THE ROLE OF DRINKING CONTEXT IN THE RELATIONSHIP BETWEEN IMPULSIVITY AND ALCOHOL USE IN DAILY LIFE

A Thesis

presented to

the Faculty of the Graduate School

at the University of Missouri-Columbia

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

---

by

ANNA PORTER

Dr. Denis McCarthy, Thesis Supervisor

DEC 2023

The undersigned, appointed by the dean of the Graduate School, have examined the thesis entitled

THE ROLE OF DRINKING CONTEXT IN
THE RELATIONSHIP BETWEEN
IMPULSIVITY AND ALCOHOL USE IN
DAILY LIFE

presented by Anna Porter,

a candidate for the degree of Master of Arts,

and hereby certify that, in their opinion, it is worthy of acceptance.

Professor Denis McCarthy

Professor Ed Merkle

Professor Brett Froeliger

ACKNOWLEDGEMENTS

I extend my heartfelt gratitude to my advisor, Dr. Denis McCarthy, whose unwavering support, guidance, and expertise have been instrumental in shaping this Master's thesis. Your dedication to excellence, patience, and insightful feedback have significantly enriched my academic journey. I am truly fortunate to have had the opportunity to learn under your mentorship.

Special thanks go to the other members of my thesis committee – Dr. Brett Froeliger and Dr. Ed Merkle. Your invaluable feedback, constructive criticism, and expert insights have significantly enriched the depth and quality of this research. The diverse perspectives each of you brought to the table have been instrumental in shaping the final outcome of this thesis.

I would also like to express my sincere appreciation to the members of the Alcohol Cognitions Lab. The collaborative environment of the lab has been a source of support and encouragement throughout this research endeavor. To my lab mates, thank you for the countless discussions, brainstorming sessions, and shared moments of both triumph and challenge. Our lab meetings were not just about science; they were a medley of inside jokes, laughter and tears, and the occasional debate over whether time is real. Thanks for turning the lab into a place where learning was not only intellectually stimulating but also hilariously entertaining.

TABLE OF CONTENTS

LIST OF TABLES

Table

LIST OF FIGURES

Figure

THE ROLE OF DRINKING CONTEXT IN THE RELATIONSHIP BETWEEN IMPULSIVITY AND ALCOHOL USE IN DAILY LIFE

Anna M. Porter

Dr. Denis McCarthy, Thesis Supervisor

ABSTRACT

Alcohol consumption among young adults is prevalent, with 29% of individuals reporting binge drinking in the past month. Impulsivity is a well-established risk factor for problematic alcohol use. However, little is known about the real-time association between momentary impulsivity and alcohol use, particularly in naturalistic settings. This study employed Ecological Momentary Assessment (EMA) to investigate the relationship between trait and state impulsivity and alcohol-related behaviors, focusing on the moderating role of drinking context. Results revealed that both state and trait impulsivity were positively associated with breath alcohol concentration (BrAC) during drinking occasions. The association between momentary impulsivity and BrAC was moderated by drinking location, showing a stronger association when away from home. There was not a significant relationship between day-level impulsivity and alcohol-related consequences. This study contributes valuable insights into the nuanced relationship between impulsivity, drinking context, and alcohol-related behaviors, highlighting the importance of considering both trait and state impulsivity measures in naturalistic settings. The findings have implications for personalized interventions targeting impulsivity and contextual factors to mitigate alcohol-related harm among young adults.

The Role of Drinking Context in the Relationship Between Impulsivity and Alcohol Use in Daily Life

Introduction

Alcohol is the most widely-used substance among young adults, with 29% reporting binge drinking in the past month (SAMHSA, 2022). Impulsivity, broadly defined as action with little forethought of consequences, is a multidimensional construct shown to be a robust risk factor for alcohol use and related consequences (Dick et al, 2010; Lejuez et al, 2010; de Wit, 2009). While individual differences in impulsivity are broadly associated with problematic alcohol use (Coskunpinar et al., 2013; Stautz & Cooper, 2013), less is understood about how event-levels changes in impulsivity are associated with alcohol use in daily life, and what environmental factors may impact the relationship between momentary impulsivity and alcohol use.

Previous work on impulsivity and alcohol use has primarily measured impulsivity using two distinct methods: 1) self-report questionnaires which conceptualize impulsivity at the global, trait level and, 2) behavioral tasks which assess impulsivity as a state-level behavior at a specific moment in time. Although behavioral tasks are useful in studying momentary impulsivity in lab-based settings, they are more difficult to utilize in naturalistic settings. There is also considerable evidence that self-report and behavioral measures of impulsivity have little convergence (Cyders & Coskunpinar, 2011), suggesting that these measures are assessing related but distinct constructs. Ecological momentary assessment (EMA) offers the ability to measure state-based impulsivity in the natural environment using the same self-report methods as trait impulsivity measures. Previous research (Tomko et al., 2014; Halvorson et al., 2021) has validated the

correlation between EMA self-report state-based and trait-based impulsivity assessments. The current study aimed to utilize EMA to explore the real-time association between trait- and state-level impulsivity and alcohol-related behaviors and consequences, with a specific focus on the moderating role of drinking context.

