Within person emotion regulation and daily alcohol and cannabis use.

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**Abstract**

Affect regulation models of alcohol and cannabis use hypothesize that people drink or use cannabis to regulate negative affective states, but evidence from intensive longitudinal studies make it clear that negative affect does not reliably precede alcohol or cannabis use in people’s daily lives (Dora, Piccirillo, et al., 2022b; Dora, Smith, et al., 2022). However, these tests of affect regulation models reflect a relatively narrow conceptualization of how people regulate their emotions in their daily lives: that people experience negative emotions and then seek to regulate them with substances. Process models of emotion regulation (Gross, 1998, 2015) recognize emotion regulation as a multi-phase process including emotion identification, followed by the selection and implementation of emotion regulation strategies. It may be that substance use serves an emotion regulation function *only* when people decide that a negative emotion can and should be changed, or when people have no other effective strategies to regulate or avoid their experience of emotion (Cooper, 1994). The goal of the proposed Registered Report is to test the value of focusing on components of the emotion regulation process that may more clearly signal people’s *need* for emotion regulation, such as people’s appraisals of their emotions or the emotion regulation strategies they report implementing.

**Introduction**

Affect regulation models hypothesize that alcohol and cannabis use behaviors (such as use, intoxication, and the experience of consequences) are motivated by a desire to alleviate or avoid negative affect. This is supported by experimental (Bresin et al., 2018) and survey research showing that people who report coping motives for use are more likely to drink or use cannabis, become intoxicated, and report more negative consequences (Bonar et al., 2017; Bresin & Mekawi, 2019, 2021; Dora, Piccirillo, et al., 2022b; B. L. Stevenson et al., 2019). However, evidence from large scale pre-registered integrative data analyses and multiverse analyses suggest there is little to no robust evidence to support the notion that alcohol or cannabis use behaviors (such as use, intoxication, or consequences) are more likely to occur following experiences of higher than usual negative affect (Dora, Piccirillo, et al., 2022b; Dora, Smith, et al., 2022)[[1]](#footnote-1). Although affect regulation models frame use as motivated by a desire to regulate emotions, actual tests of these models reflect a relatively narrow conceptualization of how people regulate their emotions in their daily lives. Central to the present study, prior research has not been fully informed by process models of emotion regulation. Refining our understanding of the affective and cognitive antecedents of alcohol and cannabis outcomes is critical towards advancing theories of negative affect motivated substance use.

Process models of emotion regulation (Gross, 1998, 2015) describe emotion regulation as a multi-phase process that begins with emotion identification (e.g. the perception, valuation, and actions related to an emotion), followed by the selection of specific strategies (e.g. what emotion regulation strategies are possible/available) and finally to the implementation of a chosen strategy. Process models thus imply that substance use behaviors serve an emotion regulation function when people decide that negative emotions can and should be changed, or when people anticipate experiencing negative emotions that they wish to avoid. Further, affect regulation models of substance use hypothesize that substance use occurs as a result of people having no other effective strategies to regulate their emotions (Cooper, 1994). However, prior research testing the affective regulation function of substance use has largely focused on a single aspect of this process (emotion identification: people’s perceptions of negative affect), assuming that substance use serves to relieve people’s negative emotions. It is also possible, however, that substance use may help people avoid negative emotions altogether. In the current study, we focus on components of the emotion regulation process that may more clearly signal people’s need or desirefor emotion regulation, such as people’s appraisals of their emotions, or the emotion regulation strategies they report implementing. It may be that a high need for emotion regulation may serve as a more proximal and specific risk for alcohol or cannabis use than the mere presence of negative emotions.

Some prior research has suggested that individual differences in emotion regulation are associated with alcohol and cannabis use behaviors. Recent meta-analyses have suggested that people with lower emotion regulation abilities (often referred to as “emotion dysregulation and measured with the Difficulties in Emotion Regulation Scale) reported modestly higher (r = .23 - .28) levels of alcohol and drug use (Weiss et al., 2022), and people with substance use disorders reported lower emotion regulation abilities than people without substance use disorders (Stellern et al., 2023). These same meta-analyses also reported that individual differences in the tendency to implement different emotion regulation *strategies* were also moderately associated with substance use and substance use disorders, although these findings were derived from far fewer studies (ranging from 2 to 12). For example, people who reported using more adaptive strategies in general, and reappraisal specifically, reported less alcohol (but not drug) use while those who reported more maladaptive strategies reported more alcohol (but not drug) use, but this finding did not hold for suppression specifically (Weiss et al., 2022). On the other hand, people with substance use disorders reported higher levels of suppression, but not lower levels of reappraisal, than people without substance use disorders (Stellern et al., 2023). However, this existing research is limited in its predominant focus on emotion regulation abilities (rather than the implementation of strategies), a narrow range of emotion regulation strategies (e.g. only reappraisal and suppression), a relatively small number of studies, and a focus on between person associations. In order to understand how emotion regulation is associated with alcohol and cannabis use behaviors in people’s daily lives, it is critical to measure these processes as they unfold from day to day.

In the present study, we focus on a wide range of emotion regulation strategies people report implementing in their daily lives. Recent ecological momentary assessment research indicates that people implement a variety of emotion regulation strategies in response to negative emotions (Smith et al., 2022). Many strategies have been broadly categorized as adaptive (e.g., acceptance, problem-solving, cognitive reappraisal) or maladaptive (e.g., avoidance, rumination, suppression) based on their association with mental health problems (Aldao et al., 2010) or dysphoria (Kalokerinos et al., 2015; Wenze et al., 2018). Some are described as engagement strategies, in that they are active responses which seek to change either the source of the emotion (such as problem solving) or how someone responds to the emotion (such as seeking social support or reappraisal)[[2]](#footnote-2). Other responses reflect disengagement strategies (such as denial, suppression, or avoidance), in that they are active responses focused on short term relief or avoidance, but which do not address the source of or response to the emotion. Finally, other “strategies” are thought to be reflexive reactions to emotions (such as rumination or self-criticism) that reflect ineffective attempts at engagement. Using maladaptive strategies such as rumination or self-criticism may prolong or worsen people’s emotional states, in turn making alcohol or cannabis use behaviors more likely or more severe as a means of regulating emotions, because other attempted strategies were unsuccessful. We hypothesized that alcohol or cannabis use would be more likely or more severe (e.g. more intoxication or consequences) when people report using more maladaptive strategies (such as disengagement or reflexive strategies) and fewer adaptive ones (such as reappraisal or problem solving).

To date, there have been only a few studies examining the association of daily emotion regulation with alcohol and cannabis use behaviors, with relatively mixed outcomes. There is some initial support that using more adaptive emotion regulation strategies may be protective against alcohol or cannabis use (although only one study has reported cannabis use outcomes). For example, one early study indicated that using adaptive emotion regulation strategies was negatively associated with drinking that same day (Park et al., 2004), and a recent study suggested that adaptive strategies were protective against cannabis use (Weiss et al., 2017). On the other hand, that same study did not find an association of adaptive strategies with alcohol use or heavy drinking, and only some adaptive strategies were negatively associated with co-use of alcohol and cannabis (Weiss et al., 2017). Generally, studies examining associations of maladaptive strategies (such as avoidance) have not found associations with substance use outcomes (Luoma et al., 2020; Park et al., 2004; Weiss et al., 2017). Thus, our goal was to test whether these findings can be replicated in a large, pre-registered sample of young adults studied with a broader array of emotion regulation strategies tested on a broad range of alcohol and cannabis use behaviors.

