Suicidal Thoughts Are Associated With Reduced Source Attribution of Emotion

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Approximately 9% of people think about suicide during their lifetime. Suicidal thoughts are consistently associated with perceived failures in emotion regulation. However, factors contributing to these perceptions remain insufficiently clear. New evidence suggests that when people know little about the cause of their emotions (i.e., low source attribution of emotion), they perceive themselves as less successful in regulating them. Therefore, emotion regulation deficits in people with suicidal thoughts might be related to lower knowledge about sources of emotions. We examined this question in two ecological momentary assessment studies ($N_1 = 396$, $N_2 = 195$). We found that participants with current suicidal thoughts knew less about the sources of their emotions compared to participants with no suicidal thoughts history (Studies 1 and 2), and even when compared to controls with similar levels of psychiatric symptoms but no history of suicidal thoughts (Study 2). Using language processing, we found that written descriptions of the source of participants' emotions were less concrete among those with suicidal thoughts compared to participants with no suicidal thoughts history. Among suicidal participants, suicidal thoughts were more likely to be present in moments when participants knew less than usual about the source of their negative emotions (Study 2), and low knowledge of the source was associated with more frequent and prolonged suicidal thoughts (Studies 1 and 2). Finally, lower perceived success in emotion regulation mediated the association between source attribution of emotion and the occurrence of suicidal thoughts. Findings suggest that reduced knowledge about the source of negative emotions might increase the risk for suicidal thinking.

General Scientific Summary
This study suggests that people with current suicidal thoughts know less about the source of their negative emotions compared to people without suicidal thoughts. It also suggests that in moments when people with suicidal thoughts know less than usual about the source of their negative emotions, they are more likely to think about suicide.

Keywords: suicide, suicidal thoughts, emotion, source attribution, ecological momentary assessment

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Suicide is a leading cause of death, with over 700,000 people who died by suicide in 2019 (World Health Organization, 2021). Suicidal behavior is typically preceded by suicidal thoughts (O'Connor & Nock, 2014), which involve thoughts or imagery of engaging in suicidal behavior (House et al., 2020). Suicidal thoughts are consistently associated with perceived failures in

regulating negative emotions (see Colmenero-Navarrete et al., 2022 for a review). Emotion regulation difficulties also predicted the persistence of suicidal thoughts over time (Miranda et al., 2013; Raudales et al., 2020). However, factors that contribute to difficulties in emotion regulation remain poorly understood.

We sought to better understand these difficulties by focusing on a relatively underexplored, yet important aspect of emotion regulation, which is people's knowledge about the source of their emotions (Boden & Berenbaum, 2011). Specifically, some of the most central emotion regulation strategies target the source of the emotion (e.g., situation modification, cognitive reappraisal; Gross, 2015). To the extent that people know little about the source of their negative emotions (Boden & Berenbaum, 2011), they may be unable to use such strategies, and ultimately experience less success in emotion regulation (Millgram et al., 2023). Therefore, emotion regulation deficits in people with suicidal thoughts (Rogier et al., 2024) might be partly related to reduced knowledge about sources of emotions. The current project tested this possibility in two ecological momentary assessment (EMA) studies.

Suicidal Thoughts and Emotion Regulation

Approximately 9.2% of adults experience suicidal thoughts during their lifetime (Nock et al., 2008). Suicidal thoughts can involve a desire to die, intentions of killing oneself, and visual imagery of suicidal acts (House et al., 2020). About 30% of people who think about suicide will attempt suicide (Nock et al., 2008).

According to central theories of suicide, hopelessness about one's ability to control aversive mental states contributes to the emergence of suicidal thoughts (Baumeister, 1990; Beck et al., 1975). Negative emotions are typically aversive (Watson & Clark, 1984). Therefore, hopelessness about one's ability to downregulate negative emotions may increase the likelihood that suicidal thoughts emerge (Miranda et al., 2013). Supporting this idea, approximately 95% of people who think about suicide rated the urge to escape negative emotions as one of the top reasons for considering ending their life (May et al., 2020). This puts negative emotions, and their regulation, at the forefront of understanding suicidal thoughts. Indeed, research on emotion regulation in suicide has repeatedly found associations between suicidal thoughts and perceived emotion regulation difficulties (Brausch et al., 2022; Hatkevich et al., 2019; Rajappa et al., 2012). Such perceptions, in turn, prospectively predicted suicidal thoughts in a 2–3-year follow-up study, after accounting for depressive symptoms and mood disorders (Miranda et al., 2013). A key question arising from these findings is what are the factors contributing to perceptions of emotion regulation failure among people with suicidal thoughts? Here we propose that lower knowledge about the source of negative emotions could be one such factor.

Source Attribution of Negative Emotions

When people experience negative emotions, they may try to identify what made them feel this way. At times, people identify an external source, such as an argument with their romantic partner. On other occasions, they may identify an internal source, such as a memory of an unpleasant social interaction. However, sometimes people can be unsure or completely fail to identify the source of their emotions (Clore et al., 2001). Boden and Berenbaum (2011) were the first to conceptualize people's clarity about the source of emotions. They

found individual differences in people's ability to clearly identify the source of their feelings and theoretically and empirically distinguished between source clarity and type clarity, which refers to the type of emotion experienced (e.g., anger vs. fear; see also Eckland & Berenbaum, 2021). In a recent EMA study by our group, people reported no knowledge about the source of their negative emotions 8.1% of the time, whereas 24.4% of the time they reported being unsure or only vaguely identified the source (Millgram et al., 2023). Together, these findings suggest that people can be more or less skilled in making inferences about the causes of their own emotions. At the same time, situational factors like momentary cognitive load or characteristics of the source itself (e.g., whether the source is internal or external; acute or chronic), are likely to impact source attribution of emotion. Such variation in trait and state source attribution can have implications for people's perceived success in emotion regulation. This is because linking emotions to their source can be the first step for using certain effective emotion regulation strategies.

Emotions are inherently "about something" (Lazarus, 1991). Therefore, central emotion regulation strategies target what the emotion is about (Gross, 2015). For instance, situation modification involves changing the situation that caused the emotion (e.g., asking to be treated by a familiar doctor to reduce anxiety over a medical procedure; Quoidbach et al., 2015), and cognitive reappraisal typically involves reinterpreting the situation (e.g., reinterpreting the procedure as beneficial in the long run; Uusberg et al., 2019). Because such strategies target the source, when the ability to attribute the emotion to a source is limited, these strategies can become unavailable. For instance, without linking feelings of anxiety to the medical procedure, it's impossible to modify the situation or reinterpret it. There are also strategies that do not require source attribution of emotion (e.g., mindfulness, acceptance). However, lower source attribution is expected to restrict the number of effective emotion regulation strategies at one's disposal. As a result, regulation can become less attainable, which can reduce perceived success in regulation. Supporting this idea, Boden and Thompson (2015) found that people with lower source clarity used more expressive suppression, a strategy that requires no knowledge about the source and is typically considered less effective. Similarly, when people knew less about the source of their emotions in daily life they attempted emotion regulation to a lesser extent, were less likely to use strategies that target the source (situation modification; cognitive reappraisal, social support), and ultimately perceived themselves as less successful in regulation (Millgram et al., 2023). Because suicidal thoughts are closely linked to perceived failures in emotion regulation (Colmenero-Navarrete et al., 2022), we sought to build on these findings to better understand suicidality. Specifically, reduced source attribution of emotion may decrease perceived success in emotion regulation, which in turn, may increase the likelihood that suicidal thoughts would emerge among vulnerable individuals.

