can be used to facilitate psychological well-being, but also to identify ability that may directly impact on suicide prevention.

A spiritual history can be included as part of the social history at the time of hospital admission, during a new patient evaluation, or as part of an outpatient visit (86). There is also evidence that addressing spiritual issues enhances the doctor-patient relationship and helps to build trust (87). If spiritual needs are identified, then spirituality-based intervention can be introduced. Especially, mindfulness is a practice that has long been associated with spiritual development (88, 89). Because mindfulness has its roots in Asian culture, it especially can be an effective intervention to enhance spirituality among Koreans. Yong et al. demonstrated that spirituality training program including mindfulness meditation showed beneficial effects on spiritual well-being for middle manager nurses in Korea (90). The significant improvement in spiritual well-being and spiritual integrity in the experimental group was supported by similar results in other health care professionals (91, 92). Therefore, spirituality-based programs can be introduced within continuing education and staff development programs for mental health professionals.

Although there is some evidence that social support is associated with decreasing suicide risk in patients with depression (93, 94), we did not identify this independent relationship among the two. Social support is defined as the perception of the individual regarding relationships with other positive resources that assist the individuals to cope not only with every day events, but also with stressful situations (95, 96). Because FSSQ aims to measure the person's satisfaction with functional and affective aspects of the individual's social support (97, 98), not all aspects and sources of social support may be evaluated. Some studies have also suggested that depressive symptoms are mediating factors which affect the relationship between suicide and psychosocial factors (99, 100). Depression might weaken the protective effect of social support on suicide attempts. Therefore, the mediating effects of depressive symptoms on the association between social support and suicide should be considered in interpreting the results.

Our study does have some limitations. First, we used self-reporting scales to assess psychological symptoms, including BDI, STAI, CTQ, FACIT-Sp-12, and FSSQ; self-reporting can exaggerate the reported severity of symptoms (101, 102). Second, because of the cross-sectional design of this study, we cannot certainly infer causality between suicide attempts and the other variables studied. Therefore, further study with a prospective design which identifies causality may be needed in order to clarify how significant factors such as spirituality contribute to the alleviation of the effects of the risk factors on suicide. Third, despite the classification between anxiety and/or depressive disorder, we considered the two disorders as one group. One of the most prevalent findings in psychiatry is the frequent comorbidity between anxiety disorders and depressive disorders (103). Co-morbidity has many origins such as genetic factors (104, 105) and environmental experiences, including stressful life events (106, 107). Although anxiety disorders and depressive disorders have displayed frequent comorbidity, the specificity of each diagnosis may be identified in order to differentiate

between the outcomes in the different populations (108). Fourth, despite the various severities of depressive symptoms, we regarded different depressive disorders as a single group. Because this study was performed at a general hospital located in Seoul, the capital of South Korea, participants coming all over the country had different associated symptoms and severities difficult to characterize a specific population. Also, participants had different comorbidities including physical and mental disorders (e.g., somatic symptom and related disorders, trauma- and stressor- related disorders, sleep-wake disorders etc.) Therefore, further study classifying depressive disorders with the severity and symptomatology may be required. Fifth, high risk groups are excluded from the study; exclusion criteria such as substance abuse could make a biased population due to the high comorbidity between substance use disorders and depressive/anxiety disorders. Sixth, our study could have been improved by using previous medical records. Because participants were joined and evaluated at their first visit, previous medical records of them could not be identified. We did not consider past substance abuse which could have contributed to suicidality. Finally, although suicide attempts are a definite behavioral indicator of suicide, they cannot evaluate the severity and frequency of suicidal ideation and any specific plans for suicide attempts. According to the continuum model of suicide, suicidal ideation has been shown to be an important indicator of future suicide attempts (109). Therefore, further study assessing various aspects of suicidality with several scales and detailed clinical interviews may be required.

Identifying independent factors associated with suicide attempts might be important for establishing effective plans of suicide prevention. Clinicians need to be aware of the types of childhood maltreatment and the broad range of household dysfunction they may encounter. An awareness of the relationship between specific types of childhood abuse and suicide attempts may benefit interventions for people with depression. In particular, early prevention efforts aimed at children who have experienced sexual and emotional abuse may reduce their risks for the development of suicide. In addition, an assessment of spirituality level in conjunction with psychiatric risk factors may also be recommended in screening patients at risk of suicide. A brief spiritual history is recommended for all patients visiting psychiatric clinics. The findings of this study highlight the associations between spiritual well-being and suicide in patients with depression, which should prompt clinicians to take into account spirituality in an effort to improve psychological well-being in patients with depression and/or anxiety. In conclusion, an assessment and strategic interventions to decrease depression and support spirituality might be significant for suicide prevention.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The Institutional Review Board of the Ethics Committee of Seoul St. Mary's Hospital at The Catholic University of Korea (KC09FZZZ0211). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

HT was involved in conceiving of the study, carrying out all aspects of the data collection and analysis, and writing of the manuscript. J-HC provided critical feedback and aided in editing the first draft. All authors contributed to and have approved the final manuscript.

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REVIEW
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The Social Roots of Suicide: Theorizing How the External Social World Matters to Suicide and Suicide Prevention

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The past 20 years have seen dramatic rises in suicide rates in the United States and other countries around the world. These trends have been identified as a public health crisis in urgent need of new solutions and have spurred significant research efforts to improve our understanding of suicide and strategies to prevent it. Unfortunately, despite making significant contributions to the founding of suicidology – through Emile Durkheim's classic Suicide (1897/1951) – sociology's role has been less prominent in contemporary efforts to address these tragic trends, though as we will show, sociological theories offer great promise for advancing our understanding of suicide and improving the efficacy of suicide prevention. Here, we review sociological theory and empirical research on suicide. We begin where all sociologists must: with Durkheim. However, we offer a more comprehensive understanding of Durkheim's insights into suicide than the prior reviews provided by those in other disciplines. In so doing, we reveal the nuance and richness of Durkheim's insights that have been largely lost in modern suicidology, despite being foundational to all sociological theories of suicide – even those that have moved beyond his model. We proceed to discuss broadly acknowledged limitations to Durkheim's theory of suicide and review how more recent theoretical efforts have not only addressed those concerns, but have done so by bringing a larger swatch of sociology's theoretical and empirical toolkit to bare on suicide. Specifically, we review how recent sociological theories of suicide have incorporated insights from social network theories, cultural sociology, sociology of emotions, and sociological social psychology to better theorize how the external social world matters to individual psychological pain and suffering. We conclude by making explicit bridges between sociological and psychological theories of suicide; by noting important limitations in knowledge about suicide – particularly regarding the roles of organizations, inequality, and intersectionality in suicide – that sociology is well situated to help address.

Keywords: Sociology, Durkheim, suicide, social connectedness, social networks, social psychology, suicide contagion, suicide prevention

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INTRODUCTION

The past 20 years have seen dramatic rises in suicide rates in the United States and other countries around the world (Curtin et al., 2016; Lee et al., 2018; Martini et al., 2019). These trends have been identified as a public health crisis in urgent need of new solutions (Office of the Surgeon General and National Action Alliance for Suicide Prevention, 2012) and have spurred significant research efforts to improve our understanding of suicide (Joiner, 2005; Klonsky and May, 2015; O'Connor and Kirtley, 2018) and strategies to prevent it (Wyman et al., 2010; Wasserman et al., 2015). Unfortunately, despite making significant contributions to the founding of suicidology – through Emile Durkheim's (1897/1951) classic *Suicide* – sociology's role has been less prominent in contemporary efforts to address these tragic trends, though as we will show, sociological theories offer great promise for advancing our understanding of suicide and improving the efficacy of suicide prevention.

Here, we review sociological theories of suicide with the explicit goal of building bridges. We begin where all sociologists must: with Durkheim. However, we offer a more comprehensive understanding of Durkheim's insights into suicide than prior reviews provided by non-sociologists (Joiner, 2005). This is critical. Much of the nuance and richness of Durkheim's insights have been lost in modern suicidology, and yet Durkheim is foundational to understanding sociological theories of suicide, as well as understanding the potential of sociology for suicidology. We also discuss limitations in the Durkheimian approach and how more recent efforts have not only addressed those concerns but have done so by bringing sociology's broader theoretical and empirical toolkit to bare on suicide. These insights draw largely from social network theories, cultural sociology, sociology of emotions, and sociological social psychology. We conclude by making explicit bridges between sociological and psychological theories of suicide and by noting important limitations in knowledge about suicide – particularly regarding the roles of organizations, inequality, and intersectionality – that sociological scholarship is uniquely prepared to address.

Durkheim Explained

The sociological study of suicide remains rooted in founder Émile Durkheim's (1897/1951) empirical study of suicide, still the disciplines' greatest contribution to suicidology (Joiner, 2005). Durkheim's theory posits two core principles: (1) that the structure of suicide rates is a positive function of the structure of a group or class of people's social relationships and those (2) that social relationships vary according to their level of integration and (moral) regulation. Though Durkheim never clearly defined his dimensions, sociologists have generally treated integration as the structural elements of social relationships like the number and density of ties (Pescosolido, 1990, 1994; Bearman, 1991) and regulation as the degree to which a collective's moral order controls and coordinates its member's attitudes and behaviors (Bjarnason, 1998; Abrutyn and Mueller, 2016). Additionally, Durkheim articulated two continua and four types of suicide related to integration and regulation: egoistic/altruistic suicides (too little ↔ too much *integration*) and anomic/fatalistic suicides (too little ↔ too much *regulation*).

Importantly, Durkheim was not interested in the subjective appraisals suicide decedents provided for why they chose suicide, but rather saw suicide, like alcohol abuse or homicide, as a symptom of collective breakdown of society. In turn, rather than focus interventions to reduce suicide on individuals, he argued [like many population health scientists today (Pescosolido, 1992; Hall and Lamont, 2009)] that a more efficacious avenue to protect individual well-being lies in collective public projects to produce protective structural changes. These changes can restore the integrative and regulative functions of the social groups to which individuals belong or lessen the intense pressure on individuals in social groups where integration and regulation have exceeded "healthy" levels. Durkheim was writing at a time of immense political, economic, and cultural change, which in turn motivated his emphasis on the types of suicide predicated on *too little* integration or regulation over the dangers of *too much*. Consequently, empirical research examining when and why connectedness or moral clarity might prove fatal to a group's members was sidelined until rather recently; a point we will return to below.

Integration and Suicide

Of the two social factors, Durkheim's *integration* has had the most profound impact on both sociology and suicidology. In explaining the power of integration, Durkheim argued that the more extensive and denser a collective's social relationships – i.e., the more integrated the collective – the more enmeshed individual group members become, and, therefore, the more meaning and purpose individuals feel about their lives. He remarked, "The bond that unites [individuals] with the [group] attaches them to life [and] prevents their feeling personal troubles so deeply (1951:209–210)." He continues that suffering physically, psychologically, or spiritually, "does not exist for the believer firm in his faith or the man strongly bound by ties of domestic or political society" (ibid., 212). This collective belonging protects individuals from what Durkheim termed "egoistic" suicide, or suicides resulting from isolation and a lack of collective belonging. Integration, then, is borne of the recurring social relationships that require tending and care, and which are embedded in larger networks that form groups, communities, or perhaps, even nation-states. This includes being tied to families and neighborhoods (Bjarnason, 1994; Maimon and Kuhl, 2008; Maimon et al., 2010) as well as communities (Baller and Richardson, 2002). These relationships provide members with what sociologists call social capital, or tangible and intangible benefits built on membership (Coleman, 1988; Portes, 2014).

In recent theories of suicidology, integration has been operationalized through perceptions about belongingness (Joiner, 2005) and connectedness (Centers for Disease Control and Prevention, n.d.; Klonsky and May, 2015). However, Durkheim was not interested in *perceptions* or *appraisals*, which he argued were subjective. Instead, integration is meant to be a characteristic of the group, not of individuals (Turner, 1981; Pescosolido, 1994; Mueller and Abrutyn, 2016). Regardless,

Durkheim's basic premise – that being highly integrated (whether measured at the collective level or through individual perceptions) is protective against suicide – has received consistent strong empirical support across time and space and disciplinary boundaries (Stack, 2000; Joiner, 2005; Wray et al., 2011).

Conversely, the flipside of egoistic suicide – suicides caused by too much integration or *altruistic* suicide – has received scant theoretical and empirical attention (Davies and Neal, 2000; Stack, 2004). In Durkheim's estimation, tight-knit societies could rob individuals of their ability to make decisions under certain conditions, leading to suicides for the "good of the group." He pointed, for instance, to Hindu *Sati*, a rare form of suicide in which Hindu widows are compelled to throw themselves on their husband's funeral pyre (Abrutyn, 2017). Though Durkheim thought over-integrated suicides relics of earlier forms of society, Abrutyn and Mueller (2016) have argued they are more common than we think. Pointing to the literature on social capital (Coleman, 1988; Portes, 2014) and on suicide clusters (Niedzwiedz et al., 2014), they argue that in the meso-level of society, we can find numerous examples of communities where social structure can be exceedingly dense, like some religious communities (Coleman, 1988), high schools and neighborhoods (Mueller and Abrutyn, 2016), army bases, and institutions like prisons or psych wards (Abrutyn and Mueller, 2018). Indeed, many of these places are disproportionately vulnerable to the emergence of suicide clusters (Haw et al., 2013). This highlights potential downsides to connectedness, such as groupthink or high costs for non-conformity (Portes, 2014) and cautions scholars from positing connectedness as a purely protective phenomena.

Regulation and Suicide

Durkheim also argued that suicide rates were related to the degree to which a given group's rules and social norms were consensually clear, coherent, and shared. Living in a poorly regulated society or social group resulted in what Durkheim termed "anomic" suicides. In essence, Durkheim posited that humans, as animals, were not inherently moral creatures, but had to acquire morality from without. Notably, "moral" was synonymous with "social" in Durkheim's day, and thus he saw social bonds as having integrative features like intimacy *and* regulative features like moral obligations and expectations. Thus, Durkheim set up several routes to de-regulation causing suicide. First, societies where norms were constantly changing and or where there was a general breakdown in moral clarity, people's ability to easily identify their purpose would be constantly under attack. Second, regulation could suddenly be weakened, either by a change of status in the individual (e.g., losing a job) or by a collective crisis (e.g., an economic recession or global pandemic) that challenged society's ability to provide clear moral or social guidance. In short, Durkheim saw a sense of shared moral clarity as an independent force providing protection to members of a group. While Durkheim emphasized the societal level, it is important to note that we can also develop moral relationships with a group (Lawler et al., 2009) and an abstract system of norms (Abrutyn and Lizardo, 2020), which expands the "web" in which a given person may find themselves protected.

Like integration, too much regulation may also cause what Durkheim termed "fatalistic" suicide. For Durkheim, fatalistic suicides occurred when members of a group or social category were subjected to intense psychic and physical coercion such that there was no hope for a future without suffering. Though Baumeister (1990) has argued, suicide is very often about escape from pain, like other Durkheimian types, fatalistic suicides refer to a class of suicides that are not limited by specific individual motives. To date, few studies have explicitly explored Durkheim's fatalistic suicide, though we can provide some examples of its possible research potential. First, structural inequality or violent oppression within families or communities may render groups of oppressed individuals disproportionately vulnerable to (fatalistic) suicides. For example, we know that women in violent relationships often feel trapped and over-regulated (Summers-Effler, 2004); and are more susceptible to suicidality (Chang, 1996). Women in rural China or Iran, for instance (Fei, 2010; also, Aliverdinia and Pridemore, 2009), may also fit this pattern, as may women of color who emigrate to another country and find themselves in precarious employment situations (van Bergen et al., 2009). Second, suicide bombers are often over-regulated (by some military or colonizing political system, as well as over-integrated into their local community), which may produce the type of structure that delimits options for resisting and expressing one's obligations to their community (Pedahzur et al., 2003; Abdel-Khalek, 2004).

Durkheim's Limitations

Despite the importance of Durkheim's theory to suicidology generally, and sociology of suicide more specifically, Durkheim's theory is not without limitations which have in turn shaped more contemporary sociological theories of suicide.

One of the oldest and most notable limitations of Durkheim is methodological. Durkheim fails to adequately address the ecological fallacy of studying suicide rates to understand individual behavior. Durkheim forcefully argued that societal- or macro-level forces (integration and regulation) *caused* individual-level behavior (suicide), and yet the link between societal-level social forces and individual behavior is challenging yet crucial to document. Compounding Durkheim's methodological limitations was the intellectual climate of his day. As a nascent discipline, Durkheim worked hard to distinguish and legitimize sociology apart from psychology and anthropology. Hence, using social psychological or cultural ideas – two sets of phenomena associated, respectively, with the other disciplines – was impossible. He could not, for instance, think about identity or emotions in sociological terms and, therefore, could not bring sociology into the micro-level of social reality. As we shall see, this limitation, as well as Durkheim's explicit rejection of Gabriel Tarde's imitation theory (Abrutyn and Mueller, 2014b), has also constrained contemporary sociologists, until rather recently, from thinking about how suicide may spread from one person to another. Finally, Durkheim's own lack of attention to power and inequality, and the legacy it has generated, represents a major limitation. Though Durkheim sees regulation as comforting and supportive, there is a line between moral (and physical) authority being an

anchor in a chaotic storm and it being a source of domination and oppression. This line, as we shall see, has obscured the role inequality, stratification, and oppression play in suicidality. In short, regardless of the importance of Durkheim's basic insights, they fall short of helping us understand (a) why a particular person dies by suicide and (b) the mechanisms through which external social forces get inside someone's psyche generating pain and rendering them vulnerable to suicide.

In this next section, we map sociological advances in understanding suicide by focusing on the new *structural* and then *cultural/social psychological* approaches that have emerged over the last two or three decades. To be sure, Durkheim's approach continues to loom large over sociology, with a recent review lamenting the sheer lack of new approaches to the sociology of suicide (Wray et al., 2011), and thus while we highlight all major scholarship and theoretical contributions as possible, the basic dearth in research programs or teams is a more general limitation of the sociology of suicide. Like Durkheim, these theoretical and methodological projects build on the idea that there are emergent, distinct properties that are not reducible to the individual and her perceptions or decision-making. Yet, they do not deny the importance of intra-personal factors, instead they seek to supplement them. Collectively, these advances have great significance for general theories of suicide and for suicide prevention.

Structural Insights

One of the first big innovations to Durkheim's macro theory was to incorporate advances from structural sociology – and namely insights from social network theories – to elaborate how social integration and regulation matter to suicide. Social structure is a notably elusive concept, but it usually refers to sets of stable social arrangements that evince certain properties regardless of the specific incumbents. Social structures deeply shape individual life chances (Fourcade and Healy, 2013) by sorting us into particular opportunities, experiences, subcultures, social roles and obligations. They can be both easy to measure, as in the neighborhoods we live in or the schools we attend, or complex and intangible. Network theories facilitate the identification of local social structures that are salient to the individual and more closely capture the reality of the social world that surrounds them in their daily lives (Perry et al., 2018).

One of the greatest advances in sociology of suicide is the social network elaboration of Durkheim's theory. This approach allows for greater specificity of social structures and cross-fertilization with contemporary social theory. With Durkheim's "societies" translated into the operation of different networks, solidarity comes from the presence (or absence) of strong, interlocking social relationships. The power of the external social world is preserved, while situating the individual more realistically in it. Another advantage of a network approach is that it avoids the overly optimistic view of personal ties as always protective. Indeed, a plethora of work within the social network perspective has long demonstrated that the presence of *negative* ties is potentially more powerful in affecting individual well-being than positiveties (Abrutyn and Mueller, 2014a; Perry et al., 2018).

Perhaps most importantly, a network approach highlights how integration and regulation coexist and in fact likely co-determine place-based vulnerability to suicide. An idea that is contrary to Durkheim's four distinct "ideal-types" of suicide (egoistic, anomic, fatalistic, and altruistic). Instead, scholars advanced a curvilinear theoretical predictive plane with four dangerous poles matching Durkheim's types (as seen in **Figure 1**). One dimension, running from left to right, represents integration. Another dimension, running from back to front, represents regulation. Both dimensions run from high to low, and their interaction generates the four types of suicide. When individuals live in social structures characterized by too little integration or regulation, the threads of the social safety net are too far apart to catch them when crises destabilize their equilibrium. Egoistic and anomic suicides are then theorized as "diseases of the infinite" because of the extreme gaps in the societal safety net that normally support individuals during times of individual or community crisis. Conversely, the social safety net closes up when social structures are overregulated or over-integrated. With no flexibility or give in the safety net, individuals who experience crises hit a wall that shatters rather than supports. It is in the center of the net, where ties are moderately integrated and regulated that individuals can be safely caught and restrained from their suicidal impulses (Pescosolido and Georgianna, 1989; Pescosolido, 1990, 1994).

A recent study illustrates the power of this structural approach. Using novel US data connecting the social profile of individuals to the social profile of the communities where they live, the study draws from social network theory's principles of selective attachment or homophily (i.e., the tendency of individuals to connect with similar others, sometimes called "assortative relating" in psychology) and differential association (i.e., individuals sometimes come to behave more like those with whom they interact) (Pescosolido et al., 2020a). Specifically, researchers examined whether the presence of more "like" or "similar-others" would affect individual suicide risk and found that community "sameness" generally reduces individual risk of suicide. This multi-level examination of individuals' embedded lives provides a glimpse into how "sameness" taps into structural ties, normative climates, and social diffusion processes. In fact, some of the most robust suicide research findings at the individual level are dramatically moderated by a consideration of their social environmental counterpart (Muller et al., 2020; Pescosolido et al., 2020a). Recent research further reaffirms the notion that current gaps in societal safety nets contribute to emotional distress and suicidality during the COVID-19 pandemic (Fitzpatrick et al., 2020).

Collectively, these findings suggested a critical and fundamental sociological insight into suicide: connectedness is protective *to a point*. Where there are too few others at risk (e.g., the employed in an upper middle-class community), socially supportive ties may be unavailable but when others share the same fate, the sense of individual failure transforms into structural failure (e.g., unemployed in a rust-belt community), potentially reducing the psychological harm of the experience. But when that sense of despair or fatalism engulfs the community as a whole, the ability to see *any* future can be restricted in isolated

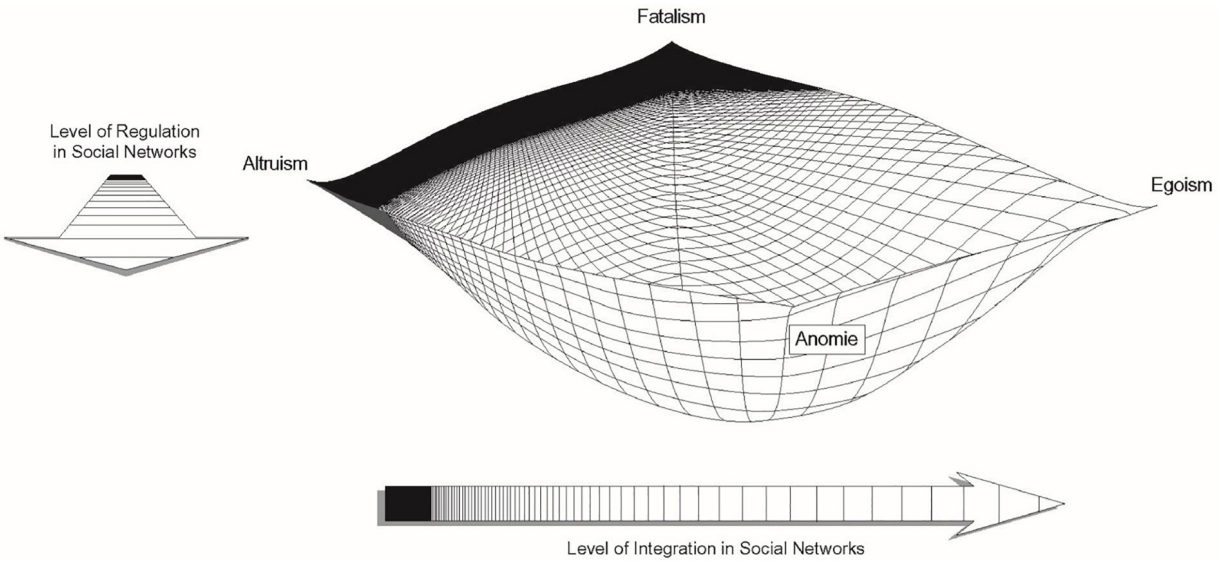

FIGURE 1 | Networks and the Durkheimian theory of suicide.

and historically stigmatized communities (Pescosolido et al., 2020a). These studies illustrate how essential it is to consider the roles of social structure and culture in social interaction, as a core feature of theories of suicide; to not do so contradicts basic contributions to contemporary population health research (Pescosolido, 1992; Hall and Lamont, 2009). It also illustrates that while Durkheim offered foundational insights into suicide, focusing overly on his specific hypotheses rather than the general theoretical propositions or attempting an artificially general theory of suicide, only weakens our capacity to understand how the external social world shapes suicide. And while structural insights into suicide represent major advances, contemporary sociological research raises two theoretical issues that cannot be ignored, and must be synthesized into, the understanding of suicide as a complex phenomenon – culture and contagion.

