



Research paper

Before the attempt: How people think and plan in suicide crises

Irene Xu^{a,*}, Ross Jacobucci^b, Brooke A. Ammerman^a^a Department of Psychology, University of Wisconsin-Madison, Madison, WI, USA^b Center for Healthy Minds, University of Wisconsin-Madison, Madison, WI, USA

ARTICLE INFO

Keywords:

Suicide attempt
Proximal cognitive process
Suicide planning
Suicide contemplation
Reasons for living and dying
Machine learning

ABSTRACT

Cognitive processes preceding suicidal attempts (SA) remain poorly understood, particularly in distinguishing those who act on suicidal thoughts from those who do not. This study compared proximal contemplation and planning processes during suicidal crises that ended in suicide attempts (SA+, $n = 417$) versus those that involved suicide planning but did not end up in an attempt (SP+, $n = 191$). Participants reported on the degree and timing of reasons for dying (RFD), reasons for living (RFL), mulling, and planning features. In both groups, ideation and mulling typically began 3–12 h before the episode's endpoint, and all planning features typically began 1–3 h prior. Planning preceded 66 % of attempts when measured with a single-item and 89 % when defined by considering any one of the three components (i.e., method, location, or time). Mulling was reported in 72 % of SA+ episodes and 84 % of SP+ episodes. Machine learning models identified top contemplation features associated with classification in the SA+ group: (1) heightened focus on RFD, (2) absence of mulling, (3) greater consideration of beliefs that encourage suicide, (4) lower consideration of personal responsibilities as RFL, and (5) shorter mulling duration. For planning features, SA+ classification was associated with (1) earlier method decision, (2) later location decision, (3) later location consideration, and (4) lower plan specificity. By capturing the content, intensity, and duration of contemplation and planning during crises, these findings reveal how specific cognitive patterns may inform behavioral risk and highlight the value of precise measurement in understanding suicide decision-making.

1. Introduction

Suicide is a leading cause of death worldwide (World Health Organization, 2019), yet cognitive processes immediately preceding suicidal behavior remain poorly understood. While research identified distal and proximal factors such as negative affect, life stressors, and alcohol use that often precede a suicide attempt (SA) by hours (Bagge et al., 2013a, 2014, 2017, 2023; King et al., 2024), little is known about the cognitions that drive the progression to suicidal behavior during crisis moments (Britton et al., 2012). During a crisis, individuals may weigh reasons for and against suicide, or focus on how to carry out an attempt and consider the practical steps. These processes drive consequential decisions, making them essential targets for intervention.

Much prior research has treated such cognitive processes as a unitary process, but increasing evidence points to the importance of distinguishing between its dimensions. Factor analysis identified suicidal desire and planning as separable constructs, each independently associated with risk for suicidal behavior (Joiner Jr et al., 2003), and

subsequent research supported the value of parsing cognition during crisis into specific elements (e.g., Bagge et al., 2013b; Chalker et al., 2015). In line with this, the present study adopts a framework that differentiates contemplation (i.e., thinking about *whether* to attempt suicide) and planning (i.e., thinking about *how* to attempt suicide), to better understand the cognitive processes leading up to SA.

Within each process, two commonly conflated dimensions — degree and duration — are assessed separately. Degree reflects the cognitive effort exerted and the number of relevant factors considered, while duration reflects the time spent engaging in contemplation or planning (Oxford University Press, 2023, 2024). These aspects may vary independently; for instance, one person might contemplate briefly but consider multiple factors, while another might contemplate for weeks with a narrower focus. This distinction is crucial, as many suicide prevention strategies encourage individuals to thoroughly explore reasons for living and prolong contemplation, based on the premise that deeper reflection reduces imminent risk and extended duration allows more time for intervention (Britton et al., 2012; Brown et al., 2005; Linehan

* Corresponding author at: Department of Psychology, University of Wisconsin-Madison, 1202 W Johnson St, Madison, WI 53706, USA.

E-mail addresses: mxu226@wisc.edu (I. Xu), jacobucci@wisc.edu (R. Jacobucci), baammerman@wisc.edu (B.A. Ammerman).

<https://doi.org/10.1016/j.jad.2025.119660>

Received 9 January 2025; Received in revised form 6 June 2025; Accepted 9 June 2025

Available online 11 June 2025

0165-0327/© 2025 Elsevier B.V. All rights reserved, including those for text and data mining, AI training, and similar technologies.

et al., 2006). However, research on decision fatigue suggested that prolonged contemplation can impair decision-making by overwhelming cognitive capacity (Baumeister et al., 2008). For example, prolonged contemplation may lead to stronger reasons for dying, and the act of thinking itself may be overwhelming and make suicide more likely. Clarifying the characteristics of proximal suicidal cognition may help explain why contemplation and planning is linked to reduced risk in some cases and elevated risk in others.

1.1. Prevalence of contemplation and planning

Estimates of contemplation prevalence prior to SA ranged from 36 to 87 %, depending on how it was defined. Lower estimates (36–54 %) defined contemplation as suicidal ideation (SI) beginning at least 3 h before the attempt (Bagge et al., 2013b; Spokas et al., 2012). Higher estimates (up to 87 %) used broader definitions, such as any consideration of the potential consequences of suicide (Xu et al., 2024). Intermediate rates (59–60 %) emerged when contemplation was defined as “mulling” or strongly considering whether to attempt suicide (Heesen et al., 2024; Millner et al., 2017). These discrepancies highlight the heterogeneous operationalization of contemplation across studies.

Measurement variability in suicide planning (SP) is similarly reflected in its wide prevalence estimates. Planning prevalence ranged from 28 to 72 % when using single-item questions such as “Have you made a plan to kill yourself?” (Bornheimer et al., 2023; Kessler et al., 1999, 2005; Nock et al., 2008). Studies assessing specific components of planning, such as method, location, or timing, found that 63 % of individuals with SI who denied planning still considered a method, and 38 % thought about a location (Millner et al., 2015). Definitions that counted any one of these components as evidence of planning yielded higher prevalence ranges (Fox et al., 2020). These patterns illustrate how definitional precision may influence estimates and complicate cross-study comparisons.

1.2. Duration of contemplation and planning

Discrepancies in how contemplation and planning were measured extend to their timescale, which also varies widely across studies. For contemplation, studies of individuals hospitalized or recently discharged after an SA found short timelines: Deisenhammer et al. (2009) found that half contemplated for <10 min before their attempt; Kattimani et al. (2016) reported that half reported contemplating for <30 min before attempts; and Wasserman et al. (2008) found that most contemplated for less than one day. In contrast, Millner et al. (2017) reported longer timelines among inpatients, with SI beginning about two weeks prior, mulling 6 h before, and the decision to attempt made 5 min before SA. Heesen et al. (2024) observed the longest timelines, with SI starting two months before, mulling three weeks prior, and the decision made 1 h before SA. These extended timelines may partly reflect sampling differences, as Heesen et al. (2024) recruited community participants without acute suicidality.

For the timescale of planning, Millner et al. (2017) found that on average, planning started 2 h before the attempt, with the final decision made 30 min prior. Similarly, Bagge et al. (2013b) observed that two-thirds of planning began within 3 h of the attempt among individuals hospitalized for recent SA. Conversely, Heesen et al. (2024) reported much longer timelines, with average planning beginning six years before the attempt in a community sample.

1.3. Degree of contemplation and specificity of planning

Preliminary evidence supported the distinction between the duration and degree of contemplation. Xu et al. (2024) assessed the degree of contemplation prior to SA by evaluating consideration of six commonly reported consequences (e.g., impact on family and friends). Results suggested that the overall degree of contemplation, defined as the

summed consideration of all factors, was not associated with the duration of contemplation. Interestingly, those who aborted their attempt spent more time mulling if they had extensively considered reasons for dying (RFD; as opposed to reasons for living, RFL; Jobs and Mann, 1999), whereas those who attempted were more likely to mull for longer if they thought less about RFD. These findings suggest that the duration and degree of contemplation could be distinct and independently related to the suicide risk, though replication is needed.

