

Childhood neglect is associated with low affect and high stress in habitual alcohol drinkers

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Abstract

Objective: Adverse childhood experiences, ranging from childhood trauma to neglect or mistreatment, show associations with alcohol dependence in adulthood. Alcohol researchers have not yet clearly demonstrated the potential impact of childhood maltreatment on everyday drinking in alcohol consumers who do not have an alcohol use disorder (AUD). This study examined whether a history of childhood neglect results in differential ratings of stress, affect, and desire to drink, during typical alcohol consumption in moderate to heavy drinkers without an AUD.

Methods: The parent study from which these analyses were generated recruited overall healthy, albeit moderate to heavy alcohol users who fell above National Institute on Alcohol Abuse and Alcoholism (NIAAA) classifications for low-risk drinking. Childhood Trauma Questionnaire (CTQ) responses were collected, and real-time surveys were collected in participants' natural environments approximately every three hours between 9 a.m. and 9 p.m. using iPhones equipped with a study-created application probing stress, affect, and desire for alcohol, while participants followed their typical drinking routine (3 days) and during a brief period of imposed abstinence (3 days).

Results: Thirty-six participants averaging 41 years of age and consuming an average of 17 (± 5) drinks per week participated in this study. CTQ responses showed low prevalence of childhood abuse, but moderate to high emotional ($M = 17.39$, $SD = 6.77$) and physical neglect ($M = 11.11$, $SD = 3.31$) scores. Multilevel modeling revealed significantly higher stress and lower affect ratings among participants reporting higher physical neglect. Alcohol consumption was significantly associated with decreased stress, and increased affect and desire for alcohol. A significant interaction showed that as childhood physical neglect ratings increased, the benefits observed following drinking (of decreased stress, and increased affect and desire for alcohol) were reduced.

Conclusions: These results suggest that moderate to heavy healthy daily drinkers with histories of greater childhood physical neglect experience poorer mood and higher stress on a daily basis, with smaller improvement experienced from drinking alcohol. Among moderate to heavy daily drinkers without an AUD, those with greater childhood physical neglect experience poorer mood and higher stress on a daily basis, and have smaller improvements in stress, affect and desire while/following drinking alcohol than those with less childhood physical neglect.

Introduction

Childhood trauma is strongly associated with alcohol dependence in adulthood, as has been demonstrated in a wide range of populations (Cross et al., 2015; Magnusson et al., 2012; Waldrop et al., 2007). Patterns of alcohol use, including age of onset and prevalence of heavy consumption, are differentially influenced by childhood and adult trauma experiences, with childhood trauma resulting in

greater psychopathological consequences (Waldrop et al., 2007). However, severe experiences of abuse are not a requisite for the development of maladaptive drinking behaviors in adulthood. Adverse childhood experiences – which can include instances of inequality, lack of health care access, poor mental health, and parental maltreatment (Loudermilk et al., 2018; Walker, 2015) – are significantly associated with binge drinking (Loudermilk et al., 2018). Early life maltreatment has been shown to have direct links to vulnerability toward stress-related drinking in adulthood

(Young-Wolff et al., 2012), and youth supervisory neglect increases an adult's odds of classification as a risky-drinker compared to a low-risk or abstinence classification (Snyder & Merritt, 2016). This growing body of literature indicates history of childhood maltreatment, including parental neglect, is sufficient to increase one's risk of developing maladaptive behavioral patterns associated with alcohol consumption in adulthood.

Experiences of childhood mistreatment are often divided as experiences of neglect or abuse, with further divisions such as physical, emotional, or sexual abuse (Liebschutz et al., 2018). Although experiences of childhood abuse and neglect have been shown to result in different adult experiences of stress, depression, anxiety, post-traumatic stress disorder, and psychopathology (Bifulco et al., 2006; Carter et al., 2005; Cohen et al., 2017; Johnstone et al., 2009; Teicher et al., 2018; Widom et al., 2007), fewer differences have been found between subcategories, such as physical and emotional neglect. In studies examining childhood mistreatment and adult alcohol use, abuse is frequently linked to severe alcohol use, problematic drinking patterns, and early age of drinking onset, whereas neglect is more commonly linked to general alcohol use (Cohen et al., 2017; Dube et al., 2006; Mezquita et al., 2014; Rehan et al., 2017; Widom et al., 2007). Studies differentiating childhood physical and emotional neglect have found both categorizations to be meaningful in predicting depression, anxiety, and alcohol use in later life, with fewer differences between physical and emotional divisions than between neglect, abuse, or neither division (Cohen et al., 2017; Dube et al., 2006; Grummitt et al., 2021; Rehan et al., 2017). With this history of results as background, this study examined behavioral associations of alcohol consumption in adults with histories of childhood neglect, to explore effects of greater and lesser experiences of neglect on emotional responses to alcohol consumption.

