Emotion Regulation in Daily Life among Adults with Suicidal Thoughts

Yael Millgram[1,2]

Daniel D.L. Coppersmith [2]

Gal Sheppes[1]

Rebecca Fortgang[2]

Amit Goldenberg[2,3,4]

Matthew K. Nock[2]

[1]School of Psychological Sciences, Tel Aviv University

[2]Psychology Department, Harvard University

[3]Harvard Business School, Harvard University

[4]Digital, Digital, Data, & Design Institute, Harvard University

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Correspondence should be addressed to Yael Millgram (yaelmillgram@tauex.tau.ac.il), School of Psychological Sciences, Tel Aviv University, Ramat Aviv 6997801, Tel Aviv, Israel.

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Abstract

Background. Emotion regulation difficulties are highlighted as a risk factor for suicidal thoughts. However, little is known on how people with suicidal thoughts regulate emotions in daily life using ecologically valid methods. Prior research also rarely differentiated between emotion regulation deficits that are specifically associated with suicidal thoughts, and deficits that characterize high levels of psychopathology, regardless of suicidality.

Methods. We conducted two Ecological Momentary Assessment studies (EMA; N_1=396; N_2=195). We compared adults with current suicidal thoughts to adults with and without a history of suicidal thoughts (Study 1), and to adults with low or high levels of psychiatric symptoms (Study 2). Participants completed a week-long EMA period with 6 surveys per day, assessing emotion regulation attempts, strategies, perceived regulatory success and effort.

Results. Participants with suicidal thoughts differed from participants with high psychiatric symptoms only in their regulatory effort and in their use of alcohol or drugs to regulate emotions. Elevated use of distraction, rumination, and self-injury did not differentiate between participants with suicidal thoughts and participants with high psychiatric symptoms but no suicidality. Among participants with suicidal thoughts, self-injury and the use of substances were the only emotion regulation strategies that predicted momentary suicidal thinking.

Conclusions. Suicidal thoughts are associated with the use of less effective emotion regulation strategies and difficulties in implementing strategies in daily life. However, many difficulties are not specific to suicidal thoughts. The use of substances to regulate emotions and heightened regulatory effort may be unique to suicidal populations.

Introduction

Suicide is a leading cause of death, with over 700,000 people who died by suicide in 2019 (WHO, 2021). Suicidal behaviors are typically preceded by suicidal thoughts, with approximately 30% of people who think about suicide who attempt suicide (Nock et al., 2008). Emotion regulation difficulties are highlighted as a risk factor for suicidal thoughts (Colmenero-Navarrete et al., 2022; Raudales et al., 2020). Specifically, there is accumulating evidence for relationships between suicidal thoughts and certain emotion regulation strategies (see Rogier et al., 2024 for a meta-analysis). However, current research is constrained by several limitations.

One primary limitation is restricted ecological validity. The majority of studies on emotion regulation and suicidal thoughts used questionnaires (Hatkevich et al., 2019; Neacsiu et al., 2018; Pisani et al., 2013; Franz et al., 2021; Morrison & O'Connor, 2008). These studies revealed associations between suicidal thoughts and reduced access to emotion regulation strategies (Raudales et al., 2020; Rajappa et al., 2012; Brausch et al., 2022), increased rumination and expressive suppression (see Rogier et al., 2024), or reduced use of cognitive reappraisal (Ong & Thompson, 2019). Though informative, recent findings question the relevance of global self-report questionnaires to the same processes in daily life (Koval et al., 2023). Therefore, it is unknown whether findings obtained via questionnaires reflect how people with suicidal thoughts regulate everyday emotions. Because questionnaires assess emotion regulation retrospectively at a single time point, they are also more vulnerable to memory biases, and assess emotion regulation at a low (vs. high) resolution (Chang et al., 2018).

A handful of studies used behavioral or neurological measures to assess emotion regulation processes in the lab. Miller et al. (2018), for example, used fMRI to assess the ability of youth with and without a history of suicidal thoughts to decrease emotional reactions to

negative images. They found no group differences in reported negative affect post regulation. However, youth with a history of suicidal thoughts had greater activity in the dorsolateral prefrontal cortex (dlPFC) during regulation, reflecting greater regulatory effort. An EEG study with participants with a history of suicidal thoughts (n=10) found reduced ability to implement cognitive reappraisal to decrease negative emotion as indicated by higher Late Positive Potentials (LPPs) post regulation, compared to participants with no suicidal thought history (Kudinova et al., 2016). These studies provide valuable information suggesting that suicidal individuals may show less success or exert more effort in regulating emotions. At the same time, laboratory studies can also be limited in capturing emotion regulation in naturalistic settings (Shiffman et al., 2008). This is because laboratory studies involve artificial static stimuli as opposed to dynamic and personally relevant events (Heiy & Cheavens, 2014).

To our knowledge, no study thus far has compared emotion regulation in daily life between adults with and without suicidal thoughts using naturalistic methods. In the current studies we used participants' smartphones to collect high resolution data in their natural environment (Ecological Momentary Assessment; EMA). EMA reduces memory biases, maximizes ecological-validity and evaluates psychological processes in real world contexts (Shiffman et al., 2008).

Another limitation pertains to the specificity of findings to suicidal populations. Suicidal thoughts are usually accompanied by a wide range of psychiatric symptoms (Xu et al., 2023). Previous studies typically compared people with either current or a history of suicidal thoughts, to controls that were not matched on psychiatric symptoms (Brausch et al., 2022; Decker et al., 2019; Khazem and Anestis, 2016; Miranda et al., 2013; Rajappa et al., 2012). These comparisons do not allow to distinguish patterns of regulation that are unique to suicidal thoughts, from

patterns that characterize high levels of psychopathology, regardless of suicidality. Furthermore, some studies included participants with either current or past suicidal thoughts interchangeably (Khazem and Anestis, 2016; Kudinova et al., 2016), making it hard to distinguish between the acute stage of suicidal thinking, and trait-like patterns of regulation that characterize people with past suicidal thoughts.