Source Attribution of Emotion and Suicidal Thoughts

To our knowledge, no study has examined the link between source attribution of emotion and suicidal thoughts. Our previous work focused on emotion regulation but did not examine implications for suicidality (Millgram et al., 2023). Although we tested whether lower source attribution is associated with reduced success in regulation (Millgram et al., 2023), we did not test this among suicidal

individuals, nor did we test whether source attribution of emotion or perceived regulatory success predicts the occurrence of suicidal thoughts. Eckland et al. (2021), and Boden and Thompson (2015) examined associations between trait (and not state) source clarity and symptoms of depression and found no significant direct associations. However, there are important differences between these investigations and the current project which could account for previous null findings. Both previous studies used a retrospective questionnaire to assess trait source clarity, assessed depressive symptoms and not suicidal thoughts, and did not preselect clinical populations. In the current investigation, we specifically focused on suicidal thoughts. We recruited clinical samples and used EMA to assess source attribution of naturally occurring negative emotions several times a day. This allowed us to assess differences in source attribution across both individuals and situations in real time. To ensure that differences in reported knowledge about the source do not reflect a response bias, we also used an indirect measure. Specifically, we expected that more knowledge about the source will lead people to form a more concrete explanation for why they feel the way they do (Brainerd et al., 2012). We therefore asked participants to provide a written description of the source of their emotion. To validate our assessment of source attribution, we assessed the degree to which the words in participants' written descriptions were concrete.

The Current Investigation

We tested three hypotheses. First, because source attribution of emotion varies across individuals, we hypothesized that people with current suicidal thoughts would have lower knowledge about the source of their negative emotions compared to people with no history of suicidal thoughts. We had no a priori prediction with respect to people with past suicidal thoughts.

Second, because source attribution of emotion can vary across situations, we expected that in moments when suicidal individuals know less than usual about the source of their emotions, they would be more likely to think about suicide, and their suicidal thoughts would be more severe. To the extent that lower source attribution of emotion increases the likelihood that suicidal thoughts would emerge, more frequent instances of low source attribution should give rise to more frequent suicidal thoughts. Additionally, to the extent that lower source attribution impairs successful emotion regulation, negative emotions should persist, potentially increasing the duration of suicidal thoughts. Therefore, we also hypothesized that among suicidal individuals, reduced source attribution of emotion will predict more frequent and prolonged suicidal thoughts. Finally, with regard to our proposed mechanism, we hypothesized that among people with suicidal thoughts, lower perceived success in regulation would mediate the association between low source attribution of negative emotions and the occurrence and severity of suicidal thoughts.

We conducted two EMA studies. EMA involves using participants' smartphones to collect high-frequency data in their natural environment. EMA reduces recall bias and maximizes ecological validity (Shiffman et al., 2008). In Study 1 we used a large sample from the general population and compared people with current suicidal thoughts, people with past suicidal thoughts, and people with no history of suicidal thoughts. Comparing these groups was designed to reveal whether lower source attribution of emotion characterizes people who currently think about suicide (proximal predictor) or people who are generally more vulnerable to suicidal thoughts. In Study 2, we prescreened participants and recruited participants with past-week suicidal thoughts, participants with comparable levels of psychiatric symptoms, but no history of suicidal thoughts, and healthy controls. This was designed to test whether reduced source attribution of emotion is specific to people with suicidal thoughts or characterizes those with psychopathology more broadly (see Millner et al., 2019).

To assess source attribution of emotions we collected participants' reports of their knowledge about the source of their negative emotions. We also used language processing to assess the concreteness of the words in participants' written descriptions of the source. To ensure that findings were not driven by group differences in the intensity of negative emotions (by the fact that people with suicidal thoughts experience more intense emotions), in all analyses we controlled for person-mean negative emotion and for the intensity of momentary negative emotion. Because stable negative emotion can result in experiencing negative emotions without a clear trigger, we also controlled for emotional inertia (Kuppens et al., 2010). Finally, to ensure that results are not driven by related, yet distinct constructs, we controlled for measures that reflect attention to emotion and emotional clarity.

Study 1

We used a general population sample to compare source attribution of emotion across people with current suicidal thoughts, past suicidal thoughts, and people with no history of suicidal thoughts. We also tested associations between source attribution of emotion and the frequency and duration of suicidal thoughts.

Method

Data were collected as part of a larger research project (Millgram et al., 2023). We describe parts of the protocol that are relevant to the current investigation. A list of all measures appears in the online supplemental materials.

Participants

The sample size was determined based on a power analysis described in Millgram et al. (2023; see the online supplemental materials). To ensure that this sample was sufficient to detect group differences in source attribution, we conducted a post hoc power analysis using "simr" package in R (Green & MacLeod, 2016), with 100 simulations, $\alpha = .05$. We estimated power to detect differences between three groups in their source attribution. The power analysis indicated that a sample of 396 participants would enable the detection of a small effect $R^2_{\text{marginal}} = .004$; $R^2_{\text{conditional}} = .07$ with 90.0% power, 95% confidence interval (CI) [82.38, 95.10].

We recruited 401 participants through Prolific (Palan & Schitter, 2018). Participants were U.S. residents, aged 18 and above. Five participants were removed from the study. One participant failed two attention checks in the baseline survey, and four participants failed more than 10% of attention checks embedded in each EMA survey (a total of 42 attention checks; see preregistration for Millgram et al., 2023), resulting in a final sample of 396 participants. Forty-three participants reported suicidal thoughts during the past month, 129

participants reported a lifetime history of suicidal thoughts, and 224 participants reported no lifetime history of suicidal thoughts (see Table 1 for demographic and clinical characteristics). The gender identities in the sample were 205 female, 183 male, four genderqueer, nonbinary, or gender-fluid, one transgender, one unsure, and two preferred not to say. The racial and ethnic identities in the sample were 298 White/Caucasian, 34 Black/African American, 28 Asian, 22 Hispanic/Latino, three Middle Eastern or North African, one Native American/American Indian, nine identified as "other," and one preferred not to say.

Procedure

The study included a baseline survey followed by a 7-day EMA period. For the EMA, participants downloaded a smartphone-based app (Metricwire). Following recommendations by Eisele et al. (2022) the app sent six surveys per day. Five surveys were sent at random times at least 90 min apart between 9 a.m. and 6:30 p.m. and stayed open for 1 hr. The last survey each day was sent at a random time between 8 p.m. and 9 p.m. and remained open for 6 hr. Participants were paid $3.5 for the baseline survey with an additional $0.25 for each completed EMA survey. Participants received $1 bonus for any day they completed five surveys or more. All study procedures were approved by the Harvard University-Area Institutional Review Board (22-0128). Electronic informed consent was obtained from all participants. At the end of the baseline survey, and of the study, participants received resources for treatment and safety (e.g., suicide prevention hotline numbers).