Measuring Impulsivity

Impulsivity is associated with a wide array of psychological disorders, including substance use disorders, gambling disorder, personality disorders, and mood disorders. However, the diverse conceptualizations and approaches to the measurement of impulsivity make it difficult to draw conclusions about what aspects of impulsivity are associated with these disorders or their symptoms. Definitions of impulsivity have often been broad and overlapping, varying not only in how impulsivity is defined, but also in the number and types of lower order factors theorized to comprise it. Many models of impulsivity focus on the construct as a trait-based, person-level variable, relatively consistent across situations and contexts (Dick et al., 2010; King et al., 2014). From this perspective, impulsivity is measured as a stable personality trait using questionnaires and self-report measures that ask participants to aggregate their behavior over a long period of time.

Trait models of impulsivity have been highly successful in identifying individuals at risk for various negative outcomes or risky behaviors (Stautz & Cooper, 2013; VanderVeen et al., 2016; Verdejo-Garcia et al., 2008; Sher & Trull, 1994). Whiteside and Lyman's UPPS model (2001) is one of the most widely used measures of trait impulsivity and is grounded in the Five Factor Model of personality (FFM; Costa & McCrae, 1999). The UPPS model incorporated previous conceptualizations of trait impulsivity into four

impulsive traits: urgency, the tendency to act rashly as a response to emotional states; lack of premeditation, the tendency to act without thinking; lack of perseverance, poor persistence with tasks; and sensation seeking, a proclivity to seek out new, stimulating experiences (Whiteside & Lyman, 2001). These impulsive traits have been shown to have unique relationships with specific alcohol use behaviors and consequences (Smith et al., 2007; Coskunpinar et al., 2013; MacKillop et al., 2007).

There is also evidence for state-like, situation-level changes in impulsivity, which may be important in understanding and predicting risky behaviors in the moment. State-based impulsivity models (Dick et al., 2010; Dougherty et al., 2002, 2005a, 2005b; Marsh et al., 2002), and the related concepts of executive function (Nigg, 2000) and cognitive control (Friedman & Miyake, 2004), have primarily employed lab-based, behavioral tasks that capture a time-limited "snapshot" of impulsive behavior. These behavioral tasks, similar to trait models, are multifactorial and tend to focus on distinct impulsive behaviors (e.g., prepotent response inhibition, delay discounting, resistance to distractor interference).

Congruity Between Trait and State Measures

Multiple efforts have been made to delineate the correspondence between self-report and behavioral task measures of impulsivity. Nigg (2000) and Dick et al., (2010) each proposed frameworks for mapping task to questionnaire measures. Nigg (2000) indicated that inhibitory processes could be categorized into four different phases of processing: interference control, cognitive inhibition, behavioral inhibition, and oculomotor inhibition. Dick et al. (2010) recommended organization into five cognitive processes and five dispositions towards rash action that would allow for the direct

comparison between task and questionnaire measures. In a meta-analytic review following the proposed framework by Dick et al. (2010), Cyders and Coskunpinar (2011) found that lack of perseverance, lack of premeditation, and negative urgency correlate with behavioral measures of prepotent response inhibition and that lack of premeditation and sensation seeking related to delay response. However, these relationships tended to be small and the construct validity of these measures is questionable (King et al., 2014, Sharma et al., 2014, Stevens et al., 2018). Other studies show no relationship between questionnaire and behavioral measures (Reynolds et al., 2006; Dick et al., 2010), indicating that these lab-based behavioral tasks may be measuring a separate aspect of impulsivity from questionnaire-based measures (Friedman & Miyake, 2004).

As Cyders and Coskunpinar (2011) illustrate, despite some shared variance between questionnaire and lab-based measures ($r = 0.097$), a larger proportion of variance is not shared. This may indicate that these measures are tapping into related but distinct constructs. Another potential explanation for this modest overlap is psychometric. Lab-based behavioral tasks provide a behavioral "snapshot", which may not be representative of an individual's aggregated levels of impulsivity over multiple occasions. In contrast, personality-based questionnaire measures of impulsivity ask individuals to aggregate behavior over longer periods of time, tapping into a more general summary of impulsivity.

Ecological momentary assessment (EMA; Stone & Shiffman, 1994) provides a potential solution for this congruity and method problem by allowing for the collection of multiple self-report assessments of impulsivity across time for the same participant. EMA also reduces recall bias and occurs in the participant's natural environment, allowing for

the assessment of situational differences that are difficult to account for in lab-based state impulsivity measures. Two validated measures, the Momentary Impulsivity Scale (MIS; Tomko et al., 2014) and EMA UPPS-P (Halvorson et al., 2021), have been developed that match methods between trait-based and state-based measures. The MIS appears to tap into the same variability as general, trait-based questionnaire measures (Stevens et al., 2020). Several studies using these EMA state-based impulsivity measures have demonstrated associations between within-person fluctuations in day-to-day impulsivity and alcohol use and related problems and suggest that these associations are moderated by individual characteristics (Stamates et al., 2019; Pedersen et al., 2019).

Situational Influences

Given this complexity in measuring impulsivity as a multidimensional construct with unique and separate trait and state conceptualizations, disentangling the momentary level effects of impulsivity on alcohol-related behavior is a significant challenge. There are clear variations in the measurement of impulsivity, the stability of impulsivity as a construct, and how that may differentially relate to in-the-moment impulsive actions. Furthermore, predicting behavior goes beyond the group level and may differ based on interactions between the individual and the situation. Fleeson (2007) argues that trait-based person-level characteristics are an aggregate of an individual's average behavior over many situations and specific situation-level variables can cause state-based behavioral deviations from person-level norms. Less is understood about what specific situational factors are important in predicting individual, state-based differences in the relationship between impulsivity and alcohol use.