Stress and desire for alcohol are also strongly associated with levels of drinking (Breese et al., 2006; Mayhugh, Rejeski, et al., 2018; Miller et al., 1974; Seo et al., 2011; Uhart & Wand, 2008). Desire for alcohol is used in this study as a more relevant marker of "alcohol craving", as desire has been shown to be a more relevant rating in these non-AUD drinkers than craving (Peterson et al., 2021). Stress reduction is a motivator for alcohol consumption; drinking has been shown to decrease acute ratings of stress, and even the expectancy of alcohol lowers stress in alcohol users (Anthenelii & Grandison, 2012; Cooper et al., 1992; de Wit et al., 2006; Keyes et al., 2012; Pohorecky, 1991). Affect, i.e. overall positive or negative emotion (Diener & Emmons, 1984), is also highly associated with alcohol use, with poor affect motivating alcohol consumption, and acute alcohol use improving affect (Armeli et al., 2000; Hussong & Chassin, 1994; Simons et al., 2005). A history of adverse childhood experiences is known to increase adulthood psychological distress (Dube et al., 2003; Easton, 2012; Kalmakis et al., 2015; Karatekin, 2017; Manyema et al., 2018; Mersky et al., 2013; Mosley-Johnson et al., 2021; Nurius et al., 2015) and alcohol consumption may be used as a mechanism to self-medicate or decrease the everyday stress experienced by those with a history of childhood

maltreatment. However, less is known about how alcohol cyclically affects these experiences. Do those with early life maltreatment drink alcohol because it reduces their feelings of increased stress? This is the line of questioning that this study aimed to explore.

In an effort to examine the relationship between a history of childhood neglect and behavioral associations with alcohol consumption, the current study assessed desire for alcohol, affect, and stress, in healthy, habitual drinkers via ecologically valid survey responses collected throughout the day. Participants experiencing higher levels of neglect were hypothesized to experience higher stress, lower affect, and a greater desire to drink compared to participants without childhood trauma, with drinking hypothesized to decrease stress and desire to drink and increase affect across all participants.

Methods

Participants

The data analyzed in this manuscript come from a larger study examining behavioral and brain responses to abstinence in healthy, non-binging, habitual alcohol consumers. The full protocol involved four study visits (eligibility screening, behavioral baseline, MRI scans following a period of participants' typical drinking routine, and a brief period of imposed alcohol abstinence) and recruited drinkers who consumed above National Institute on Alcohol Abuse and Alcoholism (NIAAA) classification of low-risk drinking, i.e. males ≥ 14 drinks per week, females ≥ 7 drinks per week (NIAAA, 2011), on at least 50% of days over the previous three months. At the initial in-person screening visit, all participants signed informed consent forms approved by the Wake Forest Health Sciences Institutional Review Board. Recruitment targeted potential participants 24–60 years of age who reported no current illnesses and were healthy overall. Participants were excluded if they had a current or historic alcohol use disorder (AUD) diagnosis, reported any negative behavioral symptoms associated with their drinking, or if they binge-drank (males ≥ 4 drinks, females ≥ 5 drinks, consumed in ≤ 2 hours; NIAAA, 2011) more than once monthly on average. Overall, this pattern ensured consistent moderate to heavy consumption without frequent periods of abstinence in otherwise healthy drinkers. Patterns of alcohol use were assessed using the Timeline Followback (TLFB; Vakili et al., 2008), a well-established, retrospective measure of alcohol consumption, which was administered following informed consent, at each participant's first study visit. Other exclusion criteria included: Regular morning drinking or "eye openers" (alcohol consumed before 10 a.m.), self-reported problems with alcohol or drugs, a history of withdrawal symptoms, a score > 20 on the Center for Epidemiological Studies Depression Scale (Eaton et al., 2012), active psychiatric diagnoses (excluding depression if well controlled for > 2 months), use of psychoactive or anticonvulsant medications, and a history of neurological disease or serious head injury. Participants were also excluded for other concurrent drug use (screened at each study visit via saliva drug test, monitoring

methamphetamine, cocaine, marijuana, amphetamine, opiates, and benzodiazepines).

