EXAMINATION OF A BI-DIRECTIONAL RELATIONSHIP BETWEEN URGENCY AND ALCOHOL USE

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The proposed study examined whether negative urgency and positive urgency are dynamic traits that hold bi-directional relationships with binge and prolonged alcohol use across time. Individuals between the ages of 18-30 were recruited from Amazon Mechanical Turk (MTurk; n = 179) and university student (n = 66) pools. Participants completed three batteries of self-report assessments approximately 30 days apart, each containing measures assessing negative and positive urgency, as well as drinking frequency and binge behavior during the prior month. Latent variable cross-lagged panel models examined the effects of alcohol use from the previous month on negative and positive urgency while controlling for concurrent and autoregressive effects. Results of the current study indicated that for the full sample, there was not an effect for the influence of binge/prolonged drinking on either negative or positive urgency during the subsequent month. However, when examined separately by sample (Turkers vs. university) and gender (male vs. female), significant effects were found more for individuals who were Turkers, male, and/or heavy drinkers, suggesting that increases in positive and negative urgency at Time 2 could be partially explained by variance in drinking patterns at Time 1 for these individuals. However, these relationships were not replicated again between Time 2 and Time 3 due to a decrease in all drinking behaviors during these times. Lastly, the study found that while urgency scores were related to psychosocial problems and dependence symptoms associated with drinking, there was no evidence to support that urgency scores had substantial relationships to specific frequency and/or bingeing behavior across the overall sample, although positive urgency had support for a relationship with bingeing, particularly

among heavily drinking men. Thus, while the primary findings did not indicate any effects for a general sample of young adults, the effects observed among heavy male drinkers in the present study add to a growing body of literature indicating potential for interactive effects among personality, environmental, and sociobiological factors across the trajectory of the human lifespan. Future research that continues to examine urgency and how it relates to alcohol use in longitudinal contexts, utilizing diverse samples, is warranted.

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To my husband Terr, the love of my life, my best friend, my partner in sickness and health,

PhD's and everything else.

To Dr. Adinoff, who opened a window and

kept an unwavering faith in me through out. Thank you.

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CHAPTER 1

INTRODUCTION

1.1 Public Health Significance of Alcohol Use

It is estimated that one in four deaths in the United States can be attributed either directly, indirectly, or to the disease burden related to alcohol, tobacco, and illicit drug use (National Institute on Drug Abuse, 2012). In addition to increased mortality, alcohol and drug misuse present a significant economic burden to the United States, with an estimated $700 billion annual cost related to crime, lost work productivity, and health care (National Drug Intelligence Center, 2011; SAMHSA, 2014). Data from the National Survey on Drug Use and Health (SAMHSA, 2014) report that in 2014, slightly more than half of Americans above the age of twelve endorsed current alcohol consumption. Individuals in early life are especially susceptible towards the problematic use of alcohol – that is, heavy frequent and/or binge drinking – which tends to increase as individuals progress through late adolescence and peaks at about 22 years of age (Fillmore, 1988; Johnstone, 1996).

Problematic drinking among individuals in adolescence and young adulthood is a significant risk factor in the development of alcohol use disorder (AUD); for example, approximately 20% of college students meet the criteria for an AUD (Blanco, 2008). Individuals with problematic alcohol use are also at substantially increased risk of experiencing significant negative life consequences such as illness, missed school or work, or car crashes (Ellickson, 1996). Identification of individuals in adolescence/early adulthood with problematic alcohol consumption, before dependence occurs, bears significant clinical and societal implications. Specifically, it allows for early intervention or preventative measures to be implemented when

such efforts may be particularly impactful to the development and trajectory of AUDs throughout the lifespan (Conrod, et al.,; Medicine, 2009).

1.2 Personality as a Risk Factor for Problematic Alcohol Use

1.2.1 Impulsivity

Impulsivity is a construct that has been closely studied in relation to addiction and substance use disorders (SUDs), including AUDs, as well as problematic drinking among both children and adults. Individuals with SUDs consistently score higher on measures of impulsivity (Schutz, 2014). Furthermore, longitudinal studies have inferred that impulsivity is pre-existent to the development of SUDs and could be considered a vulnerability marker (Verdejo-Garcia, 2008). Impulsivity may be particularly relevant to clinical outcomes as well; individuals who are high in impulsivity tend to have less optimistic SUD treatment outcomes, including higher rates of relapse and treatment dropout across nicotine, alcohol, marijuana, cocaine, and opiate use disorders (Loree, 2014).

Impulsivity is conventionally defined as a behavioral tendency to act without adequate forethought or consideration of consequences, or as a predisposition towards rapid, unplanned reactions to internal or external stimuli (Sharma, 2014). However, as a relatively older construct that has been examined across a multitude of fields, the study of impulsivity has suffered from lack of a concise definition or operationalization among researchers (Castellanos-Ryan, 2016). Various models encompass biopsychological, neuropsychological, and/or personality-based perspectives; among these, impulsivity tends to either overlap with or be distinguished from constructs such as disinhibition and sensation seeking (Berg, Latzman, Bliwise, & Lilienfeld, 2015). Assessment methodologies are likewise highly diverse and include a plethora of observational reports, lab-based tasks, and physiological or self-report measures.