Measures

Baseline Survey

Suicidal Thoughts. We used the Columbia-Suicide Severity Rating Scale (Posner et al., 2008; Risk Assessment Version) to assess current and lifetime history of suicidal thoughts. The Columbia-Suicide Severity Rating Scale is an established and widely used measure to assess suicidal thoughts and behaviors (Mundt et al., 2013). Participants rated whether in the past month or in their lifetime they have had thoughts of killing themselves ("Have you actually had any thoughts of killing yourself?" $0 = no$, $1 = yes$). Frequency of suicidal thoughts was assessed using the item "How many times have you had these thoughts?" ($1 = less$ $than\ once\ a\ week$, $2 = once\ a\ week$, $3 = 2–5\ times\ a\ week$, $4 =$ $daily\ or\ almost\ daily$, $5 = many\ times\ each\ day$). Duration of suicidal thoughts was assessed using the item "When you have the thoughts how long do they last?" ($1 = fleeting,\ few\ seconds\ or\ minutes$, $2 = less$ $than\ 1\ hr/some\ of\ the\ time$, $3 = 1–4\ hr/a\ lot\ of\ time$, $4 = 4–8\ hr/most$ $of\ day$, $5 = more\ than\ 8\ hr/persistent\ or\ continuous$).

Attention to Emotion and Emotion Clarity. To assess attention to emotions and emotion clarity we used the Alexithymia scale (Preece et al., 2018; $\alpha = .86$).

EMA

In each survey, participants reported on their negative emotions in the past hour ("In the past hour, how much did you experience negative emotions?" $0 = not\ at\ all$, $10 = extremely$; see the online supplemental materials for convergent validity of this measure). If participants reported negative emotions, they indicated how much they knew what made them feel this way ("If you felt negative at all, do you know what made you feel this way?" $1 = no$, $5 = I\ am$ $confident\ about\ what\ made\ me\ feel\ this\ way$), and described it in writing ("Please shortly describe what made you feel negative").

Emotional Inertia. We computed a negative emotional inertia score for each participant (Kuppens et al., 2010). We ran an autocorrelation model to predict negative emotion at time t from negative emotion at time $t − 1$, and extracted for each participant their individual slope. Each slope represents the degree to which current negative emotion is predicted by previous negative emotion, for that participant.

Table 1
Demographics and Clinical Characteristics (Study 1)

Variable	Current suicidal thoughts ($n = 43$)	History of suicidal thoughts ($n = 129$)	No history of suicidal thoughts ($n = 224$)	Statistic
Age (year)	34.4 (12.0)	36.9 (11.5)	38.8 (12.2)	$F = 2.90$
Sex (% female)	58.1	57.4	49.6	$\chi^2 = 3.09$
Race (% White)	76.7	77.5	73.7	$\chi^2 = 0.71$
Employment (% full or part time)	60.5	69.0	78.6	$\chi^2 = 8.05*$
Suicide attempt history (%)	46.5	17.8	0	$\chi^2 = 90.2*$
Frequency of suicidal thoughts (%)				
Less than once a week	30.2			
Once a week	11.6			
2–5 times a week	39.5			
Daily or almost daily	16.3			
Many times each day	2.3			
Duration of suicidal thoughts (%)				
Fleeting, few seconds or minutes	20.9			
Less than 1 hr/some of the time	55.8			
1–4 hr/a lot of time	11.6			
4–8 hr/most of day	7.0			
More than 8 hr/persistent or continuous	4.7			

Note. Suicide attempt history = percentage of participants that attempted suicide at least once in their lifetime.
* $p < .05$.

Concreteness of Written Descriptions of the Source. We relied on a preestablished and widely used concreteness dictionary that includes concreteness ratings for 37,058 English words (Brysbaert et al., 2014). Our data set contained 5,190 responses including 3,920 unique words. We removed low-information stop-words (words that do not convey semantic meaning like "is," "the"), resulting in 3,771 unique words. For the analysis, we used only words that had a concreteness rating, resulting in 1,858 unique words. To form a response-level concreteness score, we averaged across the concreteness ratings of all the unique words within each response.

Analytic Approach

We ran multilevel models (measurements nested within persons) using lme4 package in R (Bates et al., 2015), with p values calculated using lmerTest (Kuznetsova et al., 2017). We included a random intercept for participant and random slopes for each Level-1 predictor. Following Barr et al. (2013), when models did not converge or resulted in singular fits, we removed the random effect explaining the least variance. Continuous Level-1 predictors were person-mean centered, and continuous Level-2 predictors were grand-mean centered. To estimate effect size, following Nakagawa and Schielzeth (2013), we calculated marginal R^2 (R_M^2), which estimates the proportion of variance explained by the fixed effects, and conditional R^2 (R_C^2), which estimates the proportion of variance explained by both fixed and random effects. In all analyses, we controlled for the intensity of momentary negative emotion (entered as a Level-1 predictor), for participant-mean negative emotion, and for emotional inertia (entered as Level-2 predictors).

Transparency and Openness

Study 1 was not preregistered. Study 1 data, materials, and code are publicly available on the Open Science Framework at https://osf.io/un46a/?view_only=77d1d5ef10b8416789c7c416abd81dd9 (Millgram et al., 2024).

Results

The total number of completed surveys was 12,132. The average number of surveys completed per person was 35.05 ($SD = 7.86$, 83.5% compliance, median compliance = 90.5%). The three groups did not significantly differ in their compliance, $F(2, 393) = 0.65$, $p = .525$ (83%, 83.4%, and 83.6% compliance for participants with current, past, and no suicidal thoughts, respectively).

Did Groups Differ in Their Source Attribution of Emotion?

We conducted a multilevel regression model, including only surveys where participants reported negative emotions within the past hour (nonzero responses; 5,466 surveys). Source attribution of emotion was entered as the dependent variable, and group (No suicidal thoughts, Past suicidal thoughts, Current suicidal thoughts) as the independent variable.

People with current suicidal thoughts knew less about the source of their negative emotions ($M = 3.60$, $SE = 0.12$) compared to people with no history of suicidal thoughts ($M = 3.95$, $SE = 0.07$), $b = -0.35$, $SE = 0.14$, $t(315.45) = -2.48$, $p = .014$, $R_M^2 = .09$, $R_C^2 = .49$ (see Figure 1A). People with a history of suicidal thoughts did not differ from people with current suicidal thoughts, $b = -0.20$,

$SE = 0.14$, $t(312.72) = -1.41$, $p = .159$, $R_M^2 = .09$, $R_C^2 = .49$, or people with no history of suicidal thoughts, $b = -0.14$, $SE = 0.09$, $t(334.45) = -1.55$, $p = .123$, $R_M^2 = .09$, $R_C^2 = .49$, such that their mean source attribution fell between the other two groups ($M = 3.80$, $SE = 0.08$). Because groups significantly differed in their employment status, we repeated the analysis controlling for employment. We also controlled for age, and for alexithymia. Results remained unchanged (see the online supplemental materials).

Did Groups Differ in the Concreteness of Their Written Descriptions of the Source?

Supporting the convergent validity of our measures, we found a positive correlation between participants' reported knowledge about the source and the concreteness of their written description of that source, $r(5, 190) = .337$, $p < .001$. Next, we ran a multilevel regression model with concreteness scores as the dependent variable, and group as the independent variable. We controlled for negative emotion, response length (number of words not counting stop words), and the proportion of words within the response that had a concreteness rating in the dictionary.