Design

Ecological momentary assessment (EMA) is a real-time survey method that minimizes recall bias and maximizes ecological validity with repeated sampling in participants' present environment via mobile technology (Shiffman et al., 2008). Survey responses collected in a well-controlled laboratory setting cannot capture the full breadth of drinking or abstinence experiences, whereas EMA allows for the study of microprocesses that influence real-world behavior and experiences (Shiffman et al., 2008; Smyth & Stone, 2003). For the EMA protocol used in this study, each participant was issued an anonymous portable device (Apple iPhone) equipped with a study-created web-based application through which surveys were distributed. Survey responses were collected across two quasi-experimental periods in participants' natural day-to-day environment, each approximately three days in duration. During the control period, participants were asked not to make any changes to their usual drinking routine, while during the experimental period, participants were asked to abstain from all alcohol. The order of the experimental and control periods was randomized in a sex-stratified crossover design. Participants were simultaneously issued mini BACtrack breathalyzers (BACtrack C6 Manual, 2017) which they were instructed to use each time they completed an EMA survey. BACtrack data was saved to a BACtrack application on each participant's study issued iPhone but were not analyzed in conjunction with EMA survey data. These data were used to ensure participants remained abstinent on assigned abstinence days and check for alcohol consumption on typical drinking days.

Measures

A commonly used retrospective measure for assessing adverse childhood experiences is the Childhood Trauma Questionnaire (CTQ), a measure that has high internal consistency (ranging from $\alpha = 0.66$ – 0.92) and high reliability (test-retest reliability ranging $\rho = 0.79$ – 0.86) (Bernstein et al., 1994; Bernstein et al., 2003). The CTQ includes five subscales: physical abuse, emotional abuse, sexual abuse, physical neglect, and emotional neglect (Bernstein et al., 1997; Bernstein et al., 1994). Individual items are scored on 5-point Likert scales, resulting in possible subscale scores ranging 5–25 (Liebschutz et al., 2018). Subscale scores are classified as none to low (5–10), low to moderate (11–15), moderate to severe (16–20), and severe to extreme trauma exposure (20–25; Liebschutz et al., 2018). The CTQ also includes three questions to screen for underreporting of traumatic experiences.

EMA surveys were collected during both experimental and control conditions upon waking for the day and before retiring at night, as well as prior to having a first drink and after drinking had ceased (all participant-initiated surveys), and when prompted via a text message approximately every two hours, followed by a one-hour window in which participants could complete the prompted survey (Shiffman, 2007). Surveys included measures of stress (“How stressed

are you right now?” with responses Not at all – Extremely), affect (“How good or bad do you feel right now?” with responses Bad – Good), and desire for alcohol (“How much do you desire a drink right now?” with responses Not at all – Extremely) among others not reported here. Stress and affect have been widely assessed using EMA methods across a wide array of areas of study including eating behaviors and disorders, stress-related diseases, weight loss and management, and substance abstinence (Engelberg et al., 2005; Fanning et al., 2020; Focht et al., 2002; Goldschmidt et al., 2014; Haedt-Matt & Keel, 2011; Hausenblas et al., 2010; Kanning & Schlicht, 2010; Mayhugh, Rejeski, et al., 2018; Reichenberger et al., 2018; Shiffman et al., 2008; Smyth et al., 2008; Yoshiuchi et al., 2008). Although alcohol research has traditionally assessed alcohol craving, desire for alcohol has been found to be a more meaningful metric in this non-AUD population (Peterson et al., 2021). Response scales were presented as a horizontal line with vertical rungs. In order to express their current state, participants were asked to slide a cursor along the horizontal line, which was labeled only with the nominal labels (rather than numerical values). The absence of numerical values allowed for a focus on the qualitative aspects of participants' feeling states. Stress and desire for alcohol, scales that would traditionally be measured 0–10, were assessed with 0–1000 values, with the inflated range intended to make the sliding value feel as continuous as possible (rather than stepped if only 11 values were possible). Feelings scales, widely used in EMA research, are traditionally coded -5 to 5, to capture a neutral to negative range and a neutral to positive range. As such, affect was probed -5.00 to 5.00, sticking with the historically used values while maintaining the continuous feel of ratings used with the stress and desire for alcohol scales. With each question prompt, the cursor was anchored in the center of the scale, requiring participants to slide the cursor right (indicating higher levels) or left (indicating lower levels) across the horizontal scale.

Statistical Analyses

Overall, participants responded to 91% of combined self-initiated and random alert EMA reports during their typical drinking, and 94% during abstinence, with participants completing an average of 25.9 (± 4.3) surveys during their typical drinking period and an average of 21.4 (± 2.5) surveys during abstinence. During typical consumption, participants completed an average of 3.8 (± 1.6) surveys prior to drinking and 3.1 (± 1.8) surveys after drinking. EMA analyses were performed using multi-level models on 1,673 complete EMA responses ($n=105$ reports excluded representing 5.9%). We believe that these data support the high quality of the EMA data that were collected.