We also extend the prior literature by examining whether people’s appraisals of the malleability and importance of changing their emotions influences alcohol and cannabis use behaviors. People are more likely to regulate their emotional states if they believe those states are undesirable and that they can change them (Ford & Gross, 2019). Appraisals may also influence what types of emotion regulation strategies people attempt to regulate their emotions. When people believe their emotions are less malleable, especially when they believe it is important to change how they feel, they are thought to have a lower ability to tolerate distress and thus be more likely to engage in maladaptive behaviors to escape, avoid, or regulate their emotions (Veilleux, 2023). Indeed, some between person research suggests that people who believe their emotions are less malleable also report less cognitive reappraisal (De Castella et al., 2013; Ford et al., 2018; R. B. King & dela Rosa, 2019; Kneeland et al., 2020; Ortner & Pennekamp, 2020; Tamir et al., 2007), and higher levels of enacting maladaptive emotion regulation strategies (e.g., emotional and cognitive avoidance (De Castella et al., 2018; Moumne et al., 2020; Ortner & Pennekamp, 2020). Several recent EMA studies have demonstrated that when people reported that it was important to change how they feel, they also reported higher levels of *either* concurrent maladaptive and adaptive strategies (Feil et al., 2020; Larrazabal et al., 2022; Swerdlow et al., 2022). Taken together, this may indicate that alcohol or cannabis use behaviors may be more likely or more severe when people have reported lower malleability or higher importance appraisals. One prior study of 92 young adults surveyed over 28 days suggested that day-level difficulty with managing emotions was not associated with nighttime alcohol use, however the authors noted that this study may have been underpowered to detect effects (Emery & Simons, 2020). We further hypothesize that when people report high levels of *both* appraisals make substance use especially likely because they signal a high need for emotion regulation but also a lack of effective strategies.

Finally, it may be that the mere presence of maladaptive emotion regulation strategies or emotion appraisals is insufficient to motivate alcohol or cannabis use behaviors. Specifically, affect regulation models imply that substance use occurs *when existing attempts at regulation have failed.* For example, although suppression may make negative emotions worse in the long term, they may succeed in the short term, and thus if substance use is motivated by a need to regulate affect, even using maladaptive strategies like suppression may make alcohol or cannabis use behaviors less likely if it effectively dampens negative affect. Thus, we will explore whether maladaptive emotion regulation strategies or emotion appraisals *only* predict alcohol or cannabis outcomes when people are also currently experiencing negative emotions.

To improve on prior literature, we also aim to test these hypotheses at two distinct timescales across multiple related outcomes. In addition to a reliance on small samples, a lack of emphasis on replication, and a general lack of pre-registration, progress in refining theories of affect regulation has been hampered by the vagueness of affect regulation theories as to *when* affect may be related to alcohol or cannabis use behaviors, or *which behaviors* should be predicted. Should affect regulation be observed as use following a *day* characterized by higher than usual negative affect (Dora, Piccirillo, et al., 2022b), or only the *moments* prior to use (Dora, Smith, et al., 2022; Jahng et al., 2011)? Does affect influence whether people use (Duif et al., 2020; Dvorak et al., 2018; M. A. Russell et al., 2020), how much they use or how intoxicated they get (Dvorak & Simons, 2014; B. Stevenson et al., 2019), or the number of consequences they experience(Waddell et al., 2021)? By testing our hypotheses at both the daily and momentary (e.g. immediately prior to the use episode) level, we will clarify both *whether* and *when* emotion regulation behaviors may be related to alcohol and cannabis use behaviors. Moreover, by predicting use and intoxication of alcohol or cannabis, as well as consequences of use, we will be able to identify *whether* and *which* alcohol and cannabis use behaviors may be most susceptible to disruptions in emotion regulation processes.

The primary goal of this Stage 1 Registered Report is to test the degree to which implementing maladaptive emotion regulation strategies in people’s daily lives is associated with greater risk for alcohol or cannabis use or consequences. We tested our hypotheses in a high-risk sample of young adults who reported weekly alcohol or cannabis use. We focused on young adulthood because this age has the highest rates of binge and heavy alcohol use, as well as alcohol use disorder. Moreover, young adults (aged 18 – 25) who drank at least 4 times in the past month (similar to our inclusion criteria) had even higher rates of alcohol use disorder (>42%) than young adults in general (17%, Substance Abuse and Mental Health Services Administration, 2021). Our first aim is to test whether using relatively more maladaptive than adaptive emotion regulation strategies predicts alcohol or cannabis outcomes. Our second aim is to test whether reporting lower malleability appraisals, higher importance appraisals, or their interaction, predicts alcohol or cannabis use, higher levels of intoxication from either substance, or a higher number of negative consequences of use later that day. Our final goal was to integrate our first two aims into affect motivation models of substance use: do appraisals or maladaptive emotion regulation strategies predict alcohol and cannabis outcomes even more strongly on days when people report higher negative affect in general, or when they report higher levels of specific dimensions of negative affect (e.g. depression, anxiety, anger, or general distress). Table 1 lists our proposed hypotheses.

**Methods**

Participants were recruited for a larger study on the development of alcohol and cannabis use problems during young adulthood. The study was approved by the human subjects board at the University of Washington. All of the data for the proposed study have been collected at the time of submission. They can be accessed by the first author, and demographic data have been accessed and analyzed for the purposes of reporting demographic data to funding agencies. No variables central to the present hypotheses have been accessed, viewed, or analyzed by the study team.

**Sample size justification***.* The sample size for the larger project was determined by a power analysis for the main aims of the study, which reflect a different set of analyses than those in the present study. Thus, we conducted simulations to determine our power to detect the smallest effect size of interest (Anvari & Lakens, 2021). Because power is most limited for the hypothesized interactions between appraisal importance and appraisal competence on alcohol intoxication (H4), we focus on this effect here. Based on previous EMA research by our group (Dora et al., 2022; Dora, Piccirillo, et al., 2022a), we expected participants to contribute 10 drinking episodes on average across the 32 days of participation. We used a Shiny app (Lafit et al., 2021) to simulate power for mixed-effects models to determine the smallest interaction effect we were powered to detect. For this simulation, we set sample size to 497 and the time points per participant to 10. Most other required parameters came from pilot data (N = 105) in which we were able to model this interaction (to set the parameters for the fixed intercept, fixed main effects, standard deviations of error term and random effects, and correlations between random effects) and estimate means and standard deviations of the independent variables. We then explored the power we had to detect a range of effect sizes. This revealed that we are adequately powered (> 95%) to detect an interaction term that reflects that the increase in intoxication increases an additional 4 points for every one standard deviation increase in appraisal importance for every one standard deviation increase in appraisal competence, which we consider a small but meaningful effect size.

