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ORIGINAL ARTICLE

Reappraisal and Suppression Each Moderate the Association Between Stress and Suicidal Ideation: Preliminary Evidence From a Daily Diary Study

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Abstract

Background Stressful life events are a common antecedent of suicidal thoughts. However, not all stressful events lead to increased suicidal thinking, even among those who frequently have suicidal thoughts. In this study, we examined whether the ways that individuals regulate their emotions moderates the association between stressful events and suicidal thinking. Building on prior research we hypothesized that cognitive reappraisal is associated with a weaker relationship between stress and same-day suicidal thoughts, and that expressive suppression is associated with a stronger relationship between stress and suicidal thoughts.

Method We used a daily diary method to collect self-reports of stressful events and suicidal thoughts over a 28-day period. At baseline, we assessed participants' tendency to use cognitive reappraisal and expressive suppression.

Results Consistent with our first hypothesis, we found that at higher levels of reappraisal, there was a weaker relationship between stress and suicidal thoughts. Contrary to our second hypothesis, we found that at higher levels of expressive suppression there was also a weaker relationship between stress and suicidal thoughts.

Conclusions In contrast to laboratory-based findings suggesting that expressive suppression has negative psychological effects, these preliminary daily diary results suggest that expressive suppression could be an effective short-term emotion regulation strategy among individuals considering suicide.

Keywords Suicide · Emotion regulation · Stress · Daily diary

Introduction

Suicide, the 10th leading cause of death among Americans, is a major public health concern (CDC 2018). Suicidal ideation, or thoughts about one's own death, is one of the most potent risk factors for attempted suicide (Franklin et al. 2017). Understanding the conditions under which suicidal ideation occurs is therefore an imperative step for understanding how to help prevent individuals from taking their own lives. The experience of stressful events is a common precipitant of a range of suicidal thoughts and behaviors (STBs; Liu and Miller 2014). However, the field currently lacks a nuanced understanding of the link between stressful events and suicidal ideation. Specifically, we know that experiencing stressful events will not lead to STBs under all circumstances, even among those who frequently have suicidal thoughts, but we have little understanding of the circumstances or contexts that may moderate the link between stress and STBs. In the current investigation, we employed a daily diary method to focus on the moderating role of different emotion regulation strategies in the relationship between stress and suicidal ideation.

A large body of research links stressful life events to suicidal ideation. Both social (e.g., divorce, interpersonal conflict, peer victimization) and non-social (e.g., financial strain, work/school performance, health concerns) stressful events are associated with STBs (Ang and Huan 2006; Cole et al. 2015; Horwitz et al. 2011; Schatten et al. 2015; Wilburn and Smith 2005). Some of the most well-cited theories of STBs suggest that emotional distress resulting from

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these types of stressful events is a proximal causal factor in STBs (Baumeister 1990; Shneidman 1993). Whereas the experience of stressful events and the resulting emotional distress is ubiquitous among human beings, fewer than 10% of adults have seriously considered suicide at some point in their lives, and even fewer have acted on these thoughts (Nock et al. 2008). Thus, the association between stressful life events and STBs likely depends on a range of other moderating factors (Cha and Nock 2009). A central tenet of each of the theories mentioned above is that an inability to effectively modulate emotional reactions to stressful events may be a critical link between such events and STBs. We therefore hypothesized that stressful events may be particularly likely to lead to suicidal thinking when someone has difficulty regulating the emotional distress that is associated with stressful events.

Emotion regulation refers to the process of altering the experience or expression of emotions in order to achieve a goal (Gross 1998; McRae and Gross 2020). Emotion regulation has been shown to be important for reducing the deleterious effects of stressors in support of social functioning (English et al. 2012), life satisfaction (Cohn et al. 2009) and physical health (Song et al. 2013). Conversely, difficulties with emotion regulation have been implicated in numerous clinical syndromes, including STBs (Aldao et al. 2010; Rajappa et al. 2012) and is often a key target for clinical intervention. Although innumerable emotion regulation strategies exist, two of the most commonly studied strategies are cognitive reappraisal and expressive suppression.

