

Separating Presence From Severity in Suicidal Ideation: Evidence From Multilevel Hurdle Models

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Suicidal ideation is inherently episodic, yet most analytic approaches treat it as a single continuous process, handling zero inflation as a nuisance through transformation or ill-fitting models. Such approaches may obscure distinct mechanisms governing whether ideation occurs versus how severe it becomes. We applied multilevel hurdle models to ecological momentary assessment data from a large sample of psychiatrically acute adolescents with recent suicidal thoughts ($n = 244$) to examine whether affective states differentially predict suicidal ideation occurrence and severity. Hurdle models decompose ideation into a binary component (presence) and a continuous component (intensity conditional on presence). Negative and positive affect were partitioned into within-person (momentary) and between-person (person-level average) components, with models examining concurrent and lagged associations while accounting for temporal persistence. Results revealed dissociable processes. Person-level average negative affect robustly predicted ideation occurrence, whereas momentary fluctuations showed weak prospective associations with presence of suicidal ideation. In contrast, both momentary and person-level average negative affect predicted greater severity once ideation was present. Positive affect showed modest concurrent associations with lower suicidal ideation presence and severity but did not reliably predict presence of prospective suicidal thinking. These findings suggest affective states, and specifically negative affect, may primarily function as amplifiers of ideation severity rather than acute triggers of ideation presence. Multilevel hurdle models offer a useful framework for capturing the episodic structure of suicidal ideation and informing real-time prevention efforts.

General Scientific Summary

We analyzed suicidal thoughts in a way that separates whether thoughts are present at all from how intense they are when they occur. Using real-time reports from adolescents recently hospitalized due to suicide risk, we found that adolescents who generally experience higher levels of negative emotion are more likely to have suicidal thoughts, but momentary spikes in negative emotion mainly make those thoughts more severe rather than are associated with whether or not someone is having suicidal thoughts at any moment. These findings suggest that different processes may drive the presence versus the escalation of suicidal thinking and that prevention efforts may need to target each process differently.

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Data from this study have been used in three prior articles, two of which have no conceptual overlap with the current article and the third which is programmatically related to this article: One article (Patel, Mournet, et al.,

2025; *Journal of Affective Disorders*) focuses on nightmares as predictors of nonsuicidal and suicidal thinking) and the other (Kleiman et al., 2025; cited in the Method section of this article) focuses on improving study compliance. The third article (Patel, Edershile, et al., 2025; cited in this article) was a two-study article that used data from the first 101 participants from the study reported in this article. This article compared high versus low arousal emotion components as predictors of nonsuicidal and suicidal thinking. This specific article has not been published or presented elsewhere.

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continued

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Suicidal ideation is inherently episodic, even in the short term, characterized by alternating periods of elevated (i.e., non-zero) and absent suicidal thinking, yet the statistical methods most commonly applied to its study implicitly assume a continuous process. Even in populations at elevated clinical risk, suicidal ideation is absent at most assessment occasions, yielding data that are characterized by a large excess of zeros and a highly skewed distribution among nonzero values. In intensive longitudinal studies, including ecological momentary assessment (EMA), the modal observation is therefore the absence of suicidal ideation rather than its presence (Glenn et al., 2022; Hallensleben et al., 2018; Kleiman et al., 2017), even in some of the highest-risk groups (e.g., during acute psychiatric care or shortly following discharge from care for severe suicidal thinking/behavior).

Despite this well-known empirical feature, the distribution of suicidal ideation is rarely modeled in a manner that reflects its actual underlying structure. Most studies either ignore the excess of zero values, apply transformations that do not address zero inflation (e.g., log transformation), or rely on models that are poorly matched to the data-generating process (e.g., Gaussian, [zero-inflated] Poisson or negative binomial models). These approaches treat the distribution of suicidal ideation as a statistical nuisance, rather than as a potentially informative feature of the phenomenon itself. Critically, the zero-inflated structure of suicidal ideation aligns with a clinically meaningful distinction between whether suicidal ideation is present at all and how severe it is once present. Indeed, the processes that govern the emergence of suicidal ideation may be a qualitatively different process from those that govern its escalation, persistence, or intensity. Theoretical work, such as ideation-to-action frameworks (Klonsky et al., 2018), make a clear distinction that having no ideation and any level of ideation above zero reflect qualitatively different states. Analytic approaches that collapse across these processes (i.e., treating zero and nonzero values as arising from the same processes) risk obscuring mechanisms that are central to both theoretical models of suicide risk and the development of targeted interventions.

A small subset of studies has begun to address this issue by modeling ideation presence and severity separately (Grove et al., 2025; Kleiman et al., 2021). Although informative, these approaches

typically estimate independent models for zero versus nonzero ideation and for ideation intensity, implicitly assuming that these processes are unrelated. In contrast, hurdle models provide a unified framework that explicitly decomposes zero outcomes from the distribution of positive values while allowing shared predictors and individual differences to influence both processes (Cameron & Trivedi, 2013). Hurdle models are therefore particularly well suited to suicidal ideation, where the distinction between occurrence (i.e., present vs. absent) and severity (e.g., 1–10) is theoretically central, allowing for the modeling of the qualitatively distinct states. However, despite their conceptual relevance, hurdle models have rarely been applied to data on suicidal ideation (e.g., Falcó et al., 2024; Glenn et al., 2019; Huh et al., 2018) and to our knowledge have not yet been applied to study suicidal ideation in a multilevel framework. EMA designs provide a unique opportunity to leverage hurdle models in a multilevel framework, allowing researchers to simultaneously examine within-person dynamics, between-person heterogeneity, and temporal dependencies in suicidal thinking. To date, this potential remains largely untapped.