**Sample.** Participants were young adults at baseline (n = 497, age 18 – 22, *Mage* = 20.3, *SD* = 1.3, 45% cisgender female, 42% cisgender male), with the remaining participants identifying as nonbinary/gender queer/gender nonconforming (8.5%), transgender male or female (4.0%), or nongendered (0.2%). Participants were recruited from King, Pierce, and Snohomish Counties in Washington State from both college and non-college sources to ensure a representative sample of young adults in Washington State. We recruited using internet (Facebook, Instagram, TikTok, YouTube, Twitter, Craigslist, and Reddit) and non-internet (newspaper advertisements, flyers, and university registrar lists) sources. Participants were required to be between the ages of 18 and 22 at study screening, own a smartphone, be fluent in English, and report drinking *or* using cannabis “about once per week” or more over the past three months. Participants were excluded if they were not fluent in English or if they moved to the United States after age 12. Participants endorsed a variety of race/ethnicities: 54% solely non-Hispanic White, 28.5% Asian, 6.6% African American, 8.37% Hispanic/Latino, and 22.7% who endorsed more than one ethnicity. Most participants identified as heterosexual (52%), with the remaining participants either identifying as LGBQ+ (47.6%) or declining to respond (*n* = 2). Finally, 9.8% of the sample was born outside the U.S. Racial/ethnic proportions broadly reflected Washington census data from counties in which participants were recruited. Approximately 67% of the sample attended a 4-year college at recruitment.

***Procedure.*** All study procedures were conducted online and approved by the local IRB. Participants first completed an online screening survey, and interested participants were directed to a web survey where they completed basic demographic information, contact information, and information about past month substance use and other health behaviors to obscure the inclusion criteria. Eligible participants then completed an online survey and a virtual training session on the EMA study procedures with research assistants. For the next 8 weeks on the social weekend (Thursday to Sunday), 5 times per day, participants received texts with a link to a brief EMA survey. On Monday mornings, participants received an additional EMA to capture behavior from Sunday nights. EMAs were sent within 5 three-hour blocks in between 9am and 11pm, with at least 1 hour between surveys. Participants were initially sent one reminder at 30 minutes if they had not completed their survey; we changed this to 20- and 40-minute reminders after the first 60 participants to increase response rates. Participants received $50 for the baseline survey and could earn paid $1 per EMA, with a $5 bonus for completing 80% (i.e. 17/21) of EMAs for a given weekend ($258 total possible).

**Measures**

For most scales in the EMA and the baseline assessment, we randomly administered a subset of 75% - 80% of items from each subscale to reduce demand on participants (Graham et al., 2006; Silvia et al., 2014). For state measures of urgency, emotions, and appraisals, we used visual analogue slider bars to increase variability in responding and avoid anchoring effects (Palmblad & Tiplady, 2004), including only end-point labels and a single central anchor.

**Ecological Momentary Assessment Measures.**

For daily models, we will generally compute a mean of each predictor across all observations prior to the onset of use. For non-use days, we will compute the mean of all observations prior to the median time of substance use onset. For momentary models, we will use predictors from the last EMA before substance use was initiated. For non-use days, we will use predictors from the EMA prior to the median time of substance use onset.

*Emotion regulation strategies.* At each EMA, we asked participants to report which of 12 emotion regulation strategies they had used in the past hour. Participants were shown a single prompt: “Since the last assessment/since you woke up this morning, which of the following did you do? Check all that apply.” For these items, we adapted single items from the Cognitive Emotion Regulation Questionnaire (CERQ; (Garnefski & Kraaij, 2007), as reported in our prior work (K. M. King et al., 2018). Seven items measured the ER strategies of acceptance, problem-solving, rumination, cognitive reappraisal, avoidance, distraction, and suppression. We also included four items adapted from the Brief COPE (Carver, 1997) measuring seeking emotional support from others, emotional expression, self-blame, and mindfulness. The twelfth item was “None of the above”.

To compute a measure of the ratio of maladaptive emotion regulation strategies, we will compute the total number of maladaptive strategies endorsed (e.g., rumination, distraction, avoidance, suppression, self-blame) by the total strategies endorsed at either the daily or EMA level. We have found in our prior work that this measure is associated with critical outcomes like individual differences in anxiety and depressive symptoms, as well as the current experience of emotion (Alawadhi et al., 2023; Smith et al., 2022).

*Emotion appraisals.* At each EMA, we asked participants to rate *right now* how well they think they could control, fix, or change their current mood using a visual analog scale scored from 0 to 100 (with the specific number not displayed), with a scale from “not at all” to “completely” and a midpoint of “somewhat. Similarly, participants completed a visual analog scale of how important they believe it is for them to control, fix, or change their current mood with anchors “not at all important” and “extremely important” and a midpoint of “somewhat important”. To compute a day level aggregate of importance appraisals, we will average participant responses to this item within each day prior to the onset of use.

*Negative affect* was measured by participants rating how much they felt specific negative emotions in the past hour using a visual analog scale scored from 0 to 100 (with the specific number not displayed) and with anchors “not at all”, “very much,” and a central anchor of “somewhat” (J. A. Russell, 1980). We selected emotion words to reflect multiple dimensions of negative affect, based on the PANAS-X and other prior work (Larson & Lampman-Petraitis, 1989; Silk et al., 2003). We administered two words each from seven sets of items reflecting four negative affect dimensions (anger, sadness, anxiety, and general distress). Each dimension (except general negative affect) will be scored as the mean of items within that dimension. General negative affect will be scored as the mean of all negative affect items within each day. Specific dimensions of negative affect will be computed as the mean of all subscale items.

*Alcohol and cannabis use behaviors.* Participants reported on their alcohol and cannabis use during morning assessments, or at the second assessment of the day in case the morning assessment was missed. *Alcohol and cannabis use.* Participants reported how many drinks they had the night before on a visual analogue scale ranging from 0 to 30 or more drinks. The scale was presented together with a definition of a standard alcoholic drink. Participants also reported how much cannabis they used on a visual analogue scale ranging from 0 to 28 grams. There are substantial challenges in obtaining reliable reports of cannabis use quantities (Prince et al., 2018). Thus, for the present study, we will focus on predicting whether or not participants reported alcohol or cannabis use (e.g. use/non-use). *Alcohol and cannabis intoxication.* For both alcohol and cannabis, participants reported how intoxicated they got on a visual analogue scale ranging from 0 = ‘Not at all/I didn’t use [alcohol or cannabis]’ to 100 = ‘Very high’. *Alcohol and cannabis consequences.* Finally, we measured positive and negative consequences of alcohol and cannabis use using 21 items adapted from Lee et al. (2017). We measured 13 negative consequences of alcohol or cannabis use with items such as “I hurt or injured myself by accident”, “I had a hangover”, or “I did something I wouldn’t normally do when sober”. Nine positive consequences included “I felt more energetic”, “I was in a better mood”, and “I felt more creative”. Participants reported which of the consequences they experienced as a result of their alcohol or cannabis use the previous day, or indicated they did not use, or that they did use but experienced no consequences of use. Because our pilot data indicated that participants frequently used *both* alcohol and cannabis, we did not ask participants to separately attribute consequences they experienced to a specific substance.

All substance use variables will be reverse lagged to line up with the affect assessments of the previous day.

**Analytic Plan**

The main hypotheses will be tested with generalized linear mixed models (GLMM). GLMMs are a flexible class of analyses that allows for the analysis of non-independent (i.e., clustered) data while accommodating a range of dependent variable distributions (e.g., continuous, ordinal, binary, and count data). Data processing and analysis will be conducted in R (R Development Core Team, 2016), a flexible open source data analytic software, and GLMMs will be fit with the *brms* package (Bürkner, 2017).