Cognitive reappraisal involves altering the emotional impact of an event by thinking about that event in a different way (Gross 1998; Gross and John 2003). For example, if a student receives a "C" on a test, she can reappraise the event by considering that it is merely the first test of the semester and there will more opportunities to improve the grade. In response to aversive events, cognitive reappraisal is shown to decrease subjective ratings of negative emotions and alter the neurobiological correlates of negative emotion (Buhle et al. 2014; Davis et al. 2011; Gross 1998; Gross and John 2003; McRae et al. 2010; Silvers et al. 2017). Perhaps most relevant to this study, the tendency to use cognitive reappraisal in response to distressing emotions is associated with reduced suicidal ideation (Forkmann et al. 2014; Ghorbani et al. 2017; Ong and Thompson 2019).

Expressive suppression involves limiting outward expressions of emotion after the emotion has already generated a response (i.e., behavioral, psychological, or physiological) within the individual (Gross 1998; Gross and John 2003). Extending the example used above, this student might suppress her feelings by forcing herself not to frown or cry. Numerous cross-sectional and laboratory-based studies have shown that expressive suppression is associated with increased sympathetic nervous system activation (Gross and Levenson 1993, 1997; Roos et al. 2018), increased rumination (Liverant et al. 2011; Zawadzki 2015), and more severe symptoms of depression (Mohiyeddini et al. 2014) and anxiety (Zawadzki 2015). Expressive suppression is thus generally considered a less effective emotion regulation strategy than cognitive reappraisal (Gross and John 2003), though the association between expressive suppression and STBs is unclear. Multiple studies show that engaging in expressive suppression is associated with increased suicidal thinking (Forkmann et al. 2014; Ghorbani et al. 2017), although results are mixed (Ong and Thompson 2019).

A limitation of many of the studies discussed above is their cross-sectional design, which fails to capture within-person day-to-day fluctuations in constructs of interest. Our field has recently begun to recognize that suicidal thoughts can be fleeting, varying in presence and intensity throughout even a single day (Kleiman et al. 2017; Nock et al. 2009). Similarly, other impactful life events including stressors, are shown to be daily-level processes (Chaudhury et al. 2017; Troy et al. 2019). Capturing this type of ideographic variability using experience sampling methods (e.g., daily diary, ecological momentary assessment) is critical for better understanding suicide risk broadly and for understanding the complex relationships between key risk factors, such as stressful life events, and suicide.

Generally speaking, daily diary studies (i.e., studies which assess factors on a daily level) accord with those using cross-sectional methods to suggest that the experience of stress predicts same-day STBs (Kleiman et al. 2018). Similarly, studies using experience sampling methods have shown that emotion regulation is important for reducing the intensity of emotional reactions following stressors (Chaudhury et al. 2017). However, no study to our knowledge has examined whether habitual use cognitive reappraisal and expressive suppression might protect against the onset of suicidal thoughts following stress among those at risk for STBs. In the present study, we sought to address this critical gap in the literature.

Aims and Hypotheses

Our primary aim in this study was to identify whether habitual use of cognitive reappraisal and expressive suppression differentially moderate the degree to which stressful experiences in daily life are associated with STBs. Previous research has demonstrated that cognitive reappraisal may protect against the effects of acute stressful experience (Brans et al. 2013; Mauersberger et al. 2018; Troy et al. 2019). Accordingly, we predicted that the use of cognitive reappraisal would moderate the association between stressful events and same-day suicidal ideation such that among those who tend to use cognitive reappraisal more, stressful events

would be less likely to lead to suicidal thinking. We were less certain about the moderating role of expressive suppression, but due to many prior studies reporting negative consequences of using expressive suppression, we hypothesized that the tendency to use this strategy would be associated with an increased association between stress and suicidal ideation.