To pinpoint the emotion regulation challenges that are specifically associated with the presence of suicidal thoughts, we used a two-study investigation with three comparison groups. In Study 1 we used a general population sample, and compared people with current suicidal thoughts, people with past suicidal thoughts, and people with no history of suicidal thoughts. In Study 2, we recruited people with current suicidal thoughts, people with comparable levels of psychiatric symptoms but no history of suicidal thoughts (i.e., psychiatric controls), and people with low levels of symptoms and no history of suicidal thoughts (i.e., healthy controls).

Finally, greater specificity is required to better understand the exact nature of emotion regulation impairments characterizing people with suicidal thoughts. Previous research focused on general deficits (e.g., items such as: When I'm upset, I believe there is nothing I can do to make myself feel better"; Miranda et al., 2013), or on a small set of specific regulatory strategies (e.g., cognitive reappraisal; Kudinova et al., 2016). Leading theoretical models of emotion regulation (Gross, 2015; and Sheppes et al. 2015) suggest that emotion regulation is a multi-stage process (Gross, 2015). To gain a more accurate understanding of emotion regulation in suicidal populations, there is a need to distinguish between those stages, and assess for deficits in each stage individually (Sheppes et al. 2015).

We therefore focused on three stages of regulation. Emotion regulation is initiated in response to an unwanted emotional reaction (Gross, 2015). Therefore, the first stage of

regulation is identifying the need to regulate and attempting to change one's emotional state (identification stage; Raugh & Strauss, 2021). Next, people select which emotion regulation strategies to use (selection stage; Matthews et al., 2021). Finally, people implement the selected strategies (implementation stage; Shafir et al., 2015). This stage can involve varying degrees of effort and perceived regulatory success (Scheffel et al., 2021; Wylie et al., 2023).

In the current studies we assessed emotion regulation attempts (identification stage), the use of eight emotion regulation strategies (selection stage), perceived regulatory success and effort (implementation stage). We also tested whether each emotion regulation strategy is associated with momentary suicidal thoughts in Study 2 (Stanley et al., 2021). Addressing limitations pertaining to low ecological validity and low specificity (i.e., specificity to suicidal populations; identification of the exact impairments in regulation), can provide new insight into the unique emotion regulation challenges of people who contemplate suicide.

Study 1

We used a general population sample to compare people with current suicidal thoughts, people with past suicidal thoughts and people with no history of suicidal thoughts. Participants completed a week-long EMA period assessing their emotion regulation attempts, strategies, and perceived regulation success.

Method

Data were collected as part of a larger research project (see Millgram et al., 2023). A list of all measures appears in the Supplementary Materials.

Participants.

The sample size was determined based on a power analysis described in Millgram et al., 2023 (see Supplemental Materials). Participants were 401 United States residents, aged 18 and

above, recruited through Prolific (Palan & Schitter, 2018). 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 (see pre-registration for Millgram et al., 2023), resulting in a final sample of 396 participants. Forty-three participants reported current suicidal thoughts during the past month, 129 participants reported past suicidal thoughts, and 224 participants reported no lifetime history of suicidal thoughts (see Table 1 for demographic and clinical characteristics). Suicidal thoughts were assessed using the Columbia-Suicide Severity Rating Scale (C-SSRS; Posner et al., 2008). Participants were paid $3.5 for a baseline survey with an additional $0.25 for each EMA survey, and a $1 bonus for any day they completed over four surveys. The maximum amount participants could earn was $21.

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 participants 6 surveys per-day. Five surveys were sent at random times at least 90 minutes apart between 9 am and 6:30 pm and stayed open for 1 hour. The last survey each day was sent at a random time between 8pm and 9 pm and remained open for six hours. All study procedures were approved by the Harvard University-Area Institutional Review Board (IRB# 22-0128).

Table 1. Demographics and Clinical Characteristics

	Study 1				Study 2			
	Current Suicidal thoughts (n=43)	Past suicidal thoughts (n=129)	No history of suicidal thoughts (n=224)	Statistic	Current suicidal thoughts (n=64)	Psychiatric controls (n=64)	Healthy controls (n=67)	Statistic
Age, mean (SD)	34.4 (12.0)	36.9 (11.5)	38.8 (12.2)	F=2.90	23.31 (4.62)	26.09 (5.51)	26.69 (7.47)	F=5.81*
Sex, (% female)	58.1%	57.4%	49.6%	χ^2=3.09	81.3%	84.4%	71.6%	χ^2=3.49
Race (% white)	76.7%	77.5%	73.7%	χ^2=0.71	73.4%	79.7%	70.1%	χ^2=1.60
Employment (% full or part time)	60.5%	67.0%	78.6%	χ^2=8.05*	53.1%	71.9%	67.2%	χ^2=5.30
Suicide attempt history, %	46.5%	17.8%	0%	χ^2=90.2*	32.8%	0%	0%	χ^2=48.17*
NSSI history, %	-	-	-	-	75%	32.8%	16.4%	χ^2=49.09*
GAIN-SS score, mean (SD)	-	-	-	-	10.83 (3.92)	09.86 (2.22)	2.72 (1.22)	F=230.7*

Notes. *p<0.05. Current suicidal thoughts=suicidal thoughts in the past month (Study 1), suicidal thoughts in the past week (Study 2). Suicide attempt history=percent of participants that attempted suicide at least once in their lifetime. NSSI history=percent of participants that engaged in Non-Suicidal Self-Injury at least once in their lifetime. GAIN-SS score=Global Appraisal of Individual Needs Short Screener.