Across all aims, we will repeat models across 5 outcomes: the likelihood of alcohol or cannabis use, the level of alcohol or cannabis intoxication, and the number of negative consequences reported for each daily use episode. We will repeat these models at 2 time scales: with day-level predictors (prior to the onset of use) and with momentary predictors (the last EMA prior to use). First, we will test simple unconditional models predicting each alcohol and cannabis outcome from each predictor (and interactions, if hypothesized). We will interpret interactions for which the Bayes Factor exceeds 6 (indicating that the evidence for a model including the interaction is 6 times stronger compared to a model excluding the interaction) as evidence in favor of our hypothesis, in order to avoid retaining weak interactions that confirm our hypotheses. Next, we will include covariates to test the degree to which the predictor effects are robust to their inclusion. We will report the posterior probability that the effect size for each model is larger/smaller than our smallest effect size of interest, which serves as our threshold for strong inferences. Because we only have relatively weak ideas about what our smallest effect sizes of interest should be, effects where the bulk of the credible interval are larger than zero but smaller than the SESOI will be interpreted as tentative evidence in favor of the hypotheses.

*Smallest effect size of interest.* For predicting the likelihood of daily alcohol or cannabis use, we define a 1.10 fold increase in the probability of any use as the smallest effect size of interest, in line with effect sizes observed in our prior work (Dora, Piccirillo, et al., 2022b; Dora, Smith, et al., 2022). In our pilot data, alcohol and cannabis intoxication were rated on a similar 100 point scale, with SDs around 27. Thus, for the proposed study, the smallest effect size of interest will be 5, or a roughly 20% difference in the SD intoxication for a 1 SD difference in a predictor. Finally, for consequences, the smallest effect size of interest will be a .25 change in the number of negative consequences for a 1 SD change in a predictor.

*Aggregation and Centering.* Day level predictors will be centered within person (CWP) to separate within-person from between-person variance (Enders & Tofighi, 2007), allowing us to make accurate inferences about how daily fluctuations in the predictors are associated with alcohol and cannabis outcomes above and beyond individual differences in a person’s average level.

*Covariates.*Forall models, we will include a core set of covariates. At the person level, we will control for age, gender, college/non-college status. Continuous covariates (age) will be grand mean centered. Binary covariates (gender, college/non-college) status will be dummy coded (0/1) with male and college as the reference group, respectively.

At the daily level, we will control for time effects (i.e., week of study, weekend versus weekday, observation number). We will explore whether including person level grand-mean centered averages of key within-person predictors (e.g. emotion regulation, appraisals, and negative affect) improves model fit or changes the within-person parameter estimates. In our experience, because the CWP and GMC variables are perfectly uncorrelated, the inclusion of both rarely influences parameter estimates drawn from GLMMs.

We will also control for differences in Covid-19 restrictions throughout the data collection period by including a variable in the model that indicates in which of the four stages of the ‘Safe Start Washington: A Phased Approach to Recovery’ the data were collected (Stage 1: no social gatherings, closed restaurants, bars, and nightclubs; Stage 2: gatherings with up to 5 people, restaurants at 50% capacity, bars and nightclubs closed; Stage 3: gatherings with up to 50 people, restaurants at 75% capacity, bars at 25% capacity, nightclubs closed; Stage 4: no restrictions).

*Treatment of missing data.*Data missing at the item level (due to random item presentation) or observation level (due to participant non-compliance) will be addressed using multilevel multiple imputation (MI). In brief, MI handles missing data by defining a joint distribution for all variables, from which missing data values can be generated via Bayesian estimation. Although alternatives are available (e.g., full information maximum likelihood), we selected MI as an approach for several advantages pertinent to the proposed analyses. First, MI has demonstrated greater efficiency in parameter estimation compared to maximum likelihood-based approaches (Enders, 2017). Second, MI methodologies have been extended recently to accommodate complex multilevel and nonlinear design (i.e., interactions and polynomial effects; (Enders et al., 2020), both of which are central to the structure of our data and the hypotheses of the proposed work. Third, to our knowledge, MI can more optimally handle mixtures of continuous and categorical distributions and hold fewer assumptions about data-generating processes for both explanatory and outcome variables (Enders, 2017).

We will impute missing data from the EMAs using the *mice* and *miceadds* packages (Robitzsch & Grund, 2023; van Buuren et al., 2015; Zhang, 2016). The imputation algorithm implemented by *mice* imputes the EMA data while taking into account the nested structure of the data, and can handle non-normal data such as counts and zero-inflated skewed data. We will include key variables from the baseline assessment that predict missingness, as well as items in the EMAs that were asked at each assessment to improve the imputation of EMA items that were not measured. We used passive imputation to compute interactions and negative affect scores within the imputation model. We will impute 20 datasets, which has been suggested to be sufficient by prior literature (Enders, 2010). Imputations will be conducted on two Markov chains simultaneously to compute potential scale reduction factors as a means of diagnosing convergence of estimation procedures. Potential scale reduction factors assess convergence by comparing between- and within-chain variances for each model parameter to determine whether both chains are producing similar means and variances for a given parameter (i.e., a posterior distribution), with values lower than 1.10 considered acceptable (Enders, 2017). Descriptive steps will further be taken to ensure reliability of MI results. Namely, density plots of the observed versus imputed values will be generated for study variables to check whether imputed values reflect an appropriate distributional form given the observed data (Azur et al., 2011). Pooling in a Bayesian framework is relatively straightforward, as the posterior distribution across all 20 models can simply be combined into a single posterior.

*Individual model specification.* We will model random intercepts and slopes for within-person predictors to estimate individual differences in the level of the outcome and magnitude of the within-person association (Barr et al., 2013). To bring all variables into scale alignment, which improves model fit and convergence, we will within-person standardize all predictors between or within person (as appropriate). We will check model convergence with trace plots, and check model fit with posterior predictive checks. We will examine model convergence with the *Rhat* statistic and effective sample sizes within each imputed model, because variation in parameters caused by the imputation itself (which introduces random variation in the missing data to provide more stable estimates) artificially inflates these statistics.

*Model priors.* We will use normally distributed priors with a mean of zero and a standard deviation of 0.5 on all fixed main and interaction effects for our models. For covariance components, we used Cauchy distributed priors with a mean of 0 and an SD of 1.

*Exploratory tests*. We will perform these tests in the same way as our primary tests. We will perform posterior predictive checks to ensure that these models fit the data well.

*Table 1. Proposed hypotheses.*

|  |  |  |  |
| --- | --- | --- | --- |
| **Confirmatory Hypothesis** | **Predictor** | **Outcome** | **Type** |
| **Aim 1** | | | |
| 1. Maladaptive ER will predict daily substance use | Maladaptive/Adaptive ER ratio | Daily alcohol use | Confirmatory |
| Daily alcohol intoxication |
| Daily cannabis use |
| Daily cannabis intoxication |
| Daily substance related negative consequences |
| **Aim 2** | | | |
| 1. Appraisals that emotional states are undesirable will predict daily substance use. | Importance Appraisals | Daily alcohol use | Confirmatory |
| Daily alcohol intoxication |
| Daily cannabis use |
| Daily cannabis intoxication |
| Daily substance related negative consequences |
| 1. Appraisals that emotional states are difficult to change will predict daily substance use. | Confidence Appraisals | Daily alcohol use | Confirmatory |
| Daily alcohol intoxication |
| Daily cannabis use |
| Daily cannabis intoxication |
| Daily substance related negative consequences |
| 1. Importance appraisals will more strongly predict substance outcomes when confidence appraisals are also low. | Importance X Confidence Appraisals | Daily alcohol use | Confirmatory |
| Daily alcohol intoxication |
| Daily cannabis use |
| Daily cannabis intoxication |
| Daily substance related negative consequences |
| **Aim 3** | | | |
| 1. Maladaptive ER will more strongly predict substance outcomes when negative affect is higher. | Maladaptive/Adaptive ER ratio X Negative Affect | Daily alcohol use | Exploratory |
| Daily alcohol intoxication |
| Daily cannabis use |
| Daily cannabis intoxication |
| Daily substance related negative consequences |
| 1. Importance appraisals will more strongly predict substance outcomes when negative affect is higher. | Importance Appraisals X Negative Affect | Daily alcohol use | Exploratory |
| Daily alcohol intoxication |
| Daily cannabis use |
| Daily cannabis intoxication |
| Daily substance related negative consequences |
| 1. Confidence appraisals will more strongly predict substance outcomes when negative affect is higher. | Confidence Appraisals X Negative Affect | Daily alcohol use | Exploratory |
| Daily alcohol intoxication |
| Daily cannabis use |
| Daily cannabis intoxication |
| Daily substance related negative consequences |
| 1. The interaction of importance and confidence appraisals will more strongly predict substance outcomes when negative affect is higher. | Importance X Confidence Appraisals X Negative Affect | Daily alcohol use | Exploratory |
| Daily alcohol intoxication |
| Daily cannabis use |
| Daily cannabis intoxication |
| Daily substance related negative consequences |

