Psychology of Addictive Behaviors

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Exploring Real-Time Associations Between Momentary Distress Tolerance, Emotion Regulation, and Gambling Behavior in Australian Adults: An Ecological Momentary Assessment Study

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Objective: Guided by the dynamic model of relapse, this study examined whether momentary distress intolerance (DI) and emotion regulation (ER; maladaptive and adaptive strategy use) predict gambling behavior (episodes, expenditure, duration) in real time and whether momentary DI and ER interact with each other and with stable (problem gambling severity, high-risk situations) and momentary (psychological distress, state impulsivity) vulnerabilities in predicting gambling episodes. ***Method:*** A secondary analysis was conducted on an ecological momentary assessment (EMA) study comprising a pre-EMA survey of stable variables followed by a 28-day period of twice-daily smartphone-delivered EMAs of momentary variables and gambling episodes. The convenience sample included 132 Australian adults (M_{age} = 29.9 years; 58.3% male; 94.7% endorsed gambling problems) who reported gambling in a typical month. ***Results:*** Mixed-effects logistic regression analyses showed that momentary DI was associated with longer subsequent gambling duration (OR = 1.13, 95% CI [1.02, 1.25], p = .024), and maladaptive ER strategies were associated with both gambling episodes (OR = 1.24, 95% CI [1.03, 1.50], p = .023) and longer subsequent gambling duration (OR = 1.64, 95% CI [1.02, 2.65], p = .042). Adaptive ER strategy use was not significantly associated with gambling behavior. Only DI interacted with state impulsivity (OR = 1.11, 95% CI [1.03, 1.19], p = .005), whereby individuals with low impulsivity were more likely to gamble when DI was low, whereas those with high impulsivity were more likely to gamble when DI was high. ***Conclusions:*** These findings contribute to our understanding of DI and ER strategy use as dynamic, momentary vulnerabilities for gambling behavior and highlight their potential as real-time intervention targets, particularly for individuals with high impulsivity.

Public Health Significance Statement

This study shows that difficulties tolerating momentary distress and reliance on maladaptive emotion regulation strategies are linked to gambling episodes and sustained gambling duration. Importantly, individuals with high impulsivity were especially likely to gamble when distress intolerance was high. By leveraging real-time data on distress intolerance, emotion regulation, and gambling behavior, these findings support the development of interventions that deliver in-the-moment support to reduce gambling harm.

Keywords: gambling, distress tolerance, emotion regulation, ecological momentary assessment

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continued

Gambling harm is a major public health issue. Globally, around one in 10 adults (10.1%) experience harms from their gambling (up to 11.4% in Australia), with 1.4% displaying problem gambling (0.4%–0.6% in Australia; Dowling et al., 2016; Gainsbury et al., 2014; Tran et al., 2024). Problem gambling is characterized by behavioral dependence (cognitive, affective, and behavioral symptoms) and harms across several life domains (e.g., financial, relational, health, and well-being domains), affecting individuals, families, and communities (Australian Psychological Society, 2025; Langham et al., 2016). Although a minority experience problem gambling, most population-level harm arises from low- and moderate-risk gambling due to its higher prevalence in the population, underscoring the need for prevention and intervention across the full continuum of risk (Browne et al., 2017). Psychiatric comorbidity is highly prevalent (Sharma & Weinstein, 2025), with around three quarters of people seeking treatment for problem gambling also displaying current (74.8%) or lifetime (75.5%) major mental health conditions ("Axis 1 Disorders"; Dowling et al., 2015). The most common co-occurring conditions are major depressive disorder (30%), anxiety disorders (e.g., generalized and social anxiety disorders; 14%–15%), and alcohol (21%) and substance use disorders (e.g., nicotine dependence: 56%; cannabis use disorder: 12%; Dowling et al., 2015). Identifying psychological and transdiagnostic mechanisms underlying gambling behavior is therefore critical for informing prevention and treatment strategies.

Two related transdiagnostic mechanisms implicated in gambling are distress intolerance (DI) and emotion regulation (ER). DI refers to an individual's perceived or actual inability to endure distressing emotional or physical states (Zvolensky et al., 2010), while ER refers to the ways an individual modulates the intensity, duration, and expression of emotions (Gross, 1998). Models of ER distinguish between deficits (e.g., nonacceptance of emotions, poor clarity) and strategies that may be adaptive (e.g., reappraisal, acceptance) or maladaptive (e.g., suppression, rumination, avoidance; Velotti et al., 2021). Empirically, DI has been shown to predict greater reliance on maladaptive ER strategies, heightened emotional reactivity, and impulsive attempts to escape aversive states (Jeffries et al., 2016; Leyro et al., 2010). This pattern highlights how DI, emotional distress, ER strategy use, and impulsive responding are interrelated yet distinct constructs. Theoretically, greater DI may increase vulnerability to maladaptive ER strategies and impulsive or avoidant behaviors, like gambling, to escape distress (Jeffries et al., 2016). These mechanisms are implicated in the onset and maintenance of many psychiatric conditions (Leyro et al., 2010; Sheppes et al., 2015; Stellern et al., 2023), including gambling. For example, the pathways model of problem gambling identifies an emotionally vulnerable subgroup characterized by greater emotional dysregulation and a poorer ability to cope, particularly in high-risk situations that exacerbate stress (Blaszczynski & Nower, 2002; Nower et al., 2022).

A limited literature has examined the associations between DI and gambling. In an early study, Daughters et al. (2005; $n = 32$) found that treatment-seeking adults who relapsed within 2 weeks of a quit attempt displayed greater DI and emotional vulnerability (negative affect and heightened stress reactivity) compared with those who sustained abstinence for at least 3 months, suggesting that DI undermines recovery attempts. In a subsequent study, Ledgerwood et al. (2009; $n = 102$) found that people with problem gambling had greater DI than healthy controls, suggesting that difficulty enduring unpleasant emotional states may contribute to problematic gambling behavior. There is substantial cross-sectional evidence linking DI to addictions more broadly, with systematic review evidence highlighting medium negative associations with problem substance use (Mattingley et al., 2022). Broader addiction research also links DI to lapse and relapse, with DI predicting poorer smoking cessation outcomes (albeit inconsistently; Veilleux, 2019) and greater alcohol and substance use (Anderson et al., 2025; Greenberg et al., 2016; Zaorska et al., 2023).