In this study, we focused on affective predictors of suicidal thinking occurrence and severity using multilevel hurdle models. Affective states are well-established predictors of suicidal ideation, with negative affect increasing risk and positive affect potentially offering short-term protection (Bentley et al., 2021; Coppersmith et al., 2023; Kleiman et al., 2026; Patel, Edershile, et al., 2025; Scott & Brown, 2025). In addition, emotion-related vulnerabilities like emotion dysregulation are associated with risk for suicidal thinking (Colmenero-Navarrete et al., 2022). Moreover, multiple theories of suicide risk either explicitly involve affective processes (Baumeister, 1990; Klonsky & May, 2015) or include processes that are proximal and affect-like in nature (e.g., perceived burdensomeness in the interpersonal theory of suicide; Joiner et al., 2009).

Because affect fluctuates on short timescales, it aligns well with the episodic nature of suicidal ideation and is suited to intensive longitudinal study. EMA research confirms that momentary affect predicts short-term variation in suicidal ideation (Hallensleben et al., 2019; Kleiman et al., 2017; Mou et al., 2018; Weires et al., 2025). However, this prior work typically treats suicidal ideation as a single continuous outcome, using either traditional

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multilevel models (Hallensleben et al., 2018; Kleiman et al., 2017; Weires et al., 2025) or more advanced approaches that better capture temporal dynamics (e.g., dynamic structural equation modeling [DSEM]; Kleiman et al., 2026; Scott & Brown, 2025), but implicitly assume that affect operates similarly across ideation presence and severity. Ideation-to-action frameworks suggest that different factors may govern distinct stages of suicidal thinking and behaviors (Klonsky et al., 2018), and it may be that this principle extends to the emergence/recurrence versus escalation of ideation intensity. For example, the Three Step Theory (Klonsky & May, 2015) distinguishes between the occurrence of suicidal desire (in the first step of the model) and the escalation of severe desire (in the second step), with different predictors for each. Models like this suggest that it is plausible, for instance, that affect contributes weakly to whether ideation occurs but more strongly to its severity once present, or vice versa.

The Present Study

The present study uses multilevel hurdle models to examine how affective states relate uniquely to the presence versus absence and severity of suicidal ideation, if present, over time in a group of psychiatrically acute adolescents, who were recently hospitalized for suicidal thoughts and/or behaviors. Studying adolescents at acute clinical risk both due to the recency of suicidal thoughts/behaviors and due to the increased presence of risk factors (e.g., emotion regulation difficulties; Silvers et al., 2012) provides a critical test case for analytic approaches designed to capture the episodic structure of suicidal ideation, where ideation is most frequent, dynamic, and clinically consequential. Rather than specifying strong a priori directional hypotheses, our primary aim was to test whether affective processes are differentially associated with suicidal ideation presence versus its intensity once present. This approach allows us to evaluate whether affective states primarily function as predictors of ideation presence, escalation (ideation severity), or both, while accounting for within-person dynamics and between-person heterogeneity.

The primary focus in our models was on the overall experience of negative and positive affect, and thus we focus on composite affect scores for our primary analyses. It is possible, though, that specific affect states serve as meaningful indicators of presence versus severity of suicidal thinking and overall composites of affect could miss these nuances. Research shows that different composites of affect states or different individual affect states predict different aspects of suicidal thinking (Ben-Zeev et al., 2012; Kuehn et al., 2024; Patel, Edershile, et al., 2025; Weires et al., 2025). For example, in one EMA study, low arousal negative affect (e.g., sad, empty) was a stronger prospective predictor of suicidal thinking than high arousal negative affect (e.g., mad, stressed), but both negative affect arousal composites had similar contemporaneous associations with suicidal thinking (Patel, Edershile, et al., 2025). Another EMA study (Ben-Zeev et al., 2012) found that some affect states (e.g., boredom, tension, sadness) were associated with suicidal thinking but others were not (e.g., worthless, helpless). Thus, we also explored a supplementary model with individual affect states included instead of composite scores. This allowed us to potentially generate hypotheses about individual affect states for future work.

Method

We report how we determined our sample size, all data exclusions (if any), all manipulations, and all relevant measures in the study. Data for the study are not currently publicly available due to the sensitive nature of the data collected from psychiatrically acute adolescents. At the conclusion of the study, in line with our data sharing agreements, data will be posted on the NIMH Data Archive. This study was not preregistered.