Measures

Baseline Survey.

Suicidal thoughts. We used the Columbia-Suicide Severity Rating Scale (C-SSRS; Posner et al., 2008; Risk Assessment Version) to assess past-month and lifetime history of suicidal thoughts. The C-SSRS is an established and widely used measure (Mundt et al., 2013), with the electronic administration of the C-SSRS demonstrating comparable psychometric properties (Greist et al., 2014).

Ecological Momentary Assessment.

At the beginning of 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 Supplemental Materials for convergent validity, showing correlations between this measure and discrete negative emotions assessed at baseline). Next, participants reported on their emotion regulation attempts *("In the past hour, how much did you <u>try</u> to decrease your negative emotions?" 0=Not at all, 10=A lot*), and their use of emotion regulation strategies (*0=Not at all; 10=A lot*). Emotion regulation strategy items were adapted from Kalokerinos et al. (2017), Gruber et al. (2013) and Nock et al. (2009). Participants were given the following instructions: "*We will now ask you about the ways you tried to decrease your negative emotions"*. Participants rated their use of situation modification *("I took steps to change the situation I was in"*), cognitive reappraisal *("I changed the way I was thinking about the situation"*), social support *("I turned to someone close to me"*), rumination ("*I concentrated and dwelled on how I felt*"), body relaxation *("I tried to take deep breaths and relax my body*"), expressive suppression ("*I tried not to show my emotions on the outside*"), distraction ("*I*

distracted myself"), substance use ("*I drank alcohol or used drugs*"), emotional eating *("I ate something to make myself feel better*") and self-injury ("*I purposely hurt myself physically*"). Finally, if participants indicated attempts to decrease negative emotions (a non-zero response), they reported on their perceived success in regulation ("*Overall, to what extent were you able to decrease your negative emotions?*"; *0=Not at all, 10=A lot*).

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., 2013). We included random intercepts and slopes. Following Barr et al., 2013, when models did not converge, 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. Following Nakagawa & Schielzeth (2013), we calculated marginal R^2 (R^2_M), which estimates the proportion of variance explained by the fixed effects, and conditional R^2 (R^2_C), which estimates the proportion of variance explained by both fixed and random effects, using MuMIn package in R (Barton, 2009). To ensure that any group differences were not driven by differences in participants' initial emotional reactions, rather than their regulation of these reactions, in all analyses we controlled for negative emotions in the past hour (emotional reactivity; see also Raudales et al., 2020).

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=90.5%). Groups did not differ in compliance, $F(2,393)=0.65$, $p=0.525$ (82.9%, 83.4% and 83.6% compliance, for

participants with current and past suicidal thoughts, and no history of suicidal thoughts, respectively).

Identification Stage: Emotion Regulation Attempts.

We ran a multilevel regression model including only surveys when participants reported negative emotions in the past hour (non-zero responses; 5,466 surveys). Group (no suicidal thoughts history, past suicidal thoughts, current suicidal thoughts) was entered as a level-2 predictor, and regulation attempts were entered as the dependent variable. We controlled for emotional reactivity. Participants with suicidal thoughts did not differ from participants with no suicidal thought history in their regulation attempts, b=-0.08, SE=0.32, t(330.7)=-0.23, p=0.816, R^2_M=0.004, R^2_C=0.39. They also did not differ from participants with past suicidal thoughts, b=0.10, SE=0.34, t(324.9)=0.30, p=0.768, R^2_M=0.004, R^2_C=0.39.

Selection Stage: Emotion regulation strategies.

We repeated the previous analysis with each strategy as the dependent variable, including only surveys when participants indicated some level of regulation attempts (non-zero responses, 4,271 surveys). See Table 2 for a summary of the results. Participants with current suicidal thoughts used more self-injury and substances (alcohol, drugs) to regulate emotions compared to the other two groups (see Figure 1). Both participants with current and past suicidal thoughts used distraction and rumination to a greater extent compared to participants with no history of suicidal thoughts. Participants with current suicidal thoughts also used more expressive suppression compared to participants with no suicidal thought history. Groups did not differ in their use of cognitive reappraisal, situation modification, social support, body relaxation and emotional eating. This suggests that participants with suicidal thoughts did not use strategies that are considered more effective (e.g., cognitive reappraisal) to a lesser extent, but instead used

strategies that are considered less effective (e.g., substances) to a greater extent. The use of self-injury and substances was unique to the acute phase of suicidal thoughts, as it differentiated between people with current vs. past thoughts about suicide.

Implementation Stage: Perceived Emotion Regulation Success.

We repeated the previous analysis with perceived emotion regulation success as the dependent variable. Participants with both current and past suicidal thoughts perceived themselves as less successful in regulation compared to participants with no history of suicidal thoughts, b=-0.74, SE=0.31, t(317.6)=-2.38, p=0.018, R^2_M=0.07, R^2_C=0.48 for current vs. no suicidal thoughts, and b=-0.63, SE=0.21, t(312.4)=-3.02, p=0.003, R^2_M=0.07, R^2_C=0.48 for past vs. no suicidal thoughts. Participants with current suicidal thoughts did not differ from participants with past suicidal thoughts, b=-0.11, SE=0.32, t(312.6)=-0.32, p=0.746, R^2_M=0.07, R^2_C=0.48, suggesting that lower perceived success is a trait-like characteristic of people with a history of suicidal thoughts and not unique to the acute stage of suicidal thinking.