By contrast, ER has been more extensively studied in gambling. An initial systematic review ($k = 20$) across gambling disorder and video gaming established that ER deficits are reliably associated with greater gambling severity and harms (Marchica et al., 2019). A subsequent meta-analysis of 38 studies (representing 5,242 participants) found robust associations between difficulties accessing adaptive strategies and a tendency to use maladaptive strategies with gambling disorder (Velotti et al., 2021). Most recently, an expanded systematic review ($k = 48$) extended these findings by focusing on specific ER strategies, reporting significant associations with gambling severity in 96% of studies. Notably, maladaptive avoidance-based strategies (e.g., avoidance, rumination) emerged as the most consistent contributors to the onset and maintenance of gambling disorder (Neophytou et al., 2023).

Taken together, these reviews suggest that ER deficits and greater use of maladaptive than adaptive strategies are consistently linked with gambling severity, whereas DI remains comparatively under-researched. Cross-sectional evidence also suggests that DI and ER are interrelated and may interact with other individual vulnerabilities to amplify risk. In alcohol use disorder, evidence suggests that DI is significantly associated with ER difficulties even when accounting for alexithymia (inability to identify and describe emotions), depressive symptomatology, age, and sex (Zaorska et al., 2023). While the relationship between DI and ER has not specifically been examined in gambling research, there is evidence that ER difficulties have been linked to greater impulsivity and trait vulnerabilities such as negative urgency (Williams et al., 2012), as well as to higher psychological distress (Artemi et al., 2025). Greater gambling severity and exposure to high-risk situations also appear to exacerbate difficulties in regulating emotions (Blaszczynski & Nower, 2002; Nower et al., 2022). Intervention research also supports their clinical relevance.

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For example, a dialectical behavior therapy program (comprising mindfulness, distress tolerance, ER, and interpersonal effectiveness modules) was associated with improvements in DI, gambling expenditure, and abstinence in a small sample of 14 people with problem gambling (Christensen et al., 2013), and an ER-enhanced group treatment similarly reduced gambling severity among 21 treatment-seeking adults (Månsson et al., 2022). Similarly, de Lisle et al. (2014) found that DI and emotion dysregulation mediated links between mindfulness and gambling severity in adults seeking gambling treatment. Together, these findings highlight DI and ER as promising, and potentially interacting, treatment targets. Most evidence is cross-sectional, however, limiting understanding of their dynamic interplay in predicting gambling behavior in daily life.

The dynamic model of relapse conceptualizes gambling episodes as the product of stable risks (e.g., gambling severity, trait vulnerabilities, high-risk situations) interacting with momentary states (e.g., psychological distress, impulsivity; Witkiewitz & Marlatt, 2004). Ecological momentary assessment (EMA) is well suited to examine these processes in addictions (Votaw & Witkiewitz, 2021), as it repeatedly captures experiences and behavior in real time, reducing recall bias and enhancing ecological validity (Shiffman et al., 2008). EMA research shows that momentary DI and ER predict same-day substance use (Sandel-Fernandez et al., 2023) and that DI fluctuates substantially within individuals (Veilleux et al., 2018). While gambling EMA research is emerging, including studies examining associations between momentary vulnerabilities (e.g., craving, self-efficacy, positive outcome expectancies, motives) and gambling behavior (Dowling et al., 2021; Goldstein et al., 2014; Hawker et al., 2020, 2026; Kim et al., 2023), only one has assessed ER, albeit as a stable baseline factor. Kim et al. (2023; $n = 84$) found that greater ER difficulties unexpectedly predicted a lower likelihood of in-play sports betting across a 14-day EMA period. This counterintuitive finding underscores the need to further examine DI and ER as momentary, fluctuating processes in gambling behavior.

Building on this limited evidence, the current data set—drawn from a 28-day EMA study with 132 Australian adults—offers the first opportunity to examine DI and ER as momentary processes in gambling, extending earlier analyses that focused on gambling motives (Hawker et al., 2026). Findings revealed that coping, enhancement, and social motives predicted greater gambling expenditure (while financial motives did not predict gambling behavior) and that momentary DI amplified the effect of coping and enhancement motives on subsequent gambling. Momentary DI therefore appeared to increase vulnerability for motive-driven gambling in the moment, reinforcing its relevance as a dynamic risk factor in gambling behavior and associated harm (Hawker et al., 2026). These analyses treated momentary DI and ER only as moderators of motive-episode associations; they did not estimate or report the main within-person effects of DI or ER on subsequent gambling behavior, leaving a gap in the available literature.

The Present Study

Guided by the dynamic model of relapse (Witkiewitz & Marlatt, 2004), this EMA study extends earlier analyses of gambling motives (Hawker et al., 2026) by examining the role of momentary DI and ER in gambling behavior. Although the present sample did not necessarily comprise individuals in treatment or attempting recovery, this model provides a useful framework for understanding momentary risk processes that can precipitate gambling episodes in a regular gambling sample. This study examines whether momentary DI and ER strategy use independently predict subsequent gambling behavior and whether they interact with each other and with other stable and momentary vulnerabilities. Understanding these dynamic processes has important implications for developing real-time interventions to reduce gambling-related harm. It is hypothesized that:

Hypothesis 1 (H1): Momentary DI will be positively associated with subsequent gambling episodes, expenditure, and duration.

Hypothesis 2 (H2): Momentary maladaptive ER strategies will be positively associated with subsequent gambling episodes, expenditure, and duration, while adaptive ER strategies will be negatively associated with these outcomes.

Hypothesis 3 (H3): ER strategies will moderate the relationship between DI and gambling episodes, such that maladaptive ER strategies will amplify, and adaptive ER strategies will attenuate, the positive association between DI and gambling episodes.

Hypothesis 4 (H4): Stable (problem gambling severity, high-risk situations) and momentary (psychological distress, state impulsivity) vulnerabilities will amplify the relationships between momentary DI, ER strategy use, and subsequent gambling episodes.