Participants and Recruitment

Participants ($n = 244$) were drawn from a larger three-site study examining affective and interpersonal predictors of suicidal thoughts and behaviors among adolescents recently admitted to acute psychiatric care (Patel, Edershile, et al., 2025). We used all data available at the time from the ongoing study.

Adolescents and at least one parent or legal guardian were recruited either during the hospitalization or within 90 days following discharge. Eligibility criteria included (a) admission to inpatient, partial hospital, or emergency psychiatric services due to severe suicidal ideation or suicidal behavior, and (b) age 12–17 years, or age 18 and currently enrolled in high school. This sample is ideal to address our current questions regarding presence versus severity of suicidal thinking because the participants comprise a group known to be at high risk for suicide (i.e., those in the period immediately after discharge from acute psychiatric care; Chung et al., 2017).

Procedure

Adolescents completed 28 days of EMA via the MetricWire mobile application. Participants received up to six surveys per day: one morning survey and one nighttime survey delivered at fixed times based on self-reported sleep and wake schedules, and up to four random surveys delivered outside of school hours with a minimum 2-hr interval between prompts. All data for this study come from the random surveys.

Participants received a \$25 gift card for each week that they had 65% or greater compliance and one entry into a raffle with a 1-in-20 chance of winning an additional \$50 gift card for each week in which they completed at least 75% of scheduled surveys, as well as another supplemental gamified approach to win an additional raffle entry if they located a hidden emoji in a survey question (Kleiman et al., 2025). Although six surveys were administered daily, compliance requirements for participants were calculated assuming a maximum of five surveys per day, allowing participants to miss approximately one survey per day due to contextual constraints (e.g., extracurricular activities or after-school employment limiting phone access). Moreover, in the present study, we report compliance figures for the four random surveys sent each day, as the data from these surveys were the focus of this article.

Measures

Affect

At each random survey time point, we assessed six positive affect states (calm, excited, happy, satisfied, proud, hopeful) and seven negative affect states (lonely, stressed, mad, scared, guilty, sad, empty, tired). All items were assessed on the present moment

(i.e., “Right now, how [AFFECT] do you feel?”) on a 0 (*not at all*) to 10 (*extremely*) scale. The affective composites had excellent multilevel reliability at the between-person ($\alpha = .93$ for negative affect, $\alpha = .96$ for positive affect) and within-person ($\alpha = .82$ for negative affect, $\alpha = .87$ for positive affect) levels. This supported our decision to use composite scores in our primary analyses.

Suicidal Thinking

Consistent with our prior work (Glenn et al., 2021), we used a four-item composite suicidal thinking measure used in our prior work that assessed: passive suicidal ideation (“Right now, how strongly do you wish you weren’t alive anymore?”), active suicidal ideation (“Right now, how strongly do you want to kill yourself?”), suicidal intent (“Right now, how strong is your intent to kill yourself?”), and desire to take action to die by suicide (“Right now, how strongly do you want to take action to kill yourself?”). All items were on a 0 (*not at all*) to 10 (*extremely*) scale. The four-item (0–40) suicidal ideation composite had strong multilevel reliability ($\alpha = .96$ between, $\alpha = .88$ within).

Analytic Strategy

We used multilevel hurdle models to account for the zero-inflated and skewed distribution of suicidal ideation in intensive longitudinal data. Hurdle models separate the outcome into two linked components: a binary component modeling whether suicidal ideation is present (occurrence) and a continuous component modeling ideation severity when it is present (intensity). This approach allows predictors to have distinct associations with ideation presence versus severity. Conceptually, these models are equivalent to jointly estimating a mixed-effects logistic regression for ideation occurrence and a mixed-effects regression model for ideation intensity, while estimating shared predictors and random effects across both processes.

Suicidal ideation was modeled using a hurdle lognormal distribution, selected based on preliminary inspection indicating a large excess of zero responses and a right-skewed, approximately unimodal distribution among nonzero values (See Supplemental Figure S1 for the full distribution). Separate models examined (a) contemporaneous associations between affective composites (negative and positive affect) and suicidal ideation measured at the same assessment, (b) lagged associations predicting suicidal ideation at the subsequent assessment ($T + 1$), and (c) an exploratory lagged model examining individual affect states at time T as predictors of suicidal ideation at $T + 1$. Lagged models included prior suicidal ideation to account for temporal persistence.

Affective predictors were decomposed into within-person (momentary deviations from an individual’s mean) and between-person (individual mean) components to distinguish dynamic effects from stable individual differences. Negative and positive affect (or their individual components) were entered simultaneously in all models. Random intercepts were included throughout, and random slopes for all predictors were included for both the occurrence and intensity components to capture individual differences in affective reactivity. Covariances between random effects within the same part of the model were estimated (the default in *brms*).

In the supplementary individual affect models, we did not include the between-person effect for ratings of excited because the between-person average of excited was highly correlated with the between-person averages of happy, satisfied, proud, and lonely (between group r range from .86 to .90; see Table 1 for between- and within-person correlations); the same was not true for within-person ratings, so those were retained. This high correlation was likely leading to convergence errors and suppressor effects that were not present once that effect was removed.