Time of day at which surveys were submitted was recorded in 24-hour notation, and across participants. Time was centered at 3 p.m. because surveys were prompted for completion between 9 a.m. and 9 p.m. Time was included in the model as a linear variable, and squared to operationalize potential quadratic trends in ratings across the day, e.g. ratings increasing linearly across the day, versus accelerating or decelerating (Raudenbush, 2001). Additional variables were included in the model to contrast pre- and post-drinking

to test for effects of drinking state (Mayhugh, Laurienti, et al., 2018; Mayhugh, Rejeski, et al., 2018; Peterson et al., 2021).

All EMA survey responses with complete data were categorized to operationalize the quasi-experimental design. We created a dummy variable which took on a value of 1 if the report occurred after having consumed an alcoholic beverage on a typical drinking day, and 0 otherwise (post-drinking). During the abstaining days (i.e. experimental days), there was no equivalent since participants were not consuming any alcoholic beverages. To address this issue, we also created a dummy variable which took on a value of 1 if the report occurred before having consumed an alcoholic beverage on a drinking day and 0 otherwise (pre-drinking). Given these two dummy variables, the reference category (0 for both dummy variables) represented an EMA report which occurred on an abstaining day (i.e., the experimental condition). Furthermore, although the data set could be construed to have a 3-level structure (i.e., multiple EMA reports nested within days which in turn were nested within individuals), we elected to model findings using a 2-level structure (i.e., multiple EMA reports nested within individuals). The reason was that the proportion of variance associated with between day variation was small (accounting for less than 1%, about 10%, and about 9% of the variance for desire, stress, and affect outcomes respectively). Additionally, the operationalization of the quasi-experimental design in a 3-level structure was essentially analogous to its modeling in the 2-level design and thus did not provide substantive added value. Notwithstanding, we ran all analyses using 2- and 3-level models and obtained similar results.

The 2-level nested hierarchical model was used to examine differences in ratings across the day, using physical and emotional neglect scores as continuous moderators of within person effects (Raudenbush et al., 2019; Schwartz & Stone, 1998). Separate models were run for each rating scale (stress, affect, and desire for alcohol) following transformations to the outcome variables because of deviations from normality i.e., standardization of EMA survey values within persons followed by the addition of a standardized between-person value for aggregated EMA scores.

The modeling for these analyses was a step-up approach and involved (a) estimating the intraclass correlation coefficients; (b) adjusting the models for the effects of diurnal variation (linear and quadratic effects of time modeled); (c) testing the effects of the quasi-experimental manipulation by entering the pre-drinking and post-drinking dummy variables; and (d) testing the moderating effects of childhood neglect by entering cross-level interaction terms for the intercept, the linear and quadratic effects of time of day, and for the quasi-experimental manipulation. All models included a random intercept with all predictor variables modeled as fixed effects. All EMA modeling was performed using HLM 8.1 software (Raudenbush et al., 2019). The final model reads as follows:

1. Level-1 Models

$$\text{Rating}_{ij} = \beta_{0j} + \beta_{1j} * (\text{Time of Day} - \text{Linear}_{ij}) + \beta_{2j} * (\text{Time of Day} - \text{Quadratic}_{ij}) + \beta_{3j} * (\text{Pre-Drinking}_{ij}) + \beta_{4j} * (\text{Post-Drinking}_{ij}) + r_{ij}$$

2. Level-2 Models (CTQ scores centered around the grand mean)

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (\text{Neglect score}_j) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11} * (\text{Neglect score}_j)$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21} * (\text{Neglect score}_j)$$

$$\beta_{3j} = \gamma_{30} + \gamma_{31} * (\text{Neglect score}_j)$$

$$\beta_{4j} = \gamma_{40} + \gamma_{41} * (\text{Neglect score}_j)$$

3. Mixed Models

$$\text{Rating}_{ij} = \gamma_{00} + \gamma_{01} * (\text{Neglect score}_j) + \gamma_{10} * (\text{Time of Day} - \text{Linear}_{ij}) + \gamma_{11} * (\text{Neglect score}_j) * (\text{Time of Day} - \text{Linear}_{ij}) + \gamma_{20} * (\text{Time of Day} - \text{Quadratic}_{ij}) + \gamma_{21} * (\text{Neglect score}_j) * (\text{Time of Day} - \text{Quadratic}_{ij}) + \gamma_{30} * (\text{Pre-Drinking}_{ij}) + \gamma_{31} * (\text{Neglect score}_j) * (\text{Pre-Drinking}_{ij}) + \gamma_{40} * (\text{Post-Drinking}_{ij}) + \gamma_{41} * (\text{Neglect score}_j) * (\text{Post-Drinking}_{ij}) + u_{0j} + r_{ij}$$

We performed a sensitivity analysis by creating a dichotomous variable to contrast participants with scores below the median on both physical and emotional neglect (score = 1) versus all others (score = 0) and modeling effects on outcome variables contrasting the highest quintile of responses versus all other responses.