**Table 2. Study Design Table**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Question** | **Hypothesis** | **Sampling plan** | **Analysis Plan** | **Rationale for deciding the sensitivity of the test for confirming or disconfirming the hypothesis** | **Interpretation given different outcomes** | **Theory that could be shown wrong by the outcomes** |
| Maladaptive emotion regulation will predict daily substance use | The ratio of maladaptive/adaptive ER strategies will predict daily alcohol use, intoxication, cannabis use, intoxication, and substance related negative consequences | The sample size was determined based on the aims of the larger project. For the present study, we simulated the power of the present study to detect the smallest effect size of interest for analyses with the lowest potential power (described above). Results indicated that we are adequately powered (> 95%) to detect an interaction term that reflects that the increase in intoxication increases an additional 4 points for every one standard deviation increase in a predictor, which we consider a small but meaningful effect size. | We will predict 5 alcohol and cannabis outcomes from the ratio of maladaptive::adaptive strategy use, first at the EMA prior to the onset of use and then at the day-level. We will test simple unconditional models predicting each alcohol and cannabis outcome from the predictor, and then test whether the effects are robust to the inclusion of covariates. | We define a 1.10 fold increase in the probability of any alcohol or cannabis use as the SESOI. For intoxication, the SESOI is 5. For consequences, the SESOI is .25. | Null findings would suggest that *when* people report using less adaptive and more maladaptive ER strategies, they aren’t more likely to subsequently engage in alcohol or cannabis use behaviors (or these behaviors are not higher). A positive finding would indicate that they are. | Affect regulation theories generally hypothesize that alcohol and cannabis use outcomes are more likely or more intense when people cannot otherwise effectively regulate their emotions (such as using relatively maladaptive ER strategies and relatively few adaptive ones).  Null or negative findings would provide evidence that, at least as observed in daily life, how people regulate their emotions *in general* does not influence people’s later alcohol or cannabis use behaviors as hypothesized. |
| Appraisals that emotional states are undesirable will predict daily substance use. | Importance appraisals will predict daily alcohol use, intoxication, cannabis use, intoxication, and substance related negative consequences | See above | See above | See above | A null finding would suggest that *when* people report that it is more important to change how they feel, people aren’t any more likely to engage in alcohol or cannabis use behaviors, while a positive effect would suggest that this is true. | Prior research on appraisals and substance use is sparse. Affect regulation theories generally hypothesize that alcohol and cannabis use outcomes are more likely or more intense when people want to regulate their emotions but are struggling to do so, such as when they believe it is important to change how they feel.  This finding would either expand (if supported) or narrow (if null) the range of emotion regulation behaviors that could be used to explain how and when people might be likely to engage in alcohol or cannabis use to regulate their emotions. |
| Appraisals that emotional states are difficult to change will predict daily substance use. | Confidence appraisals will predict daily alcohol use, intoxication, cannabis use, intoxication, and substance related negative consequences | See above | See above | See above | A null finding would suggest that *when* people report that they are less confident that they can change how they feel, people aren’t any more likely to engage in alcohol or cannabis use behaviors, while a negative effect would suggest that this is true. | Prior research on appraisals and substance use is sparse.  Affect regulation theories generally hypothesize that alcohol and cannabis use outcomes are more likely or more intense when people want to regulate their emotions but are struggling to do so, such as when they believe it is difficult to change how they feel.  This finding would either expand (if supported) or narrow (if null) the range of emotion regulation behaviors that could be used to explain how and when people might be likely to engage in alcohol or cannabis use to regulate their emotions. |
| Importance appraisals will more strongly predict substance outcomes when confidence appraisals are also low. | The interaction of important and confidence appraisals will predict daily alcohol use, intoxication, cannabis use, intoxication, and substance related negative consequences | See above | In addition to the general analysis plan describe above, we will interpret interactions for which the Bayes Factor exceeds 6 (indicating that the evidence for a model including the interaction is 6 times stronger compared to a model excluding the interaction) as evidence in favor of our hypothesis, in order to avoid retaining weak interactions that confirm our hypotheses. | See above | A positive finding would suggest that how importance appraisals influence alcohol and cannabis use outcomes depends on how effectively people believe they can change their emotions.  A null finding would rule out the possibility of this interdependence. | Again, there is little research on appraisals in the context of affect regulation theory. Findings would clarify how importance and confidence appraisals might additively or interactively predict alcohol and cannabis use outcomes, and either expand or narrow our understand of what aspects of affect regulation are relevant to alcohol and cannabis use in people’s daily lives. |
| Maladaptive ER will more strongly predict substance outcomes when negative affect is higher. | The interaction of the ratio of maladaptive/adaptive ER strategies by negative affect will predict daily alcohol use, intoxication, cannabis use, intoxication, and substance related negative consequences | See above | See above | See above | This hypotheses tests whether our first hypothesis further depends on people’s current affective state. A positive finding would suggest that ER strategies are *only* relevant to use when negative affect is also elevated.  A null finding would suggest that ER strategies influence alcohol and cannabis outcomes regardless of a person’s level of negative emotions. | There is no theory to guide this specific hypothesis.  Positive findings would clarify *when (and if)* emotion regulation is relevant to alcohol and cannabis outcomes. |
| Importance appraisals will more strongly predict substance outcomes when negative affect is higher. | The interaction of importance appraisals by negative affect will predict daily alcohol use, intoxication, cannabis use, intoxication, and substance related negative consequences | See above | See above | See above |  | See above |
| Confidence appraisals will more strongly predict substance outcomes when negative affect is higher. | The interaction of confidence appraisals by negative affect will predict daily alcohol use, intoxication, cannabis use, intoxication, and substance related negative consequences | See above | See above | See above |  | See above |
| The interaction of importance and confidence appraisals will more strongly predict substance outcomes when negative affect is higher. | The three-way interaction of important and confidence appraisals by negative affect will predict daily alcohol use, intoxication, cannabis use, intoxication, and substance related negative consequences | See above | See above | See above |  | See above |

**References**

Alawadhi, Y. T., Smith, M. R., & King, K. M. (2023). The relations between real-time use of emotion regulation strategies and anxiety and depression symptoms. *Journal of Clinical Psychology*, *79*(4), 1082–1098. https://doi.org/10.1002/jclp.23458