All models were estimated in a Bayesian framework using Monte Carlo sampling with 8,000 draws implemented in the *brms* R package (Bürkner, 2021). Convergence was evaluated using standard diagnostics, including potential scale reduction factors

Table 1

Between-Person (Below Diagonal) and Within-Person (Above Diagonal) Correlations Between Individual Affect States and Suicidal Ideation.

Variable/Measure	Tired	Lonely	Stressed	Mad	Guilty	Sad	Scared	Empty	Calm	Excited	Happy	Satisfied	Proud	Hopeful	SI
Tired	—	.25	.30	.21	.19	.32	.19	.36	-.09	-.20	-.21	-.18	-.20	-.18	.14
Lonely	.50	—	.41	.34	.30	.46	.23	.45	-.13	-.19	-.25	-.21	-.20	-.20	.22
Stressed	.63	.67	—	.47	.38	.49	.39	.34	-.28	-.23	-.32	-.30	-.27	-.26	.26
Mad	.54	.68	.76	—	.39	.50	.36	.32	-.29	-.23	-.32	-.29	-.24	-.27	.29
Guilty	.50	.65	.67	.77	—	.43	.51	.34	-.16	-.16	-.21	-.19	-.17	-.18	.25
Sad	.58	.80	.76	.78	.79	—	.77	.51	-.27	-.30	-.39	-.35	-.32	-.34	.36
Scared	.52	.61	.76	.78	.87	.77	—	.28	-.17	-.12	-.20	-.18	-.14	-.15	.25
Empty	.56	.83	.62	.62	.61	.76	.55	—	-.21	-.27	-.34	-.30	-.29	-.31	.29
Calm	-.32	-.42	-.46	-.44	-.35	-.46	-.36	-.43	—	.35	.46	.43	.35	.38	-.22
Excited	-.22	-.33	-.28	-.20	-.16	-.30	-.10	-.46	.63	—	.62	.55	.55	.52	-.20
Happy	-.28	-.43	-.38	-.34	-.27	-.43	-.23	-.54	.73	.86	—	.68	.60	.61	-.25
Satisfied	-.25	-.34	-.31	-.25	-.20	-.35	-.14	-.45	.67	.90	.89	—	.66	.60	-.21
Proud	-.23	-.31	-.27	-.22	-.12	-.29	-.05	-.43	.60	.88	.83	.91	—	.65	-.20
Hopeful	-.23	-.36	-.27	-.27	-.17	-.32	-.13	-.46	.68	.86	.87	.91	.89	—	-.23
SI	.46	.54	.52	.58	.58	.69	.54	.6	-.37	-.25	-.37	-.26	-.26	-.31	—
<i>M</i>	4.37	3.07	3.23	1.92	1.82	2.45	1.65	2.88	5.85	4.21	5.09	4.38	4.00	4.59	3.02
<i>SD</i>	3.46	3.24	3.07	2.64	2.62	2.92	2.49	3.35	2.86	3.24	3.17	3.24	3.35	3.28	6.38
<i>ICC</i>	.517	.513	.463	.405	.493	.450	.483	.580	.437	.461	.502	.517	.548	.547	.633
<i>Autocorrelation</i>	.146	.179	.151	.100	.184	.170	.130	.149	.142	.173	.147	.187	.171	.159	.183

Note. All bolded effects significant at $p < .05$. Effect in italics are not significant: sad ↔ proud, sad ↔ excited, and guilty ↔ proud; all between group. ICC = intraclass correlation; SI = suicidal ideation; autocorrelation = one lag autocorrelation.

($\hat{R}$) and effective sample sizes (ESS) for the bulk and tails of the posterior distributions. $\hat{R}$ reflects convergence across chains, and values close to 1.0 indicate good model convergence. ESS quantifies the number of independent-equivalent posterior draws after accounting for autocorrelation in the Markov chains. Although 8,000 posterior draws were obtained, successive samples are correlated; ESS reflects the amount of independent information contained in those draws. Bulk ESS evaluates precision in estimating central posterior quantities (e.g., means), whereas tail ESS evaluates precision in estimating distributional extremes (e.g., credible interval bounds). Values greater than 400 are generally sufficient for stable estimation (Vehtari et al., 2021). Results are reported separately for the occurrence and intensity components, with odds ratios summarizing effects in the occurrence component and regression coefficients summarizing effects in the intensity component.

Transparency and Openness

We report how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in the study, and we follow APA Journal Article Reporting Standards for longitudinal studies (Appelbaum et al., 2018).

Results

Demographics

The average age of the sample was 14.32 years ($SD = 1.68$ years). The sample was 78.9% female sex. Regarding gender, 54.3% identified as female, 20.1% identified as male, 11.9% nonbinary or gender fluid, 9.5% transgender, with the remainder declining to report gender. Regarding race, the sample was 49.8% White, 20.4% Black/African American, 12.7% more than one race, and the remainder identified as another race or chose not to report. Regarding ethnicity, 25.9% of the sample identified as Hispanic or Latine.