Results

Twenty-two women and fourteen men participated in this study. Their demographics and alcohol use information are included in Table 1. The average age of participants was 41 years. Four participants identified as African American or black, with the remaining 32 identifying as white. Participants had completed an average of 16 years of formal education (equivalent to a Bachelor's degree), with a range of 13 to 18+ years (some college, associates degrees, bachelor's degrees, and masters or professional degrees). The majority of participants reported fulltime employment, an average personal annual income of \$45–50,000 and average household annual income of \$90–100,000. Males consumed more drinks per week on average than females. Participants had been consuming alcohol for an average of 25 years. Personal income, household income, and education level were not significantly associated with average alcohol consumption or neglect scores.

Childhood Trauma Questionnaire (CTQ) responses collected from the participants showed low prevalence of childhood abuse (physical, emotional, and sexual; average subscale scores of 6.99, average $SD = 0.71$), but moderate to high neglect scores, with substantial variability across the range of scores of emotional neglect (subscale $M = 17.39$, $SD = 6.77$) and physical neglect ($M = 11.11$, $SD = 3.31$).

Average scores on individual items and totals for each subscale are included in Table 2. Although both neglect subscale scores were highly correlated with overall CTQ scores (emotional neglect, $r = 0.89$, $p < 0.001$; physical neglect, $r = 0.87$, $p < 0.001$), physical abuse ($r = 0.33$, $p = 0.047$), emotional abuse ($r = 0.45$, $p = 0.006$), and sexual abuse ($r = 0.34$, $p = 0.042$), subscale scores showed only low to moderate correlation with overall CTQ scores in this

sample indicating neglect scores drove overall CTQ trends. The statistical analysis was limited to continuous neglect scores for the following reasons: (a) participants reported the full range of potential scores on the emotional neglect subscale, (b) the two neglect subscales were highly correlated ($r = 0.86$, $p < 0.001$), and (c) there was a high correlation between emotional and physical neglect scores and overall CTQ scores.

Table 1

Demographic and Drinking Information for All Participants.

	Full sample (n=36)	Males (n=14)	Females (n=22)
Age in years	41 (± 11) [24-59]	38 (± 9) males	43 (± 13)
Race			
African American or black	4 (11%)	2 (13%)	2 (9%)
White	32 (89%)	12 (87%)	20 (91%)
Socioeconomic Status			
Annual personal income	\$45-50K (\pm \$35K) [\$40K median, \$100K mode]	\$55-60K (\pm \$30K) [\$50K median and mode]	\$40-45K (\pm \$35K) [\$40K median and mode]
Household personal income	\$90-100K (\pm \$55K) [\$95K median, \$120K mode]	\$100-110K (\pm \$50K) [\$90K median and mode]	\$85-90K (\pm \$60K) [\$90K median, \$120K mode]
Total years of education	16.3 (± 1.5) [13-18]	16.2 (± 1.5)	16.2 (± 1.5)
Patterns of Alcohol Consumption^a			
Total years drinking	25 (± 12)	22 (± 9)	27 (± 13)
Average consumption over the past 90 days	211 (± 73)	268 (± 80)	173 (± 68)
Average consumption per day	2.9 (± 0.9)	3.7 (± 1.2)	2.4 (± 0.7)

Note: Participants listed for the full sample and separated for males and females.

^a Drink counts were measured via number of standard drinks (containing approximately 14g of alcohol, e.g. 12oz of beer, 5oz of wine, 1.5oz of distilled spirits).

Table 2

Average CTQ scores, Divided by the Five Abuse and Neglect Subscales.

Subscale	Subscale Total Score Ranges	Average Rating Per Item	Subscale Average Total
Emotional Abuse	5 – 19	1.519 (± 0.906)	7.595
Physical Abuse	5 – 12	1.292 (± 0.496)	6.459
Sexual Abuse	5 – 19	1.302 (± 0.741)	6.512
Emotional Neglect	5 – 25	3.438 (± 1.450)	17.189
Physical Neglect	5 – 14	2.200 (± 0.865)	11.090

Note: Potential ratings on individual items ranged 1–5, with potential subscale totals ranging 5–25. Overall CTQ scores averaged 58.611 (± 14.033).