Aldao, A. (2013). The Future of Emotion Regulation Research: Capturing Context. *Perspectives on Psychological Science*, *8*(2), 155–172. https://doi.org/10.1177/1745691612459518

Aldao, A., Nolen-Hoeksema, S., & Schweizer, S. (2010). Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clinical Psychology Review*, *30*(2), 217–237. https://doi.org/10.1016/j.cpr.2009.11.004

Anvari, F., & Lakens, D. (2021). Using anchor-based methods to determine the smallest effect size of interest. *Journal of Experimental Social Psychology*, *96*, 104159. https://doi.org/10.1016/j.jesp.2021.104159

Azur, M. J., Stuart, E. A., Frangakis, C., & Leaf, P. J. (2011). Multiple imputation by chained equations: What is it and how does it work? *International Journal of Methods in Psychiatric Research*, *20*(1), 40–49. https://doi.org/10.1002/mpr.329

Barr, D., Levy, R., Scheepers, C., & Tily, H. (2013). Random effects structure for confirmatory hypothesis testing: Keep it maximal. *Journal of Memory and Language*, *68*, 255–278. https://doi.org/10.1016/j.jml.2012.11.001

Bonar, E. E., Goldstick, J. E., Collins, R. L., Cranford, J. A., Cunningham, R. M., Chermack, S. T., Blow, F. C., & Walton, M. A. (2017). Daily associations between cannabis motives and consumption in emerging adults. *Drug and Alcohol Dependence*, *178*, 136–142. https://doi.org/10.1016/j.drugalcdep.2017.05.006

Bresin, K., & Mekawi, Y. (2019). Do marijuana use motives matter? Meta-analytic associations with marijuana use frequency and problems. *Addictive Behaviors*, *99*, 106102. https://doi.org/10.1016/j.addbeh.2019.106102

Bresin, K., & Mekawi, Y. (2021). The “Why” of Drinking Matters: A Meta-Analysis of the Association Between Drinking Motives and Drinking Outcomes. *Alcoholism, Clinical and Experimental Research*, *45*(1), 38–50. https://doi.org/10.1111/acer.14518

Bresin, K., Mekawi, Y., & Verona, E. (2018). The effect of laboratory manipulations of negative affect on alcohol craving and use: A meta-analysis. *Psychology of Addictive Behaviors*, *32*, 617–627. https://doi.org/10.1037/adb0000383

Bürkner, P. (2017). brms: An R Package for Bayesian Multilevel Models Using Stan. *Journal of Statistical Software*, *80*, 1–28. https://doi.org/10.18637/jss.v080.i01

Carver, C. S. (1997). You want to measure coping but your protocol’ too long: Consider the brief cope. *International Journal of Behavioral Medicine*, *4*(1), 92–100. https://doi.org/10.1207/s15327558ijbm0401\_6

Cooper, M. L. (1994). Motivations for alcohol use among adolescents: Development and validation of a four-factor model. *Psychological Assessment*, *6*(2), 117–128. https://doi.org/10.1037/1040-3590.6.2.117

De Castella, K., Goldin, P., Jazaieri, H., Ziv, M., Dweck, C. S., & Gross, J. J. (2013). Beliefs About Emotion: Links to Emotion Regulation, Well-Being, and Psychological Distress. *Basic and Applied Social Psychology*, *35*(6), 497–505. https://doi.org/10.1080/01973533.2013.840632

De Castella, K., Platow, M. J., Tamir, M., & Gross, J. J. (2018). Beliefs about emotion: Implications for avoidance-based emotion regulation and psychological health. *Cognition and Emotion*, *32*(4), 773–795. https://doi.org/10.1080/02699931.2017.1353485

Dora, J., Piccirillo, M., Foster, K., Arbeau, K., Armeli, S., Auriacombe, M., Bartholow, B., Beltz, A., Blumenstock, S., Bold, K., Bonar, E., Braitman, A., Carpenter, R., Creswell, K., DeHart, T., Dvorak, R., Emery, N., Enkema, M., Fairbairn, C., … King, K. (2022a). *The daily association between affect and alcohol use: A meta-analysis of individual participant data*. https://doi.org/10.31234/osf.io/xevct

Dora, J., Piccirillo, M., Foster, K. T., Arbeau, K., Armeli, S., Auriacombe, M., Bartholow, B. D., Beltz, A. M., Blumenstock, S. M., Bold, K., Bonar, E., Braitman, A., Carpenter, R. W., Creswell, K., DeHart, T., Dvorak, R., Emery, N. N., Enkema, M., Fairbairn, C., … King, K. M. (2022b). The daily association between affect and alcohol use: A meta-analysis of individual participant data. *Psychological Bulletin*, *In Press*. https://doi.org/10.1037/bul0000387

Dora, J., Schultz, M., Shoda, Y., Lee, C., & King, K. (2022). No evidence for trait- and state-level urgency moderating the daily association between negative affect and subsequent alcohol use in two college samples. *Brain and Neuroscience Advances*.

Dora, J., Smith, M. R., Seldin, K., Schultz, M. E., Kuczynski, A. M., Moss, D. J., Carpenter, R. W., & King, K. M. (2022). Exploring associations between affect and marijuana use in everyday life via specification curve analysis. *Journal of Psychopathology and Clinical Science*, *in press*. https://doi.org/10.31234/osf.io/j375w

Duif, M., Thewissen, V., Wouters, S., Lechner, L., & Jacobs, N. (2020). Associations between affect and alcohol consumption in adults: An ecological momentary assessment study. *The American Journal of Drug and Alcohol Abuse*, *46*(1), 88–97. https://doi.org/10.1080/00952990.2019.1635606

Dvorak, R. D., & Simons, J. S. (2014). Daily associations between anxiety and alcohol use: Variation by sustained attention, set shifting, and gender. *Psychology of Addictive Behaviors*, *28*(4), 969–979. https://doi.org/10.1037/a0037642

Dvorak, R. D., Stevenson, B. L., Kilwein, T. M., Sargent, E. M., Dunn, M. E., Leary, A. V., & Kramer, M. P. (2018). Tension reduction and affect regulation: An examination of mood indices on drinking and non-drinking days among university student drinkers. *Experimental and Clinical Psychopharmacology*, *26*(4), 377–390. https://doi.org/10.1037/pha0000210

Emery, N. N., & Simons, J. S. (2020). The role of affect, emotion management, and attentional bias in young adult drinking: An experience sampling study. *Psychopharmacology*, *237*(5), 1557–1575. https://doi.org/10.1007/s00213-020-05480-5

Emery, N. N., Stanton, K., Baumgardner, S., Simons, J. S., Douglass, M. A., & Prince, M. A. (2023). Discrete emotions and global affect: Applying empirically driven approaches to experience sampling data to model state and trait affective structure and affect-alcohol use associations in a heavy drinking young-adult sample. *Behaviour Research and Therapy*, *167*, 104356. https://doi.org/10.1016/j.brat.2023.104356

Enders, C. K. (2010). *Applied missing data analysis*. Guilford Press.