Social-ecological frameworks posit that drinking-related outcomes at the event level are the product of the interaction between individual characteristics, social, locational, and situational characteristics, and alcohol use (Freisthler et al., 2014). Social context involves the number and types of people one is drinking with and the relationships between those individuals. Social drinking context is also related to alcohol consumption and risk behaviors (Beck et al., 2008; Larsen et al., 2012). Specifically, solitary drinking has shown to be related to higher levels of alcohol consumption and alcohol-related problems, lower positive alcohol expectancies, stronger coping motives, and less motivation to reduce alcohol use (Christiansen, 2002; Creswell et al., 2014; Keough et al, 2015; Keough et al., 2016; Monk & Heim, 2014; Armeli et al., 2014a,b; Blevins et al., 2018). Social drinking contexts are significant predictors of increased positive and negative alcohol expectancies (Monk & Heim, 2013a, 2013b, 2014; Bot et al., 2005, Larsen et al., 2012) and spending time with other people appears to drive alcohol consumption on days when individuals did not plan to drink (Griffin et al., 2021).

Locational context refers to the location in which one is drinking along with characteristics of that location, such as the proximity to alcohol and location-specific alcohol norms. Location may modify alcohol response; traditional lab settings are associated with greater low arousal positive effects (i.e., calm, relaxed) following alcohol consumption than a simulated bar setting (Corbin et al., 2015). Greater proportion of bars and alcohol availability within a geographic area are related to higher amounts and frequency of alcohol use (Gruenewald et al., 2014) and location is related to greater frequency of certain alcohol-related risky behaviors such as alcohol-impaired driving (Gruenewald et al., 2014; Bahler et al., 2014) and fighting (Nyaronga et al., 2009).

The Present Study

The proposed project utilized EMA to assess the relationship between self-report measures of impulsivity at both the trait and state level and alcohol consumption and related consequences across various drinking contexts. First, I tested the association of global, trait-level and momentary self-report impulsivity with alcohol use. My first hypothesis was that within a drinking event, greater momentary impulsivity would be associated with greater BrAC. I also tested whether baseline trait impulsivity moderated the association between momentary impulsivity and BrAC.

The second aim tested the effects of drinking context on the relationship between momentary impulsivity and alcohol use and related consequences. Hypothesis 2 was that there would be significant differences in impulsivity across different drinking contexts such that, within a drinking event, drinking with others (versus alone) and drinking away from home (versus at home) would be associated with higher self-reported impulsivity. My third hypothesis was that there would be significant differences in the relationship between impulsivity and BrAC across different drinking contexts, with the relationship being stronger when drinking with others (versus alone) and when drinking away from home (versus at home). My final hypothesis was that there would be significant differences in the relationship between day level impulsivity and next day reported alcohol consequences across different drinking contexts, with the relationship being stronger when drinking with others (versus alone) and when drinking away from home (versus at home). I extended previous work in this area through the use of portable breathalyzers to verify self-reported alcohol use and by including a longer (6-week)

duration of EMA self-report that allows for greater insight into the variability of alcohol-related consequences.

Methods

Participants

Participants are taken from a larger study on alcohol impaired driving. Participants were recruited from a large midwestern university and surrounding areas via study flyers and mass university emails. To be eligible, participants must have (a) been at least 21 years old and (b) report drinking 4+/5+ standard alcoholic drinks for females/males on at least one occasion within the past six months. Exclusion criteria included pregnancy or nursing, body mass index (BMI) >30 or <18, having a substance use disorder or psychiatric condition, or having any medical conditions or medication contraindications to alcohol consumption. The final sample includes 185 participants. A total of 16,024 evening reports were collected, with 10,436 of those reports including a BrAC reading.

Procedure

Overview. Participants came in for a baseline assessment of individual differences, part of which included an alcohol administration task that was not related to this study. After at least a week following the baseline assessment, participants completed six weeks of EMA reports in the morning and at specified prompts during the evening. All study procedures were approved by the University of Missouri internal review board.

EMA Procedure. Before beginning the EMA portion of the study, participants were trained on how to use the TigerAware EMA survey application (Morrison et al.,

2018) and how to measure BrAC using a portable breath alcohol analyzer. Participants completed daily morning reports 30 minutes after waking and four or five daily evening reports: 6:00 p.m., 8:00 p.m., 10:00 p.m., 12:00 a.m., and 2:00 a.m. (2:00 a.m. report added post-COVID). Pre-COVID, if participants endorsed drinking in one of the main evening reports, they received three small follow up prompts soon after the main report. Post-COVID, small evening reports were added at 7:00 p.m., 9:00 p.m., 11:00 p.m., and 1:00 a.m. Participants could also initiate reports at other times if they were consuming alcohol. Morning reports assessed whether participants consumed alcohol the previous evening. If participants reported drinking, the amount of alcohol consumed, drinking consequences, number of drinking companions, and number and type of drinking locations were collected. Evening report questionnaires also varied. Participants completed MIS state impulsivity items at all main evening drinking reports but did not complete MIS or context items in the pre-COVID follow up drinking prompts or post-COVID small evening reports. When participants reported drinking on a main evening report, amount of alcohol consumed, current number of drinking companions, and current location were collected. Participants were prompted to provide breath alcohol analyzer samples at all evening reports.

Measures

Baseline Assessments

Demographics. Demographic information, including age, sex, race, and income, was collected at baseline using a self-report survey.