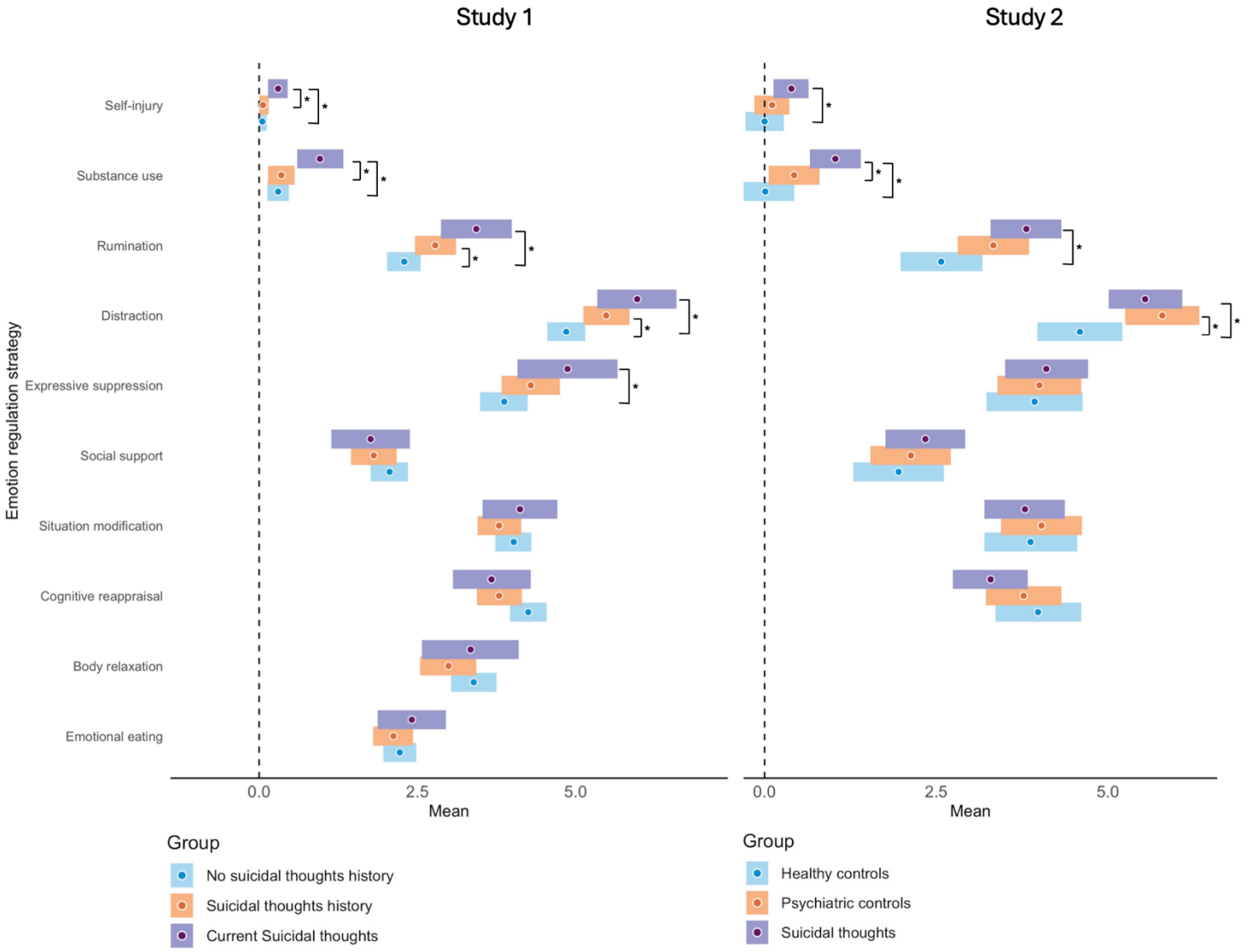

Figure 1. Differences in emotion regulation strategy use in daily life as a function of group. Participants with current suicidal thoughts used more self-injury, substance-use, rumination and distraction compared to healthy controls or people with no history of suicidal thoughts. They differed from psychiatric controls only in their use of substances (alcohol, drugs) to regulate emotions, and from people with past suicidal thoughts in their use of self-injury and substances. Error bars represent 95% Confidence Intervals around the mean.