Enders, C. K. (2017). Multiple imputation as a flexible tool for missing data handling in clinical research. *Behaviour Research and Therapy*, *98*, 4–18. https://doi.org/10.1016/j.brat.2016.11.008

Enders, C. K., Du, H., & Keller, B. T. (2020). A model-based imputation procedure for multilevel regression models with random coefficients, interaction effects, and nonlinear terms. *Psychological Methods*, *25*, 88–112. https://doi.org/10.1037/met0000228

Enders, C. K., & Tofighi, D. (2007). Centering predictor variables in cross-sectional multilevel models: A new look at an old issue. *Psychological Methods*, *12*(2), 121–138. https://doi.org/10.1037/1082-989X.12.2.121

Fairlie, A. M., Cadigan, J. M., Patrick, M. E., Larimer, M. E., & Lee, C. M. (2019). Unplanned Heavy Episodic and High-Intensity Drinking: Daily-Level Associations With Mood, Context, and Negative Consequences. *Journal of Studies on Alcohol and Drugs*, *80*(3), 331–339. https://doi.org/10/gpkkqc

Feil, M., Halvorson, M., Lengua, L., & King, K. M. (2020). A state model of negative urgency: Do momentary reports of emotional impulsivity reflect global self-report? *Journal of Research in Personality*, *86*, 103942. https://doi.org/10.1016/j.jrp.2020.103942

Ford, B. Q., & Gross, J. J. (2019). Why Beliefs About Emotion Matter: An Emotion-Regulation Perspective. *Current Directions in Psychological Science*, *28*(1), 74–81. https://doi.org/10.1177/0963721418806697

Ford, B. Q., Lwi, S. J., Gentzler, A. L., Hankin, B., & Mauss, I. B. (2018). The cost of believing emotions are uncontrollable: Youths’ beliefs about emotion predict emotion regulation and depressive symptoms. *Journal of Experimental Psychology: General*, *147*(8), 1170–1190. https://doi.org/10.1037/xge0000396

Garnefski, N., & Kraaij, V. (2007). The Cognitive Emotion Regulation Questionnaire: Psychometric features and prospective relationships with depression and anxiety in adults. *European Journal of Psychological Assessment*, *23*(3), 141–149.

Graham, J. W., Taylor, B. J., Olchowski, A. E., & Cumsille, P. E. (2006). Planned missing data designs in psychological research. *Psychological Methods*, *11*(4), 323–343. https://doi.org/10/d7v7nv

Gross, J. J. (1998). The emerging field of emotion regulation: An integrative review. *Review of General Psychology*, *2*(5), 271–299. https://doi.org/10.1017.S0048577201393198

Gross, J. J. (2015). The Extended Process Model of Emotion Regulation: Elaborations, Applications, and Future Directions. *Psychological Inquiry*, *26*(1), 130–137. https://doi.org/10.1080/1047840X.2015.989751

Hussong, A. M. (2007). Predictors of drinking immediacy following daily sadness: An application of survival analysis to experience sampling data. *Addictive Behaviors*, *32*(5), 1054–1065. https://doi.org/10.1016/j.addbeh.2006.07.011

Jahng, S., Solhan, M. B., Tomko, R. L., Wood, P. K., Piasecki, T. M., & Trull, T. J. (2011). Affect and alcohol use: An ecological momentary assessment study of outpatients with borderline personality disorder. *Journal of Abnormal Psychology*, *120*(3), 572–584. https://doi.org/10.1037/a0024686

Kalokerinos, E. K., Greenaway, K. H., & Denson, T. F. (2015). Reappraisal but not suppression downregulates the experience of positive and negative emotion. *Emotion*, *15*(3), 271–275. https://doi.org/10.1037/emo0000025

King, K. M., Feil, M. C., & Halvorson, M. A. (2018). Negative Urgency Is Correlated With the Use of Reflexive and Disengagement Emotion Regulation Strategies. *Clinical Psychological Science*, *6*(6), 822–834. https://doi.org/10.1177/2167702618785619

King, R. B., & dela Rosa, E. D. (2019). Are your emotions under your control or not? Implicit theories of emotion predict well-being via cognitive reappraisal. *Personality and Individual Differences*, *138*, 177–182. https://doi.org/10.1016/j.paid.2018.09.040

Kneeland, E. T., Goodman, F. R., & Dovidio, J. F. (2020). Emotion Beliefs, Emotion Regulation, and Emotional Experiences in Daily Life. *Behavior Therapy*, *51*(5), 728–738. https://doi.org/10.1016/j.beth.2019.10.007

Lafit, G., Adolf, J. K., Dejonckheere, E., Myin-Germeys, I., Viechtbauer, W., & Ceulemans, E. (2021). Selection of the Number of Participants in Intensive Longitudinal Studies: A User-Friendly Shiny App and Tutorial for Performing Power Analysis in Multilevel Regression Models That Account for Temporal Dependencies. *Advances in Methods and Practices in Psychological Science*, *4*(1), 251524592097873. https://doi.org/10.1177/2515245920978738

Larrazabal, M. A., Naragon-Gainey, K., & Conway, C. C. (2022). Distress tolerance and stress-induced emotion regulation behavior. *Journal of Research in Personality*, *99*, 104243. https://doi.org/10.1016/j.jrp.2022.104243

Larson, R. W., & Lampman-Petraitis, C. (1989). Daily emotional states as reported by children and adolescents. *Child Development*, *60*(5), 1250–1260. https://doi.org/10.2307/1130798

Lee, C. M., Cronce, J. M., Baldwin, S. A., Fairlie, A. M., Atkins, D. C., Patrick, M. E., Zimmerman, L., Larimer, M. E., & Leigh, B. C. (2017). Psychometric analysis and validity of the daily alcohol-related consequences and evaluations measure for young adults. *Psychological Assessment*, *29*(3), 253–263. https://doi.org/10.1037/pas0000320

Luoma, J. B., Pierce, B., & Levin, M. E. (2020). Experiential avoidance and negative affect as predictors of daily drinking. *Psychology of Addictive Behaviors*, *34*(3), 421–433. https://doi.org/10.1037/adb0000554

Moumne, S., Hall, N., Böke, B. N., Bastien, L., & Heath, N. (2020). Implicit Theories of Emotion, Goals for Emotion Regulation, and Cognitive Responses to Negative Life Events. *Psychological Reports*, 003329412094211. https://doi.org/10.1177/0033294120942110

Ortner, C. N. M., & Pennekamp, P. (2020). Emotion malleability beliefs and event intensity and importance predict emotion regulation in daily life. *Personality and Individual Differences*, *159*, 109887. https://doi.org/10.1016/j.paid.2020.109887

Palmblad, M., & Tiplady, B. (2004). Electronic diaries and questionnaires: Designing user interfaces that are easy for all patients to use. *Quality of Life Research*, *13*(7), 1199–1207. https://doi.org/10.1023/B:QURE.0000037501.92374.e1

Park, C. L., Armeli, S., & Tennen, H. (2004). The daily stress and coping process and alcohol use among college students. *Journal of Studies on Alcohol*, *65*(1), 126–135. https://doi.org/10.15288/jsa.2004.65.126

Prince, M. A., Conner, B. T., & Pearson, M. R. (2018). Quantifying cannabis: A field study of marijuana quantity estimation. *Psychology of Addictive Behaviors*, *32*(4), 426–433. https://doi.org/10.1037/adb0000370

R Development Core Team. (2016). R: A Language and Environment for Statistical Computing. *R Foundation for Statistical Computing Vienna Austria*, *0*, {ISBN} 3-900051-07-0. https://doi.org/10.1038/sj.hdy.6800737

Robitzsch, A., & Grund, S. (2023). *miceadds: Some Additional Multiple Imputation Functions, Especially for “mice.”* https://CRAN.R-project.org/package=miceadds

Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, *39*(6), 1161–1178. https://doi.org/10.1037/h0077714