Recent studies started to quantify the specificity of suicide planning. When suicide planning was defined as having detailed three plan components (i.e., method, location, and time), individuals specifying all components were twice as likely to attempt suicide within 28 days compared to those who only specified a method (Linthicum and Ribeiro, 2022). Similarly, among adolescents, having a more detailed plan was associated with higher odds of reporting a history of suicidal behavior (Beaton et al., 2023). Assessing planning specificity provides insight into risk beyond the presence of a plan.

1.4. Current study

Improving intervention efforts requires a better understanding of how people think and plan in the moments leading up to suicidal behavior. This study investigates the processes of contemplation and planning during suicide crises, assessing both their degree and duration in relation to whether individuals proceeded with a suicide attempt. Specifically, we (1) describe the presence, degree, and duration of contemplation; (2) identify characteristics of contemplation associated with attempting suicide by examining individuals who attempted and those who planned but did not attempt; (3) describe the presence, specificity, and duration of planning; and (4) investigate which planning characteristics are associated with group classification (i.e., attempted vs. planned but did not attempt).

2. Method

2.1. Participants

Participants were 608 adults recruited from CloudResearch, a high-quality online research platform (Douglas et al., 2023). Eligible participants were at least 18 years old, had made a suicide plan that did not end in an attempt (SP+ group, $n = 191$) or made a suicide attempt (SA+ group, $n = 417$) within the past five years, and rated their recall of the event at least “moderately well” (≥ 3 on a 1–5 scale). Participants completed surveys on their own digital devices and were compensated. Validity checks included bot detection, attention checks, reasonable response times, and age-appropriate reporting of SI, SP, or SA onset (Peterson et al., 2024). Demographic comparisons showed that compared to the SA+ group, the SP+ group was older, more likely to identify as heterosexual, and less likely to identify as Hispanic (Table 1).

2.2. Measures

2.2.1. History of self-injurious thoughts and behaviors

Participants completed the self-report version of the Self-Injurious Thoughts and Behaviors Interview-Revised (SITBI-R; Fox et al., 2020) that assessed the lifetime presence and frequency of non-suicidal self-injury (NSSI), SP, and SA. The SITBI-R has good test-retest reliability and convergent validity, and has been widely used in research studies (Fox et al., 2020; Nock et al., 2007).

2.2.2. Proximal contemplation and planning

No validated measure of suicide contemplation and planning that assesses both degree and duration exists. Previous studies examined aspects of contemplation and planning but have primarily focused on duration (e.g., Bagge et al., 2013b). Thus, this study utilized newly developed self-reported items adapted from established measures (e.g.,

Table 1
Characteristics of demographics, past SITB, and the recent suicidal episode.

	SA+ Group n = 417	SP+ Group n = 191	Full sample n = 608	p	Effect size
Age, <i>M</i> (<i>SD</i>)	38.53 (12.40)	43.71 (15.06)	40.16 (13.50)	<.001	0.39 ^a
Gender, % (<i>n</i>)				.32	0.06 ^b
Woman	54.20 (226)	56.02 (107)	54.77 (333)		
Man	36.45 (152)	36.65 (70)	36.51 (222)		
Trans/non-binary/queer	8.15 (34)	4.71 (9)	7.07 (43)		
Sexual orientation, % (<i>n</i>)				.039	0.08 ^b
Heterosexual	70.98 (296)	79.06 (151)	73.52 (447)		
LGB+	28.78 (120)	20.42 (39)	26.15 (159)		
Race, % (<i>n</i>)				.24	0.16 ^b
White	74.34 (310)	80.63 (154)	76.32 (464)		
Black/African	21.82 (91)	18.85 (36)	20.89 (127)		
American Indian/Alaska Native	4.80 (20)	1.57 (3)	3.78 (23)		
Asian	2.16 (9)	0.52 (1)	1.64 (10)		
Native Hawaiian/Pacific Islander	0.72 (3)	0 (0)	0.49 (3)		
Hispanic/Latino, % (<i>n</i>)	15.83 (66)	8.90 (17)	13.65 (83)	.026	0.09 ^b
Years of education, <i>M</i> (<i>SD</i>)	13.99 (2.11)	13.99 (1.91)	13.99 (2.05)	.98	0.00 ^a
Past SITB					
NSSI, % (<i>n</i>)	72.66 (303)	60.73 (116)	68.91 (419)	.003	0.12 ^a
Suicide plan, % (<i>n</i>)	78.18 (326)	96.86 (185)	84.05 (511)	<.001	0.23 ^a
Suicide attempt, % (<i>n</i>)	86.57 (361)	25.65 (49)	67.43 (410)	<.001	0.60 ^a
Recency of the recent episode, % (<i>n</i>)				.007	0.14 ^b
0–6 months	24.94 (104)	38.22 (73)	29.11 (177)		
6–12 months	23.98 (100)	17.28 (33)	21.88 (133)		
1–2 years	22.54 (94)	17.80 (34)	21.05 (128)		
3–5 years	28.54 (119)	26.70 (51)	27.96 (170)		
Primary method in recent episode, % (<i>n</i>)					
Overdose	49.40 (206)	47.12 (90)	48.68 (296)		
Cutting/stabbing	23.26 (97)	9.42 (18)	18.91 (115)		
Firearms	3.12 (13)	9.42 (18)	5.10 (31)		
Hanging	4.56 (19)	7.85 (15)	5.59 (34)		
Crashing a car	2.40 (10)	5.76 (11)	3.45 (21)		
Suffocation	5.04 (21)	1.57 (3)	3.95 (24)		
Hit by train/car	2.88 (12)	4.71 (9)	3.45 (21)		
Other	10.79 (45)	16.75 (32)	12.66 (77)		

Years of Education: Less than high school = 8, Some high school = 10; High school/GED = 12, Some college/Technical School = 14, College = 16, Graduate degree = 18. Past SITB does not include the most recent episode. SITB = self-injurious thoughts and behaviors, NSSI = non-suicidal self-injury, SI = suicidal ideation, SP = suicide planning, SA = suicide attempt. The primary methods that did not have at least 5 % endorsement within either group were grouped into the “Other” category.

^a Cohen's *d*.

^b Cramér's *V*.

Pathway to Suicidal Action Interview, Millner et al., 2017; Reasons for Living Inventory, Linehan et al., 1983) to comprehensively assess contemplation and planning occurring in the context of the most recent suicidal episode. Participants were instructed to focus on their *most recent* suicidal episode (SA for the SA+ group; SP for the SP+ group) when answering survey questions. They first recalled an endpoint for the episode: SA+ group identified the point when they began acting (e.g., consuming pills), and SP+ group identified when they decided not to attempt or moved on to other activities. Visual aids illustrated the progression from contemplation and planning to the end of the suicidal episode, with figures highlighting specific steps (e.g., mulling, deciding on the method). See Supplement A–D for all items and visual aids.

2.2.2.1. Contemplation. Contemplation presence was operationalized in two ways: (1) engaging in mulling, defined as “strongly considering attempting suicide, perhaps going back and forth in one's mind about whether to do it or not” (Millner et al., 2017), assessed with a single yes/no item; and (2) considering any RFL or RFD, defined as having a nonzero score on at least one RFL/RFD item. The degree of contemplation was measured by asking participants to rate how strongly they considered nine RFD (e.g., hopelessness, burdensomeness) and nine RFL (e.g., responsibilities, future goals), each on a 0–4 scale (0 = not at all, 4 = very strongly). Summed scores represented the total degree of RFD and RFL, and an RFD-RFL balance score (total RFD / [total RFD + RFL]) was created to reflect the overall focus of contemplation, with scores over 50 % indicating greater focus on RFD. To access duration, participants reported the timing of (1) initial ideation onset, (2) mulling onset,

and (3) deciding to act (SA+ group only), using pre-defined intervals (e.g., 0 s, 1–59 s, 1–15 min, ..., to 2+ weeks).

2.2.2.2. Planning. Planning presence was assessed in two ways: (1) a direct yes/no single-item question for the SA+ group, “During this suicidal episode, did you make a plan to kill yourself?” and (2) whether participants in either group considered at least one planning component (i.e., method, location, or time; Fox et al., 2020). Plan specificity was operationalized as the total number of components reported (0–3). For participants endorsing any planning component, follow-up questions assessed the timing of both (1) consideration onset and (2) the decision point using pre-defined intervals.

