

Emotional and behavioral regulation as mediators of the association between adversity and
dysregulated drinking

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Abstract

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Young adult alcohol misuse results in over 1,500 deaths per year; thus, understanding contributing factors is crucial. Childhood adversity (CA) has been a demonstrated predictor of alcohol use, and behavioral and emotional dysregulation may be mechanisms for this association. Using ecological momentary assessment (EMA) of young adults aged 18-22 ($N=496$), this dissertation investigated how experiences of CA contribute to dysregulated drinking through effects on behavioral and emotional dysregulation in three studies. Study 1 investigated how different categorizations of CA relate to young adult behavioral and emotional dysregulation. Study 2 examined behavioral and emotional dysregulation as mediators of the associations between CA and daily dysregulated drinking. Finally, Study 3 used idiographic modeling to explore relations between negative affect, emotion dysregulation, and binge drinking in a high CA subsample. Overall results suggested that CA, specifically experiences characterized by threat, is associated with increased emotional dysregulation. Although there is limited support for behavioral dysregulation as a process linking CA and dysregulated drinking, emotion dysregulation appears to be a more likely pathway.

Table of Contents

Study 1: Childhood adversity and self-regulation in young adults: Comparing conceptualizations and levels of reporting	6
Table of Contents	7
Abstract	9
Introduction	10
Methods	18
Results	29
Discussion	32
References	38
Tables and Figures	54
Study 2: Childhood adversity and dysregulated drinking: The role of regulation	61
Table of Contents	62
Abstract	64
Introduction	65
Methods	73
Results	86
Discussion	89
References	95
Tables and Figures	113
Study 3: Daily emotion dysregulation and binge drinking: An idiographic examination .	126
Table of Contents	127
Abstract	129
Introduction	130
Methods	134
Results	140
Discussion	142
References	148
Tables and Figures	161

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**Study 1: Childhood adversity and self-regulation in young adults: Comparing
conceptualizations and levels of reporting**

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Study 1 Table of Contents

Abstract	9
Introduction	10
Childhood Adversity	10
<i>Cumulative Adversity</i>	10
<i>Dimensional Framework</i>	11
Childhood Adversity and Self-regulation	12
EMA	16
Current study	17
Methods	18
Participants	18
Recruitment and Inclusion	18
Procedure	19
<i>Baseline Assessment</i>	19
<i>EMA orientation/training</i>	19
<i>EMA data collection</i>	20
Following orientation and baseline assessment, participants	20
Measures	21
<i>Baseline Measures</i>	21
<i>Global self-report of dysregulation</i>	23
<i>EMA Measures</i>	23
Emotion dysregulation	24
<i>Behavioral Dysregulation</i>	25
Data Analysis	25
General analytic approach	25
Covariates	26
General model fitting approach	26
<i>Daily Models</i>	26
<i>Global self-report Models</i>	27
<i>Missing data</i>	27
Results	29
Descriptive statistics	29
Emotional dysregulation	29

<i>Daily Report</i>	29
<i>Global report</i>	30
Behavioral regulation	30
<i>Daily Report</i>	30
<i>Global report</i>	31
Discussion	32
Strengths, Limitations, and Next Steps	36
References	38
Tables and Figures	54
Figure 1	54
Table 1	55
Table 2	56
Figure 2	57
Table 3	58
Table 4	60

Abstract

Background. More than 50% of youth experience childhood adversity, or exposure to highly negative or stressful life events, before age 18. Experiences of childhood adversity have been associated with countless negative outcomes, including emotional and behavioral dysregulation, which are important transdiagnostic risk factors for psychopathology. Adverse experiences can be categorized into deprivation (i.e., the absence of expected environmental inputs in social and cognitive spheres) and threat (i.e., actual or threatened experiences of harm to one's physical or emotional safety), each thought to have a differential impact on the development of behavioral and emotional regulation. However, previous research has been limited in that it has relied mainly on 1) cumulative measurement of adversity, which potentially obscures differences in risk, and 2) global self-report, which may not accurately reflect patterns of dysregulation.

Method. The current study investigated how different categorizations of adversity relate to young adult behavioral and emotional dysregulation via daily and global self-reports. Young adults, ages 18-22 (N=496, 55% female), provided baseline information on their demographics and experiences of childhood adversity and daily reports of their behavioral (negative urgency) and emotional dysregulation (affective dynamics and reflexive emotion regulation) in an ecological momentary assessment (EMA) design. GLMMs provided confirmatory analyses to examine threat, deprivation, and cumulative risk as predictors of behavioral and emotional dysregulation. **Results.** Results indicated that threat and cumulative adversity were similarly related to most measures of daily emotion dysregulation (excluding ratio of reflexive regulation) and behavioral regulation, while deprivation was unrelated to all daily regulation measures. In contrast, all configurations of adversity were associated with global self-reports of both emotional and behavioral regulation in most cases. Moreover, global estimates were larger than those for daily regulation. **Conclusions.** Findings suggest that adverse childhood experiences of threat have a significant impact on daily emotional and behavioral regulation, particularly in comparison to those characterized by deprivation. Given this, associations between cumulative adversity and regulation appear to be driven by experiences of threat. Moreover, daily and global self-reports of emotional and behavioral regulation have only a small correlation and appear to be differentially influenced by childhood adversity. Future research should examine moderators of these associations and seek to better understand the discrepancies between daily and global self-reports.

Introduction

Childhood Adversity

Adverse childhood experiences have been broadly defined to include experiences from emotional neglect to neighborhood violence. Research suggests that over 60 percent of individuals endure some adversity prior to age 18 (Felitti et al., 2019; Finkelhor et al., 2015; Merrick et al., 2018). The impact of childhood adversity on adult physical and mental health has been much researched in recent years. Childhood adversity has been linked to several adverse outcomes across the lifespan, including physical ailments, psychological distress, and homelessness (Felitti et al., 2019; Nurius et al., 2015; Roos et al., 2013).

Cumulative Adversity

For much of the past twenty-five years, experiences of childhood adversity (CA) have been primarily considered in their cumulative form. While there is no fixed list of experiences said to capture CA, adversities such as child maltreatment (i.e., abuse or neglect), household dysfunction (e.g., caregiver substance use or mental illness), or sociodemographic risk factors associated with risk (e.g., low parental education) are often included in cumulative CA measures. Though said to be atheoretical, the cumulative CA approach is rooted in psychosocial and stress theories of development. The bioecological model of development theorizes that concentric layers of normative and stressful environmental experiences from most proximal (e.g., parental physical abuse) to more distal or contextual (e.g., neighborhood violence) shape youth development (Bronfenbrenner, 2005; Bronfenbrenner & Morris, 2006). Stressful experiences are thought to disrupt and tax the stress response system, resulting in aberrations in long-term system functioning and the development of self-regulatory strategies (Danese & McEwen, 2012; Evans et al., 2013; Shonkoff et al., 2012). Cumulative CA research has also demonstrated that individuals who deal with one adverse experience are more likely to deal with others (Evans et al., 2013; Felitti et al., 1998, 2019). Cumulative CA classifies

exposure to singular experiences categorically (experience is present or absent) and generally sums the dichotomous adversities. Across the use of cumulative CA, more adverse experiences (thus higher cumulative CA) have been broadly associated with negative developmental outcomes (Evans et al., 2013; Felitti et al., 2019).

Dimensional Framework

More recently, a dimensional model of CA suggests that while an individual factor approach may account for similarities in experience, a cumulative approach obfuscates the unique impact of different dimensions of adversity, namely experiences of threat and deprivation (McLaughlin et al., 2014; McLaughlin & Sheridan, 2016; Sheridan & McLaughlin, 2014). This theory proposes a bidimensional framework for CA comprised of *deprivation*, the absence of expected environmental inputs in social and cognitive spheres, and *threat*, comprised of actual or threatened experiences of harm to one's physical safety. With the understanding that experiences within these two domains often co-occur, deprivation and threat are hypothesized to have a differential neurological impact and subsequent outcomes (McLaughlin et al., 2014).

Deprivation. Deprivation is characterized by caregiver inaction or absence of expected inputs. Deprivation includes experiences of neglect—acts of caregiver omission, including inadequacies in providing necessities (food, clothing, shelter), as well as poor emotional support (Erickson & Egeland, 2002; McLaughlin et al., 2014). Experiences of deprivation are typified by deficits in cognitive and social stimulation. This dimensional framework suggests that CA experiences of deprivation result in insufficient cognitive stimulation in experience-dependent neural networks, resulting in a neural structure unequipped to support complex cognitive and social processes (McLaughlin et al., 2014; McLaughlin & Sheridan, 2016; Sheridan & McLaughlin, 2014).

Threat. Threat experiences are conceptualized in line with the American Psychiatric Association's (APA) conception of traumatic events outlined in the *Diagnostic and Statistical*

Manual of Mental Disorders (American Psychiatric Association [APA], 2013). These events involve exposure to real or threatened harm, death, or violence. Exposure may include directly experiencing or witnessing, learning of the impact on an individual in the close social circle, or repeatedly being exposed to aversive details of trauma (e.g., being repeatedly exposed to the details of another's sexual abuse) (American Psychiatric Association [APA], 2013; McLaughlin & Sheridan, 2016). Examples of threat experiences can include things such as sexual, physical, and emotional abuse, and interpersonal or contextual violence (Berman et al., 2022; McLaughlin & Sheridan, 2016).

A small but growing body of literature has empirically compared these two frameworks. The research that does exist (e.g., Henry et al., 2020) has limited examinations of the theorized mechanisms. In addition, research that does compare these conceptualizations and their associations with theorized mechanisms is often limited to childhood (Lambert et al., 2017; Sheridan et al., 2020), precluding conclusions about the endurance of purported impacts.

Childhood Adversity and Self-regulation

Adverse experiences have been found to impact self-regulatory processes (Evans & English, 2002; Lengua et al., 2007). Broadly, self-regulation can be defined as “the primarily volitional regulation of attention, emotion, and executive functions for goal-directed actions” (Blair & Raver, 2012, p. 311; Blair & Ursache, 2011). The impact of adversity on self-regulation is theorized to occur through a process known as experiential canalization, wherein the environment, genetic background, and neurobiological processes combine to influence one another and child development to maximize functioning in a particular environment (Blair & Raver, 2012; Gottlieb, 1991, 1997). Thus, individuals who experience adversity develop self-regulatory skills to function in an adverse environment most optimally. However, the affective and behavioral accommodation may be less effective in other environments and across time.

Behavioral and emotion dysregulation reflect ineffectual self-regulatory processes. Emotion dysregulation involves processes in which there may be aberrations in effective emotion regulation (Gross & John, 2003). Emotion regulation (ER) is a complex process of an individual's experience, expression, and modulation of an emotional experience (Gross, 2015; Gross & John, 2003), and ER strategies are specific responses to emotional experiences aimed at modulating that experience. Emotion dysregulation is marked by undesirable emotional experiences, including emotions that endure longer than desired, change too quickly or slowly, are context-inappropriate, or interfere with appropriate behavior (Beauchaine & Haines, 2020; Cole et al., 2019), and by the use of ER strategies (e.g., denial or suppression) that inadvertently prolong or enhance the experience of negative emotions. Behavioral dysregulation refers to difficulty or inability in exercising control over individual impulses. Urgency, or the tendency to act impulsively in response to strong affect, is a type of behavioral dysregulation (Cyders & Smith, 2008; Whiteside & Lynam, 2001). CA has been associated with an overall increase in dysregulation—specifically, individuals exposed to CA have shown elevated levels of both urgency (Oshri et al., 2018; Shin et al., 2009; Wardell et al., 2016) and emotion dysregulation (Gruhn & Compas, 2020; Lavi et al., 2019; Milojevich et al., 2019).

Like many of the other outcomes in threat/deprivation research, emotional and behavioral regulation have been mainly examined in an aggregated maltreatment/CA context, with a focus on physical and sexual abuse. Broadly, children who have experienced maltreatment have shown deficits in the identification and production of emotional expression, labeling contextual causes of emotion, and regulating their own emotions (Camras et al., 1996; Fishbein et al., 2009; Rogosch et al., 1995; Shields & Cicchetti, 1997). Moreover, CA has been associated with stress reactivity aberrations, short-term goal focus, as well as impulsive action (Levitt et al., 2021; Lovallo, 2013; Lovallo et al., 2013). Experiences of childhood maltreatment are associated with urgency among young adults (Arens et al., 2012; Gagnon et al., 2013; Ramakrishnan et al., 2019), and some researchers have found this association to be unique to

urgency among other facets of impulsivity (Gagnon et al., 2013). Similarly, childhood maltreatment has been linked longitudinally to emotion dysregulation in young adults, including increased intensity and variability of negative emotions and altered sensitivity to emotional cues (Grusnick et al., 2020; Teicher et al., 2015; Warmingham et al., 2019). Researchers suggest that ostensibly adaptive ER techniques may not be environmentally adaptive for the maltreated child, and thus, they may not be the learned response to managing emotion. Further, suppressing or dampening emotion may be a reasonable response in the case of maltreatment in that emotional displays may be met with aggression or indifference (Cole et al., 1994). For example, emotional expression and seeking support from a caregiver were less likely among those who experienced neglect (Shipman et al., 2005). More recent evidence supports this pattern. Compared to those who had experienced abuse, youth who had experienced neglect had increased emotion dysregulation related to a lack of emotional clarity and emotional awareness (Berzenski, 2019).

Because threat involves the *input* of negative actions, youth who experience threat may develop attentional biases toward negative facial expressions, as well as emotions and increased reactivity and lack of inhibition in the context of negative affect or expression (Lambert et al., 2017; McLaughlin et al., 2014), laying the groundwork for emotional and behavioral dysregulation. These threat responses are theorized to be associated with the fear learning processes. Childhood experiences of threat are believed to disrupt opportunities to distinguish between danger and safety. The learning associated with the threat cannot be effectively extinguished—individuals learn that threat is pervasive with no opportunity for alternative experiences, and even when the specific threat is absent, the threat response can be reactivated through exposure to other potential threats or similar contextual cues (Bouton, 2002; McLaughlin et al., 2014). Emerging evidence suggests that experiences of threat, compared to deprivation, may be more strongly associated with urgency and emotional dysregulation (Grusnick et al., 2020; Lambert et al., 2017; Milojevich et al., 2019).

Given that deprivation is characterized by caregiver *inaction*, researchers hypothesize that children with experiences characterized by deprivation are unlikely to be afforded proper scaffolding and modeling for emotional development (Erickson & Egeland, 2002; Shipman et al., 2005). At the earliest stages in life, infants rely on the external actions of caregivers to regulate their affect. Responsive caregivers' facial expressions and actions activate infants' sympathetic nervous system and serve to modulate arousal (van der Kolk & Fislér, 1994). With this type of experience-expected learning absent in neglectful environments, infants may fail to learn successful affect regulation (Glaser, 2000). This absent learning may set the stage for poor emotion identification and modulation later, deficits fundamental in emotion dysregulation (Beauchaine & Haines, 2020) and urgency (Atkinson et al., 2020; Emery et al., 2014). These difficulties in cognitive processing of emotion (e.g., difficulties identifying, differentiating, and regulating emotion) may result in the use of reflexive ER (e.g., suppression or denial) strategies in response to aversive affective arousal (Emery et al., 2014; Shishido et al., 2013). Both deprivation and threat have also demonstrated associations to urgency. Some research suggests that the association between urgency and threat experiences is stronger, while other evidence suggests that deprivation is similarly associated with increased urgency (Oshri et al., 2018). Overall, urgency is underexamined regarding specific dimensions of CA.

Emotional and behavioral regulation and cumulative CA have been examined among both high-risk populations and more universal samples (Evans et al., 2013). Cumulative CA has been associated with higher levels of avoidant coping (Thompson et al., 2016). In their review of the literature, Wright and colleagues (2013) noted that avoidance, emotional distancing, and detachment were some of the regulation styles found in youths who had experienced multiple adversities; they found that positive strategies like seeking social support were limited among those with high levels of CA exposure. Moreover, cumulative adversity has been consistently tied to increased levels of negative urgency (e.g., Arens et al., 2012; Gagnon et al., 2013; Ramakrishnan et al., 2019). Some evidence suggests that the overall CA count has a stronger

effect size on urgency than aggregated ratings of CA intensity (Ramakrishnan et al., 2019) or specific classes of CA (Shin et al., 2018).

Given the breadth of characterizations and limited research comparing approaches, understanding differential characterizations and their respective associations to self-regulation is a critical aim.

EMA

Reliance on global self-report of regulation further limits the literature's scope on these relationships. Global, also known as trait, self-report asks participants to assess and report on their typical patterns of regulation (Koval et al., 2023). While global self-report offers a measure of habitual behavior, retrospective report has been shown to be subject to recall bias and lack of ecological validity. In fact, recent evidence indicates that global self-reports share only small-to-moderate correlations with daily self-reports of ER (Koval et al., 2023) and negative urgency (Feil et al., 2020; Mostajabi et al., 2023). Thus, it is unclear both how different conceptualizations relate to daily self-regulation and if currently understood associations with global self-reported regulation appear on the daily level. Daily sampling methods offer an alternative to global self-report. Ecological momentary assessment (EMA) is a form of experience sampling that relies on repeated assessment of mood/behavior, minimizing the period of recall and maximizing assessment of individuals in their present context (Ebner-Priemer & Trull, 2009; Hamaker & Wichers, 2017). The majority of the associations described above utilize global self-report measures. Particularly in the case of urgency, there are very few studies examining the association between CA and daily or momentary measures of emotional or behavioral dysregulation.

Current study

This study compared conceptualizations of CA as predictors of daily emotional and behavioral regulation in young adults. We characterized CA using both cumulative and dimensional approaches. Hypotheses were as follows:

- H1. Threat and cumulative CA will be positively associated with both daily and global emotional and behavioral dysregulation
- H2. Deprivation will be positively associated with daily and global emotional but not behavioral dysregulation
- H3. Threat will have the largest association with daily and global behavioral dysregulation
- H4. Associations between childhood adversity and dysregulation will be larger for global self-report as compared to momentary report

Methods

Participants

Participants were part of a sample recruited for participation in a larger study on the development of alcohol and marijuana use problems during young adulthood. The sample included young adults ($n = 496$, $M_{\text{age}}(\text{SD}) = 20.4(1.3)$, *range* 18 – 22) who reported drinking alcohol or using marijuana regularly. Participants were recruited from King, Pierce, and Snohomish Counties in Washington State from both college (76%) and non-college (24%) sources to provide a representative sample of young adults. Participants were sampled from a variety of community areas with variable race/ethnic and socioeconomic profiles to facilitate demographic variation. Participants' median monthly income was \$500 or less, and most participants had at least one parent with a college or graduate degree (72%). Participants were predominantly non-Hispanic White (54%), followed by biracial/multiracial (20%), East Asian (7.5%), Hispanic (6.3%), Southeast Asian (4.2%), and African American (3.6%). Of the biracial/multiracial participants, 65.9% included White as one of their identities, 30.9% included East Asian, and 23.7% included Southeast Asian, with other endorsed identities including Middle Eastern (15.5%), African American (11.3%), Hispanic (11.3%), South Asian (8.2%), Native American (8.2%), Pacific Islander (6.2%), and African (3.1%). Full demographic information in Table 1.

Recruitment and Inclusion.

All study procedures were completed online. We recruited using social media (Facebook, Instagram, Snapchat, TikTok, YouTube, Twitter, Craigslist, Reddit) and non-internet (newspaper advertisements and flyers) sources. Interested potential participants were directed to a web survey where they completed basic demographic, contact, and past-month substance use information. Eligible participants were between the ages of 18 and 22 at study screening, owned a smartphone, were fluent in English, and reported at least weekly use of alcohol or cannabis in the past three months. Participants were excluded if they moved to the United

States after age 12 to screen out participants who were not acculturated to United States norms of substance use, in line with the aims of the parent study. Surveys also included items designed to screen for invalid or careless responding (Kim et al., 2018) and allowed the survey to be taken only a single time for each IP address. Participants who met study criteria scheduled an appointment using an online reservation system to meet with a research assistant for their baseline visit.

Procedure

Baseline Assessment

Research assistants verified participants' identities using a photo ID before completing consent. Participants were paid \$50 for completion of the baseline assessment. In accordance with COVID-19 guidelines, baseline assessments began on Zoom. Assessments continued online for consistency during the remainder of the study.

EMA orientation/training

EMA procedures were modeled after successful implementation in prior studies (Feil et al., 2019; Halvorson et al., 2019). Research staff were trained to answer questions, build rapport, and motivate participants to complete the EMA surveys. As part of the consent process, research staff described the study, emphasizing the intensive nature of the sampling procedures, the importance of high compliance (and bonuses for compliance), and the scientific significance of the data collected. The goals of these procedures were to ensure that participants understood the rigor of the study before agreeing to participate, to build rapport between the participant and study staff, and to highlight the importance of the EMA survey data. Staff presented participants with a calendar of the dates for which they would be receiving EMAs (i.e., Thursday – Sunday for the next 8 weeks, between 9 am and 11 pm) and asked participants to identify occasions they may be unable to complete EMAs (e.g., long work shifts,

trips abroad). Participants who indicated being unable to respond to 50% or more of the prompts were discontinued from the study. Staff identified themselves as the participant's personal contact for the duration of the EMA period. Participants were also reminded that if they missed more than one day of data collection, research staff would personally call them to check in and troubleshoot, ensuring support for study participation. Participants were trained on EMA measures during this initial call. Research staff sent a sample survey to the participants' smartphones and guided them through the steps to complete the survey. Research staff defined key measures and provided examples as needed.

EMA data collection

Following orientation and baseline assessment, participants received texts with a link to a brief EMA survey for the next 8 weekends (Thursday to Sunday), 5 times per day. On Monday mornings, participants received an additional EMA to capture behavior from Sunday nights. EMAs were sent within five three-hour blocks between 9 am and 11 pm, 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-, 40-, and 55-minute reminders after two months of data collection to improve compliance.

We used several methods to improve participant compliance with assessments (Shiffman et al., 2008). Research staff completed phone check-ins after the first day of data collection to troubleshoot and boost compliance as needed. Participants received e-mail and text reminders the day before each weekend of data collection. Survey links were active for an hour after the initial text was received to allow flexibility in survey completion, with reminder texts sent as described above. Prior research has suggested that participants can exhibit high compliance with daily data collection when electronic reminders are used (Hufford & Shiffman, 2002; Shiffman et al., 2008). In addition, we increased compliance by offering "bonuses":

Participants were paid \$1 per EMA, with a \$5 bonus for completing 80% (i.e., 17/21) of EMAs for a given weekend (\$208 total possible).

Measures

These measures came from a more extensive assessment battery. We report the measures relevant to the current study here.

Baseline Measures

Threat. We measured threat as a composite of items across several measures capturing the experience of threat. The Childhood Trauma Questionnaire (CTQ)(Bernstein et al., 2003) is a self-report measure assessing recall of childhood trauma history, including three subscales measuring abuse with 15 total items covering emotional, physical, and sexual abuse ($\alpha = 0.66-0.92$). We adapted 16 items from the Violence Exposure Scale-Revised (VEX-R)(Fox & Leavitt, n.d., 1995) as a self-report measure of exposure to violence ($\alpha = 0.72-0.86$) within the home and community. We used percent of maximum possible scoring (POMP) to combine scores across subscales and form a composite of threat. We then standardized scores for comparison with deprivation.

Deprivation. We measured deprivation as a composite of items measuring experiences of neglect in childhood. The Multidimensional Neglectful Behavior Scale (MNBS)(Strauss et al., 1995) is a 25-item self-report scale that measures adolescent and adult recall of neglect across domains, including physical, emotional, and cognitive ($\alpha = 0.80-0.89$) developmental needs. The Childhood Experience of Care and Abuse Questionnaire (CECA.Q)(Bifulco et al., 2005; N. Smith et al., 2002) is a 40-item self-report measure assessing experiences of abuse and neglect; we used eight items tapping emotional neglect ($\alpha = 0.87-0.92$). We used percent of maximum possible (POMP) scoring to combine scores across subscales and form a composite of deprivation. We then standardized scores for comparison with threat.