People with current suicidal thoughts provided less concrete descriptions of the source ($M = 2.91$, $SE = 0.05$) compared to people with no history of suicidal thoughts ($M = 3.06$, $SE = 0.02$), $b = -0.15$, $SE = 0.05$, $t(285.95) = -2.72$, $p = .007$, $R_M^2 = .009$, $R_C^2 = .08$ (see Figure 1B). Again, people with a history of suicidal thoughts did not significantly differ from either group ($M = 3.01$, $SE = 0.03$), $b = 0.09$, $SE = 0.06$, $t(275.49) = 1.67$, $p = .095$, $R_M^2 = .009$, $R_C^2 = .08$, compared to currently suicidal participants, and $b = -0.05$, $SE = 0.04$, $t(290.79) = -1.47$, $p = .144$, $R_M^2 = .009$, $R_C^2 = .08$, compared to people with no suicidal thoughts history.

Is Source Attribution of Emotion Associated With Frequency and Duration of Suicidal Thoughts?

We ran a multilevel regression model, including only participants in the currently suicidal group. Source attribution of emotion was entered as the dependent variable, and the reported frequency of suicidal thoughts was entered as the independent variable. More frequent suicidal thoughts predicted lower source attribution of emotions, $b = -0.32$, $SE = 0.13$, $t(42.53) = -2.48$, $p = .017$, $R_M^2 = .10$, $R_C^2 = .53$. We repeated the analysis with the duration of suicidal thoughts. Longer duration of suicidal thoughts predicted lower source attribution of emotion, $b = -0.30$, $SE = 0.13$, $t(29.97) = -2.31$, $p = .029$, $R_M^2 = .10$, $R_C^2 = .51$.

Discussion

Study 1 suggests that people with suicidal thoughts know less about the cause of their negative emotions compared to people with no history of suicidal thoughts. Analysis of the text produced by participants provides further support for our hypothesis using an indirect measure. Furthermore, lower source attribution of emotion was associated with more frequent and prolonged suicidal thoughts. People with past suicidal thoughts did not differ from either group. This suggests that reduced source attribution may characterize the acute phase of suicidal thinking, rather than general vulnerability to suicidal thoughts.

Study 1 has several limitations. First, a potential explanation for the results is that group differences were driven by differences in

Figure 1

Source Attribution of Emotion By Group (Study 1)
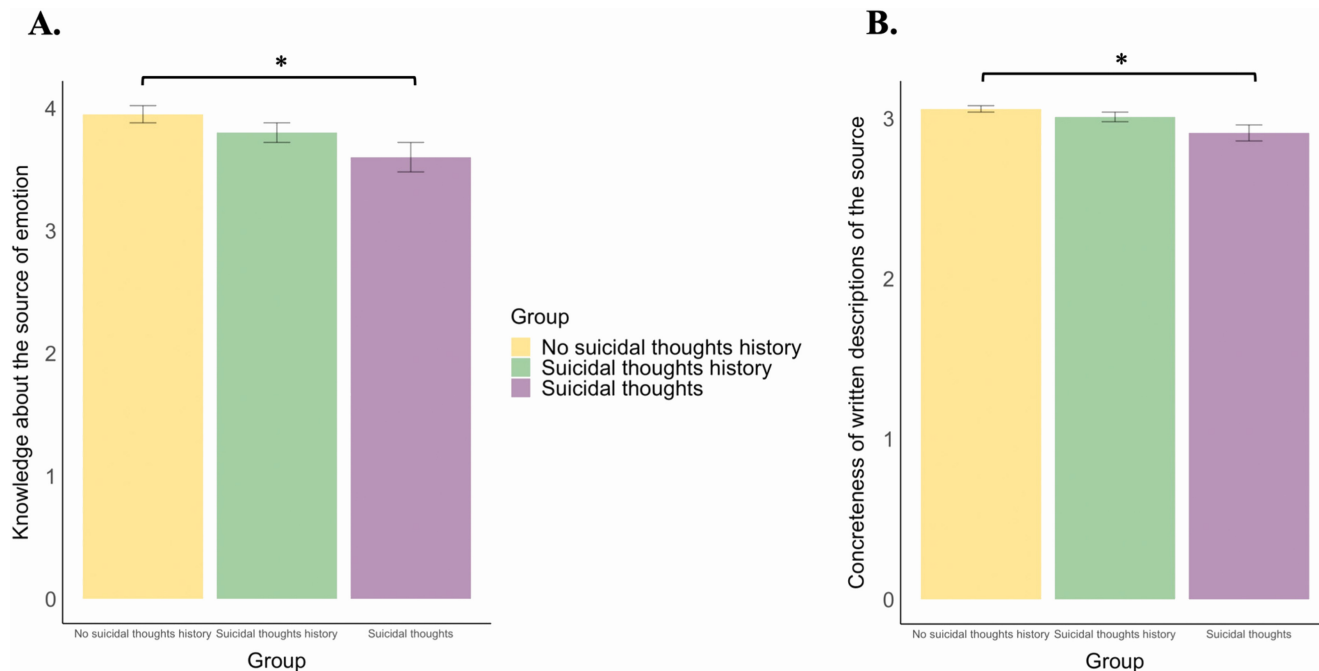
Note. Differences in knowledge about the source of emotion (Panel A) and in the concreteness of written descriptions of the source (Panel B) as a function of group. Error bars represent $\pm SE$ from the mean. Participants with current suicidal thoughts knew less about the sources of their negative emotions and provided less concrete descriptions of these sources compared to participants with no history of suicidal thoughts. People with past suicidal thoughts did not differ from either group. See the online article for the color version of this figure.
* $p < .05$.

the overall levels of psychopathology across groups. Second, in Study 1 we did not assess suicidal thoughts in the EMA surveys, and therefore could not assess momentary associations between reductions in source attribution and suicidal thoughts. Finally, Study 1 did not test our proposed mechanism, according to which lower perceived success in regulation mediates the relationship between source attribution of emotion and suicidal thoughts. In Study 2 we addressed these limitations.

Study 2

In Study 2 we recruited three groups: people with current suicidal thoughts, people with comparable levels of past-year psychiatric symptoms, only with no history of suicidal thoughts, and people with low levels of psychiatric symptoms and no suicidal thoughts history. We compared these groups to test whether lower source attribution is specifically related to suicidal thoughts, or whether it is related to overall high levels of psychopathology. In Study 2 we also assessed momentary suicidal thoughts. We tested whether lower source attribution of emotion predicted the occurrence and severity of momentary suicidal thoughts, and whether this relationship was mediated by perceived success in emotion regulation.

Method

We describe parts of the protocol that are relevant to the current investigation. A list of all measures appears in the online supplemental materials.

Participants

We conducted a power analysis using "simr" package in R (Green & MacLeod, 2016) with 100 simulations and $\alpha = .05$. We estimated power to detect a small effect size for differences between three groups in source attribution of emotion ($R^2_{\text{marginal}} = .03$; $R^2_{\text{conditional}} = .36$). The analysis indicated that a sample of 210 participants (70 participants per group) would enable the detection of such effect with 94.0% power, 95% CI [87.40, 97.77].