Exposure to Suicide

While Durkheim presented himself as a general theory of suicide, there are intricate aspects of social interaction that fall outside his purview but are related to how social structures and connectedness impact suicide. A second major line of sociological scholarship examines exposure to suicide through one's social networks and communities and in so doing offers perhaps the clearest example of how social ties can produce harm (Abrutyn and Mueller, 2014a). Decades of research from a variety of methodological approaches and causal modeling strategies has confirmed that exposure to (1) media reports of suicides (Stack, 1987, 2005, 2009; Gould, 2001; Romer et al., 2006; Gould et al., 2014)– especially celebrity suicides – or (2) personal role models, like parents or friends (Abrutyn and Mueller, 2014a; Mueller and Abrutyn, 2015; Mueller et al., 2015a; Randall et al., 2015; Fletcher, 2017; Myfanwy et al., 2017), is associated with increased risk of suicidality. This line of research emerged from a series of studies by sociologist David Phillips (1974, 1979) that found that suicide rates among audiences exposed to media reports of suicides would spike temporarily. At the time, this was radical in that Durkheim famously denied the roles of micro-sociological processes related to social interaction, as well as diffusion or contagion in suicide. Phillips turned to a forgotten sociologist, Gabriel Tarde, to think theoretically through what he came to call suicide *suggestion*, a term derived from Tarde, who wrote about the diffusion of ideas and behaviors through social relationships (Abrutyn and Mueller, 2014b). Tarde was what would be called a social psychologist, but in the late 19th/early 20th century, his epistemology was too close to psychology, and thus Durkheim rejected it out of hand. Durkheim firmly committed to the idea that larger structural forces were *causal*, and thus, he is usually understood as rejecting the idea that suicide could "spread" or be "socially contagious." And while research has repeatedly found, using more conservative methods than Phillips, an association between media exposure and increases in suicide rates, like Durkheim, these studies fall short in their ability to identify the primary mechanism or mechanisms that link the media exposure to the individual-level actions.

Nevertheless, a series of promising studies emerged following Phillips' work, which focused on the consequences of being exposed to a personal role model's suicidality (Tishler, 1981; Farberow et al., 1987; Niederkrotenthaler et al., 2012). With the growth of network analysis in the 21st century, suicide scholars in this burgeoning tradition began taking cues from network studies that found many social behaviors, like obesity and smoking, were socially "contagious," net of individual factors (Christakis and Fowler, 2007, 2008). It became apparent that the structure of a person's social network mattered, as longitudinal research found that adolescent exposure to friends of friends was associated with greater risks of suicidality (Baller and Richardson, 2009). Likewise, networks appear to have gendered effects, with girls being most at risk of suicidality when they have exceedingly

small social networks or are immersed in exceedingly large ones (Bearman and Moody, 2004). Additionally, in a groundbreaking study, Baller and Richardson (2002) used spatial analysis to determine how crucial characteristics of place – like the degree of infrastructure – are to the clustering of suicides in places. They concluded that the structure of place and diffusion processes cannot be divorced from each other; once again illustrating the importance of theorizing and modeling the multiple levels of society within which human behavior is situated. Despite these advances, the question remained *why* and *how* suicide contagion worked.

While this is still an area in need of further exposition, in one unique study, researchers leveraged network data with pairs of adolescent friends to determine whether knowledge of a suicide attempt was necessary for suicide contagion to occur (Mueller and Abrutyn, 2015). The study found that youth who did not know their friend had attempted suicide were not at higher risk of suicidality over time, though if they did know they were. Additionally, exposure to a friends' suicidal thoughts was not sufficient to increase risk of suicidal thoughts or behaviors 1 year later. These findings suggest the power of behavioral role modeling. How, why, and when social behaviors diffuse through social networks or contexts is an important and ongoing area of inquiry within sociology of suicide specifically (Abrutyn et al., 2019) and social network science more generally (Kadushin, 2012).

Regulation, Culture, and Behavior

While these structural sociological theories described above offer multiple important advances for the sociology of suicide, they leave several unexplored social scientific questions – specifically, what mechanisms translate structure into meaningful social beliefs and practices that shape our attitudes and behaviors related to mental health and, ultimately, suicidality. Arguably, these gaps in the sociology of suicide can be addressed by drawing on insights from the broader theories in the sociology of culture and sociological social psychology. The incorporation of culture and sociological social psychology matters for several reasons. Eschewing explanations that motivate behavior by intra-personal perceptions, sociologists have generated substantial evidence that individual behavior is motivated – and justified – in reference to the web of social relationships and the broader structures and cultures in which these are embedded (Vaisey, 2009; Lizardo et al., 2016). We begin by reviewing theoretical advances that reconceptualize Durkheim's regulation as a cultural force to better elaborate how culture shapes behavior and suicide.

Durkheim's choice of regulation as a key causal force was rooted in the idea that collective ways of acting and thinking not only reinforced integration – that is, everyone is or is believed to be doing the same things, and thus share more than they differ – but that they were psychologically, emotionally, and socially healthy (Bearman, 1991). Although Durkheim could not imagine using cultural analysis, his conceptual ideas about regulation square quite neatly with contemporary cultural sociology. Groups of all sizes have cultures, and these cultures are shared – within reason – providing individual members with a sense of who they are, what they are supposed to feel, think, and do under various conditions, and what it means to belong to that group (Fine, 2010). Culture is activated every time members interact in real life or when one member anticipates or imagines interacting with another member; culture is also activated whenever we come into contact with externalized representations of it (Patterson, 2014), such as a Catholic individual seeing a crucifix. Members watch each other and sanction each other (see networks) to regulate each other's behavior. However, culture also is internalized in our conceptions of the generalized other: people do not just act because they do not want to be sanctioned by others, but rather are motivated to act by the cultural schema, scripts, and frames they are exposed to and internalize and come to take for granted as normative (D'Andrade, 1984; Vaisey, 2009; Lizardo et al., 2016).

This set of insights is fundamental to explaining social behavior of all kinds but has largely been neglected in suicidology, even as structural and psychological accounts of suicide have been criticized since the 1960s for ignoring the role cultural meanings play in understanding and explaining variations in suicidality across time, space, and groups/classes of people (Douglas, 1967; Farberow, 1975; Baechler, 1979). And though it may be tempting to dismiss cultural regulation as a causal mechanism, research on other types of behavior shows culture not only shapes us; it regulates us morally – that is, it may proscribe *or* prescribe a behavior as a *normative* option under a shared set of conditions.

This is imperative for suicidology for two reasons. First, the last two decades have seen theories attempting to explain how suicide ideation is transformed into action expand dramatically (Joiner, 2005; Klonsky and May, 2015; O'Connor and Kirtley, 2018). Second, these theories largely neglect the simple fact that suicide is a *social act* and therefore is replete with cultural meanings (Boldt, 1988; Kral, 1994) that attempters symbolically externalize to their intended and unintended audiences, who make sense of the suicide via meanings they too have internalized. Put in the language of many current psychological theories, cultural sociology argues that suicide is not just about acquiring the proper cognitive and practical capacities to attempt, but also the *normative* capacity, or the belief that suicide is a viable and socially acceptable option for expressing outwardly something felt internally (Canetto, 1993; Kral, 1994; Abrutyn et al., 2019).

Recent decades have seen a growing body of historical, anthropological, and sociological evidence supporting the argument that culture matters to suicide. Research clearly demonstrates that societies and/or subgroups within those societies carry different beliefs about suicide across time and space (Barbagli, 2015) and death more generally (Long, 2004). These beliefs, ultimately, contribute to notions of when suicide is justified (Canetto, 1993; Hecht, 2013), if ever, and, therefore, erect prohibitions for entire classes of people or may make suicide a *normative* option (Niezen, 2009; Fei, 2010; Kitanaka, 2012; Abrutyn, 2017). This argument extends beyond whole cultures and applies to subpopulations and their subcultures. For instance, research has shown that how Americans interpret the suicides of men and women is through very different "cultural

scripts" (Canetto, 1993, 1997), which has consequences for how their performed suicidality may be expressed and received by both the attempter and her intended (and unintended) audience (Hjelmeland et al., 2002), and, for which type of person might be at risk of suicide under certain conditions (Canetto, 2015). Other research has found distinctive beliefs and, subsequently, suicidal practices among young Latinas in the United States (Gulbas et al., 2015), in rapidly growing urban spaces in southern India (Chua, 2014), and some Indigenous communities in the United States (Tower, 1989) and Canada (Kral, 2012).

A second body of research underscoring the role of culture in suicide comes from a clinical psychology of bereavement. In short, Robert Neimeyer and his many collaborators have demonstrated that sudden deaths, like suicides, are shocking and compel individuals to make sense of them, to sift through available meanings as part of the bereavement process (Gillies and Neimeyer, 2006; Neimeyer et al., 2014). Though not a sociologist, Neimeyer and colleagues repeatedly find that meaning-making and bereavement always occur within the confines of a collective, as they build a coherent sense of why the death happened through each member's individual meanings and more general societal ones (Neimeyer et al., 2006; Currier et al., 2015). In the event that collective meaning-making fails or that unhealthy meanings are arrived at, bereavement can become prolonged, thereby placing the individual at a significantly higher risk of emotional distress and suicidality.

A similar set of studies examine how structure and culture interact together, marrying Durkheimian insights to some of the more innovative cultural studies. For instance, research in Indigenous communities has made important connections between the social, cultural, and geographic circumscription that delimits social networks within some indigenous communities to the intergenerational negative affect experienced and passed on due to discrimination and prejudice (Kral, 2012; Stevenson, 2014). In one community, for instance, youth associated suicide with *belongingness*; that is, to die by suicide was to express one's commitment to the group's expectations and its members (Niezen, 2009). In rural China, Fei (2010) also identified linkages between structure and culture: where traditional patriarchal families tightly constrained women's ability to express grievances, suicide had become means of expressing grievance, justice, and anger. Finally, in a recent publication, sociologists Muller et al. (2020) leveraged extremely unique longitudinal data linked to death records to examine how male adolescents' desired occupations translated into risk of suicide by mid-life when those occupations became unavailable due to economic declines in those occupations. The structural changes in the labor market interacted with cultural ideals for work and success, such that when worked declined, men who expected a reliable working-class job were more likely to die by suicide (and also drug overdose) than their peers. This study suggests that it is not simply occupational or education attainment that generates risk of suicide, and not simply economic societal changes; but rather, the macro-societal translates into distress through an individual's cultural values, identities, and expectations.

A third set of studies revolved around an in-depth ethnographic case study of a community called "Poplar Grove," a white, affluent, homogeneous community with an intense high-pressure culture revealed that youth and parents alike had developed suicide explanation that had expanded for whom suicide was an option (Abrutyn et al., 2019). Youth believed other youth used suicide to escape the intense pressure and that the misery induced by the pressure caused suicide (Mueller, 2017; Abrutyn et al., 2019). Though more research is necessary on this (for some promising studies, linking attitudes to suicide see Gould et al., 2014; Phillips and Luth, 2018), this study suggests that identification with perceived and socially legitimated motives for suicide may increase youth's vulnerability to suicide and may be one explanation for why suicide clusters form and persist (Mueller and Abrutyn, 2016; Mueller, 2017; Abrutyn et al., 2019). Further teasing out the mechanisms that translate external social environmental factors into internal psychological pain is a crucial project for the sociology of suicide. One strategy is to integrate principles drawn from sociological social psychology; a project the sociology of suicide has recently begun and which we turn to next.

The Necessary Role of Social Psychology

Although Durkheim was not and could not be a social psychologist, contemporary sociological social psychology offers key mechanisms for understanding and explaining suicide within the context of structural and cultural contexts. Durkheim recognized in *Suicide* that individual's membership in a specific group or category of people made them more or less vulnerable based on that collective's integrative and regulative characteristics. Contemporary accounts have extended these insights, linking them to individual feelings or beliefs about who we are and what we are supposed to be doing. However, it is the mechanism linking us to the group, or what sociological social psychologists call *identities* and the *emotional* attachment we have to our identities and to the group that help us make sense of why structures and cultures may be harmful or protective.

The basic premise of a social psychological theory of suicide, then, rests on four key aspects of identity and emotion (Abrutyn and Mueller, 2016). First, persons whose identity is structurally and culturally embedded in a relationship, group, or broader social system will feel higher levels of commitment to the identity. Commitment depends on both intensive (intimate and affectual) and extensive (dense and numerous) social ties that evoke the identity (Stryker, 2008). Second, where commitment to an identity is high, the person will also be affectually attached to the bond itself (Lawler, 2002). Third, the more committed an individual is to an identity and attached to a bond, the more influence other members have on the feelings, thoughts, and actions of the individual. Fourth, where fewer alternative identities and bonds exist, subjectively and/or objectively, cultural regulation will be at its most powerful as continued commitment and attachment are more desirable than exclusion and isolation (Goffman, 1961). Below, then, we examine a little more closely what identities are and why emotions, especially social emotions, can help explain suicidality.

Identity

Identities are internalized meanings that cluster around how an individual understands themselves, as a social object, in relationship to a real person (one's child), a group (e.g., family or congregation), a social class (e.g., race, sex, and occupation), or an abstract collective (e.g., American), which are embedded in social structure (Stryker, 1980; Burke and Stets, 2009; Hogg, 2018) and culture (Abrutyn, 2014). In turn, like the example of Catholic objects imbued with collective emotions and public meaning, our identities are objects inseparable from the collectives they are anchored, which makes them as emotionally charged as the external objects themselves. They matter to us because the relationships that allow them to exist matter. And, like any object that takes on meaning in interaction, relationships are where people acquire these identities as they learn about who they are, the expectations that others have of them and that they have others, what rewards, performances, and influence they can expect to have, and so forth. Identity matters, then to suicide and mental health, because it is one prominent pathway through which the external social world comes to matter to perceptions of self. Our identity renders painful the possibility of exclusion, rejection, and isolation from cherished social groups, not simply because we feel lonely, but because a part of our self can be damaged or lost through these social experiences. And, when we assign blame to our self for the rejection by a group (etc.), emotions signaling we are "bad" or "worthless" may snowball into psychache (Shneidman, 1993) and negative emotion feedback loops (Scheff, 1988).

Returning, then, to the study of Poplar Grove, youth in this community did indeed internalized a very clear, rigid, coherent sense of what was expected of the "typical" Poplar Grove youth (Mueller and Abrutyn, 2016; Mueller, 2017). The small nature of the community delimited the variation in how this identity could be performed, and thus made even the counterfactual cases we spoke with painfully aware of expectations. And, because the school took on an outsized role in community life, this identity was trans-situational, defining nearly all of the relationships inside and outside of school. This had three key consequences for the suicide problem in Poplar Grove. First, youth had also internalized the cultural script of pressure leads to emotional distress, which can lead to suicide being a normative option for expressing one's identity and extinguishing the pain. Second, the community had set most of the kids up to fail, as only one kid could be captain of the football team, lead actor in the big school play, or most popular kid. Anything short of five AP classes per semester and straight A's was viewed as a failure by youth, making falling short of expectations the norm and not the exception. Third, fear of failure, imagining or anticipating failure, and actual failure all lead to the same thing: shame (Abrutyn and Mueller, 2016; Mueller and Abrutyn, 2016). Shame is a painful social emotion signaling that the person has not only not met expectations but are actually a "bad" person because of doing so; it is social in that they believe, whether true or not, that others judge them as deficient. Identities are intimately implicated in this process, as not meeting expectations generate negative affect that compels us to meet them (Burke and Stets, 2009), but because of the second consequence described above, failing was perceived as a chronic, normal state of adolescence. And thus, we must consider, in a bit more detail, the role of emotions in suicidology.

Emotions

Generally speaking, suicidology has focused on cognitive appraisals of emotions (Cavanaugh et al., 2003), as opposed to the affect themselves, which is very often shaped by the cultural world around us. Emotions are both the "glue" of social relationships and can signal our successful integration (Lawler, 2002) or fulfillment of obligations or expectations, or our failure to do so; and, as such, are a fundamental element of how Durkheim's regulation becomes internalized into psychological well-being or pain (Scheff, 1997; Lewis, 2003). Thus, emotions create and sustain attachments to others and our own commitment to the identity associated with the attachment. In turn, this level of integration engenders greater regulation as we are more likely to adopt the feelings, thoughts, and actions of those we are most affectually attached (Lawler et al., 2009). On the other hand, emotions, particularly negative social emotions like embarrassment, guilt, or shame, are the signals that this connection is in danger, dissolving, or lost (Abrutyn and Mueller, 2014c). The link between identity and culture points, then, to two key insights drawn from scholarship on emotions and behavior. First, when we are not performing our identities as others expect or as we expect, we feel negative social emotions like embarrassment, guilt, and shame (Lewis, 1971; Scheff, 1997). What makes us feel bad about ourselves, or creates the cognitive appraisals like worthlessness or hopelessness, is very much a product of the cultural milieu that provides us with expectations about who we are and why we are supposed to do. Second, depending on the structural and cultural context, these social emotions may endure over time, making it increasingly difficult to live up to expectations and overwhelming our ordinary cognitive and behavioral functions, leading us to draw from existing cultural options for dealing with those emotions.

In particular, shame or the social emotions that that the self is viewed as being corrupt, polluted, deficient, and contemptuous by others – objectively or not – plays a key role (Abrutyn and Mueller, 2014c). Research has demonstrated the role shame plays in a range of negative behaviors, such as domestic violence (Lansky, 1987), eating disorders (Scheff, 1989), and criminality (Braithwaite, 1989). It also has some anecdotal links to suicide (Mokros, 1995; Lester, 1997; Kalafat and Lester, 2000). The shame pathway, then, can be tied directly to our discussion of social psychology, identity, and expectations: failing to meet expectations can trigger shame. In part, this may be due to the publicly shared cultural meanings. For instance, research in cultures or subcultures with strong traditional male norms evince far more "honor" suicides as failure to meet masculine expectations are closely tied to suicide as a way of restoring honor (Adinkrah, 2012; Cleary, 2012). Sudden loss of status, in most cases, is followed by intense shame and the need to process the shame. Shame also plays a role for those in subordinate positions, whose identities are wrapped up in being powerless. In some traditionally patriarchal societies, like rural China (Fei, 2010), there may be no other culturally available recourse to processing their shame besides suicide. Indeed, as Zhang's (2010;

Zhang et al., 2017) use of strain theory and innovative methods reveal, there are severe structural constraints on access to many legitimate means to reducing anxiety and stress. Youth, too, are in a relatively powerless position coupled with being at a disadvantaged cognitive and emotional developmental state that precludes being able to see far into the future. Shame can be experienced so acutely for these kids, the availability, accessibility, and applicability of a suicide script may be the only ingredient missing for leading to suicide vis-à-vis drug or alcohol abuse. Thus, social emotions are a powerful vehicle, particularly when rooted in salient social identities in valued social environments, through which the external social world is translated to internal psychological pain.

DISCUSSION

Sociological theories of suicide, inspired by Durkheim's original work, help explain how the external social world matters to individual well-being and psychache, thereby revealing the social roots of suicide. The external social world is complex and multi-layered and can be characterized by network structures and shared cultures which in turn impact individual group members through their social identities and social emotions. That the external social environment matters to human development across the life course, including to physical and mental health, and even suicide, is not necessarily new. However, as rates of suicide have climbed in the United States and around the world, the importance of understanding the social environment's roles in suicide and suicide prevention has become more prominent and even urgent (Wyman, 2014). Sociology, with our long tradition of specifying how society conditions human lives, is well situated to answer this call, while also building bridges into other disciplines.

Implications for Psychological Theories of Suicide

Many psychological theories of suicide acknowledge social and environmental factors, facilitating the incorporation of sociological insights to suicide. For example, belongingness is critical to Joiner's (2005) interpersonal theory (IPT) of suicide, and connectedness is a key component of Klonsky and May's (2015) three-step theory of Suicide (3ST). There are two primary ways that sociological insights should, we argue, be incorporated into major psychological theories of suicide. First, while psychological theories of suicide recognize that the external social world matters, they generally distill the social world down to an individual's perception of it (e.g., belongingness and connectedness). Sociological research suggests this is insufficient and that using strategies to measure the external social world independent of a person's perception or experience is important. This could be as simple as using egocentric network methodology (Perry et al., 2018) to better measure the culture and structure of a person's proximate social environments (Perry and Pescosolido, 2015; Perry et al., 2016). This approach would involve having focal research respondents report their multiplex network ties (often friends, family, etc.) using name generators and characterizing them through theory-informed name interpreters. An ideal research design then involves interviewing some of the nominated network ties, so that data does not rely solely on the focal respondents' perception.

Second, structural-cultural insights into suicide reveal that cultural scripts for suicide that prevail in people's salient social groups may impact their capacity for suicide (Canetto, 1993; Abrutyn et al., 2019; Mueller, 2017). While the notion of individuals' capacity for suicide already exists (Joiner, 2005), recognizing that *normative* capacity – or how a group's beliefs about why people die by suicide, who is expected to be vulnerable to suicide, as well as when, where, and how people suicide – contributes to making suicide an accessible and applicable option for an individual. Recognizing – and measuring – this may be a useful pathway for future research to examine; particularly given research linking explicit and implicit beliefs about suicide to suicide attempts and even death (Gould et al., 2004; Nock et al., 2010; Phillips and Luth, 2018).

Implications for Suicide Prevention

Recognizing the importance of the social environment is also critical to strategies for suicide prevention. Some current suicide prevention strategies recognize the potential of broader, upstream environmental interventions, such as the Centers for Disease Control and Prevention's (n.d.) emphasis on social connectedness in communities. The focus on building connectedness has also been leveraged to great effect in schools. Specifically, building trust between youth and adults in schools is associated with lower rates of suicidality among students (Wyman et al., 2010, 2019). Similarly, there are suicide prevention interventions that address cultural biases, like mental health stigma, in communities or schools (Wasserman et al., 2015; Pescosolido et al., 2020b). These interventions raise mental health awareness and normalize discussing mental health, which may foster help-seeking and diminish suicidality in the entire community. Additionally, suicide prevention strategies in healthcare – specifically so-called "Zero Suicide" approaches – promote changes in the social environment within healthcare organizations to improve medicine's ability to prevent suicide (Labouliere et al., 2018). Specifically, a major component in the Zero Suicide model is generating system wide *cultural* change that renders suicide prevention a core organizational goal of any medical setting (Labouliere et al., 2018). Finally, recent research suggests that interventions into economic safety nets are associated with suicide rates; specifically, increases in the minimum wage are associated with meaningful decreases in suicide mortality (Gertner et al., 2019), perhaps especially when unemployment is high (Kaufman et al., 2020). This suggests that macro-level economic policies, untheorized as suicide prevention, may actually be powerful tools for just that.

While collectively these interventions show promise, limitations remain. For example, in terms of culture, much of these interventions focus narrowly on mental health stigma, despite substantial research that demonstrates a plethora of cultural beliefs that can promote vulnerability to suicide and its precursors. This may be particularly harmful when connectedness is leveraged in schools. Schools that house harmful youth cultures may find that intensifying connectedness, even when combined with positive mental health messaging,

may, at worst, amplify their harmful culture or, at best, find that the unaddressed harmful culture undermines any positive cultural interventions (Mueller and Abrutyn, 2016). Similarly, with regard to organizational interventions like Zero Suicide, it is potentially not enough to encourage an organization to value suicide prevention and mental health; it is likely necessary to broaden the scope of research and understand the external pressures, obligations, or cultural directives the organization faces and examine how mental health and suicide prevention complements or competes with those other organizational directives. This critique is motivated by previous sociological research that shows that understanding how organizations balance competing goals is crucial to effective prevention (Perrow, 1999; Vaughan, 1999). Unfortunately, when organizations face external pressures (e.g., resource scarcity), public health safety is often deprioritized in favor of more dominant goals (see Vaughan, 1996).

Future Directions

This last point highlights a broader limitation in suicidology that in turn points to a crucial future direction for research. Zero Suicide approaches are one of the only explicitly organizational approaches to understanding suicide or suicide prevention. In general, though we acknowledge the role of several key organizations [schools (Erbacher et al., 2014) and healthcare (Gordon et al., 2020)] in suicidology, we have largely neglected to theorize or examine empirically the role of organizations in suicide risk and prevention. This is a major limitation since suicide prevention largely takes place within formal organizations, and several formal organizations are implicated in suicide risk [e.g., occupations (Skipper and Williams, 2012), military (Bryan et al., 2012), and schools (Wyman et al., 2019)]. It is also a missed opportunity to leverage organizational science to improve suicide prevention. Within organizational science there are substantial literatures that have identified how to build safety systems to prevent hard to predict tragedies (Perrow, 1999; Vaughan, 1999), like suicide. An organizational approach to suicide prevention has other advantages, as it can help identify existing unused safety systems in organizations that could be leveraged for suicide prevention. For example, schools generally have existing multi-tiered systems of support – often for academic interventions (Eagle et al., 2015) or violence prevention (Payne and Elliott, 2011) – that potentially could be leveraged efficiently and effectively for suicide prevention (Harms, 2019).

There is a second critical future direction and current substantial limitation that warrants discussion. To date, theories of suicide largely neglect how structural inequality, colonization, and intersecting systems of oppression, privilege, and power shape vulnerability to suicide. Though there have been some exiting new efforts to theorize how structural inequality and intersectionality matter to suicidology (Brooks et al., 2020; Opara et al., 2020; Standley, 2020), much more work is needed. Based on broader research within the sociology of mental health – which does take up this issue – the patterns are likely to be complex and again not distillable to individual experiences with discrimination or prejudice (McLeod, 2015; Williams et al., 2019; Laster Pirtle, 2020). Prior research on mental health and inequality demonstrates that external social structures condition mental health above and beyond individual experiences (Sewell et al., 2016; Huyser et al., 2018; Williams, 2018). While it's beyond the scope of this review to propose a new theory of inequality, power, and suicide, we can point scholars to useful theories of inequality in mental and physical health to aid them as we collectively take up this critical agenda (Phelan et al., 2010; Ridgeway, 2011; Carbado et al., 2013; Westbrook and Schilt, 2014; Phelan and Link, 2015; Sewell, 2016; Spencer and Grace, 2016). Additionally, understanding inequality will likely have real consequences for suicide prevention. For example, though upstream suicide prevention strategies are showing great promise in schools (Wyman et al., 2010; Wasserman et al., 2015), many schools struggle to sustain even evidence-based strategies over the long-run (Singer et al., 2019). This may be in part because many schools, particularly those that serve disadvantaged youth, experience intense resource scarcity (Leachman et al., 2017). Thus, considering the complex ways that inequality shapes suicide and suicide prevention is necessary to a robust, comprehensive theory of suicide.