Trait Impulsivity. The UPPS-P (Whiteside & Lyman, 2001; Cyders et al., 2007) is a 59-item measure assessing five domains of impulsivity: (1) Negative Urgency, (2) Positive Urgency, (3) Lack of Premeditation, (4) Lack of Perseverance, and (5) Sensation Seeking. Each item is rated on a scale from 1 (agree strongly) to 4 (disagree strongly), with higher overall sum scores relating to higher overall impulsivity. The UPPS-P is a widely used measure of trait impulsivity with good internal consistency and external validity (Whiteside & Lyman, 2001).

EMA Evening Assessments

Drinking. At each evening report, participants responded "yes" or "no" to the question "Have you been drinking in the last two hours?" If participants responded "yes", they were prompted to report how many standard alcoholic drinks they had consumed up to that point. At each evening drinking report, participants were prompted to blow into the breathalyzer. Participants were not provided with their breathalyzer reading.

Drinking Context. At each evening drinking report, participants were prompted to report who they were with and where they were located. Types of drinking companions included romantic partner, friend, coworker, child, parent, other family member, and other. Locations included home, bar, restaurant, friend's home, outside, and other public location.

Impulsivity. Self-report impulsivity was assessed during evening EMA prompts using the Momentary Impulsivity Scale (MIS; Tomko et al., 2014). This 4-item measure of state impulsivity asks participants to rate their current impulsivity on a 5-point Likert scale ranging from 1 (very slightly/not at all) to 5 (extremely). Examples of items include

"I said things without thinking" and "I have felt impatient". The MIS has shown high content validity with other traditional scales of impulsivity (Tomko et al., 2014; Stamates et al., 2018).

EMA Morning Assessments

Drinking. At each morning report, participants responded "yes" or "no" to the question "Did you drink last night?" If participants responded "yes", they were prompted to report how many standard alcoholic drinks they consumed the previous evening.

Drinking Consequences. If participants reported drinking the previous evening, they were prompted to report any consequences that occurred as a result of drinking. Consequences spanned a wide range, including physical (e.g. hangover), interpersonal (e.g. problems with your friends), and risky behaviors (e.g. drove a car when you knew you had too much to drink).

Data Analytic Strategy

Multilevel models were used to account for the interdependence of repeated observations within the same individual. Observations were nested within three levels: moment, day, and individual. Individual-level variables included age, sex, and baseline UPPS score. Day-level variables included drinking consequences (coded 1 = experienced a drinking consequence, 0 = did not experience a drinking consequence) and whether it was a weekend (coded 1 = weekend, 0 = weekday). Day-level predictors were centered on person-level means. Momentary-level variables included time, BrAC, drinking location (coded 1 = away from home, 0 = at home), drinking companions (coded 1 = with others, 0 = alone), and MIS score. Momentary-level predictors were centered on day-

level means. Only momentary reports that included a positive breathalyzer reading were included in analyses. Additionally, reports were excluded that had missing data for one of the main predictor variables. Next-day reports were lagged by one day to match previous-day assessments.

All analyses were performed using R Studio (version 2023.06.2). In all analyses, I specified random intercepts and added fixed effects of time. Age, sex, and weekend were included as covariates. Analyses for hypothesis 1 included MIS scores (momentary-level) as a predictor of BrAC (momentary-level). I then added the interaction between baseline UPPS score (individual-level) and MIS scores (momentary-level) to test whether baseline impulsivity moderated individual differences in the association between momentary impulsivity and alcohol use. Analyses for hypothesis 2 included location (momentary-level) and drinking companions (momentary-level) as predictors of MIS score (momentary-level). Analyses for hypothesis 3 included location (momentary-level) and drinking companions (momentary-level) as moderators of the relationship between MIS score (momentary-level) and BrAC (momentary-level). Hypothesis 4 tested location (day mean) and drinking companions (day mean) as moderators of the relationship between MIS score (day mean) and alcohol consequences (day-level).

Results

A total of 2,854 drinking reports were included in analyses. There was an average of 8.45 drinking days per participant (range = 1-33) and, on drinking days, participants reached an average BrAC of 0.054 g% (range = 0.007 – 0.25 g%, *SD* = 0.05).

Hypothesis 1

Both within-person MIS scores ($b = 0.017$, $p < 0.001$) and between-person total UPPS score ($b = 0.0002$, $p = 0.015$) were positively associated with BrAC during drinking occasions. However, UPPS total score did not significantly moderate the association between MIS scores and BrAC. Separate models were run for each of the UPPS subfacets. Positive urgency ($b = 0.001$, $p = 0.004$), lack of perseverance ($b = 0.0002$, $p = 0.015$), and sensation seeking ($b = 0.009$, $p = 0.005$) were positively associated with BrAC, but did not moderate the association between MIS scores and BrAC. There was also a main effect of age, with age being negatively associated with BrAC ($b = -0.002$, $p < 0.001$).

Hypothesis 2

Drinking location was a significant predictor of MIS scores, with locations away from home (versus at home) being associated with higher MIS scores ($b = 0.127$, $p < 0.001$). Drinking companions were a significant predictor of MIS scores, such that drinking with others (versus alone) was associated with higher MIS scores ($b = 0.061$, $p = 0.020$).

Hypothesis 3

Drinking location moderated the association between MIS scores and BrAC ($b = 0.012$, $p = 0.022$; see Table 1). Moments in which individuals reported higher MIS scores than their average were associated with higher BrAC, and this relationship was stronger in locations away from home (versus at home; see Figure 1). There was also a main effect of drinking location on BrAC ($b = 0.019$, $p < 0.001$). Drinking companions did not moderate the association between MIS score and BrAC. There was a main effect of

drinking companions on BrAC (b = 0.015, p < 0.001). There was also a main effect of age on BrAC (b = -0.002, p = 0.003).