Method

Participants

This secondary data analysis is based on a sample of 132 adults (58.3% male), with an average age of 29.9 years ($SD = 8.6$, $Mdn = 28.0$, range = 18–64), recruited from the Australian community during the COVID-19 pandemic (July 2020 to April 2021; Hawker et al., 2026). Eligible participants were aged 18 or older, owned a smartphone, and reported gambling on at least one activity other than lotteries in a typical month prior to COVID-19. Typical gambling participation (reported in Table 1) was assessed to contextualize the sample during this time period, as pandemic-related social distancing restrictions likely altered gambling patterns due to reduced access to land-based venues and increased online gambling (Jenkinson et al., 2020).

Participants were most commonly born in Australia (53.8%), employed on a full-time or part-time/casual basis (65.2%), had an associate or undergraduate diploma or bachelor's degree (57.6%), and used an iOS/iPhone smartphone (61.4%). Most participants reported gambling in a typical month on number games (74.2%, e.g., lotteries, keno, Powerball, bingo), sports/event results (70.5%), racing events (68.9%), and electronic gaming machines (67.4%), while around half gambled on table games (49.2%) and informal private betting (48.9%). Nearly all participants (94.7%) reported risky gambling on the Problem Gambling Severity Index (PGSI), with over half reporting problem gambling (52.3%), 29.6% reporting moderate-risk gambling, 12.9% reporting low-risk gambling, and only 5.3% reporting nonproblem gambling. Table 1 provides sample descriptive statistics.

Table 1
Sociodemographic and Gambling-Related Characteristics for the Sample

Sample characteristic	*n*	%
Sociodemographic characteristics		
Age (*M, SD*)	29.9	8.6
Gender (male)	77	58.3
Born in Australia	71	53.8
Employment status		
Full-time employment	55	41.7
Part-time or casual employment	31	23.5
Full-time student	34	25.8
Full-time home duties	3	2.3
Retired	1	0.8
Sick or disability pension	1	0.8
Other	7	5.3
Highest education level		
Did not complete year 12 or equivalent	1	0.8
Year 12 or equivalent	25	18.9
Vocational qualification	9	6.8
Associate diploma	14	10.6
Undergraduate diploma	15	11.4
Bachelor's degree	47	35.6
Postgraduate diploma	4	3.0
Master's degree	16	12.1
Doctoral degree	1	0.8
Smartphone operating system		
iOS/iPhone	81	61.4
Android	51	38.6
Gambling-related characteristics		
Gambling participation		
Number games (e.g., lotteries, keno, Powerball, or bingo)	98	74.2
Sports or event betting	93	70.5
Horse/harness/greyhound racing	91	68.9
Electronic gaming machines	89	67.4
Table games	65	49.2
Informal private betting	64	48.9
PGSI problem gambling severity (*M*, *SD*)	7.7	5.1
Nonproblem gambling (*n*, %)	7	5.3
Low-risk gambling (*n*, %)	17	12.9
Moderate-risk gambling (*n*, %)	39	29.6
Problem gambling (*n*, %)	69	52.3
IGS-10 high-risk situations		
Positive reinforcement (*M*, *SD*)	10.6	2.9
Negative reinforcement (*M*, *SD*)	13.5	4.4

Note. *n* = 132. PGSI scores indicate nonproblem gambling (score of 0), low-risk gambling (scores of 1–2), moderate-risk gambling (scores of 3–7), and problem gambling (scores of 8–27). Higher IGS-10 subscale scores (range = 4–16 for positive reinforcement; 6–24 for negative reinforcement) indicate more frequent gambling in positively or negatively reinforcing situations. PGSI = Problem Gambling Severity Index; IGS-10 = Inventory of Gambling Situations-Short Form.

Measures

Pre-EMA Survey

The pre-EMA survey assessed demographic information and baseline gambling participation, problem gambling severity, and high-risk situations.

Demographic Characteristics. Participants reported their age, gender, country of birth, employment status, educational attainment, and smartphone operating system via single items.

Gambling Participation. Pre-EMA gambling participation was captured via single-item reports of the number of days in a typical month pre-COVID-19 that participants engaged in six gambling activities (with 1 or more days coded as endorsement in Table 1). The activities included number games (e.g., lotteries, keno, Powerball, or bingo), sports or event betting, horse/harness/greyhound racing, pokies (electronic gaming machines), informal private betting, and table games.

Problem Gambling Severity. The nine-item PGSI (Ferris & Wynne, 2001) was used to measure past-year problem gambling severity in terms of both behavioral dependence (e.g., gambling more than one can afford to lose; four items) and adverse consequences (e.g., gambling-related health problems; five items). Items are rated on a 4-point scale from 0 (*never*) to 3 (*almost always*). Total scores indicate nonproblem gambling (score of 0), low-risk gambling (scores of 1–2), moderate-risk gambling (scores of 3–7), and problem gambling (scores of 8 or more). The PGSI has demonstrated excellent internal consistency in previous research (Brazeau & Hodgins, 2022; Ferris & Wynne, 2001; Holtgraves, 2009) and in this study (α = .91).

High-Risk Gambling Situations. High-risk gambling situations were assessed using the 10-item Inventory of Gambling Situations–Short Form (IGS-10: Smith et al., 2011). The scale measures the typical likelihood of gambling heavily in high-risk situations over the past year, reflecting relatively stable individual tendencies rather than momentary environmental events. The two subscales distinguish between high-risk situations linked to positive reinforcement (e.g., pleasant emotions, celebration; four items) and negative reinforcement (e.g., unpleasant emotions, interpersonal conflict; six items). Items are rated on a 4-point scale from 1 (*never*) to 4 (*almost always*). The IGS-10 subscales have demonstrated good-to-excellent internal consistency in previous research (Smith et al., 2011) and in this study (α = .83–.89).