CONCLUSION

Sociology is best known for our Durkheimian insight into why people die by suicide – namely, that lacking meaningful social relationships that support us during difficult times and celebrate us when times are good is extremely harmful to individual well-being. However, a review of the full body of sociological scholarship, and especially the empirical and theoretical advances of the past 10 years, reveal the social roots of suicide. Incorporating sociological insights into how the external social environment can matter to suicide and suicide prevention may help us better understand the complexity of suicide and determine how to effectively intervene.

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Stressful Experiences in University Predict Non-suicidal Self-Injury Through Emotional Reactivity

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Theoretical perspectives on non-suicidal self-injury (NSSI; direct and deliberate self-injury without lethal intent such as self-cutting or hitting) have long underscored the affective regulating properties of NSSI. Less attention has been given to the processes through which individuals choose to engage in NSSI, specifically, to regulate their distress. In the present study, we tested one theoretical model in which recent stressful experiences facilitates NSSI through emotional reactivity. Further, we tested whether the indirect link between stressful experiences and NSSI was moderated by several NSSI specific risk factors (e.g., having friends who engage in NSSI). Given the widespread prevalence of NSSI among community-based samples of adolescents and emerging adults, we surveyed 1,125 emerging adults in first-year university at a large academic institution (72% female, *M*age = 17.96, 25% with a recent history of NSSI at Time 1). Participants completed an online survey three times (assessments were 4 months apart), reporting on their recent stressful experiences in university, emotional reactivity, NSSI, as well as three NSSI specific risk factors (i.e., close friend engagement in NSSI, high self-disgust, and low fear of pain). As expected, path analysis revealed that there was a significant indirect effect of recent stressful experiences on NSSI engagement, through emotional reactivity. However, this effect was maintained across moderator analyses. These novel findings underscore the salient role of proximally occurring stressors in the prediction of NSSI among emerging adults in university, and can inform developing theoretical perspectives on NSSI.

Keywords: non-suicidal self-injury, self-harm, emotional reactivity, stressful experiences, post-secondary students, emerging adults, developmental, longitudinal

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INTRODUCTION

Non-suicidal self-injury (NSSI), which refers to the direct and deliberate destruction or alteration of bodily tissue in the absence of lethal intent (American Psychiatric Association, 2013), is a widespread mental health concern among adolescents and emerging adults (18–25 years) (Swannell et al., 2014; Gillies et al., 2018). Although NSSI often has its onset in adolescence, a second peak period of new onset may occur during the emerging adult years (Whitlock et al., 2011; Gandhi et al., 2018). Young adults attending post-secondary school may be particularly at risk for NSSI; as many as 20–30% of university students report having engaged in NSSI (Gandhi et al., 2018; Wester et al., 2018), and as many as 10–15% of emerging adults may start engaging in NSSI for the first

time during the university years (Kiekens et al., 2019). Further, there is some evidence that emerging adults in university are more likely to engage in NSSI than same-aged peers not in university (Swannell et al., 2014). Engagement in NSSI confers heightened risk for aversive outcomes among students, including academic underperformance (Kiekens et al., 2016), other mental health challenges (e.g., depressive symptoms), and suicidal behavior during the later university years (Hamza and Willoughby, 2016; Kiekens et al., 2018; Burke et al., 2019). Despite the widespread prevalence of NSSI among post-secondary students (Swannell et al., 2014; Wester et al., 2018) and mounting referrals for service on college and university campuses (Xiao et al., 2017), there is a lack of theoretically informed research on the processes through which NSSI occurs, or its associated mitigating factors, during the post-secondary years. Elucidating the processes through which NSSI is initiated and maintained, as well as identifying students most at risk, is critically important to informing theory on NSSI, as well as early NSSI prevention efforts on university campuses.

Theoretical perspectives on NSSI have long underscored the affect regulating properties of NSSI (Nock and Prinstein, 2004; Chapman et al., 2006; Klonsky and Glenn, 2009), and over a decade of research has provided strong support for the role of NSSI in the modulation of emotions (Lloyd-Richardson et al., 2007; Klonsky, 2009; Turner et al., 2012; Schoenleber et al., 2014; Victor et al., 2016; Jonsson et al., 2019). Recently this literature was consolidated in a meta-analysis; researchers found that emotion regulation was the most commonly reported motivation for NSSI engagement among individuals with a history of NSSI (Taylor et al., 2018). Findings from real-time and event-level sampling studies have yielded comparable findings, such that individuals report increases in negative affect prior to NSSI, and decreased negative affect following NSSI engagement (Hamza and Willoughby, 2015; Rodríguez-Blanco et al., 2018).

Although converging evidence demonstrates that NSSI is commonly used as an emotion regulation strategy, less attention has been paid to the processes leading up to individuals engaging in NSSI to regulate their distress. Nock's (2009, 2010) integrated model on the development and maintenance of NSSI, provides a compelling description of the distal and proximal processes through which NSSI engagement may be initiated and sustained. According to Nock, early risk factors (e.g., childhood maltreatment or early invalidating environments) predispose individuals to respond to more proximally occurring stressful or aversive affective experiences with heightened emotional reactivity. Emotional reactivity, in this context, encompasses emotional sensitivity (i.e., the tendency to respond to stressful life events with heightened negative affect), emotional intensity (i.e., the tendency to experience strong emotions), and emotional persistence (i.e., difficulty returning to a neutral emotion state following a stressor) (Nock et al., 2008). Emotional reactivity has long been underscored as a temperamental factor, shaped by early biological influences but also by environmental factors, that lead to over arousal particularly in the context of extreme stress (Strelau, 1996; Muris and Ollendick, 2005). Nock suggests that heightened emotional reactivity may be the mechanism through which stress leads to increased problem coping behavior, such as NSSI (Nock, 2009, 2010).

There is some empirical support for Nock's model, as stress exposure has been widely implicated in NSSI engagement. Specifically, exposure to early abuse and other early aversive family experiences (e.g., severe parent mental illness, domestic violence) have been shown to heighten risk for NSSI engagement in adolescence and early adulthood (Ford and Gómez, 2015; Tatnell et al., 2016; Titelius et al., 2017; Brown et al., 2018). Research on other proximally occurring or developmentally relevant stressors (e.g., stressful experiences during the transition to university) in adolescence and emerging adulthood are limited, but emerging research suggests that recent stressful experiences may also exacerbate risk for NSSI in these populations (Liu et al., 2016). For example, in two studies of community-based adolescents, researchers demonstrated that exposure to stressful experiences predicted increased risk for NSSI onset over time (Hasking et al., 2013; Voon et al., 2014). Further, recent work involving daily diary and ecological momentary assessment sampling with adult community and clinical-based samples has shown that exposure to interpersonal stressors predicts increased risk for NSSI in the short term (Kyron et al., 2018; Victor et al., 2019). Researchers have urged that studying proximal stressful life events in relation to NSSI is necessary, because exposure to recent stressors has been shown to be a key precipitating factor for other mental health concerns, such as depressive episodes and suicidality (Bagge et al., 2013; Liu et al., 2016; Paul, 2018).

Although research on exposure to stressful life events and emotional reactivity is limited, there is evidence that emotional reactivity may mediate the association between stressful life events and NSSI (Nock and Mendes, 2008; Nock, 2009). Individuals who engage in NSSI consistently self-report higher levels of emotional reactivity than individuals who do not engage in NSSI (Nock and Mendes, 2008; Smith et al., 2017; Liu et al., 2020). Further, in some lab-based studies, it has been found that individuals who engage in NSSI report greater negative affect and show heightened physiological arousal (e.g., skin conductance, startle response) following mood inductions or exposure to stressors relative to individuals who do not engage in NSSI (Nock and Mendes, 2008; Nock et al., 2008; Rinnewitz et al., 2018), although these findings have been more mixed (Hooley and Franklin, 2017). In a meta-analysis on studies of emotion dysregulation and NSSI, emotional reactivity was found to be the dimension most strongly associated with NSSI engagement (as compared to other measures of dimensions of emotion dysregulation) (You et al., 2018). Emotional reactivity also has long been strongly implicated in the development of psychological distress and other mental health concerns in previous research (Strelau, 1996; Strelau and Zawadzki, 2011). It is possible then that the experience of stressful life events leads to NSSI indirectly through heightened emotional reactivity (for a similar finding on emotional reactivity as mediator of the association between psychological disorders and NSSI–see Nock et al., 2008).

In the model on the development and maintenance of NSSI, Nock (2009, 2010) regards emotional reactivity as a general risk factor for a variety of problem behaviors (e.g., substance

use, disordered eating), consistent with functionalist perspectives on problem behavior engagement (Swerdlow et al., 2020). The particularly novel aspect of Nock's model is that it outlines NSSI specific factors to explain why individuals choose NSSI when distressed as opposed to other coping behaviors. For example, an individual may be more likely to engage in NSSI when distressed if they also have friends who engage in this behavior, or are not deterred by the prospective of pain. In a more recent theoretical model of NSSI engagement, Hooley and Franklin (2017) similarly assert that there are likely NSSI specific barriers that prevent individuals from accessing the coping benefits of NSSI; in the absence of these barriers, individuals are thought to be at heightened risk. Some of these proposed absent barriers map well onto the risk factors identified by Nock (e.g., having awareness of NSSI, low self-worth, low aversion to physical pain).

In the present study, we draw on Nock's model and focus on three potential NSSI specific risk factors that may moderate associations among exposure to stressful experiences, emotional reactivity, and NSSI. First, according to Nock, individuals may choose to engage in NSSI because they have learned about or observed the behavior from others (e.g., social learning hypothesis). This hypothesis is supported by findings that adolescents and young adults who engage in NSSI are more likely to have friends who engage in NSSI than individuals who do not engage in NSSI (Hasking et al., 2013; Quigley et al., 2017). Further, research has shown that an individual's disclosure of NSSI to a friend increases the friend's risk for NSSI engagement over time (Hasking et al., 2015). It follows then that individuals may be more likely to engage in NSSI when distressed, if they have friends who also engage in this behavior. Another reason individuals may choose NSSI over other coping behaviors is because they have highly negative views toward themselves, and believe that they are deserving or worthy of self-derogation (i.e., self-punishment hypothesis). Research has consistently shown that individuals who engage in NSSI report lower levels of self-esteem and self-worth (Forrester et al., 2017), and higher levels of self-criticism than individuals without a history of NSSI (Xavier et al., 2016; Ammerman and Brown, 2018). Self-disgust has been regarded as one form of self-criticism that may be particularly relevant to NSSI, because it is thought to involve hatred toward the self, as well as self-blame (Gilbert et al., 2004; Smith et al., 2015). Finally, another risk factor that may increase risk for NSSI specifically in the context of negative emotions is low aversion to pain (i.e., the pain analgesia hypothesis) (Nock, 2009). In a recent meta-analysis on pain sensitivity and NSSI, individuals who engaged in NSSI demonstrated greater pain tolerances during lab-based tasks involving exposure to pain, and rated pain as less aversive than individuals who did not engage in NSSI (Kirtley et al., 2016; Koenig et al., 2016). Moreover, research has shown that individuals who engage in NSSI report lower fear of pain over time (Willoughby et al., 2015). These findings suggest that individuals who do not perceive pain as aversive may be more likely to engage in NSSI.

Although Nock provides a useful framework for conceptualizing the processes through which NSSI occurs, there is a paucity of theoretically-driven longitudinal examinations exploring the interaction between general risk (e.g., emotional reactivity in response to stressors) and NSSI specific risk factors (e.g., friends who engage in NSSI) in the prediction of NSSI over time. Moreover, Nock's model has yet to be applied to the study of NSSI among emerging adults in university, though exposure to stressful experiences may be particularly pronounced during this period of development (Arnett, 2015), and rates of NSSI increase during this time (Wester et al., 2018; Kiekens et al., 2019). In the present study, we utilized a three-wave longitudinal research design to examine associations among recent stressful life events in university, emotional reactivity, three NSSI specific risk factors, and NSSI behavior, in a university student sample.

Conceptual models often underscore that stressful experiences lead to mental health challenges, such as NSSI (i.e., stress sensitivity/stress exposure hypothesis), but it is also possible that NSSI may lead to increased stressful experiences for individuals (i.e., stress generation hypothesis) (Burke et al., 2015; March-Llanes et al., 2017). For example, authors have long argued that individuals who are more emotionally reactive are likely to elicit more stressful experiences from their environment (Strelau, 1996). The use of a longitudinal research design in the present study enabled us to examine the direction of effects among study variables, as well as explore emotional reactivity as a mediating factor. Elucidating the processes through which recent stressful life events may lead to heightened emotional reactivity and increase risk for NSSI (or vice versa), is essential for informing efforts to circumvent NSSI among students. Moreover, identifying who is most at risk for NSSI specifically, will inform targeted prevention and intervention efforts on college and university campuses, and extend research on theory on the development and maintenance of NSSI. We expected that consistent with Nock's model, stressful experiences in university would be associated with increased risk for NSSI through emotional reactivity (i.e., an indirect effect), and that this indirect effect would be most pronounced among those with NSSI specific risk factors.

MATERIALS AND METHODS

Participants

In the present study, 1,125 English-speaking emerging adults at a large academic institution in Canada (72% female, 28% male, 1% other, *M*age = 17.96, SD = 0.69) completed a survey three times as part of a larger ongoing longitudinal research project. Participants completed the survey starting in September of their first-year of university, and again at 4 and 8 month follow-ups. Thirty-two percent of participants identified as East Asian, 23% identified as South Asian, 21% percent of participants identified as Caucasian, 6% identified as Arab or West Asian, and 18% identified as other, including Black, West Indian, Filipino and Latin American.

Procedure

Students were recruited during their first month of university to participate in a study on student experiences in first-year university (the study was not advertised as a study specifically on NSSI). Students were recruited broadly across campus using printed and electronic advertisements (e.g., Facebook posting,

student club websites, etc.), and in-person class announcements. Interested participants contacted the lab via phone or email, and if they were eligible (i.e., enrolled in first year, and lived in the surrounding area of the university) they were assigned a unique ID number to complete the online survey. A Qualtrics survey link was sent to participants three times (baseline, fourth month, and eighth month follow-up). As compensation, participants received a gift card for a vendor of their choice (e.g., Tim Horton's, Amazon, Cineplex Odeon, etc.) in the amount of $10 at Time 1, $15 at Time 2, and $20 at Time 3.

The study was approved by the University of Toronto's Research Ethics Board (protocol: 36254), and active informed consent was obtained from all participants at each time of assessment. Although research has consistently found that asking young adults to report on their self-injury does not have any associated iatrogenic effects (Gould et al., 2005; Whitlock et al., 2013), at each assessment participants were given a 24-hour distress line contact number, as well as a list of several local resources and supports. Participants could also access these resources anytime during the survey using a "Feeling Distressed" button. At the end of the survey, participants also completed a positive mood induction which required them to reflect on one positive event from the previous day (Seligman et al., 2005).

Measures

Demographics

At Time 1, participants reported on their age in years, their gender (1 = *male,* 2 = *female, 3 = transgender, 4 = unsure, 5 = prefer not to disclose, 6 = other*), and ethnicity.

Recent Stressful Experiences

At each assessment point, participants reported on their recent stressful experiences using the 49-item Inventory of College Students' Recent Life Experiences (ICSRLE) (Kohn et al., 1990). Participants were asked to indicate how much each stressor (e.g., lower grades than hoped for, not enough time for sleep, conflict with friends and family) had recently been a part of their life on a scale ranging from 1 = *not at all a part of my life* to 4 = *very much a part of my life.* Ratings were averaged such that higher scores represented greater exposure to stressful experiences. The ICSRLE has demonstrated strong psychometric properties among university samples (Kohn et al., 1990; Osman et al., 1994). In the present study, Cronbach's alphas at Time 1, Time 2, and Time 3 were 0.93, 0.94, and 0.95, respectively.

Emotional Reactivity

At each assessment point, participants completed the Emotion Reactivity Scale (ERS) (Nock et al., 2008). This measure consists of 21 items capturing three aspects of emotion reactivity: sensitivity (eight items; "I tend to get emotional very easily"), arousal/intensity (10 items; e.g., "When I experience emotions, I feel them very strongly"), and persistence (three items; e.g., "When I am angry/upset, it takes me much longer than most people to calm down"). For each statement, participants were asked to rate their experience on a scale from 0 = *not at all like me* to 4 = *completely like me.* Ratings were averaged across all items such that higher scores represented greater emotion reactivity. The ERS has shown strong internal consistency, convergent and divergent validity, and criterion-related validity among university students with and without a history of NSSI (Nock et al., 2008; Kleiman et al., 2014). Cronbach's alphas at Time 1, Time 2, and Time 3 were 0.95, 0.95, and 0.96, respectively.

Non-suicidal Self-Injury

At each assessment point, participants completed an adapted version of the Inventory of Statements about Self-Injury (ISAS) (Klonsky and Glenn, 2009). The measure was limited to directly self-injurious behaviors that involved direct or deliberate destruction of bodily tissue, consistent with NSSI as defined in the DSM-5 (i.e., cutting, biting, burning, carving, severe scratching, banging or hitting self, rubbing skin against rough surfaces). Participants were asked to indicate whether they engaged in each of the behaviors listed without suicidal intent within the last four months. Consistent with previous longitudinal research on NSSI, we treated NSSI a categorical variable (the presence/absence of NSSI at each assessment) (Baetens et al., 2015; Buelens et al., 2019; Gandhi et al., 2019; Robinson et al., 2019); this normalized the NSSI variable and brought outliers back into bounds. The ISAS has been shown to have good structural and construct validity, and test re-test reliability, among university undergraduate populations (Klonsky and Glenn, 2009; Glenn and Klonsky, 2011).

Friend Engagement in NSSI

At Time 1, one item was used to assess whether the participant had any close friends who engaged in NSSI: "Do you have any close friends who engage non-suicidal self-injury (i.e., harming one's self on purpose without suicidal intent) such as self-cutting or burning." This approach to assessment is comparable with other existing research on friend engagement in NSSI (Hasking et al., 2013).

Self-Disgust

At Time 1, self-disgust was assessed with the "disgusting self" subscale from the Self Disgust Scale (SDS) (Overton et al., 2008). Participants responded to five items (e.g., "I find myself repulsive," "I hate myself") on a 7-point scale ranging from 1 = *strongly agree* to 7 = *strongly disagree.* All items were averaged such that higher scores represented greater self-disgust. This measure has been shown to have good internal consistency, test-retest reliability, and concurrent validity with university students (Overton et al., 2008; Simpson et al., 2010). Cronbach's alpha was 0.81 in the present study.

Fear of Pain

In order to assess aversion to pain the Fear of Pain Questionnaire-9 (FPQ-9) was administered at Time 1 (McNeil and Rainwater, 1998; McNeil et al., 2017). Although we did not assess pain tolerance directly, the FPQ-9 assesses aversion to nine painful experiences (e.g., "getting a papercut on your finger," "gulping a hot drink before it has cooled"), by asking participants to rate how fearful they are of experiencing the pain associated with each item on a scale from 1 = *not at all* to 5 = *extreme.* All items were summed to a single score, with higher values indicating higher fear of pain. The FPQ-9 is a shortened version of the

FPQ-III, and has demonstrated sound internal consistency and concurrent, convergent, and divergent validity among university students (McNeil et al., 2017). Cronbach's alpha in the present study was 0.82.

Missing Data

Missing data occurred in two primary circumstances: (1) missing data within the wave (i.e., participants did not answer all questions within the survey), and (2) missing data between waves (i.e., participants did not complete the survey for a particular wave). There was very little missing data within the wave (<1%). Overall, the study also had very strong retention across the waves: 83% of participants completed all three waves of the survey, with 10% of participants completing two waves, and 7% only completing one wave. Although participants did not differ on the primary study variables, independent samples *t*-tests revealed that participants who completed all three waves were younger and more likely to be female than participants who only completed one or two waves. Missing data was estimated using the full information maximum likelihood (FIML) method. FIML was chosen due to its ability to retain cases with missing data, therefore avoiding potentially biased parameter estimates through pairwise and listwise deletion (Schafer and Graham, 2002).

Plan of Analysis

The associations among stress, emotional reactivity, and NSSI were examined using path analysis in Mplus 8 (Muthen and Muthen, 2017). An autoregressive cross-lagged model was tested, which included stability paths within variables across time (i.e., autoregressive paths), concurrent associations among variables within waves, and associations between variables across time (i.e., cross-lagged paths). Age and gender as assessed at Time 1 were included as covariates in all analyses, with paths from age and gender to each of the other variables at each assessment point. The weighted least square mean and variance adjusted estimator was used (WLSMV) to predict presence/absence of NSSI at each assessment (Brown, 2006). Model fit was evaluated using the comparative fit index (CFI), the root mean square of approximation (RMSEA) and the non-normed fit index (TLI) (Schreiber et al., 2006). As recommended by Hu and Bentler (1999) and Schreiber et al. (2006), CFI values >0.95, RMSEAs <0.06, and TLI values >0.95 were used, simultaneously, to indicate good model fit (Hu and Bentler, 1999; Schreiber et al., 2006).

In order to identify the best fitting model overall, a Chi-Square Difference Test of relative fit was used to test whether the pattern of associations significantly varied across time by comparing a model in which paths were unconstrained over time to a model in which paths were constrained to be equal over time (i.e., a nested model) (Muthen and Muthen, 2017). To test whether three proposed NSSI specific risk factors (i.e., having friends who engage in NSSI, having high self-disgust, having low fear of pain) moderated the association between stressful experiences and NSSI through emotional reactivity, three multi-group analyses were performed. For each proposed moderator, a model in which the paths were unconstrained across group (e.g., having friends who engaged in NSSI vs. not having friends who engaged in NSSI, having high vs. low self-disgust, having high vs. low fear of pain) was compared to a nested model in which the paths were constrained to be equal by group using the Chi-Square Difference Test of relative fit. When the Chi-Square Difference Test of relative fit statistic was non-significant, the most parsimonious model (constrained) was interpreted. To test for significant indirect effects in the final model, we report on bias-corrected bootstrapped confidence intervals, based on a sample of 5,000 bootstrap samples (Hayes, 2009).

TABLE 1 | Means and standard deviations of study variables.

Variable	M(SD)
Age (T1)	17.96 (0.69)
Stress (T1)	1.97 (0.43)
Stress (T2)	1.98 (0.44)
Stress (T3)	1.97 (0.47)
Emotional reactivity (T1)	1.60 (0.89)
Emotional reactivity (T2)	1.59 (0.90)
Emotional reactivity (T3)	1.62 (0.94)
Self-disgust (T1)	3.08 (1.24)
Friends (T1)	0.24 (0.43)
Fear of pain (T1)	26.4 (6.73)

T1, Time 1; T2, Time 2; T3, Time 3.

RESULTS

Preliminary Analyses

Means and standard deviations of study variables at each assessment point are provided in **Table 1**, and study correlations are provided in **Table 2**. At Times 1, 2, and 3, 25%, 23%, and 17.5% of participants reported a recent history of NSSI (i.e., NSSI within the past 4 months), respectively. The most common forms of NSSI were rubbing skin against rough surfaces, banging or hitting, and severe scratching for Wave 1, and banging and hitting, severe scratching, and biting for Times 2 and 3. On average participants reported 1–2 methods of NSSI (means of 1.53, 1.51, and 1.63, respectively). At Time 1, 24% of all participants reported having a close friend who engaged in NSSI. Independent samples *t*-tests comparing individuals who engaged in NSSI vs. those who did not engage in NSSI on the study measures at Time 1 are presented in **Table 3**.

Primary Results

First, associations among stressful experiences in university, emotional reactivity, and NSSI were examined, using autoregressive cross-lagged modeling in Mplus (Muthen and Muthen, 2017). The Chi-Square Difference Test of relative fit revealed that the unconstrained model (CFI= 1.00, RMSEA = 0.012, TLI = 0.996) did not provide a significantly better fit to the constrained model, $[X^2(6) = 7.813]$, $p = 0.25$, so all further interpretations were based on the constrained model, which was more parsimonious and had good model fit (CFI = 0.999, RMSEA = 0.015, TLI = 0.995). We also ran the

TABLE 2 | Correlations among study variables.

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Gender	–	0.005	0.172**	0.142**	0.167**	0.238**	0.249**	0.273**	0.066*	0.039	0.083*	0.031	0.178**	0.013
2. Age		–	−0.059	−0.059	−0.045	−0.012	0.015	0.008	−0.01	0.013	0.004	−0.056	−0.032	−0.043
3. Stress1			–	0.701**	0.624**	0.534**	0.472**	0.479**	0.248**	0.191**	0.173**	0.451**	0.089**	0.138**
4. Stress2				–	0.745**	0.448**	0.531**	0.494**	0.205**	0.235**	0.174**	0.396**	0.096**	0.124**
5. Stress3					–	0.436**	0.449**	0.559**	0.180**	0.210**	0.177**	0.394**	0.061	0.119**
6. ERS1						–	0.766**	0.715**	0.263**	0.223**	0.240**	0.390**	0.183**	0.057
7. ERS2							–	0.790**	0.213**	0.234**	0.233**	0.361**	0.174**	0.061
8. ERS3								–	0.224**	0.225**	0.260**	0.376**	0.158**	0.086**
9. NSSI1									–	0.483**	0.483**	0.291**	0.016	0.178**
10. NSSI2										–	0.493**	0.227**	0.077*	0.181**
11. NSSI3											–	0.225**	0.015	0.114**
12. SDS1												–	0.027	0.080**
13. FPQ1													–	0.008
14. Peer1														–

ERS, emotional reactivity; NSSI, non-suicidal self-injury; SDS, self-disgust; FPQ, fear of pain; peer, peer engagement in NSSI. Gender (0 = male, 1 = female); NSSI1, NSSI2, NSSI3 (0 = absence of NSSI, 1 = presence of NSSI), and Peer1 are categorical variables (0 = no, 1 = yes).