Preliminary Results

Table 1 shows correlations, means, standard deviations, intra-class correlations, and autocorrelations for all study variables. The 244 participants completed a total of 11,101 random surveys, yielding an average of 45.5 surveys per participant ($SD = 29.31$ surveys). This yielded an effective compliance rate of 43.6% (range 1%–94.6% compliance) on the 4×/daily random surveys. Twelve participants (4.9%) completed <5. Daily compliance rate (i.e., how many random surveys were completed on an individual day) was unrelated to suicidal ideation reported that day (hurdle $OR = 1.01$, 95% credible intervals [CI] = [0.94, 1.09]; intensity $b = -0.03$, 95% CI = [−0.07, 0.01]). Suicidal ideation ratings were highly zero-inflated, with the modal response being zero (63.8% of all responses were zero; within-person rates ranged from 0% to 100%, $SD = 35.8\%$) and right-skewed distribution among nonzero values, supporting the use of a hurdle modeling approach.

Contemporaneous Association Between Affective Composites and Suicidal Thinking

The model showed good convergence, with no evidence of problematic sampling ($\hat{R} = 1.00$ for all parameters). We also had

adequate effective sample sizes across all parameters: the smallest bulk ESS was 1,005 and the smallest tail ESS was 2,015.

Occurrence of Suicidal Thinking (Hurdle Component)

Results are shown in the first set of columns in Table 2. At the same assessment occasion, momentary (within-person) level of negative affect was strongly associated with suicidal thinking occurrence. Specifically, higher within-person negative affect was associated with higher probability that suicidal thoughts were present. On average, between-person negative affect was also associated with suicidal thinking occurrence. In contrast, higher momentary positive affect was associated with increased odds of no suicidal thinking at the same time point. Average levels of positive affect were not reliably related to ideation occurrence on average.

Severity of Suicidal Thinking (Intensity Component)

Results are shown in the second set of columns in Table 2. When suicidal ideation was present, within-person negative affect was associated with greater ideation severity at the same time point. Specifically, higher momentary (i.e., within-person) negative affect levels were associated with greater intensity of suicidal thinking. On average, between-person negative affect was also associated with greater ideation severity, such that higher average negative affect levels were associated with greater intensity of suicidal thinking. Both momentary and average levels of positive affect were associated with lower ideation intensity.

Temporal Association Between Affective Composites at Time T and Suicidal Thinking at Time $T + 1$

The model showed good convergence, with no evidence of problematic sampling ($\hat{R} = 1.00$ for all parameters). There were adequate effective sample sizes across all parameters: the smallest bulk ESS was 1,007 and the smallest tail ESS was 1,944.

Occurrence of Suicidal Thinking (Hurdle Component)

Results are shown in the first set of columns on the bottom of Table 2. Within-person fluctuations in negative or positive affect showed no associations with next time-point ideation occurrence. However, as would be expected, suicidal ideation at the prior assessment was associated with increased odds of ideation being present at the subsequent assessment. As before, individuals with higher average (i.e., between-person) levels of negative affect exhibited markedly higher odds of suicidal ideation occurrence, and average levels of positive affect were not related to ideation occurrence.

Severity of Suicidal Thinking (Intensity Component)

Results from the continuous component are shown in the second set of columns on the bottom of Table 2. Within-person negative affect at time T was associated with higher severity of suicidal thinking at $T + 1$ when suicidal thinking was present at $T + 1$. Like the occurrence models, between-person (i.e., average) negative affect and suicidal thinking were both associated with severity of suicidal thinking. No significant associations were observed for positive affect either in the moment or on average.

Table 2

Results of Multilevel Hurdle Models Showing Contemporaneous (Top) and Temporal (Bottom) Associations Between Negative and Positive Affect and Suicidal Ideation