2.3. Data analysis

For Aims 1 and 3, we conducted group comparisons on 25 contemplation and 10 planning variables. Timing variables, initially reported in intervals, were converted to seconds using midpoints and then log-transformed to address skewness. Bonferroni correction was applied across 35 comparisons, setting the significance level at .00143.

For Aims 2 and 4, we employed machine learning models to classify group status (SP+ Group = 0, SA+ Group = 1), specifically using Random Forest (RF; Breiman, 2001) and XGBoost (Chen and Guestrin, 2016) algorithms. We chose these algorithms over traditional regression methods to better capture non-linear relationships and complex feature interactions. RF reduces overfitting by averaging predictions across multiple trees, while XGBoost iteratively improves outcomes through

gradient boosting. We applied nested cross-validation (10 inner and 10 outer folds) to tune hyperparameters and evaluated model performance using auROC, which reflects the model's ability to distinguish between groups, with 0.5 indicating chance-level and values closer to 1 indicating better classification. Based on the best performing model, we computed Shapley values (Lundberg and Lee, 2017) with the DALEX package (Biecek, 2018) on a 5-fold cross-validation to quantify each variable's contribution to classification. Global Shapley values captured overall variable importance, while local Shapley values reflected each variable's contribution to individual classification. To examine the potential influence of recall bias, we repeated the classification models in a restricted subsample of participants whose most recent suicidal episode occurred within the past two years as a robustness check.

Data missing at random occurred when the probability of missing data was partially explained by observed data. For example, mulling duration was missing when participants reported no mulling (SA+: 28 %, SP+: 16 %), and timing variables (e.g., onset and decision times for method, location, and time) were missing when participants denied considering these components (method: SA+: 14 %, SP+: 10 %; location: SA+: 38 %, SP+: 33 %; time: SA+: 63 %, SP+: 70 %). To address this, we applied the separate class method by imputing -1 (out of range) for missing values. This approach allowed tree-based models to treat missingness as an informative category while preserving the observed distribution (Saar-Tsechansky and Provost, 2007; Ding and Simonoff, 2010). Data analyses were conducted in R (R Core Team, 2024) using the tidymodels ecosystem (Kuhn and Wickham, 2020).

3. Results

Most participants in both groups reported a lifetime history of NSSI and SP before the recent episode. However, SA+ group was significantly more likely to have a history of NSSI, whereas SP+ group showed a higher likelihood of past SP. Additionally, 87 % of SA+ group reported prior SA, compared to about 26 % of SP+ group. Approximately half of the SA and SP episodes occurred in the past 12 months, though SP episodes were significantly more recent ($\chi^2[3, N = 608] = 12.18, p = .007, V = 0.14$). For the recent episode, overdose was the most common method used or considered in both groups, followed by cutting/

stabbing. In SA+ group, the most recent SA was characterized by moderate to high levels of intent to die ($M = 2.93, SD = 0.94$) and perceived lethality ($M = 2.37, SD = 1.07$), while injury severity was minimal ($M = 0.47, SD = 0.50$), all measured on a 0–4 scale. For SP+ group, endpoints of the episode included: deciding not to attempt without seeking help (27 %), moving on to alternative harmless (21 %) or harmful (15 %) behavior, deciding not to attempt after seeking help (15 %), deciding to attempt later (12 %), and being interrupted (11 %). All descriptive statistics and group comparisons are reported in Table 1. Additional information on the frequency of lifetime self-injurious thoughts and behaviors and history of suicide-focused treatment is provided in Supplement E.

3.1. Aim 1. Contemplation: prevalence, degree, and duration

Contemplation prevalence was examined in two ways. Using the mulling item, the SP+ group was more likely to report mulling (84 % vs. 72 %; $\chi^2[1, N = 608] = 10.24, p = .00138, V = 0.13$). Using the presence of any RFL or RFD, nearly all participants reported a nonzero degree of contemplation (SA+: 99.52 %, SP+: 100 %; $\chi^2[1, N = 608] = 0.04, p = .84, V = 0.01$).

Both groups engaged in a moderate level of RFL and RFD contemplation, with RFD contemplated more intensely than RFL. The top five RFDs were consistent across groups: (1) hopelessness about the future, (2) feeling like a failure, (3) feeling isolated, (4) feeling like a burden, and (5) escaping mental pain being the most intensely contemplated. Notably, the rank order of “feeling isolated” and “feeling like a burden” differed slightly in the SP+ group (see Table 2).

When comparing total contemplation, the SA+ group reported more intense total RFD contemplation than the SP+ group, while total RFL contemplation did not differ. Among individual RFD, the SA+ group rated considering feelings of isolation and moral/religious beliefs favoring suicide more intensely. No differences were observed for individual RFL. While the SA+ group showed a greater RFD-RFL balance ($t [374.37] = 2.82, p = .005$), this difference did not remain significant after Bonferroni correction.

No significant group differences were observed in the duration of proximal contemplation (see Table 3). In both groups, ideation and

Table 2
Degree of proximal contemplation in the recent suicidal episode.

	SA+ Group <i>n</i> = 417	SP+ Group <i>n</i> = 191	<i>p</i>	Cohen's <i>d</i>
Contemplating RFD (0–4), <i>M</i> (<i>SD</i>)				
Hopeless about the future	3.25 (1.01)	3.27 (1.08)	.77	0.03
Feel like a failure	3.22 (1.01)	3.19 (1.09)	.84	0.02
Feel isolated	3.14 (1.06)	2.75 (1.37)	<.001	0.34
Feel like a burden	3.08 (1.15)	2.83 (1.34)	.02	0.23
Escape mental pain	2.98 (1.17)	2.66 (1.41)	.01	0.25
Escape my past	2.74 (1.32)	2.50 (1.50)	.05	0.18
Escape my responsibilities	2.40 (1.40)	2.06 (1.53)	.01	0.24
Escape physical pain	2.32 (1.44)	2.00 (1.55)	.02	0.22
Moral/religious beliefs	1.41 (1.48)	0.96 (1.33)	<.001	0.31
Contemplating RFL (0–4), <i>M</i> (<i>SD</i>)				
(Not cause) others' pain	2.45 (1.41)	2.67 (1.40)	.08	0.15
My responsibilities	2.27 (1.41)	2.51 (1.48)	.08	0.16
Pain, blood, or violence of suicide	1.87 (1.49)	1.83 (1.45)	.66	0.04
Aversion of treatment or nonfatal injury	1.80 (1.42)	1.81 (1.55)	.78	0.03
Others' perception of suicide	1.76 (1.48)	1.44 (1.45)	.02	0.21
Enjoyable things	1.66 (1.41)	1.60 (1.42)	.53	0.06
Hopeful about getting better	1.60 (1.38)	1.67 (1.30)	.71	0.03
Future plans and goals	1.58 (1.41)	1.64 (1.36)	.58	0.03
Moral/religious beliefs	1.44 (1.51)	1.24 (1.52)	.12	0.14
Total RFD (0–36), <i>M</i> (<i>SD</i>)	24.51 (6.76)	22.28 (6.78)	<.001	0.35
Total RFL (0–36), <i>M</i> (<i>SD</i>)	16.44 (9.05)	16.36 (7.85)	.91	0.01
Total RFD + Total RFL (0–72), <i>M</i> (<i>SD</i>)	41.05 (12.47)	38.63 (10.89)	.02	0.20
RFD-RFL Balance, <i>M</i> (<i>SD</i>)	62 % (16 %)	59 % (16 %)	.005	0.20