EMA of Momentary Factors and Gambling Behavior

The EMA protocol was administered via the MetricWire smartphone application, a secure platform for real-time data collection (https://metricwire.com). Time-based assessments (t-EMA) were used to capture momentary factors, and event records (e-EMA) were used to capture gambling behavior. Participants received semirandom prompts twice daily for 28 consecutive days, starting from enrolment in the app, with prompts delivered within two fixed windows: morning (9:00 a.m.–12:00 p.m.) and evening (5:30 p.m.–8:30 p.m.). Each notification remained active for 2 hr.

The t-EMAs (3 min to complete) captured momentary DI, ER (maladaptive and adaptive strategy use), psychological distress, and state impulsivity. Gambling behavior could be reported during a prompted t-EMA or via a self-initiated e-EMA (1–2 min to complete). When gambling was reported in a t-EMA, participants indicated whether the episode had already been logged through an e-EMA; if not, they were prompted to provide details on expenditure and duration. EMA items were selected for brevity and delivered in a fixed order to minimize participant burden, although this approach did not address potential reactivity to repeated measurement. Table 2 presents the EMA constructs, items, response formats, and coding used in analyses.

Procedure

This study reports a secondary analysis of data originally collected by Hawker et al. (2026). Participants were recruited in Australia via convenience and snowball sampling, using social media platforms

Table 2
Ecological Momentary Assessment Constructs, Items, Response Formats, and Coding Used in Analyses

Construct and source of item	EMA item	Response option	Response category employed in analyses
t-EMA items			
Momentary distress intolerance: Via the Momentary Distress Intolerance Scale validated for use in EMA studies (Veilleux et al., 2018).	Please indicate your perception of the ability to tolerate your feelings right now in this moment (a) I want to stop what I'm doing right now so I can feel better (b) Right now, my emotions are getting in the way (c) I can keep doing what I'm doing right now, regardless of what I feel (reverse scored)	(1) *Strongly disagree* (2) *Moderately disagree* (3) *Mildly disagree* (4) *Neither agree nor disagree* (5) *Mildly agree* (6) *Moderately agree* (7) *Strongly agree*	Item summed to yield a total score (range = 3–21), analyzed as continuous
Momentary emotion dysregulation: Via a scale of momentary emotion regulation strategy use validated for use in EMA studies (Short et al., 2018)	Did anything upsetting or stressful happen to you since the last prompt? *Administered following a "Yes" response.* Did you do any of the following	(0) No (1) Yes	(0) No (1) Yes
Adaptive strategies	(a) I thought about it in a different way (*cognitive reappraisal*) (b) I tried to accept that this is the way things are (*acceptance*) (c) I tried to think about a way to fix the problem (*problem solving*)	(0) No (1) Yes	"Yes" responses summed to yield a total score (range = 0–3 strategies utilized), analyzed as continuous
Maladaptive strategies	(d) I tried not to think about it (*thought suppression*) (e) I kept my emotions to myself (*emotion suppression*) (f) I could not stop thinking about it (*rumination*) (g) I did something impulsive to make me feel better (e.g., using alcohol or drugs; *impulsive behaviour [negative urgency]*) (h) I went out of my way to avoid thoughts, situations, or activities that would make me upset again (*avoidance*)	(0) No (1) Yes	"Yes" responses summed to yield a total score (range = 0–5 strategies utilized), analyzed as continuous
Momentary psychological distress: Via a single-item distress thermometer validated in cross-sectional research (Donovan et al., 2014)	How distressed have you been today and over the past week?	(0) *no distress* to (10) *extreme distress*	(0) No distress (score of 0) (1) Any distress (scores of 1–10)
Momentary state impulsivity: Via the Momentary Impulsivity Scale validated for use in EMA studies (Tomko et al., 2014)	Since the last prompt (a) I said things without thinking (b) I spent more money than I meant to (c) I have felt impatient (d) I made a "spur of the moment decision"	(1) *Very slightly or not at all* (2) *A little* (3) *Moderately* (4) *Quite a bit* (5) *Extremely*	(0) Lower state impulsivity (score of 1) (1) Higher state impulsivity (scores of 2–5)
e-EMA items			
Gambling event	Have you gambled since the last prompt?	(0) No (1) Yes	(0) No (1) Yes
	Has this event already been recorded? *The following items were administered following a "No" response.*	(0) No (1) Yes	(0) No (1) Yes
Gambling expenditure	Did you win or lose overall?	(1) Win: *Enter winnings minus money spent* (2) Loss: *Enter money spent minus total lost* (3) Broke even (4) I don't know the outcome of this bet yet	(0) $0 (won or broke even) (1) Loss of $1–$30 (2) Loss of $31 or more
Gambling duration	How much time did you spend gambling?	*Enter numeric value*	(0) 45 min or less (1) More than 45 min

Note. t-EMAs were administered twice daily in the 28-day EMA protocol. e-EMAs were administered as a part of a t-EMA where a gambling event was reported, and they could be self-initiated any time. EMA = ecological momentary assessment; t-EMAs = time-based EMAs; e-EMAs = event-based EMAs.

and online groups/forums, between July 2020 and April 2021, with only one wave of data collection. Interested individuals accessed a 30-min pre-EMA survey hosted by an online platform, Qualtrics, which confirmed eligibility and obtained informed consent. Among participants who completed the survey, training for the EMA protocol consisted of emailed instructions to download the MetricWire smartphone app, enroll in the study within the app, and commence the 28-day EMA protocol. To ensure participant uniqueness, enrolment required a unique email address and mobile phone number, and EMA data were linked to device-level identifiers. Participants who completed ≥75% of t-EMAs were reimbursed with a 30 AUD e-gift voucher. Ethical approval was obtained from the Deakin University Human Research Ethics Committee (2020-039).

Transparency and Openness

This study describes a secondary analysis of previously collected data that were not preregistered. Anonymized data, analytical code, and research materials are available upon reasonable request to the corresponding author. Data analysis (including power calculations) was conducted in Stata Version 18 (StataCorp, 2023). All data exclusions, manipulations, and measures in this study have been reported. This study is reported in accordance with Journal Article Reporting Standards (Appelbaum et al., 2018) and the Checklist for Reporting EMA Studies (Liao et al., 2016).