Contemporaneous associations (DV = suicidal ideation at time T)				
Effect	Hurdle component		Intensity component	
	<i>OR</i> (error)	95% CI	<i>B</i> (error)	95% CI
Between-person fixed effects				
Negative affect	2.77 (0.89)	[2.20, 3.49]	0.28 (0.03)	[0.23, 0.34]
Positive affect	0.90 (0.91)	[0.74, 1.09]	−0.06 (0.03)	[−0.11, −0.002]
Within-person fixed effects				
Intercept	0.03 (0.51)	[0.01, 0.13]	0.42 (0.18)	[0.06, 0.78]
Negative affect time T	1.64 (0.95)	[1.50, 1.80]	0.19 (0.02)	[0.16, 0.22]
Positive affect time T	0.83 (0.97)	[0.77, 0.88]	−0.07 (0.01)	[−0.10, −0.04]
	Posterior mean	95% CI	Posterior mean	95% CI
Random effects (hyperparameters)				
Intercept	2.49	[2.18, 2.83]	0.61	[0.54, 0.69]
Negative affect slope	0.36	[0.26, 0.46]	0.13	[0.10, 0.17]
Positive affect slope	0.24	[0.16, 0.34]	0.08	[0.05, 0.11]
Correlations (ρ)	ρ	95% CI	ρ	95% CI
Intercept, negative affect	0.02	[−0.21, 0.26]	0.17	[−0.17, 0.48]
Intercept, positive affect	0.09	[−0.22, 0.39]	0.34	[−0.01, 0.65]
Negative affect, positive affect	0.14	[−0.29, 0.51]	0.27	[−0.14, 0.6]
Temporal associations (DV = suicidal ideation at time $T + 1$)				
Effect	Hurdle component		Intensity component	
	<i>OR</i> (error)	95% CI	<i>B</i> (error)	95% CI
Between-person fixed effects				
Negative affect	2.54 (0.89)	[2.04, 3.17]	0.26 (0.03)	[0.20, 0.32]
Positive affect	0.92 (0.91)	[0.77, 1.09]	−0.04 (0.03)	[−0.09, 0.02]
Within-person fixed effects				
Intercept	0.04 (0.53)	[0.01, 0.14]	0.55 (0.19)	[0.18, 0.91]
Negative affect time T	1.06 (0.97)	[0.99, 1.13]	0.05 (0.01)	[0.02, 0.08]
Positive affect time T	1.03 (0.98)	[0.98, 1.09]	0.003 (0.01)	[−0.02, 0.02]
Suicidal ideation time T	1.13 (0.99)	[1.11, 1.15]	0.03 (0.002)	[0.02, 0.03]
	Posterior mean	95% CI	Posterior mean	95% CI
Random effects (hyperparameters)				
Intercept	2.30	[2.01, 2.63]	13.87	[7.46, 13.87]
Negative affect slope	0.15	[0.04, 0.25]	1.28	[1.04, 1.28]
Positive affect slope	0.09	[0.01, 0.18]	1.20	[1.01, 1.20]
Correlations (ρ)	ρ	95% CI	ρ	95% CI
Intercept, negative affect	−0.32	[−0.65, 0.05]	0.14	[−0.45, 0.63]
Intercept, positive affect	0.05	[−0.53, 0.63]	0.26	[−0.46, 0.84]
Negative affect, positive affect	−0.42	[−0.94, 0.35]	0.26	[−0.71, 0.89]

Note. *OR* = odds ratio; error = standard deviation of the posterior distribution; CI = credible interval. The *brms* default hurdle responses are keyed such that higher *ORs* in the hurdle model = lower odds of “crossing” the hurdle and having a nonzero response. We have reversed these *ORs* (i.e., $1/OR$) so that they are displayed on a more intuitive scale, where higher *ORs* = higher odds of having a nonzero response, thus making these already incredibly dense findings hopefully slightly less dense. Significant associations are indicated in bold font.

Supplementary Analyses Examining the Temporal Association Between Individual Affective States at Time T and Suicidal Thinking at Time $T + 1$

Table 3 shows the results from the fixed effect parts of the supplementary model predicting suicidal thinking at time $T + 1$ using individual affect states. Like the prior models, the model assessing

the effect of individual affect states showed good convergence, with no evidence of problematic sampling ($\hat{R} = 1.00$ and adequate effective sample sizes across all parameters; minimum tail ESS = 3,342, Bulk ESS = 1,932). As in the prior models, suicidal thinking at time T was associated with both components (hurdle and intensity) of suicidal thinking at time $T + 1$. Random effect covariances for this model are shown in Table 1.

Table 3

Results of Multilevel Hurdle Model Predicting Suicidal Ideation at Time $T + 1$ Using Individual Affect States