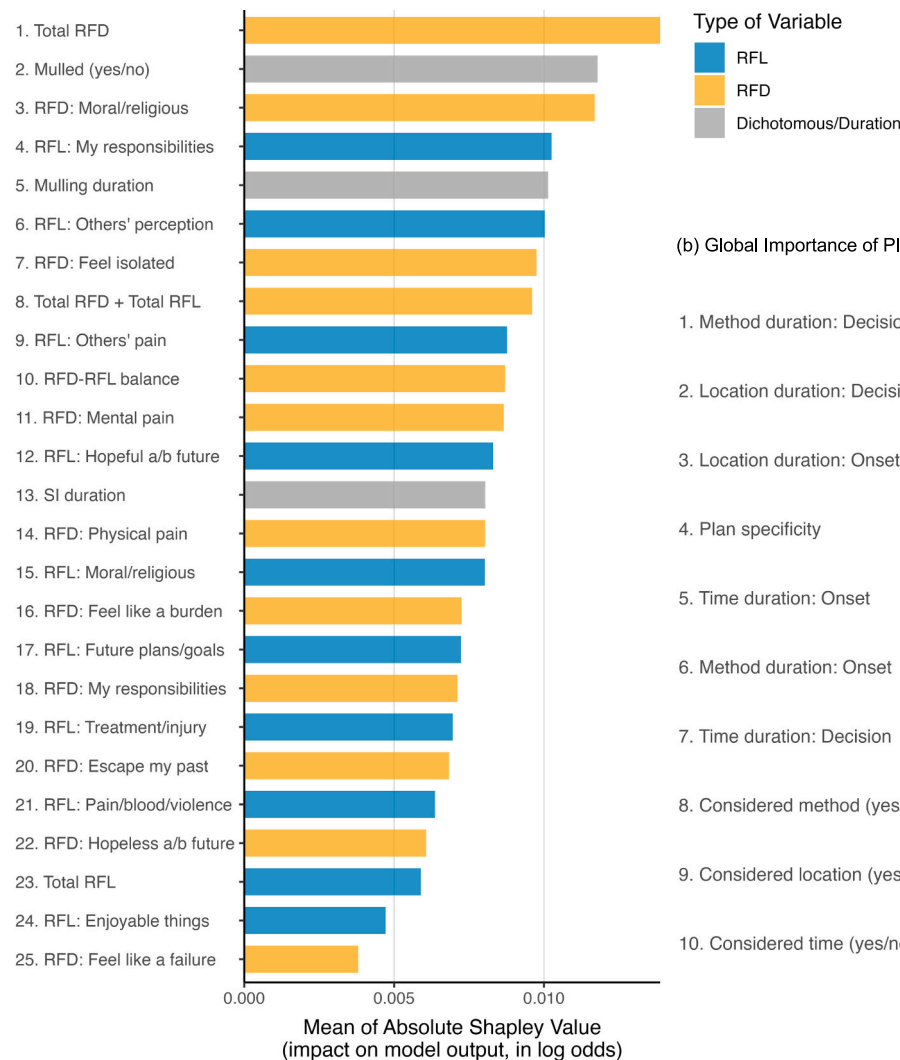
Note. After Bonferroni correction for 35 comparisons, the adjusted significance level is 0.00143. Comparisons that remain significant after correction are bolded. RFD-RFL Balance = Total RFD/(Total RFD + Total RFL).

Table 3
Timing of proximal contemplation and planning.

	SA+ Group		SP+ Group		p	Cohen's d
	M (SD)	% (n) reported	M (SD)	% (n) reported		
Contemplation						
SI onset	3.95 (1.30)	100 % (417)	4.10 (1.43)	100 % (191)	.22	0.11
Mulling onset	3.91 (1.19)	72 % (300)	4.00 (1.25)	84 % (161)	.44	0.08
Decision to attempt	3.63 (1.54)	100 % (417)	–	–	–	–
Planning						
Method onset	3.74 (1.36)	86 % (358)	3.77 (1.45)	90 % (172)	.79	0.03
Method decision	3.79 (1.37)	85 % (355)	3.60 (1.55)	82 % (156)	.19	0.13
Location onset	3.47 (1.51)	62 % (260)	3.77 (1.59)	67 % (128)	.09	0.19
Location decision	3.64 (1.41)	62 % (258)	3.78 (1.62)	61 % (117)	.41	0.10
Time onset	3.86 (1.42)	37 % (155)	3.44 (1.63)	30 % (58)	.08	0.29
Time decision	3.68 (1.55)	37 % (154)	3.48 (1.52)	29 % (56)	.40	0.13

Note. The adjusted significance level after Bonferroni correction for 35 comparisons is 0.00143. Duration values reflect the following intervals: 0 = 0 s, 0–1.48 = <1 min, 1.48–2.71 = 1–15 min, 2.71–3.36 = 16–59 min, 3.36–3.86 = 1–3 h, 3.86–4.14 = 3–12 h, 4.14–4.81 = 12–24 h, 4.81–5.24 = 1–2 days, 5.24–5.64 = 3–6 days, 5.64–5.96 = 1–2 weeks, and 5.96–6.26 = 2+ weeks. Since not every participant mulled, considered method, location, or time, we also report the number of participants who reported the corresponding stages during the recent suicidal episode.

(a) Global Importance of Contemplation Variables



(b) Global Importance of Planning Variables

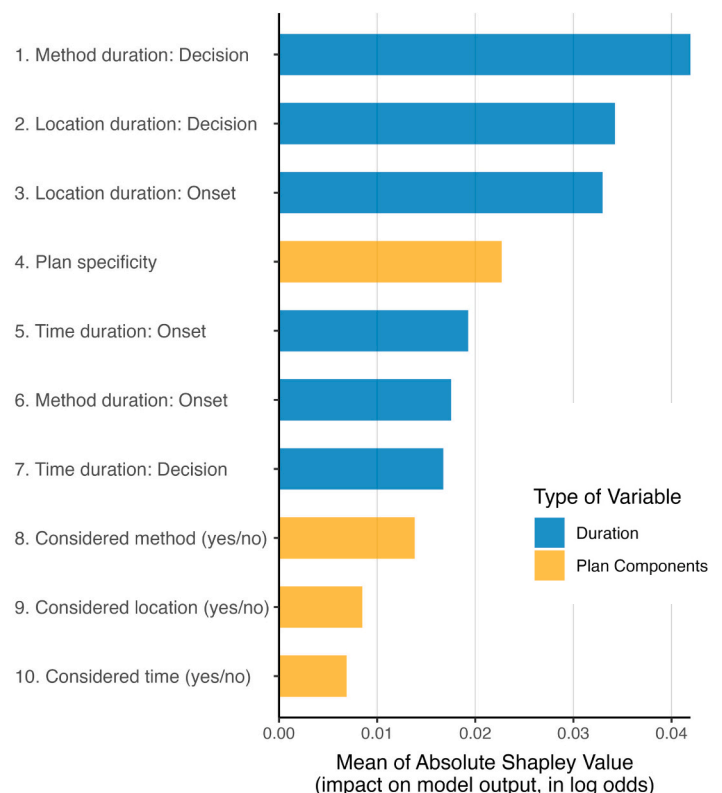


Fig. 1. Global importance of proximal contemplation and planning. *Note.* Mean of absolute Shapley values represent the importance of each variable (i.e., feature) by their contribution a model's classification. A longer bar indicates the corresponding feature has a larger contribution to the model. SI = suicidal ideation; RFD = reasons for dying; RFL = reasons for living. RFD-RFL balance = percentage of contemplation that was RFD (i.e., Total RFD / (Total RFD + Total RFL)).

mulling occurred, on average, 3 to 12 h before the end of the episode. Among individuals in the SA+ group, the decision to attempt was made, on average, 1 to 3 h before the attempt.

3.2. Aim 2. Contemplation: feature importance

The RF model outperformed XGBoost, with a median auROC of 0.69 (range: 0.61–0.77) compared to 0.66 for XGBoost (range: 0.58–0.72). Global and local feature importance based on Shapley values from the best RF model are shown in Figs. 1 and 2, respectively. No single feature dominated predictions, suggesting that contributions were distributed across multiple features. The five most influential features in the model, as determined by their average absolute Shapley values, were (1) the degree of total RFD, (2) the presence of mulling, (3) the degree to which moral/religious beliefs encouraging suicide were considered, (4) the degree to which personal responsibilities favoring living were considered, and (5) the duration of mulling. Higher degrees of total RFD and greater moral/religious beliefs favoring suicide were linked to classification in the SA+ group, while mulling (presence and greater duration) and greater consideration of personal responsibilities as RFL were linked to classification in the SP+ group.