Method

Participants

Participants were 46 adults who had attempted suicide at least once in the past year and were drawn from a study assessing the daily factors that influence suicidal thinking. The average age was 23.40 years (SD = 4.36 years, range 18.11–38.76 years). The sample was 78.2% female, 15.3% male, and the remainder were another gender or did not wish to disclose their gender.

Procedure

Participants in the present study were recruited from online forums related to suicide. They were asked to complete a set of baseline measures on a secure website and then complete 28 days of smartphone-based monitoring using mEMA (https://ilumivu.com/). During the 28-day monitoring period, participants completed a brief daily diary survey at the end of the day assessing daily life events, mood, and suicidal thinking. Participants also completed real-time monitoring throughout the day. However, given that we were interested in data only available in the daily diary portion, we did not use any of these data for this report. For more sample and procedure information see Kleiman et al. (2017).

Measures

Emotion Regulation

At baseline, participants completed the emotion regulation questionnaire (ERQ; Gross and John 2003), a 10-item measure of individuals' tendency to regulate emotions using reappraisal and suppression. Six items assess reappraisal and four items assess suppression. Reliability for both reappraisal and suppression were acceptable ($\omega = 0.88, 0.86$, respectively).

Daily Stressful Events

Each night, participants were presented a list of 18 types of life events and were asked to select which events happened during the day. The second and third authors generated this list of life events, which they expected would be relevant for a sample of suicidal adults based on prior work (Bagge et al. 2013). This list contained events that were both interpersonal (e.g., "argument with significant other") and non-interpersonal (e.g., "unexpected expense or other money problem") in nature. We summed these items to create a daily negative events score.

Daily Suicidal Thinking

Each night, participants answered three questions on a three-point scale, based on the Beck Suicide Scale (Beck and Steer 1991) assessing: (1) wish to live, (2) wish to die, (3) desire to kill oneself. We summed these items to create a daily composite suicidal thinking score. The reliability of the daily suicidal thinking ratings ($\lambda = 0.13$) was appropriate for state-like measures (Nezlek 2017).

Analytic Strategy

We conducted two multi-level models using the *lme4* R package (Bates et al. 2015). Each model contained the main effect of the relevant ERQ subscale (reappraisal in one model, suppression in the other) as a level-2 (i.e., participant level) variable, the main effect of daily stressful events as a level-1 (i.e., day level) variable, and the cross-level interaction between the two. The outcome variable in each model was daily suicidal thinking (as a level 1 variable). All level-1variables were participant-mean centered using the *EMAtools* package (Kleiman 2017). All level-2 variables were grand-mean centered. We further explored any significant interaction first by plotting it and then by probing the simple slopes, by using the *reghelper* package (Hughes 2020). Post-hoc statistical power for each of the two cross-level interaction models was calculated using the Multilevel (ML) Power Tool syntax implemented in R (Mathieu et al. 2012). Due in part to the relatively small level-2 sample size, power was low in the interaction models tested for reappraisal ($1 - \beta = 0.091$) and suppression ($1 - \beta = 0.051$).

Results

Participants completed a total of 924 days of data (M = 20.08 days/person, SD = 13.70). Results of the multi-level models testing the association among daily suicidal

thinking and the interactions between (1) reappraisal and daily stress and (2) suppression and daily stress are presented in Table 1.

In the model testing cognitive reappraisal, as can be seen in the leftmost columns in Table 1, daily stress had a significant positive main effect on suicidal thoughts, whereas trait cognitive reappraisal did not. There was a significant interaction between stress and cognitive reappraisal, which is plotted in the left panel of Fig. 1. Consistent with our hypothesis, simple slopes analyses showed that the association between daily stressful events and daily suicidal thinking was stronger among those who reported lower (− 1SD, $b = 0.45$, $t = 8.44$, $p < 0.001$) and average ($b = 0.31$, $t = 9.25$, $p < 0.001$) levels of cognitive reappraisal relative to those who reported higher levels of cognitive reappraisal (+ 1SD, $b = 0.17$, $t = 3.88$, $p < 0.001$).