Data Analysis

Data were analyzed in Stata Version 18 (StataCorp, 2023). In total, 245 participants completed the pre-EMA survey, 142 downloaded the MetricWire app, and 134 provided at least two EMAs required for analyses. Of these, 101 completed ≥75% of t-EMAs. Two participants were excluded (one identifying as trans or gender diverse, one preferring not to specify gender) as these identities could not be combined or modeled separately within the analyses, which covaried for gender (Cameron & Stinson, 2019). These participants were retained in a supplemental sensitivity analysis to assess the robustness of findings to this exclusion (described below). The final analytic sample for the primary analyses comprised 132 participants.

There were no missing data in the pre-EMA or EMA surveys due to forced response formats. Duplicate gambling episodes were identified across t-EMAs and self-initiated e-EMAs. All e-EMAs were reviewed and merged with the corresponding t-EMA: Episodes logged prior to the EMA protocol were excluded, those logged during the protocol were merged with the subsequent t-EMA, distinct multiple events were linked to the relevant t-EMA, and exact duplicates were deduplicated, so only one record was retained. For gambling expenditure, responses of "I don't know the outcome of this bet yet" were coded as missing. The t-EMA compliance rate was calculated as the total number of completed EMAs divided by the total number administered (i.e., 2 daily × 28 days × 132 participants), multiplied by 100 to yield a percentage. Weekly compliance was calculated as the number of completed EMAs within each 7-day window divided by the number of EMAs administered during that week. In addition, correlations between participant-level compliance rates and key variables (gender, age, PGSI, and momentary DI and ER) were examined to assess whether compliance varied by participant characteristics (see Supplemental Table S1).

Independent variables (momentary DI and ER strategy use) were analyzed as continuous. Moderator variables were dichotomized using established cutoffs or distributional splits to aid interpretation of simple slopes: PGSI scores (0–7 = below the problem gambling threshold, 8–27 = problem gambling), IGS-10 high-risk situations (median splits: positive reinforcement = 11, negative reinforcement = 15), and momentary states. Where ER was examined as a moderator of DI, it was dichotomized as none versus any strategy use. Dependent variables (gambling episode, expenditure, and duration) were analyzed as categorical, with cut points selected based on clear distributional patterns in the data. All response categories for momentary variables are shown in Table 1. Before testing the multilevel hypotheses, within-person correlations among momentary DI, ER strategy use, distress, and impulsivity were examined to assess construct distinctiveness (Supplemental Table S2). Although one maladaptive ER item captured negative urgency, the state impulsivity scale reflected broader impulsive responding. As these constructs were related, but not redundant, they were modeled separately: State impulsivity was included only as a moderator (H4) and was not entered into models assessing maladaptive ER as a predictor (H2), avoiding analytic redundancy.

To test H1–H2, mixed-effects regressions with logit links examined associations between DI, adaptive and maladaptive ER strategy use, and gambling outcomes. Binary logistic regressions were used for gambling episodes and duration and ordinal logistic regressions for expenditure. To test H3–H4, the same models were extended with interaction terms to assess moderation. All momentary predictors and moderators were lagged to the prior t-EMA to ensure correct temporal ordering. Models were adjusted for age, gender, time, and the prior value of the outcome. Significance thresholds were set at $\alpha = .05$ for main effects and $\alpha = .03$ for moderation analyses. While seemingly arbitrary, this more conservative threshold for interactions was considered to provide a reasonable balance between avoiding Type I and Type II error when testing multiple interaction terms in EMA models and is consistent with similar moderation analyses in previous research (Dowling et al., 2021; Hawker et al., 2020, 2026). Significant interactions were probed using pairwise comparisons of marginal means. Odds ratios (ORs) were interpreted as small (1.68), medium (3.47), or large (6.71; Chen et al., 2010). The study was originally powered for within-person EMA analyses, with an expected ESS of ∼196 (assuming $\rho = .50$), providing ∼80% power to detect small effects ($\beta \approx .19$). Post hoc estimates indicated adequate power for DI models (e.g., ESS = 258, ∼87% power for gambling episodes) but potentially limited power for some ER models (e.g., ESS = 153, ∼23% for gambling expenditure; ESS = 156, ∼26% for gambling duration), ∼73%, particularly for expenditure and duration outcomes.

Finally, two sensitivity analyses were conducted for the main regression models (H1–H2). First, models were rerun including the two participants who were initially excluded on the basis of gender (revised $n = 134$); in these models, gender was removed as a covariate. Second, models were rerun excluding the seven participants with a baseline PGSI score of 0 (nonproblem gambling; revised $n = 125$). Results from both sensitivity analyses are reported in Supplemental Tables S3–S4 and confirmed the same overall pattern of findings, with only slight differences noted in relation to H2.

Results

EMA Descriptive Statistics

Across the 28-day EMA protocol, participants completed 5,864 t-EMAs out of 7,392 administered, yielding an overall compliance rate of 79.3%. Weekly compliance rates were high in Weeks 1–3 (88.9%, 90.2%, and 83.5%, respectively) but declined substantially in Week 4 (54.8%). On average, participants completed 44.4 t-EMAs (*SD* = 13.6, range = 4–56) and reported 14.9 gambling episodes (*SD* = 10.5, range = 0–47). Participants reported a moderate mean level of momentary DI (*M* = 10.5, *SD* = 3.3, range = 0–21) and endorsed 414 instances of maladaptive ER strategy use and 392 instances of adaptive strategy use. Participant-level compliance was slightly higher among women and among those with greater gambling severity and moderately higher among those with higher average momentary DI, whereas compliance was unrelated to age or ER strategy use (Supplemental Table S1). Additional descriptive statistics, including strategy-specific ER frequencies, are provided in Supplemental Tables S5–S6. Within-person correlations assessing construct distinctiveness showed that momentary DI was not correlated with adaptive or maladaptive ER use and that adaptive and maladaptive strategies were only weakly related (Supplemental Table S2).