Cumulative Adversity. Cumulative adversity included a combination of threat and deprivation items, as well as other experiences that did not fit neatly in either dimension. The first set of additional items reflected childhood socioeconomic status. Two items were selected from the 6-item short form (Blumberg et al., 1999) of the U.S. Department of Agriculture's 18-item Food Security Scale (Carlson et al., 1999; Price et al., 1997), assessing access to "nutritionally adequate and safe foods" and the financial ability to secure these foods in U.S. households. Participants respond "yes" or "no" to items assessing access to food. Participant-reported parent education level was also included to reflect socioeconomic risk. If participants indicated more than one value for parental education (e.g., different values for different parents), the highest value was used. Adversity was scored as 1 for parents with educational attainment below a high school diploma and 0 for a high school diploma and above. Participants also indicated if their mother or father had an alcohol or drug use problem. Participants received a score of 1 if they endorsed either parent having a problem with drugs or alcohol. To form the cumulative adversity score, we used the traditional sum of binary scored present or absent experiences. Mean scores on the MNBS subscales (physical, emotional, and cognitive neglect), CTQ subscales (sexual, physical, and emotional abuse), and VEX-R total scores above 1 were counted as present (1), and scores of 1 or below were counted as absent (0). Adverse experiences were then summed up to form a cumulative adversity score.

Global self-report of dysregulation

Affective dynamics. Global negative affectivity was measured using the mean of the anxiety/depression subscale on the Achenbach Adult Self-Report scale (Achenbach & Rescorla, 2003), assessing the intensity of negative affect. Global affective dynamics were measured with the Emotion Reactivity Scale (Nock et al., 2008), assessing dynamics of individual negative affect ($\alpha = .94$). We employed the sensitivity subscale as a measure of reactivity and the persistence subscale as a measure of variability.

Emotion dysregulation. We computed two measures of emotion dysregulation. The Cognitive Emotion Regulation Questionnaire (CERQ) (Jermann et al., 2006) assessed ER strategies used. We first formed a composite measure of reflexive ER by taking the mean of catastrophizing, rumination, and self and other blame subscales (α 's = .68-.93). We also computed the ratio of mean reflexive strategies to engagement strategies (acceptance, putting events into perspective, reappraisal, and refocus on planning) to reflect a degree of global emotion dysregulation.

Behavioral Dysregulation. In the 59-item Impulsive Behavior Scale (UPPS-P) (Lynam et al., 2006), participants report their levels of impulsivity in response to a number of situations, attitudes, and behaviors. In the present study, we include an average of two factors: positive urgency and negative urgency. Participants were asked how well each of these statements fit them using a 1-4 Likert scale, where 1 = agree strongly to 4 = disagree strongly. Scoring yielded means for each subscale (Lynam et al., 2006; Whiteside & Lynam, 2001). The 59-item UPPS-P Scale has demonstrated good convergent and discriminant validity (Cyders & Smith, 2007; Whiteside et al., 2005), including the urgency subscale ($\alpha = 0.86$). Total urgency was standardized so that values represented the number of standard deviations from the sample mean.

EMA Measures

Emotion dysregulation.

Affective dynamics. At each EMA, we measured affect using items taken from the Positive and Negative Affect Scale - expanded (Watson & Clark, 1994) and other prior work (Jacobson et al., 2020; Larson & Lampman-Petratis, 1989), using two words each randomly presented from seven sets of items reflecting four negative (anger, sadness, anxiety, and general distress) and three positive (joviality, attentiveness, serenity) affect dimensions. Participants rated the extent to which they experienced each emotion using a sliding scale from zero to 100. Using these scales, we computed several measures of affective dynamics, including within-day NA intensity, variability, and reactivity of negative emotions (Jahng et al., 2008; Koval et al., 2013; Kuppens et al., 2010). *Intensity* was computed as the mean NA. Daily SD of NA represented affect *variability*. *Reactivity* was computed as the root mean squared successive difference (RMSSD), reflecting both variability and temporal dependency over time (Jahng et al., 2008).

Reflexive emotion regulation. We measured regulation strategies using a checklist of 8 items adapted from the CERQ (Jermann et al., 2006), which measures the use of specific strategies (acceptance, problem-solving, rumination, reframing, distraction, avoidance, emotion suppression, thought suppression) to regulate affect, as well as four items adapted from the Brief-COPE (Carver, 1997), an inventory of different coping skills (emotional support, emotional expression/venting, mindfulness/spirituality, self-criticism). Participants endorsed which items they used since the prior assessment, using a “check all that apply” style of question, selecting “none of the above” if participants did not use any of the strategies in the specified period. We formed a composite measure of reflexive strategies by summing endorsement of the following strategies at each EMA: avoidance, criticism, rumination, suppression, and distraction. In addition, because research suggests that individuals exposed to higher negative affect report higher levels of all ER strategies (Compas et al., 2017; M. R.

Smith et al., 2023), we examined relative use of reflexive strategies to engagement strategies (acceptance, problem solving, reappraisal, support seeking, emotional expression, and using mindfulness or medication to improve mood) by computing the ratio of daily mean reflexive to engagement strategy use.

Behavioral Dysregulation

Daily Urgency. Six items were adapted from the UPPS-P (Lynam et al., 2006) subscales of urgency to assess momentary impulsivity in the EMA surveys. These items were adapted by changing the language from general trait descriptors to past tense statements that participants rated based on their experience since the last assessment. Further, affect content was removed from urgency items when appropriate to make the items affect-independent. For example, the urgency item “when I am upset, I often act without thinking” became “I acted without thinking.” Participants were prompted to rate how strongly they agreed with the impulsivity-related statements on a slider bar that ranged from “Strongly Disagree” to “Strongly Agree.” These slider bars were scored continuously from 0 to 100 based on the slider position. In each EMA survey, 8 of the total 12 impulsivity items were presented at random to reduce participant burden. Three of the items were randomly selected from the urgency items. First, EMA urgency item averages were created for each assessment within a given day (prior to drinking onset). Then, momentary means were averaged to create a day-level urgency score.

Data Analysis

General analytic approach

Data processing and analyses were conducted in R (R Core Team, 2024), a flexible open-source data analytic software. We tested hypotheses with generalized linear models (GLMM). GLMMs are a flexible class of analyses that allow for the analysis of non-independent (i.e., clustered) data while accommodating a range of dependent variable distributions (e.g., continuous, categorical, ordinal, and count data). GLMMs allow researchers to account for

nesting within different data structures and simultaneously model effects across nesting levels. GLMM analyses were conducted using well-vetted packages in R, including glmmTMB (Brooks et al., 2017) and lme4 (Bates et al., 2015).

Covariates. All models included a core set of covariates. At level 2 (between person), we controlled for age, gender, college/non-college status, and income. Categorical covariates (gender, college/non-college status) were dummy coded (0, 1) with male and college as the reference groups, respectively. Continuous level 2 (person-level) predictors were grand-mean centered (GMC). In addition, all EMA models also included study week and month to control for time effects and reactivity over the study.

General model fitting approach. We compared initial nested models using relative fit indices (AIC, BIC, -2 log-likelihood) to determine whether including key covariates improved model fit.

Daily Models

In these models, baseline adversity was examined as the predictor of dysregulation aggregated across the EMA period. These models served as a comparison to the global self-report associations. Models were tested using GLMM to account for the nested structure of the data. Predictors and covariates were entered into the model simultaneously. This model was repeated across daily reports of urgency, count of reflexive ER strategies, ratio of reflexive to engagement ER strategies, and EMA affective dynamics (intensity, sensitivity, variability). Models were repeated with cumulative adversity as the primary predictor in place of threat and deprivation. See example model below.

$$Avgurgency_{ij} = \beta_0 + u_{0j} + B_1 threat_j + \beta_2 deprivation_j + B_{3-k} covariates_j$$

$$e_{ij} \sim N(0, \sigma_e^2)$$

$$u_j \sim N(0, \sigma_u^2)$$

Global self-report Models

For the global-self report models, childhood adversity, characterized as threat or deprivation, was tested as the predictor of global self-report of emotional and behavioral dysregulation. Models were tested using GLM. All predictors and covariates were entered into the model simultaneously. This model was repeated for global self-report of reflexive ER strategy use and urgency, ratio of reflexive emotional dysregulation, and baseline emotional reactivity (intensity, variability, and sensitivity). We repeated these analyses with cumulative adversity as the primary predictor. See example model below.

$$GSR_urgency_j = \beta_0 + B_1 threat + \beta_2 deprivation + B_{3-k} covariates + e_i$$

$$e_i \sim N(0, \sigma_e^2)$$

Missing data

To reduce participant burden, we presented participants with a randomly selected subset of urgency and affect items at each assessment, and these items are consequently missing completely at random (MCAR) by definition. However, additional data were missing, given the length and intensity of our assessment protocol. Participants completed a total of 51,471 EMAs, with a completion rate of 77.7%. Survey completion declined over the participants' 8 weeks in the study, ranging from 99.6% in week one to 23% in week 8.

Data are considered missing completely at random (MCAR) if all data have an equal probability of missingness. Data for which the probability of missingness depends on observed values are considered missing at random (MAR). However, when the probability of missingness is based on unknown factors, data may be considered missing, not at random (MNAR). There are a variety of ways to manage missing data; for data that are MCAR, excluding subjects due to missingness is not a problem because, given the assumption that the data are missing entirely by chance, the remaining data still reflect an unbiased population sample. However, when data are MAR, listwise deletion (deleting participants missing data on any model variable)

removes individuals acknowledged not to be missing randomly and results in biased estimates (Kenward & Carpenter, 2007; Schafer, 1999; Schafer & Graham, 2002). Similarly, other strategies, such as mean imputation and last observation carried forward, require often unmet assumptions and result in distorted distributions and biased estimates (Molenberghs & Kenward, 2007; van Buuren, 2018). Multiple imputation is an alternative to these approaches, aiming to minimize estimate biases and unmet assumptions. In multiple imputation, a plausible value for each missing data point is modeled and estimated separately. This process is repeated multiple times for all missing values to create several complete imputed datasets (van Buuren, 2018). We used the mice package (v.3.16.0; van Buuren & Groothuis-Oudshoorn, 2011) to impute missing EMA values following data cleaning and prior to analysis.

We imputed 10 total imputations over 20 iterations. We imputed raw scores for most EMA variables (negative affect, ER, and urgency items; a total of 41 individual variables) using predictive mean matching. Predictive mean matching uses similar values on other observed responses in non-missing rows to compute an imputed value. Imputation models for affect and regulation items included related EMA variables (hour, study day, signal, and other urgency and negative affect items). We attempted to include relevant baseline items in the imputation models as well, but these models failed to produce complete imputation, so only EMA items were included in the model. Mood and regulation composite scales were passively imputed. To check convergence, we visually compared plots of imputed to observed variables and examined plots of imputed parameters' means and standard deviation across iterations. See sample convergence plot in Figure 1. Imputed variable distribution plots appeared similar to observed data distributions. Visual parsimony between intersequence variability and intrasequence variability suggested convergence (van Buuren & Groothuis-Oudshoorn, 2011). In addition, we calculated the potential scale reduction factor (PSRF), a value reflecting the within-chain to between-chain variability, where values below 1.2 suggest that chains have converged (Gelman et al., 2004). The mean PSRF for this imputation was 1.06.

Results

Descriptive statistics

Sample descriptives (e.g., means, SDs, correlations) for predictors and outcomes at the between and within-person level are provided in Table 2. A majority of the sample reported experiencing some childhood adversity (Figure 2), with the proportion who experienced threat (53%) lower than those who experienced deprivation (75%). Daily negative affect ($M=10$) and urgency ($M=11.28$) were low, ranging from 0 to 100. Individuals used an average of 2.6 reflexive and 3.1 engagement strategies for a mean ratio of reflexive strategies of 0.46. Deprivation and threat had a moderate, positive correlation ($r=0.62$, 95% CI[0.62,0.63]). Threat ($r's = 0.07-0.15$, $p>0.01$) and deprivation ($r's = 0.05-0.12$, $p>0.01$) shared small correlations with affect and regulation. Table 3 contains a correlation matrix of primary variables.

Emotional dysregulation

A summary of daily and global estimates can be found in Table 4.

Daily Report

Threat and cumulative adversity were associated with most measures of emotion dysregulation, providing partial support for hypothesis 1. Threat was associated with higher daily use of reflexive strategies ($RR=1.21$, 95% CI[1.08,1.35]), as well as daily NA intensity ($B=0.23$, 95% CI[0.09,0.36]), variability ($B=0.16$, 95% CI[0.07,0.25]), and reactivity ($B=0.15$, 95% CI[0.06,0.25]); threat was not associated with ratio of dysregulation. Cumulative CA had similar associations with reflexive strategies ($B=1.19$, 95% CI[1.09,1.30]), and daily NA dynamics: intensity ($B =0.15$, 95% CI[0.08,0.21]), variability ($B =0.14$, 95% CI[0.09,0.19]), and reactivity ($B =0.14$, 95% CI[0.09,0.19]), but was not related to ratio of dysregulation. Deprivation was unrelated to emotion dysregulation or affective dynamics, in contrast to Hypothesis 2.

Global report

Results of global reports of emotional dysregulation provided partial support for hypothesis 1 and hypothesis 4. Threat, deprivation, and cumulative adversity were associated with nearly all measures of emotional dysregulation. Threat's associations with global report of reflexive strategies ($B=0.19$, 95% CI[0.18,0.20]), ratio of dysregulation ($B=0.17$, 95% CI[0.16,0.18]), NA intensity ($B=0.36$, 95% CI[0.35,0.37]), variability ($B=0.13$, 95% CI[0.12,0.14]), and reactivity ($B=0.27$, 95% CI[0.26,0.28]) were generally larger than those of deprivation related to reflexive strategies ($B=0.04$, 95% CI[0.03,0.05]), ratio of dysregulation ($B=0.01$, 95% CI[0,0.02]), NA intensity ($B=0.07$, 95% CI[0.06,0.08]), variability ($B=0.04$, 95% CI[0.03,0.05]), and reactivity ($B=0.004$, 95% CI[-0.01,0.01]). Estimates for cumulative adversity were similar to those for threat for reflexive strategies ($B=0.17$, 95% CI[0.16,0.18]), ratio of dysregulation ($B=0.12$, 95% CI[0.11,0.13]), negative affect intensity ($B=0.35$, 95% CI[0.34,0.36]), variability ($B=0.10$, 95% CI[0.10,0.11]), and reactivity ($B=0.20$, 95% CI[0.19,0.21]).

Behavioral regulation

A summary of daily and global estimates can be found in Table 4.

Daily Report

Urgency was associated with both threat ($B=0.12$, 95% CI[0.03,0.21]) and cumulative adversity ($B=0.16$, 95% CI[0.09,0.23]), providing further support for hypothesis 1. In line with hypothesis 2, deprivation was not related to behavioral regulation ($B=0.06$, 95% CI[-0.03,0.14]). Compared to the other measures of adversity, threat demonstrated the largest association with regulation measures, in support of hypothesis 3. However, while threat was hypothesized to relate more strongly to urgency, threat was similarly associated with daily emotional dysregulation and urgency.

Global report

Global self-report of urgency was associated with threat ($B = 0.21$, 95% CI[0.20,0.22]) and cumulative adversity ($B = 0.28$, 95% CI[0.27,0.28]), providing further support for hypothesis 1. In contrast with hypothesis 2, deprivation was also related to urgency ($B = 0.12$, 95% CI[0.11,0.13]). Compared to the other measures of adversity, threat demonstrated the largest association with regulation measures, in support of hypothesis 3. Again, threat was similarly associated with global self-report of emotional dysregulation and urgency. Overall estimates for these associations were larger than those for daily reports, providing support for hypothesis 4.

Discussion

Given the various approaches to conceptualizing childhood adversity (CA), understanding how these approaches differentially relate to transdiagnostic measures of emotional and behavioral dysregulation is crucial. The present study sought to compare the associations of cumulative CA and emotional and behavioral dysregulation to those of CA dimensions of threat and deprivation. Hypotheses were largely supported. Results demonstrated that threat, but not deprivation, was related to most aspects of daily emotion dysregulation. Cumulative CA and threat shared similar effect sizes across daily regulation. This pattern of associations was slightly different in global self-report (GSR) measures of dysregulation. Threat, deprivation, and cumulative risk were each associated with nearly all GSR measures of emotional and behavioral dysregulation, but effect sizes were generally larger for GSR compared to daily regulation. Threat had the largest association with GSR affective intensity and reactivity, while cumulative adversity had its largest relation to GSR urgency.

Threat but not deprivation was related to daily emotional dysregulation. The original theory of threat and deprivation as dimensions of adversity posits that, compared to deprivation, exposure to threat is thought to alter fear processing, resulting in heightened attention and reactivity to emotional stimuli as well as difficulties in emotional downregulation. While the magnitudes of effects for threat are consistently larger than those for deprivation as related to psychopathology (Lee et al., 2025), the current study is among a limited subset of literature to examine deprivation and threat regulation processes in young adults and in daily life as opposed to child or adolescent samples. The results of the present study mirror similar findings in younger samples. For example, prospective research in youth has found threat but not deprivation to be associated with more emotion dysregulation or reflexive strategy use (Milojevich et al., 2019; Ning et al., 2024). In young adult samples, threat has also been related to increased affect intensity, variability, and reactivity (Grusnick et al., 2020; Myroniuk et al.,

2025). Taken together, this suggests that threat experiences may be related to more emotional variability and attempts to regulate.

In contrast, experiences of deprivation are theorized to have a more considerable impact on cognitive development, including arenas like executive functioning. Indeed, research on youth has supported this assertion (Ning et al., 2024; Schäfer et al., 2023). Challenges with executive functioning may be associated with less variability in strategy use, resulting in less predictive opportunity. Moreover, small samples of youth have found deprivation to be related to decreased emotional awareness and expression (Ortiz-Jiménez et al., 2024; Shipman et al., 2005). This blunted awareness or expression may explain the lack of daily associations found here. Alternatively, these patterns may not be as canalized as theory suggests; it could be that these patterns hold only for youth and change over time through other learning.

As expected, threat but not deprivation was related to daily urgency. To the author's knowledge, no other studies have examined daily urgency as a function of threat and deprivation or other conceptualizations of childhood adversity. Accumulating evidence with global self-reports has similarly found that behavioral dysregulation is more strongly associated with experiences of threat. For example, a meta-analysis of the association between child maltreatment and various facets of impulsivity revealed that associations for experiences of threat were more consistent than for those of deprivation for specific facets of impulsivity. It is also notable that experiences of deprivation are underexamined in comparison to experiences of threat (Liu, 2019). For example, deprivation is often limited to family level factors, while threat may also include environmental factors such as neighborhood violence.

Effect size similarities between CA and threat suggest that experiences of threat may account for a significant proportion of CA associations with emotional and behavioral dysregulation. Suppose there are indeed differential pathways for threat and deprivation in association with emotional and regulatory processes. In that case, cumulative measures of

adversity obscure these differences, or the overall effect is diluted by diverging relations. One study in a sample of youth with a high maltreatment history reported a similar pattern of findings in relation to internalizing symptoms, threat, and cumulative CA, which had similarly sized effects and were both larger than deprivation (Henry et al., 2020). That pattern is echoed in the mechanistic pathways examined here. It is important to note that the theory for the association between cumulative CA and dysregulation outcomes is less clear and leans heavily on mechanisms posited by the role of threat in development.

The three conceptualizations examined in this study were related to most global self-report measures of dysregulation. Most estimates were small to medium. Compared to deprivation, both threat and cumulative CA were more robust predictors of all global self-report measures of emotion dysregulation and affective dynamics. Estimates for threat were the largest, followed by cumulative risk, then deprivation. Threat and deprivation had their largest associations with NA intensity and reactivity, while deprivation had its strongest relation to urgency but was not related to NA reactivity. Compared to the absent association with daily ratio of reflexive strategies, threat and cumulative adversity did have small associations with global self-report. Deprivation remained unrelated to this measure. Like their daily counterparts, the minimal effects with reflexive ratio suggest that this measure may provide less insight into the effects of adversity on self-regulation.

Findings for deprivation were surprising. Deprivation was not associated with any regulation at the daily level, but it was related to nearly all measures of regulation – including urgency, via global self-report. Both significant and nonsignificant associations for deprivation and regulation were often quite close to 0 ($|b's| = 0.001-0.12$). Both here and in the broader literature, various configurations of childhood CA broadly have been associated with higher global self-report of negative affect and emotion dysregulation (Ion et al., 2023; Lambert et al., 2017; Oshri et al., 2015). However, given that deprivation estimates in global self-report models

were also small, this pattern may be a better reflection of the discrepancies between daily and global self-report. Global self-report asks respondents to think broadly about their behavior and make aggregate generalizations. Thus, biases of global recall may be reflected at this level of reporting. Global *perceptions* of behaviors rather than actual behavior captured on a daily level may significantly influence the findings for deprivation.

Overall, differences in findings for daily and global self-reports are consistent with the literature that retrospective measures of regulation are often larger than daily associations. As mentioned above, global self-report measures may capture retrospective biases, other confounds not present in daily data, or retrospective narratives about the self that are formed *after* events rather than during. Global measures also capture a larger timescale and likely include a wider variety of experiences, and experiences that are marked by more dysregulation or higher negative emotions may be more memorable (Kensinger, 2009; Koval et al., 2023; Rozin & Royzman, 2001). On the other hand, daily measures capture only a limited scope of experience and behavior and may or may not be reflective of one's general experience with regulation. It should be noted that neither daily nor global measures of regulation included assessment of context for regulation in this study. Measures that look at regulation in specific experiences, using both daily and GSR, may have more similarities.

Researchers continue to search for fitting conceptualizations of adversity. Recent research using data-driven methods suggests refined dimensions of threat and deprivation may best characterize adverse experiences for young people (Chow et al., 2024; Sheinbaum et al., 2024; Sosnowski et al., 2023). For example, one study (Chow et al., 2024) parsed threat into parental threat, victimization, traumatic events, and parental discipline, while another divided threat into betrayal and non-betrayal threat (Sosnowski et al., 2023). Notably, measures of environmental and household deprivation typically loaded onto one dimension. Thus, while

dimensions account for adversities' cooccurrence and provide theoretical direction over examinations of individual adversities, work remains to fine-tune categorization.

Despite its limitations, a cumulative approach still has considerable value. First, it can encapsulate experiences that may not fit neatly into the categories of threat or deprivation (e.g., parental substance use problems). Next, a cumulative method sidesteps measurement concerns of equivalence in capturing experiences of threat and deprivation. Finally, much of the literature on childhood adversity, and thus our understanding of adversity's impact, takes a cumulative approach. Thus, while deprivation and threat may be variably captured across studies, the accumulation of adverse experiences remains more consistent in that a higher amount is thought to have more adverse impact.

Strengths, Limitations, and Next Steps

This study has several strengths. The combined sample size and number of EMA measures provide a sizeable sample of behavior and statistical power for analyses. Broad and differentiated measures of adversity provide an opportunity to understand how specific dimensions of adverse experiences may influence regulation differently. Momentary measures of self-regulation provide a timelier reflection of how these processes play out in daily life. However, the limitations of this study must also be noted. First, diversity limitations in the sample limit its generalizability and may limit the range of adverse experiences. Individuals with marginalized sociodemographic identities (e.g., individuals with low-income backgrounds, gender and sexual minorities, racial/ethnic minorities) have disproportionately higher experiences of childhood adversity (Merrick et al., 2018). Although the sample had gender and sexual orientation diversity (8.5% nonbinary/genderqueer/gender non-conforming, 4.0% transgender male or female, 0.2% nongendered, and 47.6% LGBTQ+) and represented the racial makeup of the population from which it was drawn, the proportion of many racial and ethnic minorities was small, only 8% of parents had socioeconomic risk as measured by limited

educational attainment, and 67% of the sample attended a 4-year college at recruitment. Similarly, examining these questions in a population uniquely sampled for their experiences of adversity may provide both a broader view and more opportunities for more tailored recommendations. Retrospective reports of adversity in this study are subject to the concerns of recall bias and potential confounding of all global self-report measures. However, some evidence indicates that retrospective measures more strongly predict subjective (e.g., self-report) measures of well-being compared to prospective measures (Reuben et al., 2016). Overall, evidence suggests that retrospective reports of adversity can be measured reliably, and concerns are unlikely to wholly undermine conclusions drawn about the associations between childhood adversity and outcomes in adolescence and young adulthood (Brown et al., 2007; Hardt & Rutter, 2004; Mersky et al., 2017; Patten et al., 2014). Next, we measured behavioral and emotional regulation without emotional contextualization. While this approach seeks to minimize the degree to which participants may variably make judgments and infer cause and effect, context is a notable determinant of the type and effectiveness of regulatory strategy deployed (Aldao, 2013; Greenaway et al., 2018; Wenzel et al., 2020). It may be that adversity is associated with how individuals regulate their emotions in certain situations compared to others. Alternatively, experiences of adversity may not dictate the degree of regulation attempts made as measured in this study, but rather may be related to the effectiveness of regulation efforts. Future research should consider both the context and effectiveness of regulation to elucidate these associations.