In the model testing expressive suppression, as can be seen in the rightmost columns in Table 1, daily stress had a significant positive main effect on suicidal thoughts, whereas trait expressive suppression did not. There was a significant interaction between stress and suppression, which is plotted in the right panel of Fig. 1. Simple slopes analyses showed that the association between daily stressful events and daily suicidal thinking was stronger among those who reported lower (− 1SD, $b = 0.36$, $t = 7.63$, $p < 0.001$) and average ($b = 0.28$, $t = 8.42$, $p < 0.001$) levels of expressive suppression relative to those who reported higher levels of expressive suppression (+ 1SD, $b = 0.20$, $t = 3.94$, $p < 0.001$).

Table 1 Results of multilevel analyses testing the interactions between daily stressful events and reappraisal/suppression and daily suicidal thinking

	Reappraisal			Suppression		
	B	95% CI	*p*	*B*	95% CI	*p*
Intercept	0.00	− 0.08 to 0.08	0.986	0.00	− 0.08 to 0.08	0.987
ERQ subscale	− 0.00	− 0.07 to 0.07	0.972	− 0.00	− 0.06 to 0.06	0.990
Daily stressful events	0.33	0.26 to 0.40	< 0.001	0.29	0.22 to 0.35	< 0.001
ERQ subscale × stressful events	− 0.12	− 0.17 to − 0.06	< 0.001	− 0.06	− 0.11 to − 0.01	0.028

Pseudo-R^2 for reappraisal model = 0.094, pseudo-R^2 for suppression model = 0.080; within-person residual variance for reappraisal model (σ^2) = 1.603, σ^2 for suppression model = 1.626