$^{*}p < 0.05$. $^{**}p < 0.01$.

model with gender as a grouping variable (moderator) rather than a covariate. The Chi-Square Difference Test, [$X^2(6) = 4.994$], $p = 0.54$, indicated that model unconstrained by gender (CFI = 0.999, RMSEA = 0.014, TLI = 0.995), did not provide significantly better fit to the model constrained for gender (CFI = 1.000, RMSEA = 0.008, TLI = 0.999), suggesting the pattern of associations did not significantly differ by gender. The final model is presented in **Figure 1**.

Next, three multi-group analyses were conducted to examine whether the pattern of associations varied depending on the presence of three NSSI specific risk factors (i.e., having friends who engaged in NSSI vs. not, high self-disgust vs. low self-disgust using a mean split, and high fear of pain vs. low fear of pain using a mean split). In these moderated analyses, the baseline model testing the unconstrained model by group, was compared to a model in which paths were constrained across group (e.g., having a close friend who engaged in NSSI vs. not having a close friend who engaged in NSSI). The model unconstrained for having peers who engaged in NSSI (CFI = 1.000, RMSEA = 0.000, TLI = 1.000) did not provide a significantly better fit than the unconstrained model (CFI = 1.000, RMSEA = 0.000, TLI = 1.000), [$X^2(6) = 6.417$], $p = 0.38$. The model unconstrained for self-disgust (CFI = 1.000, RMSEA = 0.000, TLI = 1.000) did not provide a significantly better fit than the model constrained for self-disgust (CFI = 0.998, RMSEA = 0.014, TLI = 0.994), [$X^2(6) = 8.801$], $p = 0.19$. Finally, the model unconstrained for fear of pain (CFI = 1.000, RMSEA = 0.000, TLI = 1.000) did not provide a significantly better fit than the model constrained for fear of pain (CFI = 1.000, RMSEA = 0.001, TLI = 1.000), [$X^2(6) = 6.912$], $p = 0.33$. Findings suggest that the pattern of associations did not significantly vary based on the moderators; this was also the case when we ran the analyses using one standard deviation above or below the mean to delineate low and high risk groups. As a result we present results collapsed across groups in **Table 4**. Our test of indirect effects revealed that exposure to stressful experiences in university at Time 1 predicted increasing risk for NSSI at Time 3 indirectly through heightened emotional reactivity $B = 0.010$, SE = 0.003, Bootstrap CIs [0.005, 0.017], and this effect was unidirectional.

DISCUSSION

Recent research suggests that NSSI is a widespread mental health concern among emerging adults in post-secondary school (Swannell et al., 2014; Wester et al., 2018), and that the early university years may represent a period of increased risk for onset of NSSI (Gandhi et al., 2018). Despite the widespread prevalence of NSSI, little is known about the processes through which NSSI develops or is maintained during the university years. In the present study, we sought to address this gap in the literature by examining associations among stressful experiences in university, emotional reactivity, three proposed NSSI specific risk factors (i.e., friend engagement in NSSI, self-disgust and fear of pain) and NSSI. As predicted, exposure to stressful experiences was associated with increased risk for NSSI through emotional reactivity. We also anticipated that the indirect effect would be

TABLE 3 | Mean differences between NSSI and no NSSI groups on study measures at Time 1.

Variable	Total *M(SD)*	NSSI *M(SD)*	No NSSI *M(SD)*	t-statistic	*p*
Age	17.96 (0.69)	17.95 (0.73)	17.96 (0.68)	$t(1053) = 0.334$	$p = 0.14$
Gender	0.72 (0.45)	0.77 (0.42)	0.70 (0.46)	$t(495.96) = -2.283$	$p = 0.23$
Stress	1.97 (0.43)	2.15 (0.43)	1.91 (0.40)	$t(1110) = -8.525$	$p < 0.001$
Emotional reactivity	1.60 (0.89)	2.00 (0.90)	1.46 (0.84)	$t(1114) = -9.080$	$p < 0.001$
Self-disgust	3.08 (1.24)	3.69 (1.30)	2.86 (1.14)	$t(428.17) = -9.525$	$p < 0.001$
Friends	0.24 (0.43)	0.38 (0.49)	0.20 (0.40)	$t(409.80) = -5.478$	$p < 0.001$
Fear of pain	26.4 (6.73)	26.57 (6.68)	26.34 (6.75)	$t(476.415) = -0.487$	$p = 0.63$

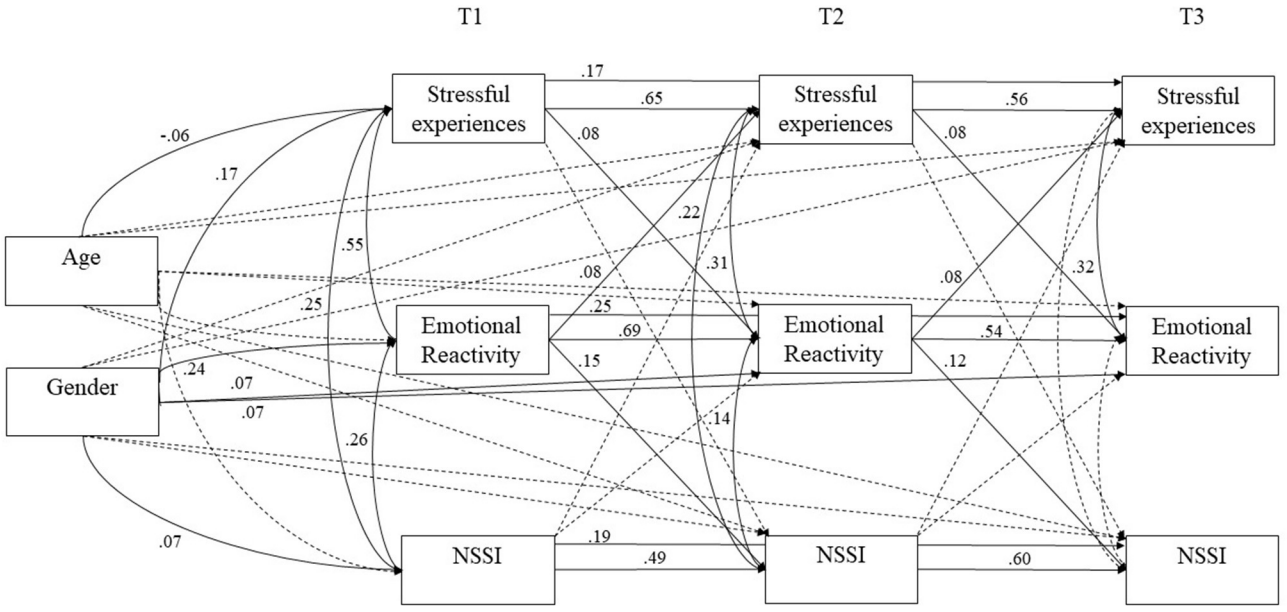

FIGURE 1 | Path analysis model. T1 denotes Time 1, T2 denotes Time 2, and T3 denotes Time 3. All paths tested are included in the model; dotted lines denote non-significant paths, solid lines denote significant paths.

stronger for those who reported having friends who engaged in NSSI, high levels of self-disgust, and low fear of pain (relative to those without these NSSI specific risk factors). This hypothesis was not supported; the indirect effect of stressful experiences on NSSI was maintained across individuals with and without the NSSI specific risk factors.

Stressful Experiences, Emotional Reactivity, and NSSI

The transition to university is thought to be a time of increased challenge for many students, as they encounter new stressors (e.g., living away from home for the first time, navigating new peer relationships, increased academic demands) (Arnett et al., 2014; Arnett, 2015). Although research on recently occurring and developmentally relevant stressors in relation to NSSI is limited (Liu et al., 2016), research has shown that recent or acute stressors may exacerbate risk for other mental health concerns such as depression and suicidality (Bagge et al., 2013; Paul, 2018). In line with this research, we found that greater exposure to recent stressful experiences predicted increased risk for NSSI, and this effect was unidirectional. In addition, consistent with Nock's (2009) proposed model, this relation was also indirect through emotional reactivity, which has been widely implicated in NSSI (Nock and Mendes, 2008; Nock et al., 2008; Smith et al., 2017; Liu et al., 2020). Although some researchers have argued that emotionally reactive individuals may elicit more stressful experiences from their environments (Strelau, 1996), our findings are more consistent with stress exposure models of risk, and suggest that stressful experiences may lead to heightened risk for NSSI behaviors, rather than the reverse (March-Llanes et al., 2017). Moreover, our study is the first to demonstrate that emotional reactivity may be a key mechanism to account for this association among university students.

NSSI Specific Risk Factors

According to Nock (2009, 2010), individuals may be more likely to engage in NSSI when distressed, if they also experience NSSI specific risk factors. To our knowledge, our study is one of the first to examine the proposed associations between general risk

TABLE 4 | Path coefficients.

Path	*B*	*SE*	*p*	*95% CI*
STRESS1 → STRESS2	0.653	0.019	0.000	[0.616, 0.691]
STRESS2 → STRESS3	0.563	0.023	0.000	[0.518, 0.608]
STRESS1 → STRESS3	0.171	0.022	0.000	[0.128, 0.214]
ERS1 → STRESS2	0.083	0.019	0.000	[0.046, 0.121]
ERS2 → STRESS3	0.079	0.018	0.000	[0.043, 0.114]
NSSI1 → STRESS2	0.013	0.011	0.220	[−0.008, 0.035]
NSSI2 → STRESS3	0.035	0.029	0.220	[−0.021, 0.091]
GENDER1 → STRESS2	0.011	0.025	0.654	[−0.038, 0.061]
GENDER1 → STRESS3	0.035	0.022	0.120	[−0.009, 0.079]
AGE1 → STRESS2	−0.023	0.024	0.330	[−0.070, 0.023]
AGE1 → STRESS3	−0.004	0.020	0.843	[−0.043, 0.036]
STRESS1 → ERS2	0.084	0.018	0.000	[0.050, 0.119]
STRESS2 → ERS3	0.084	0.017	0.000	[0.050, 0.118]
ERS1 → ERS2	0.694	0.019	0.000	[0.656, 0.731]
ERS2 → ERS3	0.539	0.029	0.000	[0.482, 0.596]
ERS1 → ERS3	0.247	0.028	0.000	[0.191, 0.302]
NSSI1 → ERS2	0.013	0.010	0.174	[−0.006, 0.032]
NSSI2 → ERS3	0.034	0.025	0.174	[−0.015, 0.084]
GENDER1 → ERS2	0.073	0.026	0.005	[0.022, 0.123]
GENDER1 → ERS3	0.067	0.024	0.004	[0.021, 0.114]
AGE1 → ERS2	0.028	0.017	0.090	[−0.004, 0.061]
AGE1 → ERS3	0.006	0.017	0.712	[−0.027, 0.040]
STRESS1 → NSSI2	0.013	0.034	0.709	[−0.054, 0.079]
STRESS2 → NSSI3	0.010	0.027	0.709	[−0.043, 0.063]
ERS1 → NSSI2	0.154	0.034	0.000	[0.087, 0.221]
ERS2 → NSSI3	0.119	0.027	0.000	[0.066, 0.171]
NSSI1 → NSSI2	0.487	0.030	0.000	[0.429, 0.546]
NSSI2 → NSSI3	0.597	0.051	0.000	[0.496, 0.679]
NSSI1 → NSSI3	0.188	0.043	0.000	[0.104, 0.272]
GENDER1 → NSSI2	0.003	0.044	0.951	[−0.083, 0.089]
GENDER 1 → NSSI3	0.034	0.050	0.497	[−0.065, 0.133]
AGE1 → NSSI2	0.020	0.044	0.640	[−0.065, 0.106]
AGE1 → NSSI3	0.002	0.045	0.970	[−0.087, 0.090]

Numbers after variables indicate assessment wave; B, standardized coefficient; SE, standard error; ERS, Emotion reactivity; CI, confidence intervals.

factors for psychopathology (e.g., emotional reactivity to stressful experiences) and NSSI specific risk factors (e.g., having friends who engage in NSSI, high self-disgust, and low fear of pain) in one comprehensive model. Although we predicted that the NSSI specific risk factors would moderate the mediational pathway, this was not supported. Instead, stressful experiences predicted increased risk for NSSI indirectly through emotional reactivity across groups. There are several possible reasons that we did not find evidence of moderated mediation in the present study. One strong possibility is that the relevance of the NSSI specific risk factors varies among individuals with a history of NSSI. For example, some individuals may engage in NSSI because they have friends who engage in the behavior, but for others this risk factor may not be relevant. Indeed, in the present study 70% of individuals who engaged in NSSI at Time 1, reported they did not have any close friends who engaged in the behavior, so it is not surprising this factor did not emerge as a strong moderator. In contrast, the association between emotional reactivity in response to stressful experiences and NSSI seemed to be more relevant across the entire sample (and well-differentiated individuals with recent NSSI from those without recent NSSI). Future research using a person-centered approach to assessment, which takes into account associations among NSSI specific risk factors, could be used to explore variability in NSSI specific risk factors among those who engage in NSSI (and identify those most relevant to the majority of individuals who engage in NSSI).

Another potential explanation for our non-significant moderation is that the proposed NSSI specific risk factors may be more relevant to first time NSSI onset, rather than NSSI continuation or remittance during the university years. We examined changes in recent NSSI history, rather than first time onset NSSI. It is possible that learning about NSSI from friends may increase an individual's likelihood of trying NSSI for the first time, but that the affective reinforcing properties of NSSI maintain this behavior over time. This is consistent with research that has shown that emotion regulation (and intrapersonal motivations for engaging in NSSI) are far more prevalent than interpersonal motivations for NSSI (Taylor et al., 2018). Moreover, Hooley and Franklin (2017) have similarly argued that the motivations underlying first time NSSI engagement (e.g., trying to fit in with peers) may differ from those that sustain the behavior such as affect regulation, which is thought to be reinforced over time. In the future, researchers could specifically examine whether Nock's (2009) proposed risk factors interact with stressful experiences and emotional reactivity to predict first-time engagement.

It is also important to note that we did find group differences at baseline between students who engaged in NSSI and those who did not engage in NSSI, on two of the NSSI specific risk factors. Akin to past research, we found that individuals who engaged in NSSI were more likely to report having a friend who engaged in NSSI than individuals who did not engage in NSSI (Hasking et al., 2013; Quigley et al., 2017). Further, we also found that individuals who engaged in NSSI reported higher self-disgust than individuals without an NSSI history, similar to previous research on negative self-beliefs, self-disgust and NSSI (Smith et al., 2015; Xavier et al., 2016; Forrester et al., 2017; Ammerman and Brown, 2018). Thus, our findings on peer engagement and self-disgust are not inconsistent with previous research on risk factors for NSSI. However, our findings are novel, in that they show that even in the absence of these risk factors, the association between stressful experiences and NSSI through emotional reactivity was maintained.

Inconsistent with Nock's (2009) hypothesis that high fear and aversion to pain will deter individuals from engaging in NSSI (i.e., the pain analgesia hypothesis), individuals who engaged in NSSI did not report lower fear of pain than individuals who did not engage in NSSI. This finding seems to conflict with research that individuals who self-injure demonstrate greater pain tolerances in the lab (Kirtley et al., 2016; Koenig et al., 2016) and reduced fear of pain (Willoughby et al., 2015). However, some authors have suggested that differences in pain sensitivity observed in lab-based studies may more strongly reflect differences in

willingness to endure pain, rather than measurable differences in pain sensitivity (e.g., tolerating pain because one believes they are deserving of such pain) (Hamza et al., 2014; Kirtley et al., 2016; Fox et al., 2017, 2018). In support of this contention, in one study it was found that a positive self-worth induction negated differences in willingness to endure pain between individuals who did and did not self-injure (which were present prior to the induction) (Hooley and St. Germain, 2014). Thus, it may be difficult to disentangle differences in physiological pain sensitivity from one's willingness to endure pain (i.e., the affective-cognitive component). Alternatively, it is also possible that lab and self-report measures assess different aspects of the pain experience (perceived rather than physiological), and/or that individuals may be poor at identifying their own pain aversion via self-report (Edwards and Fillingim, 2007). Future research on pain sensitivity and NSSI should examine associations between fear of pain and pain tolerance as assessed in the lab.

Limitations and Future Directions

Despite the many strengths of the study, which include the test of a theoretically informed development model of NSSI engagement in a large sample of emerging adults, there are also several notable limitations. First, although the present study included a large sample of participants from a large academic institution in Canada, participants were predominantly female, East and South Asian, Caucasian, and from middle to upper-class family backgrounds. As a result, the present findings may not be generalizable to all university student populations, emerging adults more generally, or clinical based samples. Second, the present study utilized self-report assessments of study constructs, which are subject to recall errors (e.g., forgetting NSSI episodes). We did use comparatively shorter assessment intervals (e.g., every 4th months), than are often used in research on NSSI (e.g., annual and/or lifetime assessments). Nevertheless, future research could use more proximal assessments (e.g., shorter intervals) to capture the proposed developmental processes, or consider applying daily diary and ecological assessment approaches to capture interactions among stressful experiences, emotional reactivity, and NSSI as they occur in real time. It is possible that more recently occurring antecedents to NSSI may have stronger predictive effects, which may also account for why the moderators (assessed at Time 1) were not significant in the present analyses. Third, given the large size of the sample utilized in the present study, we chose to utilize self-report measures for key constructs; however, the study would have benefited from multiple assessments of variables, including lab-based measures. In particular, research suggests individuals may have difficulty self-reporting on their own pain sensitivity (Edwards and Fillingim, 2007); future research could also utilize experimental methods to examine differences in pain sensitivity and fear between individuals who engage in NSSI and who do not engage in NSSI.

An important extension of our work is to examine additional potential NSSI specific risk factors. In the present study we focused on three NSSI specific factors relevant to Nock's (2009) model; however, Nock and other researchers (Hooley and Franklin, 2017) have suggested that there may be other factors which could increase the likelihood an individual chooses NSSI to regulate their distress, rather than another coping behavior. For example, aversion to NSSI stimuli, such as blood or wounds, may be a strong deterrent to NSSI, even in the context of distress (Franklin et al., 2016; Hooley and Franklin, 2017). Our measure of peer influence also was specifically focused on close friend engagement. Although researchers have suggested that close friends may have the greatest influence (Quigley et al., 2017), it is also possible that participants learned of NSSI from broader peer groups or other social influences not considered in the present study (such as the media). Additionally, perceived social acceptability of NSSI may promote or hinder NSSI engagement (Hooley and Franklin, 2017); theoretically, an individual may be more likely to engage in this behavior if they think it will be accepted by close others, or if this barrier can be effectively overcome (e.g., an individual is confident they can conceal the behavior from others). Finally, Nock (2010) has also suggested that in the context of distress, individuals may choose NSSI because it's more easily accessible than some other coping behaviors (e.g., substance use). Research incorporating real time assessments of coping could better capture availability of alternatives during moments of distress.

Conclusions and Implications

The results of the present study highlight that NSSI is a widely occurring mental health concern among emerging adults in university. Given that previous research has shown that NSSI is a robust predictor of later suicidal behavior (Kiekens et al., 2018; Muehlenkamp and Brausch, 2019), NSSI prevention should represent an important priority on college and university campuses. Our findings provide empirical support for Nock's (2009) developmental model of NSSI, and suggest that proximally occurring stressors may precipitate NSSI episodes among post-secondary students, through increased emotional reactivity (such as intense and persistent negative affect). Findings suggest that identifying effective strategies to help students manage stressors, and emotional responses to stressors during the transition to university, may also serve to reduce risk for NSSI engagement during the early university years.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Toronto Research Ethics Board. The patients/participants provided informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

CH, AG, NH, and LE were involved in the conceptualization of the study, and the development of the study protocol. CH, AG, and LE were involved in participant recruitment and data

collection. CH lead the data analyses with consultation from AG, LE, and NH. CH wrote the first draft of the manuscript, with all authors working on several edits of this paper. All authors contributed to the article and approved the final submitted version.

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Intrapersonal and Interpersonal Functions as Pathways to Future Self-Harm Repetition and Suicide Attempts

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Background: Research has identified functions of non-suicidal self-harm/self-injury (NSSH) but whether functions change over time, from adolescence to early adulthood, or predict the continuation of the behavior prospectively remains unclear. This study aimed to prospectively explore whether intrapersonal and interpersonal NSSH functions in adolescence predict repetition of self-harm (regardless of suicidal intent) and incident suicide attempts in early adulthood.

Methods: Participants were 528 individuals with NSSH at age 16 years from the Avon Longitudinal Study of Parents and Children (ALSPAC), a population-based birth cohort in the UK. Descriptive statistics were used to explore changes in functions over time from age 16 to 21, and logistic regression used to examine associations between NSSH functions and repeat self-harm and suicide attempts at age 21, 24, and 25 years.

Findings: The majority of 16-year-olds with NSSH endorsed intrapersonal (e.g., affect regulatory) functions only (73% at 16 years and 64% at 21 years). Just under half of adolescents (42%) and three quarters of 21 years olds reported more than one function simultaneously. A greater number of intrapersonal functions at 16 years independently predicted future repetition of self-harm at ages 21–25 years, over and above interpersonal functions (OR = 1.46, 95% CI 1.06–2.01). Interpersonal functions during adolescence did not predict repeat self-harm or suicide attempts in adulthood.

Discussion: Our findings suggest that intrapersonal but not interpersonal NSSH functions are a prospective risk factor for future self-harm and might also predict incident suicide attempts. The results highlight the central role of underlying affective difficulties and motivations in self-harm maintenance.

Keywords: Avon Longitudinal Study of Parents and Children, self-harm, non-suicidal self-injury, non-suicidal self-harm, suicide attempt, non-suicidal self-harm functions

INTRODUCTION

Self-harm encompasses both non-suicidal and suicidal behaviors and is a major risk factor for future suicide attempts (Ribeiro et al., 2016; National Confidential Inquiry into Suicide Safety in Mental Health, 2018; Mars et al., 2019) and poor mental health/well-being (Jacobson and Gould, 2007; Mars et al., 2014a). "Self-harm" is defined as any deliberate self-poisoning or self-injury to the body (e.g., cutting) irrespective of degree of suicidal intent (Hawton et al., 2003), and has a peak incidence in adolescence (Geulayov et al., 2018). This definition of self-harm does not separate suicidal from "non-suicidal self-harm" (NSSH i.e., self-harm that includes both direct self-injury and self-poisoning without suicidal intent) nor from "non-suicidal self-injury" (NSSI i.e., self-harm which excludes self-poisoning and is defined as the intentional destruction of one's own body tissue without suicidal intent and for purposes not socially sanctioned: American Psychiatric Association, 2013). In this paper, we use the broader term "NSSH" to refer to any self-harm that occurs without suicidal intent but recognize that the specific definition used may vary across studies. Notably, like self-harm, NSSH is higher in adolescence (international pooled prevalence of 17.2% compared to 13.4% for young adults and 5.5% for adults: Swannell et al., 2014), highlighting the need to identify factors that should be key targets for prevention and/or early intervention.

One factor that has received increasing attention is *why* people self-harm, that is, the functions that NSSH serves. There are many specific functions of NSSH and empirical evidence suggests that these specific functions fall broadly within two conceptually distinct categories (e.g., Klonsky et al., 2015): intrapersonal functions or reinforcement where the focus is on self (e.g., self-punishment; feeling generation/anti-dissociation; and regulating affect, the most commonly reported function; Klonsky, 2007, 2009), and interpersonal functions or reinforcement where the focus is on others (e.g., interpersonal influence; peer bonding; and seeking support/care, consistent with the "cry of pain" model; Nock, 2008). A wealth of studies over the past decade have extended our understanding of these functions (e.g., Selby et al., 2014; Taylor et al., 2018), and as a result, we now know a number of things that can inform our conceptualisations and work: (1) intrapersonal affect regulatory functions such as "releasing emotional pressures" are well-documented (Wolff et al., 2019) and tend to be the primary function of NSSH (Klonsky, 2009), which means that NSSH can be understood largely from the perspective of emotion regulation/dysregulation (Chapman et al., 2006; Andover and Morris, 2014); (2) intrapersonal and interpersonal functions can be positioned within broader theoretical models of NSSH as two maintaining and reinforcing routes to NSSH (Nock, 2009, 2010), but are not mutually exclusive. Indeed, studies have shown that most people simultaneously endorse multiple functions of NSSH within both domains (e.g., Klonsky and Glenn, 2009; Klonsky, 2011). Whilst however, these functions are "non-suicidal," they also predict suicidal outcomes such as suicide attempts (e.g., Roley-Roberts et al., 2017). This association between NSSH functions and suicide attempts can be understood in terms of common mechanisms/risk factors (e.g., emotion distress/dysregulation and affective disorders: Hamza et al., 2012; Mars et al., 2014b; Victor and Klonsky, 2014; Law et al., 2015; Grandclerc et al., 2016). Alternatively, individuals who engage in NSSH develop capability for suicide through habituation to pain and fear (Joiner et al., 2012; Klonsky et al., 2013). As we describe below, there are a large number of cross-sectional studies of functions in relation to both specific aspects of NSSH behavior, and suicidality. Yet, there are gaps with only a handful of studies *prospectively* examining the extent to which functions predict future NSSH repetition over time, and there are to the best of our knowledge no prospective studies that have examined how NSSH functions predict incident suicide attempts.