Effect	Hurdle component		Intensity component	
	OR (error)	95% CI	B (error)	95% CI
Between-person fixed effects				
Tired	1.24 (0.89)	[0.98, 1.57]	0.07 (0.04)	[−0.01, 0.14]
Lonely	0.88 (0.85)	[0.64, 1.21]	−0.08 (0.05)	[−0.17, 0.01]
Stressed	0.72 (0.83)	[0.51, 1.04]	−0.01 (0.06)	[−0.12, 0.10]
Mad	0.95 (0.80)	[0.61, 1.45]	0.00 (0.06)	[−0.11, 0.11]
Scared	1.29 (0.78)	[0.78, 2.09]	0.02 (0.07)	[−0.12, 0.16]
Guilty	0.95 (0.82)	[0.64, 1.42]	−0.01 (0.06)	[−0.13, 0.11]
Sad	2.09 (0.81)	[1.39, 3.17]	0.18 (0.06)	[0.06, 0.30]
Empty	1.32 (0.85)	[0.97, 1.80]	0.08 (0.04)	[0.002, 0.17]
Happy	0.90 (0.79)	[0.57, 1.43]	0.01 (0.08)	[−0.16, 0.17]
Satisfied	1.63 (0.74)	[0.89, 2.92]	0.09 (0.10)	[−0.10, 0.28]
Proud	1.15 (0.77)	[0.68, 1.92]	0.07 (0.08)	[−0.09, 0.23]
Calm	0.93 (0.84)	[0.66, 1.30]	−0.03 (0.05)	[−0.13, 0.07]
Hopeful	0.63 (0.80)	[0.41, 0.99]	−0.14 (0.07)	[−0.28, 0.00]
Within-person fixed effects				
Intercept	0.04 (0.34)	[0.01, 0.36]	0.47 (0.31)	[−0.13, 1.09]
Tired (time T)	1.07 (0.98)	[1.02, 1.12]	0.01 (0.01)	[−0.01, 0.03]
Lonely (time T)	1.03 (0.98)	[0.98, 1.08]	0.001 (0.01)	[−0.02, 0.02]
Stressed (time T)	1.01 (0.98)	[0.96, 1.06]	0.001 (0.01)	[−0.02, 0.03]
Mad (time T)	0.98 (0.97)	[0.93, 1.04]	0.002 (0.01)	[−0.02, 0.02]
Scared (time T)	1.00 (0.97)	[0.93, 1.06]	0.003 (0.01)	[−0.02, 0.02]
Guilty (time T)	1.02 (0.97)	[0.96, 1.08]	−0.01 (0.01)	[−0.03, 0.02]
Sad (time T)	0.99 (0.97)	[0.94, 1.06]	0.01 (0.01)	[−0.02, 0.04]
Empty (time T)	1.00 (0.97)	[0.94, 1.05]	0.02 (0.01)	[−0.01, 0.04]
Happy (time T)	1.04 (0.97)	[0.97, 1.12]	0.0004 (0.01)	[−0.02, 0.03]
Satisfied (time T)	0.99 (0.97)	[0.93, 1.05]	−0.03 (0.01)	[−0.05, 0.00]
Proud (time T)	1.01 (0.97)	[0.95, 1.07]	0.02 (0.01)	[−0.01, 0.05]
Calm (time T)	0.99 (0.97)	[0.94, 1.04]	−0.01 (0.01)	[−0.03, 0.01]
Excited (time T)	1.04 (0.97)	[0.98, 1.10]	0.01 (0.01)	[−0.01, 0.04]
Hopeful (time T)	0.99 (0.97)	[0.93, 1.05]	−0.0004 (0.01)	[−0.03, 0.02]
Suicidal ideation (time T)	1.14 (0.99)	[1.11, 1.17]	0.02 (0.00)	[0.01, 0.03]
	Posterior mean	95% CI	Posterior mean	95% CI
Random effects (hyperparameters)				
Intercept	0.10	[0.07, 0.14]	0.61	[0.51, 0.71]
Tired	0.92	[0.86, 0.99]	0.06	[0.02, 0.09]
Lonely	0.95	[0.87, 1.00]	0.04	[0.01, 0.08]
Stressed	0.96	[0.89, 1.00]	0.05	[0.00, 0.08]
Mad	0.95	[0.88, 1.00]	0.03	[0.00, 0.06]
Scared	0.91	[0.80, 1.00]	0.02	[0.00, 0.05]
Guilty	0.91	[0.82, 0.99]	0.03	[0.00, 0.06]
Sad	0.93	[0.84, 1.00]	0.07	[0.04, 0.10]
Empty	0.94	[0.87, 1.00]	0.05	[0.01, 0.08]
Happy	0.91	[0.83, 0.99]	0.03	[0.00, 0.07]
Satisfied	0.94	[0.86, 1.00]	0.04	[0.00, 0.08]
Proud	0.95	[0.88, 1.00]	0.03	[0.00, 0.08]
Calm	0.93	[0.85, 1.00]	0.02	[0.00, 0.04]
Excited	0.90	[0.83, 0.98]	0.06	[0.03, 0.09]
Hopeful	0.95	[0.88, 1.00]	0.04	[0.00, 0.09]
Suicidal ideation	0.10	[0.07, 0.14]	0.61	[0.51, 0.71]

Note. OR = odds ratio; error = standard deviation of the posterior distribution; CI = credible interval. Higher ORs for hurdle component = higher odds of having a nonzero response. Significant associations are indicated in bold font.

Occurrence of Suicidal Thinking (Hurdle Component)

Results are shown in the first set of columns of Table 3. Individuals with higher average (i.e., between-person) levels of sadness and lower levels of hopefulness exhibited higher odds of suicidal ideation occurrence. Higher within-person ratings of tiredness were associated with greater odds of suicidal ideation occurrence.

Severity of Suicidal Thinking (Intensity Component)

Results from the continuous component are shown in the second set of columns in Table 3. Between-person ratings of sadness and empty were positively associated with severity of suicidal thinking at $T + 1$ when suicidal thinking was present at $T + 1$. There were no significant within-person affective predictors.

Discussion

The goal of this study was to use multilevel hurdle models to clarify whether affective states function as predictors of suicidal ideation occurrence, severity once present, or both. Across contemporaneous and lagged analyses, results revealed dissociable processes governing ideation occurrence versus ideation severity. Stable individual differences in negative affect were robustly associated with the likelihood of experiencing suicidal ideation, whereas momentary affective fluctuations showed weaker and less consistent associations with ideation presence. In contrast, both person-level (trait-like) and momentary negative affect were strongly associated with ideation intensity once ideation was present, even after accounting for ideation persistence. Together, these findings suggest that affective states primarily function as amplifiers of suicidal ideation severity rather than as acute triggers of ideation occurrence. Although we interpreted the strong concurrent association as consistent with an “amplifier” role, negative affect and suicidal ideation may instead reflect co-occurring features of a shared underlying state; accordingly, the findings from contemporaneous analyses do not permit conclusions about underlying mechanisms.