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Tables and Figures

Figure 1

Convergence plots for imputed data for selected sample variables.

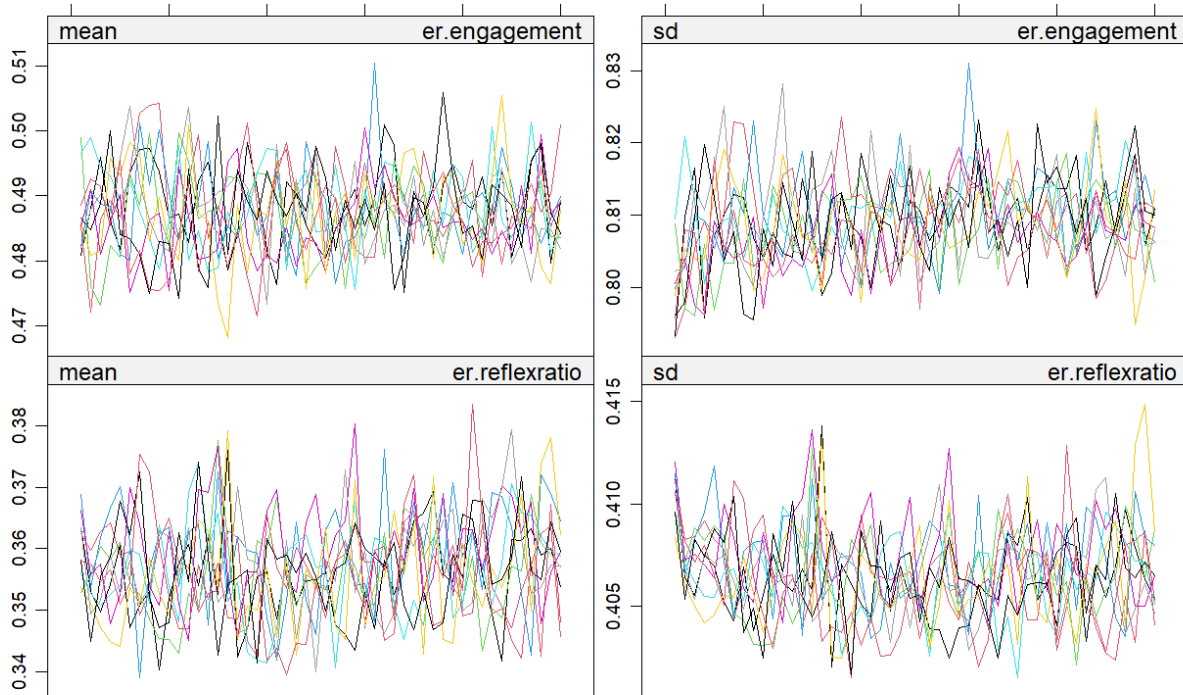


Table 1*Sample demographic information*

Variable			N = 495	Variable			N = 495
Age				Parental Education			
	Mean (SD)		20.41 (1.31)	Graduate/Professional school			205 (41%)
	Range		18, 23	BA or BS (4-year college degree)			152 (31%)
Sex				High school (HS) graduate			27 (5.5%)
Male			224 (44%)	Some graduate/professional school			27 (5.5%)
Female			271 (56%)				
Race and Ethnicity				AA degree (2-year college)			19 (3.8%)
White			265 (54%)	Some college			19 (3.8%)
Biracial or multiracial			113 (23%)	No response			14 (2.8%)
East Asian			37 (7.5%)	Some vocational/technical school			13 (2.6%)
Southeast Asian			21 (4.2%)	GED (HS equivalency diploma)			7 (1.4%)
African American			18 (3.6%)	Some HS			7 (1.4%)
Hispanic			15 (3.0%)	8th grade or less			4 (0.8%)
South Asian			11 (2.2%)	Childhood Adversity (CA)			
Middle Eastern			7 (1.4%)	<i>Threat (POMP score)</i>			
No response			3 (0.6%)		Mean (SD)		0.15 (0.16)
Pacific Islander			2 (0.4%)		Range		0,1
African			1 (0.2%)	<i>Deprivation (POMP score)</i>			
Native American			1 (0.2%)		Mean (SD)		0.19 (0.17)
Another race and/or ethnicity			1 (0.2%)		Range		0,1
College Status				<i>Cumulative CA (count)</i>			
No college			115 (23%)		Mean (SD)		5.74 (2.41)
College			376 (76%)		Range		0,11
Income							
\$0-\$500			161 (33%)				
\$501-\$1000			96 (19%)				
\$1001-\$1500			80 (16%)				
\$1501-\$2000			59 (12%)				
\$2001-\$2500			38 (8%)				
\$2501-\$3000			28 (6%)				
\$3001-\$4000			12 (2%)				
\$4001+			19 (4%)				

Note. Counts and percentages are shown for categorical variables (race, sex, college status, income, parental education). Means, standard deviations, and ranges are shown for continuous variables (age, adversity).

Table 2*Means and standard deviations for key variables*

Daily Variable			N = 83328	GSR Variable			N = 495
Affective dynamics							
<i>NA intensity</i>				<i>NA intensity</i>			
	Mean (SD)	10.54	(13.06)		Mean (SD)	0.63	(0.43)
	Range	0	,100		Range	0	,1.8
<i>NA variability</i>				<i>NA variability</i>			
	Mean (SD)	6.34	(6.73)		Mean (SD)	2.8	(1.06)
	Range	0	,70.41		Range	1	,5
<i>NA reactivity</i>				<i>NA reactivity</i>			
	Mean (SD)	6.65	(8.83)		Mean (SD)	2.52	(0.96)
	Range	0	,99.57		Range	1	,5
Emotional Dysregulation				Emotional Dysregulation			
<i>Reflexive strategies</i>				<i>Reflexive strategies</i>			
	Mean (SD)	1.	(0.60)		Mean (SD)	2.64	(0.61)
	Range	0	,5		Range	1.08	,4.42
<i>Reflexive ratio</i>				<i>Reflexive ratio</i>			
	Mean (SD)	0.35	(0.35)		Mean (SD)	.45	(0.07)
	Range	0	,1		Range	0.24	,0.69
Behavioral Dysregulation				Behavioral Dysregulation			
<i>Urgency</i>				<i>Urgency</i>			
	Mean (SD)	12.27	(17.06)		Mean (SD)	3.10	(0.55)
	Range	0	,100		Range	1.17	,4.92

Note. Means, standard deviations, and ranges are shown for continuous and count variables (affective dynamics, reflexive ratio, and behavioral dysregulation).

Figure 2

Distributions of childhood adversity characterizations.

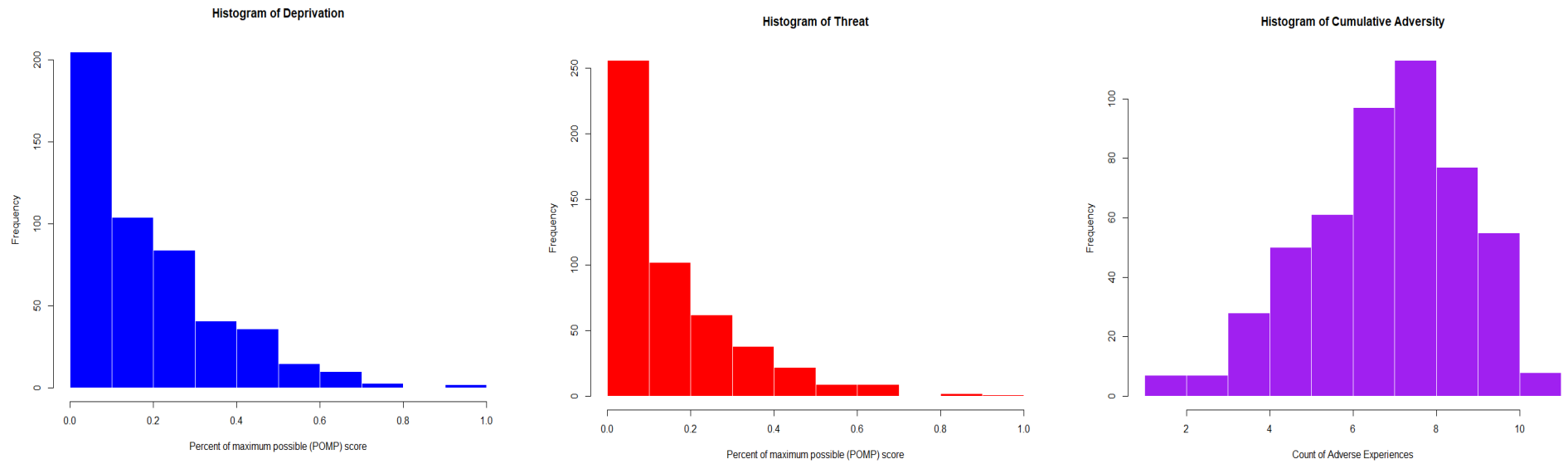


Table 3*Correlations with confidence intervals for key variables*

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Income																
2. No College	.36** [.35, .36]															
3. Male	-.02** [-.03, -.01]	-.12** [-.13, -.11]														
4. Age	.35** [.34, .36]	.46** [.45, .47]	.03** [.02, .04]													
5. Threat	.01* [.00, .01]	.20** [.19, .20]	-.14** [-.15, -.13]	-.02** [-.03, -.01]												
6. Deprivation	-.01** [-.02, -.00]	.20** [.20, .21]	-.13** [-.13, -.12]	-.01** [-.02, -.00]	.62** [.61, .62]											
7. Cumulative	-.00 [-.01, .00]	.17** [.16, .17]	-.11** [-.12, -.11]	-.06** [-.07, -.06]	.62** [.62, .62]	.68** [.67, .68]										
8. EMA Reflexive	.05** [.04, .06]	.09** [.08, .09]	-.09** [-.10, -.08]	.01** [.00, .02]	.13** [.12, .14]	.09** [.08, .09]	.11** [.10, .12]									
9. EMA Ratio	.02** [.00, .03]	.07** [.05, .08]	-.07** [-.08, -.06]	.00 [-.01, .02]	.07** [.06, .09]	.07** [.05, .08]	.08** [.06, .09]	.71** [.70, .71]								

10. NA Intensity	.09**	.12**	-.04**	.01**	.15**	.11**	.15**	.43**	.23**								
	[.09, .10]	[.11, .13]	[-.05, -.03]	[.01, .02]	[.14, .15]	[.11, .12]	[.14, .16]	[.43, .44]	[.22, .24]								
11. NA Variability	.05**	.11**	-.15**	.00	.17**	.12**	.14**	.27**	.16**	.53**							
	[.04, .06]	[.10, .11]	[-.16, -.14]	[-.00, .01]	[.16, .18]	[.12, .13]	[.13, .15]	[.26, .28]	[.14, .17]	[.53, .54]							
12. NA Reactivity	.05**	.08**	-.13**	-.01	.10**	.08**	.11**	.26**	.14**	.51**	.96**						
	[.04, .06]	[.07, .09]	[-.13, -.12]	[-.02, .00]	[.10, .11]	[.08, .09]	[.11, .12]	[.25, .27]	[.13, .16]	[.50, .51]	[.96, .96]						
13. GSR Reflexive	.04**	.15**	-.20**	.06**	.26**	.20**	.20**	.17**	.09**	.26**	.22**	.15**					
	[.03, .05]	[.15, .16]	[-.21, -.19]	[.05, .07]	[.26, .27]	[.19, .20]	[.20, .21]	[.16, .18]	[.08, .11]	[.25, .27]	[.21, .23]	[.15, .16]					
14. GSR Ratio	.01	.12**	-.18**	-.05**	.24**	.16**	.15**	.12**	.11**	.19**	.19**	.14**	.71**				
	[-.00, .01]	[.11, .12]	[-.18, -.17]	[-.05, -.04]	[.23, .24]	[.16, .17]	[.14, .15]	[.11, .13]	[.09, .12]	[.18, .20]	[.19, .20]	[.13, .14]	[.71, .72]				
15. GSR NA Intensity	-.06**	.19**	-.31**	-.01*	.46**	.37**	.39**	.17**	.14**	.19**	.26**	.17**	.56**	.53**			
	[-.07, -.05]	[.18, .20]	[-.32, -.31]	[-.02, -.00]	[.45, .46]	[.36, .38]	[.38, .39]	[.16, .18]	[.13, .15]	[.18, .20]	[.25, .27]	[.16, .18]	[.55, .56]	[.52, .53]			
16. GSR NA Variability	-.00	.15**	-.33**	.01*	.34**	.25**	.22**	.15**	.10**	.22**	.25**	.19**	.53**	.51**	.67**		
	[-.01, .00]	[.15, .16]	[-.34, -.33]	[.00, .02]	[.33, .34]	[.24, .26]	[.21, .22]	[.14, .16]	[.09, .11]	[.21, .23]	[.24, .25]	[.18, .19]	[.53, .54]	[.51, .52]	[.67, .67]		
17. GSR NA Reactivity	.00	.11**	-.26**	.03**	.18**	.16**	.16**	.14**	.14**	.16**	.18**	.13**	.47**	.47**	.53**	.62**	
	[-.01, .01]	[.10, .12]	[-.26, -.25]	[.02, .04]	[.17, .19]	[.15, .17]	[.15, .17]	[.13, .14]	[.12, .15]	[.15, .16]	[.17, .18]	[.13, .14]	[.47, .48]	[.46, .47]	[.53, .54]	[.62, .63]	

Note. Values in square brackets indicate the 95% confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014). * indicates $p < .05$. ** indicates $p < .01$.

Table 4

Summary table of standardized estimates for adversity predictors and dysregulation and affect outcomes

	Urgency	Reflexive	Ratio	NA	NA Variability	NA Reactivity
Daily report						
Threat	0.12**	0.19**	0.04	0.13**	0.11***	0.11**
Deprivation	0.05	-0.04	0.01	0.03	0.03	0.04
Cumulative Adversity	0.13***	0.17***	0.05	0.13***	0.12***	0.13***
Global Self report						
Threat	0.21***	0.19***	0.17***	0.36***	0.13***	0.27***
Deprivation	0.12***	0.04***	0.01	0.07***	0.04***	0.004
Cumulative Adversity	0.26***	0.17***	0.12***	0.32***	0.10***	0.15***

Note. * indicates $p < .05$. ** indicates $p < .01$. *** indicates $p < .001$

Study 2: Childhood adversity and dysregulated drinking: The role of regulation

Michele R. Smith

A dissertation (part 2 of 3)

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Study 2 Table of Contents

Abstract	64
Introduction	65
Childhood adversity as a risk factor	65
Adversity and alcohol use	66
Self-regulation: a potential mediator	67
Threat.	69
Deprivation.....	69
Prospective, pre-drinking self-regulation.....	70
Ecological Momentary Assessment	71
The current study	71
Hypotheses.....	72
Methods	73
Participants	73
Sample.	73
Recruitment and screening procedures.....	74
Procedure.....	74
<i>Baseline Assessment.</i>	74
<i>EMA orientation/training.</i>	75
Following orientation and baseline assessment, participants	75
Measures	76
Baseline Measures	76
EMA Measures	78
Covariates	80
Data Analyses	81
Analyses	81
Missing Data	84
Results	86
Descriptive statistics	86
Random effects	86
Adversity and drinking	86
Behavioral and Emotional Dysregulation and Dysregulated Drinking.....	87
Indirect Associations.....	87

Exploratory Analyses	87
How much more than you planned?	87
Cumulative adversity	88
Threat and Deprivation Associations with Global Self-Report	88
Discussion	89
Strengths, Limitations, and Next Steps	93
References	95
Tables and Figures	113
Table 1	113
Table 2	114
Table 3	115
Figure 1	117
Figure 2	118
Figure 3	119
Figure 4	120
Figure 5	121
Figure 6	122
Figure 7	123
Figure 8	124

Abstract

Background. Up to one-third of young adults report dysregulated drinking behavior each month, and alcohol misuse by young adults results in over 1,500 deaths per year. Thus, it is crucial to understand etiologic factors that contribute to the development of dysregulated alcohol use. Experiences of childhood adversity are widespread and may contribute to adolescent and young adult substance use disorders. However, findings in the literature are inconsistent on the association of adversity and alcohol use. Examining unique dimensions of childhood adversity (threat and deprivation) may help clarify this connection. Moreover, as both potential consequences of adversity and strong predictors of dysregulated drinking, behavioral and emotional dysregulation are potential mechanisms for exploration. **Method.** The present study used an ecological momentary assessment (EMA) design to examine how threat and deprivation contribute to daily dysregulation processes that may lead to daily dysregulated drinking (binge drinking or drinking more than planned). Regular alcohol or marijuana-using young adults, ages 18-22 (N=496, 55% female), provided baseline information on their demographics and experiences of childhood adversity and daily reports of their behavioral (negative urgency) and emotional dysregulation (affective dynamics and reflexive emotion regulation), and alcohol intentions and use. GLMMs provided confirmatory analyses to examine threat, deprivation, and behavioral and emotional dysregulation as predictors of daily dysregulated drinking. Joint significance testing was used to assess indirect pathways. Exploratory analyses tested models using cumulative adversity, global self-report of regulation and drinking, and number of drinks more than planned as an additional measure of dysregulated drinking. **Results.** Results indicated that neither threat nor deprivation was directly related to daily dysregulated drinking. Only daily emotion dysregulation (use of reflexive strategies) had small, positive associations with same-day number of drinks and binge drinking. In turn, only use of daily count reflexive emotion regulation strategies provided an indirect pathway from threat to an increased number of drinks. Exploratory analyses revealed a similar pattern for cumulative adversity and supported an additional indirect path from threat to number of drinks more than planned via negative affect reactivity. In addition, global self-report supported a direct path from threat to number of drinks, but no indirect pathways were supported. **Conclusions.** Among a sample of substance users, findings suggest that adversity, regardless of its configuration, does not directly relate to daily dysregulated drinking. Same-day emotional but not behavioral dysregulation is associated with increased drinking. However, threat may relate to daily alcohol use by way of its impact on same-day emotion dysregulation. Taken together, results provide a clear direction for emotion regulation augmentation as a potential target of intervention. Null findings suggest that alternative mechanisms for the association between adversity and later substance use disorders should be explored.

Introduction

Alcohol misuse is prevalent, damaging, and costly. An estimated 88,000 people die from alcohol-related causes yearly (National Institute of Alcohol Abuse and Alcoholism [NIAAA], 2018). Drinking may be dysregulated because of objective quantity (binge or heavy drinking) or drinking in excess of a person's pre-drinking intentions (i.e., drinking more than planned). Dysregulated drinking in early adulthood is a risk factor for future alcohol dependence (Bonomo et al., 2004). The continuum hypothesis (Enoch, 2006) proposes that drinking behaviors and impairments lie on a continuum wherein the impairments associated with dysregulated drinking (drinking more than planned or binge drinking) are qualitatively the same but may be less severe than those with alcohol dependence. This theory also posits that dysregulated drinking is undergirded by the same bottom-up/top-down regulation imbalance proposed to underlie alcohol dependence (Enoch, 2006; Lannoy et al., 2014). Thus, dysregulated drinking during young adulthood may represent an early-stage risk factor for later alcohol misuse and is an important behavior to understand.

Childhood adversity as a risk factor

The pervasive experience of childhood adversity (CA) impacts most Americans and has been consistently associated with psychopathology, including substance use disorders (Jung et al., 2020; Kessler et al., 2010; Pilowsky et al., 2009). Notably, global estimates suggest that approximately 30% of adolescent and young adult substance use disorders may be attributable to experiences of CA (Kessler et al., 2010). Exposure to CA has been suggested as a risk factor for dysregulated drinking, but prior research has significant limitations. While some research suggests there is a clear link between early adversity and dysregulated drinking (Keyes et al., 2012; Shin et al., 2009), other research suggests that the relationship is more complex or even absent (Fang & McNeil, 2017; Font & Maguire-Jack, 2016; Jung et al., 2020). Cumulative CA research has found a graded association between CAs and alcohol misuse (Anda et al., 2002;

Dube et al., 2006; Rogers et al., 2022), including binge drinking specifically (Baiden et al., 2022; Crouch et al., 2018; Fang & McNeil, 2017; Pilowsky et al., 2009). Among adolescents and young adults, the number of CAs has often been associated with an increased likelihood of alcohol use (Dube et al., 2006; Forster et al., 2019; King et al., 2017), drunkenness, alcohol problems (Gilbert et al., 2009; King et al., 2017; Shin et al., 2018), and bingeing (Allem et al., 2015; Forster et al., 2019; Grigsby et al., 2020). However, multiple studies fail to support this pattern (Dawson-Rose et al., 2020; Kameg et al., 2020; Krinner et al., 2020). One potential contributor to differences in these associations is the lack of specificity in adversity. Broadband measurement of adversity potentially obfuscates differences in risk, which could account for the inconsistent associations between CA and dysregulated drinking. Growing theory (McLaughlin et al., 2014) posits that adverse experiences can be generally categorized into *deprivation* (i.e., the absence of expected environmental inputs in social and cognitive spheres) and *threat* (i.e., actual or threatened experiences of harm to one's physical or emotional safety), and each confers risk for psychopathology through different pathways.

Adversity and alcohol use

Examinations of alcohol use suggest that threat is a notable predictor of alcohol use in young adults. A review found that CA characterized by threat (most notably physical, sexual, or emotional abuse) was associated with an increased likelihood of alcohol use and alcohol use problems in young adults. Conversely, findings for deprivation (i.e., neglect) were generally nonsignificant (Schwartz et al., 2022). Two studies have demonstrated that experiences of threat are more strongly associated with drinking specifically (Font & Maguire-Jack, 2016; Keyes et al., 2012), but there is extremely limited research examining dimensions of threat and deprivation as predictors of dysregulated alcohol use. Changes in emotion variability (Larson et al., 2002), self-regulation (Casey & Jones, 2010), and heightened problem drinking (Substance Abuse and Mental Health Services Administration (SAMHSA), 2020) make young adulthood a

key period wherein self-regulation may shape the impact of CA on dysregulated drinking behavior.

Self-regulation: a potential mediator

Behavioral and emotional dysregulation may help explain the relation between dimensions of CA and dysregulated drinking. Childhood adversity has also been associated with behavioral (e.g., urgency) and emotional dysregulation (e.g., emotional volatility and reflexive regulation strategies like rumination) (Evans & English, 2002; Lengua et al., 2007), which themselves are strong predictors of dysregulated drinking behavior. Urgency, the tendency to act impulsively in response to strong affect (Whiteside & Lynam, 2001), has been more strongly associated with psychopathology (Berg et al., 2015) compared to other facets of impulsivity. Emotion dysregulation reflects processes in which there may be aberrations in effective emotion regulation (Gross & John, 2003). Emotion dysregulation is marked by the characteristics of one's emotional experiences, such as emotions that endure longer than desired, change too quickly or slowly, are context-inappropriate, or interfere with appropriate behavior (Beauchaine & Haines, 2020; Cole et al., 2019), and by the use of emotion regulation (ER) strategies (e.g., denial or suppression) that inadvertently prolong or enhance the experience of negative emotions. Emotion dysregulation is a central feature of psychopathology (Beauchaine & Haines, 2020; Cole et al., 1994).

Individuals exposed to CA have shown elevated levels of both urgency (Oshri et al., 2018; Shin et al., 2009; Wardell et al., 2016) and emotion dysregulation (Gruhn & Compas, 2020; Lavi et al., 2019; Milojevich et al., 2019). Ostensibly maladaptive behavioral or emotional responses to situations may be environmentally adaptive for maltreated youth, and they may not learn typically adaptive responses to managing emotion. For example, suppressing or dampening emotions may be a reasonable response in the case of maltreatment when emotional displays may be met with aggression or indifference (Cole et al., 1994; Gruhn &

Compas, 2020). Broadly, youth who have experienced maltreatment have shown deficits in the identification and production of emotional expression, labeling contextual causes of emotion, and regulating their own emotions (Luke & Banerjee, 2013; Pollak et al., 2000). Yet, little research has disentangled threat and deprivation dimensions of adversity and their impact on these aspects of regulation.