Participants were recruited based on a screening survey assessing the presence of lifetime and past-week suicidal thoughts and a well-validated measure for psychiatric symptoms (Global Appraisal of Individual Needs Short Screener [GAIN-SS]; Dennis et al., 2006). To assess suicidal thoughts participants rated the item: "Have you ever seriously thought about killing yourself for longer than a few minutes?" ($0 = no$, $1 = yes$). Next, participants rated the item: "When was the last time you seriously thought about killing yourself?" ($1 = in\ the\ past\ 7\ days$, $2 = 2\ weeks\ ago$, $3 = 4\ weeks\ ago$, $4 = 8\ weeks\ ago\ (1–2\ months\ ago)$, $5 = 12\ weeks\ ago\ (2–3\ months\ ago)$, $6 = 3–6\ months\ ago$, $7 = 6\ months−1\ year\ ago$, $8 = more\ than\ 1\ year\ ago$).

Psychiatric symptoms were assessed using the GAIN-SS ($\alpha = .90$; Dennis et al., 2006). We selected the GAIN-SS because it enables us to assess psychiatric symptoms across a longer period (past year) and because it covers a wide range of symptoms. It includes an internalizing disorder subscreener ($\alpha = .88$), an externalizing disorder subscreener ($\alpha = .78$), a substance disorder subscreener ($\alpha = .86$), and a crime/violence subscreener ($\alpha = .66$).

The screening survey was distributed on Prolific. Eligible participants were invited to the main study on the next day. We invited participants who had suicidal thoughts in the past week, participants with similar levels of past-year psychiatric symptoms but no history of suicidal thoughts, and participants with low symptom levels (GAIN-SS ≤ 3) and no history of suicidal thoughts. Suicidal thoughts were assessed again in the main study. We removed participants with inconsistent responding: 10 participants who were recruited to the suicidal group but then reported no suicidal thoughts within the past week in the main study, six participants who were recruited to the high symptoms group, but reported a history of suicidal thoughts in the main study, and five participants who were recruited to the low symptoms group but reported a history of suicidal thoughts in the main study. Twenty additional participants were excluded for failing one or more of three attention checks that were embedded in the EMA surveys on Days 3, 5, and 7.

The final sample included 195 participants. Sixty-seven participants reported low psychiatric symptoms within the past year (GAIN-SS ≤ 3) and no history of suicidal thoughts ($N = 67$, $M_{GAIN-SS} = 2.72$, $SD = 1.22$); 64 participants reported comparable psychiatric symptoms as the suicidal group but no history of suicidal thoughts ($N = 64$, $M_{GAIN-SS} = 10.86$, $SD = 2.22$), and 64 participants reported having suicidal thoughts within the past week ($N = 64$, $M_{GAIN-SS} = 11.83$, $SD = 3.92$).

Groups differed in their psychiatric symptoms, $F(2, 192) = 230.7$, $p < .001$, such that participants with low psychiatric symptoms reported significantly less symptoms compared to the other two groups (95% CI [8.01, 10.22], $p < .001$, compared to suicidal participants, and 95% CI [7.04, 9.25], $p < .001$, compared to people with high symptoms). As intended, participants with high psychiatric symptoms and participants with current suicidal thoughts did not differ in their symptoms, 95% CI [−0.15, 2.09], $p = .104$ (see Table 2 for demographic and clinical characteristics). The gender identities in the sample were 140 female, 40 male, 14 genderqueer, nonbinary, or gender-fluid, and one transgender. The racial and ethnic identities were 145 White/Caucasian, 13 Black/African American, 13 Asian, 16 Hispanic/Latino, two Middle Eastern or North African, one Native American/American Indian, and five identified as "other."

Procedure

The study included a baseline survey followed by a 7-day EMA period. Participants downloaded an app (Metricwire) that sent them six surveys per day. Five surveys were sent at random times at least 90 min apart between 9 a.m. and 7 p.m. and stayed open for 1 hr. The last survey each day was sent at a random time between 8 p.m. and 9 p.m. and remained open for 6 hr. Participants were paid $15 for the baseline survey. The payment structure for the EMA period was identical to Study 1. All study procedures were approved by the Harvard University-Area Institutional Review Board (21-0422). Electronic informed consent was obtained from all participants. At the end of each EMA survey, participants were provided with resources for treatment and safety (e.g., suicide prevention hotlines). Resources were also provided at the end of the screener, the baseline survey, and at the end of the study.

Baseline Survey

Suicidal Thoughts.   Participants completed a self-report version of the Self-Injurious Thoughts and Behaviors Interview (SITBI; Fox

et al., 2020). The SITBI is widely used and has established predictive and convergent validity (Fox et al., 2020). To assess the frequency of suicidal thoughts participants indicated the number of days they had suicidal thoughts in the past week, month, year, and in their lifetime. To assess the duration of suicidal thoughts, participants rated the item: "Thinking about all of the times that you have had thoughts like this, how long did these thoughts usually last each time?" $1 = 0 s$, $2 = 1–59 s$, $3 = 1–15 min$, $4 = 16–60 min$, $5 = less\ than\ 1\ day$, $6 = 1–2\ days$, $7 = 3–6\ days$, $8 = 1–2\ weeks$, $9 = 2+\ weeks$, $10 = wide\ range$). For testing associations between source attribution of emotion and duration of suicidal thoughts, we removed the "wide range" responses from the analysis.

Attention to Emotion and Emotion Clarity

We used the attention to emotion and the emotional clarity subscales of the Difficulties in Emotion Regulation Scale Short-Form (Kaufman et al., 2016; α = .77 and α = .86, respectively).

EMA

The EMA measures of negative emotions and source attribution of emotion were identical to Study 1. To assess perceived regulation success, participants first indicated whether they tried to decrease their negative emotions ("In the past hour, how much did you try to decrease your negative emotions?" $0 = not\ at\ all$, $10 = a\ lot$). If they tried, they indicated their perceived success in decreasing the intensity of their negative emotions ("Overall, to what extent were you able to decrease your negative emotions?" $0 = not\ at\ all$, $10 = a\ lot$). Following Kleiman et al. (2017), to assess suicidal thoughts, participants rated their suicidal desire ("Right now, how strong is your desire to die?" $0 = not\ at\ all$, $10 = very\ strong$) and intent ("Right now, how strong is your intent to kill yourself?" $0 = not\ at\ all$, $10 = very\ strong$). Following Kleiman et al. (2018), we operationalized the occurrence of suicidal thoughts as a nonzero response on either suicidal desire or intent ($0 = no\ desire\ or\ intent$, $1 = some\ level\ of\ suicidal\ desire\ or\ intent$). To assess the severity of suicidal thoughts we averaged across these two items. Please see the online supplemental materials for convergent validity of these measures.

Emotional Inertia

We assessed emotional inertia following the procedure outlined in Study 1.

Concreteness of Written Descriptions of the Source

We followed the same procedure outlined in Study 1. The current data set contained 1,713 written responses including 2,009 unique words. We removed low information stop words, resulting in 1,876 unique words, with 1,652 unique words that had a concreteness rating in the dictionary.

Analytic Approach

Our analytic approach was identical to Study 1.