Full output from the models is included in Tables 3 (emotional neglect) and 4 (physical neglect), whereas step-up models appear in the online Supplement. Tables 3 and 4 describe the results of multilevel models including linear and quadratic effects of time, dummy variables operationalizing

the quasi-experimental manipulation, and cross-level moderating effects of emotional neglect and physical neglect respectively for EMA reports of desire, stress, and affect among 36 healthy alcohol consumers falling above NIAAA classification for low-risk drinking. Intraclass correlation coefficient (ICC) values from the models were 0.667 for stress, 0.610 for affect, and 0.197 for desire for alcohol; thus indicating 66.7% of variance in stress ratings, 61.0% of affect ratings, and 19.7% of desire ratings were between subjects, with the remaining variance present within subjects. For all three outcome variables, step-up models showed both linear and quadratic effects of time of day (see Table 2 in the Supplement) indicating that desire increased during the day, peaking late in the afternoon, and subsequently decreasing; stress increased early in the day peaked early in the afternoon and subsequently decreased; and affect increased throughout the day peaking late in the afternoon and subsequently decreasing. Adding dummy variables operationalizing the quasi-experimental design showed that desire and affect were higher, whereas stress was lower following a drink in comparison to surveys recorded prior to drinking and on abstention days. Stress was also lower prior to drinking, suggesting an anticipatory effect of consuming alcohol.

Table 3

Moderating Effects of Emotional Neglect for EMA Reports of Desire, Stress, and Affect

		Desire Coefficient (significance level)	Stress Coefficient (significance level)	Affect Coefficient (significance level)
Fixed Effects				
Intercept		0.149 (0.107)	-0.003 (0.990)	0.264 (0.182)
Moderator effect of emotional neglect		-0.007 (0.597)	0.045 (0.215)	-0.082 (0.008)
Linear Time		0.071 (<0.001)	-0.012 (0.033)	0.016 (0.003)
Moderator effect of emotional neglect		0.002 (0.050)	-0.003 (0.003)	0.002 (0.041)
Quadratic Time		-0.011 (<0.001)	-0.006 (<0.001)	-0.009 (<0.001)
Moderator effect of emotional neglect		0.0003 (0.028)	0.00008 (0.611)	0.0001 (0.502)
Dummy variable before drinking		-0.079 (0.134)	-0.250 (<0.001)	0.040 (0.498)
Moderator effect of emotional neglect		0.005 (0.564)	0.007 (0.451)	-0.008 (0.410)
Dummy variable after drinking		0.263 (<0.001)	-0.373 (<0.001)	0.191 (0.007)
Moderator effect of emotional neglect		-0.030 (0.002)	0.011 (0.309)	-0.012 (0.272)
Variance components	σ^2	0.749	0.936	0.938
	τ	0.242	1.963	1.289

The moderating effects of physical neglect on reactions to consuming alcohol were statistically significant for all three outcome measures, indicating that individuals with higher scores on physical neglect experienced smaller increases in desire and affect, and less decrease in stress after drinking in

comparison to persons with lower scores on physical neglect (see Table 4). The moderating effects of emotional neglect achieved statistical significance only for the EMA desire scores (see Table 3).

Table 4

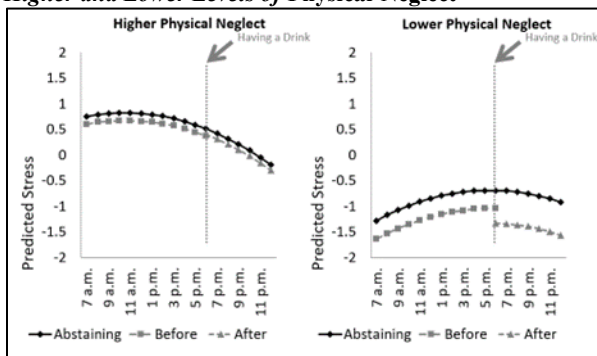
Moderating Effects of Physical Neglect for EMA Reports of Desire, Stress, and Affect

		Desire Coefficient (significance level)	Stress Coefficient (significance level)	Affect Coefficient (significance level)
Fixed Effects				
Intercept		0.1489 (0.111)	-0.003 (0.991)	0.268 (0.151)
Moderator effect of physical neglect		-0.003 (0.928)	0.144 (0.047)	-0.210 (<0.001)
Linear time		0.070 (<0.001)	-0.012 (0.034)	0.016 (0.005)
Moderator effect of physical neglect		0.004 (0.006)	-0.008 (<0.001)	0.005 (0.003)
Quadratic time		-0.011 (<0.001)	-0.006 (<0.001)	-0.009 (<0.001)
Moderator effect of physical neglect		0.0006 (0.022)	-0.00002 (0.943)	0.0006 (0.060)
Dummy variable before drinking		-0.077 (0.145)	-0.252 (<0.001)	0.041 (0.487)
Moderator effect of physical neglect		0.004 (0.820)	0.021 (0.251)	-0.020 (0.286)
Dummy variable after drinking		0.260 (<0.001)	-0.376 (<0.001)	0.191 (0.007)
Moderator effect of physical neglect		-0.062 (0.002)	0.053 (0.015)	-0.045 (0.039)
Variance components	σ^2	0.747	0.928	0.932
	τ	0.246	1.800	1.131