3.3. Aim 3. Planning: prevalence, specificity, and duration

Planning prevalence was examined in two ways. Using the direct question, 66 % of the SA+ group reported their attempts were planned. Using the more precise definition (considering at least one planning component), 89 % of the SA+ group and 93 % of the SP+ group reported planning (see Table 4).

Plan specificity was comparable between groups, with both groups considering an average of 1.9 out of three planning components. Among those who reported planning, 42 % of the SA+ group and 23 % of the SP+ group considered all three components (method, location, and time). Within the SA+ group, among those who denied planning, 71 % reported considering at least one component. No significant group differences were observed for specific components or their combinations (see Table 4). Differences in the timing of proximal planning stages were also non-significant (see Table 3). In both groups, all planning occurred one to three hours before the episode's endpoint.

3.4. Aim 4. Planning: feature importance

The RF model outperformed XGBoost, with a median auROC of 0.63 (range: 0.53–0.80), compared to 0.60 for XGBoost (range: 0.43–0.69). Feature importance based on the best RF model is shown in Figs. 1 and 2. Similarly, no single feature had a dominant influence on classifications. The five most important features were (1) the timing of method decision, (2) the timing of location decision, (3) the timing of first considering the location, (4) plan specificity, and (5) the timing of first considering the time for attempt. Earlier decisions on method and considerations of time, later location considerations and decisions, and considering fewer than two plan components were associated with classification in the SA+ group. As a follow-up to address potential recall bias, classification models for Aims 2 and 4 were repeated in a subsample whose episode occurred within the past two years (SA+: $n = 298$, SP+: $n = 140$). Results remained consistent with those from the full sample (see Supplement F).

4. Discussion

This study aimed to capture cognitive processes as they unfolded within a single suicidal episode, offering insight into factors that may differentiate crises that result in action from those that do not. We focused on two distinct but related domains, contemplation and planning, and examined their prevalence, degree, and duration, during high-risk episodes. By comparing individuals who planned suicide without

attempting (SP+ group) to those who made an attempt (SA+ group), we identified key differences using group comparisons and machine learning methods, including using Shapley values to interpret feature importance and their relationship to group classification. The most important features distinguishing the two groups included the total degree of RFD, the presence of mulling, moral/religious beliefs that encouraged suicide, and the presence and timing of suicide planning steps.

4.1. Contemplation: prevalence and duration

Nearly all participants reported contemplating reasons for and against suicide, with initial SI and mulling starting 3–12 h before the episode's endpoint in both groups. Mulling was more prevalent in the SP+ group compared to the SA+ group, consistent with prior research (Xu et al., 2024). This suggests that individuals who attempted were less likely to engage this cognitively demanding process of grappling with ambivalence. However, the extent to which mulling contributed to the decision to delay or abort an attempt remains unclear. The lower rate of mulling in the SA+ group may reflect group differences in dispositional or situational factors. One possibility is that individuals in the SA+ group were more impulsive at a trait level, consistent with some prior research showing that impulsive behavior is associated with a higher likelihood of SA among those with SI (Dhingra et al., 2015; Nock et al., 2018; Wetherall et al., 2018). Alternatively, it is possible that individuals in the SA+ group experienced higher distress that depleted the cognitive resources for mulling (Baumeister et al., 2008). The role of mulling may differ depending on dispositional differences and crisis contexts — potentially protective in some situations and risk-enhancing in others. Future research should clarify the conditions under which mulling facilitates or deters behavioral escalation.

4.2. Degree of contemplation: reasons for dying

Total degree of RFD was greater in the SA+ group and the most important feature in group classification. This aligns with prior studies showing that baseline RFD is associated with a history of multiple SA (Fox et al., 2021) and is predictive of reattempt in 12 and 24 months (Brüderer et al., 2018; Gysin-Maillart et al., 2022). These results suggest that high degrees of RFD could reflect higher suicidal intent. High RFD may also indicate cognitive inflexibility, where individuals become “trapped” in ruminative thought patterns, making it difficult to shift attention to RFL. Cognitive inflexibility has been linked to suicidal behaviors, with studies finding it is elevated shortly after an SA (Perrah and Wichman, 1987) and predicts more severe SI within two months (Novak et al., 2022). Future studies should explore how cognitive inflexibility impacts attention shifts from RFD, track its changes during crises, and assess intervention responsiveness.

As previous studies suggested (Ernst et al., 2024), RFD and RFL likely represent distinct but correlated constructs. As Fig. 2 shows, a high balance (>80 % RFD) was associated with attempting; a low balance (<40 % RFD) was linked to not attempting; while intermediate balances were not predictive. This highlights the utility of assessing both RFD and the relative balance between RFD and RFL to better understand risk escalation.

Certain RFD were more prominent in the SA+ group, including moral/religious beliefs that favor suicide, feelings of isolation, mental pain, physical pain, and perceived burdensomeness. Although religion may protect against suicide (Poorolajal et al., 2022), the perceived acceptability of suicide has been shown to predict future suicidal behaviors (Phillips and Luth, 2020). Similarly, reflections on the meaning or beliefs surrounding death may facilitate suicidal behavior, particularly when suicide is seen as morally acceptable (Xu et al., 2024). This suggests that suicidal individuals may selectively focus on beliefs that encourage suicide during crises. Feelings of isolation and burdensomeness also ranked highly among predictors of the SA+ group, aligning