Hypothesis 4

Day-level drinking location and drinking companions did not moderate the association between MIS scores and alcohol consequences. Day-level within- and between-person MIS scores were not significantly associated with experiencing alcohol consequences. There was a main effect of day-level location on alcohol consequences (b = 0.392, p = 0.011). On days where a greater proportion of drinking moments were away from home, the likelihood of experiencing an alcohol-related consequence was significantly higher. There were also main effects of between- (b = -0.084, p = 0.020) and within-person (b = 0.073, p < 0.001) BrAC on alcohol consequences. Individuals with a lower average BrAC (between-person) were more likely to experience an alcohol-related consequence. On days when an individual's average BrAC was higher than their average BrAC throughout the study, the likelihood of experiencing an alcohol-related consequence was significantly higher.

Discussion

Impulsivity is a robust predictor of alcohol use and related problems (Coskunpinar et al., 2013; Stautz & Cooper, 2013), however little research has examined the relationship between event-level impulsivity and alcohol use in daily life. Although behavioral task measures of impulsivity can provide in-the-moment "behavioral snapshots" of impulsivity, they are difficult to use in real world environments and show little convergence with self-report measures of impulsivity (Cyders & Coskunpinar,

2011). The current study addressed this gap by utilizing EMA to examine the relationship between event-level self-report measures of impulsivity and alcohol use and alcohol-related consequences in daily life and testing whether this relationship differed by drinking context. Overall, results indicated that momentary impulsivity was significantly associated with alcohol use during drinking events and that this association differed across drinking locations. Specifically, during events in which individuals reported greater than usual impulsivity, they also reached a higher BrAC and this relationship was stronger when they were drinking in locations away from home (as opposed to drinking at home). These findings are consistent with a growing literature supporting within-person variability in impulsivity as an important predictor of alcohol use in daily life (Pedersen et al., 2019; Stamates et al., 2019; Trull et al., 2016). Importantly, this study is the first to use objective measurements of alcohol use (BrAC) to validate this relationship, as previous studies have solely relied on participant self-report of alcohol use.

Although a significant relationship was observed between momentary impulsivity and alcohol use, I did not find a significant relationship between day-level impulsivity and alcohol-related consequences. This is contrary to a large body of literature implicating impulsivity as a strong predictor of negative alcohol-related consequences (Stautz & Cooper, 2013). However, in contrast to prior studies, the current study examined alcohol consequences as a dichotomous outcome, and did not examine either the number or type of alcohol-related consequences. Future research may wish to include a broader range of consequences to better account for how within-person variation in impulsivity may relate to specific types of alcohol consequences.

Results also did not support the hypothesis that trait-level impulsivity moderated the association between momentary impulsivity and alcohol use. In other words, individuals with higher self-reported trait impulsivity do not show a stronger momentary relationship between impulsivity and alcohol use. Previous work has shown similar results, with Feil and colleagues (2020) finding that global trait negative urgency did not moderate the momentary relationship between negative affect and impulsive behaviors. There was, however, a main effect of both trait and momentary measures of self-report impulsivity on alcohol use. This suggests that both trait and momentary impulsivity make unique contributions to event-level alcohol consumption and suggests that each need to be accounted for to understand the impact of impulsivity on alcohol use. Furthermore, this study did not examine specific facets of state impulsivity (e.g., urgency, lack of premeditation) or other aspects of alcohol use that may be differentially related to trait and state impulsivity (e.g., rate of alcohol consumption). Previous work has demonstrated that distinct facets of self-report impulsivity have unique associations with specific alcohol use behaviors (McCarty et al. 2017; Smith et al., 2007). Future work is needed to test the interplay between trait and momentary impulsivity across impulsivity facets and aspects of consumption.

Consistent with my hypotheses, drinking context was an important predictor of alcohol use. My findings that there were main effects of drinking location and drinking companions on BrAC were consistent with previous literature showing that both social and physical aspects of drinking context are related to drinking behaviors (Stanesby et al., 2019). Moderation effects on the relationship between momentary impulsivity and BrAC varied between social versus physical contexts. While being away from home was a

significant moderator of the relationship between momentary impulsivity and BrAC, being with others (versus alone) did not significantly moderate this association. These may be due the lack of detail collected about characteristics of drinking companions. Particularly for young adults, heavy drinking seems to be primarily associated with being around a large group of friends who are also drinking heavily (Trim et al., 2011). However, this relationship may differ according to other group characteristics. For example, drinking groups with low expectations about alcohol use are associated with lighter drinking compared to drinking groups with high expectations about alcohol use (Bourdeau et al., 2017). Thus, future studies examining the relationship between drinking context, impulsivity, and alcohol use may benefit from inclusion of additional characteristics of the social drinking environment that may be specific to impulsivity-related drinking risk.

There are several key limitations to the present study. First, our sample was comprised of primarily White individuals recruited from a university area, which may limit generalizability of the current findings. For example, previous work has found differences in the developmental course of specific facets of impulsivity and their relationship to alcohol use in European American versus African American individuals (Pedersen et al., 2012). Given the focus on drinking context in the present study, it should be noted that the majority of data for the current project was collected during the COVID-19 pandemic. Results must be interpreted with caution given the limited breadth and variability of drinking contexts due to COVID-19 social distancing measures. The current study also did not examine the bidirectionality of the relationship between momentary impulsivity and alcohol use. It may be the case that momentary impulsivity

and alcohol-related behaviors exhibit a reciprocal relationship in which impulsivity in one moment may impact alcohol use which may further produce changes in momentary impulsivity. Furthermore, the sampling time frame may not have been frequent enough to capture the true nature of the relationship between momentary impulsivity and alcohol use. Future studies examining this relationship may wish to use more frequent sampling during drinking events and to look at the potential bidirectionality of this relationship.