Table 2. Emotion regulation strategies in daily life as a function of group

Strategy	Study 1								Study 2							
	Current Suicidal thoughts *M* (*SE*)	**Past suicidal thoughts** *M* (*SE*)	**No suicidal thoughts** *M* (*SE*)	**Predictor**	*b*	*SE*	*t*	*p*	**Current Suicidal thoughts** *M* (*SE*)	**Psychiatric controls** *M* (*SE*)	**Healthy controls** *M* (*SE*)	**Predictor**	*b*	*SE*	*t*	*p*
Self-Injury	.31 (.08)	.07 (.04)	.05 (.04)	Current vs. no suicidal thoughts	**.26**	**.09**	**3.01**	**.003**	.39 (.13)	.11 (.13)	.00 (.14)	Suicidal vs. healthy controls	**.39**	**.19**	**2.02**	**.044**
				Current vs. past suicidal thoughts	**.24**	**.09**	**2.67**	**.008**				Suicidal vs. psychiatric controls	.28	.18	1.65	.120
				Past vs. no suicidal thoughts	.02	.06	.33	.741				Healthy vs. psychiatric controls	.11	.19	.55	.581
Substance-use	.96 (.18)	.35 (.11)	.30 (.09)	Current vs. no suicidal thoughts	**.66**	**.20**	**3.26**	**.001**	1.03 (.19)	.43 (.19)	.01 (.21)	Suicidal vs. healthy controls	**1.02**	**.28**	**3.65**	**<.001**
				Current vs. past suicidal thoughts	**.62**	**.21**	**2.90**	**.004**				Suicidal vs. psychiatric controls	**.60**	**.26**	**2.30**	**.023**
				Past vs. no suicidal thoughts	.05	.14	.34	.731				Healthy vs. psychiatric controls	.42	.28	1.49	.139
Rumination	3.43 (.29)	2.78 (.17)	2.29 (.14)	Current vs. no suicidal thoughts	**1.14**	**.32**	**3.59**	**<.001**	3.81 (.26)	3.33 (.26)	2.57 (.30)	Suicidal vs. healthy controls	**1.23**	**.39**	**3.13**	**.002**
				Current vs. past suicidal thoughts	.64	.33	1.94	.053				Suicidal vs. psychiatric controls	.48	.36	1.31	.193
				Past vs. no suicidal thoughts	**.49**	**.21**	**2.30**	**.022**				Healthy vs. psychiatric controls	.76	.40	1.91	.057
Distraction	5.96 (.32)	5.47 (.19)	4.83 (.15)	Current vs. no suicidal thoughts	**1.13**	**.35**	**3.18**	**.002**	5.54 (.27)	5.79 (.27)	4.59 (.31)	Suicidal vs. healthy controls	**.95**	**.41**	**2.31**	**.022**
				Current vs. past suicidal thoughts	.49	.37	1.31	.190				Suicidal vs. psychiatric controls	-.25	.38	-.66	.511
				Past vs. no suicidal thoughts	**.64**	**.24**	**2.68**	**.008**				Healthy vs. psychiatric controls	**1.20**	**.41**	**2.91**	**.004**
Expressive suppression	4.87 (.40)	4.29 (.23)	3.87 (.19)	Current vs. no suicidal thoughts	**1.00**	**.44**	**2.26**	**.024**	4.10 (.31)	4.00 (.31)	3.93 (.36)	Suicidal vs. healthy controls	.17	.47	.37	.712
				Current vs. past suicidal thoughts	.58	.47	1.25	.211				Suicidal vs. psychiatric controls	.13	.43	.30	.763
				Past vs. no suicidal thoughts	.42	.30	1.40	.162				Healthy vs. psychiatric controls	.07	.47	.15	.878
Social support	1.76 (.32)	1.81 (.18)	2.06 (.15)	Current vs. no suicidal thoughts	-.30	.35	-.85	.397	2.34 (.29)	2.13 (.30)	1.95 (.34)	Suicidal vs. healthy controls	.18	.44	.40	.693
				Current vs. past suicidal thoughts	-.05	.37	-.14	.892				Suicidal vs. psychiatric controls	.21	.41	.51	.610
				Past vs. no suicidal thoughts	-.25	.24	-1.05	.297				Healthy vs. psychiatric controls	.39	.44	.87	.383

Situation modification	4.12 (.30)	3.79 (.18)	4.02 (.14)	Current vs. no suicidal thoughts	.10	.33	.31	.754	3.79 (.30)	4.03 (.30)	3.87 (.34)	Suicidal vs. healthy controls	-.09	.45	-.20	.846
				Current vs. past suicidal thoughts	.33	.35	.94	.348				Suicidal vs. psychiatric controls	-.24	.42	-.59	.558
				Past vs. no suicidal thoughts	-.22	.23	-.99	.324				Healthy vs. psychiatric controls	.16	.45	.35	.729
Cognitive reappraisal	3.67 (.31)	3.79 (.18)	4.25 (.15)	Current vs. no suicidal thoughts	-.58	.35	-1.67	.095	3.29 (.28)	3.77 (.28)	3.98 (.32)	Suicidal vs. healthy controls	-.69	.42	-1.7	.097
				Current vs. past suicidal thoughts	-.12	.36	-.34	.733				Suicidal vs. psychiatric controls	-.48	.39	-1.3	.215
				Past vs. no suicidal thoughts	-.46	.23	-1.95	.052				Healthy vs. psychiatric controls				
Body relaxation	3.34 (.39)	2.99 (.23)	3.39 (.18)	Current vs. no suicidal thoughts	-.05	.43	-.12	.905	-	-	-		-	-	-	-
				Current vs. past suicidal thoughts	.35	.45	.77	.442					-	-	-	-
				Past vs. no suicidal thoughts	-.40	.29	-1.36	.174					-	-	-	-
Emotional eating	2.46 (.28)	2.12 (.16)	2.23 (.13)	Current vs. no suicidal thoughts	.23	.31	.75	.455	-	-	-		-	-	-	-
				Current vs. past suicidal thoughts	.34	.32	1.06	.292					-	-	-	-
				Past vs. no suicidal thoughts	-.11	.21	-.52	.605					-	-	-	-

Study 2

In Study 2 we compared people with current suicidal thoughts to psychiatric controls (i.e., participants matched on psychiatric symptoms) and healthy controls. To broaden the focus on the implementation stage of regulation, we also assessed emotion regulation effort (Miller et al., 2018). Finally, we tested whether each emotion regulation strategy predicted momentary suicidal thinking.

Method

Participants.

The sample size was determined based on a power analysis described in Millgram et al., 2024 (see Supplemental Materials). Participants were recruited based on their responses to a screening survey assessing their lifetime and past-week suicidal thoughts and a well-validated measure for psychiatric symptoms (GAIN-SS; Dennis et al., 2006). 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*). These types of items were used in past research to measure active suicidal ideation (Millner et al., 2015).

Psychiatric symptoms were assessed using the Global Appraisal of Individual Needs Short Screener (GAIN-SS; α=0.90 in the current sample; Dennis et al., 2006). The screener includes an internalizing disorder sub-screener (α=0.88 in the current sample), an externalizing disorder sub-screener (α=0.78 in the current sample), a substance disorder sub-screener (α=0.86 in the current sample), and a crime/violence sub-screener (α=0.66 in the current sample).