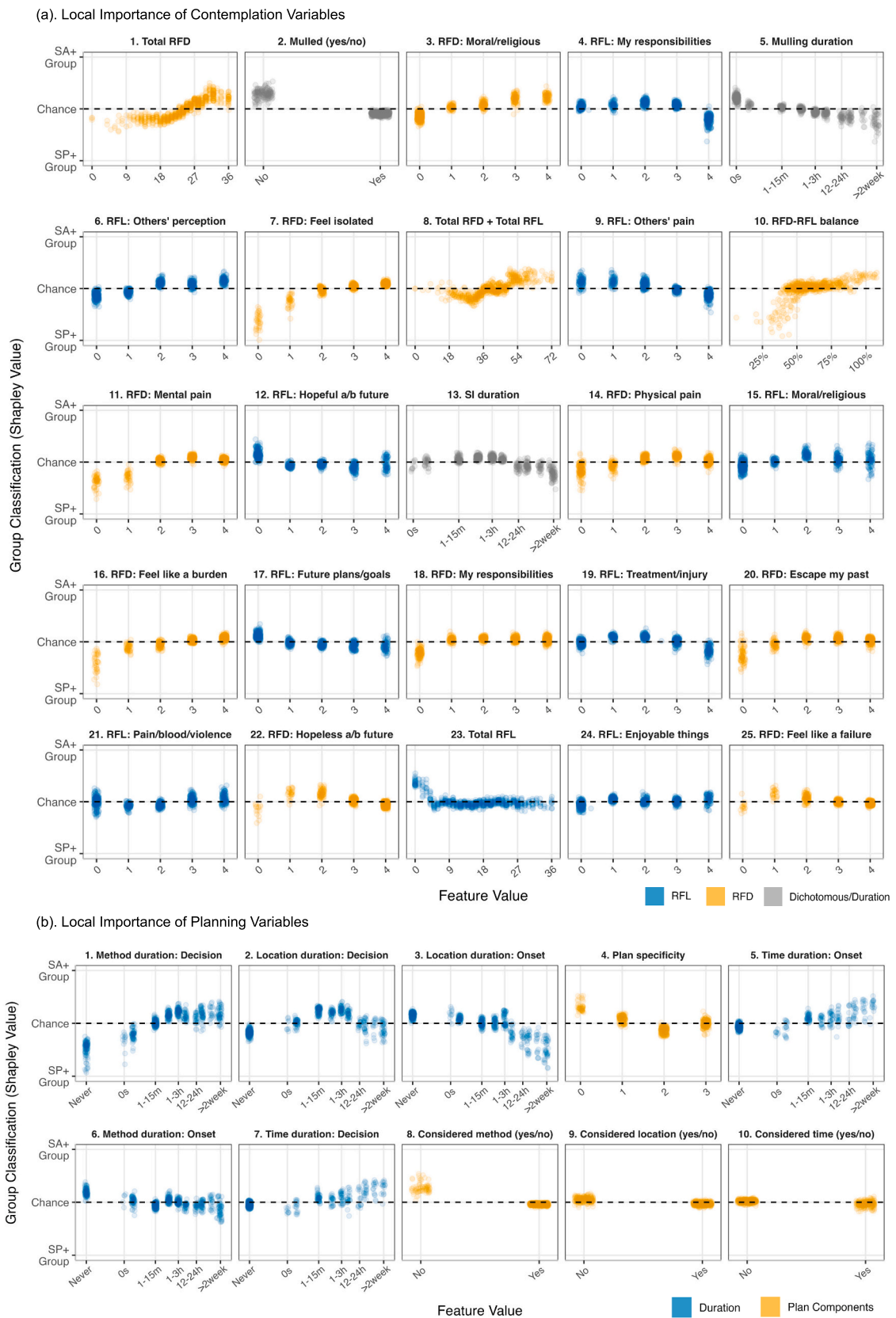


Fig. 2. Local importance of proximal contemplation and planning. *Note.* Local Shapley values demonstrate the influence of each feature value (i.e., a specific value of a variable) on individual observations (i.e., for a specific participant). Features are ordered by their aggregate global importance (i.e., bar length of Fig. 1). SI = suicidal ideation; RFD = Reasons for dying; RFL = Reasons for living; RFD-RFL balance = percentage of contemplation that was RFD (i.e., Total RFD / (Total RFD + Total RFL)).

Table 4
Reports of suicide planning in the recent suicidal episode.

	SA+ Group n = 417	SP+ Group n = 191	p	Effect size
Single-item 'planned', % (n)	66 % (275)	100 % (191)		
Considered method, % (n)	86 % (358)	90 % (172)	.19	0.05 ^b
Considered location, % (n)	62 % (260)	67 % (128)	.31	0.04 ^b
Considered time, % (n)	37 % (155)	30 % (58)	.12	0.06 ^b
Plan specificity (0–3), M (SD)	1.85 (0.99)	1.87 (0.94)	.79	0.02 ^a
Considered at least 1 component, % (n)	89 % (379)	93 % (179)	.12	0.06 ^b
Among those who reported planning	n = 275	n = 191		
0 component	1 % (3)	6 % (12)		
Exactly 1 component	19 % (53)	23 % (44)		
Method only	18 % (50)	20 % (38)		
Location only	0.7 % (2)	1 % (2)		
Time only	0.4 % (1)	2 % (4)		
Exactly 2 components	38 % (104)	46 % (91)		
Method + location	33 % (91)	42 % (81)		
Method + time	4 % (10)	5 % (9)		
Location + time	1 % (3)	0.5 % (1)		
Exactly 3 components	42 % (115)	23 % (44)		
Among those who denied planning	n = 142	–		
0 components	29 % (41)	–		
Exactly 1 component	37 % (52)	–		
Method only	31 % (44)	–		
Location only	4 % (6)	–		
Time only	1.4 % (2)	–		
Exactly 2 components	23 % (32)	–		
Method + location	18 % (25)	–		
Method + time	4 % (6)	–		
Location + time	0.7 % (1)	–		
Exactly 3 components	12 % (17)	–		

^a Cohen's *d*.

^b Cramér's *V*.

with theoretical models (Joiner, 2005; Klonsky and May, 2015). However, with responses clustered at the higher end, their ability to separate groups was limited. Finally, intense thoughts of escaping mental and physical pain were also associated with the SA+ group, aligning with prior findings (Breslau et al., 2012; Igen et al., 2013).

4.3. Degree of contemplation: reasons for living

Having extremely low degree of RFL was associated with classification in the SA+ group, suggesting that the mere presence of any RFL may provide some protective value against attempting. However, overall intensity of RFL was not a meaningful predictor, with little value in distinguishing between groups. This aligns with prior research suggesting that RFL alone may not prevent attempts when RFD are overwhelming (Brüderl et al., 2018; Fox et al., 2021; Gysin-Maillart et al., 2022). Similarly, Xu et al. (2024) found no difference in the degree of RFL between those who attempted and those who aborted an attempt, further supporting the idea that RFL's protective value may be limited during a crisis.

Certain RFL, such as personal responsibilities and avoiding causing others pain, were key features of the SP+ group, similar to prior research (Xu et al., 2024). Clinically, these RFL may be protective; however, it is also critical to assess whether such responsibility becomes overwhelming and contributes to distress that undermines the protective value. Even minimal hope for improvement or future plans/goals was associated with classification in the SP+ group, highlighting the role of fostering positive expectations about the future. Hope and future-

oriented thinking may provide cognitive and emotional anchors that reduce the likelihood of acting on suicidal thoughts (Huen et al., 2015; Nam et al., 2024). Research suggests future orientation (i.e., the ability to envision a life beyond the current distress) could be key in building resilience and suicide prevention (Chang et al., 2018; O'Connor and Nock, 2014).

4.4. Planning: prevalence and specificity

When directly asked, 66 % of the SA+ group reported their attempt was planned. However, when planning was operationalized as considering at least one component (method, location, or time), 89 % of the SA+ group and 93 % of the SP+ group met criteria for planning during the episode. These rates exceed previous studies (36–54 %; Bagge et al., 2013b; Chalker et al., 2015; Spokas et al., 2012), highlighting the importance of how planning is defined (Millner et al., 2015).

Plan specificity, measured as the number of components considered, was comparable between groups, with both averaging 1.9 components. However, low specificity (0 and 1) was linked to the SA+ group. Moderate specificity (2) to the SP+ group, and high specificity (3) was not predictive of either group. This contrasts findings in adolescents, where higher specificity was more strongly associated with attempts (Beaton et al., 2023), potentially reflecting sample differences or the use of nonlinear models in the current study. These results suggest that the relationship between plan specificity and suicide risk may be more complex than previously assumed and warrants replication.

4.5. Planning: duration

Distinct patterns in the duration of planning emerged between groups. In the SA+ group, individuals were more likely to start thinking about the time of the attempt earlier in the episode and make early decisions about method and time, but delay thinking about and deciding on location. Additionally, never considering method or location was associated with classification in the SA+ group, whereas never considering time was more common in the SP+ group. Beaton et al. (2023) similarly found that consideration of timing predicted SA history more strongly than consideration of method or location. This highlights a gap in common treatment approaches, which often emphasize the method (e.g., Yip et al., 2012) but may overlook the planned timing of the attempt. Timing considerations can include specific dates (e.g., anniversaries), future milestones (e.g., when a child grows up), certain days of the week, or times of day. Assessing whether individuals have identified a date and time they consider acceptable or favorable for an attempt may offer a critical opportunity for intervention. While *t*-tests suggested no group differences in the timing of planning, machine learning results revealed variability across components and emphasized the importance of examining each one along multiple dimensions: whether it was considered, when it was first considered, and whether a decision was reached.

4.6. Clinical implications

These results suggest several actionable strategies. First, efforts to reduce risk during crises may benefit from targeting the intensity of RFD, as extensive contemplation may deplete cognitive capacity and impair decision-making (Baumeister et al., 2008). Strengthening RFL may be most protective when grounded in reasons the individual clearly identifies as deterring suicide, rather than those that provoke ambivalence or distress. Second, findings suggest that risk does not increase linearly with the extent of planning. For example, both early decisions about a method and the absence of ever considering a method were associated with attempts. Assessing which components have been considered or decided upon, in what order, and how this pattern aligns with the individual's typical crisis response style may offer greater insight into acute risk than overall planning extent. Lastly, clinicians

should inquire about the specific RFD and RFL most strongly associated with attempts, including beliefs about suicide acceptability and interpersonal responsibilities, to better inform risk evaluation and intervention.