Transparency and Openness

Study 2 was not preregistered. Study 2 data, materials, and code are publicly available on the Open Science Framework at https://

Table 2
Demographics and Clinical Characteristics (Study 2)

Variable	Suicidal thoughts ($n = 64$)	High psychiatric symptoms ($n = 64$)	Low psychiatric symptoms ($n = 67$)	Statistic
Age (year)	23.31 (4.62)	26.09 (5.51)	26.69 (7.47)	$F = 5.81^*$
Sex (% female)	81.3	84.4	71.6	$\chi^2 = 3.49$
Race (% White)	73.4	79.7	70.1	$\chi^2 = 1.60$
Employment (% full or part time)	53.1	71.9	67.2	$\chi^2 = 5.30$
GAIN-SS score	11.83 (3.92)	10.86 (2.22)	2.72 (1.22)	$F = 230.7^*$
NSSI history (%)	75	32.8	16.4	$\chi^2 = 49.09^*$
Suicide attempt history (%)	32.8	0	0	$\chi^2 = 48.17^*$
Frequency of suicidal thoughts				
Past week (number of days)	3.81 (1.79)			
Past month (number of days)	10.52 (8.94)			
Past year (number of days)	115.9 (117.9)			
Duration of suicidal thoughts (%)				
1–59 s	7.8			
1–15 min	12.5			
16–60 min	15.6			
Less than one day	14.1			
1–2 days	21.9			
3–6 days	10.9			
1–2 weeks	1.5			
2+ weeks	3.1			
Wide range	12.5			

Note. GAIN-SS score = Global Appraisal of Individual Needs Short Screener; NSSI history = percentage of participants that engaged in nonsuicidal self-injury at least once in their lifetime; Suicide attempt history = percentage of participants that attempted suicide at least once in their lifetime.
$^* p < .05.$

osf.io/un46a/?view_only=77d1d5ef10b8416789c7c416abd81dd9 (Millgram et al., 2024).

Results

The total number of completed surveys was 3,725. The average number of surveys completed per person was 28.26 ($SD = 11.32$, 67.3% compliance, 76.2% median compliance). Groups did not significantly differ in their compliance rate, $F(2, 192) = 1.78$, $p = .172$ (61.4%, 66.4%, and 72.6% for participants with suicidal thoughts, with high and low psychiatric symptoms, respectively).

Did Groups Differ in Their Source Attribution of Emotion?

We ran a multilevel regression model including only surveys where participants reported negative emotions within the past hour (nonzero responses; 1,780 surveys). Group (low psychiatric symptoms, high psychiatric symptoms, suicidal thoughts) was entered as a Level-2 predictor, and source attribution of emotion as the dependent variable. We controlled for momentary negative emotion, person-mean negative emotion, and emotional inertia.

Replicating Study 1, participants with current suicidal thoughts knew less about the causes of their negative emotions ($M = 3.44$, $SD = 0.10$) compared to participants with low symptoms ($M = 4.13$, $SD = 0.14$), $b = -0.69$, $SE = 0.18$, $t(168.95) = -3.75$, $p < .001$, $R_M^2 = .12$, $R_C^2 = .40$ (see Figure 2). They also knew less about the source compared to participants with high psychiatric symptoms ($M = 3.81$, $SD = 0.11$), $b = -0.37$, $SE = 0.15$, $t(160.65) = -2.42$, $p = .017$, $R_M^2 = .12$, $R_C^2 = .40$. Finally, participants with high psychiatric symptoms did not differ from participants with low symptoms, although the difference approached significance, $b = -0.32$, $SE = 0.16$, $t(172.31) = -1.96$, $p = .052$, $R_M^2 = .12$, $R_C^2 = .40$.

In the online supplemental materials, we report these analyses controlling for additional covariates. To account for current symptoms, we repeated the analysis controlling for past month psychiatric symptoms assessed by the GAIN-SS (Dennis et al., 2006), and for person-mean levels of positive emotion, rumination, self-injury, and substance use assessed throughout the EMA period. Finally, we controlled for age, attention to emotions, and emotional clarity. The difference between participants with suicidal thoughts and participants with low symptoms persisted when controlling for all covariates. The difference between participants with suicidal thoughts and participants with high symptoms persisted when controlling for age, current symptoms, person-mean levels of positive emotion, rumination, self-injury, and substance use and for attention to emotions and was marginal when controlling for emotional clarity.

Did Groups Differ in the Concreteness of Their Written Descriptions of the Source?

We found a significant positive correlation between reports of source attribution of emotion and the concreteness of written descriptions of the source, $r(1,713) = .507$, $p < .001$.

People with current suicidal thoughts provided less concrete descriptions of the source ($M = 2.96$, $SE = 0.04$) compared to people with low symptoms ($M = 3.08$, $SE = 0.05$), $b = -0.15$, $SE = 0.06$, $t(171.52) = -2.53$, $p = .012$, $R_M^2 = .009$, $R_C^2 = .06$. The concreteness of written descriptions among people with high symptoms fell between the two groups and did not significantly differ from either group ($M = 3.01$, $SE = 0.04$), $b = 0.08$, $SE = 0.05$, $t(153.34) = 1.40$, $p = .164$, $R_M^2 = .009$, $R_C^2 = .06$, compared to suicidal participants, and $b = -0.07$, $SE = 0.06$, $t(164.03) = -1.26$, $p = .209$, $R_M^2 = .009$, $R_C^2 = .06$, compared to the low symptoms group.

Figure 2

Source Attribution of Emotion By Group (Study 2)
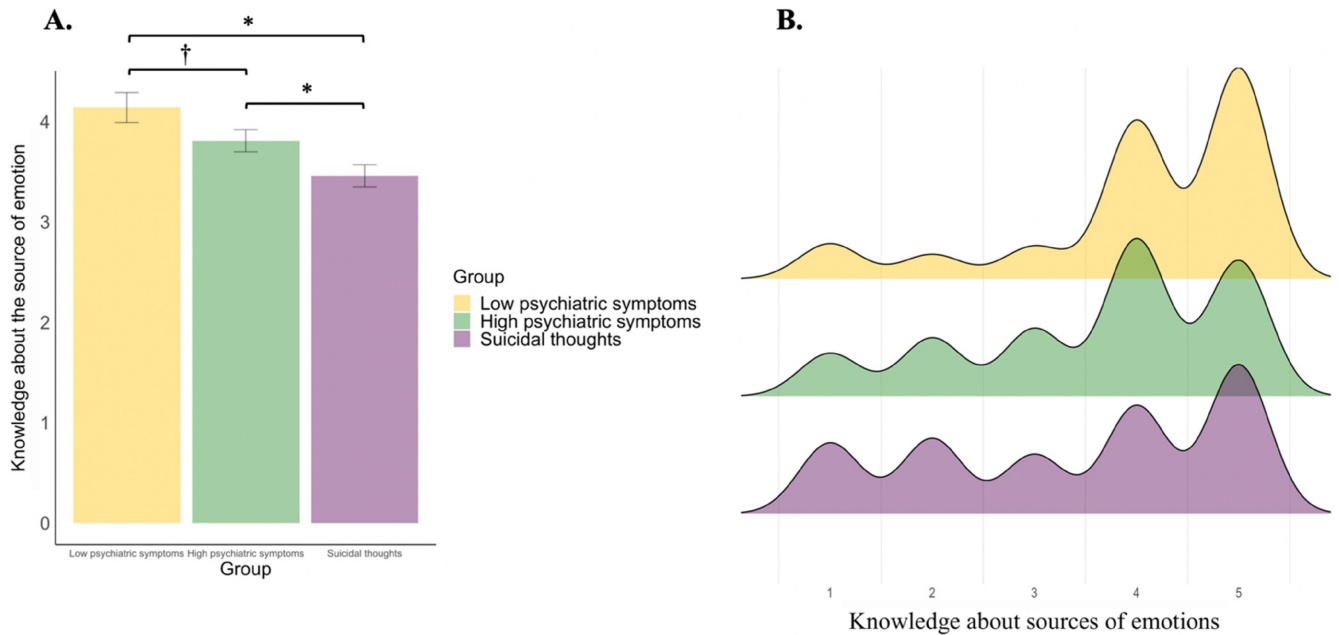
Note. Group differences in means (Panel A) and distributions (Panel B) of knowledge about sources of negative emotions in daily life. Error bars represent ± *SE* from the mean. Participants with current suicidal thoughts knew less about the sources of their negative emotions compared to participants with high psychiatric symptoms and participants with low psychiatric symptoms. See the online article for the color version of this figure.
† $p = .052$.   * $p < .05$.