The screening survey was distributed on Prolific. Eligible participants were invited to the main study beginning the next day. We invited participants who had suicidal thoughts in the past week, participants with comparable levels of past-year psychiatric symptoms but no history of suicidal thoughts (i.e., psychiatric controls), and participants with low symptom-levels (GAIN-SS≤3) and no history of suicidal thoughts (i.e., healthy controls). Suicidal thoughts were assessed again in the main study. We removed participants with inconsistent responding (Klimes-Dougan et al., 2022): 10 participants who were recruited to the suicidal group but reported no past-week suicidal thoughts in the main study, 6 participants who were recruited to the psychiatric control group, but reported a history of suicidal thoughts in the main study, and 5 participants who were recruited to the healthy control 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 embedded in the EMA surveys on days 3, 5 and 7.

The final sample included 195 participants. Sixty-seven healthy controls (N=67, $M_{GAIN-SS}$=2.72, $SD_{GAIN-SS}$=1.22); 64 psychiatric controls (N=64, $M_{GAIN-SS}$=10.86, SD_{GAINSS}=2.22), and 64 participants who reported suicidal thoughts within the past week (N=64, $M_{GAIN-SS}$=11.83, $SD_{GAIN-SS}$=3.92). Groups differed in their psychiatric symptoms, $F(2,192)=230.7$, $p<0.001$, such that healthy controls reported significantly less symptoms compared to the other two groups ($CI_{95\%}$[8.01, 10.22], $p<0.001$, compared to suicidal participants, and $CI_{95\%}$[7.04, 9.25], $p<0.001$ compared to psychiatric controls). As intended, psychiatric controls and participants with current suicidal thoughts did not differ in their symptom levels, $CI_{95\%}$[-0.15, 2.09], $p=0.104$, but differed with respect to experiencing suicidal thoughts (See Table 1 for demographic and clinical characteristics).

Procedure

The study included a baseline survey followed by a 7-day EMA period. Participants downloaded the same app (Metricwire) that sent them 6 surveys per-day. Five surveys were sent at random times at least 90 minutes apart between 9am and 7pm and stayed open for 1 hour. The last survey each day was sent at a random time between 8pm and 9pm and remained open for six hours. Participants were paid $15 for the baseline survey. The payment structure for the EMA was identical to Study 1. At the end of each survey, participants were provided with resources for treatment and safety. All procedures were approved by the Harvard University-Area Institutional Review Board (IRB# 21-0422).

Measures

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; Nock et al., 2007).

Ecological Momentary Assessment.

The EMA measures were identical to Study 1 with the following exceptions. There were slight differences in the items assessing rumination (*"I concentrated and dwelled on the situation"*), and expressive suppression (*"I tried not to express my negative feelings"*). Study 2 did not include items assessing emotional eating and body relaxation. To assess regulatory effort, if participants tried to decrease their negative emotions, they rated how effortful in was for them ("*Overall, how much effort it took for you to decrease your negative emotions?*"; *0=Not at all, 10=A lot*). Finally, similar to Kleiman et al., (2017), to assess momentary suicidal thoughts, participants rated their current 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*).

Analytic Approach

Our analytic approach was identical to Study 1.

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; Median=76.2%). Groups did not differ in their compliance rate, $F(2,192)=1.78$, $p=0.172$ (61.4%, 66.4% and 72.6% for participants with suicidal thoughts, psychiatric and healthy controls, respectively).

Identification Stage: Emotion regulation attempts

We ran a multilevel regression model including only surveys when participants reported negative emotions in the past hour (non-zero responses; 1,780 surveys). Group (low symptoms, high symptoms, suicidal thoughts) was entered as a level-2 predictor, and regulation attempts as the dependent variable. We controlled for emotional reactivity. We did not find group differences between participants with suicidal thoughts and healthy controls, $b=-0.65$, $SE=0.38$, $t(179.3)=-1.70$, $p=0.091$, $R^2_M=0.03$, $R^2_C=0.40$, or psychiatric controls, $b=-0.36$, $SE=0.35$, $t(154.2)=-1.04$, $p=0.301$, $R^2_M=0.03$, $R^2_C=0.40$, indicating that people with suicidal thoughts did not differ in their emotion regulation attempts.

Selection Stage: Emotion regulation strategies

We repeated the previous analysis with each strategy as the dependent variable, including only surveys when participants indicated some level of regulation attempts (non-zero responses, 1,327 surveys). See Table 2 for a summary of the results. Participants with suicidal thoughts differed from psychiatric controls only in their use of substances like alcohol and drugs to

regulate emotions (see Figure 2). Both participants with suicidal thoughts and psychiatric controls used distraction to a greater extent compared to healthy controls. People with suicidal thoughts also used more rumination, self-injury and substances compared to healthy controls. Groups did not differ in their use of cognitive reappraisal, situation modification, social support, and expressive suppression.

Implementation Stage: Perceived Emotion Regulation Success and Effort

We repeated the previous analysis with perceived emotion regulation success and effort as dependent variables. Participants with suicidal thoughts reported less success in regulation (M=3.97, SE=0.23) compared to healthy controls (M=4.95, SE=0.27), b=-0.98, SE=0.35, t(164.4)=-2.81, p=0.006, R^2_M=0.04, R^2_C=0.38. Psychiatric controls (M=4.56, SE=0.23) did not significantly differ from people with suicidal thoughts, b=-0.59, SE=0.33, t(148.8)=-1.82, p=0.072, R^2_M=0.04, R^2_C=0.38, or healthy controls b=-0.39, SE=0.35, t(164.8)=-1.11, p=0.269, R^2_M=0.04, R^2_C=0.38. Participants with suicidal thoughts also reported more effort in regulation (M=5.91, SE=0.20) compared to healthy controls (M=4.86, SE=0.24), b=1.05, SE=0.31, t(155.8)=3.37, p<0.001, R^2_M=0.13, R^2_C=0.42, and psychiatric controls (M=5.29, SE=0.21), b=0.62, SE=0.29, t(138.3)=2.14, p=0.034, R^2_M=0.13, R^2_C=0.42, even after accounting for the intensity of the negative emotions being regulated (see Figure 3B).