Cross-sectional studies of associations between NSSH functions and NSSH behavior have examined characteristics such as method, frequency and severity of NSSH. Studies have found that intrapersonal relative to interpersonal functions better predict life-time frequency of NSSH (e.g., Saraff et al., 2015), more clinically severe NSSH (greater current frequency of NSSH and urges; Klonsky et al., 2015), and retrospective reports of continued engagement in NSSH from adolescence to adulthood (Halpin and Duffy, 2020). Associations for interpersonal functions are typically, though not always, smaller, and there is evidence also that the need to self-harm for interpersonal reasons might be time-limited and restricted since these functions increase the likelihood of NSSH cessation from adolescence to adulthood (Halpin and Duffy, 2020). It seems therefore, that when NSSH does operate as an interpersonal behavioral coping strategy that this is usually during adolescence, perhaps in response to the complex social and relational challenges faced by adolescents during this period of development. Consistent with this, Muehlenkamp et al. (2013) found that interpersonal functions are more commonly endorsed for *initiating* NSSH (which typically happens during adolescence), whilst intrapersonal functions are more likely to underpin self-reported *repeated* NSSH. In comparison to interpersonal functions therefore, intrapersonal functions might better maintain NSSH over time. Further support for the reinforcing/maintaining effects of intrapersonal functions comes from studies showing that individuals who more frequently self-injure experience the most benefits in terms of reduced negative affect (e.g., Klonsky, 2009), and perceive NSSH as being effective in meeting their intrapersonal needs (Brausch and Muehlenkamp, 2018). Taken together, the evidence from cross-sectional studies of NSSH functions and behavior supports an affect regulation perspective (Chapman et al., 2006; Andover and Morris, 2014) rather than social signaling hypothesis (Nock, 2008) of NSSH maintenance/repetition, and highlights potential changes in the reasons why people engage in NSSH over time i.e., interpersonal functions are typically most prominent during adolescence whilst intrapersonal persist across adolescence and adulthood.

The empirical association between NSSH functions and suicidality (ideation and past attempts) has also been explored throughout many cross-sectional studies, typically of University/College students. These studies also highlight the relative importance of intrapersonal functions for aspects

of suicidality (Klonsky and Olino, 2008; Paul et al., 2015; Roley-Roberts et al., 2017; Brausch and Muehlenkamp, 2018; O'Loughlin et al., 2020), though there is variation in effect sizes. For example, Klonsky and Glenn (2009) found small associations between suicide attempts and both intrapersonal and interpersonal function domains, but suicidal ideation was more strongly associated with intrapersonal than interpersonal functions. Ultimately, the patterns across most studies in nonclinical adults suggests that intrapersonal functions may heighten the risk for a more imminent engagement in suicide attempts (e.g., O'Loughlin et al., 2020) but that interpersonal functions could also be important. There are fewer studies of functions in adolescents [see Taylor et al. (2018), for review], and of the studies that have explored functions in relation to suicide, the findings are also mixed (e.g., Nock and Prinstein, 2005; Lloyd-Richardson et al., 2007).

Unfortunately, a key limitation of cross-sectional studies is the reliance on retrospective reports of NSSH behavior and characteristics/functions and suicide-related outcomes. Only a small handful of longitudinal studies have examined whether NSSH functions predict future NSSH repetition, finding also that intrapersonal functions are key to repetition. Yet, these studies use relatively short-time periods and/or small samples. Glenn and Klonsky (2011a) found that neither intrapersonal nor interpersonal functions prospectively predicted the frequency (repetition) of NSSH at 12 months in a sample of 51 students, though the small sample renders conclusions tentative. In a high risk inpatient sample of 40 adolescents, intra- but not interpersonal functions are associated with NSSH maintenance over 6 months (Yen et al., 2016), an effect that has been replicated in a 3-year longitudinal study of 51 students from late adolescence to early adulthood (Kiekens et al., 2017). Finally, in a clinical sample of 262 adults with Borderline Personality Disorder followed up every 2 years over a 16-year period, intra- but not interpersonal reasons were significantly more likely to be reported by those with more extensive self-harm (Zanarini et al., 2013). To the best of our knowledge therefore, only one non-clinical study in this area (Kiekens et al., 2017) has examined how functions predict self-harm outcomes over at least several years and during the period of adolescence to adulthood, yet the sample size was small. Moreover, with regards to NSSH functions and suicidal behavior, to the best of our knowledge there are no prospective studies examining whether NSSH intra- and interpersonal functions predict first-time suicide attempts among those with NSSH. Such studies can help us understand who, from those who engage in NSSH, are more at risk of making subsequent suicide attempts. In sum, longitudinal work to date suggests that intrapersonal NSSH functions might better maintain NSSH. Yet, long-time prospective studies (i.e., >3 years) of NSSH functions and self-harm/suicidal outcomes that use large samples are needed to clarify the nature of these associations over time, especially from adolescence—when NSSH is more likely to be initiated—through to adulthood.

Another gap in the literature relates to longitudinal studies of stability or changes in functions over long time periods, from adolescence to adulthood. Understanding stability in functions (or lack thereof) is important for continued refinement of theoretical models (Nock, 2009, 2010) which currently do not delineate changes in the reinforcing properties of functions over time; and second, for contextualizing prospective associations between NSSH functions and NSSH behavior/suicide attempts. For example, if intrapersonal functions maintain self-harm, then we'd simultaneously expect some degree of stability in functions over time. There is some albeit limited longitudinal work here, with studies of University students (Glenn and Klonsky, 2011b) and clinical samples (Victor et al., 2016; Daukantaite et al., 2020; Pérez et al., 2020) finding moderate to large stability coefficients over short time periods (<12 months) when assessing functions *via* the Inventory of Statements about Self-Injury (ISAS; Klonsky and Glenn, 2009). Whilst the size of these coefficients varies across the studies, intrapersonal functions are typically more highly endorsed at multiple time points than interpersonal ones, and might therefore better reinforce self-harm over time. ISAS (Pérez et al., 2020). Taken together, the findings from these studies suggest some degree of stability but also change in both intrapersonal and interpersonal functions over relatively short time frames. We are not aware of any long-term prospective studies examining patterns in functions over time in lower risk non-clinical samples. Such studies are an important endeavor since they can elucidate whether functions change when NSSH is potentially becoming entrenched during periods of developmental transition to adulthood, and whether they are subsequently likely to predict other outcomes over time.

In sum, whilst there exist some longitudinal studies of NSSH functions and self-harm outcomes these mostly use small samples and span short-time frames of <12-months. This study therefore extends previous research by using a large community-based cohort sample to examine the contribution of intrapersonal and interpersonal functions to self-harm outcomes during developmental transition from adolescence into early adulthood, and whether functions change over time. This contribution is important to establish on theoretical and clinical grounds, and specifically in relation to continued engagement in (i.e., repetition of) self-harm and incident suicide attempts. This study fills this gap *via* three specific objectives:

- describe the intrapersonal and interpersonal functions of self-harm at age 16 and 21 and examine how they change over these two time points.
- explore whether the number of NSSH intrapersonal and interpersonal functions at age 16 years predicts continued engagement in/repetition of self-harm in young adulthood.
- explore whether the total number of NSSH intrapersonal and interpersonal functions at age 16 years predicts future incident suicide attempts (from age 16 to age 25 years).

METHODS

Sample

The Avon Longitudinal Study of Parents and Children (ALSPAC) is an ongoing population-based birth cohort study examining influences on health and development across the life-course. The ALSPAC core enrolled sample consists of 14,541 pregnant women residing in the former county of Avon in South West

England (UK), with expected delivery dates between 1st April 1991 and 31st December 1992 (Boyd et al., 2013; Fraser et al., 2013; Northstone et al., 2019). Of the 14,062 live births in the core sample, 13,798 were singletons/first-born of twins and were alive at 1 year of age. Participants have been followed-up regularly since recruitment through questionnaires and research clinics. The study website contains details of all the data that is available through a fully searchable data dictionary http://www.bris.ac.uk/alspac/researchers/our-data. Ethical approval for the study was obtained from the ALSPAC Ethics and Law Committee and the Local Research Ethics Committees. Study data were collected and managed using REDCap electronic data capture tools hosted at University of Bristol (Harris et al., 2009, 2019).

The present investigation is based on the subsample of participants who completed a detailed self-report questionnaire on self-harm at age 16 years ($N = 4{,}806$), and who were then followed over three additional waves of data collection at ages 21, 24, and 25 years. Self-harm was assessed with the question: "Have you ever hurt yourself on purpose in any way (e.g., by taking an overdose of pills, or by cutting yourself)?" which was endorsed by 905 (18.8%) participants. As our interest was in functions for NSSH, those who reported they had ever attempted suicide at age 16 years were excluded from the analysis ($n = 325$). This also enabled us to investigate the relationship between NSSH functions at baseline and first-time suicide attempts at follow-up. The number of participants with NSSH at age 16 years (who had never made a suicide attempt) and who had data on self-harm functions was 528, after excluding 41 participants with missing data on self-harm functions and 11 with missing data on suicidal intent.

Measures

Predictor: Self-Harm Functions

At ages 16- and 21-years, young people who said they had self-harmed were asked to select the reason(s) for their most recent self-harm episode from a pre-defined list of six options. Response options included "to show how desperate I was feeling;" "I wanted to die;" "to punish myself;" "to frighten someone;" "to gain relief from a terrible state of mind;" and "other reason." Those who selected "other reason" were asked to specify their motivation(s) using a free text response. These free-text responses were then categorized into themes by BM. There were 18 additional response categories identified at age 16 years and 16 additional categories at age 21 years. Participants were able to select more than one response option. Each function was coded as present or absent and summed to give (a) the total number of functions, (b) the total number of intrapersonal functions, and (c) the total number of interpersonal functions. See **Supplementary Table 1** for a full list of functions. At each time point, participants who did not select a reason for their self-harm, provided the response "I don't know," or selected a reason endorsed by fewer than five participants (out of the 905 who had self-harmed) were coded as missing ($n = 41$ at 16 years and $n = 2$ at 21 years). This step was necessary to comply with ALSPAC confidentiality rules. In addition, as our analysis focused on NSSH functions at age 16 years, participants who selected "I wanted to die" as a reason for their most recent self-harm episode at 16 years were excluded from the analysis. Data on self-harm functions was not recorded at age 24 or 25 years.

Outcome Measures: Past Year Self-Harm and New Onset Suicidal Self-Harm

Self-harm was assessed *via* self-report at ages 21, 24, and 25 years. Participants were sent an online/postal questionnaire at ages 21 and 25 years and were invited to attend a research clinic at 24 years. The questions were based on those used in the Child and Adolescent Self-harm in Europe (CASE) study (Madge et al., 2008). Each time, participants were asked an initial screen question "Have you ever hurt yourself on purpose in any way (e.g., by taking an overdose of pills, or by cutting yourself)?" Response options were Yes or No. Those who responded positively were then asked a series of follow-up questions to assess past year self-harm frequency and presence of suicidal intent. Past year frequency was recoded into a binary presence/absence variable (0 = no past year self-harm; 1 = past year self-harm) and incudes those who have self-harmed with or without suicidal intent.

Participants were classified as having ever attempted suicide if they: (a) selected "I wanted to die" as a reason for self-harm (asked at ages 16, 21, and 25); or (b) answered "yes" to: "On any of the occasions when you have hurt yourself on purpose, have you ever seriously wanted to kill yourself?" (asked at all time points). Suicide attempts were assessed in the same way at age 16 years. As those who had self-harmed with suicidal intent at age 16 years were excluded from the analysis, the lifetime suicidal self-harm measure at follow-up refers to incident suicide attempts occurring after the age of 16 years.

Response options from the three follow-up periods were then combined to generate two outcome variables: (1) any repeat self-harm during follow up (past year self-harm reported at any time point at age 21, 24, or 25 years), and (2) incident suicide attempt during follow up (lifetime suicide attempt since age 16 reported at age 21, 24, or 25 years).

Covariates

Covariates were child sex and two measures of socioeconomic position- maternal education level shortly after birth (O levels or lower versus A levels or higher) and income quintiles. Income was assessed *via* maternal questionnaire and included average weekly household disposable income recorded at age 3 and 4 years, divided into quintiles and rescaled to account for family size, composition, and estimated housing benefits (Gregg et al., 2008).

Statistical Analysis Plan

We first report descriptive data on changes in NSSH functions over time using complete case data. All main (outcome) analysis was imputed and used logistic regression to examine associations between NSSH functions at age 16 years (total number of functions, number of intrapersonal functions, and number of interpersonal functions) and the two self-harm outcomes: repeat self-harm and suicide attempts reported at age 21–25 years using imputed data (see below for details). Analysis models of interpersonal/intrapersonal functions were mutually adjusted

for each other (Model 1). Analyses were also adjusted for relevant confounders (Model 2). Unadjusted results are provided for comparison.

Missing Data

The main analyses looking at self-harm outcomes were conducted on an imputed dataset based on those who had data on self-harm functions at 16 years ($N = 528$). The number with complete data (combined self-harm outcome data and information on all confounders) was 198 for repeat self-harm and 192 for suicide attempts. The proportion with missing outcome data for past year self-harm at each time point was 33.5% at age 21, 39.0% at 24 and 36.6% at 25 years. The proportion with missing outcome data for lifetime suicide attempts at each time point was 33.0% at age 21, 39.0% at 24 and 39.2% at 25 years. Missing outcome and confounder data were imputed using Multiple Imputation by Chained Equations (MICE; Royston and White, 2011). One hundred imputed datasets were generated. The imputation model incorporated all variables used in the analyses as well as relevant auxiliary variables (e.g., socioeconomic status, mental health outcomes, substance use, and earlier or later recordings of variables of interest). This method assumes that data are missing at random (MAR), whereby any systematic differences between the missing and the observed values can be explained by differences in observed data. All analyses were conducted using Stata version 15. Outcome data were imputed for each point separately and then combined in each dataset as detailed previously. The OR estimates were broadly consistent across the compete case and imputed datasets, however the complete case data are less precise due to the smaller sample size (**Supplementary Table 2**).

RESULTS

Table 1 shows the self-harm functions endorsed by participants at ages 16 and 21 years in the complete case sample (descriptive statistics for sample demographics use imputed data and therefore appear in **Table 3** with the main analyses). Of the 528 participants who had engaged in NSSH at 16 years, 488 (92.4%) reported at least one intrapersonal function and 143 (27.1%) reported at least one interpersonal function. Only 7.6% of the sample reported interpersonal functions only, with most participants reporting either intrapersonal functions only (72.9%) or both types (19.5%). Thus, 92% reported some form of intrapersonal function. At age 16 years, 58% endorsed only one function and the remaining 42% endorsed two, three or in some cases more NSSH functions simultaneously.

Data on self-harm at age 21 years was available for 351 out of the 528 who reported self-harm at age 16 years (66.5%). Of these, 61 reported past year self-harm at 21, and information on functions was available for 59 individuals. All 59 reported at least one intrapersonal function and 21 (35.6%) reported at least one interpersonal function. Most participants reported intrapersonal functions only (64.4%) with the remainder reporting both types (35.6%). Thus, 100% reported some form of intrapersonal function. At age 21 years, 25.4% endorsed only one function and the remaining 74.6% multiple self-harm functions.

TABLE 1 | Comparison of self-harm functions at 16 and 21 years: complete case data.

	Self-harm functions at age 16 years $N = 528$	Self-harm functions at age 21 years $N = 59$
All functions		
Total number, median (IQR)	1 (1, 2)	2 (1, 3)
One function	306 (58.0%)	15 (25.4%)
Two functions	155 (29.4%)	19 (32.2%)
Three or more functions	53 (10.0%)	15 (25.4%)
Four or more functions	14 (2.7%)	10 (17.0%)
Intrapersonal functions		
Total number, median (IQR)	1 (1, 2)	2 (1, 3)
Zero functions	40 (7.6%)	N/A
One function	328 (62.1%)	21 (35.6%)
Two functions	137 (26.0%)	23 (39.0%)
Three or more functions	23 (4.3%)	15 (25.4%)
Interpersonal functions		
Total number, median (IQR)	0 (0, 1)	0 (0, 1)
Zero functions	385 (72.9%)	38 (64.4%)
One function	127 (24.1%)	16 (27.1%)
Two or more functions	16 (3.0%)	5 (8.5%)
Intrapersonal functions only	385 (72.9%)	38 (64.4%)
Interpersonal functions only	40 (7.6%)	N/A
Both intra- and interpersonal functions	103 (19.5%)	21 (35.6%)

Age 21 includes the self-harm function "I wanted to die". Participants who endorsed this function at age 16 years were excluded from the analysis.

TABLE 2 | Proportions of Intrapersonal and Interpersonal NSSH functions at age 16 and 21.

Age 16 functions	Age 21 functions	
	Intrapersonal only	**Interpersonal only/both**
Intrapersonal only ($n = 45$)	31 (68.9%)	14 (31.1%)
Interpersonal only/both ($n = 14$)	7 (50%)	7 (50%)
	At least one intrapersonal	**At least one interpersonal**
At least one intrapersonal ($n = 57$)	57 (100%)	20 (35.1%)
At least one interpersonal ($n = 14$)	14 (100%)	7 (50%)

Chi-square could not be computed since these categories are not mutually exclusive/from a single cross-tab i.e., individuals who reported at least one intrapersonal function can also report interpersonal, and vice versa.

Changes in NSSH Functions Over Time

Table 2 shows changes in self-harm functions between 16 and 21 years for the 59 participants who self-harmed in the past year at age 21 and had data on self-harm functions (referring to the most recent episode). Of those who reported only intrapersonal functions at age 16, the majority (68.9%) still reported intrapersonal functions only at age 21. Thirty-one percent reported either interpersonal functions only, or both types at 21 years (n.b. these categories were combined due to

TABLE 3 | Sociodemographic and NSSH function characteristics at baseline according to self-harm outcome: imputed data.

	Participants with NSSH at 16 years *N* = 528 M (SE) or %	Participants with repeat self-harm at follow-up (past year) M (SE) or %	Participants with new onset suicide attempt at follow-up M (SE) or %
Female sex	79.9%	79.9%	76.3%
Maternal education (missing data)			
O-Levels or lower	52.0%	46.0%	54.1%
A-Levels or higher	48.0%	54.0%	45.9%
Family income quintiles			
1st	14.1%	16.9%	9.6%
2nd	17.7%	19.8%	24.4%
3rd	21.5%	18.1%	19.5%
4th	22.8%	18.5%	20.7%
5th	23.9%	26.7%	25.8%
NSSH functions at age 16 years			
All functions			
Total number, median (IQR)	1 (1, 2)	1 (1, 2)	1 (1, 2)
One function	58.0%	53.1%	51.6%
Two functions	29.4%	30.0%	28.1%
Three or more functions	12.7%	16.9%	20.4%
Intrapersonal functions			
Total number, median (IQR)	1 (1, 2)	1 (1, 2)	1 (1, 2)
Zero functions	7.6%	4.4%	3.9%
One function	62.1%	60.4%	59.5%
Two functions	26.0%	28.2%	29.3%
Three or more functions	4.4%	6.9%	7.31%
Interpersonal functions			
Total number, median (IQR)	0 (0, 1)	0 (0, 1)	0 (0, 1)
Zero functions	72.9%	73.9%	71.8%
One or more functions	27.1%	26.1%	28.2%
Intrapersonal functions only	72.9%	73.9%	71.8%
Interpersonal functions only	7.6%	4.4%	3.9%
Both intra- and interpersonal functions	19.5%	21.7%	24.3%

Responses reflect self-harm functions for last time young person self-harmed.
Non-suicidal self-harm functions were measured at age 16.
Sample sizes at follow-up are not available as data are imputed.

low cell counts). Of those who reported either interpersonal only or both types at 16 years, half switched to intrapersonal only at age 21.

All participants reported at least one intrapersonal function at age 21 years. Participants were more likely to endorse an interpersonal function at 21 years if they had reported at least one interpersonal function at baseline (50% compared to 35.1% among those who reported at least one intrapersonal function at 16).

Association Between Number of NSSH Functions and Future Repeated Self-Harm: Imputed Data (*N* = 528)

The proportion of the sample who reported repeat self-harm (past year self-harm at 21, 24, or 25 years) was 33.5% (95% CI 28.3–38.6%). At follow-up, nearly one-third (29.2%; 95% CI 23.8–34.5%) reported having attempted suicide for the first time since age 16 years. **Table 3** shows the sociodemographic and NSSH function characteristics at baseline for different outcome variables. **Table 4** shows the results of the logistic regression analysis between NSSH functions at 16 and future self-harm and suicide attempts.

Repeat Self-Harm

In fully adjusted models, there was strong evidence for an association between total number of NSSH functions at 16 years and future repetition of self-harm at ages 21–25 years (adjusted OR = 1.40, 95% CI 1.07, 1.84). The odds of repetition were higher among those participants who endorsed a greater number of intrapersonal functions at 16 years (adjusted OR = 1.46, 95% CI 1.06, 2.01), but we did not find an association with interpersonal functions (adjusted OR = 1.30, 95% CI 0.85, 2.01).

TABLE 4 | Functions of NSSH as predictors of future self-harm and suicide attempts: imputed data.

	Unadjusted		Model 1		Model 2	
	OR (95%CI)	***P*-value**	**OR (95%CI)**	***P*-value**	**OR (95%CI)**	***P*-value**
Repeat self-harm						
Total functions	1.39 (1.07, 1.81)	0.014	-	-	1.40 (1.07, 1.84)	0.015
Intrapersonal functions	1.43 (1.04, 1.96)	0.028	1.46 (1.07, 2.00)	0.018	1.46 (1.06, 2.01)	0.021
Interpersonal functions	1.19 (0.78, 1.81)	0.419	1.28 (0.83, 1.96)	0.265	1.30 (0.85, 2.01)	0.230
New onset suicidal self-harm						
Total functions	1.24 (0.92, 1.67)	0.152	-	-	1.28 (0.95, 1.74)	0.108
Intrapersonal functions	1.32 (0.92, 1.88)	0.130	1.33 (0.93, 1.90)	0.119	1.36 (0.94, 1.97)	0.101
Interpersonal functions	1.04 (0.67, 1.62)	0.863	1.09 (0.70, 1.72)	0.699	1.15 (0.73, 1.82)	0.548

Model 1: Included both intrapersonal and interpersonal functions. Model 2: Adjusted for sex, maternal education, and household income.

Future Suicide Attempts

In fully adjusted models, there was weak evidence for an association between the total number of NSSH functions (adjusted OR = 1.28, 95% CI 0.95, 1.74), and the total number of intrapersonal functions (adjusted OR = 1.36, 95% CI 0.94, 1.97) reported at age 16 years and future suicide attempts (findings do not reach conventional levels of significance). We did not find evidence for an association with interpersonal functions (adjusted OR = 1.15, 95% CI 0.73, 1.82) with suicide attempt.

DISCUSSION

Whilst many studies have empirically examined associations between intra- and interpersonal self-harm functions and how they relate to self-harm and suicidal outcomes, few have done this longitudinally nor during periods of developmental transition. This study elucidates whether NSSH functions change over time within individuals and clarifies the nature of the association between NSSH functions in adolescence and future self-harm and suicide attempts in early adulthood using a prospective cohort study.

Regarding the endorsement of *any* specific intra- and/or interpersonal self-harm function at age 16 and 21, we found that 42% simultaneously endorsed multiple (usually two or three) specific functions during adolescence and this increased to 74.6% during adulthood. This pattern is consistent with studies of adults and adolescents that have used broader validated measures of NSSH functions such as the ISAS (Klonsky and Glenn, 2009) or FASM (Functional Assessment of Self-Mutilation; Lloyd-Richardson et al., 2007) where the number of functions seems to be higher in adulthood [e.g., Nock and Prinstein, 2005; Lloyd-Richardson et al., 2007; Klonsky, 2011; see also the meta-analysis by Taylor et al. (2018)]. The pattern suggests that individuals might discover more specific functions for NSSH over time, though our discrepancy in function endorsement during adolescence and adulthood may be due in part to sample characteristics. In adulthood, our focus was on a smaller number who reported repeat self-harm in the previous year at age 21 years. We also included one additional "suicidal function" item ("I wanted to die") at 21 years which was reported by 14 (23.7%) participants. Those who endorsed this function at age 16 were excluded to ensure our study sample only contained those who had harmed without suicidal intent at baseline, but excluding these individuals could have more generally reduced the number of functions at baseline (cross-sectional work suggests that the number of functions correlates positively with past suicide attempts i.e., there are on average more functions present in those who have attempted suicide; e.g., Klonsky and Glenn, 2009). We are likely therefore to be capturing adults with more chronic and entrenched self-harm.

When comparing the patterns of intrapersonal and interpersonal functions, we found that 92% of adolescents and 100% of adults endorsed at least one specific intrapersonal function (alone or alongside interpersonal functions). Similarly high percentages have been reported in some previous non-clinical samples (e.g., Saraff and Pepper, 2014), though the pooled prevalence of intrapersonal functions across a range of sample types is slightly lower at 66–81% (interpersonal functions is lower still at 33–56%: Taylor et al., 2018). More frequent endorsement of intrapersonal functions at both time points is also consistent with previous studies of stability over 12 months (Glenn and Klonsky, 2011b; Daukantaite et al., 2020). This pattern is important to understand because more frequently endorsed stable functions might better reinforce self-harm over time.

We also found that endorsing both types of function was more common during adulthood than at 16 years, and that no adults endorsed interpersonal functions *only* compared with 7.6% during adolescence. Rather, when interpersonal functions were present in adulthood they were always accompanied by intrapersonal functions; this pattern suggests that interpersonal functions may trigger self-harm initiation during adolescence but only serve to maintain self-harm over time in the presence of intrapersonal reasons. This conclusion fits with previous work highlighting the importance of interpersonal functions for self-harm initiation, but not maintenance (Muehlenkamp et al., 2013; Tatnell et al., 2014). Moreover, our data suggests that whilst the majority (68.9%) endorse intrapersonal only during both adolescence and adulthood, for others there is a switch to fewer general types of functions (i.e., from endorsing *both* interpersonal and intrapersonal, to intrapersonal only) or an accumulation of

the types of reasons as they move into adulthood (i.e., a change to endorsing intra- as well as interpersonal functions).