H1: Momentary DI Predicting Gambling Behavior

Mixed-effects regression models (Table 3; involving 88 participants providing 585–701 observations) indicated that momentary DI was positively associated with gambling duration to a small degree, but not gambling episode or expenditure, after adjusting for age, gender, time, and the previous outcome. Specifically, each unit increase in momentary DI was associated with 13% higher odds of reporting a subsequent gambling duration of 45 min or more (*OR* = 1.13, 95% CI [1.02, 1.25], *p* = .024). Both sensitivity analyses confirmed the same pattern of findings (Supplemental Table S3–S4).

H2: Momentary Maladaptive and Adaptive ER Strategy Use Predicting Gambling Behavior

Mixed-effects regression models (Table 3; involving 32–100 participants providing 76–434 observations) indicated that momentary maladaptive ER strategy use was positively associated with gambling episode and duration to a small degree (but not expenditure), whereas adaptive ER strategy use showed no significant associations, after adjusting for age, gender, time, and the previous outcome. Each unit increase in maladaptive ER strategy use was associated with 24% higher odds of reporting a subsequent gambling episode (*OR* = 1.24, 95% CI [1.03, 1.50], *p* = .023) and 64% higher odds of reporting a subsequent gambling duration of 45 min or more (*OR* = 1.64, 95% CI [1.02, 2.65], *p* = .042). Across both sensitivity analyses, the same pattern of findings was observed for gambling episodes, whereas associations with gambling duration became nonsignificant (Supplemental Table S3–S4). This suggests that the duration effect is sample dependent and may be a less stable association that does not generalize when gender-diverse participants are included or when the sample is restricted to those with at least low-risk gambling.

H3: Momentary ER Strategy Use Moderating the Relationship Between Momentary DI and Subsequent Gambling Episodes

Moderated mixed-effects regression models (Table 4; involving 100 participants providing 434 observations) showed no evidence of momentary maladaptive or adaptive ER strategy use moderating the relationship between momentary DI and subsequent gambling episodes. This null finding was consistent whether DI was entered as a continuous predictor with dichotomous ER (none vs. any strategy use) as the moderator, when the roles of DI and ER were reversed and when both variables were modeled as continuous.

H4: Stable and Momentary Moderators of the Relationship Between Momentary DI, ER Strategy Use, and Subsequent Gambling Episodes

Moderated mixed-effects regression models (Table 4; involving 100 participants providing 434 observations) showed no significant moderation effects of stable (problem gambling severity, high-risk situations) or momentary (psychological distress, state impulsivity) vulnerabilities on the relationship between momentary DI, ER strategy use, and subsequent gambling episodes, with the exception of momentary state impulsivity (*OR* = 1.11, 95% CI [1.03, 1.19], *p* = .005, small effect). Pairwise comparisons (Figure 1) indicated that

Table 3
Mixed Effect Regressions Examining Relationships Between Momentary Distress Intolerance, Emotion Regulation Strategy Use, and Gambling Behavior

Predictor	Outcome *OR* [95% CI]		
	Gambling episode	Gambling expenditure	Gambling duration
Distress intolerance	1.01 [0.98, 1.05][a]	1.05 [1.00, 1.11][b]	1.13 [1.02, 1.25][c]*
Use of adaptive emotion regulation strategies	1.21 [0.93, 1.56][d]	1.14 [0.67, 1.91][e]	1.83 [0.81, 4.15][f]
Use of maladaptive emotion regulation strategies	1.24 [1.03, 1.50][d]*	1.01 [0.73, 1.41][e]	1.64 [1.02, 2.65][f]*

Note. Analyses were adjusted for age, gender, time, and outcome measured at previous time point. Odds ratios were interpreted as small (1.68), medium (3.47), or large (6.71; Chen et al., 2010). CI = 95% confidence interval.
[a] 132 participants providing 5,732 observations. [b] 88 participants providing 585 observations. [c] 88 participants providing 701 observations. [d] 100 participants providing 434 observations. [e] 32 participants providing 76 observations. [f] 35 participants providing 90 observations.
* $p < .05$.

Table 4

Moderated Regression Analyses of the Relationship Between Momentary Distress Intolerance, Emotion Regulation Strategy Use, and Subsequent Gambling Episodes

Interaction term (Predictor × Moderator)	*OR* [95% CI]
Stable (pre-EMA-measured) moderators	
Problem gambling severity (PGSI)	
Distress Intolerance × Problem Gambling Severity[a]	1.05 [0.98, 1.12]
Adaptive Emotion Regulation × Problem Gambling Severity[b]	0.99 [0.60, 1.64]
Maladaptive Emotion Regulation × Problem Gambling Severity[b]	1.27 [0.87, 1.85]
High-risk situations (IGS-10)	
Distress Intolerance × Positive Reinforcement[a]	1.05 [0.98, 1.12]
Distress Intolerance × Negative Reinforcement[a]	1.02 [0.95, 1.09]
Adaptive Emotion Regulation × Positive Reinforcement[b]	1.17 [0.69, 1.99]
Adaptive Emotion Regulation × Negative Reinforcement[b]	0.89 [0.53, 1.50]
Maladaptive Emotion Regulation × Positive Reinforcement[b]	1.02 [0.70, 1.48]
Maladaptive Emotion Regulation × Negative Reinforcement[b]	1.05 [0.72, 1.53]
Momentary (EMA-measured) moderators	
Emotion regulation[b]	
Distress Intolerance × Adaptive Emotion Regulation	0.77 [0.55, 1.08]
Distress Intolerance × Maladaptive Emotion Regulation	1.11 [0.80, 1.55]
Psychological distress	
Distress Intolerance × Psychological Distress[a]	1.03 [0.97, 1.09]
Adaptive Emotion Regulation × Psychological Distress[b]	0.42 [0.11, 1.62]
Maladaptive Emotion Regulation × Psychological Distress[b]	0.85 [0.32, 2.31]
State impulsivity	
Distress Intolerance × State Impulsivity[a]	1.11 [1.03, 1.19]*
Adaptive Emotion Regulation × State Impulsivity[b]	0.96 [0.30, 3.06]
Maladaptive Emotion Regulation × State Impulsivity[b]	1.32 [0.52, 3.37]

Note. All analyses were adjusted for age, gender, time, and outcome measured at the previous time point. Odds ratios were interpreted as small (1.68), medium (3.47), or large (6.71; Chen et al., 2010). CI = confidence interval; EMA = ecological momentary assessment; PGSI = Problem Gambling Severity Index; IGS-10 = Inventory of Gambling Situations–Short Form.
[a] 132 participants providing 5,732 observations. [b] 100 participants providing 434 observations.
* $p < .03$ (to control for Type 1 error: Dowling et al., 2021; Hawker et al., 2020, 2026).

when DI was low, individuals with low impulsivity were more likely to gamble than those with high impulsivity ($p = .014$). Conversely, when DI was high, individuals with high impulsivity were more likely to gamble than those with low impulsivity ($p = .001$).