Threat. Individuals who experience threat may develop attentional biases toward negative facial expressions and emotions, and increased reactivity and lack of inhibition in the context of negative affect or expression (Lambert et al., 2017; McLaughlin et al., 2014), laying the groundwork for both urgency and emotion dysregulation. Further, these threat responses are theorized to be associated with the fear learning processes. Early threat is believed to disrupt learning opportunities to distinguish between danger and safety. Individuals learn that threat is pervasive, and even when the specific threat is absent, the threat response can be reactivated through exposure to other potential threats or similar contextual cues—including heightened negative emotion (Bouton, 2002; McLaughlin et al., 2014). Emerging evidence suggests that experiences of threat may be uniquely associated with urgency and emotional dysregulation (Lambert et al., 2017; Milojevich et al., 2019), though this has yet to be substantiated in an emerging adult population.

Deprivation. Researchers hypothesize that youth who experience deprivation are unlikely to be afforded proper scaffolding and modeling for emotional development (Erickson & Egeland, 2002; Shipman et al., 2005). In turn, this may be associated with poor emotion identification and modulation later in development, which are deficits fundamental in emotion dysregulation (Beauchaine & Haines, 2020) and urgency (Atkinson et al., 2020; Emery et al., 2014). These difficulties in cognitive processing of emotion (e.g., difficulties identifying, differentiating, and regulating emotion) may result in the use of maladaptive or reflexive ER strategies in response to aversive affective arousal, e.g., suppression or denial (Emery et al., 2014; Shishido et al., 2013)

Despite decades of research on negative affect motivated drinking, the association between emotion dysregulation and dysregulated drinking is underexamined. In the small body of extant literature, researchers typically operationalize emotion dysregulation with specific reflexive strategies or a composite measure of difficulties with emotion regulation. For example,

a systematic review found only 5 (3 global retrospective reports and 2 experimental paradigms within groups of binge drinkers) studies that explored the associations between ER and binge drinking (Lannoy et al., 2021). Associations between emotion dysregulation and general drinking behavior have been variable, but evidence suggests that heightened emotion dysregulation may be associated with increased problem drinking behavior (Brown & Melas, 2024; Lannoy et al., 2021; Stellern et al., 2023). Reflexive ER strategies (e.g., denial or suppression) have been positively associated with substance problems (Aldao et al., 2010) but show mixed relations with quantity of alcohol use (Roos et al., 2020). Moreover, very few of these studies measure associations in daily life (Roos et al., 2020). Thus, the real-time association between impaired emotional regulation and dysregulated drinking is unclear. Urgency has been more consistently related to heightened risk for dysregulated alcohol use, such as binge drinking and alcohol-related problems (Adan et al., 2017; Coskunpinar et al., 2013), but researchers have noted a dearth of research examining associations between dysregulated drinking and specific facets of impulsivity in individuals' daily lives (Coskunpinar et al., 2013) and continue to call for prospective studies to corroborate the emotion-driven behavioral dysregulation pathway to dysregulated drinking (Bø et al., 2016; Lannoy et al., 2021).

Prospective, pre-drinking self-regulation

Nearly all evidence documenting the effects of adversity on regulation and alcohol use relies on people's global self-reports—that is, people reporting on their impressions of their general tendencies in responding to stress or negative emotion. These studies make the strong assumption that people's global self-reports accurately reflect typical behavior in everyday situations (e.g., that an individual's endorsement of using suppression when they experience negative emotions reflects how they behave in response to day-to-day experiences). The discussion sections of these studies also make the explicit assumption that the *between-person* associations between behavioral and emotional dysregulation and dysregulated alcohol use

mirror *within-person* associations, such that people are more likely to drink when they are also more dysregulated. However, multiple studies, including our own research, have shown that inferences from global self-reports do not reliably generalize to within-person data (Dora et al., 2022; Feil et al., 2020; Fisher et al., 2018). There is immense added value in understanding when a problematic behavior is or is not observed, which cannot be gleaned from global reports.

Ecological Momentary Assessment

Ecological momentary assessment (EMA) offers an improved way of studying risk factors for dysregulated drinking. EMA presents a way of understanding the proximal risk factors for dysregulated drinking in the natural environments in which it occurs. EMA is the use of computer-assisted technology to study phenomena of interest in people's daily lives (Ebner-Priemer & Trull, 2009). As smartphones have become widespread and easily accessible (Villanti et al., 2017), studies employing EMA have also become more prevalent as the ubiquity of personal smartphones allows this type of research to be conducted cost-effectively. One review (Stanesby et al., 2019) suggested that individual emotion was indeed related to risk for binge drinking, but only ¼ of studies used EMA, and most focused only on emotion states rather than the degree of emotional or behavioral dysregulation (Simons et al., 2010; Stanesby et al., 2019).

The current study

Although substantial prior research has tested emotion and behavior dysregulation as mediators of the impact of adversity on psychopathology, in the absence of strong causal designs (e.g., experiments or quasi-experimental designs), such data can only provide evidence in support of statistical mediation, which provides limited support for an inference of causal mediation (Nguyen et al., 2020). However, given the centrality of mediation to theories of the downstream consequences of adversity, the current study still provides a critical advance by testing the plausibility of these pathways as they unfold in daily life. This study aims to expand upon the existing literature on the downstream outcomes of CA and clarify its impact on

emotional and behavioral dysregulation and, in turn, dysregulated drinking. We examined how childhood adversity and daily emotional and behavioral dysregulation were associated with daily dysregulated alcohol use and whether emotional and behavioral dysregulation mediated those associations. Our hypotheses were as follows:

Hypotheses

H1: Threat and deprivation will be positively related to average number of drinks (baseline), daily dysregulated drinking, and number of drinks

H1a: These associations will be larger for threat

H2: Momentary behavioral dysregulation will be positively related to daily dysregulated drinking and number of drinks

H3: Momentary emotion dysregulation will be positively related to daily dysregulated drinking but not number of drinks

H4: Momentary emotional and behavioral dysregulation will mediate the associations between threat, deprivation, and daily dysregulated drinking.

H4a: Compared to momentary urgency, momentary emotion dysregulation will have a larger effect.

Methods

Participants

Participants were recruited for participation in a larger study on the development of alcohol and marijuana use problems during young adulthood.

Sample.

Participants were young adults ($n = 496$, $M_{\text{age}}(\text{SD}) = 20.4(1.3)$, range 18 – 22) who reported drinking alcohol or using marijuana regularly. Participants were recruited from King, Pierce, and Snohomish Counties in Washington State from both college (76%) and non-college (24%) sources to ensure a representative sample of young adults in Washington State. Variation in race/ethnicity and socioeconomic status (SES) was achieved by sampling from a wide variety of community locations and neighborhoods with differential aggregate SES (as indicated by the 2020 Census). Most participants had at least one parent with a college or graduate degree (72%) and a median monthly income of \$500 or less. Participants were predominantly non-Hispanic White (54%), followed by biracial/multiracial (20%), East Asian (7.5%), Hispanic (6.3%), Southeast Asian (4.2%), and African American (3.6%). Of the biracial/multiracial participants, 65.9% included White as one of their identities, 30.9% included East Asian, and 23.7% included Southeast Asian, with other endorsed identities including Middle Eastern (15.5%), African American (11.3%), Hispanic (11.3%), South Asian (8.2%), Native American (8.2%), Pacific Islander (6.2%), and African (3.1%). Full demographic information can be found in Table 1.

Participants who were between 18 and 22 at the time of screening, owned a smartphone, were fluent in English, and reported at least weekly use of alcohol or cannabis in the past three months were invited to participate. Participants who moved to the United States after age 12 were excluded to screen out participants who were not acculturated to United States norms of substance use.

Recruitment and screening procedures.

All study procedures were online. We recruited using Internet (Facebook, Instagram, Snapchat, TikTok, YouTube, Twitter, Craigslist, Reddit) and non-Internet (newspaper advertisements and flyers) sources. Potential participants were directed to a web survey where they completed basic demographic information, contact information, and information about their past month substance use. To promote honest responding, we also included items about multiple health risk behaviors (e.g., tobacco use, diet, and sleep) to screen the eligibility criteria for the present study. Surveys also included items designed to screen for invalid or careless responding (Kim et al., 2018), including the name of a fake drug to screen for over-reporting (Pape & Storvold, 2006). In addition, surveys could only be taken a single time per IP address. To assess our false positive rate, we compared responses in the baseline data to the screening survey to determine the proportion of participants who met substance use criteria in the screening survey but who denied substance use at baseline. The false positive rate was 0.004%, suggesting our screening procedures were effective. Participants who met study criteria scheduled an appointment using an online reservation system to meet with a research assistant for their baseline visit.

Procedure***Baseline Assessment.***

Baseline assessments took place virtually via Zoom. Assessments were initially virtual in accordance with the COVID-19 guidelines and were continued for the duration of the study for consistency. Participants verified their identities using a photo ID before completing consent. Participants completed the baseline assessment online and were paid \$50.

EMA orientation/training.

EMA procedures were modeled after successful implementation in prior studies (Feil et al., 2020; Halvorson et al., 2021). Research staff were trained to answer questions, build rapport, and motivate participants to complete the EMA surveys. As part of the consent process, research staff described the study, emphasizing the intensive nature of the sampling procedures, the importance of high compliance (and bonuses for compliance), and the scientific significance of the data collected. The goals of these procedures were to ensure that participants understood the rigor of the study before agreeing to participate, to build rapport between the participant and study staff, and to highlight the importance of the EMA survey data. Staff presented participants with a calendar of the dates for which they would be receiving EMAs (i.e., Thursday – Sunday for the next 8 weeks, between 9 am and 11 pm) and asked participants to identify times or days they may not be able to complete EMAs (e.g., long work shifts or trips out of the country). If participants indicated that they anticipated being unable to respond to 50% or more of the prompts, their participation in the study was discontinued. Staff identified themselves as the point of contact for the extent of the EMA period and reminded participants that staff would check in via phone and troubleshoot any issues to support study completion if participants missed more than 1 day of data collection. Research staff then guided participants through a sample survey sent to their smartphones. Research staff defined key measures and provided examples as needed.

Following orientation and baseline assessment, participants received texts with a link to a brief EMA survey for the next 8 weekends (Thursday to Sunday), 5 times per day. On Monday mornings, participants received an additional EMA to capture behavior from Sunday nights. EMAs were sent within five three-hour blocks between 9 am and 11 pm, with at least 1 hour between surveys. Participants were initially sent one reminder at 30 minutes if they had not

completed their survey. After the first two months of data collection, we changed the schedule to 20-, 40-, and 55-minute reminders to improve compliance.

We used several methods to improve participant compliance with assessments (Shiffman et al., 2008). We had phone check-ins after the first day of data collection to troubleshoot and as needed to boost compliance. We sent e-mail and text reminders the day before each weekend of data collection. Survey links were active for an hour after the initial text was received to allow some flexibility in survey completion, with a reminder text sent to participants who had not completed the survey within the first 30 minutes. Prior research has suggested that participants can exhibit high compliance with daily data collection when electronic reminders are used (Hufford & Shiffman, 2002; Shiffman et al., 2008). We also increased compliance by offering “bonuses”: Participants were paid \$1 per EMA, with a \$5 bonus for completing 80% (i.e., 17/21) of EMAs for a given weekend (\$208 total possible).

Measures

These measures came from a more extensive assessment battery. Below we report the measures relevant to the current study.

Baseline Measures

Adversity.

Deprivation. We measured deprivation as a composite of items measuring experiences of neglect in childhood. The Multidimensional Neglectful Behavior Scale (MNBS) (Strauss et al., 1995) is a 25-item self-report scale that measures adolescent and adult recall of neglect across developmental needs, including physical, emotional, and cognitive ($\alpha = 0.80-0.89$) domains. The Childhood Experience of Care and Abuse Questionnaire (CECA.Q) (N. Smith et al., 2002) is a 40-item self-report measure assessing experiences of abuse and neglect; we used eight items tapping emotional neglect ($\alpha = 0.87-0.92$). We used percent of maximum possible scoring (POMP) to

combine scores across subscales to form a composite of deprivation. Scores were standardized for comparison with threat.

Threat. Threat was a composite of various items. The Childhood Trauma Questionnaire (CTQ) (Bernstein et al., 2003) is a self-report measure assessing recall of childhood trauma history, including three subscales measuring abuse with 15 total items covering emotional, physical, and sexual abuse ($\alpha = 0.66-0.92$). We adapted 16 items from the Violence Exposure Scale-Revised (VEX-R) (Fox & Leavitt, n.d., 1995) as a self-report measure of exposure to violence ($\alpha = 0.72-0.86$). We used percent of maximum possible scoring (POMP) to score across subscales to form a composite of threat. Scores were standardized scores for comparison with deprivation.

Cumulative Adversity. Cumulative adversity included a combination of threat and deprivation items, as well as other experiences that do not fit neatly in either dimension. The first set of additional items reflected childhood socioeconomic status. Two items were selected from the 6-item short form (Blumberg et al., 1999) U.S. Department of Agriculture's 18-item Food Security Scale (Carlson et al., 1999; Price et al., 1997), assessing access to "nutritionally adequate and safe foods" and the financial ability to secure these foods in U.S. households. Participants respond "yes" or "no" to items assessing access to food. Parent education level was also included to reflect socioeconomic risk (1-below HS diploma; 0-HS diploma and above). To form the cumulative adversity score, we used the traditional sum of binary scored present or absent experiences. Mean scores on the MNBS subscales (physical, emotional, and cognitive neglect), CTQ subscales (sexual, physical, and emotional abuse), and VEX-R total scores above 1 were counted as present (1) and scores 1 or below were counted as absent (0). Adverse experiences were then summed up to form a cumulative adversity score. Although participants reported on parental substance use, a common

factor included in cumulative adversity scores, this was excluded due to its demonstrated outsized impact on the development of substance use (Haardörfer et al., 2021; Pedersen & von Soest, 2013; Rossow et al., 2016).

EMA Measures

Behavioral dysregulation.

Daily Urgency. Urgency items from the UPPS-P (Lynam et al., 2006), a broadband measure of impulsivity, assessed momentary impulsivity in the daily EMA surveys. Six items from the urgency subscale were adapted by changing the language from general trait descriptors to past-tense statements that participants rated based on their experience since the last assessment. Affect content was also removed from urgency items when appropriate to make the items affect-independent. For example, the urgency item “when I am upset, I often act without thinking” became “I acted without thinking.” Participants were prompted to rate how strongly they agreed with the impulsivity-related statements on a slider bar that ranged from “Strongly Disagree” to “Strongly Agree,” and slider bars were scored continuously from 0 to 100 based on the slider position. In each EMA survey, 8 of the total 12 impulsivity items were presented at random to reduce participant burden. To reduce participant burden, we presented participants with a randomly selected subset of three urgency items at each assessment. EMA urgency item averages were created for each assessment within a given day (prior to drinking onset) and then were averaged to create a day-level urgency score. Other EMA measures were presented in full at each assessment.

Emotional dysregulation.

Affective dynamics. We measured affect using items taken from the Positive and Negative Affect Scale (PANAS; Watson et al., 1988). Two words from seven sets of items reflecting four negative (anger, sadness, anxiety, and general distress) and three positive (joviality, attentiveness, serenity) affect dimensions were randomly presented at each EMA.

Participants rate the extent to which they experience each emotion using a sliding scale from zero to 100. Using these scales, we computed several measures of emotion dysregulation, including within-day intensity, variability, and reactivity of negative emotions (Jahng et al., 2008; Koval et al., 2013; Kuppens et al., 2010). *Intensity* was computed as the daily mean negative affect (NA). *Variability* was computed as the within-day standard deviation of NA. We computed *reactivity* as the root mean squared successive difference (RMSSD), reflecting both variability and temporal dependency over time (Jahng et al., 2008).

Reflexive Emotion Regulation. We measured ER strategies since the last assessment using a checklist of 8 items adapted from the Cognitive Emotion Regulation Questionnaire (CERQ) (Jermann et al., 2006) which measures the use of specific strategies (acceptance, problem-solving, rumination, reframing, distraction, avoidance, emotion suppression, thought suppression) to regulate affect, as well as four items adapted from the Brief-COPE (Carver, 1997), an inventory of different coping skills (emotional support, emotional expression/venting, mindfulness/spirituality, self-criticism). At each EMA, participants endorsed which items they used since the prior assessment using a “check all that apply” style of question, selecting “none of the above” if participants did not use any of the strategies in the specified period. We formed a composite measure reflecting the count of reflexive regulatory strategies by summing endorsement of the following strategies at each EMA: avoidance, criticism, rumination, suppression, and distraction. Because research suggests that individuals exposed to higher negative affect report higher levels of all ER strategies (Compas et al., 2017; M. R. Smith et al., 2023), we also examined the relative use of reflexive strategies. We computed the ratio of daily mean reflexive strategies to engagement strategies (acceptance, problem-solving, reappraisal, support seeking, emotional expression, and using mindfulness or medication to improve mood) to reflect a degree of daily emotion dysregulation.

Daily Dysregulated drinking

At each morning assessment, participants reported on alcohol use they consumed the day prior through a numeric response to the following question: “How many alcoholic drinks did you have yesterday? Please remember that a drink refers to a “standard” drink size: 12 oz. beer, 8-9 oz. malt liquor, 5 oz. wine, 1.5 oz. hard liquor. Select 0 if you didn't drink yesterday.” In the second assessment of each day, participants’ intentions to drink were assessed with the item “How many drinks do you intend to have later today? (If more than 15, select 15).” We predicted multiple measures of drinking to capture various forms of dysregulated drinking behavior. *Number of drinks* was measured using the reported count of drinks. *Binge Drinking* was measured as present or absent (1 or 0). Using sex assigned at birth, binge drinking was coded for females who reported drinking 4 or more drinks and males who reported 5 or more drinks. Similarly, *High Intensity Drinking* was measured as present or absent (1 or 0). Using sex assigned at birth, binge drinking was coded for females who reported drinking 8 or more drinks and males who reported drinking 10 or more drinks. Participants also received a daily prompt only in the second EMA survey of the day assessing intentions to drink alcohol (Lewis et al., 2020). Participants were asked to select a number 0-15 in response to the prompt, “How many drinks do you intend to have later today? (If more than 15, select 15).” *Drinking more than planned* was then operationalized as present or absent (1 or 0) for participants whose reported number of drinks exceeded the intended number of drinks reported earlier the same day.

Covariates

We included key covariates at both the person and observation levels in all models. We included week in the study and month to control for reactivity and temporal effects. Weekend day was also included to account for differences in drinking during the week. Based on existing evidence of sex and age differences in emotion and behavioral regulation (Weafer & de Wit, 2014; Zimmermann & Iwanski, 2014), we controlled for gender (0 = male, 1 = female) and age

in all models. Given differences in heavy drinking among young adults in college (Benz et al., 2017; Carter et al., 2015; Linden-Carmichael & Lanza, 2018), college status (0 = non-college student, 1 = college student) was included as a covariate.

Data Analyses

Analyses

We conducted all analyses in R (v.4.3.1; Posit team, 2023). As the data produced by EMA are nested at multiple levels (EMAs within days within individuals), a multilevel modeling approach was required. This was achieved using General Linear Mixed Models (GLMMs), which can account for nesting within data and are sufficiently flexible to cope with count variables with positive skew, such as alcohol use. GLMM also models heterogeneity across participants using random intercepts and/or slopes. GLMM analyses were conducted using well-vetted packages in R, including glmmTMB (M. Brooks et al., 2015/2023; M. E. Brooks et al., 2017) and lme4 (Bates et al., 2015). We calculated descriptive statistics and correlations for all variables used in analyses.

Following imputation, we examined our hypotheses using GLMM to examine the effects of adversity and emotional and behavioral dysregulation predicting same-day dysregulated drinking. Sex, age, income, college/non-college status, and weekend days were also included as covariates for all models. Age was grand mean centered. Binary covariates (sex, college/non-college, weekend day) were dummy coded (0/1) with female, non-college, and weekday as the reference groups, respectively. In addition, to correctly reflect the EMA nature of the data, all models also included study week and month to control for reactivity over the study. Level 1 (i.e., EMA-level, within-person) predictors were centered within-person (CWP) to separate within-person from between-person variance (Enders & Tofighi, 2007), allowing us to more accurately infer how fluctuations in regulation influence drinking behavior, above and

beyond individual differences in a person's average level of regulation. All continuous level 2 (i.e., non-EMA-level, between person) predictors were grand-mean centered (GMC).

Below are the general equations for the count model (1) and the logistic models (2):

$$(1) \log(\lambda[\text{DrinkCount}_{ij}]) = \beta_0 + \beta_1 \text{Threat}_j + \beta_2 \text{Deprivation}_j + \beta_3 \text{EmotionDysregulation}_{ij} + \beta_4 \text{Male}_j + \beta_5 \text{age}_j + \beta_6 \text{income}_j + \beta_7 \text{college}_j + \beta_8 \text{weekend}_j + \beta_9 \text{studyweek}_j + \beta_{10} \text{studymonth}_j$$

$$(2) \text{logit}(\text{PR}[\text{BinaryDysregulatedDrinking}_{ij} = 1]) = \beta_0 + \beta_1 \text{Threat}_j + \beta_2 \text{Deprivation}_j + \beta_3 \text{EmotionDysregulation}_{ij} + \beta_4 \text{Male}_j + \beta_5 \text{age}_j + \beta_6 \text{income}_j + \beta_7 \text{college}_j + \beta_8 \text{weekend}_j + \beta_9 \text{studyweek}_j + \beta_{10} \text{studymonth}_j$$

Nested models were compared using relative fit indices (AIC, BIC, -2 log-likelihood) to determine appropriate distributions and whether including key covariates and random effects improved model fit. We used a GLMM with a random intercept because our unit of analysis was at the day level, with observations nested within person. We tested random slope models to account for the shared variance between observations within person. However, given the repeated lack of convergence for several models, we proceeded with random intercept-only models.

For drink count, we tested several distributions to assess the most appropriate reflection of our data. We hypothesized that a zero-inflated negative binomial (ZINB) model would be the most appropriate fit for the data to account for the excess zeroes (days when participants did not drink for whatever reason) and overdispersion (high variability in drinking behavior around the mean). We also tested a multilevel negative binomial (which accounts for overdispersion, but not excess zeros) and a multilevel zero-inflated Poisson (ZIP) model (which accounts for excess zeros, but not overdispersion) in order to evaluate which of these models fit the data better. We then compared the ZINB and negative binomial hurdle (NBH) models in order to account for excess zeros in our alcohol data and overdispersion (Figure 1). Zero-inflated and hurdle models are models used to account for excess zeros. However, zero-inflated models posit that separate processes produce count values and excess zeros and allow the count

distribution to range from 0 to infinity. Hurdle models, on the other hand, theorize that there is a “hurdle” or threshold that separates zeros from counts; thus, the hurdle approach includes two models: a binary model and a count model truncated at zero (Atkins et al., 2013; Feng, 2021; Hu et al., 2011). NBH models consistently had lower AIC compared to ZINB models ($M_{\Delta AIC} > 10$), so we proceeded with NBH for count data. Because dysregulated drinking was measured as a binary (0 or 1) variable, we used generalized linear mixed models following a Bernoulli distribution.

Within our models, emotional and behavioral dysregulation and negative mood were person-mean centered to identify how a person’s daily level of dysregulation and negative mood prior to drinking compared to their average levels across the duration of the study. As continuous variables, behavioral regulation ratio of reflexive regulation, and affective dynamics variables were also standardized; the count of reflexive ER strategies was not standardized in order to maintain interpretability.

Mediation was assessed using the joint significance test. This approach assesses mediation by testing, in separate regression analyses, whether independent variable X is predictive of mediator M, and whether mediator M is predictive of outcome Y (Fritz & MacKinnon, 2007; MacKinnon et al., 2004). Mediation is said to be present if the two paths are “jointly significant.” Compared to other mediational approaches, the joint significance test has proven to be among the most appropriate, known to control type 1 error rates, and be among the most computationally facile and versatile (MacKinnon et al., 2002).