Overall, the present study indicates that higher momentary impulsivity is associated with higher alcohol consumption during drinking occasions and that specific drinking contexts can impact the strength of this relationship. These findings highlight the importance of within-person variation in impulsivity as a predictor of alcohol use in real-world drinking environments, over and above trait impulsivity. This study also has important implications for the role of drinking context by providing preliminary evidence that social aspects of drinking context can change the relationship between momentary impulsivity and alcohol use. Further research is needed to understand how specific state impulsivity facets may differentially relate to other aspects of alcohol use and number and types of alcohol-related consequences.

References

Armeli, S., Dranoff, E., Tennen, H., Austad, C. S., Fallahi, C. R., Raskin, S., Wood, R., & Pearlson, G. (2014a). A longitudinal study of the effects of coping motives, negative affect and drinking level on drinking problems among college students. *Anxiety, Stress, & Coping, 27*(5), 527–541.

Armeli, S., O'Hara, R. E., Ehrenberg, E., Sullivan, T. P., & Tennen, H. (2014b). Episode-Specific Drinking-to-Cope Motivation, Daily Mood, and Fatigue-Related Symptoms Among College Students. *Journal of Studies on Alcohol and Drugs, 75*(5), 766–774.

Bähler, C., Dey, M., Dermota, P., Foster, S., Gmel, G., & Mohler-Kuo, M. (2014). Does Drinking Location Matter? Profiles of Risky Single-Occasion Drinking by Location and Alcohol-Related Harm among Young Men. *Frontiers in Public Health, 2*, 64.

Beck, K. (2008). Social Context of Drinking and Alcohol Problems Among College Students. *American Journal of Health Behavior, 32*(4). https://doi.org/10.5993/AJHB.32.4.9

Blevins, C. E., Abrantes, A. M., & Stephens, R. S. (2018). The relationship between situational determinants of use and drinking motives. *Addiction Research & Theory, 26*(1), 28–34.

Bourdeau, B., Miller, B. A., Voas, R. B., Johnson, M. B., & Byrnes, H. F. (2017). Social drinking groups and risk experience in nightclubs: Latent class analysis. *Health, risk & society*, *19*(5-6), 316-335.

Bot, S. M., Engels, R. C. M. E., & Knibbe, R. A. (2005). The effects of alcohol expectancies on drinking behaviour in peer groups: observations in a naturalistic setting. *Addiction, 100*(9), 1270–1279.

Christiansen, M., Vik, P. W., & Jarchow, A. (2002). College student heavy drinking in social contexts versus alone. *Addictive Behaviors, 27*(3), 393–404.

Corbin, W. R., Scott, C., Boyd, S. J., Menary, K. R., & Enders, C. K. (2015). Contextual influences on subjective and behavioral responses to alcohol. *Experimental and Clinical Psychopharmacology, 23*(1), 59–70.

Coskunpinar, A., Dir, A. L., & Cyders, M. A. (2013). Multidimensionality in Impulsivity and Alcohol Use: A Meta-Analysis Using the UPPS Model of Impulsivity. *Alcoholism: Clinical and Experimental Research, 37*(9), 1441–1450.

Costa, P. T., & McCrae, R. R. (1999). A five-factor theory of personality. *The five-factor model of personality: Theoretical perspectives*, *2*, 51-87.

Creswell, K. G., Chung, T., Clark, D. B., & Martin, C. S. (2014). Solitary Alcohol Use in Teens Is Associated With Drinking in Response to Negative Affect and Predicts Alcohol Problems in Young Adulthood. *Clinical Psychological Science, 2*(5), 602–610.

Cyders, M. A., & Coskunpinar, A. (2011). Measurement of constructs using self-report and behavioral lab tasks: Is there overlap in nomothetic span and construct representation for impulsivity? *Clinical Psychology Review, 31*(6), 965–982.

Cyders, M. A., Smith, G. T., Spillane, N. S., Fischer, S., Annus, A. M., & Peterson, C. (2007). Integration of impulsivity and positive mood to predict risky behavior: development and validation of a measure of positive urgency. *Psychological assessment*, *19*(1), 107.

de Wit, H. (2009). Impulsivity as a determinant and consequence of drug use: a review of underlying processes. *Addiction Biology*, *14*(1), 22–31.

Dick, D. M., Smith, G., Olausson, P., Mitchell, S. H., Leeman, R. F., O'Malley, S. S., & Sher, K. (2010). REVIEW: Understanding the construct of impulsivity and its relationship to alcohol use disorders. *Addiction Biology, 15*(2), 217–226.

Dougherty, D. M. (2005a). The conceptualization and role of impulsivity: Bipolar disorder and substance abuse. *Psychiatric Times*, *22*(8), 30-30.

Dougherty, D. M., Marsh, D. M., & Mathias, C. W. (2002). Immediate and delayed memory tasks: A computerized behavioral measure of memory, attention, and impulsivity. *Behavior Research Methods, Instruments, & Computers*, *34*(3), 391–398.