Discussion

This secondary data analysis is the first to use EMA methodology to examine the role of momentary DI and ER in gambling behavior. Guided by the dynamic model of relapse (Witkiewitz & Marlatt, 2004), this study tested whether momentary DI and ER (maladaptive and adaptive strategy use) predicted gambling episodes, duration, and expenditure and whether these processes were interrelated or influenced by stable (problem gambling severity, high-risk situations) and momentary (psychological distress, state impulsivity) vulnerabilities.

H1: Momentary DI Predicting Gambling Behavior

The first hypothesis (H1) was partially supported, as greater momentary DI predicted longer subsequent gambling duration, but not gambling episodes or expenditure. Each one-unit increase in momentary DI was associated with 13% higher odds of gambling for 45 min or more. This pattern was observed among participants who reported, on average, a moderate level of DI across the 28-day EMA period, suggesting that difficulties tolerating distress may increase the risk of sustained gambling once an episode is initiated. These findings extend a small body of cross-sectional research showing that DI is elevated in people with problem gambling and undermines gambling recovery attempts in treatment-seeking adults (Daughters et al., 2005; Ledgerwood et al., 2009) by showing that DI also fluctuates within individuals and predicts sustained gambling in daily life. These findings suggest that momentary DI may act less as a trigger for gambling episodes and more as a proximal factor sustaining gambling once initiated, consistent with models of relapse focused on persistence and impaired control (e.g., Witkiewitz & Marlatt, 2004).

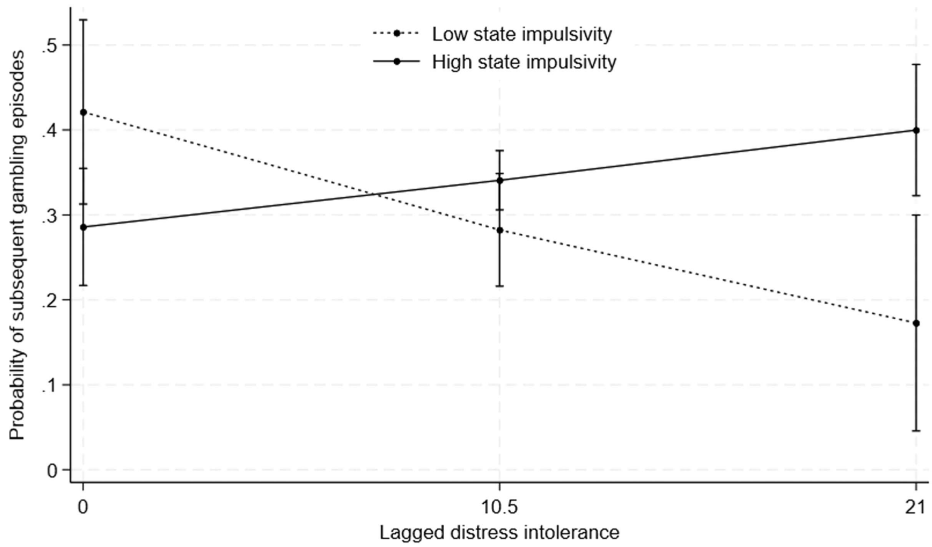
H2: Momentary Maladaptive and Adaptive ER Strategy Use Predicting Gambling Behavior

The second hypothesis (H2) was also partially supported, as momentary maladaptive ER strategy use, but not adaptive strategy use, predicted gambling behavior. Each one-unit increase in maladaptive ER was associated with 24% higher odds of gambling and 64% higher odds of gambling for a longer duration of 45 min or more. Sensitivity analyses showed that the effect for gambling episodes was robust, whereas the duration effect became nonsignificant when gender-diverse participants were included or those with nonproblem gambling were excluded, indicating that the duration association is less stable. Across the EMA period, participants reported using maladaptive strategies slightly more often than adaptive ones (94.3% cf. 89.3%), with emotion suppression, thought suppression, and rumination the most frequently endorsed maladaptive strategies. This pattern indicates that most participants had access to both adaptive and maladaptive coping options, but maladaptive strategies carried greater short-term risk.

These findings extend systematic review and meta-analytic evidence that maladaptive ER use is robustly linked to problem gambling (Marchica et al., 2019; Neophytou et al., 2023; Velotti et al., 2021), with maladaptive avoidance-based strategies most consistently implicated (Neophytou et al., 2023). Importantly, the present study moves beyond retrospective designs to show that maladaptive ER strategies immediately precede gambling initiation and sustained gambling in daily life. The null effects for adaptive ER may theoretically reflect that adaptive strategies exert more distal rather than immediate benefits (Gross, 1998), reducing vulnerability to gambling over longer timeframes rather than in the acute emotional states captured by EMA. Alternatively, they may reflect limited statistical power in ER analyses. Taken together, this suggests that while maladaptive ER has proximal effects on gambling, the protective influence of adaptive ER may only emerge in longer-term or cumulative processes.