Through assessing the functions of NSSH during adolescence we were able to examine whether these maintain future self-harm behavior. Greater endorsement of intrapersonal NSSH functions at 16 years independently predicted future repetition of self-harm at ages 21–25 years, over and above interpersonal functions. Since intrapersonal functions are also associated with greater NSSH frequency (e.g., Saraff et al., 2015) and self-harm cessation is driven by improvements in affect regulation (Whitlock et al., 2015), it is perhaps not surprising that intrapersonal functions (which capture emotion dysregulation) predict continued engagement in self-harm. Like other cross-sectional studies (e.g., Muehlenkamp et al., 2013) and in line with our conclusions based on patterns/changes in functions over time, these results support both an emotion dysregulation perspective of self-harm maintenance (Chapman et al., 2006; Andover and Morris, 2014; Wolff et al., 2019) and Nock's (2009, 2010) theoretical model which proposes that intrapersonal functions reinforce and maintain self-harm (e.g., Nock, 2009). The notion that self-harm is maintained into adulthood because it is effective in regulating affect is supported by Brausch and Muehlenkamp's (2018) cross-sectional exploration of the relative greater perceived effectiveness of NSSH for intrapersonal functions. As Brausch and Muehlenkamp (2018) cogently explain, if NSSH is effective in meeting the desired function this can lead to increased NSSH severity (e.g., lifetime frequency) because the self-harm needs have been met and continue to be reinforced over time. We apply the same logic here: if self-harm is effective and meets intrapersonal needs (e.g., it works to regulate emotion/affect), then the behavior is repeated.

We did not find an association between the number of interpersonal functions and future repetition of self-harm. This finding is also consistent with past work that has demonstrated the centrality of interpersonal functions for self-harm initiation, but not maintenance (Muehlenkamp et al., 2013; Tatnell et al., 2014). One explanation for the lack of association over time is to do with the effectiveness of self-harm for interpersonal reasons, as discussed by Brausch and Muehlenkamp (2018). If interpersonally driven self-harm is generally wholly ineffective in achieving the intended outcome such as to "show how I am feeling," it is therefore not reinforced. Alternatively, if it is effective, it may lead to receiving support/care, which could reduce future risk of repetition. Our conclusions are tentative here since we did not measure the effectiveness of functions. These alternative plausible explanations need empirically investigating. Our findings, taken together with Brausch and Muehlenkamp, highlight the need to reconsider the reinforcing properties of interpersonal functions outlined by Nock's (2009; 2010) model of NSSH.

Regarding incident suicide attempts, we found weak evidence for an association with intrapersonal functions (Sterne and Smith, 2001; Amrhein et al., 2019; findings did not reach conventional levels of statistical significance but could be clinically important). The relationship between intrapersonal functions and suicide attempts has been documented in a number of cross-sectional studies (e.g., Klonsky and Olino, 2008) and might be explained by common mechanisms such as emotion dysregulation, that is, intrapersonal functions are an indicator of emotion distress which increases suicide desire/ideation and attempts. Alternatively, we suggest that one way in which intrapersonal functions could be associated with suicide attempts is *via* repeat self-harm. Psychological models emphasize the importance of capability for suicide (Joiner et al., 2012) and there is evidence that repeat rather than single episode self-harm elevates risk of suicide (Zahl and Hawton, 2004; Haw et al., 2007).

Interpersonal functions during adolescence were not associated with incident suicide attempts. This is perhaps not surprising if we assume that functions do predict suicide attempts *via* repeat self-harm (the latter of which was also not associated with interpersonal functions). These results suggest instead that interpersonal functions might have limited relevance over the long-term for self-harm maintenance or clinical severity in general, including suicide risk. The notion that interpersonal functions (alone) are generally less clinically significant is supported by previous studies (e.g., Klonsky and Glenn, 2009; Klonsky et al., 2015). Yet, it is important to also determine whether the *ineffectiveness* of interpersonal functions can account for the lack of association with suicide attempts and repeat self-harm, that is, whether the self-harm is ineffective in meeting interpersonal needs and as a result the behavior is not maintained, nor risk of suicide increased. There is some suggestion from Brausch and Muehlenkamp's (2018) findings that interpersonal functions are not perceived to be immediately effective in achieving desired NSSH outcomes. More recently, Snir et al.'s (2018) analysis suggests a more complex pattern of intra- and interpersonal consequences of self-harm in adolescents: self-harm measured at 3-months predicted decreases in negative affect (intrapersonal) at 12-months for adolescents high in peer support (interpersonal), and increases in negative affect for those low in peer support. Further long-term prospective studies are needed to examine functional consequences of self-harm to elucidate whether the events and experiences that occur immediately after the injury and in the future (e.g., reduced negative affect, support from family/friends) are reinforcing. Interestingly, our patterns in functions over time also highlights the fact that interpersonal functions might only exert an influence in adulthood when accompanied by intrapersonal functions.

Future Directions and Limitations

This is a novel study and strengths include the prospective design over a long time-period, permitting exploration of prospective associations from adolescence to adulthood, and the large population-based sample. Yet, there are some limitations. First, our data only permitted exploration of associations over time between NSSH functions at age 16 and repetition of *any self-harm* at age 21 and 25 years (i.e., both suicidal and non-suicidal combined); future research must separate these out to identify whether NSSH during adolescence predicts NSSH in adulthood. Studies here should endeavor also to extend the time period, beginning in early adolescence (age 12–14) to capture early onset self-harm since incidence in the community is also high in younger adolescents (Geulayov et al., 2018).

Second, participants were asked about their motivations related to the last time they self-harmed (which we then categorized into the two broad intrapersonal or interpersonal domains), and this may not necessarily be representative of all specific functions that are driving the self-harm for that individual. We did not explore patterns in specific functions due to small sample sizes for some functions, and it is also worth noting that there is overwhelming empirical support for the two distinct but related function domains (e.g., Klonsky et al., 2015).

Third, we excluded adolescents who had attempted suicide at age 16. This was necessary to ensure we were able to focus on functions of NSSH only, however we recognize that we will have excluded some adolescents who have engaged in both behaviors. Our findings are therefore only generalisable to those who have never attempted suicide by age 16. Findings may also not generalize to other ethnic groups, as 97% of the sample were white.

Fourth, determination of suicidal intent was based on self-report and may include bias; for example, adolescents may be ambivalent or fluctuate in their intent to die and reports may be influenced by current mood state or change over time. We found that some young people reported wanting to die on the most recent occasion but then responded negatively to the later question "have you ever seriously wanted to kill yourself" (23% at age 21 years and 16% at age 25 years). For this group, self-harm may have been an expression of distress, rather than a reflection of suicidal intention. Previous work with this cohort has found that participants who have self-harmed with suicidal intent were more likely than those with non-suicidal self-harm to use overdose as a method and to have sought help, providing some support for the distinction between the groups.

Fifth, the amalgamation of data across data collection waves means that we were not able to examine self-harm frequency, yet, studies have shown important associations between functions and frequency (e.g., Saraff et al., 2015) and therefore the potential for functions to predict progression to more frequent self-harm. Other work has shown that more NSSH functions is associated with higher NSSH frequency; thus, our finding that more NSSH functions predicts repeated NSSH might be because more NSSH functions is a proxy for higher NSSH frequency. Future longitudinal work should measure both NSSH functions and frequency to determine if each provides unique information about future NSSH.

Sixth, as with all cohort studies, there was some loss to follow-up, and it is possible that non-random response may have biased our complete case analyses. Data from simulation studies suggest that unbiased results can be obtained using multiple imputation even with large proportions of missing data (up to 90%), provided data are missing at random and the imputation model is properly specified (Madley-Dowd et al., 2019). Although we cannot say with absolute certainty that the data were missing at random, our imputation models included a wealth of auxiliary information, which increases the plausibility of the missing at random assumption.

Finally, we did not examine the potential interaction between intrapersonal and interpersonal functions. Nor did we examine other potential affective/interpersonal covariates, moderators or mediators [see Abdelraheem et al. (2019), for review] such as depression which could help to explain associations between functions over time, and/or the associations between functions and future self-harm/suicidal behavior. For example, one possibility is that repeat self-harm mediates the relationship between intrapersonal functions and suicide attempts. We did not examine this possibility in this study as data were combined across time points and a clear temporal relationship which is necessary for mediation, could not be established (repeat self-harm and suicide attempts were assessed over the same time period). Future work should also examine how NSSH functions relate to a range of distal and proximal vulnerability factors that might maintain and predict NSSH over time, providing a more comprehensive test of Nock's (2009; 2010) etiological model of NSSH. Such an endeavor is important for continued refinement of evidence-based theories that explain why people engage in and repeat self-harm.

Theoretical and Clinical Implications

Ultimately, our findings suggest that intrapersonal functions maintain self-harm and might also elevate risk of suicide attempts, whilst interpersonal functions do not. That is, intrapersonal functions play a crucial role as self-harm is potentially becoming entrenched over time throughout adolescence to early adulthood, coinciding with a period of significant adjustment where normative development involves the learning of adaptive emotion regulation skills (Gullone et al., 2010). These findings extend previous cross-sectional and prospective work regarding the reinforcing mechanisms of self-harm and with replication would suggest the need to refine existing models of NSSH (i.e., Nock, 2009, 2010) to capture changes and/or stability in the reinforcing properties of functions over time, and/or in relation to onset vs. maintenance. The findings highlight the utility of positioning self-harm maintenance within an affect regulatory framework of NSSH (Chapman et al., 2006; Andover and Morris, 2014; Wolff et al., 2019), that is, underlying affective difficulties and affect-laden reasons keep the self-harm going from adolescence to adulthood. If intrapersonal functions represent greater risk over time then improvements in affect regulation skills and strategies could lead to the cessation of NSSH. This was evidenced by Whitlock et al. (2015), though cessation has also been attributed also to improvements in interpersonal relationships (Tatnell et al., 2014; Whitlock et al., 2015). It is important to further understand however, whether in the context of NSSH, interpersonal relationships matter *via* their impact on emotion (e.g., Snir et al., 2018).

In contrast, the notion that *continued* engagement in self-harm occurs because normal interpersonal functions/communication methods continue to fail (the "cry of pain" model; Nock, 2008) is not supported by our data, yet it is clear that interpersonal functions are crucial to understand. During adolescence they may play a more prominent role in self-harm initiation, whereas in adulthood they are less common and do not occur without the presence of intrapersonal functions. Even though intrapersonal functions maintain the self-harm, for some people functions may change and evolve (e.g., from

intrapersonal to both intrapersonal and interpersonal). We recommend therefore that clinician assessment of self-harm should repeatedly enquire about all functions, and this may give some indication of the likelihood of future repetition and suicide risk. Moreover, therapeutic interventions such as Dialectical behavior Therapy (DBT; Linehan, 2015) that develop emotion regulation skills along with interpersonal communication skills may be most effective. DBT has already shown to produce simultaneous reductions in self-harm and suicidal behavior (Linehan et al., 2006; Stanley et al., 2007).

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because, there are charges for accessing ALSPAC data. Requests to access the datasets should be directed to http://www.bristol.ac.uk/alspac/researchers/access/.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethical approval for the study was obtained from the ALSPAC Ethics and Law Committee and the Local Research Ethics Committees. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

KG led the conceptualization of the paper and study and drafted the original manuscript. BM and EP contributed to conceptualization, design, led on the methods, approach to analysis, with KG, BM, and EP agreeing the final analytic strategy, and conducted the statistical analyses. All authors contributed to drafts of the manuscript, including approving the final version of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.688472/full#supplementary-material

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Testing Whether Suicide Capability Has a Dynamic Propensity: The Role of Affect and Arousal on Momentary Fluctuations in Suicide Capability

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To prevent suicidal behaviors, it is crucial to understand the mechanisms and processes that enable an individual to act on suicidal thoughts. Suicide capability, which involves an increased pain tolerance and fearlessness of death, is a critical factor that enables an individual to endure the physical pain necessary to make a lethal suicide attempt. Extant research has largely conceptualized suicide capability as developing linearly in response to painful and provocative experiences, but the emerging literature on the temporal dynamics of suicide has been challenging the notion of linearity in suicide risk. Few studies have directly measured and compared *changes* in suicide capability in response to rumination on different affective states. We sought to experimentally test if rumination in the context of low vs. high arousal emotions will prompt distinct changes in two core components of suicide capability: pain tolerance and fearlessness of death on two undergraduate student samples. In both studies, participants provided measures of subjective emotional state as well as pain threshold, tolerance, and persistence before and after completing experimental manipulations which included both emotion and rumination induction procedures. In the second study, measures of fearlessness about death and physiological arousal (heart rate) were added to the experimental procedures. We found significant decreases in pain threshold, tolerance, and persistence following the experimental manipulations but found no main effects of rumination or suicide risk. These findings suggest that suicide capability can fluctuate but these changes may occur through a different mechanism and/or differ between individuals at varying levels of suicide risk.

Keywords: suicide, acquired capability for suicide, arousal, emotion regulation, affect

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INTRODUCTION

Suicide is a worldwide public health issue that claims the lives of ∼800,000 individuals annually (World Health Organization, 2014) and demands our attention. Despite the last 50 years of suicide research that has aimed to answer the questions of who, why, and what causes people to die by suicide, our attempts to predict and prevent suicide have not been fruitful (Franklin et al., 2017). Over the past 13 years, suicide rates in the United States (US) have not decreased. On average, the rate of suicide in the United States increased by 1% each year from 1996 to 2006 and grew to

2% per year from 2006 to 2018 resulting in a total increase of 35% altogether (Hedegaard et al., 2020). While there has been a recent shift in researchers' interest in the use of large scale pattern recognition and predictive analytics to predict suicide (Walsh et al., 2017) it is equally important to examine the mechanisms that enable an individual to attempt suicide, allowing us to systematically identify targets for prevention and intervention.

According to two prominent theories of suicide, the Interpersonal Theory of Suicide (ITS; Joiner, 2005) and Three-Step Theory of Suicide (3ST; Klonsky and May, 2015), a critical factor that enables an individual to make a lethal suicide attempt is the capability to endure the physical pain and overcome the fear of death. Indeed, suicide researchers have consistently demonstrated that an elevated risk for suicide is associated with pain tolerance—the maximum level of pain an individual is able to tolerate (Nock et al., 2006; Franklin et al., 2011; Pennings and Anestis, 2013). Specifically, the ability to tolerate more pain has been found to differentiate individuals who have made a suicide attempt from their counterparts who only thought about suicide (Smith et al., 2010). More recent research has also suggested that pain persistence—the difference between the point at which pain is first detected and the point at which an individual can no longer tolerate pain—may also be essential in determining the capability for suicide (Law et al., 2017). In addition to enduring physical pain, attempting suicide requires an individual to overcome their innate fear of death to inflict lethal self-injury. This is supported by existing research on suicide capability, which has found that increased fearlessness of death and dying differentiates individuals who only ideate about suicide from those who have made a suicide attempt (Smith et al., 2010, 2016; Dhingra et al., 2015).

The majority of existing research on suicide capability, however, has conceptualized this variable as relatively stable and increasing in a linear manner in response to painful and provocative experiences (Franklin et al., 2011). Yet, the trajectory of suicide risk seems to be non-linear and fluctuating depending on changes in risk factors. Increasing evidence suggests that suicidal ideation fluctuates from week to week and even from hour to hour and thus appears to be nonlinear (Witte et al., 2006; Bryan and Rudd, 2018; Kleiman et al., 2018). Indeed, the variability of suicidal ideation may be more important than average intensity for predicting future suicide attempts (Bryan et al., 2019). Similarly, suicide capability may also have dynamic propensity such that specific internal and external contexts may momentarily change an individual's ability to make a suicide attempt. The Fluid Vulnerability Theory of suicide (Rudd, 2006) posits that suicide risk fluctuates based on the interaction between predisposing baseline and acute, context dependent risk factors. Suicide capability has been consistently researched as a baseline risk factor for suicide attempts with minimal research examining its potential as an acute risk factor. Existing studies examining pain analgesia during non-suicidal self-injury (NSSI) in individuals diagnosed with borderline personality disorder (BPD) have found that individuals with BPD possess a higher threshold for pain compared to their counterparts without BPD, and this pain threshold is further heightened when they are placed in conditions that elicit high subjective stress (Bohus et al., 2000). Pain threshold has been correlated with aversive arousal in individuals with BPD (Stiglmayr et al., 2001; Ludäscher et al., 2007). Finally, a study using experiential sampling methods found that individuals would report pain analgesia during some NSSI episodes but not others (Selby et al., 2019). Thus, suicide capability may be both a baseline and an acute risk factor for suicide attempts.

In the context of suicide, emotions may be a particularly relevant contributor to momentary fluctuations in the ability to tolerate and persist through pain in order to make a suicide attempt. Notably, a large proportion of psychiatric inpatients who attempt suicide (40.9%) report feeling angry immediately before making a suicide attempt (Chapman and Dixon-Gordon, 2007). Emotions have often been posited to have two qualities: valence and arousal. Valence is defined as the perception of an emotion as being pleasant or unpleasant while arousal is defined as the state of being physiologically activated or deactivated (Barrett, 1998). Past studies have found heightened states of arousal to contribute to the probability of suicide death particularly among individuals with high capability for suicide (Ribeiro et al., 2015). Additionally, physiological differences between negative low arousal affective states (e.g., sadness) and negative high arousal affective states (e.g., anger; Marci et al., 2007) have been found to contribute to differences in pain tolerance (Carter et al., 2002). Specifically, acute experiences of emotions that are of negative valence and high arousal (e.g., anger) have been found to have analgesic effects (Rhudy and Meagher, 2001; Burns et al., 2009). Thus, it is plausible that physiological arousal may moderate the experience of pain and momentarily change suicide capability thereby enabling or disabling an individual's ability to attempt suicide.

All individuals experience a range of emotions, and the experience of negative emotions does not always increase suicide capability. Furthermore, while emotions may have an acute analgesic effect, that effect may not necessarily be sustained long enough for an individual to engage in suicidal behavior. The regulation of negative emotional experiences, related but distinct from the emotional experience itself, may be a crucial factor in understanding suicide risk. Indeed, past studies have found greater emotion dysregulation to increase the desire for suicide and, when paired with in the tendency to engage in painful and/or provocative behaviors (e.g., non-suicidal self-injury), it has also been shown to be associated increases in their suicide capability (Law et al., 2015). Rumination, the repetitive fixation on the experience, causes, and consequences of a negative emotion (Nolen-Hoeksema, 1991), is a maladaptive emotion regulation strategy that has been consistently found to exacerbate and sustain the processing of negative emotion (McLaughlin et al., 2007; Selby and Joiner, 2013). Furthermore, rumination has been associated with increases in both suicidal ideation and suicide attempts (Morrison and O'Connor, 2008; Law and Tucker, 2018). As such, it is plausible that rumination may sustain the analgesic effect of emotion, thereby creating a momentary increase in the ability to tolerate and persist through pain.

Unfortunately, there is a dearth of experimental research testing the stability of suicide capability and examining how different affective states may impact such changes in suicide

capability. Existing research on the regulation of emotional states and suicide capability thus far has been limited by the use of descriptive or correlational research designs. As such, we designed these studies to test the differential effects of rumination in the context of a high arousal (anger) vs. low arousal (sadness) emotional state on changes in suicide capability using two undergraduate student samples. We believe that first testing these basic mechanisms in a student sample without substantial suicide history is, practically and ethically, necessary to refine hypotheses and procedures before they are replicated on individuals with significant suicide history who are at greater risk for suicide. We hypothesized that ruminating on experiences of only anger and experiences of anger and sadness together (vs. only sadness) would likely result in a greater increase in suicide capability. Suicide risk, determined by the presence of lifetime suicide ideation, plans and preparatory behaviors, and suicide attempts was also examined as a potential moderator between the aforementioned relationships. Specifically, we hypothesized that individuals who are high on suicide risk will exhibit elevated levels of suicide capability that are comparable across all types of rumination. This would be consistent with existing research that individuals who are high in suicide risk already possess an elevated baseline for suicide capability (Franklin et al., 2011; Ribeiro et al., 2014a).

We also included Heart Rate as a measure of physiological arousal in Study 2. Past studies have supported the theory that a common mechanism exists between pain sensitivity and cardiovascular responses (Vassend and Knardahl, 2004). Particularly, changes in blood pressure and heart rate have been consistently demonstrated to be associated with pain threshold and pain tolerance (Campbell et al., 2006; Duschek et al., 2009). Furthermore, experimental and correlational studies alike have found rumination to be associated with increased blood pressure and heart rate (Ottaviani et al., 2016) and a delayed recovery following cardiovascular reactivity (Glynn et al., 2002). Moreover, the delayed recovery for cardiovascular reactivity can extend past 24 h following the onset of rumination (Ottaviani et al., 2011). Given the association between cardiovascular reactivity, emotion, and decreased pain sensitivity (Appelhans and Luecken, 2008) it is reasonable to anticipate that rumination in the context of different emotional states may impact change suicide capability through arousal as measured by cardiovascular reactivity.

METHODS

Study 1

Participants

Participants who completed the study were 124 undergraduates ($M_{age} = 20.86$, SD = 8.87; 82.8% female; 65.6% White) enrolled in psychology courses and recruited through the psychology research participation system. Of the 124 participants, 16.9% had thought about suicide in their lifetime, 9.7% have made plans and preparations for suicide, and 4.8% had a history of at least one previous suicide attempt. Detailed demographic information is presented in **Table 1**.

Procedures

Upon registration for the study, a secure link was sent to the participants directing them to the online phase of the study. After reviewing the informed consent form and consenting to participate in the study, participants were asked to complete a battery of online questionnaires focused on demographic variables and trait measurements of psychiatric variables such as their history of suicidal ideation and suicide attempts. They were then randomly assigned to receive instructions to a control condition where they described the room they were in or an experimental condition where they provided a narrative describing an event that made them feel (a) Anger Only, (b) Sadness Only, or (c) Anger and Sadness Combined using the Pitman Protocol (Pitman et al., 1987). Participants who did not provide appropriate narratives that contained sufficient detail (>250 words) for the emotion induction procedure were excluded from participation in the laboratory phase of the study. Between their participation in the online phase and the laboratory phase of the study, the narrative provided by each participant was written into a script and recorded into an audio file to increase immersion into the personalized imagery task used for the emotion induction procedure.

In the laboratory session, participants completed an interview assessing suicide risk, a self-report measure of baseline subjective emotional state, and a cold pressor task (CPT) to measure baseline levels of pain threshold, tolerance, and persistence. In order to minimize potential of third variable effects on pain tolerance variables participants were asked to refrain from taking analgesics (e.g., aspirin, acetaminophen) and other pain suppressants for at least 8 h (Bender et al., 2012), and ingesting sugared foods and alcoholic beverages for at least 1 h prior to their scheduled appointment (Mercer and Holder, 1997).

Participants were then guided through a personalized idiographic emotion induction using the audio file recorded from the narrative they provided in the first stage of the study and subjective emotional state following the emotion induction procedure was measured. Subsequently, participants were visually guided through the rumination induction procedure (Nolen-Hoeksema and Morrow, 1993), which was followed by another measure of subjective emotional state. They completed the CPT a second time to test for changes in state pain threshold, tolerance, and persistence. Finally, subjective emotional state was measured again at the end of the study. Suicide risk was assessed at the end of the study as a means to ensure the participants' safety after leaving the laboratory. Participants were also debriefed and provided with coping skills and local/national counseling services. All self-report questionnaires in the laboratory session were completed on laboratory computers. Suicide risk assessments and CPTs were administered by trained research assistants. The current study protocol was approved by authors' Institutional Review Board.

Measures

Self-Injurious Thoughts and Behaviors

Suicide risk was determined at baseline by the presence of lifetime suicidal ideation, plans and preparations, and attempts assessed using the Self-Injurious Thoughts and Behaviors Interview

TABLE 1 | Participant demographic information.

	Control	Anger	Sadness	Combined	Full sample
Sample 1					
N	32.00	35.00	32.00	23.00	124.00
Age (Mean, SD)	19.97 (2.83)	19.74 (2.83)	22.94 (9.59)	20.91 (5.16)	20.86 (8.87)
% Female	75.00	91.40	75.00	91.30	82.80
Race					
% White	62.50	62.90	65.60	73.90	65.60
% African-American	28.10	31.40	28.10	21.70	27.90
% Asian	0.00	0.00	0.00	0.00	0.00
% Hispanic/Latino	3.10	5.70	0.00	4.30	3.30
% Other	6.30	0.00	6.30	0.00	3.30
Lifetime suicide history					
% Ideated	9.40	14.30	25.00	21.70	16.90
% Planned	12.50	5.70	12.50	8.70	9.70
% Attempted	3.10	8.60	3.10	4.30	4.80
Sample 2					
N	25.00	18.00	24.00	17.00	84.00
Age (Mean, SD)	19.84 (2.41)	22.00 (9.99)	20.67 (3.84)	21.47 (4.22)	20.87 (5.51)
% Female	80.00	72.20	91.70	64.70	78.60
Race					
% White	56.00	72.20	58.30	70.60	63.10
% African-American	32.00	27.80	29.20	17.60	27.40
% Asian	0.00	0.00	0.00	5.90	1.20
% Hispanic/Latino	4.00	0.00	8.30	0.00	3.60
% Other	8.00	0.00	4.20	5.90	4.80
Lifetime suicide history					
% Ideated	20.00	5.60	16.70	35.30	19.00
% Planned	8.00	16.70	4.20	0.00	7.10
% Attempted	0.00	16.70	8.30	5.90	7.10

(SITBI; Nock et al., 2007). The SITBI is a structured interview which assesses the presence, age of onset, frequency, and severity of suicide related thoughts and behaviors, such as suicide attempts, gestures, plans, ideation, and NSSI. For both studies, individuals who reported no history of suicidal ideation, plans, and attempts were coded with a suicide risk rating of 0; those who have engaged in suicidal ideation only were coded with a suicide risk rating of 1; those who have engaged in plans and preparatory behaviors were coded with a suicide risk rating of 2; and finally, those who had previously made a suicide attempt was coded with a suicide risk rating of 3. In past studies, the SITBI has demonstrated strong inter-rater reliability and test-retest reliability, as well as strong concurrent and convergent validity (Nock et al., 2007).