Hypothesis testing. Hypotheses were tested using GLMM, as described above. In short, we completed 43 confirmatory hypothesis tests (4 main effects of adversity, 20 tests of affective dynamics, 4 tests of behavioral regulation, and 15 tests of ER). We used the Benjamini-Hochberg procedure to account for false discoveries (Benjamini & Hochberg, 1995), given multiple tests; corrections were made within families of tests, including behavioral regulation, reactive ER, ratio of reflexive ER, and affective dynamics.

Exploratory models. We tested three additional exploratory approaches to probe our inquiries further. The number of drinks more than planned was examined as an additional measure of dysregulated drinking to assess the combination of quantity and drinking more than intended. Given the literature debating the most appropriate approach to CA, we also ran analyses for drinking using traditional cumulative CA in place of threat and deprivation to examine if examining the collective adverse experiences had stronger predictive power. Finally, to understand how temporally specific these associations may be, we examined associations between threat, deprivation, and global self-report of regulation and drinking behavior.

Missing Data

Given the planned missingness of urgency items and intensive sampling method, the data are prone to some degree of missingness. Because planned missing data are missing completely at random (MCAR) by definition, we could impute them and estimate composite scores without bias (Graham, 2009; Graham et al., 2006; Schafer & Graham, 2002), which we have done in our pilot studies (Feil et al., 2020; Halvorson et al., 2021). The percentage of missing values across variables varied between 0 and 34%. Participants completed a total of 51,471 EMAs, with a completion rate of 77.7%. Survey completion declined over participants' 8 weeks in the study, ranging from 99.6% in week one to 23% in week 8. We elected to handle missing data with multiple imputation. Compared to standard methods (e.g., listwise deletion, mean imputation) known to result in distorted distributions and biased estimates

(Kenward & Carpenter, 2007; Schafer, 1999; Schafer & Graham, 2002), multiple imputation is an alternative to these approaches aiming to minimize estimate biases and unmet assumptions. In multiple imputation, a plausible value for each missing data point is modeled and estimated separately. This process is repeated multiple times for all missing values to create several complete imputed datasets (van Buuren, 2018). Following data cleaning and prior to analyses, we used the mice package (v.3.16.0; van Buuren & Groothuis-Oudshoorn, 2011) to impute missing data in the dataset.

We imputed 10 total imputations over 20 iterations. Specifically, we imputed the raw scores for most EMA variables (negative affect, ER, and urgency items; a total of 41 individual variables) using predictive mean matching (pmm; Little, 1988; Rubin, 1986), an imputation strategy that uses similar values on other observed responses in non-missing rows to compute an imputed value. The imputation model for the affect and regulation items included related EMA variables (hour, study day, signal, and other urgency and negative affect items). Relevant baseline items were attempted but failed to produce complete imputation; thus, only EMA items were included in the model. Affect and regulation composite scales were passively imputed. For alcohol use, we imputed the raw scores for drink count using a 2-level bootstrapped zero-inflated hurdle negative binomial distribution. The potential scale reduction factor (PSRF), for which values below 1.2 suggest comparable within-chain and between-chain variability, was acceptable at 1.10 (van Buuren & Groothuis-Oudshoorn, 2011). Visual convergence checks indicate acceptable imputation of missing data. See Figure 2.

Results

Descriptive statistics

Descriptive information (i.e., means, SDs, correlation matrix) for predictors and outcomes at the between and within-person level is provided in Table 2. Most of the sample experienced some childhood adversity, with the proportion experiencing threat (53%) slightly lower than those experiencing deprivation (75%). On average, individuals consumed 3.8 drinks on drinking days. Binge drinking occurred on roughly one-third (34.4%) of drinking days, while drinking more than planned happened even more often, on 43% of drinking days. Daily negative affect ($M=10$) and urgency ($M=11.28$) were low, ranging from 0 to 100. Individuals used an average of 2.6 reflexive and 3.1 engagement strategies for a mean ratio of reflexive strategies of 0.46, and estimates were similar on drinking days and nondrinking days. Threat (r 's = 0.07-0.15, $p>0.01$), deprivation (r 's = 0.05-0.12, $p>0.01$), and count of drinks (r 's = 0.04-0.16, $p>0.01$) shared small correlations with affect and regulation.

Random effects

Random effects represent the amount of variability each person has around the overall average drinking behavior. Intercept random effects estimates ranged for each drinking outcome, including the number of drinks (0.58-0.67), binge drinking (1.26-1.62), high-intensity drinking (0.004-0.67), and drinking more than planned (0.72-0.92).

Adversity and drinking

We first examined deprivation and threat as predictors of drink count and dysregulated drinking and found that hypothesis 1 was unsupported. Neither deprivation nor threat were directly associated with number of drinks, binge drinking, high-intensity drinking, or drinking more than planned without including measures of self-regulation in the models. See Figures 3 and 4.

Behavioral and Emotional Dysregulation and Dysregulated Drinking

Hypothesis 2 was unsupported as behavioral regulation was not related to drink count or dysregulated drinking. Only reflexive ER strategy was associated with drinking, providing partial support for hypothesis 3. Specifically, reflexive ER was related to number of drinks (0.10, 95%CI[0.02,0.19]) and binge drinking (0.20, 95%CI[0.03,0.38]) but not other measures of dysregulated drinking. That is, on drinking days, for every additional reflexive ER skill used, individual drink count was expected to increase by 11%, and the odds of binge drinking were expected to increase by 22%, holding all covariates constant. This association withstood the BH correction. Affective dynamics and dysregulation ratio were not associated with any drinking behavior, resulting in only partial support of hypothesis 3. See Figures 5 and 6.

Indirect Associations

There was limited support for hypothesis 4. Neither behavioral dysregulation, affective dynamics, nor reflexive ratio were related to drinking measures, indicating that they do not reflect the indirect associations between adversity and dysregulated drinking. Reflexive ER strategies were the only measures of dysregulation associated with drinking behavior.

In the full model (Figures 7 and 8), including both measures of adversity as additional predictors, reflexive ER maintained its positive association with number of drinks (0.10, 95%CI[0.02,0.19]). Based on joint significance testing, as threat was significantly associated with reflexive ER as well, results indicate that use of reflexive ER strategies mediates the associations between threat and number of drinks.

Exploratory Analyses

How much more than you planned?

We examined the number of drinks more than planned as an outcome measure. No measures of adversity were directly associated with this outcome. However, in the full model

with threat and deprivation, NA reactivity had a small, negative relation to the number of drinks more than planned ($RR = 0.92$, 95% CI[0.86, 0.99]), providing an indirect pathway for threat.

Cumulative adversity

As with other measures of deprivation, cumulative CA was not associated with any measures of dysregulated drinking. Cumulative CA was related to most measures of emotional and behavioral regulation (except ratio of reflexive strategies). As with threat, only reflexive strategies mediated the association between cumulative CA and number of drinks ($RR = 1.04$, 95% CI[1.01, 1.07]).

Threat and Deprivation Associations with Global Self-Report

Similar to daily associations, adversity was largely unrelated to global self-report of drinking. Unlike daily associations, threat had a marginal but significant positive relation to global self-report of average number of drinks ($b=0.08$, 95%CI[0.0001,0.16]) on drinking days in the past 30 days. No regulation strategies mediated this association. Threat was not associated with endorsement of binge drinking in the past 30 days. Deprivation was not related to number of drinks or binge drinking.

Discussion

The goal of the current study was to examine the associations between different facets of childhood adversity (CA) and dysregulated alcohol use. Specifically, we were interested in the role of behavioral and emotional dysregulation as mediators of these associations. Overall, CA was not directly associated with daily dysregulated drinking behavior. Threat emerged as a consistent predictor of momentary emotional dysregulation. Only in the case of reflexive strategies did emotion dysregulation serve as a mediator of the relation between threat and number of drinks. Exploratory analyses revealed that cumulative CA mirrored the mediation findings between threat and number of drinks via reflexive strategies, threat was related to global self-report of alcohol quantity, and NA reactivity may also mediate the relation between threat and dysregulated drinking.

Childhood experiences of threat or deprivation were not directly related to daily drinking behaviors, though exploratory findings suggest a marginal, positive association between threat and global self-report of alcohol quantity. These findings sit amongst a body of mixed evidence largely based on global self-report (Anda et al., 2002; Baiden et al., 2022; Crouch et al., 2018; Dawson-Rose et al., 2020; Dube et al., 2006; Fang & McNeil, 2017; Kameg et al., 2020; Pilowsky et al., 2009; Rogers et al., 2022). Studies utilizing the dimensional conceptualizations of adversity and associations with dysregulated drinking are nearly absent. One study loosely falling along the dimensions of threat and deprivation found that childhood experiences of abuse, but not neighborhood deprivation, were associated with binge drinking among adults (Keyes et al., 2012). One review found that while there seemed to be differences between threat and deprivation in the *likelihood* to drink, findings for binge drinking were less consistent. The present study fills a void in the literature as virtually no previous studies have jointly examined threat and deprivation (a conservative test) as predictors of young adult daily dysregulated drinking.

Although there is mixed evidence relating adversity to alcohol consumption, a more consistent finding is that CA, particularly experiences characterized by threat, have been consistently associated with alcohol motives (Goldstein et al., 2010). Though not examined here, it may be reasonable to expect that CA has a closer relationship with reasons for use rather than quantity used. The self-medication hypothesis posits that individuals with trauma histories are more *susceptible* to problematic drinking due to using drinking to cope with negative internal experiences (Bolton et al., 2009; Khantzian, 1997). Although the current study does not support the engagement in problematic drinking, it remains possible that individuals with adverse childhood experiences have higher *coping motives* for drinking. Coping motives are a consistent predictor of drinking problems (Bresin & Mekawi, 2021). In addition to increased coping motives, individuals who have experienced CA may have heightened emotional dysregulation or engage in less helpful strategies to manage stressors (Smith et al., *in prep*), resulting in increased problems. What's more, a meta-analysis revealed an indirect pathway from coping motives to use via problems (Bresin & Mekawi, 2021). Thus, the current study may have excluded key intermediary factors in processes connecting adversity to alcohol use.

Characterization of adversity may further complicate this picture. A recent exploratory factor analysis (Sosnowski et al., 2023) in a large sample of young adults suggested a four-dimension approach to adversity: Non-betrayal threat (witnessing violence, death, or experiencing violence outside of the home), betrayal threat (experiencing interpersonal or physical aggression from caregivers), emotional deprivation, and sexual assault. In addition, both types of threat (OR 1.38-1.52) were associated with greater odds for a substance use diagnosis as compared to emotional deprivation (OR 1.07), while sexual assault was not significant when controlling for other types of adversity. These findings suggest that the relation between CA and substance use may require more nuanced dimensions.

When accounting for between-person differences, we failed to support an association between daily regulation and daily dysregulated drinking or drink count in most cases. Many motivational models of alcohol use suggest that alcohol use may be motivated by a desire to cope with negative affect (Cooper et al., 1995; Cox & Klinger, 1988) as a function of reinforcement learning of alcohol use relating to decreased negative emotion (Skinner, 1969). However, other works find little evidence for the affect regulation theory on the momentary level. A large meta-analysis of drinking behavior in more than 12,000 young adults found that negative affect was not associated with drinking behavior. In fact, days with higher negative affect were related to a *lower* likelihood to drink (Dora et al., 2023). Our exploratory finding of a negative association between NA reactivity and number of drinks more than planned echoes this finding. Similarly, trait urgency has demonstrated a consistent but small effect as a predictor of drink quantity and binge drinking (Coskunpinar et al., 2013), but there is mounting evidence that fails to support relations between daily urgency and alcohol use (Dora et al., 2023; Griffin et al., 2021; McGowan et al., 2022).

One possibility is that inverse associations may have produced our null findings. That is, it may be the case that for some subsets of people, there is a positive association, and for another subset, the association is negative, but taken together, the effect is null. Moderation may be further obscuring associations. Sex has been found to moderate the association between distress tolerance (a theorized precursor for emotion dysregulation) and dysregulated drinking, such that higher levels of distress tolerance were related to higher levels of dysregulated drinking only among women (Pedrelli et al., 2018). Thus, affective dynamics and emotional and behavioral regulation may differentially impact drinking habits depending on individual characteristics.

In line with previous research, we found that reflexive strategies were related to number of drinks. Moreover, we found that emotion dysregulation in the form of reflexive strategy use

was the only supported hypothesized pathway for threat to drinking. Small-to-medium effect size associations between reflexive strategies and alcohol use have been found in the literature (Weiss et al., 2022). Null findings for the ratio of reflexive-to-engagement strategies may reflect the tendency of individuals to engage in a variety of strategies. A review of ER and substance use found that both adaptive and maladaptive strategies had similar and inverse associations with alcohol use (Weiss et al., 2022).

Reflecting on the ER process may further illuminate our findings. The process model of ER posits that the regulatory process includes five parts: situation selection, situation modification, attentional deployment, cognitive change, and response modulation. The final part of this process, response modulation, occurs after the emotion has been fully experienced and involves directly influencing some component of the emotional response (Gross, 2015b). Importantly, Gross (2015) outlines that ER is not only an alteration of emotional intensity but may also be an intent to alter duration and/or quality. Given that a central aim of ER is the “activation of a goal to influence the emotion trajectory over time” (Gross, 2015a, p. 5), drinking may serve as a behavioral extension of this aim. Indeed, drinking may be better characterized as an extension of a pattern of disengagement from emotion management. Increased drinking following a day with a high number of reflexive strategies may expose a pattern of disengagement in an effort to regulate. Some research has found that the association between ER difficulties and drinking is mediated by motives (Aurora & Klanecky, 2016), primarily those that seek to disengage from problems and emotions.

Finally, it is worth considering the role dysregulated drinking may play in emotional and behavioral regulation. A recent biological framework suggested that heavy drinking may lead to a cascade of inflammation and fronto-limbic circuitry alterations that lead to increased emotional dysregulation (Carbia et al., 2021). Like the allostatic load theory which suggests chronic exposure to stress or adversity results in the dysregulation of stress response systems and, in

turn, processes involved in self-regulation (Juster et al., 2010), the cycle of dysregulated drinking, withdrawal, and anticipation are thought to lead to disruptions in the neurological processes that underlie affective control and regulation (Carbia et al., 2021). The limited research on binge drinking and emotional processes has indeed identified binge drinking as a predictor of lower mood, emotion dysregulation, and increased impulsivity (Harris et al., 2017; Krieger et al., 2018; Stephens & Duka, 2008). Though the time scale for these associations remains unclear, the relationship between regulation and drinking may not be unidirectional. In our sample of regular drinkers, 63% report binge drinking in the past month. In sum, drinking behavior in the present sample may have short- or long-term consequences on individual behavioral and emotional regulation.

AUD prevention efforts in adolescence and young adulthood have begun to demonstrate some effectiveness (Foxcroft & Tsertsvadze, 2012; Smit et al., 2008), yet resources for such programs are limited, and gaps exist in our ability to identify those who might be most at-risk for AUDs and alcohol-related problems. Understanding specific precursors to AUDs and how they develop can help hone interventions and treatments to target the psychological factors most likely to reduce risk. Research like the present study that models the developmental pathways by which CA may relate to dysregulated alcohol use can inform more effective and targeted interventions. Based on current findings here, it may be particularly important for survivors of adversity characterized by threat to receive ER skills that contextualize reflexive strategies. For instance, a clinician suggesting distraction may want to provide both alternatives and suggestions for mindful engagement or limited reliance on reflexive strategies.

Strengths, Limitations, and Next Steps

This study has a number of strengths, including the large sample size, inclusion of EMA data, diverse measures of emotional regulation, and dysregulated drinking. Its limitations should be noted as well. First of all, while the sample was large and representative of the area from

which it was drawn in the Pacific Northwest of the United States, its racial and ethnic diversity are relatively restricted compared to the broader population. Next, while measures of adversity carefully considered broad components of deprivation and threat, additional considerations of timing and severity may be important. One study found that only early (compared to later) life (infancy/toddlerhood) neglect was associated with an increased risk for adolescent alcohol use (Yoon et al., 2020). Looking specifically at binge drinking, another study found that threat (abuse) and deprivation (neglect) were independently and jointly associated with increases in binge drinking over time and that greater severity (frequency) of CA was associated with steeper increases and more consistent binge drinking across adolescence and young adulthood (Shin et al., 2013). These findings highlight that examining this relation with more temporal variety is critical. Furthermore, though we included varied measures of affective dynamics and behavioral and emotional regulation, measures were exclusively self-reported. Future studies may additionally benefit from examining not just the presence or absence of strategy use but also strategy skill and effectiveness; moreover, physiological measures of regulation, such as heart rate variability and skin conductance, could provide methodological diversification and offer an alternative characterization of emotional regulation. Reports of drinking were gathered the morning after the evening drinking was reported to occur. Gathering next-day reports may have led to less reliable reports or systematic patterns of missingness undetected by analyses in the present study. Future research should seek to gather more temporally proximal measures of drinking behavior.

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Tables and Figures

Table 1*Sample demographic information*

Variable			N = 495	Variable			N = 495
Age				Parental Education			
	Mean (SD)		20.41 (1.31)	Graduate/Professional school			205 (41%)
	Range		18, 23	BA or BS (4-year college degree)			152 (31%)
Sex				High school (HS) graduate			27 (5.5%)
Male			224 (44%)	Some graduate/professional school			27 (5.5%)
Race and Ethnicity				AA degree (2-year college)			19 (3.8%)
White			265 (54%)	Some college			19 (3.8%)
Biracial or multiracial			113 (23%)	No response			14 (2.8%)
East Asian			37 (7.5%)	Some vocational/technical school			13 (2.6%)
Southeast Asian			21 (4.2%)	GED (HS equivalency diploma)			7 (1.4%)
African American			18 (3.6%)	Some HS			7 (1.4%)
Hispanic			15 (3.0%)	8th grade or less			4 (0.8%)
South Asian			11 (2.2%)	Childhood Adversity (CA)			
Middle Eastern			7 (1.4%)	<i>Threat (POMP score)</i>			
No response			3 (0.6%)		Mean (SD)		0.15 (0.16)
Pacific Islander			2 (0.4%)		Range		0,1
African			1 (0.2%)	<i>Deprivation (POMP score)</i>			
Native American			1 (0.2%)		Mean (SD)		0.19 (0.17)
Another race and/or ethnicity			1 (0.2%)		Range		0,1
College Status				<i>Cumulative CA (count)</i>			
No college			115 (23%)		Mean (SD)		5.35 (2.21)
College			376 (76%)		Range		0,10
Income							
\$0-\$500			161 (33%)				
\$501-\$1000			96 (19%)				
\$1001-\$1500			80 (16%)				
\$1501-\$2000			59 (12%)				
\$2001-\$2500			38 (8%)				
\$2501-\$3000			28 (6%)				
\$3001-\$4000			12 (2%)				
\$4001+			19 (4%)				

Note. Counts and percentages are shown for categorical variables (race, sex, college status, income, parental education). Means, standard deviations, and ranges are shown for continuous variables (age, adversity).

Table 2*Means and standard deviations for key variables*

Daily Variable			N = 19160	GSR Variable			N = 495
Affective dynamics							
<i>NA intensity</i>				<i>NA intensity</i>			
	Mean (SD)		9.97 (12.66)		Mean (SD)		0.63 (0.43)
	Range		0,100		Range		0,1.8
<i>NA variability</i>				<i>NA variability</i>			
	Mean (SD)		6.19 (4.22)		Mean (SD)		2.8 (1.06)
	Range		0,70.41		Range		1,5
<i>NA reactivity</i>				<i>NA reactivity</i>			
	Mean (SD)		5.28 (8.27)		Mean (SD)		2.52 (0.96)
	Range		0,99.57		Range		1,5
Emotional Dysregulation				Emotional Dysregulation			
<i>Reflexive strategies</i>				<i>Reflexive strategies</i>			
	Mean (SD)		0.17 (0.60)		Mean (SD)		2.64 (0.61)
	Range		0,5		Range		1.08,4.42
<i>Reflexive ratio</i>				<i>Reflexive ratio</i>			
	Mean (SD)		0.34 (0.35)		Mean (SD)		.45 (0.07)
	Range		0,1		Range		0.24,0.69
Behavioral Dysregulation				Behavioral Dysregulation			
<i>Urgency</i>				<i>Urgency</i>			
	Mean (SD)		11.28 (16.38)		Mean (SD)		3.10 (0.55)
	Range		0,100		Range		1.17,4.92
Dysregulated Drinking				Dysregulated Drinking			
<i>Number of drinks planned</i>							
	Mean (SD)		0.80 (1.74)				
	Range		0,15				
<i>Number of drinks (on drinking days)</i>				<i>Number of drinks</i>			
	Mean (SD)		3.80 (3.39)		Mean (SD)		3.51
	Range		1,30		Range		0,31
<i>Binge drinking (drinking days)</i>				<i>Binge drinking</i>			
			1053 (34%)				315 (64%)
<i>High intensity drinking (drinking days)</i>							
			273 (9%)				
<i>Drinking more than planned</i>							
			1316 (43%)				

Note. Counts and percentages are shown for binary variables (binge and high intensity drinking, drinking more than planned). Means, standard deviations, and ranges are shown for continuous and count variables (affective dynamics, reflexive ratio, behavioral dysregulation, number of drinks, and drinks more than planned). Daily regulation values are averages of pre-drinking initiation on drinking days or median onset behaviors.

Table 3*Correlations with confidence intervals of key study variables*

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Income											
2. No College	.36** [.35, .36]										
3. Male	-.02** [-.03, -.01]	-.12** [-.13, -.11]									
4. Age	.35** [.34, .36]	.46** [.45, .47]	.03** [.02, .04]								
5. Threat	.01* [.00, .01]	.20** [.19, .20]	-.14** [-.15, -.13]	-.02** [-.03, -.01]							
6. Deprivation	-.01** [-.02, -.00]	.20** [.20, .21]	-.13** [-.13, -.12]	-.01** [-.02, -.00]	.62** [.61, .62]						
7. Cumulative	-.00 [-.01, .00]	.17** [.16, .17]	-.11** [-.12, -.11]	-.06** [-.07, -.06]	.62** [.62, .62]	.68** [.67, .68]					
8. Reflexive	.05** [.04, .06]	.09** [.08, .09]	-.09** [-.10, .00]	.01** [.00, .02]	.13** [.12, .14]	.09** [.08, .09]	.11** [.10, .12]				

Note. Values in square brackets indicate the 95% confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014). * indicates $p < .05$. ** indicates $p < .01$.

Figure 1

Distribution of daily reported number of drinks.