Sensitivity analyses involving the use of dichotomous outcome variables (highest quintiles of raw values of desire, stress, and affect versus all other scores) and a dichotomous indicator contrasting individuals with scores below the median on both physical and emotion neglect showed similar findings (see Table 6 in Supplement). That is, individuals with both lower physical and emotional neglect scores were significantly more likely to report desire scores in the highest quintile but less likely to report stress scores in the highest quintile, following drinking in comparison to individuals with a higher score on either physical or emotional neglect.

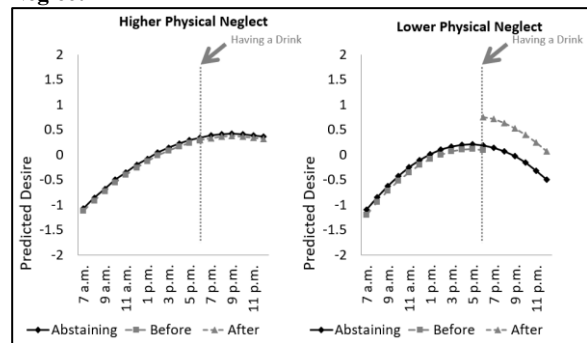
The effect on affect did not achieve statistical significance. To illustrate these findings, Figures 1, 2, and 3 depict model-predicted estimates of desire, stress, and affect scores throughout the day as a function of the quasi-experimental manipulation for three hypothetical cases namely, when people with higher (1.5 SD above the mean) and lower (1.5 SD below the mean) physical neglect scores consumed a drink at 6 p.m. Please note that interpretation of findings is based on statistical values reported in the tables; figures are provided simply to aid visualization of the overall pattern of findings.

Figure 1
Predicted Values for Stress among Individuals with Higher and Lower Levels of Physical Neglect



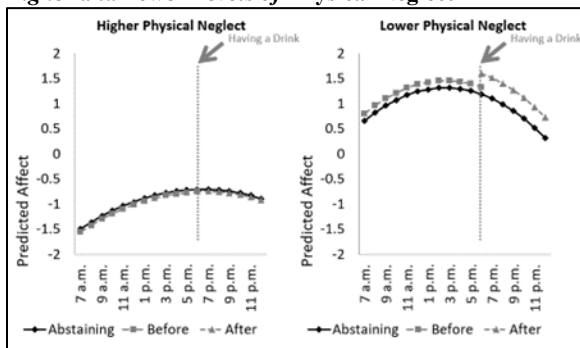
Note: Predicted values for Stress within days as a function of quasi-experimental conditions for hypothetical cases where drinking occurred at 6 p.m. (± 1.5 SD around M).

Figure 3
Predicted Values for Desire for Alcohol among Individuals with Higher and Lower Levels of Physical Neglect



Note: Predicted values for **Desire for Alcohol** within days as a function of quasi-experimental conditions for hypothetical cases where drinking occurred at 6 p.m. (± 1.5 SD around M).

Figure 2
Predicted Values for Affect among Individuals with Higher and Lower Levels of Physical Neglect



Note: Predicted values for Affect within days as a function of quasi-experimental conditions for hypothetical cases where drinking occurred at 6 p.m. (± 1.5 SD around M).

Discussion

This study explored associations between the behavioral effects of alcohol consumption with history of childhood neglect, specifically assessing desire for alcohol, affect, and stress, in healthy, habitual drinkers. We hypothesized that participants experiencing higher levels of neglect would experience higher stress, lower affect, and a greater desire to drink compared to those without childhood neglect, and that drinking would decrease stress and desire to drink while increasing affect across all participants. Overall, the findings of this study indicate that non-binging moderate to heavy drinkers with low histories of physical neglect are more likely to experience higher affect and lower stress across the day in comparison to corresponding daily drinkers with moderate to high histories of physical neglect. Although the modeling of EMA surveys in this study showed affect and stress improve as a result of consuming alcohol across the full sample of drinkers, greater benefits were observed as neglect scores decreased (specifically physical neglect), meaning that positive drinking effects were greatest for participants reporting lower physical neglect but weaker for participants with physical neglect scores in the moderate to higher range. These results suggest that moderate to heavy daily drinkers with greater histories of physical neglect experience smaller improvements following drinking. It

should be noted that although the number of EMA responses is large and the dataset rich, the sample size of participants and the composition of the sample (with limited diversity and female-dominated) are limitations which minimize the external validity of results.