Dougherty, D. M., Mathias, C. W., Marsh, D. M., & Jagar, A. A. (2005b). Laboratory behavioral measures of impulsivity. *Behavior Research Methods*, *37*(1), 82-90.

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

Fleeson, W. (2007). Situation-Based Contingencies Underlying Trait-Content Manifestation in Behavior. *Journal of Personality*, *75*(4), 825–862.

Freisthler, B., Lipperman-Kreda, S., Bersamin, M., & Gruenewald, P. J. (2014). Tracking the When, Where, and With Whom of Alcohol Use. *Alcohol Research: Current Reviews*, *36*(1), 29–38.

Friedman, N. P., & Miyake, A. (2004). The relations among inhibition and interference control functions: a latent-variable analysis. *Journal of experimental psychology: General*, *133*(1), 101.

Griffin, S. A., Freeman, L. K., & Trull, T. J. (2021). Predictors of unplanned drinking in daily life: The influence of context, impulsivity, and craving in those with emotion dysregulation. *Addictive Behaviors*, *118*, 106901.

Gruenewald, P. J., Remer, L. G., & LaScala, E. A. (2014). Testing a social ecological model of alcohol use: the California 50-city study. *Addiction*, *109*(5), 736–745.

Halvorson, M. A., Pedersen, S. L., Feil, M. C., Lengua, L. J., Molina, B. S. G., & King, K. M. (2021). Impulsive States and Impulsive Traits: A Study of the Multilevel Structure and Validity of a Multifaceted Measure of Impulsive States. *Assessment*, *28*(3), 796–812. 1

Keough, M. T., Battista, S. R., O'Connor, R. M., Sherry, S. B., & Stewart, S. H. (2016). Getting the party started--Alone: Solitary predrinking mediates the effect of social anxiety on alcohol-related problems. *Addictive Behaviors*, *55*, 19–24.

Keough, M. T., O'Connor, R. M., Sherry, S. B., & Stewart, S. H. (2015). Context counts: Solitary drinking explains the association between depressive symptoms and alcohol-related problems in undergraduates. *Addictive Behaviors*, *42*, 216–221.

King, K. M., Patock-Peckham, J. A., Dager, A. D., Thimm, K., & Gates, J. R. (2014). On the Mismeasurement of Impulsivity: Trait, Behavioral, and Neural Models in Alcohol Research among Adolescents and Young Adults. *Current Addiction Reports*, *1*(1), 19–32.

Larsen, H., Engels, R. C. M. E., Wiers, R. W., Granic, I., & Spijkerman, R. (2012). Implicit and explicit alcohol cognitions and observed alcohol consumption: three studies in (semi)naturalistic drinking settings. *Addiction*, *107*(8), 1420–1428.

Lejuez, C. W., Magidson, J. F., Mitchell, S. H., Sinha, R., Stevens, M. C., & Wit, H. D. (2010). Behavioral and Biological Indicators of Impulsivity in the Development of Alcohol Use, Problems, and Disorders. *Alcoholism: Clinical and Experimental Research*, *34*(8), 1334–1345.

MacKillop, J., Mattson, R. E., Anderson MacKillop, E. J., Castelda, B. A., & Donovick, P. J. (2007). Multidimensional assessment of impulsivity in undergraduate hazardous drinkers and controls. *Journal of Studies on Alcohol and Drugs*, *68*(6), 785-788.

Marsh, D. M., Dougherty, D. M., Mathias, C. W., Moeller, F. G., & Hicks, L. R. (2002). Comparisons of women with high and low trait impulsivity using behavioral models of response-disinhibition and reward-choice. *Personality and Individual Differences*, *33*(8), 1291–1310.

McCarty, K. N., Morris, D. H., Hatz, L. E., & McCarthy, D. M. (2017). Differential associations of UPPS-P impulsivity traits with alcohol problems. *Journal of studies on alcohol and drugs*, *78*(4), 617-622.

Monk, R., & Heim, D. (2013a). Environmental Context Effects on Alcohol-Related Outcome Expectancies, Efficacy, and Norms: A Field Study. *Psychology of Addictive Behaviors : Journal of the Society of Psychologists in Addictive Behaviors*, *27*, 814–818.

Monk, R. L., & Heim, D. (2013b). A Critical Systematic Review of Alcohol-Related Outcome Expectancies. *Substance Use & Misuse*, *48*(7), 539–557.

Monk, R. L., & Heim, D. (2014). A Real-Time Examination of Context Effects on Alcohol Cognitions. *Alcoholism: Clinical and Experimental Research*, *38*(9), 2454–2459.

Morrison, W., Guerdan, L., Kanugo, J., Trull, T., & Shang, Y. (2018, June). TigerAware: An innovative mobile survey and sensor data collection and analytics system. In 2018 IEEE third international conference on Data Science in Cyberspace (DSC) (pp. 115-122). IEEE.

Nigg, J. T. (2000). On inhibition/disinhibition in developmental psychopathology: Views from cognitive and personality psychology and a working inhibition taxonomy. *Psychological Bulletin*, *126*(2), 220–246.

Nyaronga, D., Greenfield, T. K., & McDaniel, P. A. (2009). Drinking Context and Drinking Problems Among Black, White, and Hispanic Men and Women in the

1984, 1995, and 2005 U.S. National Alcohol Surveys. *Journal of Studies on Alcohol and Drugs*, *70*(1), 16–26.

Pedersen, S. L., King, K. M., Louie, K. A., Fournier, J. C., & Molina, B. S. G. (2019). Momentary fluctuations in impulsivity domains: Associations with a history of childhood ADHD, heavy alcohol use, and alcohol problems. *Drug and Alcohol Dependence*, *205*, 107683.