Prediction of momentary suicidal thoughts

We ran models with each emotion regulation strategy (rated with respect to the past hour) as the independent variable and the intensity of current suicidal thoughts (rated with respect to the present moment) as the dependent variable, including only participants in the suicidal group.

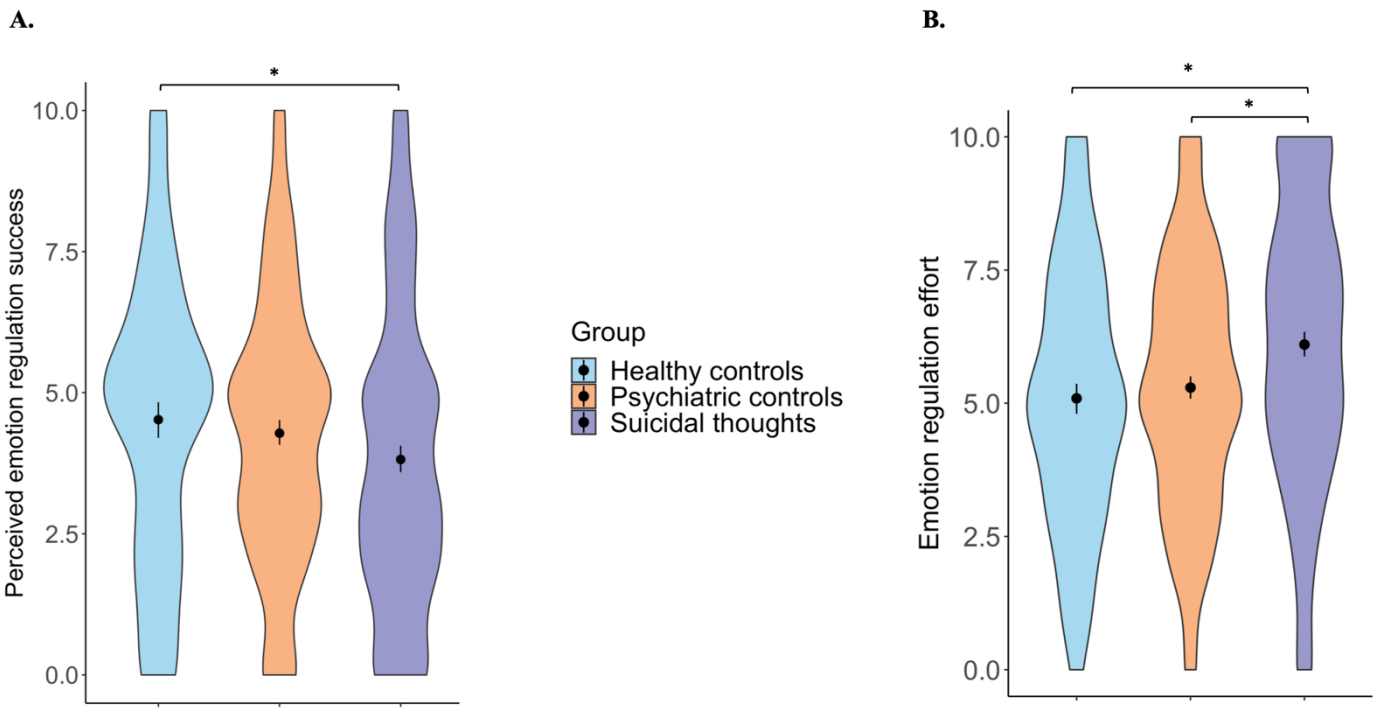

Figure 2. Differences in perceived emotion regulation success (Panel A) and effort (Panel B) as a function of group (Study 2). Participants with current suicidal thoughts reported emotion regulation to be less successful and more effortful compared to people with low levels of psychiatric symptoms. They differed from people with high psychiatric symptoms in their emotion regulation effort but not in their perceived success in regulation. Error bars represent +- SE from the mean.

We controlled for past hour negative emotion and for suicidal thoughts at the previous time point. We did not include previous time points if they were not at the same day as the current time point. A summary of the results appears in Table 3. Substance-use and self-injury predicted elevated suicidal thoughts, above and beyond past-hour negative emotion and previous suicidal thoughts. Cognitive reappraisal, situation modification, social support, distraction,

rumination, and expressive suppression did not predict suicidal thoughts after accounting for negative emotions and previous suicidal thoughts.