Subjective Emotional State

The Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) was used to evaluate the subjective emotional state of participants at baseline, after the emotion induction procedure, and after the rumination induction procedure. Participants provided ratings on 10 positive emotion items and 10 negative emotion items, which represented how they were feeling "right now, at the present moment" using a 5-point scale where 1 (not at all or very slightly) and 5 (very much). The PANAS has shown good test-retest reliability in past studies using a sample of students (Watson et al., 1988) as well as good convergent validity (Mackinnon et al., 1999). In the Study 1 sample, both the positive ($\alpha = 0.72$–0.79) and the negative ($\alpha = 0.68$–0.82) affect scales of the PANAS demonstrated fair internal consistency. In the Study 2 sample, both the positive ($\alpha = 0.90$–0.94) and the negative ($\alpha = 0.84$–0.89) affect scales of the PANAS demonstrated good to excellent internal consistency.

Baseline and State Pain Experiences

The cold pressor test (CPT) was used to examine participants' pain threshold and ability to tolerate and persist through pain past the pain threshold. The CPT is a frequently used pain induction procedure in studies examining NSSI (Bohus et al., 2000; Gratz et al., 2011). Participants were asked to submerge their hand, up to their wrist, in a cooler containing a mixture of water and crushed ice maintained at 2°C with a water circulator that prevents the water surrounding the participant's hand from warming. These

procedures are consistent with previous studies that have used the CPT to measure pain tolerance in the context of suicide and self-injury (Franklin et al., 2011; Ammerman et al., 2017).

Participants were asked to alternate hands (dominant/non-dominant) between the first trial and the second trial; furthermore, hand order was counterbalanced across trials. Time elapsed was measured and recorded using two timers which both began when the participant's hand was submerged and stopped at pain threshold and pain tolerance, respectively. The time at which participants first indicated pain was recorded as their Pain Threshold. Pain Tolerance was operationalized as the time elapsed until the participants pulled their hand out of the water and indicated that they could no longer tolerate the pain. Finally, Pain Persistence was recorded as the time elapsed between the participant's Pain Threshold and Pain Tolerance. A 2-min time limit was used for the task to reduce outliers as past studies have found that participants seldom continue past 2 min and those that do often continue due to a numbed sensation in their hand (Franklin et al., 2012).

Experimental Manipulations

Emotion Induction

An adapted version of the Pitman Protocol (Pitman et al., 1987) was used to induce the emotional contexts in which participants were told to ruminate. In the online phase of the study, participants were instructed write about a situation in which they felt sad or angry and to include specific details about the sequence of events, people involved, context, descriptions of thoughts, feelings, and physical reactions that were experienced. They were then asked to select the bodily sensations and emotions they experienced during the event from two separate lists. Finally, they listed the thoughts that they were experiencing during the situation they described. The information acquired from the participant were combined and written into scripts between 350 and 550 words in length and subsequently recorded into 2-min audio files using simple, direct language in the active voice and in the second person. The audio file was presented to the participant in the experimental session. Participants who did not provide enough detail (e.g., <250 words) in their narratives to effectively elicit emotion as part of the emotion induction procedures were not invited to participate in the laboratory phase of the study.

Rumination Induction

To induce rumination, the rumination induction protocol developed by Nolen-Hoeksema and Morrow (1993) was adapted, by changing verb tenses, to guide participants to think about their emotional state, within the context of the event they heard during the emotion induction. Participants were delivered 45 items (e.g., "think about why people treated you the way they did," "think about why you reacted the way you did.") through a series of slides over the course of 8 min.

Study 2

Participants

Participants for this study were 82 participants (M_{age} = 20.87, SD = 5.51; 78.6% female; 63.1% White) enrolled in psychology courses and recruited through the psychology research participation system. Of the 82 participants, 19.0% had thought about suicide in their lifetime, 7.1% had made plans and preparations for suicide, and 7.1% had a history of at least one previous suicide attempt. Past literature examining the role of emotion and rumination on cardiovascular activity had yielded effect sizes in the large range (Vassend and Knardahl, 2004; Ottaviani et al., 2011, 2016). Detailed demographic information is presented in **Table 1**.

Procedures

Study 2 directly replicated and extended upon Study 1 with the inclusion of measures of fearlessness of death and cardiovascular reactivity. Specifically, participants were connected to the BN-RSPEC wireless transmitters and receivers and the Biopac MP150 Data Acquisition System. Three pre-jelled electrodes were allowed to warm on the participants' skin as the initial suicide risk assessment was administered to improve the integrity of the acquired physiological data. After the initial visual inspection of the participants' physiological data and necessary adjustments were made, baseline measurements of the participants' emotional state and resting heart rate were taken. A measure of subjective fearlessness about death and the CPT was administered to measure baseline levels of suicide capability. Following the first CPT, Participants received an idiographic emotion induction, based on the narrative they provided in the online stage of the study using the Pitman Protocol (Pitman et al., 1987) in the form of an audio recording. They were then asked to rate their subjective emotional state following the emotion induction procedure. Subsequently, participants were visually and audibly guided through the rumination induction procedure (Nolen-Hoeksema and Morrow, 1993) followed, again, by a measure of subjective emotional. Subsequently, participants provided another measure of their fearlessness about death and completed the CPT again to test for changes suicide capability following the experimental manipulations. Heart rate was measured during both cold pressor tasks as well as the emotion and rumination induction tasks. Finally, after a recovery period of ∼20 min, another measurement of the participants' heart rate and subjective emotional state were taken. A final risk assessment was administered and participants were debriefed before their participation in the study was complete. All self-report questionnaires and experimental manipulations in the laboratory session were delivered using laboratory computers. Behavioral (CPT) and physiological (HR) measurements were recorded by trained research assistants.

Measures

Self-Injurious Thoughts and Behaviors

Suicide risk was determined at baseline by the presence of lifetime suicidal ideation, plans and preparations, and attempts assessed

TABLE 2 | Study 1 correlations and descriptive statistics.

	1	2	3	4	5	6	7
1. Suicide risk	1						
2. T1 threshold	−0.13	1					
3. T2 threshold	−0.18*	0.79**	1				
4. T1 tolerance	−0.15	0.58**	0.56**	1			
5. T2 tolerance	−0.18*	0.54**	0.64**	0.76**	1		
6. T1 persistence	−0.10	0.05	0.15	0.84**	0.57**	1	
7. T2 persistence	−0.15	0.17	0.24**	0.70**	0.82**	0.75**	1
Mean	0.51	16.99	13.19	41.49	32.42	24.52	20.62
SD	0.86	17.09	14.20	31.13	28.56	25.32	22.68
Min	0.00	0.00	1.00	4.00	1.00	0.00	0.00
Max	3.00	119.00	119.00	124.00	121.00	109.00	107.00

T1, Baseline; T2, Following Experimental Manipulations.
**Correlation is significant at the 0.05 level, **Correlation is significant at the 0.01 level.*

using the Self-Injurious Thoughts and Behaviors Interview (SITBI; Nock et al., 2007).

Subjective Emotional State

The Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) was used to evaluate the subjective emotional state of participants at baseline, after the emotion induction procedure, and after the rumination induction procedure. In the Study 2 sample, both the positive ($\alpha = 0.90–0.94$) and the negative ($\alpha = 0.84–0.89$) affect scales of the PANAS demonstrated good to excellent internal consistency.

Baseline and State Pain Experiences

The cold pressor test (CPT) was used to examine participants' pain threshold and ability to tolerate and persist through pain past the pain threshold. Procedures for the CPT were directly replicated from Study 1. In study 2, however, the cooler and water circulator that was used in Study 1 was replaced by an Anova A-40 Refrigerated Circulator System.

Cardiovascular Reactivity

A measure of cardiovascular reactivity was added to the laboratory phase of study 2. Specifically, we assessed for changes in Heart Rate (HR) derived from electrocardiogram (ECG) acquired using the Biopac MP150 Data Acquisition System and the BN-RSPEC wireless transmitters and receivers. Data were recorded through Acqknowledge 4.4.2 using a sampling rate of 1,000 samples per second. Pre-jelled electrodes were placed below the participants' right and left clavicles and on the left iliac fossa. Measurements were taken at 10 time points including baseline, during both sets of experimental manipulations and both cold pressor tasks, and after a 20 min follow-up recovery period. Physiological measurements that were not task-related (e.g., baseline, post-recovery) were measured using 300 s periods. In preparation for data analysis, all ECG waveforms were visually inspected for noise and heartbeats were identified using QRS peak detection.

Fearlessness of Death

In study 2, the 7-item Acquired Capability of Suicide Scale—Fearlessness About Death (ACSS-FAD; Ribeiro et al., 2014b) was included to measure fearlessness of death before and after the experimental manipulations. Participants responded to items using a 5-point Likert Scale where 0 (not at all like me) and 4 (very much like me). Scores on this scale range from 0 to 28 with higher scores indicating greater levels of fearlessness about death. In past studies, the ACSS-FAD has demonstrated adequate internal consistency as well as convergent validity with self-report measures assessing fear of suicide and the courage to attempt suicide (Ribeiro et al., 2014b). In the Study 2 sample, the ACSS-FAD demonstrated poor internal consistency ($\alpha = 0.45–0.49$) and results examining changes ACSS-FAD are uninterpretable and excluded from this report.

Experimental Manipulations

The experimental manipulation procedures used in Study 2 were directly replicated from Study 1 with the addition of an audio recording where each item of the rumination induction protocol were read aloud with their with corresponding text in visual slides.

Data Analytic Procedures

Subjective Emotional State and Manipulation Check

To determine if the emotion and rumination inductions produced the intended effect on the participants, a 4 (Time: Baseline vs. Post-Emotion vs. Post-Rumination vs. Recovery) X 4 (Neutral vs. Anger Only vs. Sadness Only vs. Anger and Sadness) repeated measure ANOVA (RM-ANOVA) and subsequent Bonferroni-corrected pairwise comparisons were used to test for main and interaction effects of Time and Condition on subjective emotional state (positive affect subscale, negative affect subscale, sad item, anger item). Based on previous studies using similar forms of experimental manipulations (Rusting and Nolen-Hoeksema, 1998; Ciesla and Roberts, 2007; Wisco and Nolen-Hoeksema, 2009), a significant increase in negative affect and items relevant to the assigned Condition (anger

TABLE 3 | Study 2 correlations and descriptive statistics.

	1	2	3	4	5	6	7	8	9	10	11	12
1. Suicide risk	1											
2. T1 threshold	−0.01	1										
3. T2 threshold	−0.05	0.65**	1									
4. T1 tolerance	0.19	0.66**	0.60**	1								
5. T2 tolerance	0.19	0.59**	0.76**	0.80**	1							
6. T1 persistence	0.24	0.38**	0.46**	0.94**	0.73**	1						
7. T2 persistence	0.32*	0.44**	0.48**	0.75**	0.92**	0.74**	1					
8. T1 fearlessness	0.02	−0.04	−0.03	0.03	0.09	0.07	0.14	1				
9. T2 fearlessness	−0.02	0.04	0.11	0.03	0.11	0.02	0.05	0.84**	1			
10. Resting HR	0.03	−0.08	−0.11	−0.14	−0.02	−0.15	0.02	−0.12	−0.07	1		
11. CPT1 HR	0.05	−0.05	−0.19	−0.09	−0.09	−0.09	−0.01	−0.17	−0.10	0.58**	1	
12. CPT2 HR	0.12	−0.08	−0.15	−0.15	−0.07	−0.14	−0.02	−0.13	−0.04	0.55**	0.74**	1
Mean	0.55	11.45	9.74	33.02	26.14	21.83	16.77	12.79	12.66	80.83	93.15	89.26
SD	0.91	7.94	7.47	22.93	18.80	18.64	14.29	4.81	4.93	10.27	10.65	10.48
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.57	68.08	61.21
Max	3.00	44.00	36.00	115.00	93.00	104.00	77.00	23.00	24.00	103.97	127.18	117.43

T1, Baseline; T2, Following Experimental Manipulations.
**Correlation is significant at the 0.05 level, **Correlation is significant at the 0.01 level.*

and sadness) between baseline and post-emotion induction was expected. It was also predicted that a significant increase between post-emotion induction and post-rumination induction would be observed. Finally, negative affect and items relevant to the Conditions were expected to decrease and return to baseline between post-rumination induction and at the end of the laboratory session. The opposite effects were anticipated for positive affect.

Primary Analyses

To test the aforementioned hypotheses, we had planned on using a series of hierarchical regression analyses but upon further consideration decided to use a Linear Mixed Model (LMM) using SPSS instead given that LMM will allow us to specify random effects and explicitly partition the variance associated with these differences instead of incorporating them into the general error term. For both Study 1 and Study 2, three separate models were used to test whether or not anger rumination would lead to greater increases of state Pain Threshold, Tolerance, and Persistence compared to sadness rumination. Study 1 Descriptive statistics and correlations can be found in **Table 2**. Study 2 descriptive statistics and correlations can be found in **Table 3**. Condition, Suicide Risk, change in pain responses between Baseline and Post-Manipulation (Time), as well as their interactions were entered into the model as fixed effects. The Repeated measure of Time on each individual participant was also entered into the model as a random effect.

Secondary Analyses

We used Model 4 in PROCESS (Hayes, 2013) with 10,000 boot strapped samples to test if the Multi-categorical Condition would have an indirect effect on suicide capability through changes in heart rate. Given that we are most interested in the effect of arousal on changes in pain responses from the first cold pressor task to the second cold pressor task, we used the difference between heart rate during the first cold pressor task and heart rate during the second cold pressor task as the mediating variable. Simple Indicator coding was used to compare each experimental condition with the Control Condition.

RESULTS

Covariate Selection

To determine an appropriate list of covariates, we used a series of analyses of variance (ANOVAs) to determine the influence of Race and Sex on changes in pain threshold, tolerance, and persistence. We then examined zero-order correlations to determine if Age and Trait Rumination, as measured by the Ruminative Response Scale (RRS; Treynor et al., 2003), were associated with changes in pain threshold, tolerance, and persistence. In Study 1, Sex was associated with changes in pain tolerance [$F_{(1, 121)} = 5.76$, $p = 0.02$] but not pain threshold or persistence (all $ps > 0.10$). There were no significant effects of Race on changes in pain responses (all $ps > 0.16$). Neither Age (all $ps > 0.58$) or Trait Rumination (all $ps > 0.16$) were correlated with changes in pain responses. As such, Sex was included as a covariate in the primary analyses examining pain tolerance.

In Study 2, there was a significant effect of Sex on changes in pain tolerance [$F_{(1, 61)} = 7.23$, $p = 0.009$] and pain persistence [$F_{(1, 61)} = 16.04$ $p < 0.001$] but not pain threshold ($p = 0.31$). There was also a significant effect of Race on changes in pain persistence [$F_{(2, 60)} = 5.17$, $p = 0.008$] but not pain threshold or tolerance (all $ps = 0.45$). Neither Age (all $ps > 0.44$) or Trait Rumination (all $ps > 0.20$) were correlated with changes in pain responses or arousal. As such, Sex was included as a covariate in the primary analyses for pain tolerance and

TABLE 4 | Study 1 fixed and random effects for pain responses.

		Pain threshold						
Fixed effects	**Parameter**	**Estimate**	**SE**	**df**	***t***	***p***	**95% confidence interval**	
							Lower bound	**Upper bound**
	Intercept	10.34	4.99	88.92	2.07	0.04	0.43	20.25
Condition	Control	−3.35	3.16	87.47	−1.06	0.29	−9.64	2.94
	Anger	−1.05	3.85	88.21	−0.27	0.79	−8.70	6.60
	Sadness	−1.06	3.12	87.15	−0.34	0.74	−7.26	5.14
	Combined	0[b]	–	–	–	–	–	–
Suicide risk	None	4.46	4.84	87.27	0.92	0.36	−5.16	14.08
	Ideators	−0.32	5.55	87.19	−0.06	0.95	−11.36	10.71
	Planners	−1.95	5.78	87.19	−0.34	0.74	−13.43	9.53
	Attemptors	0[b]	–	–	–	–	–	–
Time	Baseline	3.12	0.99	92.25	3.16	0.002	1.16	5.09
	Post–manipulation	0[b]	–	–	–	–	–	–
Random effect	**Parameter**	**Estimate**	**SE**		**Wald Z**	***p***	**95% confidence interval**	
							Lower bound	**Upper bound**
Repeated measures	Time	148.88	19.24		7.75	<0.001	115.58	191.79
		Pain tolerance						
Fixed effects	**Parameter**	**Estimate**	**SE**	**df**	**t**	***p***	**95% confidence interval**	
							Lower bound	**Upper bound**
	Intercept	15.63	12.25	93.66	1.28	0.21	−8.70	39.96
Condition	Control	−1.25	7.72	89.86	−0.16	0.87	−16.58	14.07
	Anger	−5.46	9.41	91.28	−0.58	0.56	−24.14	13.22
	Sadness	−0.66	7.61	89.57	−0.09	0.93	−15.78	14.46
	Combined	0[b]	–	–	–	–	–	–
Suicide risk	None	17.92	11.91	92.59	1.50	0.14	−5.74	41.58
	Ideators	9.87	13.63	91.66	0.72	0.47	−17.20	36.94
	Planners	14.08	14.17	91.57	0.99	0.32	−14.06	42.23
	Attemptors	0[b]	–	–	–	–	–	–
Time	Baseline	9.51	2.21	93.91	4.29	<0.001	5.11	13.90
	Post-manipulation	0[b]	–	–	–	–	–	–
Random effect	**Parameter**	**Estimate**	**SE**		**Wald Z**	***p***	**95% confidence interval**	
							Lower bound	**Upper bound**
Repeated measures	Time	862.08	112.81		7.64	<0.001	667.05	1114.13
		Pain persistence						
Fixed effect	**Parameter**	**Estimate**	**SE**	**df**	**t**	***p***	**95% confidence interval**	
							Lower bound	**Upper bound**
	Intercept	8.31	9.54	34.79	0.87	0.39	−11.06	27.68
Condition	Control	−0.23	5.51	32.37	−0.04	0.97	−11.45	10.99
	Anger	−4.84	6.80	32.86	−0.71	0.48	−18.69	9.00
	Sadness	0.03	5.47	36.11	0.01	1.00	−11.07	11.13
	Combined	0[b]	–	–	–	–	–	–

(Continued)

TABLE 4 | Continued

Fixed effect	Parameter	Estimate	SE	df	t	p	95% confidence interval	
							Lower bound	Upper bound
Suicide risk	None	9.14	9.05	34.24	1.01	0.32	−9.25	27.52
	Ideators	9.43	10.17	34.92	0.93	0.36	−11.23	30.09
	Planners	14.23	10.32	29.89	1.38	0.18	−6.86	35.32
	Attemptors	0[b]	–	–	–	–	–	–
Time	Baseline	4.87	1.90	77.10	2.57	0.01	1.09	8.65
	Post–manipulation	0[b]	–	–	–	–	–	–
Random effect	**Parameter**	**Estimate**	**SE**		**Wald Z**	**p**	**95% confidence interval**	
							Lower bound	**Upper bound**
Repeated measures	Time	346.99	121.27		2.86	0.004	174.91	688.36

[b]*Parameter was set to zero because it is redundant.*

persistence. Similarly, Race was included as a covariate in the primary analyses examining pain persistence.

Subjective Emotional State and Manipulation Check

In the Study 1 sample, we found significant main effects of Time [$F_{(2.05, 208.18)} = 3.547$, $p = 0.030$] on changes in Positive Affect such that there was a significant decrease in positive affect from rumination (M = 1.55, SD = 0.49) to recovery (M = 1.44, SD = 0.47; $p = 0.009$). There were no other significant main or interaction effects on positive affect (all $ps = 0.10 = 0.74$). In terms of Negative Affect, we found a significant main effect of Time [$F_{(2.66, 266.27)} = 7.89$, $p < 0.001$] and a significant 2-way interaction between Time and Suicide Risk [$F_{(7.99, 266.27)} = 2.997$, $p = 0.03$]. Specifically, individuals with no history of suicidal ideation, plans and preparations, and attempts exhibited a significant decrease in negative affect between the emotion induction (M = 1.98, SD = 0.63) and rumination induction task (M = 1.79, SD = 0.58, $p < 0.001$) as well as a significant decrease in negative affect following the rumination induction task at recovery (M = 1.65, SD = 0.53, $p = 0.002$). Participants who have previously made plans and preparations for suicide also exhibited a significant decrease in negative affect between the rumination induction task (M = 1.89, SD = 0.40) and recovery (M = 1.40, SD = 0.26, $p < 0.001$).

In the Study 2 Sample, we found significant main effects of Time [$F_{(2.27, 154.59)} = 7.747$, $p < 0.001$) on Positive Affect such that, compared to baseline (M = 2.62, SD = 0.99), there was a significant decrease in positive affect after the emotion induction (M = 2.10, SD = 0.90, $p = 0.001$) and this decrease was maintained following the rumination induction (M = 2.08, SD = 0.96, $p = 0.008$), and was sustained until the end of the experiment (M = 2.09, SD = 0.98, $p = 0.004$). There were no other main or interaction effects ($ps = 0.152$–0.956). For Negative Affect, we found a significant main effect of Time [$F_{(1.92,130.36)} = 97.209$, $p < 0.001$] and Suicide Risk [$F_{(3, 68)} = 2.67$, $p = 0.05$] but not Condition [$F_{(3, 68)} = 2.404$ $p = 0.08$). There was also a significant 2-way interaction between Time and Condition [$F_{(5.75, 130.36)} = 3.94$, $p = 0.001$). Specifically, compared to the Control condition (M = 1.39, SD = 0.56), the Combined condition had a significantly greater level of negative affect following the emotion induction task (M = 2.46, SD = 0.81, $p = 0.034$). There were no other interaction effects ($ps = 0.40$–0.77).

In both studies, the experimental manipulation procedures did not yield the intended effects. Specifically, the rumination inductions in both studies did not increase the intensity of the emotion generated by the emotion induction procedures. This limitation should be kept in consideration when interpreting the following results.

Changes in Pain Responses[1]

Study 1

Pain Threshold

Detailed information for the fixed and random effects found for pain responses in Study 1 are available in **Table 4**. Examining the model with both main and interaction effects, we found a significant main effect of Time [$F_{(1, 78.67)} = 5.57$, $p = 0.02$] but not Condition [$F_{(3, 80.57)} = 0.32$, $p = 0.81$], or Suicide Risk [$F_{(3, 80.58)} = 0.87$, $p = 0.46$]. There were no significant interaction effects (all $ps > 0.43$). When we removed the interaction terms, given that they did not improve the model, we similarly found a significant main effect of Time [$F_{(1, 92.90)} = 18.45$, $p < 0.001$) but not Condition [$F_{(3, 89.43)} = 0.42$, $p = 0.94$] or Suicide Risk [$F_{(3, 89.57)} = 1.00$, $p = 0.40$]. The results from a pairwise comparisons, using a Bonferroni correction to account for Family-Wise Error, indicated that there was a small but statistically significant decrease in Pain Threshold from Baseline (M = 17.41, SD = 17.47) and Post-Manipulation (M = 13.14, SD = 14.05, $d_{av} = 0.27$, $p < 0.001$, 95% CI = 5.16–14.05; See **Figure 1**).

[1]Including trait-like levels of rumination into the model as a covariate did not change the results.