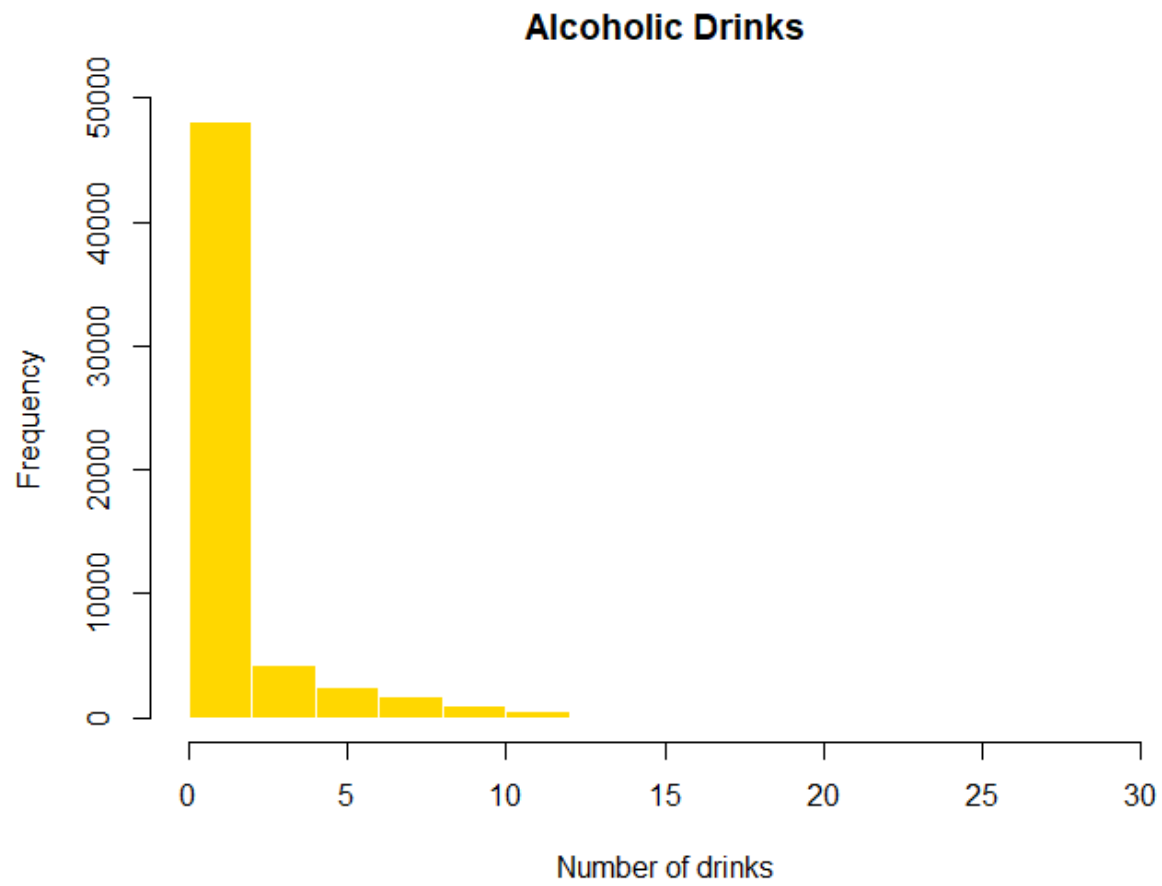


Figure 2

Convergence plots for imputed data for selected sample variables.

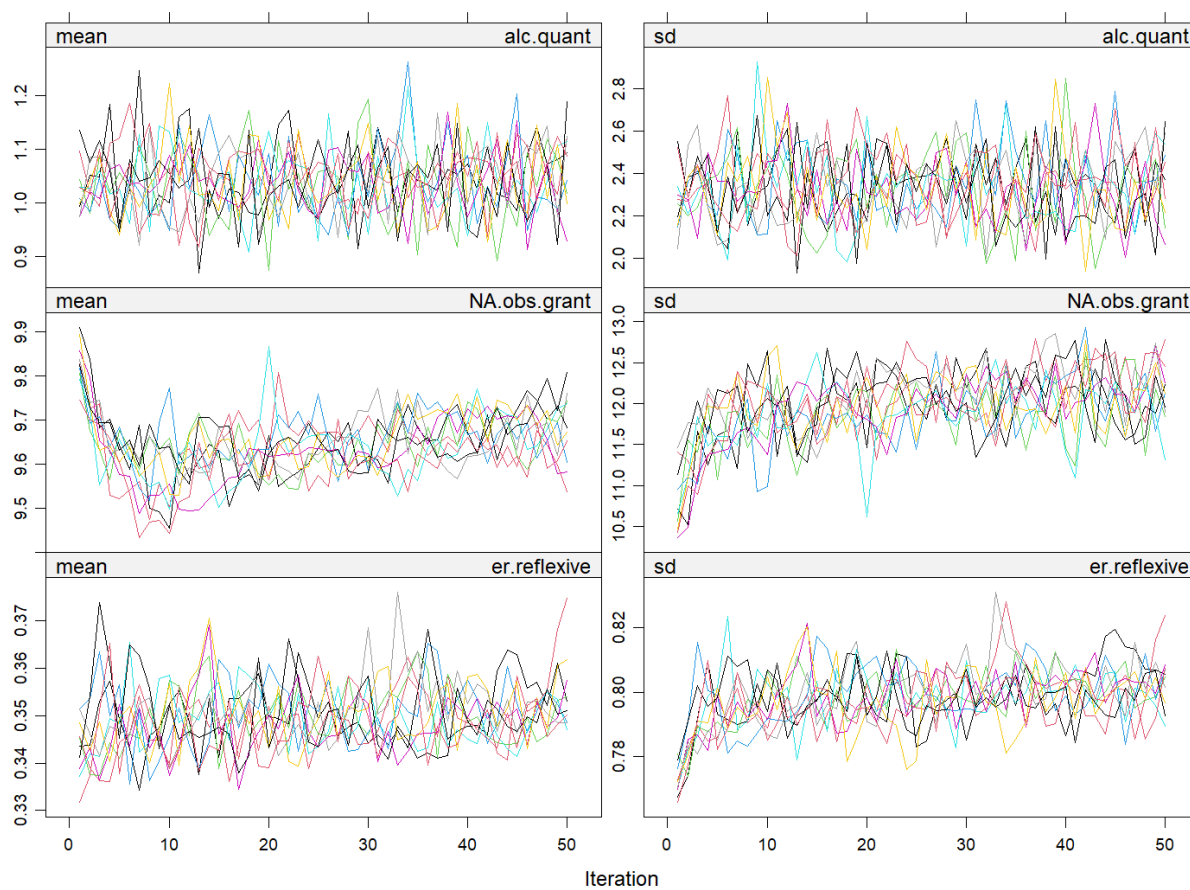


Figure 3

Standardized estimates for adversity predicting number of drinks

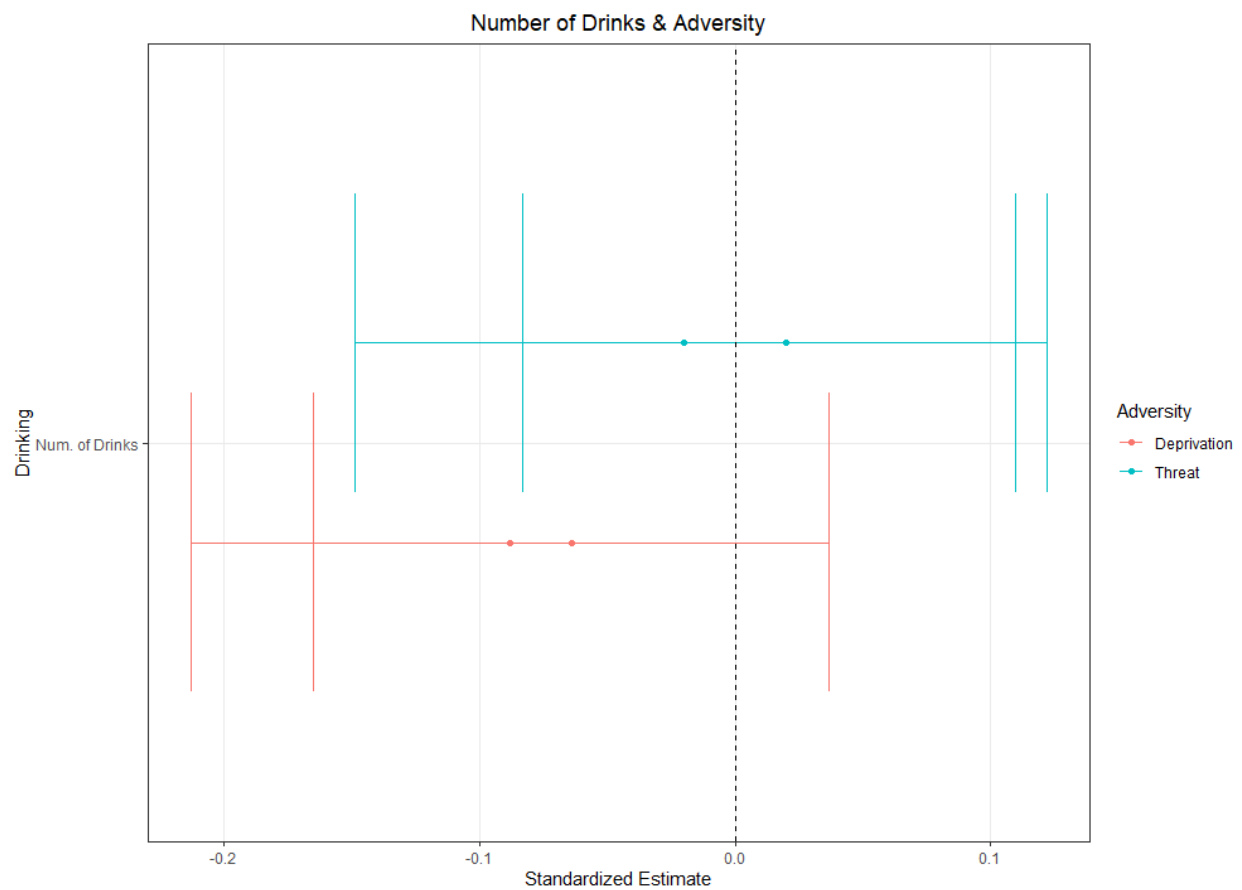


Figure 4

Standardized Relative Risk Ratios for adversity predicting dysregulated drinking

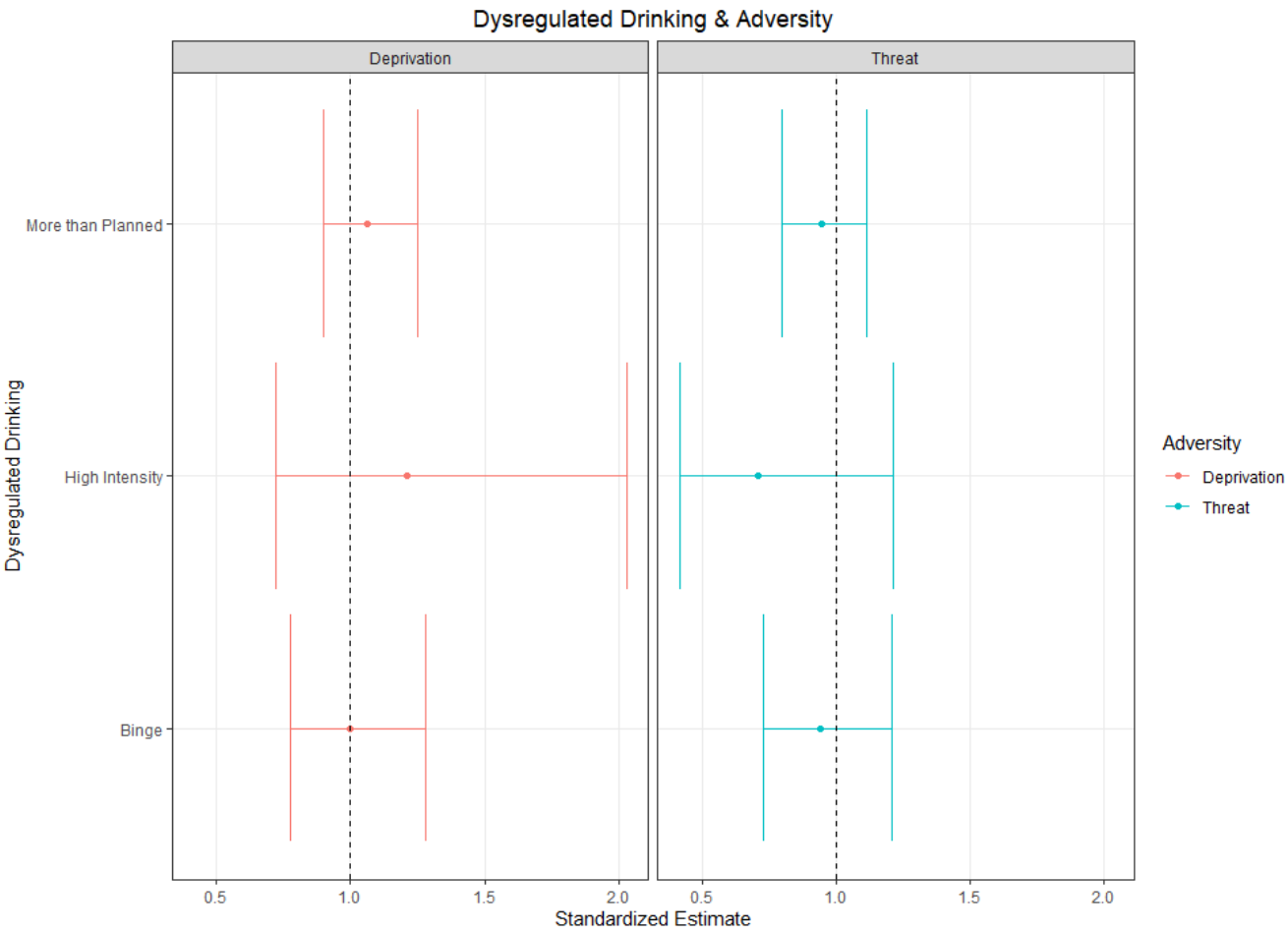


Figure 5

Standardized Relative Risk Ratios for emotional and behavioral regulation predicting dysregulated drinking

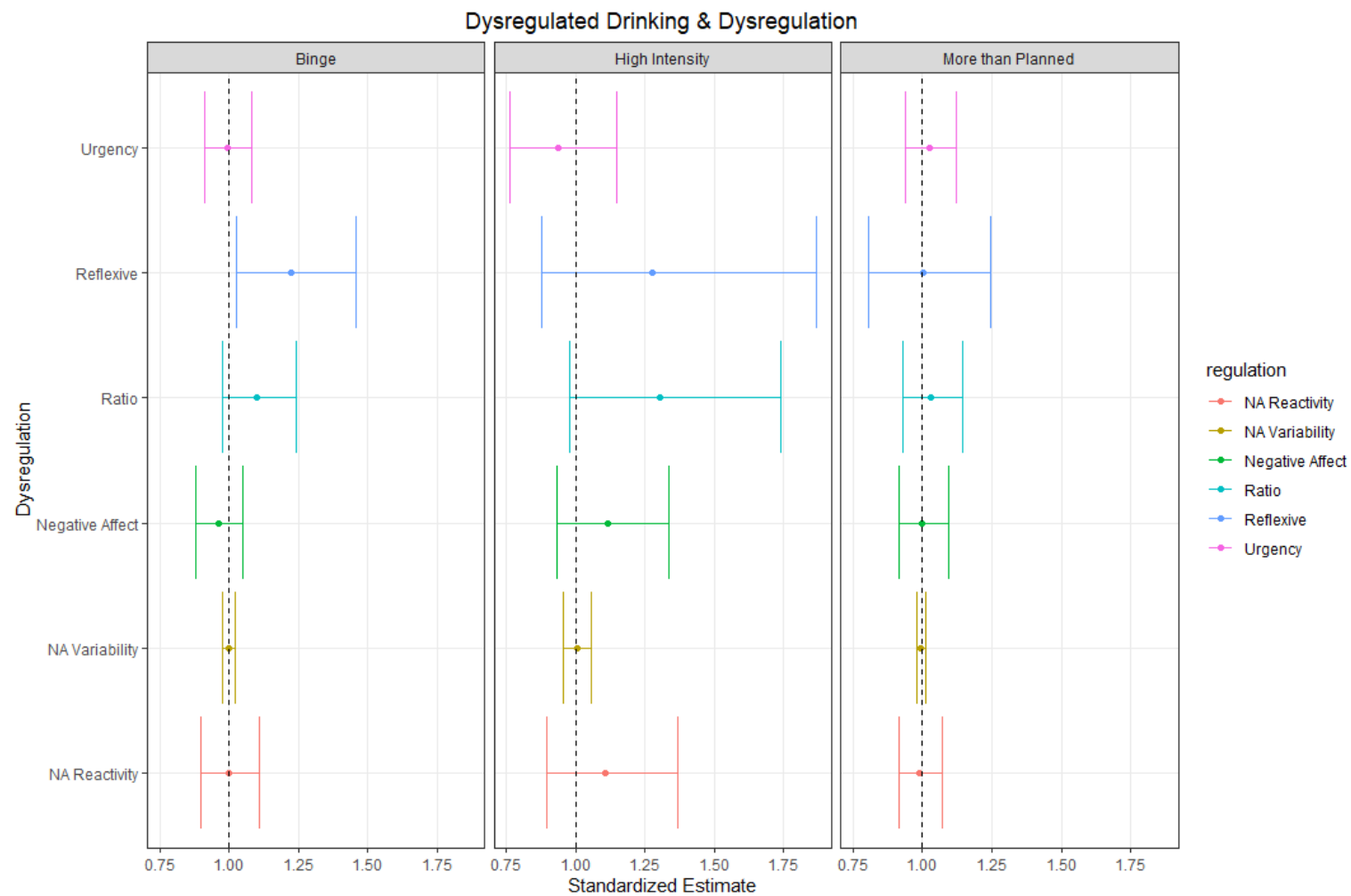


Figure 6

Standardized estimates for behavioral and emotional regulation predicting number of drinks

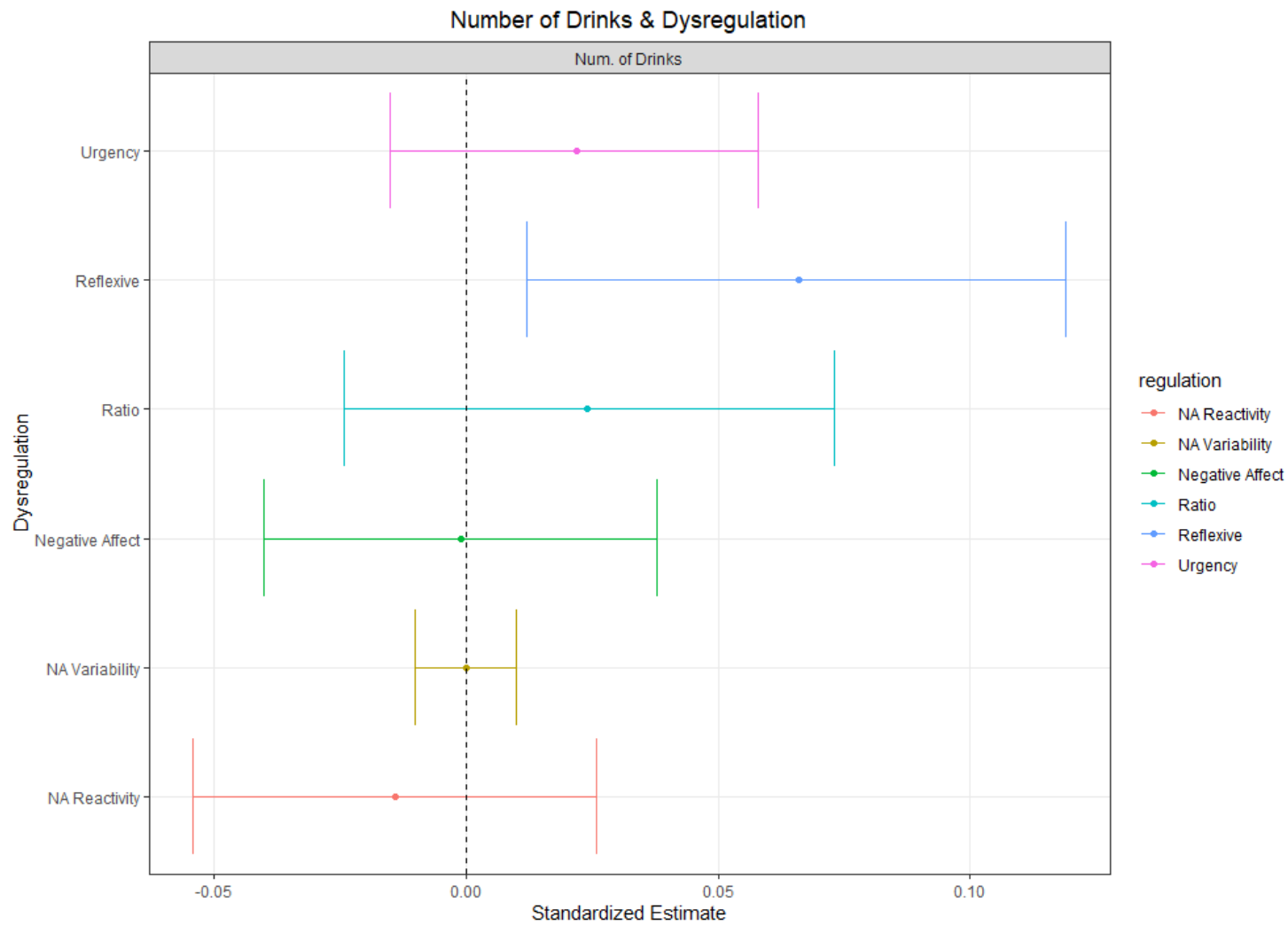
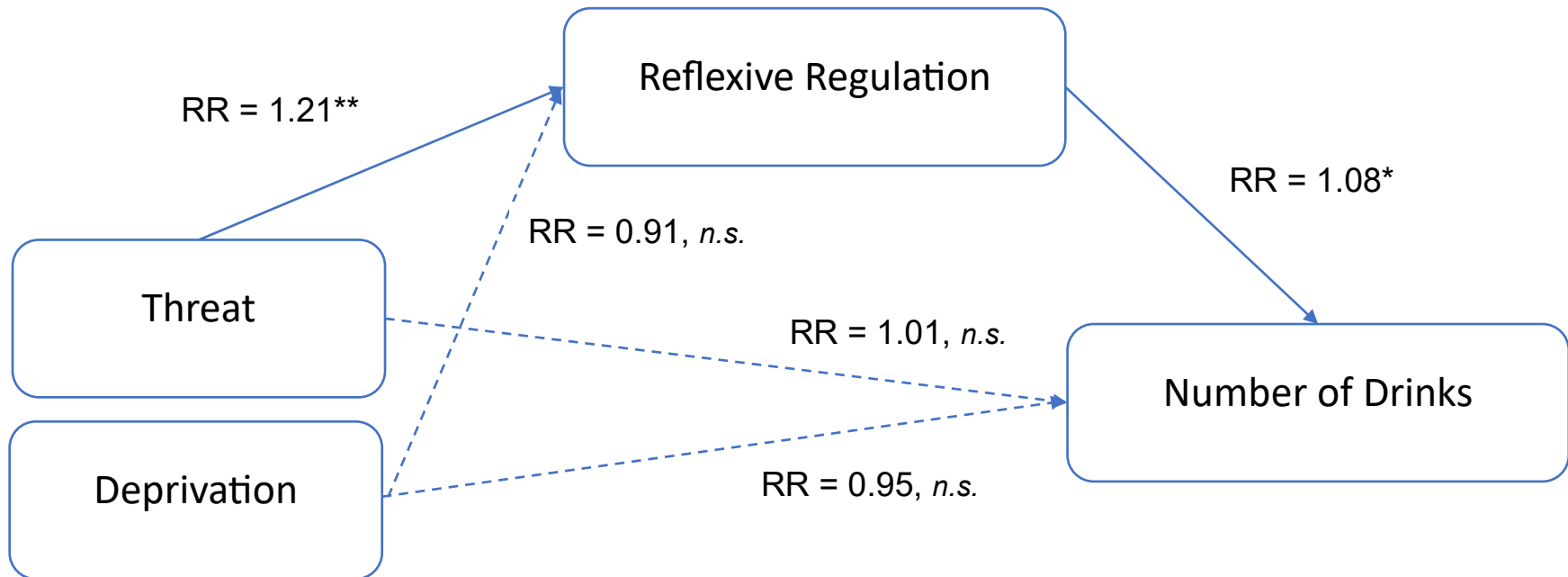


Figure 7

Indirect Path Model of Adversity and Daily Reflexive Regulation Strategies in Relation to Same Day Number of Drinks

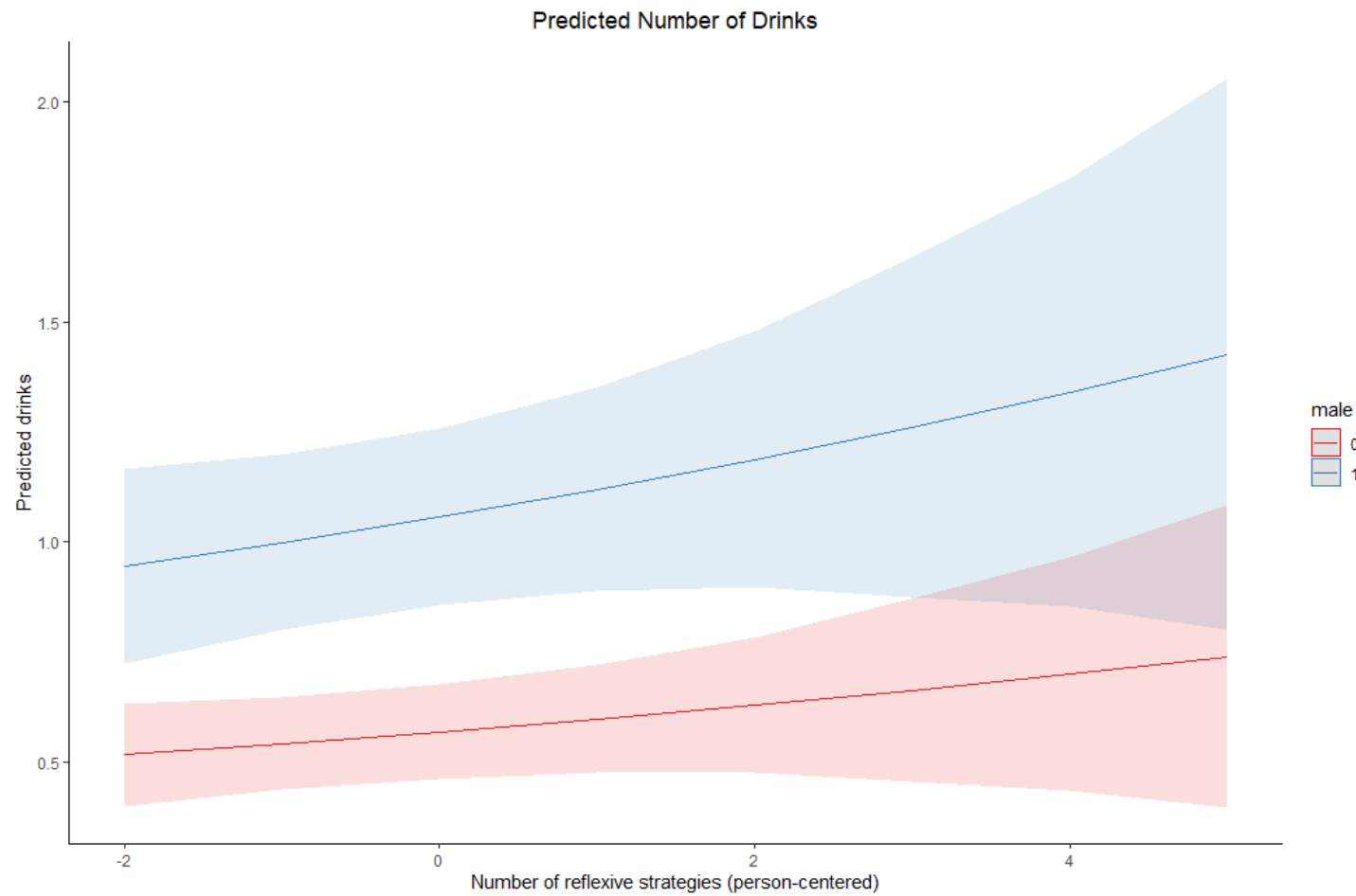


Note. Values are exponentiated estimates representing Relative Risk (RR). Dotted lines represent nonsignificant paths.