Is Source Attribution of Emotion Associated With Frequency and Duration of Suicidal Thoughts?

We ran a multilevel regression model with the number of days with suicidal thoughts as reported in the SITBI as a Level-2 predictor, and source attribution of emotion as the dependent variable, including only participants in the suicidal group. More days with suicidal thoughts in the past week were associated with less knowledge about the source during the EMA period, $b = -0.16$, $SE = 0.07$, $t(50.04) = -2.33$, $p = .024$, $R^2_M = .14$, $R^2_C = .47$. The associations between source attribution of emotion and the number of days with suicidal thoughts within the past month, $b = -0.03$, $SE = 0.01$, $t(50.3) = -1.80$, $p = .077$, $R^2_M = .12$, $R^2_C = .46$, or year, $b = -0.14$, $SE = 0.08$, $t(49.5) = -1.70$, $p = .096$, $R^2_M = .12$, $R^2_C = .47$, were not significant. We repeated the above analysis with the typical duration of suicidal thoughts. Longer duration of suicidal thoughts was associated with lower source attribution of emotion, $b = -0.17$, $SE = 0.07$, $t(49.07) = -2.27$, $p = .028$, $R^2_M = .12$, $R^2_C = .49$.

Does Source Attribution of Emotion Predict the Occurrence and Severity of Momentary Suicidal Thoughts?

Figure 3A provides a demonstration of changes in source attribution of emotion and the intensity of suicidal thoughts, for one participant. We ran a logistic multilevel regression with the occurrence of suicidal thoughts as the dependent variable and source attribution of emotion as the independent variable, including only suicidal participants. Lower knowledge about the source of negative emotions experienced in the past hour predicted an increased likelihood of

suicidal thoughts in the present moment, $b = -0.27$, $SE = 0.12$, $z = -2.22$, $p = .027$, $OR = 0.77$ (Figure 3B). Source attribution did not predict the severity of suicidal thoughts, $b = -0.03$, $SE = 0.03$, $t(675.2) = -0.90$, $p = .368$, $R^2_M = .22$, $R^2_C = .82$. This suggests that when people in the suicidal group knew less about what caused their negative emotions, they were more likely to think about suicide, but their suicidal thoughts were not more severe (see the online supplemental materials for analyses controlling for additional covariates. Results remained unchanged).

Does Perceived Success in Regulation Mediate the Link Between Source Attribution of Emotion and the Occurrence of Suicidal Thoughts?

We tested whether the link between source attribution of emotion and the occurrence of suicidal thoughts is mediated by participants' perceived success in regulating negative emotions. We tested mediation using the "mediation" package in R (Tingley et al., 2014), with 5,000 simulations. We entered the occurrence of suicidal thoughts as the dependent variable, source attribution of emotion (person mean-centered) as the independent variable, and perceived success in regulation as the mediator. We controlled for momentary negative emotion, person-mean negative emotion, and emotional inertia. We found a significant mediation effect, $b = -0.006$, 95% CI [−0.013, 0.00], $p = .014$. Lower knowledge about the source of negative emotions predicted less perceived success in decreasing them (Millgram et al., 2023), which, in turn, predicted a higher likelihood of suicidal thoughts (see the online supplemental materials for models testing each path in the

Figure 3

Momentary Suicidal Thoughts By Source Attribution of Emotion
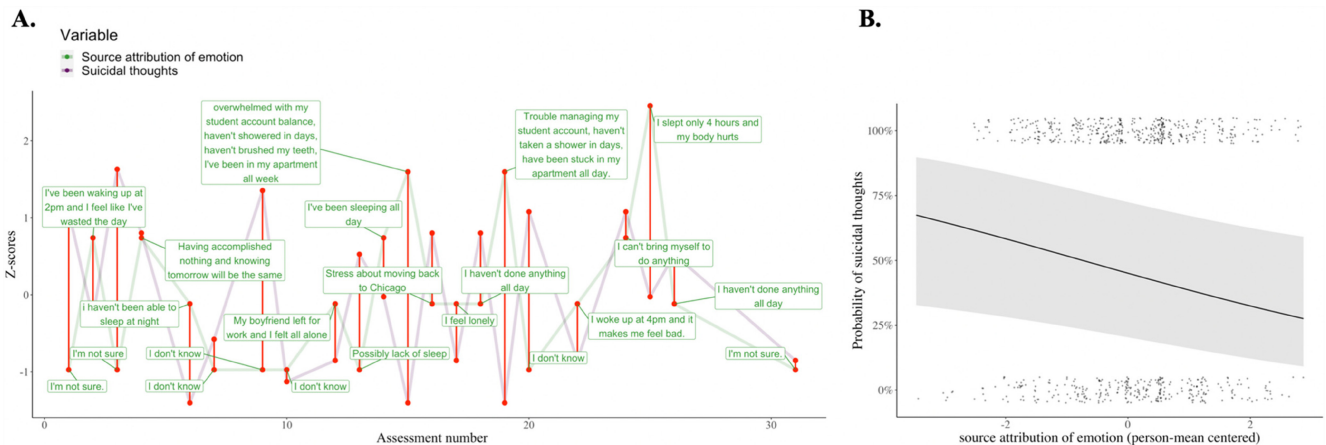
Note. Changes in source attribution of emotion and suicidal thoughts across assessments, taken from one participant (Panel A).The red (dark gray) lines represent the difference between Z scores of source attribution of emotion and suicidal thoughts. When source attribution was low, suicidal thoughts were typically high and vice versa. Panel B: The predicted probability of suicidal thoughts at different levels of source attribution of emotion (person-mean centered values). The probability of suicidal thoughts is higher the less participants knew about the source of their emotions. See the online article for the color version of this figure.

mediation analysis, and for mediation analyses with additional covariates. Results remained unchanged).