This pattern aligns with diathesis–stress and vulnerability–stress models of suicide risk (David, 2006; Mann, 1998; Wenzel & Beck, 2008). The emergence of suicidal ideation may reflect activation of an underlying vulnerability by stressors or contextual factors, whereas affective states may index the degree to which that vulnerability is expressed once ideation has occurred. This idea of flipping an “on/off” switch is in line with the idea of the state-like suicide mode featured in several cognitive vulnerability frameworks (Rudd, 2000; Wenzel & Beck, 2008). In this framework, affect is less central to flipping the “on/off” switch of ideation and more relevant to shaping the intensity of ideation during periods of elevated risk. In this context, the model captures moment-to-moment fluctuations in whether suicidal thinking is present (“on” vs. “off”), rather than the initial onset of suicidal thoughts. Future research should use hurdle models or other advanced models that capture temporal dynamics (e.g., DSEM with floor effects; Muthén et al., 2025) to test whether underlying vulnerability factors relate more strongly to presence/absence while affective states primarily predict ideation severity once present. Longitudinal designs could further examine factors that relate to the first onset of suicidal thinking. It is particularly important to model temporal dynamics in a framework like DSEM with floor effects, because doing so would allow us to appropriately account for the uneven spacing of assessments in the present study.

Positive affect showed a more modest and context-dependent role than negative affect. Higher momentary positive affect was associated with lower ideation severity and, concurrently, with lower likelihood of ideation presence, but these associations did not consistently extend to prospective prediction of subsequent ideation occurrence. Exploratory analyses of individual affective states largely supported these conclusions, with no specific positive affect states (i.e., within-person) emerging as unique predictors of subsequent suicidal ideation presence or occurrence. This suggests that positive affect may be protective against suicidal ideation in the moment, but this does not necessarily extend into subsequent moments of the day. Moreover, this effect could be due to the clinically severe nature of our sample.

Like positive affect, most specific types of negative affect were not strongly associated with ideation occurrence or severity once

broader affective dimensions and prior ideation were accounted for. The few effects that emerged were small in magnitude, suggesting that global affective processes may be more informative than discrete affective states for understanding short-term suicidal ideation dynamics. This pattern of findings is important insofar as it is reflective of the complex realities of experienced affect. Specifically, they reflect the fact that individuals often experience multiple forms of affect simultaneously (e.g., anger and sadness), and thus analyses focusing on a single discrete type of affective miss this important complexity (Bentley et al., 2021; Gonzalez et al., 2017; Patel, Edershile, et al., 2025). Adolescents, especially those with more severe psychopathology, may show reduced emotion differentiation which could introduce additional measurement error and attenuate the reliability of self-reported affective ratings (Nook et al., 2018).

Methodologically, these findings highlight the value of multilevel hurdle models for studying suicidal ideation in intensive longitudinal data. By explicitly separating ideation occurrence from ideation severity, this approach revealed patterns that would likely be obscured by models that treat ideation as a single continuous outcome. The results underscore the importance of aligning analytic approaches with the episodic structure of suicidal thinking. These distinctions have direct implications for intervention. Real-time interventions that target momentary affect may be particularly effective for reducing the severity of suicidal ideation once it is present, whereas preventing ideation onset may require addressing precipitating contextual stressors. Of note, this analytical approach may be equally applicable to other forms of psychopathology that are characterized by periodicity and severity (e.g., alcohol and substance use urges; Grossmann & Ellsworth, 2017).

Strengths of the study include a large, high-risk sample, intensive longitudinal assessment, and analytic models that capture both within-person dynamics and between-person heterogeneity. Limitations include reliance on self-report, the temporal resolution of EMA assessments (i.e., the inability with the EMA schedule employed in the current study to evaluate the associations between affect and suicidal ideation at finer temporal resolution), and the absence of measures of contextual or environmental triggers in the models. In addition, although the hurdle component models ideation presence versus absence, it does not permit inference about the precise emergence or onset of suicidal ideation that may occur between assessments, and they therefore should not be interpreted as a direct test of acute onset mechanisms. Future work could extend this approach by incorporating state-transition models, contextual stressors, or multimodal indicators of affect.

Findings should be interpreted in the context of a high-risk, clinically referred adolescent sample assessed during a period of acute vulnerability. Participants were recruited during or shortly after acute psychiatric care, and processes governing suicidal ideation in this context may differ from those operating in community, outpatient, or adult populations. In particular, the relative contribution of person-level affective vulnerability versus momentary affective fluctuations may be accentuated under conditions of elevated and persistent risk. Future work is needed to determine whether similar dissociations between ideation presence and severity extend to lower-risk or nonclinical samples.

In sum, multilevel hurdle models revealed a clear dissociation between processes governing the occurrence and severity of suicidal ideation. Stable negative affect increased the likelihood of

experiencing suicidal ideation, whereas momentary affect, particularly negative affect, primarily influenced ideation intensity once present. These findings advance understanding of suicidal ideation as an episodic process and demonstrate the value of analytic approaches that distinguish onset from escalation.

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