Russell, M. A., Linden-Carmichael, A. N., Lanza, S. T., Fair, E. V., Sher, K. J., & Piasecki, T. M. (2020). Affect relative to day-level drinking initiation: Analyzing ecological momentary assessment data with multilevel spline modeling. *Psychology of Addictive Behaviors*, *34*(3), 434–446. https://doi.org/10.1037/adb0000550

Silk, J. S., Steinberg, L., & Morris, A. S. (2003). Adolescents ’ Emotion Regulation in Daily Life: Links to Depressive Symptoms and Problem Behavior Author ( s ): Jennifer S. Silk , Laurence Steinberg and Amanda Sheffield Morris Published by: Wiley on behalf of the Society for Research in Child Develop. *Child Development*, *74*(6), 1869–1880. https://doi.org/10.1046/j.1467-8624.2003.00643.x

Silvia, P. J., Kwapil, T. R., Walsh, M. a, & Myin-Germeys, I. (2014). Planned missing-data designs in experience-sampling research: Monte Carlo simulations of efficient designs for assessing within-person constructs. *Behavior Research Methods*, *46*(1), 41–54. https://doi.org/10.3758/s13428-013-0353-y

Simons, J. S., Wills, T. A., & Neal, D. J. (2014). The Many Faces of Affect: A Multilevel Model of Drinking Frequency/Quantity and Alcohol Dependence Symptoms Among Young Adults. *Journal of Abnormal Psychology*, *123*(3), 676–694. https://doi.org/10.1037/a0036926

Smith, M. R., Seldin, K., Galtieri, L. R., Alawadhi, Y. T., Lengua, L. J., & King, K. M. (2022). Specific emotion and momentary emotion regulation in adolescence and early adulthood. *Emotion*. https://doi.org/10.1037/emo0001127

Stellern, J., Xiao, K. B., Grennell, E., Sanches, M., Gowin, J. L., & Sloan, M. E. (2023). Emotion regulation in substance use disorders: A systematic review and meta‐analysis. *Addiction*, *118*(1), 30–47. https://doi.org/10.1111/add.16001

Stevenson, B., Dvorak, R., Kramer, M., Peterson, R., Dunn, M., Leary, A., & Pinto, D. (2019). Within- and Between-Person Associations From Mood to Alcohol Consequences: The Mediating Role of Enhancement and Coping Drinking Motives. *Journal of Abnormal Psychology*, *128*, 813–822. https://doi.org/10.1037/abn0000472

Stevenson, B. L., Dvorak, R. D., Kramer, M. P., Peterson, R. S., Dunn, M. E., Leary, A. V., & Pinto, D. (2019). Within- and between-person associations from mood to alcohol consequences: The mediating role of enhancement and coping drinking motives. *Journal of Abnormal Psychology*, *128*(8), 813–822. https://doi.org/10.1037/abn0000472

Substance Abuse and Mental Health Services Administration. (2021). *Key substance use and mental health indicators in the United States: Results from the 2020 National Survey on Drug Use and Health*. Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration.

Swerdlow, B. A., Sandel, D. B., Pearlstein, J. G., & Johnson, S. L. (2022). Momentary Emotion Goals and Spontaneous Emotion Regulation in Daily Life: An Ecological Momentary Assessment Study of Desire for High Versus Low Arousal Positive Emotion. *Affective Science*, *3*(2), 451–463. https://doi.org/10.1007/s42761-022-00108-7

Tamir, M., John, O. P., Srivastava, S., & Gross, J. J. (2007). Implicit theories of emotion: Affective and social outcomes across a major life transition. *Journal of Personality and Social Psychology*, *92*(4), 731–744. https://doi.org/10.1037/0022-3514.92.4.731

van Buuren, S., Groothuis-Oudshoorn, K., Robitzsch, A., Vink, G., Doove, L., & Jolani, S. (2015). Package ‘mice.’ *Computer Software*.

Veilleux, J. C. (2023). A Theory of Momentary Distress Tolerance: Toward Understanding Contextually Situated Choices to Engage With or Avoid Distress. *Clinical Psychological Science*, *11*(2), 357–380. https://doi.org/10.1177/21677026221118327

Waddell, J. T., Sher, K. J., & Piasecki, T. M. (2021). Coping motives and negative affect: An ecological study of the antecedents of alcohol craving and alcohol use. *Psychology of Addictive Behaviors*, *35*(5), 565–576. https://doi.org/10.1037/adb0000696

Walukevich-Dienst, K., Piccirillo, M. L., Calhoun, B. H., Bedard-Gilligan, M., Larimer, M. E., Patrick, M. E., & Lee, C. M. (2023). Daily-level relationships between negative affect, negative emotion differentiation, and cannabis behaviors among a high-risk sample of young adults. *Journal of Affective Disorders*, *335*, 392–400. https://doi.org/10.1016/j.jad.2023.05.056

Weiss, N. H., Bold, K. W., Sullivan, T. P., Armeli, S., & Tennen, H. (2017). Testing bidirectional associations among emotion regulation strategies and substance use: A daily diary study. *Addiction (Abingdon, England)*, *112*(4), 695–704. https://doi.org/10.1111/add.13698

Weiss, N. H., Kiefer, R., Goncharenko, S., Raudales, A. M., Forkus, S. R., Schick, M. R., & Contractor, A. A. (2022). Emotion regulation and substance use: A meta-analysis. *Drug and Alcohol Dependence*, *230*, 109131. https://doi.org/10.1016/j.drugalcdep.2021.109131

Wenze, S. J., Gaugler, T. L., Sheets, E. S., & DeCicco, J. M. (2018). Momentary experiential avoidance: Within-person correlates, antecedents, and consequences and between-person moderators. *Behaviour Research and Therapy*, *107*, 42–52. https://doi.org/10.1016/j.brat.2018.05.011

Wolgast, M., & Lundh, L.-G. (2017). Is Distraction an Adaptive or Maladaptive Strategy for Emotion Regulation? A Person-Oriented Approach. *Journal of Psychopathology and Behavioral Assessment*, *39*(1), 117–127. https://doi.org/10.1007/s10862-016-9570-x

Zhang, Z. (2016). Multiple imputation with multivariate imputation by chained equation (MICE) package. *Annals of Translational Medicine*, *4*(2), Article 2. https://doi.org/10.3978/j.issn.2305-5839.2015.12.63

1. Very few studies have provided robust evidence that experiences of negative affect precedes greater alcohol or cannabis intoxication or negative consequences at the daily level (Fairlie et al., 2019; B. L. Stevenson et al., 2019; Walukevich-Dienst et al., 2023). Studies with positive findings (Emery et al., 2023; Hussong, 2007; Simons et al., 2014) are often characterized by small samples (<100), nuanced findings (such as multi-way interactions), a lack of pre-registration, and are not replicated, which makes it difficult to know the reliability of these findings. Although most studies report null findings when affect is averaged at the day level prior to the onset of use (e.g. Dora, Piccirillo, et al., 2022b; Simons et al., 2014), or whether it is measured immediately prior to use (Dora, Smith, et al., 2022), some daily life studies did not determine whether use episodes began prior to when affect was measured, making them unable to determine the temporal precedence of affect and daily use (Fairlie et al., 2019). [↑](#footnote-ref-1)
2. We also acknowledge that the categorization of emotion regulation as adaptive or maladaptive is not well-defined or conclusive, as variables including context, duration, and individual factors may influence associated outcomes (Aldao, 2013; Wolgast & Lundh, 2017). [↑](#footnote-ref-2)