Discussion

Consistent with Study 1, in Study 2, participants with suicidal thoughts knew less about the causes of their negative emotions compared to people with no history of suicidal thoughts who experienced either low or high psychiatric symptoms. Results remained unchanged when controlling for current symptoms, supporting the possibility that reduced source attribution of emotion is specifically associated with suicidal thoughts. However, the difference between people with suicidal thoughts and people with high symptoms was not evident in the concreteness of written descriptions of the source. Therefore, there is room to further investigate whether reduced source attribution of emotion reflects a transdiagnostic process. Among people with suicidal thoughts, when they knew less about the source of their negative emotions, they were more likely to think about suicide. Specifically, there was a 23% increase in the chances to think about suicide with every one-point decrease in knowledge about the source (about 1 *SD* below the mean). However, these suicidal thoughts were not more severe. Finally, we found support for the idea that lower perceived success in regulation mediates the association between source attribution of emotions and the occurrence of suicidal thoughts.

General Discussion

This project introduces knowledge about the source of negative emotions as a novel predictor of suicidal thoughts. Findings suggest that when vulnerable individuals do not know why they feel negative emotions they could be at greater risk to think about suicide. Using an EMA study design, we found across two different samples that people who currently think about suicide know less about the causes of their negative emotions compared to people with no history of suicidal

thoughts. This was evident when using a direct self-report measure and when using language processing to compare the concreteness of participants' written descriptions of the source.

We also found that people with suicidal thoughts know less about the sources of their emotions than people with comparable past year psychiatric symptoms, even when accounting for current symptoms. Based on these findings, low source attribution of emotion might uniquely characterize suicidal thinking. However, this difference was not evident in the concreteness of written descriptions of the source. One possibility is that our sample in Study 2 was too small to detect more subtle differences in the concreteness of written responses. Another possibility is that reduced source attribution of emotion also characterizes other clinical conditions. Future studies with larger samples, or with other clinical populations (e.g., major depressive disorder) can further clarify whether reduced source attribution is specific to suicidal thoughts or reflects a transdiagnostic process.

Source attribution of emotion did not only differ across people with and without suicidal thoughts. In moments when people with suicidal thoughts knew less than usual about the source of their emotions, they were more likely to think about suicide. Specifically, their chances to think about suicide increased by 23%, with every one-point reduction in their knowledge about the source. Furthermore, the less suicidal individuals knew about the source of their emotions, the more frequent and prolonged were their suicidal thoughts. However, lower source attribution did not predict the severity of suicidal thoughts. This suggests that source attribution could be related to the incidence (i.e., frequency, duration, likelihood of occurrence), but not the intensity of suicidal thoughts, which might be better predicted by the intensity of negative emotions (Bentley et al., 2021). Future research is needed to test this hypothesis. Finally, supporting our proposed mechanism, in moments when suicidal participants knew less about the source of their negative emotions, they perceived themselves as less successful in regulating them. These perceptions, in turn, predicted the occurrence of suicidal thoughts.

These findings contribute to the suicide literature by providing a more nuanced look into a factor that can undermine effective emotion regulation in suicide. This broadens the focus beyond emotion regulation strategies (Rogier et al., 2024), to consider the importance of emotional processes that precede strategy implementation. The current findings also contribute to the literature on emotional awareness (Boden & Thompson, 2015; Preece et al., 2018), by demonstrating the role of awareness to aspects of emotion in suicidal thoughts (Cha & Nock, 2009). They highlight the importance of awareness of the source of emotion (Boden & Berenbaum, 2011), and add to studies that showed the relevance of different facets of emotional awareness to clinical phenomena (Weissman et al., 2020).

The conclusions of this project could potentially advance prevention and therapeutic efforts. There is already preliminary evidence that source attribution of emotion can improve by monitoring sources of emotions over time (see the supplemental materials in Millgram et al., 2023). Therefore, increasing source attribution of emotion might prove as a viable intervention target. For instance, digital diaries or applications could be used to monitor the source of emotions. Our findings could also promote flexibility in emotion regulation (Aldao et al., 2015), by suggesting that people should tailor emotion regulation strategies to instances when the source is known versus not. When the source is known, using strategies that target the source like cognitive reappraisal might be most effective as they address the trigger for negative emotions (Millgram et al., 2023). When the source is unknown, strategies that do not target the source like acceptance might offer better outcomes. Treatments that teach emotion regulation skills typically do not differentiate between instances with low versus high source attribution (e.g., Gratz et al., 2015). Tailoring strategies to the level of source attribution of emotion can potentially contribute to regulatory selection flexibility (Specker et al., 2024).

Limitations and Future Directions

Our findings provide the first look into a new predictor of suicidal thoughts, both at the person level and at the momentary level. However, our studies have clear limitations that should be addressed in future studies. First, the results are correlational and do not demonstrate a causal relationship between source attribution of emotion and suicidal thinking. Manipulations that increase source attribution are required to test causal effects.

A second limitation is the focus on a relatively short time frame (7 days). We have no knowledge about the long-term implications of reduced source attribution of emotions. Longitudinal studies should test these implications for the onset and persistence of suicidal thoughts. Longitudinal studies can also establish the time scale in which source attribution predicts suicidal thoughts. We found that lower knowledge about the source predicts higher likelihood of momentary suicidal thoughts, as well as the frequency and duration of suicidal thoughts in the past month (Study 1) and in the past week (Study 2). However, people with past suicidal thoughts did not differ from people without such history in their source attribution. Additionally, source attribution did not predict the frequency of suicidal thoughts in the past month or year in Study 2. This suggests that low source attribution might be a proximal predictor of suicidal thoughts, rather than a stable trait of people who are vulnerable to suicidal thinking. This possibility, however, should be directly tested in future studies. Future research could also test associations between source attribution of emotion and suicidal behaviors.

Third, the current investigation did not touch upon the reasons for low source attribution of emotion. Low source attribution is likely to be shaped by person factors such as people's working memory capacity which allows simultaneous representations of current emotions and previous external or internal events (Calvo, 2001). Overgeneral memory (Hallford et al., 2021), for example, might make it harder to link emotions to specific events. Low source attribution of emotion is also likely to be shaped by situational factors, such as momentary cognitive load, and characteristics of the source itself, such as whether the source is internal or external, chronic or acute, and its temporal proximity to other potential sources. Further research is needed to distinguish between these possibilities and identify the antecedents of source attribution of emotion.

Future studies should also expand on the mechanism linking source attribution to suicidal thoughts. For instance, studies could test how repeated emotion regulation failures might accumulate to give rise to general beliefs about one's ability to control emotions. Future research should also consider other pathways from low source attribution to suicidal thinking. For example, low source attribution may reduce emotional clarity and differentiation (Barrett et al., 2001). Not knowing the source of one's negative emotions can also decrease feelings of self-coherence and might encourage attributing negative emotions to one's personality (e.g., internal attribution style; Alloy et al., 1988). Research on source misattribution suggests that not knowing the source of certain cognitions can even make them more compelling (Jacoby et al., 1989). If this is true of emotions, it might be harder to discount emotions without a known source.

Finally, we acknowledge that the observed effect sizes were typically small-medium in magnitude (i.e., $.09 \leq R^2 \leq .12$). These effect sizes are consistent with typical effect sizes in meta-analyses examining predictors of suicidal thoughts like hopelessness (McMillan et al., 2007). Findings should also be replicated using more diverse samples with respect to both gender and race/ethnicity.

To conclude, suicidal thoughts are consistently linked to perceived difficulties in regulating negative emotions (Colmenero-Navarrete et al., 2022). Our findings suggest that reduced knowledge about the source of negative emotions may contribute to these perceptions, increasing the likelihood that suicidal thoughts come to mind.

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