4.7. Limitations

This study should be interpreted within the context of several limitations. The cross-sectional, retrospective design precludes causal inferences and may introduce potential recall bias, particularly regarding the timing of contemplation and planning phases. Future prospective studies could provide more accurate insights into the moments leading up to an SA. Although machine learning models identified meaningful predictors, their modest performance (best RF model auROC = 0.69) limits the reliability of feature importance interpretations. Additional research is needed to replicate these findings in relation to the lethality of attempts, as cognitive and emotional factors may operate differently before higher versus lower lethality attempts. Distal planning that occurred well before a crisis may also play a role in proximal processes, as individuals who have previously contemplated may spend less time contemplating in subsequent crises (Anestis et al., 2014). How distal and proximal factors interact to influence risk remains a question for future research. Examining related factors such as alcohol use and thought controllability could further clarify pathways to suicidal behavior.

4.8. Conclusions

This study offers a detailed examination of how people think and plan during suicidal crises, focusing on a single acute episode to understand what differentiates episodes that end in attempts from those that do not. Although some features such as favorable views of death or early decisions on method were more common in episodes that ended in attempts, no single factor or combination reliably separated attempts from non-attempts. Instead, individuals engaged in a wide range of thought processes that varied in content, intensity, and timing. This variability challenges common assumptions that suicidal behavior follows a predictable or linear path. Measuring the specific characteristics of cognition, including what individuals consider, how intensely, for how long, and how these engagement influences decisions, may offer a more precise understanding of behavioral risk. Future research is needed to rigorously assess proximal cognitive dynamics in order to better capture the complex and individualized nature of suicide decision-making.

CRedit authorship contribution statement

Irene Xu: Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Ross Jacobucci:** Writing – review & editing, Funding acquisition. **Brooke A. Ammerman:** Writing – review & editing, Supervision, Methodology, Conceptualization.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jad.2025.119660>.

References

- Anestis, M.D., Soberay, K.A., Gutierrez, P.M., Hernández, T.D., Joiner, T.E., 2014. Reconsidering the link between impulsivity and suicidal behavior. *Pers. Soc. Psychol. Rev.* 18 (4), 366–386.
- Bagge, C.L., Glenn, C.R., Lee, H.J., 2013a. Quantifying the impact of recent negative life events on suicide attempts. *J. Abnorm. Psychol.* 122 (2), 359.
- Bagge, C.L., Littlefield, A.K., Lee, H.-J., 2013b. Correlates of proximal premeditation among recently hospitalized suicide attempters. *J. Affect. Disord.* 150 (2), 559–564.
- Bagge, C.L., Littlefield, A.K., Conner, K.R., Schumacher, J.A., Lee, H.J., 2014. Near-term predictors of the intensity of suicidal ideation: an examination of the 24 h prior to a recent suicide attempt. *J. Affect. Disord.* 165, 53–58.
- Bagge, C.L., Littlefield, A.K., Glenn, C.R., 2017. Trajectories of affective response as warning signs for suicide attempts: an examination of the 48 hours prior to a recent suicide attempt. *Clin. Psychol. Sci.* 5 (2), 259–271.
- Bagge, C.L., Littlefield, A.K., Wiegand, T.J., Hawkins, E., Trim, R.S., Schumacher, J.A., Conner, K.R., 2023. A controlled examination of acute warning signs for suicide attempts among hospitalized patients. *Psychol. Med.* 53 (7), 2768–2776.
- Baumeister, R.F., Vohs, K.D., Tice, D.M., 2008. The strength model of self-control. *Curr. Dir. Psychol. Sci.* 16 (6), 351–355.
- Beaton, M.A., Gratch, I., Cha, C.B., 2023. Specificity, frequency, and intent: multiple characteristics of adolescents' suicide plan correlate with their history of suicidal behavior. *Suicide Life Threat. Behav.* 53 (6), 1025–1037.
- Biecek, P., 2018. DALEX: explainers for complex predictive models in R. *Journal of Machine Learning Research* 19 (84), 1–5.
- Bornheimer, L.A., Wastler, H., Li Verdugo, J., Im, V., Burke, H., Holzworth, J., Velasquez, E., Mahmood, M., 2023. Depression, suicide intent, and plan among adults presenting in an emergency department after making a suicide attempt: exploratory differences by psychosis symptom experience. *J. Psychiatr. Res.* 157, 197–201.
- Breiman, L., 2001. Random forests. *Mach. Learn.* 45, 5–32.
- Breslau, N., Schultz, L., Lipton, R., Peterson, E., Welch, K.M.A., 2012. Migraine headaches and suicide attempt. *Headache* 52 (5), 723–731.
- Britton, P.C., Conner, K.R., Maisto, S.A., 2012. An open trial of motivational interviewing to address suicidal ideation with hospitalized veterans. *J. Clin. Psychol.* 68 (9), 961–971.
- Brown, G.K., Ten Have, T., Henriques, G.R., Xie, S.X., Hollander, J.E., Beck, A.T., 2005. Cognitive therapy for the prevention of suicide attempts: a randomized controlled trial. *JAMA* 294 (5), 563–570.
- Brüdem, J., Stähli, A., Gysin-Maillart, A., Michel, K., Reisch, T., Jobes, D.A., Brodbeck, J., 2018. Reasons for living and dying in suicide attempters: a two-year prospective study. *BMC Psychiatry* 18, 1–9.
- Chalker, S.A., Comtois, K.A., Kerbrat, A.H., 2015. Impulsivity and suicidal behavior: how you define it matters. *Int. J. Cogn. Ther.* 8 (2), 172–192.
- Chang, E.C., Yu, T., Lee, J.Y., Yu, E.A., Hirsch, J.K., 2018. Hope and future orientation in relation to suicide risk. *J. Posit. Psychol.* 13 (5), 480–488.
- Chen, T., Guestrin, C., 2016. August. Xgboost: a scalable tree boosting system. In: *Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*, pp. 785–794. New York, NY.
- Deisenhammer, E.A., Ing, C.M., Strauss, R., Kemmler, G., Hinterhuber, H., Weiss, E.M., 2009. The duration of the suicidal process: how much time is left for intervention between consideration and accomplishment of a suicide attempt? *J. Clin. Psychiatry* 70 (1), 19.
- Dhingra, K., Boduszek, D., O'Connor, R.C., 2015. Differentiating suicide attempters from suicide ideators using the Integrated Motivational-Volitional model of suicidal behaviour. *J. Affect. Disord.* 186, 211–218.
- Ding, Y., Simonoff, J.S., 2010. An investigation of missing data methods for classification trees applied to binary response data. *J. Mach. Learn. Res.* 11 (1).
- Douglas, B.D., Ewell, P.J., Brauer, M., 2023. Data quality in online human-subjects research: comparisons between MTurk, Prolific, CloudResearch, Qualtrics, and SONA. *PLoS One* 18 (3), e0279720.
- Ernst, M., Gemke, T.J., Olivi, L.J., O'Connor, R.C., 2024. Ambulatory assessment of suicidal ambivalence: the temporal variability of the wish to live and the wish to die and their relevance in the concurrent and prospective prediction of suicidal desire. *Suicide Life Threat. Behav.* 54, 831–843.
- Fox, K.R., Harris, J.A., Wang, S.B., Millner, A.J., Deming, C.A., Nock, M.K., 2020. Self-injurious thoughts and behaviors interview-revised: development, reliability, and validity. *Psychol. Assess.* 32 (7), 677–689.
- Fox, A.M., LaCroix, J.M., Bond, A.E., Perera, K.U., Luk, J.W., Goldston, D., Weaver, J., Soumoff, A., Ghahramanlou-Holloway, M., 2021. Evaluating suicide risk using the reasons for dying-reasons for living (RFD-RFL) index in a military psychiatric inpatient setting. *Psychiatry Res.* 295, 113576.
- Gysin-Maillart, A.C., Jansen, R., Walther, S., Jobes, D.A., Brodbeck, J., Marmet, S., 2022. Longitudinal development of reasons for living and dying with suicide attempters: a 2-year follow-up study. *Front. Psych.* 13, 865831.
- Heesen, K., Mérelle, S., van den Brand, I., Van Bergen, D., Baden, D., Slotema, K., van Veen, S., 2024. The forever decision: a qualitative study among survivors of a suicide attempt. *Eclinicalmedicine* 69.