Figure 1

Significant Interaction Effect Between Momentary Distress Intolerance and State Impulsivity Predicting Subsequent Gambling Episodes



H3: Momentary ER Strategy Use Moderating the Relationship Between Momentary DI and Subsequent Gambling Episodes

Unexpectedly, the third hypothesis (H3) was not supported, as momentary maladaptive and adaptive ER strategy use did not moderate the association between momentary DI and subsequent gambling episodes. This is the first gambling study to test this interaction, although addictions research has linked DI (measured by a behavioral pain tolerance test) to trait-based ER deficits among people with alcohol use disorder, even after adjusting for other vulnerabilities (Zaorska et al., 2023). While these discrepancies may reflect methodological differences (i.e., momentary vs. trait, perceived DI vs. behavioral DI, ER strategy use vs. deficits), theory supports that these mechanisms are interrelated, with greater DI expected to increase vulnerability to maladaptive ER strategies and avoidant behaviors (Blaszczynski & Nower, 2002; Jeffries et al., 2016; Nower et al., 2022). Null moderation findings may therefore reflect limited statistical power, as ER items were only presented when stress was endorsed. Future EMA studies would benefit from testing both momentary ER deficits and strategy use in larger samples to clarify whether DI and ER interact dynamically in gambling behavior.

H4: Stable and Momentary Moderators of the Relationship Between Momentary DI, ER Strategy Use, and Subsequent Gambling Episodes

The final hypothesis (H4) was partially supported. None of the examined stable or momentary vulnerabilities implicated in the dynamic model of relapse (Witkiewitz & Marlatt, 2004) moderated the effect of momentary DI or ER strategy use on subsequent gambling episodes, except for state impulsivity. When DI was low, participants with lower impulsivity were more likely to gamble than those higher in impulsivity; when DI was high, the reverse pattern emerged. These findings align with cross-sectional research showing that impulsivity, particularly emotion-contingent impulsivity, conceptualized as urgency (negative urgency: impulsivity under distress; positive urgency: impulsivity under elation), is closely linked to ER difficulties (Williams et al., 2012) and extends earlier EMA research showing that DI amplified the effect of momentary enhancement and coping motives on subsequent gambling episodes (Hawker et al., 2026). The Momentary Impulsivity Scale used here, derived from the Barratt Impulsiveness Scale (Patton et al., 1995) and clinical descriptions of impulsivity in borderline personality disorder (American Psychiatric Association, 2022), captures general impulsive tendencies in the moment. The component model of addiction (Kim & Hodgins, 2018) highlights conceptual overlap between ER deficits and urgency, suggesting that future research incorporating urgency-based measures may clarify how emotion-driven impulsivity shapes gambling behavior and relapse processes. Together, the findings suggest that momentary DI amplifies vulnerability to both impulsivity- and motive-driven gambling in daily life.

No moderating effects were found for problem gambling severity, high-risk situations, or momentary psychological distress. These findings contrast with cross-sectional research linking ER difficulties with greater problem gambling severity and high-risk situations (Blaszczynski & Nower, 2002; Nower et al., 2022) and psychological distress (Artemi et al., 2025). Null gambling severity findings are consistent with other EMA studies, however, which found that problem gambling severity did not moderate the influence of other cognitive vulnerabilities, including positive outcome expectancies (Dowling et al., 2021) or motives (Hawker et al., 2026). Given that this sample included participants across all levels of gambling risk (52.3% displayed problem gambling), aligning with public health recommendations (Browne et al., 2017), these findings suggest that momentary DI and ER may influence gambling behavior irrespective of problem gambling severity. Methodological factors may also have contributed to null findings, including small sample size, potentially underpowered moderation analyses (particularly for ER), reliance on dichotomized and single-item measures, and the distress item referencing both "today and past week," limiting its sensitivity to momentary states. Future studies would benefit from using larger, more diverse samples, multi-item measures, and fully momentary assessments of psychological distress to more sensitively detect potential moderation effects.

Study Limitations

This study had limitations. The relatively small, young convenience sample—recruited online during a period of COVID-19 restrictions that closed land-based venues and increased online gambling (Jenkinson et al., 2020)—limits generalizability, particularly to older or clinical populations. ER was measured only as strategy use, and categorization of strategies as maladaptive or adaptive is debated as it can be context dependent (Velotti et al., 2021). Conditional administration of ER items reduced sample size and power, and some models were based on a few participants and observations, further limiting detection of moderation effects. The conservative significance threshold may have reduced power as well, though any significant effects are likely more robust. Data quality issues required merging duplicate gambling event record entries, potentially reintroducing recall bias (Dowling et al., 2021). Key constructs were measured with single-item or dichotomized measures, and the psychological distress item was not fully momentary. Momentary assessment of high-risk situations would have strengthened ecological validity but was not feasible due to limits on EMA item burden. Comparable trait measures for DI and ER strategies were not administered in the pre-EMA survey, preventing examination of trait-state concordance that has been informative in our earlier EMA work (e.g., Dowling et al., 2021; Hawker et al., 2026). Finally, the 28-day, twice-daily EMA may have missed infrequent gambling or rapid state shifts (Votaw & Witkiewitz, 2021). Future research could address these contextual and methodological limitations, and validate the EMA items used in this study, to strengthen their reliability and clarify the generalizability of the findings.

Study Implications

Despite these limitations, the study has important implications. Methodologically, this study demonstrates the utility of EMA for capturing the dynamic, real-time interplay of cognitive and affective processes in gambling, allowing relapse models to be tested in ecologically valid contexts (Shiffman et al., 2008). Clinically, the findings highlight momentary DI and maladaptive ER strategy use as proximal processes associated with gambling episodes and sustained gambling duration. Interventions may benefit from targeting DI and reducing reliance on maladaptive ER strategies, ideally by promoting substitution with adaptive strategies. Approaches with preliminary support include dialectical behavior therapy (Christensen et al., 2013), ER-enhanced treatments (Månsson et al., 2022), and mindfulness-based programs wherein DI and ER mediate improvements (de Lisle et al., 2014). Emerging digital interventions, such as just-in-time adaptive interventions, also show promise for delivering tailored support during moments of vulnerability in daily life (Dowling et al., 2022, 2024, 2025; Hawker et al., 2021).

Conclusion

This EMA study contributes novel evidence that momentary DI predicts longer gambling duration, maladaptive ER strategy use predicts gambling episodes and longer duration, and state impulsivity moderates the distress intolerance–gambling relationship. These findings refine the understanding of momentary DI and maladaptive ER strategy use as dynamic vulnerabilities for gambling behavior and highlight their potential as real-time intervention targets to reduce gambling-related harm, particularly for individuals with high impulsivity.

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