Pedersen, S. L., Molina, B. S., Belendiuk, K. A., & Donovan, J. E. (2012). Racial differences in the development of impulsivity and sensation seeking from childhood into adolescence and their relation to alcohol use. *Alcoholism: Clinical and Experimental Research*, *36*(10), 1794-1802.

Reynolds, B., Ortengren, A., Richards, J. B., & de Wit, H. (2006). Dimensions of impulsive behavior: Personality and behavioral measures. *Personality and Individual Differences*, *40*(2), 305–315.

Sharma, L., Markon, K. E., & Clark, L. A. (2014). Toward a theory of distinct types of "impulsive" behaviors: A meta-analysis of self-report and behavioral measures. *Psychological Bulletin*, *140*(2), 374–408.

Sher, K., & Trull, T. (1994). Personality and Disinhibitory Psychopathology: Alcoholism and Antisocial Personality Disorder. *Journal of Abnormal Psychology*, *103*, 92–102.

Smith, G. T., Fischer, S., Cyders, M. A., Annus, A. M., Spillane, N. S., & McCarthy, D. M. (2007). On the Validity and Utility of Discriminating Among Impulsivity-Like Traits. *Assessment*, *14*(2), 155–170.

Stamates, A. L., Linden-Carmichael, A. N., Preonas, P. D., & Lau-Barraco, C. (2019). Testing daily associations between impulsivity, affect, and alcohol outcomes: a pilot study. *Addiction Research & Theory*, *27*(3), 242–248.

Stanesby, O., Labhart, F., Dietze, P., Wright, C. J. C., & Kuntsche, E. (2019). The contexts of heavy drinking: A systematic review of the combinations of context-related factors associated with heavy drinking occasions. *PLOS ONE*, *14*(7), e0218465.

Stautz, K., & Cooper, A. (2013). Impulsivity-related personality traits and adolescent alcohol use: A meta-analytic review. *Clinical Psychology Review*, *33*(4), 574–592.

Stevens, A. K., Blanchard, B. E., & Littlefield, A. K. (2018). Impulsive dispositions and alcohol: what we know, how we know it, and where to go from here. *Borderline Personality Disorder and Emotion Dysregulation*, *5*(1), 4.

Stevens, A. K., Blanchard, B. E., Talley, A. E., Brown, J. L., Halvorson, M. A., Janssen, T., King, K. M., & Littlefield, A. K. (2020). State-level impulsivity, affect, and alcohol: A psychometric evaluation of the momentary impulsivity scale across two intensive longitudinal samples. *Journal of Research in Personality*, *85*, 103914.

Stone, A. A., & Shiffman, S. (1994). Ecological momentary assessment (EMA) in behavorial medicine. *Annals of behavioral medicine*.

Substance Abuse and Mental Health Services Administration. (2022). *Key substance use and mental health indicators in the United States: Results from the 2021 National*

Survey on Drug Use and Health (HHS Publication No. PEP22-07-01-005, NSDUH Series H-57). Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration. https://www.samhsa.gov/data/report/2021-nsduh-annual-national-report

Tomko, R. L., Carpenter, R. W., Brown, W. C., Solhan, M. B., Jahng, S., Wood, P. K., & Trull, T. J. (2014). Measuring Impulsivity in Daily Life: The Momentary Impulsivity Scale. *Psychological Assessment*, *26*(2), 339–349.

Trim, R. S., Clapp, J. D., Reed, M. B., Shillington, A., & Thombs, D. (2011). Drinking plans and drinking outcomes: Examining young adults' weekend drinking behavior. *Journal of drug education*, *41*(3), 253-270.

Trull, T. J., Wycoff, A. M., Lane, S. P., Carpenter, R. W., & Brown, W. C. (2016). Cannabis and alcohol use, affect and impulsivity in psychiatric out-patients' daily lives. *Addiction*, *111*(11), 2052-2059.

VanderVeen, J. D., Hershberger, A. R., & Cyders, M. A. (2016). UPPS-P model impulsivity and marijuana use behaviors in adolescents: A meta-analysis. *Drug and Alcohol Dependence*, *168*, 181–190.

Verdejo-García, A., Lawrence, A. J., & Clark, L. (2008). Impulsivity as a vulnerability marker for substance-use disorders: Review of findings from high-risk research, problem gamblers and genetic association studies. *Neuroscience & Biobehavioral Reviews*, *32*(4), 777–810.

Whiteside, S. P., & Lynam, D. R. (2001). The Five Factor Model and impulsivity: using a structural model of personality to understand impulsivity. *Personality and Individual Differences*, *30*(4), 669–689.

Table 1

Location moderating the association between momentary impulsivity and BrAC

		95% CI		
Variable	Estimate	Lower	Upper	*p*
Intercept	**0.035**	0.028	0.043	**<.001**
MIS Mean Within	0.006	-0.002	0.015	.120
MIS Mean Between	-0.001	-0.012	0.009	.800
Location	**0.019**	0.014	0.023	**<.001**
Hour	**0.006**	0.005	0.007	**<.001**
Sex	-0.006	-0.015	0.002	.145
Weekend	-0.002	-0.005	0.002	.437
Age	**-0.002**	-0.003	-0.001	**.004**
MIS Mean Within:Location	**0.012**	0.002	0.022	**.022**

Figure 1.

Location moderating the association between momentary impulsivity and BrAC