* Indicates $p < .05$. ** indicates $p < .01$.

Figure 8

Predicted Probabilities for Number of Drinks Predicted by Daily Reflexive Regulation



Study 3: Daily emotion dysregulation and binge drinking: An idiographic examination

Michele R. Smith

A dissertation (part 3 of 3)

submitted in partial fulfillment of the

requirements for the degree of:

Doctor of Philosophy in Clinical Psychology

University of Washington

2025

Study 3 Table of Contents

Abstract	129
Introduction	130
Affect, emotion dysregulation, and binge drinking.....	131
Idiographic Assessment.....	132
The current study	133
Methods	134
Participants	134
Recruitment and screening procedures.....	134
Procedure.....	135
<i>Baseline assessment and EMA orientation</i>	135
Following orientation and baseline assessment, participants	135
Measures	136
Daily Negative Affect.....	136
Reflexive Emotion Regulation	136
Daily binge drinking.....	137
Data Analyses	138
Analytic Plan	138
Results	140
Descriptive statistics	140
Group level paths	140
Individual level paths	140
Discussion	142
Limitations	145
Conclusion	147
References	148
Tables and Figures	161
Table 1.....	161
Table 2.....	162
Figure 1	163
Table 3.....	164
Figure 2	165
Figure 3	166

Abstract

Background. Binge drinking—drinking more than 4 or 5 drinks in a drinking episode, is a global health concern. More than a quarter of young adults report recent binge drinking, and this rapid and heavy alcohol intake is associated with social and legal problems, physical harm, and increased risk for developing substance use disorders. Binge drinking has been theoretically linked to negative and dysregulated affect. Individuals who have faced childhood adversity, particularly characterized by experiences of threat, are at increased risk for dysregulated emotions and drinking behavior and thus are an important population in which to examine these relations. Despite longstanding theory, these associations are underexamined.

Methods. The present study used an ecological momentary assessment (EMA) design to examine and collect information on daily negative affect (NA), emotion dysregulation processes (use of reflexive strategies and ratio of reflexive to engagement strategies), and daily binge drinking. Participants included regular alcohol or marijuana-using young adults with a history of threat-related trauma, ages 18-22 (N=76, 75% female). Idiographic modeling via Group Iterative Multiple Model Estimation (GIMME) explored individual relations between NA, dysregulation, and binge drinking.

Results. There were significant autoregressive effects for all variables at the group level. There were no group-level associations between binge drinking, NA, and emotion dysregulation, reflecting that same-day NA and emotion dysregulation were unrelated to binge drinking for most people. For some individuals, binge drinking was predictive of next-day regulation and negative affect. Although the valence of relationships varied by individual, affect and regulation variables were often associated within and between days.

Conclusions. Associations between negative affect, emotion dysregulation, and binge drinking are highly heterogeneous. There appears to be some day-to-day inertia with affect and regulation variables, while binge drinking often lowers the likelihood of next-day engagement. Understanding and intervening in binge drinking behavior should start with a thorough understanding of how emotional processes relate to one's drinking behavior.

Introduction

The World Health Organization has classified excessive alcohol consumption as a serious global health concern (World Health Organization, 2018). Heavy episodic drinking or binge drinking consists of drinking more than 4-5 drinks (i.e., more than 60 grams of pure alcohol) in a short amount of time (generally ≤ 2 hours) (National Institute of Alcohol Abuse and Alcoholism [NIAAA], 2004; World Health Organization, 2018). Even subthreshold extreme alcohol intake has demonstrated a significant impact on physical and mental health (Topiwala et al., 2017).

Adolescence and young adulthood, periods of accelerated cognitive development (Casey & Jones, 2010), mark the height of binge drinking activity in Western countries (Substance Abuse and Mental Health Services Administration (SAMHSA), 2020; World Health Organization, 2018). On average, upwards of 30% of young adults report binge drinking in the past month (NIAAA, 2018). This developmental period is characterized by a "tension" in the brain, accelerating maturity between motivational and reward systems and lagging cognitive control systems, as well as changes in emotion experience and regulation (Casey & Jones, 2010; Larson et al., 2002). These dynamics in combination with increased independence of young adulthood create greater opportunities for engaging in risky alcohol consumption.

Young adults who have experienced childhood adversity have an increased risk for substance use and substance use problems (Jung et al., 2020; Kessler et al., 2010; Pilowsky et al., 2009). Multiple experiences of childhood adversity have been related to an increased likelihood of binge drinking (Baiden et al., 2022; Crouch et al., 2018; Fang & McNeil, 2017; Pilowsky et al., 2009). Some types of childhood adversity may create more significant risk. Experiences characterized by *threat*, or actual or threatened experiences of harm to one's physical or emotional safety (McLaughlin et al., 2014), have demonstrated stronger associations with alcohol use (Font & Maguire-Jack, 2016; Keyes et al., 2012) and increased odds of

developing alcohol dependence by up to twofold (Fuller-Thomson et al., 2016). Specifically, more experiences of threat may create a heightened risk for binge drinking behavior (Allem et al., 2015; Forster et al., 2019; Grigsby et al., 2020). Recent data suggest that the current cohort of young adults experienced among the highest rates of adversity (Hartwell et al., 2023). Thus, not only is it generally important to examine drinking in this high-risk population, but it is even more critical to understand patterns that may disproportionately impact current emerging adults.

Affect, emotion dysregulation, and binge drinking

Negative affect has long been considered a factor in drinking behavior. Affect regulation theories posit that individuals use alcohol to modulate emotional states, particularly to alleviate negative affect or enhance positive emotions (Cooper et al., 1995; Cox & Klinger, 1988). Binge drinking specifically is thought to facilitate avoidance or delay of negative affect (Ferriter & Ray, 2011). This conceptual framework aligns with the self-medication hypothesis, which suggests that individuals with difficulties in managing emotions may turn to substances like alcohol to regulate (Bolton et al., 2009; Khantzian, 1997). However, recent meta-analyses have found daily high negative affect unrelated to the likelihood of drinking or the quantity of alcohol consumed (Dora et al., 2023; Tovmasyan et al., 2022). This challenges the role of drinking in affect regulation.

Emotion dysregulation is an unpleasant emotional experience, including circumstances such as emotions that change too quickly or slowly, persist longer than desired, are context-inappropriate, or interfere with appropriate behavior (Beauchaine & Haines, 2020; Cole et al., 2019). The use of emotion regulation strategies (e.g., suppression) that inadvertently prolong or enhance the experience of negative emotions may also be classified as dysregulation. Heightened emotion dysregulation has been associated with increased problem drinking behavior (Brown & Melas, 2024; Lannoy et al., 2021; Stellern et al., 2023). Conversely, binge drinking may also be important in the development of affect dysregulation. Binge drinking is

associated with intensified negative emotion, including symptoms of anxiety and depression, as well as reduced emotional response and recognition of interpersonal emotional cues (Lannoy et al., 2021). The association between emotion dysregulation and binge drinking remains underexamined. One systematic review on emotional processes in binge drinking found that only 5 (3 global retrospective reports and 2 experimental paradigms) of the 43 studies included explored the associations between emotion regulation and binge drinking (Lannoy et al., 2021). Notable among those studies listed is that their methods may be lacking in ecological validity. One review found that fewer than 25% of studies examining the association between affect and binge drinking relied on daily reports (Stanesby et al., 2019). Researchers have advocated for more prospective, ecologically valid approaches to understanding dysregulation and drinking (Bø et al., 2016; Coskunpinar et al., 2013; Lannoy et al., 2021; Roos et al., 2020). Person-centered, or idiographic methods, can help respond to this call.

Idiographic Assessment

Idiographic methods include the in-depth analysis of individual cases, aiming to understand unique experiences, behaviors, and psychological processes. Unlike nomothetic approaches (examining interindividual variation), which seek to generalize patterns across a larger group, idiographic methods (examining intraindividual variation) emphasize complexity and individual difference, challenging assumptions derived solely from group-based data (Beltz et al., 2016; Molenaar & Campbell, 2009). A central argument for person-centered approaches is that most processes vary across time, within person, and between individuals. Despite this, nomothetic analyses typically assume that group-level averages can be generalized to individuals. However, inferences from group-level analyses may not accurately reflect individual experiences. Idiographic analyses are better suited to capture the heterogeneity and dynamism of individual processes.

These studies utilize methods such as ecological momentary assessment (EMA), a technology-based approach to studying phenomena in individuals' daily lives and natural environments (Ebner-Priemer & Trull, 2009; Trull & Ebner-Priemer, 2009), to capture dynamic behaviors like emotion variation and alcohol use (e.g., Harrington et al., 2014; Stevenson et al., 2022). For instance, research has demonstrated that while group-level analyses may suggest a uniform relationship between mood and alcohol use, idiographic models reveal significant variability, with some individuals drinking in response to positive moods and others not drinking in response to either positive or negative moods (Stevenson et al., 2022). This variability underscores the limitations of nomothetic approaches and highlights the importance of idiographic methods in understanding the complexities of binge drinking. By capturing the heterogeneity in binge drinking behaviors, idiographic research contributes to a clearer understanding and, ultimately, more personalized and effective prevention and treatment strategies.

The current study

The current study is an exploratory examination of the idiographic associations between negative affect, emotion dysregulation, and binge drinking in a sample of young adults who have experienced adversity. This study aims to better understand how individual daily affect and regulation relate to binge drinking behavior as well as the degree to which those patterns generalize across individuals.

Methods

Participants

Sample demographics are presented in Table 1. Participants in the present study ($n = 76$, $M_{\text{age}}(\text{SD}) = 20.5(1.3)$, range 18 – 22) were regular substance-using young adults who reported high scores (one standard deviation or more above the mean) of threat-based experiences of adversity¹. Participants presented here were drawn from a larger sample of regular alcohol or marijuana-using young adults ($n=496$) recruited for participation in the parent study on the development of alcohol and marijuana-use problems during young adulthood. Participants had college (67%) and non-college (33%) backgrounds. Eligible participants were between 18 and 22 at the time of screening, owned a smartphone, were fluent in English, and reported at least weekly use of alcohol or cannabis in the past three months. Participants who moved to the United States after age 12 were excluded to screen out participants who were not acculturated to United States norms of substance use. The analytic sample was reduced to 21 participants following data exclusions in analyses (see analytic plan for details).

Recruitment and screening procedures

We recruited using online (Facebook, Instagram, Snapchat, TikTok, YouTube, Twitter, Craigslist, Reddit) and community (newspaper advertisements and flyers) sources. Potential participants completed a web survey including basic demographic information, contact information, and information about their past month substance use. Surveys included items to assess for careless responding (Kim et al., 2018; Pape & Storvoll, 2006) and were limited to one

¹ Threat was a composite of various items. The Childhood Trauma Questionnaire (CTQ) (Bernstein et al., 2003) is a self-report measure assessing recall of childhood trauma history, including three subscales measuring abuse with 15 total items covering emotional, physical, and sexual abuse ($\alpha = 0.66-0.92$). We adapted 16 items from the Violence Exposure Scale-Revised (VEX-R) (Fox & Leavitt, n.d., 1995) as a self-report measure of exposure to violence ($\alpha = 0.72-0.86$). We used percent of maximum possible scoring (POMP) to scores across subscales to form a composite of threat. The 76 individuals who were one standard deviation (0.16) at or above the mean (0.15) were included in the sample.

completion per IP address. Participants who met study criteria scheduled an appointment for their baseline visit.

Procedure

Baseline assessment and EMA orientation

Baseline assessments took place virtually via Zoom from 2020 to 2022 during the COVID-19 pandemic. As a first step, participants verified their identities using a photo ID and completed consent. Following procedures from our previous studies (Feil et al., 2020; Halvorson et al., 2021), participants were then thoroughly oriented to the EMA process. Research staff described the study, emphasizing the intensive nature of the sampling procedures, the importance of high compliance (and bonuses for compliance), and the scientific significance of the data collected. Staff also answered questions and built rapport and motivation for the completion of the EMA survey. Participants and staff reviewed a calendar including dates for which they would be receiving EMAs (i.e., Thursday – Sunday for the next 8 weeks, between 9 am and 11 pm). If participants indicated that they anticipated being unable to respond to 50% or more of the EMA prompts (e.g., long work shifts or trips out of the country), we discontinued their study participation. Staff identified themselves as the participant's point of contact and informed participants that staff would complete phone check-ins to troubleshoot any issues and support study completion if participants missed more than 1 day of data collection for the extent of the EMA period. Finally, research staff guided participants through a sample survey sent to their smartphones and provided examples and definitions as needed. Participants were paid \$50 for this initial assessment.

Following orientation and baseline assessment, participants received texts with a link to a brief EMA survey 5 times per day for the next 8 weekends (Thursday to Sunday). In addition, participants received an additional EMA on Monday mornings to obtain behavior from Sunday nights. We sent EMAs within five three-hour blocks between 9 am and 11 pm, with at least 1

hour between surveys. Several steps were taken to improve compliance (Shiffman, 2009). Staff completed phone check-ins after the first day of data collection to troubleshoot as needed. We also sent email and text reminders the day prior to each weekend of data collection. Survey links remained active for one hour after the initial text to allow participants more flexibility. Participants were sent 20-, 40-, and 55-minute reminders to improve compliance (Hufford & Shiffman, 2002; Shiffman et al., 2008). Lastly, we increased compliance by offering "bonuses": Participants were paid \$1 per EMA, with a \$5 bonus for completing 80% (i.e., 17/21) of EMAs for a given weekend (\$208 total possible).

Measures

These measures came from a more extensive assessment battery. Below, we report the measures relevant to the current study.

Daily Negative Affect

We measured affect using items taken from the Positive and Negative Affect Scale (PANAS; Watson et al., 1988). Two words from seven sets of items reflecting four negative (anger, sadness, anxiety, and general distress) and three positive (joviality, attentiveness, serenity) affect dimensions were randomly presented at each EMA. Participants rate the extent to which they experience each emotion using a sliding scale from zero to 100. *Negative affect* (NA) was computed as the daily mean NA.

Reflexive Emotion Regulation

We measured ER strategies since the last assessment using a checklist of 8 items adapted from the Cognitive Emotion Regulation Questionnaire (CERQ) (Jermann et al., 2006) which measures the use of specific strategies (acceptance, problem-solving, rumination, reframing, distraction, avoidance, emotion suppression, thought suppression) to regulate affect, as well as four items adapted from the Brief-COPE (Carver, 1997), an inventory of different coping skills (emotional support, emotional expression/venting, mindfulness/spirituality, self-

criticism). At each EMA, participants endorsed which items they used since the prior assessment using a "check all that apply" style of question, selecting "none of the above" if participants did not use any of the strategies in the specified period. We formed a composite measure reflecting the count of reflexive regulatory strategies by summing endorsement of the following strategies at each EMA: avoidance, criticism, rumination, suppression, and distraction. Because research suggests that individuals exposed to higher negative affect report higher levels of all ER strategies (Compas et al., 2017; M. R. Smith et al., 2023), we also examined the relative use of reflexive strategies. We computed the ratio of daily mean reflexive strategies to engagement strategies (acceptance, problem-solving, reappraisal, support seeking, emotional expression, and using mindfulness or medication to improve mood) to reflect a degree of daily emotion dysregulation (dysregulation ratio).

Daily binge drinking

At each morning assessment, participants reported on alcohol use they consumed the day prior through a numeric response to the following question: "How many alcoholic drinks did you have yesterday? Please remember that a drink refers to a "standard" drink size: 12 oz. beer, 8-9 oz. malt liquor, 5 oz. wine, 1.5 oz. hard liquor. Select 0 if you didn't drink yesterday." In the second assessment of each day, participants' intentions to drink were assessed with the item "How many drinks do you intend to have later today? (If more than 15, select 15)." We predicted multiple measures of drinking to capture various forms of dysregulated drinking behavior. *Binge Drinking* was measured as the number of drinks beyond the binge threshold. Using sex assigned at birth, the binge drinking threshold was coded for females who reported drinking 4 or more drinks and males who reported 5 or more drinks.

Data Analyses

Analytic Plan

We conducted all analyses in R (v.4.3.1; Posit team, 2023). Group Iterative Multiple Model Estimation (GIMME) was used to examine group and person-specific associations between NA, emotion dysregulation, and binge drinking. GIMME is a data-driven algorithm designed to identify dynamic, time-varying relationships among multiple variables at both the group and individual levels. Unlike traditional methods that impose a common structure across all participants, GIMME allows for heterogeneity by estimating unique models for each individual while also detecting shared patterns across the sample. The algorithm accommodates both lagged and contemporaneous (simultaneous) relations among variables (Gates et al., 2017; Gates & Molenaar, 2012). For group-level effects, GIMME uses threshold cutoffs to assess the frequency of an effect in the sample. We used the default of a 0.75 threshold to model group-level effects. That is, in order for a path to be considered significant at the group level, it must be found in 75% of the individual-level models.

GIMME analyses were conducted using the *gimme* package (S. Lane et al., 2024). Missing data was managed with full information maximum likelihood to allow for longitudinal associations regardless of days missing data. Both drinking and non-drinking days were analyzed. Each model included the quantity of binge drinking, NA, reflexive emotion regulation, and the dysregulation ratio. Individual-level patterns and example plots are presented in the results.

The original sample was 76 participants. Participants were excluded to strengthen statistical rigor. Participants were excluded if they did not have variance on all analyzed variables ($n=31$). Next, to ensure an accurate reflection of binge drinking patterns and more closely align with GIMME recommendations for an adequate number of time points (S. T. Lane et al., 2019), participants with fewer than 30 days of data were excluded ($n=2$). Lastly,

participants with nonconverging models were excluded from the final analyses ($n=12$).

Ultimately, the final analytic sample included 21 individuals, with 1,006 observations. We performed chi-square and t-tests to compare included and excluded participants. Excluded participants did not differ significantly in terms of age, daily NA, or daily dysregulation ratio.

Participants in the analytic sample were more likely to be male ($\chi^2(1) = 462.1, p < .001$), more likely to be in college ($\chi^2(1) = 129.5, p < .001$), and used more daily reflexive strategies ($t(1256.9) = -3.9, p < .001$). In addition, the analytic sample included individuals who engaged in binge drinking more frequently ($\chi^2(1) = 63.4, p < .001$) but did not drink more when bingeing compared to excluded participants.

Results

Descriptive statistics

Descriptive statistics can be found in Table 2. On average, individuals drank on 21% of their days in the study and drank an average of 3.42 drinks per drinking day. Binge drinking was about 4.5% of days, but on drinking days, the proportion of binge drinking increased to 32%. Daily negative affect ($M=14.2$) was low, ranging from 0 to 100. Individuals used an average of less than 1 ($M=0.32$) reflexive and ($M=0.58$) engagement strategies for a mean ratio of reflexive strategies of 0.35.

Group level paths

Fifty-seven percent of the models (12/21) converged normally. There were no significant paths between variables at the group level. That is, for the majority of the sample, NA and emotion dysregulation were unrelated to same- or next-day binge drinking. There were only autoregressive effects for binge drinking, NA, and emotion dysregulation variables at the group level. Autoregressive effects for binge drinking were most often negative, indicating that binge drinking was less likely following a day of bingeing. Similarly, the dysregulation ratio was often negatively related to next day's ratio. Autoregressive paths for negative affect were most often positive, indicating some inertia of negative emotion, while autoregressive path estimates for reflexive strategy use varied. Group paths are presented in Figure 1.

Individual level paths

Individual models contained considerable heterogeneity and had 15 unique individual paths; some paths were represented across multiple individuals, tallying to 34 associations in total. Autoregressive effects were the most common and present across all variables. Across models, 40% (6) of the paths illustrated contemporaneous relations, and 60% (9) were lagged, and estimates ranged from moderate to large. Individual models found four unique associations

between binge drinking and NA or emotion dysregulation. Same-day reflexive strategies (2/34), dysregulation ratio (3/34), and negative affect (1/34) had positive associations with binge drinking. In one model, negative affect was positively related to next-day binge drinking, but the dysregulation ratio was negatively associated with binge drinking. Binge drinking also had negative associations with next-day dysregulation ratio (1/34). Binge drinking had mixed associations with next-day reflexive strategies (2/34) and negative affect (2/34), with models demonstrating positive association and negative associations; negative associations were larger than positive associations.

There were more consistent but still diverse paths for NA and emotion dysregulation variables. Negative affect was positively related to both same-day reflexive strategies (5/34) and dysregulation ratio (2/34). Reflexive strategies were positively associated with dysregulation ratio in five models. In lagged paths, negative affect was positively related to the dysregulation ratio in two models and negatively related to the ratio in another. One model found that the dysregulation ratio was positively related to next day's negative affect. Reflexive strategies had both positive (2/34) and negative (1/34) associations with next-day negative affect. The count of reflexive strategies was also negatively predictive of next day dysregulation ratio (2/34).

Discussion

Understanding individual factors that contribute to binge drinking is an essential step in the prevention and intervention of problematic drinking in young adults. Emotion dysregulation is a hypothesized yet underexamined predictor of binge drinking. The current study examined the association between negative affect (NA), emotion dysregulation, and binge drinking using idiographic methods. We identified considerable heterogeneity in individual networks of emotion dysregulation and binge drinking. Overall, results suggested that binge drinking is unrelated to same-day emotion dysregulation for most individuals in our sample. Paths from a few individuals deviated from this pattern and even suggested that binge drinking may impact next-day NA and dysregulation, but this trend did not hold at the group level. There were consistent relations among NA and reflexive emotion regulation, but the patterns of association tended to vary. Results add to a scant body of literature seeking to elucidate the role of emotional processes in binge drinking.