Table 3. Prediction of suicidal thoughts in real time by emotion regulation strategies

Variable	Predictor	*b*	*SE*	*t*	*p*
Self-injury	Self-injury (past hour)	**.39**	**.09**	**4.27**	**.004**
	Negative emotion (past hour)	**.18**	**.04**	**4.61**	**<.001**
	Suicidal thoughts at previous time point	.006	.04	.16	.876
Substance-use	Substance use (past hour)	**.12**	**.03**	**3.63**	**<.001**
	Negative emotion (past hour)	**.17**	**.04**	**4.23**	**<.001**
	Suicidal thoughts at previous time point	.12	.06	1.96	.068
Rumination	Rumination (past hour)	-.01	.02	-.68	.500
	Negative emotion (past hour)	**.18**	**.04**	**4.52**	**<.001**
	Suicidal thoughts at previous time point	.10	.06	1.66	.115
Distraction	Distraction (past hour)	.03	.02	1.66	.097
	Negative emotion (past hour)	**.18**	**.04**	**4.45**	**<.001**
	Suicidal thoughts at previous time point	.09	.06	1.54	.142
Expressive suppression	Expressive suppression (past hour)	.007	.02	.44	.661
	Negative emotion (past hour)	**.18**	**.04**	**4.44**	**<.001**
	Suicidal thoughts at previous time point	.10	.06	1.70	.109
Social support	Social support (past hour)	.02	.02	1.16	.246
	Negative emotion (past hour)	**.17**	**.04**	**4.35**	**<.001**
	Suicidal thoughts at previous time point	.10	.06	1.68	.112
Situation modification	Situation modification (past hour)	-.02	.02	-1.20	.231
	Negative emotion (past hour)	**.18**	**.04**	**4.52**	**<.001**
	Suicidal thoughts at previous time point	.10	.06	1.71	.107
Cognitive reappraisal	Cognitive reappraisal (past hour)	-0.04	.02	-1.92	.056
	Negative emotion (past hour)	**.18**	**.04**	**4.49**	**<.001**
	Suicidal thoughts at previous time point	.10	.06	1.75	.099

General Discussion

Do people with suicidal thoughts differ in whether and how they regulate emotions in daily life? The current project addressed this question by using EMA methods across two adult samples. We found that adults with suicidal thoughts did not differ from controls in their emotion regulation attempts. They also did not use strategies that are typically considered more effective (i.e., cognitive reappraisal, situation modification, social support) to a lesser extent than controls. Instead, compared to healthy controls, suicidal individuals were more likely to use distraction,

rumination, expressive suppression, self-injury, and substances like alcohol or drugs to regulate emotions.

Furthermore, people with suicidal thoughts perceived themselves to be less successful in regulation, and reported more effort in doing so, compared to healthy controls. These findings point to an effort-success gap in emotion regulation (Gruber et al., 2012), as participants with suicidal thoughts experienced reduced success despite their greater efforts. These findings also converge with laboratory studies finding reduced regulation efficacy, and heightened effort, among people with a history of suicidal thoughts (Kudinova et al., 2016; Miller et al, 2018).

At the same time, the observed patterns are not necessarily specific to suicidal thoughts. To test for specificity, we compared people with current suicidal thoughts to people with similar levels of psychiatric symptoms. We found that many emotion regulation difficulties are not specific to suicidality (e.g., increased use of rumination, expressive suppression, and distraction, reduced perceived success in regulation). However, some unique characteristics emerged. Adults with suicidal thoughts were more likely to use substances to regulate emotions, and experienced greater effort, even when compared to psychiatric controls. These findings highlight the use of alcohol or drugs and elevated regulatory effort, as emotion regulation processes that are specifically associated with suicidal thinking. Finally, substance use and self-injury were the only strategies predicting momentary suicidal thoughts within the suicidal group. They also differentiated people with current vs. past suicidal thoughts. This further emphasizes the potential role of substance use and self-injury in exacerbating suicidal thinking.

Findings also provide a nuanced examination of deficits at different stages of emotion regulation. They suggest that suicidal thoughts are not associated with deficits in the identification stage (Gross, 2015), as adults with suicidal thoughts did not differ from controls in

their emotion regulation attempts. However, suicidal thoughts were associated with emotion regulation strategies that are typically considered less effective like self-injury and substance use (selection stage) and with less success and more effort in implementing strategies (implementation stage). These findings are consistent with behavioral findings showing that adolescents who self-injure were able to generate similar solutions to non-injurers in a problem solving task, but chose to use more negative solutions and had lower self-efficacy in implementing better solutions (Nock & Mendes, 2008).

These findings can therefore encourage researchers and clinicians to focus on the selection and implementation stages of emotion regulation. Clinicians can focus on helping patients to notice which strategies they use, and reduce their dependence on strategies that can exacerbate suicidal thinking (e.g., substances) (DeCou et al., 2019). Interventions that target strategy selection could also be incorporated in just-in-time interventions for suicide prevention (Coppersmith et al., 2022). Future research could also try to support suicidal individuals' implementation of emotion regulation strategies. For instance, training in using cognitive reappraisal (Denny & Ochsner, 2014) can potentially reduce the amount of effort invested in regulation and increase regulatory success.

Limitations and Future Directions

The current project provides a descriptive overview of emotion regulation in daily life among adults with suicidal thoughts. However, the studies also have several limitations. First, results are correlational. Therefore, causal conclusions on the role of emotion regulation in the development of suicidal thinking cannot be drawn. Longitudinal studies or studies that manipulate strategy selection or implementation are needed to test causal effects.

Second, participants self-reported on their emotion regulation in each time point. Self-reports can be vulnerable to response biases, and therefore future studies should integrate behavioral measures with self-report measures. We also used community samples. Future studies should test whether findings generalize to inpatient samples.

Future research should also elucidate the role of emotion regulation effort in suicidal thoughts. There is now converging evidence across daily life and neurological assessments that suicidal individuals exert more effort in regulating emotions (Miller et al, 2018). However, it remains unclear what is the exact nature of effort in this context (e.g., the use of more strategies; limited cognitive resources; Wolpe, et al., 2024). Future studies can target the underlying cognitive processes that give rise to effortful emotion regulation in suicidal individuals (Franz et al., 2023).

To conclude, this study is the first to assess multiple emotion regulation processes in adults with suicidal thoughts using naturalistic methods. This takes us a step further in understanding what are the specific emotion regulation challenges people with suicidal thoughts encounter. Ultimately, this knowledge could help identify how these challenges can be better addressed.

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