It has been widely agreed upon that experiences of childhood mistreatment predispose individuals for problems in mental and physical health, as well as employment (Brady & Back, 2012; Putnam, 2006), including elevated instances of adulthood stress (Easton, 2012; Kalmakis et al., 2015; Karatekin, 2017; Manyema et al., 2018; Mosley-Johnson et al., 2021). Additionally, adverse childhood experiences have been strongly associated with heavy or chronic alcohol use, alcohol dependence, and alcohol use disorders (Evren et al., 2016; Evren et al., 2017; Frohe et al., 2019; Mirsal et al., 2004; Schafer et al., 2010; Schafer et al., 2007; Schwandt et al., 2012; Zaorska et al., 2020). Even specific components of childhood trauma, such as physical abuse or emotional neglect, have been linked to unhealthy alcohol consumption (Jose & Cherayi, 2020; Salokangas et al., 2019; Schwandt et al., 2012). It is common that people turn to alcohol to alleviate their elevated stress or improve their poor mood (Anthenelii & Grandison, 2012; Cooper et al., 1992; de Wit et al., 2006; Keyes et al., 2012; Pohorecky, 1991). The current results may suggest that adults with a history of childhood maltreatment or adverse childhood experiences accrue more limited positive effects following alcohol consumption; this could result in increased long-term alcohol use leading to alcohol misuse or the development of problem drinking. Very few studies have examined non-binging and non-AUD healthy drinkers who consume alcohol above NIAAA low risk levels, as captured in this study population, although they represent a large portion of the current drinking population. For example, it has been estimated that upwards of 50% of the US adult population report recent alcohol consumption, while only 4–15% of US adults have suffered from an AUD in the past year (GBD 2016 Alcohol Collaborators, 2018; NIAAA, 2011, 2017; Substance Abuse and Mental Health Services Administration, 2019). Additionally, this moderate to heavy drinking population is a subset of drinkers who can easily adhere to an experimental period of abstinence, a state that is not typical in their day-to-day life as they usually drink daily, without suffering dangerous withdrawal symptoms that would be experienced in those with more physiological tolerance to alcohol as seen in those with AUD. Future work could examine potential alcohol misuse among this population that may be due to weaker positive effects and subsequent increased alcohol intake.

This study was not without limitations. Primarily, this was a small sample of participants ($n=36$) even though they provided numerous survey reports. Within the small sample, the diversity of participants was extremely limited, with primarily white participants and a female-dominant sample. Although a robust pattern of results was observed, replication and extension are certainly warranted with samples that include a broader range of levels of childhood trauma. Additionally, the larger study from which these data were extracted only recruited non-binging and non-AUD drinkers, in part because this is a population of drinkers in

which it is feasible and ethical to study the biological effects of alcohol abstinence. Future studies are needed to replicate the reported results with a larger sample and to examine a wider range of alcohol consumers to discover whether these effects are unique to this drinking population or common to a wider range of drinkers including those with AUD. Additionally, the EMA data examined in this report were only collected across three days. The protocol was designed to minimize participant burden: study participants were asked to complete surveys approximately every three hours across two sequential weeks, and paid only \$25 per day of survey completion. In addition to this high level of participant response requirement, this population of drinkers was unlikely to abstain from alcohol willingly and successfully for significantly longer than this three-day period. By using a study designed to minimize participant burden, we therefore hoped to avoid participant attrition, while disrupting typical routines to the smallest degree possible, in an effort to capture ecologically valid survey responses. However, a major strength of this analysis is the use of EMA methodology, which allowed for the collection of more than 1,600 data points and which demonstrates high external validity because of the real-world context in which survey responses were collected. Although the retrospective nature of the CTQ may be a limitation of this study's design, strengths do include the fact that the stress and affect data were collected longitudinally using the EMA methodology. Additionally, the hierarchical mixed-modeling analyses used in this study allowed for the disentangling of multiple interacting effects, including time of day and pre- and post-alcohol consumption states. From this setup, the within subjects design also helps us make more causal claims about the effects of abstinence.

Overall, the currently described protocol consisted of a novel investigation of psychological experience associated with alcohol consumption in moderate to heavy everyday drinkers, moderated by reports of childhood emotional and physical neglect. The findings presented here constitute an exciting new finding, demonstrating significant differences in the drinking experience of daily drinkers with lower or more severe childhood neglect experiences.

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