- Huen, J.M., Ip, B.Y., Ho, S.M., Yip, P.S., 2015. Hope and hopelessness: the role of hope in buffering the impact of hopelessness on suicidal ideation. *PLoS One* 10 (6), e0130073.
- Ilgel, M.A., Kleinberg, F., Ignacio, R.V., Bohnert, A.S., Valenstein, M., McCarthy, J.F., Katz, I.R., 2013. Noncancer pain conditions and risk of suicide. *JAMA Psychiatry* 70 (7), 692–697.
- Jobes, D.A., Mann, R.E., 1999. Reasons for living versus reasons for dying: examining the internal debate of suicide. *Suicide Life Threat. Behav.* 29, 97–104.
- Joiner, T.E., 2005. *Why People Die by Suicide*. Harvard University Press.
- Joiner Jr., T.E., Steer, R.A., Brown, G., Beck, A.T., Pettit, J.W., Rudd, M.D., 2003. Worst-point suicidal plans: a dimension of suicidality predictive of past suicide attempts and eventual death by suicide. *Behav. Res. Ther.* 41 (12), 1469–1480.
- Kattimani, S., Sarkar, S., Menon, V., Muthuramalingam, A., Nancy, P., 2016. Duration of suicide process among suicide attempters and characteristics of those providing window of opportunity for intervention. *Journal of Neurosciences in Rural Practice* 7 (4).
- Kessler, R.C., Borges, G., Walters, E.E., 1999. Prevalence of and risk factors for lifetime suicide attempts in the National Comorbidity Survey. *Arch. Gen. Psychiatry* 56 (7), 617–626.
- Kessler, R.C., Berglund, P., Borges, G., Nock, M., Wang, P.S., 2005. Trends in suicide ideation, plans, gestures, and attempts in the United States, 1990–1992 to 2001–2003. *JAMA* 293 (20), 2487–2495.
- King, C.A., Allen, P.Y.G., Ahamed, S.I., Webb, M., Casper, T.C., Brent, D., Bagge, C.L., 2024. 24-hour warning signs for adolescent suicide attempts. *Psychol. Med.* 54 (7), 1272–1283.
- Klonsky, E.D., May, A.M., 2015. The three-step theory (3ST): a new theory of suicide rooted in the “ideation-to-action” framework. *Int. J. Cogn. Ther.* 8 (2), 114–129.
- Kuhn, M., Wickham, H., 2020. *Tidymodels: a collection of packages for modeling and machine learning using tidyverse principles*. <https://www.tidymodels.org>.
- Linehan, M.M., Goodstein, J.L., Nielsen, S.L., Chiles, J.A., 1983. Reasons for staying alive when you are thinking of killing yourself: the reasons for living inventory. *J. Consult. Clin. Psychol.* 51 (2), 276–286.
- Linehan, M.M., Comtois, K.A., Murray, A.M., Brown, M.Z., Gallop, R.J., Heard, H.L., Korslund, K.E., Tutek, D.A., Reynolds, S.K., Lindenboim, N., 2006. Two-year randomized controlled trial and follow-up of dialectical behavior therapy vs therapy by experts for suicidal behaviors and borderline personality disorder. *Arch. Gen. Psychiatry* 63 (7), 757–766.
- Linthicum, K.P., Ribeiro, J.D., 2022. Suicide plan prevalence, recurrence, and longitudinal association with nonfatal suicide attempt. *Suicide Life Threat. Behav.* 52 (6), 1062–1073.
- Lundberg, S.M., Lee, S.I., 2017. A unified approach to interpreting model predictions. *Adv. Neural Inf. Process. Syst.* 30, 4765–4774.
- Millner, A.J., Lee, M.D., Nock, M.K., 2015. Single-item measurement of suicidal behaviors: validity and consequences of misclassification. *PLoS One* 10 (10), e0141606.
- Millner, A.J., Lee, M.D., Nock, M.K., 2017. Describing and measuring the pathway to suicide attempts: a preliminary study. *Suicide Life Threat. Behav.* 47 (3), 353–369.
- Nam, R.J., Lowry, N.J., Lawrence, O.C., Novotny, L.J., Cha, C.B., 2024. Episodic future thinking and psychopathology: a focus on depression and suicide risk. *Curr. Opin. Psychol.* 59, 101853.
- Nock, M.K., Holmberg, E.B., Photos, V.I., Michel, B.D., 2007. Self-injurious thoughts and behaviors interview: development, reliability, and validity in an adolescent sample. *Psychol. Assess.* 19 (3), 309–317.
- Nock, M.K., Borges, G., Bromet, E.J., Alonso, J., Angermeyer, M., Beautrais, A., Williams, D., 2008. Cross-national prevalence and risk factors for suicidal ideation, plans and attempts. *Br. J. Psychiatry* 192 (2), 98–105.
- Nock, M.K., Millner, A.J., Joiner, T.E., Gutierrez, P.M., Han, G., Hwang, I., Kessler, R.C., 2018. Risk factors for the transition from suicide ideation to suicide attempt: results from the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *J. Abnorm. Psychol.* 127 (2), 139.
- Novak, L.A., Carter, S.P., LaCroix, J.M., Perera, K.U., Neely, L.L., Soumoff, A., Ghahramanlou-Holloway, M., 2022. Cognitive flexibility and suicide risk indicators among psychiatric inpatients. *Psychiatry Res.* 313, 114594.
- O’Connor, R.C., Nock, M.K., 2014. The psychology of suicidal behavior. *Lancet Psychiatry* 1 (1), 73–85.
- Oxford University Press, 2023, July. Duration, 1.a. In: *Oxford English Dictionary*. Retrieved October 21, 2024.
- Oxford University Press, 2024, March. Degree, I.6.a. In: *Oxford English Dictionary*. Retrieved October 21, 2024.
- Perrah, M., Wichman, H., 1987. Cognitive rigidity in suicide attempters. *Suicide Life Threat. Behav.* 17, 251–262.
- Peterson, C., Wang, Q., Hallett, D., Bartlett, S., Ma, A.Y., MacKay, M.M., Wang, E.Y., 2024. Dating early memories: when did events really happen? *Cogn. Dev.* 71, 101489.
- Phillips, J.A., Luth, E.A., 2020. Beliefs about suicide acceptability in the United States: how do they affect suicide mortality? *The Journals of Gerontology: Series B* 75 (2), 414–425.
- Poorolajal, J., Goudarzi, M., Gohari-Ensaf, F., Darvishi, N., 2022. Relationship of religion with suicidal ideation, suicide plan, suicide attempt, and suicide death: a meta-analysis. *Journal of Research in Health Sciences* 22 (1), e00537.
- R Core Team, 2024. *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing.
- Saar-Tschansky, M., Provost, F., 2007. Handling missing values when applying classification models. *Journal of Machine Learning Research* 8, 1623–1657.
- Spokas, M., Wenzel, A., Brown, G.K., Beck, A.T., 2012. Characteristics of individuals who make impulsive suicide attempts. *J. Affect. Disord.* 136 (3), 1121–1125.
- Wasserman, D., Thanh, T.T.H., Minh, P.T.D., Goldstein, M., Nordenskiöld, A., Wasserman, C., 2008. Suicidal process, suicidal communication and psychosocial situation of young suicide attempters in a rural Vietnamese community. *World Psychiatry* 7 (1), 47–53.
- Wetherall, K., Cleare, S., Eschle, S., Ferguson, E., O’Connor, D.B., O’Carroll, R.E., O’Connor, R.C., 2018. From ideation to action: differentiating between those who think about suicide and those who attempt suicide in a national study of young adults. *J. Affect. Disord.* 241, 475–483.
- World Health Organization, 2019. *Suicide in the World: Global Health Estimates*. World Health Organization. <https://iris.who.int/handle/10665/326948>.
- Xu, I., Millner, A.J., Fortgang, R.G., Nock, M.K., 2024. Suicide decision-making: differences in proximal considerations between individuals who aborted and attempted suicide. *Suicide Life Threat. Behav.* 54 (5), 814–830.
- Yip, P.S., Caine, E., Yousuf, S., Chang, S.S., Wu, K.C.C., Chen, Y.Y., 2012. Means restriction for suicide prevention. *Lancet* 379 (9834), 2393–2399.