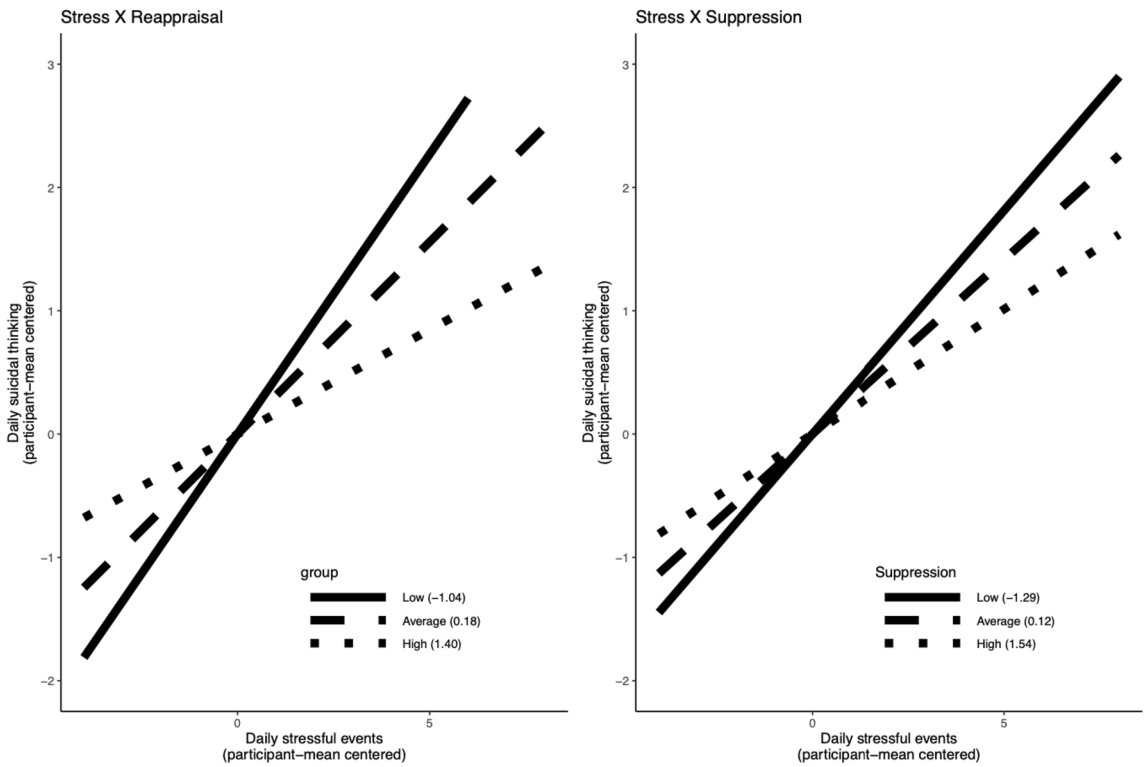

Fig. 1 Plots of the interactions between daily stressful events and reappraisal/suppression and daily suicidal thinking

Discussion

The primary goals of this study were to investigate whether the use of cognitive reappraisal and expressive suppression might differentially moderate the degree to which the experience of stressful events are associated with same-day suicidal ideation. As hypothesized, our results suggest that increased habitual use of cognitive reappraisal was associated with a weaker association between stressful events and same-day suicidal ideation. Contrary to our hypothesis, we also found that habitual use of expressive suppression was associated with a weaker relationship between stressful events and same-day suicidal ideation.

Our results are consistent with a range of studies suggesting that cognitive reappraisal may help reduce the impact of stressful events on emotional wellbeing (Aldao et al. 2010; Troy et al. 2010). Therapeutic approaches aimed at helping individuals manage emotional distress often rely on the use of cognitive reappraisal because of its demonstrated value for reducing emotional arousal following aversive events (Troy et al. 2019). Our results add to a growing body of literature indicating that cognitive reappraisal may be useful for reducing suicidal ideation. Specifically, our results provide evidence for the effectiveness of habitual use of cognitive reappraisal for managing the negative effects of daily stressors among those who experience thoughts of killing themselves. Clinicians seeking to help those who struggle with suicidal thinking, especially among patients who experience frequent stressful events, should consider empirically-supported therapies that include cognitive reappraisal (Smits et al. 2012).

In the present study we also found that higher levels of habitual expressive suppression predicted a weaker association between stressful events and suicidal ideation. This result highlights that although expressive suppression may be an ineffective emotion regulation strategy in the long run, it could be effective for reducing negative emotions over shorter temporal intervals (i.e., days), though more research is needed given the limitations discussed below. Despite previous findings indicating that habitual use of expressive suppression is linked with poor mental health outcomes including STBs, expressive suppression likely provides some reinforcing benefit, as it is commonly used as a means of regulating emotions. In fact, multiple studies have shown that expressive suppression is often used more frequently than reappraisal in daily life (Brans et al. 2013; Troy et al. 2019). Furthermore, experimental evidence indicates that expressive suppression may be used because it is effective for reducing the intensity of negative emotions in certain contexts. For example, expressive suppression has been shown to ameliorate acute negative emotional responses to aversive laboratory stimuli for those with symptoms of depression and among older adults (Liverant et al. 2008; Livingstone and Isaacowitz 2018). Our results substantiate previous evidence indicating that cognitive reappraisal is an effective short-term emotion regulation strategy, but also provide preliminary evidence that expressive suppression may exert an important buffering effect against the occurrence of suicidal thoughts following stressful events.

The debate about the effectiveness of expressive suppression is ongoing, and contrary to our findings, much prior work has indicated that the use of expressive suppression is associated with negative mental health outcomes, including suicidal ideation (Forkmann et al. 2014; Ghorbani et al. 2017). Our results add evidence to this debate and suggest the possibility that expressive suppression could be a helpful strategy for reducing risk for suicidal ideation after stressful events, but should be interpreted in the context of several critical limitations discussed in the following section.

Limitations

First, our analyses were underpowered to detect the small cross-level interaction effects we found. We therefore consider these results to be preliminary, especially with respect to expressive suppression. Future research should seek to replicate these results in a larger sample.