Negative affect and emotion dysregulation were unsupported as contributors to binge drinking in the present study. Existing research similarly indicates that emotion regulation is not a significant predictor of binge drinking in young adults. A systematic review examining emotional processes in binge drinking found no experimental data and mixed self-report data supporting impaired emotion regulation among binge drinkers (Lannoy et al., 2021). A meta-analysis revealed small-to-medium effect sizes for the relations between emotion regulation strategies and broader alcohol use, with the exception of expressive suppression, which showed no significant association (Weiss et al., 2022). However, few of the included studies examined emotion regulation as a precursor to binge drinking and instead relied on global self-report of both emotion regulation and binge behaviors. One study found that both reflexive strategy use and negative affect were unrelated to the quantity of alcohol consumed (Luoma et al., 2020). Indeed, our findings identified associations between NA (positive relation), emotion

dysregulation (negative relation), and same-day binge drinking for only one individual. While those associations were medium to large, they suggested conflicting narratives for the role of emotion in binge drinking.

Researchers have pointed to reinforcement models as the basis for the theorized connection between emotion dysregulation and binge drinking. The affective processing model of negative reinforcement posits that substance use is driven and sustained by an attempt to avoid undesirable emotional states (Baker et al., 2004). In this case, drinking is thought to provide an escape and thereby be reinforced as a strategy to disengage from aversive emotion. Binge drinking may also be positively reinforced by stimulating the reward systems and generating more positive emotions (Koob, 2013). Accordingly, coping motives have been found to account for the association between emotion dysregulation and problem drinking (Aurora & Klanecky, 2016; Messman-Moore & Ward, 2014).

Alternatively, cognitive differences have been implicated in binge drinkers (González-Roz et al., 2024). Binge drinking is characterized by periods of heavy drinking (and subsequent acute intoxication) followed by periods of abstinence (Maurage et al., 2020). In particular, this repeated pattern of high intake followed by withdrawal has been demonstrated to affect cognitive functioning in young binge drinkers negatively (Carbia et al., 2018; Field et al., 2008). Cognitive control, an aspect of executive function including processes like response inhibition, planning, working memory, and the ability to shift and direct attention, refers to processes that guide behavior and optimize decision making (Field et al., 2008; Field & Cox, 2008; Molnar et al., 2018). Among this sample of high alcohol users, deficits in cognitive control skills may impede active or flexible regulation attempts. Taken together, extant research and theory suggest that while emotional processes are relevant to binge drinking, emotion dysregulation itself may not be a primary factor in the engagement or maintenance of binge drinking behaviors in young adults.

Unsurprisingly, measures of NA and emotion dysregulation were regularly associated. Research has highlighted a significant relationship between daily negative emotions and emotion dysregulation among young adults. Daily experiences of negative emotions, such as sadness or anger, can lead to heightened emotional distress and engagement in dysregulated strategy use (Brans et al., 2013; Kalokerinos et al., 2017; M. R. Smith et al., 2023). However, results make clear that this process is neither unidirectional nor consistent across individuals. Recent evidence from experience sampling studies indicates that reflexive emotion regulation strategies may be associated with higher subsequent negative affect (Colombo et al., 2020; Wang et al., 2024; Wenze et al., 2018). Our work has found that negative emotion is related to more reflexive strategies but also more engagement strategies as compared to positive emotion (M. R. Smith et al., 2023), suggesting that for some, negative emotion is a cue to engage in more of all types of regulatory efforts.

Current findings also reinforce the role of binge drinking in contributing to emotion dysregulation and negative mood. Binge drinking among young adults is closely associated with heightened negative emotions. Research indicates that individuals who engage in frequent binge drinking often report increased levels of negative affect, including symptoms of depression and anxiety. For instance, adolescents and young adults reporting higher frequencies of binge drinking and higher quantities of alcohol consumed have also reported elevated levels of emotional distress, particularly depression (Pape & Norström, 2016). Drinking has been found to reduce next-day positive affect (Cronce et al., 2020). Moreover, experimental studies suggest that binge drinking is related to attenuated emotional awareness and responses (Lannoy et al., 2021), which may contribute to feelings of dysthymia. These data suggest that binge drinking behaviors are linked to the experience of negative emotions in young adults and suggest that this is an area to explore further.

The sample used here also presents a distinctive look at the association between affective processes and drinking. Although this sample in this study was not explicitly collected for the experience of childhood adversity, a majority of individuals (54%) in the sample reported a count of 4 or more adverse childhood experiences of threat, widely accepted as the childhood adversity threshold marking significantly higher risk of negative physical and mental health outcomes (Felitti et al., 2019). Similarly, though the sample was not selected for binge drinking behavior, more than 30% of the sample reported binge drinking in the past 30 days, and 45% of the sample met criteria for hazardous alcohol consumption on the alcohol use disorders identification test (AUDIT, (Allen et al., 1997; Reinert & Allen, 2002; Saunders et al., 1993). Both threat and frequent binge drinking have been differentially related to the development of aberrant emotional processing and fear responses. Threat has been shown to increase responsiveness to threat (McLaughlin et al., 2014, 2016), while binge drinking has been related to blunted emotional responses and lower threat responsivity (Lannoy et al., 2021). These conflicting processes may result in complicated permutations of emotional processing in this population. Limiting the sample to individuals with numerous experiences of threats may also limit our understanding of these processes in individuals with broader childhood adversity. As adverse experiences are likely to co-occur (K. E. Smith & Pollak, 2020), it may be useful to broaden the sample to include a variety of experiences and explore similarities or differences in patterns.

Limitations

There are important limitations to this study. First, this study included a small and specific sample of substance-using young adults with moderate to marked histories of adversity. The sample was made smaller by exclusions to assist with accurate and reliable data analyses—the characterization and small size of the sample limit the generalizability of the findings. However, one benefit of idiographic approaches is characterizing unique individual

experiences to inform understanding and intervention. Findings help provide limits to the overgeneralization of group patterns that may not hold for individuals.

Both drinking and emotion dysregulation are examined without context. Examining the use of specific emotion regulation strategies without context for their use or efficacy may discount important factors, such as regulation ability. Weiss and colleagues (2022) found larger effect sizes for emotion regulation *abilities* as compared to specific emotion regulation strategies in their association with substance use. Drinking context may also be important to consider. For example, one EMA study found that daily negative affect was negatively predictive of social but unrelated to solitary drinking (Luoma et al., 2020). Individual factors should be considered in context as well. For example, sex and trait anxiety have been found to moderate the association between alcohol use and next-day negative affect (Linden-Carmichael et al., 2021).

The time scale of regulation and drinking examined here may also be a point of limitation. There is much debate in the literature about the appropriate timescale to understand the unfolding of emotion regulation (Koval et al., 2015, 2020), so its predictive dynamics are also unclear. In addition, planned drinking is often predictive of higher quantities and rates of alcohol intake (Howard et al., 2024; Lauher et al., 2020), making it difficult to assess and differentiate antecedents for planning from those for engagement. Day-level affect and regulation may be unrelated to binge behavior, while affect and regulation immediately preceding planning or binge initiation may be more relevant predictors. Moreover, measuring binge drinking the next morning as we did may limit the accurate collection of higher-intensity drinking episodes, as those individuals may have been less likely to respond to morning EMA surveys.

Conclusion

Overall, findings suggest that neither negative affect nor employing ostensibly less adaptive strategies significantly relates to individual binge drinking behavior. Person-centered analyses reveal considerable variation in the association between negative affect, emotion dysregulation, and binge drinking. These findings should be replicated in a larger, broader sample of drinkers, but point to alternative or intermediary factors as stronger predictors of binge drinking behavior.

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Tables and Figures

Table 1

Sample demographic information

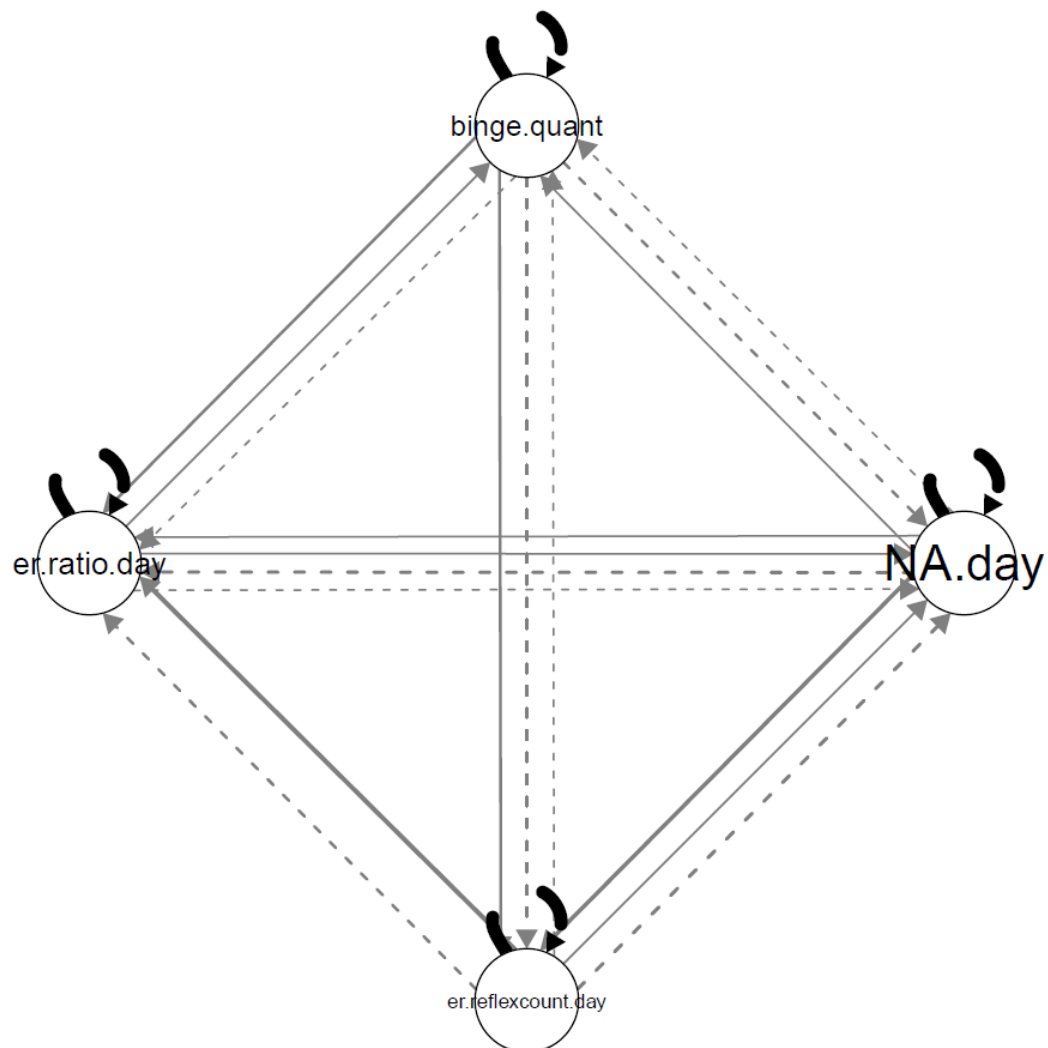
Variable		N = 76	Variable		N = 76
Age			Parental Education		
	Mean (SD)	20.3 (1.4)	8th grade or less		2 (3%)
	Range	18, 23	Some HS		3 (4%)
Sex			High school (HS) graduate		9 (12%)
Female		57 (75%)	GED (HS equivalency diploma)		1 (1%)
Race and Ethnicity			Some vocational/technical school		1 (1%)
White		36 (47%)	Some college		4 (5%)
Biracial or multiracial		18 (24%)	AA degree (2-year college)		6 (8%)
East or Southeast Asian		7 (9%)	BA or BS (4-year college degree)		18 (24%)
African American		3 (4%)	Some graduate/professional school		3 (4%)
Hispanic		6 (8%)	Graduate/Professional school		25 (1.4%)
South Asian		5 (7%)	No Response		4 (5%)
Middle Eastern		1 (1%)	Childhood Adversity (CA)		
College Status			<i>Threat (POMP score)</i>		
No college		45 (60%)	Mean (SD)		0.44 (0.13)
College		30 (40%)		Range	0,1
Income					
\$0-\$500		22 (29%)			
\$501-\$1000		14 (18%)			
\$1001-\$1500		12 (16%)			
\$1501-\$2000		12 (16%)			
\$2001-\$2500		7 (9%)			
\$2501-\$3000		4 (5%)			
\$3001-\$4000		4 (5%)			
\$4001+		1 (1%)			

Note. Counts and percentages are shown for categorical variables (race, sex, college status, income, parental education). Means, standard deviations, and ranges are shown for continuous variables (age, adversity).

Table 2*Means and standard deviations for key variables*

Daily Variable	N = 3040	
Affective dynamics		
NA intensity	Mean (SD)	13.9 (15.7)
	Range	0,100
Emotional Dysregulation		
Reflexive strategies	Mean (SD)	0..23 (0.7)
	Range	0,5
Reflexive ratio	Mean (SD)	0..39 (0.35)
	Range	0,1
Alcohol use		
Amount of drinking days		428 (14%)
Number of drinks (on drinking days)	Mean (SD)	3.42 (3.04)
	Range	0,20
Proportion of binge drinking days (on drinking days)		137 (32%)
Binge drinking quantity (on binge days)	Mean (SD)	6.97 (2.95)
	Range	0,20

Note. Means, standard deviations, and ranges are shown for continuous and count variables. Daily regulation values are averages of pre-drinking initiation on drinking days or median onset behaviors.

Figure 1*Group-level paths from GIMME*

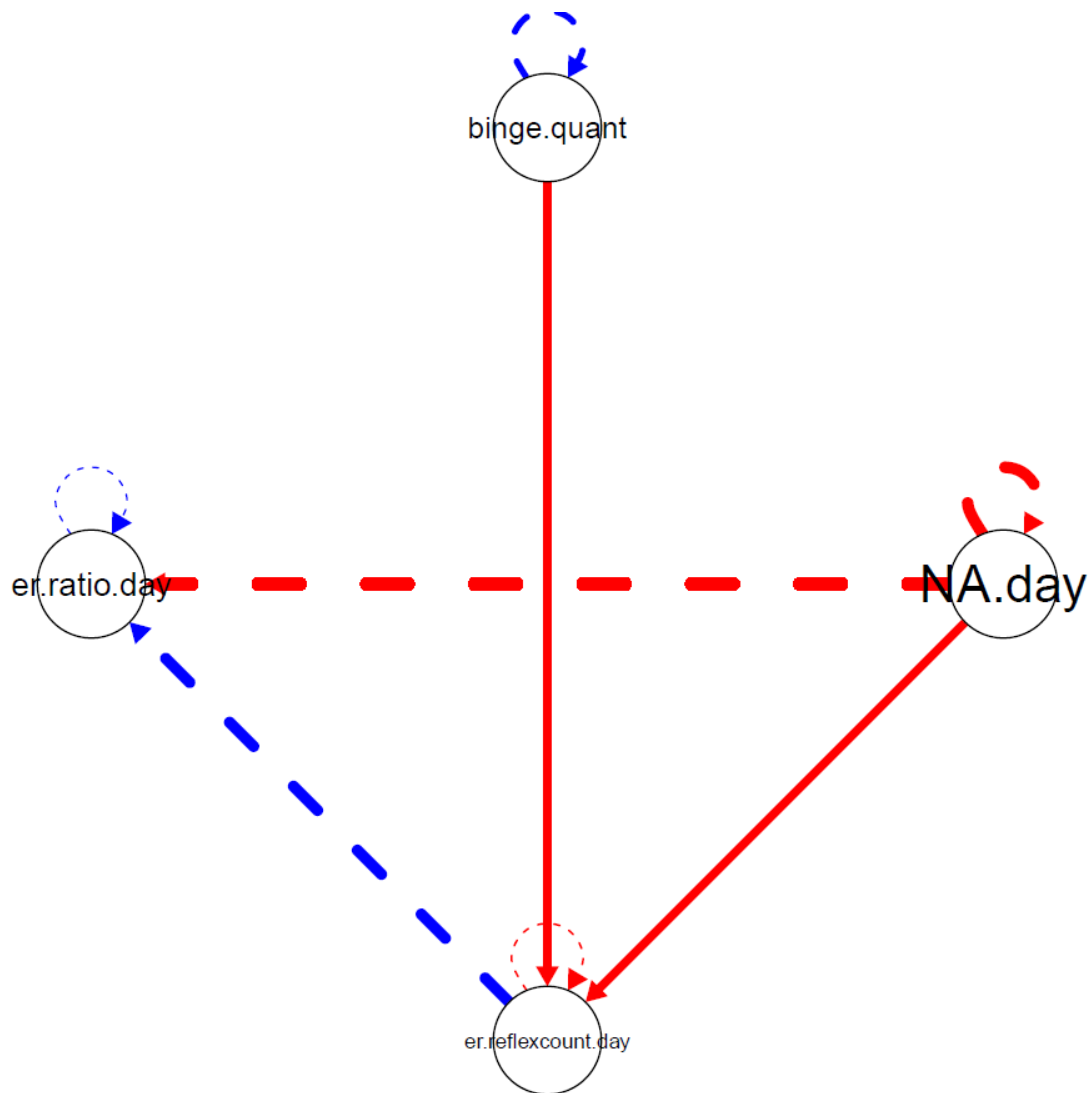
Note. Group-level paths with a 75% threshold. Black lines indicate group-level effects. Gray lines represent all paths from person-specific models. Solid lines depict contemporaneous paths. Dotted lines depict lagged effects. Looped lines suggest autoregressive paths.

Table 3*Summaries of individual-level GIMME path estimates (standardized)*

		Count of individuals with path	Proportion significant	Proportion positive	Mean positive	Proportion negative	Mean negative
Autoregressive							
<i>Binge quantity</i>	-		0.25	0.57	0.43	0.43	-0.19
<i>NA Intensity</i>	-		0.42	0.86	0.28	0.14	-0.13
<i>Reflexive strategies</i>	-		0.25	0.38	0.26	0.62	-0.12
<i>Dysregulation ratio</i>	-		0.42	0.62	0.34	0.362	-0.24
Same day (covariance)							
<i>NA → Binge</i>	1		0.05	1	.80	0	-
<i>Reflexive → Binge</i>	2		1	1	0.31	0	-
<i>Ratio → Binge</i>	3		1	0.67	0.40	0.33	-0.48
<i>NA ↔ Reflexive</i>	5		1	1	0.61	0	-
<i>NA ↔ Ratio</i>	2		1	1	0.36	0	-
<i>Reflective ↔ Ratio</i>	5		1	1	0.50	0	-
Next day (predictive)							
<i>Binge (t-1) → NA</i>	2		1	0.5	0.44	0.5	-0.58
<i>Binge (t-1) → Reflexive</i>	2		1	0.5	0.46	0.5	-0.94
<i>Binge (t-1) → Ratio</i>	1		1	0	-	1	-0.80
<i>NA (t-1) → Binge</i>	1		1	1	0.51	0	-
<i>NA (t-1) → Reflexive</i>	-		-	-	-	-	-
<i>NA (t-1) → Ratio</i>	3		1	0.67	0.68	0.33	-0.98
<i>Reflexive (t-1) → Binge</i>	1		1	0	-	1	-0.36
<i>Reflexive (t-1) → NA</i>	3		1	0.67	0.42	0.33	-0.73
<i>Reflexive (t-1) → Ratio</i>	2		1	0	-	1	-0.44
<i>Ratio (t-1) → Binge</i>	-		-	-	-	-	-
<i>Ratio (t-1) → NA</i>	1		1	1	0.81	-	-
<i>Ratio (t-1) → Reflexive</i>	-		-	-	-	-	-

Figure 2

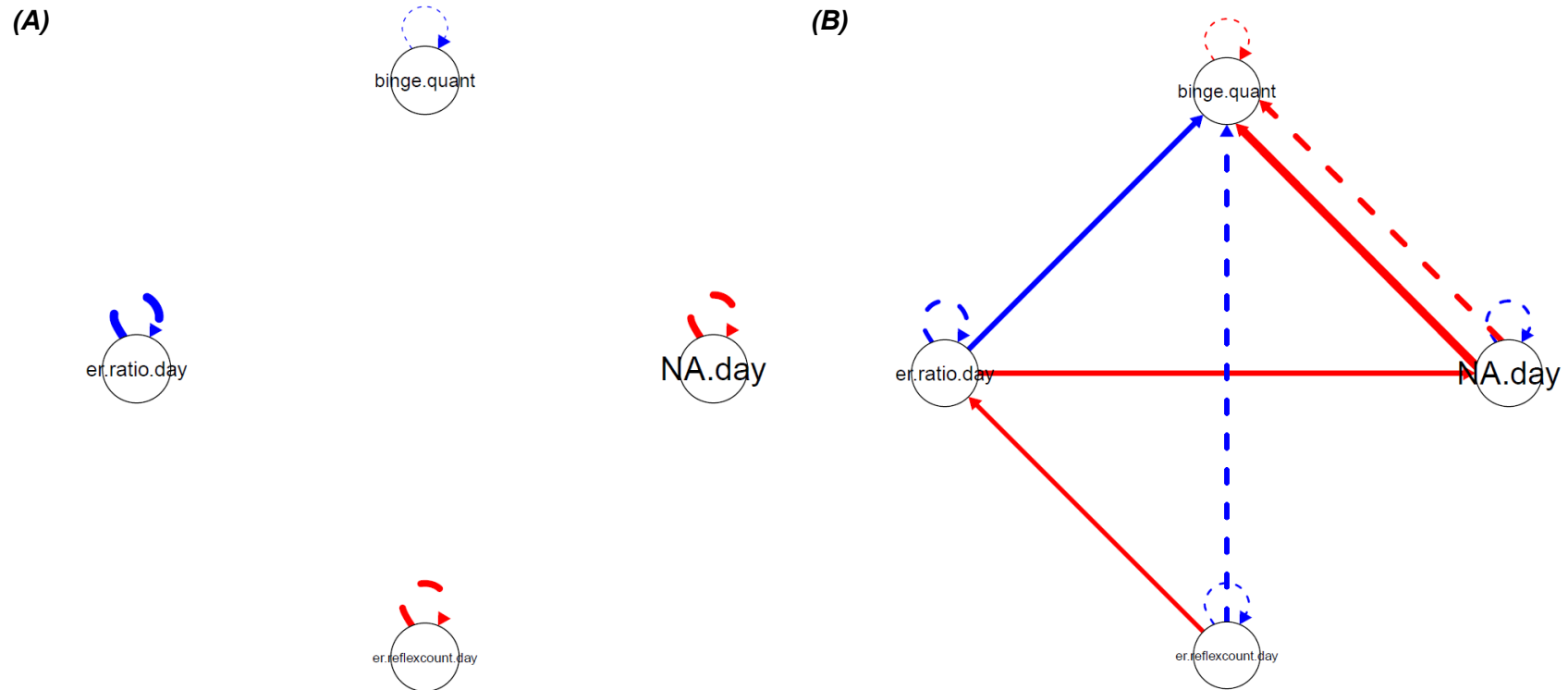
Sample plot with affect and emotion dysregulation association with binge drinking.



Note. Red lines are positive effects, and negative effects are in blue. Solid lines signify contemporaneous effects, and lagged effects are represented with dashed lines. The strength of the effect is indicated by line thickness.

Figure 3

Example plots representative of more (A) and less (B) commonly occurring paths across the sample



Note. Red lines represent positive effects, and blue lines represent negative effects. Solid lines signify contemporaneous effects, and lagged effects are represented with dashed lines. The strength of the effect is indicated by line thickness. Panel A shows an individual model in which none of the variables are significantly associated. This pattern is more common across the sample. Panel B shows an individual model in which all affective and dysregulation measures are either contemporaneously or prospectively related to binge drinking. This model also uniquely depicts a positive autoregressive effect of binge drinking, unlike the negative autoregressive effects typical of the sample, such that individual binge drinking is likely to be positively predictive of next-day drinking.