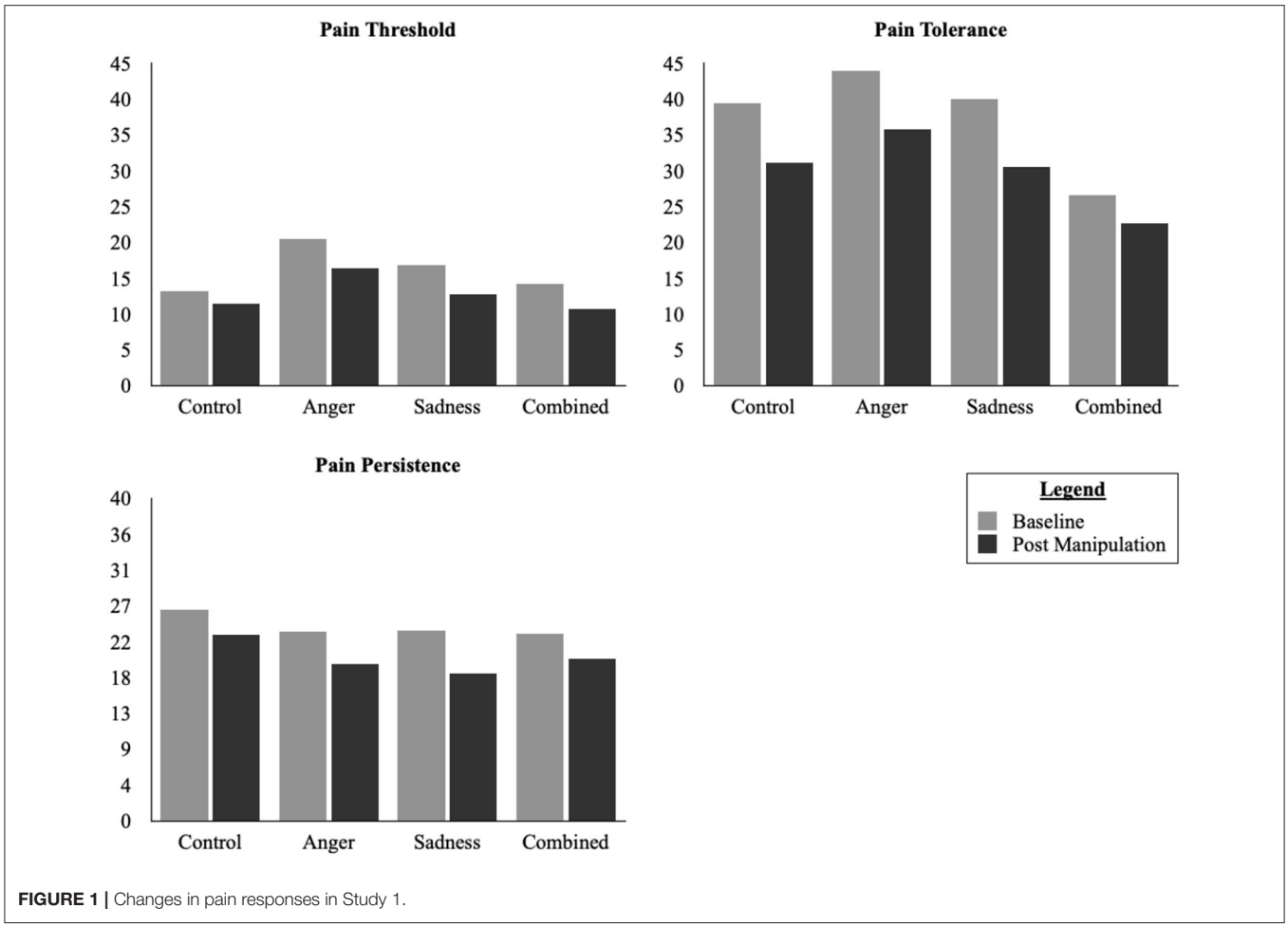

FIGURE 1 | Changes in pain responses in Study 1.

Pain Tolerance

Examining the model with both main and interaction effects, we found a significant main effect of Time [$F_{(1, 79.68)} = 5.62$, $p = 0.020$] but not Condition [$F_{(3, 81.59)} = 0.32$, $p = 0.81$], or Suicide Risk [$F_{(3, 81.60)} = 0.84$, $p = 0.47$]. There were no significant interaction effects (all $ps > 0.93$). When we removed the interaction terms, given that they did not improve the model, we similarly found a significant main effect of Time [$F_{(1, 3.91)} = 18.44$, $p < 0.001$] but not Condition [$F_{(3, 90.44)} = 0.13$, $p = 0.95$] or Suicide Risk [$F_{(3, 90.58)} = 0.98$, $p = 0.41$). The results from a pairwise comparisons, using a Bonferroni correction to account for Family-Wise Error, indicated that there was a small but statistically significant in Pain Tolerance from Baseline (M = 41.11, SD = 30.82) and Post-Manipulation (M = 32.43, SD = 28.44, $d_{av} = 0.29$, $p < 0.001$, 95% CI = 5.11–13.91; See **Figure 1**).

Pain Persistence

Examining the model with both main and interaction effects while controlling for Pain Threshold, we found no significant main effect of Time [$F_{(1, 55.21)} = 1.41$, $p = 0.24$), Condition [$F_{(3, 56.66)} = 0.38$, $p = 0.77$], or Suicide Risk [$F_{(3, 41.38)} = 0.55$, $p = 0.65$]. There were also no significant interaction effects (all $ps > 0.25$). When we removed the interaction terms for the model, however, we found a significant main effect of Time [$F_{(1, 77.10)} = 6.60$, $p = 0.01$] but not Condition [$F_{(3, 32.80)} = 0.23$, $p = 0.88$], or Suicide Risk [$F_{(3, 30.34)} = 0.65$, $p = 0.59$]. The results from a pairwise comparisons, using a Bonferroni correction to account for Family-Wise Error, indicated that there was a small but statistically significant decrease in Pain Persistence from Baseline (M = 24.14, SD = 25.01) and Post-Manipulation (M = 20.76, SD = 22.65, $d_{av} = 0.14$, $p = 0.01$, 95% CI = 1.09–8.65; See **Figure 1**).

Study 2

Pain Threshold

Detailed information for the fixed and random effects found for pain responses in Study 1 are available in **Table 5**. Examining the model with both main and interaction effects, we found no significant main effect of Time [$F_{(1, 49.87)} = 1.95$, $p = 0.17$], Condition [$F_{(3, 51.86)} = 0.66$, $p = 0.58$], or Suicide Risk [$F_{(3, 51.91)} = 0.17$, $p = 0.92$). There were no significant interaction effects (all $ps > 0.59$). When we removed the interaction terms for the model, however, we found a significant main effect of Time [$F_{(1, 63.41)} = 4.02$, $p = 0.05$] but not Condition [$F_{(3, 59.42)} = 0.52$, $p = 0.67$] or Suicide Risk [$F_{(3, 59.75)} = 0.29$, $p = 0.83$]. The results from a pairwise comparisons, using a Bonferroni correction to account for Family-Wise Error, indicated that there

TABLE 5 | Study 2 fixed and random effects for pain responses.

Pain threshold								
Fixed effects	**Parameter**	**Estimate**	**SE**	**df**	**t**	***p***	**95% confidence interval**	
							Lower bound	**Upper bound**
	Intercept	8.85	3.87	61.69	2.29	0.03	1.12	16.59
Condition	Control	−1.28	2.60	60.02	−0.49	0.62	−6.48	3.92
	Anger	−1.51	2.92	59.82	−0.52	0.61	−7.36	4.34
	Sadness	−3.27	2.72	59.69	−1.20	0.24	−8.71	2.18
	Combined	0[b]	–	–	–	–	–	–
Suicide risk	None	2.37	3.56	61.37	0.67	0.51	−4.74	9.49
	Ideators	3.58	3.93	60.68	0.91	0.37	−4.28	11.45
	Planners	2.92	4.95	60.12	0.59	0.56	−6.98	12.82
	Attemptors	0[b]		–	–	–	–	–
Time	Baseline	1.63	0.81	63.41	2.00	0.05	0.00	3.25
	Post-manipulation	0[b]	–	–	–	–	–	–
Random effect	**Parameter**	**Estimate**	**SE**		**Wald Z**	***p***	**95% confidence interval**	
							Lower bound	**Upper bound**
Repeated measures	Time	148.88	19.24		6.40	<0.001	45.13	83.24
Pain tolerance								
Fixed effects	**Parameter**	**Estimate**	**SE**	**df**	**t**	***p***	**95% confidence interval**	
							Lower Bound	**Upper Bound**
	Intercept	36.66	10.77	60.75	3.40	<0.001	15.12	58.21
Condition	Control	−3.92	7.26	59.75	−0.54	0.59	−18.43	10.60
	Anger	−4.63	8.17	59.61	−0.57	0.57	−20.98	11.71
	Sadness	−7.23	7.60	59.53	−0.95	0.35	−22.44	7.99
	Combined	0[b]	–	–	–	–	–	–
Suicide risk	None	−9.15	9.91	60.63	−0.92	0.36	−28.97	10.67
	Ideators	−4.31	10.97	60.18	−0.39	0.70	−26.26	17.64
	Planners	5.66	13.82	59.80	0.41	0.68	−21.98	33.31
	Attemptors	0[b]	–	–	–	–	–	–
Time	Baseline	6.95	1.74	62.96	4.00	<0.001	<0.001	10.42
	Post-manipulation	0[b]	–	–	–	–	–	–
Random effect	**Parameter**	**Estimate**	**SE**		**Wald Z**	***p***	**95% confidence interval**	
							Lower bound	**Upper bound**
Repeated measures	Time	446.08	73.94		6.03	<0.001	322.35	617.31
Pain persistence								
Fixed effects	**Parameter**	**Estimate**	**SE**	**df**	**t**	***p***	**95% confidence interval**	
							Lower bound	**Upper bound**
	Intercept	29.27	7.72	42.51	3.79	<0.001	13.69	44.85
Condition	Control	−1.95	5.35	53.01	−0.36	0.72	−12.68	8.78
	Anger	−1.80	5.96	49.42	−0.30	0.76	−13.78	10.17
	Sadness	−3.69	5.54	48.89	−0.67	0.51	−14.82	7.45
	Combined	0*b*	0[b]	–	–	–	–	–

(Continued)

TABLE 5 | Continued

Fixed effects	Parameter	Estimate	SE	df	t	*p*	95% confidence interval	
							Lower bound	Upper bound
Suicide risk	None	−14.40	7.08	41.81	−2.03	0.05	−28.70	−0.11
	Ideators	−9.54	7.84	41.40	−1.22	0.23	25.37	6.30
	Planners	0.35	9.92	44.74	0.04	0.97	−19.64	20.34
	Attemptors	0[b]	0[b]	–	–	–	–	–
Time	Baseline	5.47	1.63	55.93	3.35	=0.001	2.20	8.75
	Post-manipulation	0[b]	0[b]	–	–	–	–	–
Random effect	**Parameter**	**Estimate**	**SE**		**Wald Z**	***p***	**95% confidence interval**	
							Lower Bound	**Upper Bound**
Repeated measures	Time	231.14	50.72		4.56	<0.001	150.35	355.33

[b]*Parameter was set to zero because it is redundant.*

was a small but statistically significant decrease in Pain Threshold from Baseline (M = 11.45, SD = 7.94) and Post-Manipulation (M = 9.74, SD = 7.47, $d_{av} = 0.22$, $p = 0.05$, 95% CI = 0.01–3.25; See **Figure 2**).

Pain Tolerance

Examining the model with both main and interaction effects, we found a significant main effect of Time [$F_{(1, 49.56)} = 9.39$, $p = 0.004$] but not Condition [$F_{(3, 52)} = 0.91$, $p = 0.44$], or Suicide Risk [$F_{(3,52.03)} = 0.34$, $p = 0.80$). There were no significant interaction effects (all *ps* > 0.10). When we removed the interaction terms we similarly found a significant main effect of Time [$F_{(1, 62.96)} = 15.99$, $p < 0.001$] but not Condition [$F_{(3, 59.35)} = 0.30$, $p = 0.82$] or Suicide Risk [$F_{(3, 59.57)} = 0.96$, $p = 0.42$]. The results from a pairwise comparisons, using a Bonferroni correction to account for Family-Wise Error, indicated that there was a small but statistically significant decrease in Pain Tolerance from Baseline (M = 33.02, SD = 22.93) and Post-Manipulation (M = 26.14, SD = 18.80, $d_{av} = 0.33$, $p < 0.001$, 95% CI = 3.48–10.42; See **Figure 2**).

Pain Persistence

Examining the model with both main and interaction effects while controlling for Pain Threshold, we found a significant main effect of Time [$F_{(1, 43.42)} = 7.62$, $p = 0.008$] but not Condition [$F_{(3, 34.61)} = 0.89$, $p = 0.46$] or Suicide Risk [$F_{(3, 33.60)} = 1.28$, $p = 0.30$]. There were also no significant interaction effects (all *ps* > 0.10). When we removed the interaction terms for the model we similarly found a significant main effect of Time [$F_{(1, 55.93)} = 11.24$, $p = 0.001$] but not Condition [$F_{(3, 46.87)} = 0.15$, $p = 0.93$], or Suicide Risk [$F_{(3, 45.61)} = 2.54$, $p = 0.07$]. The results from a pairwise comparisons, using a Bonferroni correction to account for Family-Wise Error, indicated that there was a small but statistically significant decrease in Pain Persistence from Baseline (M = 21.83, SD = 18.64) and Post-Manipulation (M = 16.77, SD = 14.29, $d_{av} = 0.31$, $p = 0.001$, 95% CI = 2.20–8.75; See **Figure 2**).

Indirect Effects Analysis

In Study 2, we then examined the role of arousal, measured by average Heart Rate (HR) on the relationship between Condition and changes in Suicide Capability. Using Model 4 in PROCESS (Hayes, 2013) with 10,000 bootstrapped samples, we found a significant direct effect of condition [$F_{(3, 52)} = 3.09$, $R^2 = 0.15$, $p = 0.04$] on change in HR from the first cold pressor task to the second cold pressor task. Specifically, the Combined condition (B = 5.27, SE = 2.59, $p = 0.05$) but not the Anger Only or Sadness Only conditions (all *ps* > 0.19) demonstrated a significantly greater change in heart rate between the first and second cold pressor task compared to the Control condition. There were, however no significant direct effects of Condition or Heart Rate on changes in pain threshold [$F_{(4, 51)} = 2.32$, $p = 0.07$], pain tolerance [$F_{(4, 51)} = 1.62$, $p = 0.18$], and pain persistence [$F_{(4, 51)} = 0.72$, $p = 0.58$]. Although these models were not significant, we did notice a significant relative direct effect of Condition on pain threshold in the Sadness Only condition (B-6.35, SE = 2.22, $p = 0.006$). Unsurprisingly, 95% Confidence Intervals did not indicate the presence of significant indirect effects of Condition on changes in pain threshold, pain tolerance, and pain persistence through changes in heart rate. In regards to fearlessness of death, we found no significant direct effect between Condition and Changes in Heart Rate [$F_{(3, 68)} = 2.24$, $R^2 = 0.09$, $p = 0.09$]. We also found no significant direct effect between Condition or Heart Rate on changes in fearlessness of death [$F_{(4, 67)} = 1.70$, $R^2 = 0.09$, $p = 0.16$] but we did notice a significant relative direct effect of Condition on changes in fearlessness of death in the Combined condition only (B = 2.34, SE = 0.94, $p = 0.02$). There was no significant indirect effects of Condition on changes fearlessness of death through changes in heart rate.

When we compared the difference of change in HR from baseline to the first cold pressor task and baseline to the second cold pressor task, we found a significant direct effect of Condition [$F_{(3, 52)} = 3.09$, $R^2 = 0.15$, $p = 0.04$]. Specifically, compared to the Control condition, the Combined condition (B = 5.27, SE = 2.59, $p = 0.05$) but not the Anger Only or Sadness Only conditions (all *ps* > 0.19) demonstrated a significant difference between change

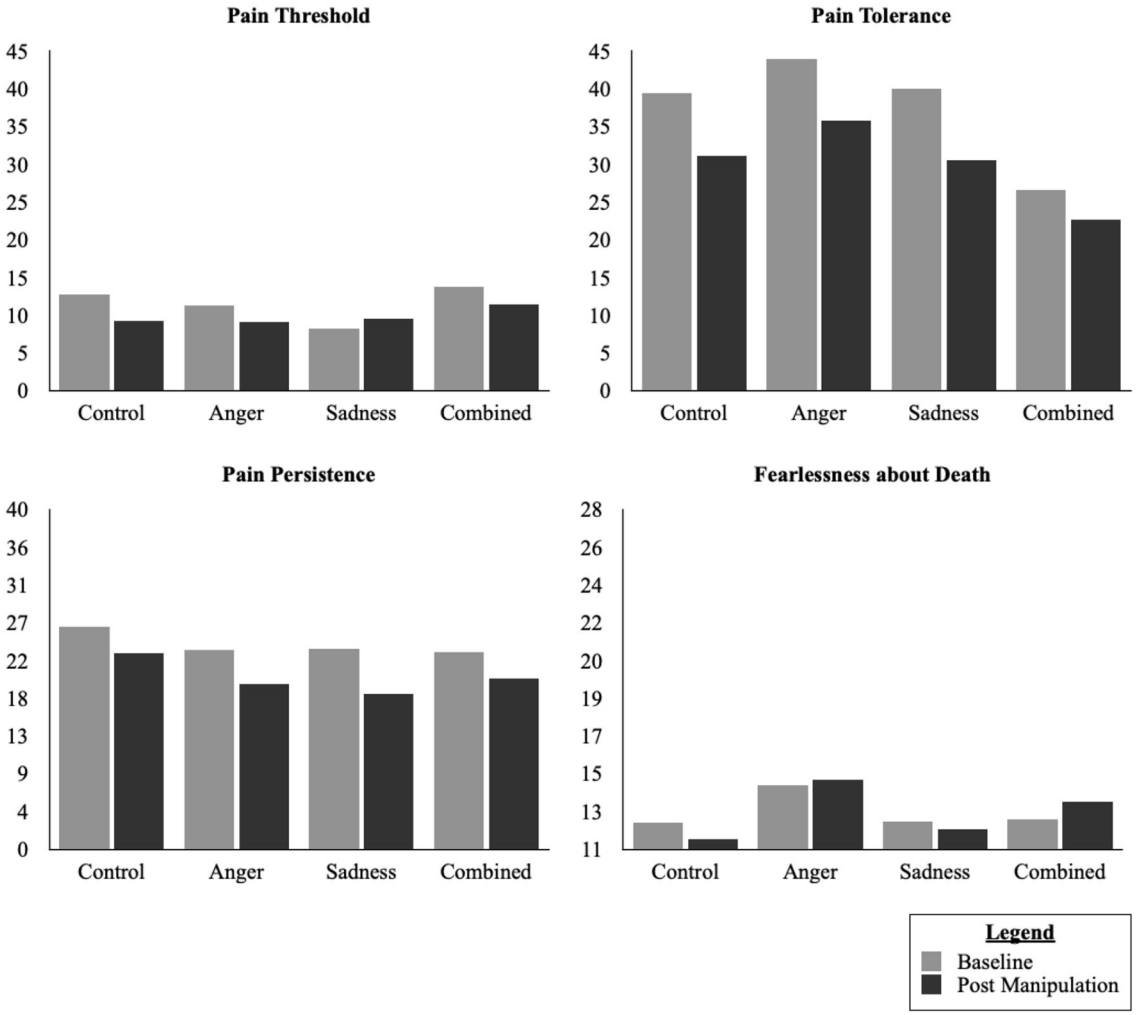

FIGURE 2 | Changes in pain responses and fearlessness of death in Study 2.

in HR from baseline to the first cold pressor task and baseline to the second cold pressor task. This difference in HR did not have any direct effects on pain threshold [$F_{(4, 51)} = 2.32$, $R^2 = 0.15$ $p = 0.07$], pain tolerance [$F_{(4, 51)} = 1.62$, $R^2 = 0.11$ $p = 0.18$], or pain persistence [$F_{(4, 51)} = 0.72$, $R^2 = 0.05$, $p = 0.58$]. We did, however, observe a significant relative direct effect of Condition on changes in pain threshold in the Sadness Only Condition (B = 6.35, SE = 2.22, $p = 0.006$). There were no significant indirect effects of Condition on changes fearlessness of death through changes in heart rate (all ps > 0.09).

DISCUSSION

This study sought to experimentally test the differential effects of laboratory-induced rumination in the context of anger vs. sadness on changes in suicide capability. Furthermore, suicide risk was examined as a potential factor moderating the aforementioned relationships. Contrary to our hypotheses, we observed small decreases in all three pain variables following the experimental manipulations. These changes, however, did not appear to be related to rumination type or suicide risk. There are several possible explanations for these findings. First, past studies have suggested that individuals may be willing to persist through pain in service of achieving a desired goal (e.g., emotional relief or suicide; Anestis et al., 2012). In this study, however, participants received no incentive for persisting through both cold pressor tasks and thus participants may have been inadvertently motivated to end the cold pressor task early such that they can flee the negative affect generated from the emotion and rumination inductions. That being said, providing an incentive for participants to persist through a cold pressor or other pain tolerance task may enhance its accuracy as a proxy for measuring pain persistence and tolerance in the context of self-injurious and suicidal behavior.

Second, these findings appear to be consistent with findings from past studies that suggest individuals with a low baseline capability may react differently to emotional experiences

compared to those with a high baseline capability (Ribeiro et al., 2014a; Law et al., 2015). Specifically, individuals who have a high baseline capability or regularly engages in non-suicidal self-injury may be more willing to tolerate and persist through pain and distress while their counterparts with low baseline capability may be more inclined to engage in behaviors that allows them to escape from pain and distress. We also found no significant differences in how suicide capability changed when comparing individuals who were asked to ruminate on high arousal emotions to those who were asked to ruminate on low arousal emotions. Although this may be attributable rumination induction's failure to amplify the emotions generated in the emotion induction. As previously mentioned, the experimental manipulation procedures did not yield the intended effects. Specifically, based on current theories and past studies, it was expected that rumination would increase the intensity of the emotion generated by the emotion induction procedures. In this study, however, the rumination induction failed to amplify the emotions and instead decreased negative affect and instead the greatest level of negative affect was found after the emotion induction and its intensity decreased following the rumination induction procedure. Both the emotion induction and rumination induction protocols, however, were selected due to their ability in past studies to elicit the expected emotional effects when compared to control and alternative conditions (Pitman et al., 1987; Rusting and Nolen-Hoeksema, 1998). Unfortunately, past studies using this combination of emotion and rumination induction procedures did not assess for changes in emotion between the two induction procedures (Law and Chapman, 2015). In this study, the addition of a measure of subjective emotional state between the two tasks may have decreased the effect of the combined emotion and rumination inductions. As such the anger and sadness rumination induced in our laboratory did not mimic past studies that have demonstrated success in using the combination of the emotion and rumination induction protocols and may not be the same as anger and sadness rumination as it occurs in a natural setting. Moreover, the experience of negative emotions may be characterized by mixed emotions. Asking participants to ruminate upon anger without sadness and sadness without anger may have resulted in a less ecologically valid representation of rumination in negative emotional experiences. Another potential factor that may have contributed to this decrease in negative emotions in between the two experimental manipulations may be the presentation of the emotion and rumination induction procedures. The emotion induction was personalized and presented with audio instructions while the rumination induction was generic and only presented as a series of slides that participants were asked to read. This difference may have impacted the participants' level of immersion in the task. It may be beneficial for future studies to consider presenting both emotion and rumination inductions using an audio format or combining the emotion and rumination induction tasks by injecting prompts for ruminative thinking into the participant's personalized scripts.

We also did not find a significant effect of suicide risk on changes in suicide capability following the experimental manipulations. When we examined the role of arousal, measured by average HR on changes in suicide capability, we found that rumination in the context of anger and sadness combined led to greater changes in HR between the first and second cold pressor task. These changes, however, did not translate into changes in suicide capability as measured by pain threshold, pain tolerance, pain persistence, and fearlessness about death. Given that a small proportion of participants in both studies reported a history of suicide attempts and/or ideation, the ability to detect the potential moderating role of suicide risk on rumination and pain experiences may have been obstructed. Accordingly, it would be important to replicate this study in a clinically relevant sample to better understand the how rumination may impact state changes in pain experiences in individuals high at risk for suicide. Suicide risk in this study was also determined solely on the presence of suicidal ideation and did not take into account other known indicators of elevated suicide risk such as tendency to cope using painful and provocative behaviors such as NSSI, the quality of an individual's suicidal ideation, the availability of a plan and means for suicide, and past history of suicide attempts (Chu et al., 2015). As such, future studies would benefit from using a more systematic assessment of suicide risk that takes into account other empirically determined factors contributing to an elevated risk for suicide.

There are several other limitations that warrant caution in the interpretation and generalization of these findings. Given that our results did not support our hypotheses, the models that were specified may not have been correct. The specific act of ruminating on an emotion may not be a factor that meaningfully contributes to changes in pain experiences. Rather, it may be the emotional experience, and its intensity, that drives the mechanisms leading to changes in the ability to tolerate pain (Carter et al., 2002). Rumination is also a coping method often used as a means to avoid the direct experience of emotions (Nolen-Hoeksema et al., 2008). Thus, the rumination induction may have provided participants with the opportunity to avoid experiencing the emotion generated in the emotion induction. Alternatively, perhaps the secondary emotions and behaviors born out of rumination such as self-blame or shame (Law and Chapman, 2015) are more salient than rumination at influencing changes in pain threshold, tolerance, and persistence. Additionally, we were also unable to measure changes in fearlessness of death given that the ACSS-FAD demonstrated poor internal consistency across all time points. It is possible that physical aspects of suicide capability (e.g., pain responses) are more stable while affective aspects of suicide capability (e.g., fearlessness) are more dynamic. Unfortunately, we were unable to determine if this is indeed the case. As such, future studies that wish to test for changes in fearlessness about death may want to consider using self-report or behavioral measures other than the ACSS-FAD. Finally, the study was lacking in diversity given that participants for both studies were largely white, heterosexual, cisgender females. Therefore, replication of this study in diverse samples will be needed to determine if our findings are generalizable.

Overall, this study represents a novel contribution to existing research on rumination and suicide risk by examining potential

mechanisms by which rumination can facilitate the transition of suicidal ideation to the act of making a suicide attempt. Although the hypotheses of this study were largely unsupported, these findings offer an alternate way of conceptualizing pain experiences as being malleable and not simply stable traits. Ultimately, these findings serve as a conceptual and methodological springboard for additional research to examine possible factors that may contribute to acute changes in suicide capability that may enable an individual to engage in suicidal behavior. By understanding how cognitive and emotional factors interface with the capability for suicide, we may be able to generate the information and knowledge required to develop or refine existing interventions that can effectively reduce suicide risk by decreasing an individual's ability to make a lethal suicide attempt.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found at: https://osf.io/8fyaj/?view_only=958c9630240f4d1588f551cd7875e41d.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Institutional Review Board at The University of Southern Mississippi where the project was conducted as part of the first author's master's thesis and doctoral dissertation. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

KL designed, coordinated, conducted both studies under the supervision, cleaned and analyzed the data, wrote the manuscript, and prepared the tables and figures. MA provided supervision on consultation on the project which was conducted as part of the KL's master's thesis and doctoral dissertation and provided critical review of the manuscript. All authors contributed to the article and approved the submitted version.

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