Second, we utilized a self-reported trait measure of the use of emotion regulation strategies, assessed at baseline only. Thus, we do not have data indicating whether individuals actually (a) are proficient at using each strategy and (b) used either strategy to reduce the emotional impact of stressful events. Our intent in using a trait measure of emotion regulation was to provide a proxy for daily use of these strategies. However, measurement of these strategies at baseline only provided an indirect test of our study's hypotheses. It is possible that in response to daily stressors during the study period, participants utilized a number of other strategies instead of or in addition to cognitive reappraisal and expressive suppression. Similarly, it is also possible that positive events, which were not measured, could have provided a buffer against the negative impacts of stressors, independent of the use of emotion regulation strategies. Our results should therefore be interpreted in light of this limitation. Future research can address this limitation by asking participants to report on their use of these strategies at each assessment point, as well as by including assessments of other emotion regulation strategies and positive events.

Third, our conceptual model that motivated this study proposed that emotion regulation strategy use following a stressor would help reduce the likelihood of experiencing suicidal thoughts. The temporal sequence of this conceptual model violates the standards of moderation set forth by the now well-accepted MacArthur approach, which specifies

that a moderator must precede the independent variable in time (Chmura Kraemer et al. 2008). Our use of a trait measure of emotion regulation measured at baseline, however, provided an index of emotion regulation tendencies that satisfies the MacArthur standard in practice. Nonetheless, future research motivated by this study would benefit from greater specificity of hypothesized effects, as well as carefully selected statistical models to test these effects as directly as possible, a concept that has recently been discussed with respect to suicide research (Millner et al. 2020).

Fourth, our 28-day data collection period precluded our ability to consider the longer-term impact of cognitive reappraisal and expressive suppression. We anticipate based on previous findings that habitual cognitive reappraisal use would exert the same moderating influence on the association between stressful events and same-day suicidal ideation. However, it is plausible that in the long-run, habitual expressive suppression may not be as helpful, and may even exacerbate the negative impacts of stressful events (Nezlek and Kuppens 2008). Future research can address this possibility by including follow-up assessments beyond a month of data collection.

Future Directions

Difficulty regulating emotions is a well-established risk factor for suicidal thoughts and behaviors (Franklin et al. 2017). Individuals with STBs are demonstrated to experience more intense negative emotions (Polanco-Roman et al. 2018) and also to act more impulsively while experiencing negative motions (Anestis and Joiner 2011). Furthermore, some evidence suggests that urges to act on suicidal thoughts could be especially high while experiencing intense negative emotions (Ammerman et al. 2015). A potential avenue for future research is to investigate whether use of expressive suppression could help individuals at risk for STBs resist self-injurious urges by tempering acute emotional distress. Such a result would help clarify the utility of using expressive suppression in moments of high vulnerability to suicidal behavior, given that our preliminary results suggest that habitual expressive suppression could be effective for helping suicidal individuals manage acute stressors.

Conclusions

This study provides evidence that higher habitual use of cognitive reappraisal and expressive suppression are each associated with a weaker association between the experience of stress and same-day suicidal ideation. These results are particularly noteworthy for expressive suppression, which has generally been considered an ineffective emotion regulation strategy by previous cross-sectional studies. Our results provide evidence that in the short term both strategies could be effective for reducing the negative emotional effects of stressors. However, due to low statistical power and the fact that our study measured use of both emotion regulation strategies at the trait level, these results should be considered preliminary. We encourage future research to address the limitations discussed above with special considerations for the specific strategies that individuals choose to use during or immediately following stressful events.

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Compliance with Ethical Standards

Conflict of Interest Peter J. Franz, Evan M. Kleiman, Matthew K. Nock declare that they have no conflict of interest related to the study described.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by the Harvard University-Area Institutional Review Board (IRB#15-1975).

Informed Consent All participants provided informed consent to take part in the study.

Animal Rights No animal studies were carried out by the authors for this article.

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