A consensus among many researchers has pointed towards an understanding of impulsivity as a multi-dimensional trait that is comprised of a combination of several separate, distinct sub-constructs (Coskunpinar, 2013; Cyders & Smith, 2008). In 1959, development of the self-report Barratt Impulsiveness Scale (BIS; Barratt, 1994) and subsequent revisions emphasized impulsivity as a multi-dimensional construct that was orthogonal to anxiety and neuroticism. The BIS-11, developed in 1995, modeled impulsivity as containing attentional, motor, and non-planning impulsiveness domains. Gray's Reinforcement Sensitivity Theory (RST; Gray, 1991) of personality yielded a more physio-biological approach to impulsiveness/personality research. Specifically, Gray hypothesized that while the Behavioral Inhibition System (BIS) may drive an organism to withdraw or avoid a stimuli, the Behavioral Activation System (BAS) drives an organism to approach stimuli. An individual with a relatively higher BAS would be more driven towards reward, and thus, more impulsive, while an individual who is higher in BIS would be more punishment-sensitive and thus, more restrained.

Such descriptive, personality-driven research emphasized the presence increased of reward responsiveness combined with an inability to plan or focus on tasks among high-impulsive individuals. Other research, particularly laboratory-based behavioral paradigms, also tends to emphasize that to be high on impulsivity necessitates an inability to inhibit an oncoming impulse. Such lab-based tasks include the marshmallow test (Walter, 1972), which tests a child's ability to delay the reception of smaller, immediate rewards in favor of larger, delayed rewards. Delayed discounting tasks also present subjects with a choice between smaller, more immediate rewards and larger, delayed rewards (Madden, 2010). Other lab-based tasks, such as the go/no-go and stop-signal reaction time tasks, the Iowa Gambling Task (IGT) and the Stroop test, measure behavioral inhibition in the absence of reward, instead observing that there exists

significant individual variation in the ability to engage in response inhibition, or the suppress motor or cognitive actions that are no longer required or inappropriate.

1.2.2 Neuroticism

While a large body of addiction/substance use research continues to maintain focus specifically on impulsivity, many personality-centered approaches have been used to represent a broad personality profile of addiction (Berg et al., 2015). Despite different nomenclature across assessments, impulsivity and neuroticism tend to comprise the most prominent personality features of those who are at risk for problematic substance use and SUDs (Ibáñez, 2010; Malouff, 2007; Ruiz, 2008; Solomon, 2009). Neuroticism, like impulsivity, is a relatively older construct that has been observed in writing for thousands of years, dating back to Hippocrates of ancient Greece (Singer, 1962). Also like impulsivity, it is considered to be multidimensional, with modern conceptualizations also rooted in bio-psychological theory. In the 1980s, Eysenck observed that there exists significant individual variation in response to environmental threat; high-neuroticism individuals tended to exhibit increased response to threat while also perceiving more threat cues in their environment (Ebstrup, 2011; Eysenck, 1985). Individuals with high-neuroticism also exhibit a general propensity towards the experience of increased negative emotionality, including fear, anxiety, anger, and depressed mood; in turn, high-neuroticism individuals are more likely to be diagnosed with mood, anxiety, and SUDs (Kotov, 2010; Lahey, 2009; Mullan M, 1986; Ormel et al., 2013). Also akin to the construct of impulsivity, ongoing research suggests that even more than being associated with SUDs, neuroticism is pre-existing risk factor, or endophenotype, for their onset (Belcher, 2014; Ersche, 2012).

Personality inventories that assess across the dimensions of impulsivity and neuroticism include the Temperament and Character Inventory (TCI; Cloninger, 1994) and the NEO-PI-R

(McCrae & Costa, 1987; McCrae, 1990). The TCI identifies an individual as high on impulsivity when he or she self-reports as being low on the subscales of Self-Directedness, high on Reward Dependence, and high on Novelty-Seeking (Acton, 2003; Piedmont, McCrae, & Costa, 1992), while high-neuroticism is associated with low Self-Directedness. The NEO-PI-R, in turn, is based off of the Five Factor Model (FFM; Costa & McCrae, 1978), which characterizes Neuroticism as one of the five factors which comprise normal personality, along with Extraversion, Agreeableness, Conscientiousness, and Openess to Experience.

Across both the TCI and the NEO-PI-R, neuroticism is associated with impulsivity (Fetterman, 2010), but the nature of its relationship to impulsivity is not entirely clear. For example, the FFM/NEO-PI-R associates impulsivity with low Agreeableness and low Conscientiousness. However, impulsivity itself is also represented on the FFM as a subscale of Neuroticism. In a conceptual convergence with other research, this indicates that impulsivity is a heterogeneous construct (Berg et al., 2015). It also reveals that while some facets of impulsivity may relate to, for example, inability to attend to stimuli or to excessively seek out reward, the "umbrella-construct" of impulsivity also includes a significant component involving affective reactivity. Reaffirming this, a meta-analytic review of impulsivity assessment found evidence of three distinct factors among self-report measures: Neuroticism/Negative Emotionality, Disinhibition versus Constraint/Conscientiousness, and Extraversion/Positive Emotionality/Sensation Seeking (Sharma, 2014). In sum, it is apparent that there is substantial overlap between impulsivity and neuroticism, but agreement as to how remains uncertain.

1.3 Emergence of Urgency Theory

In an effort to clarify the multi-dimensionality of impulsivity, Whiteside and Lynam (2001) administered the NEO-PI-R in conjunction with a number of commonly used impulsivity

measures. Exploratory factor analysis was used to identify the underlying dimensions of these measures with a result that could be understood within the framework of the FFM. The solution pointed toward four factors of impulsivity: sensation seeking, lack of premeditation, lack of perseverance, and urgency. Furthermore, each of these four factors had its own corresponding facet of the FFM: Sensation seeking represented the excitement seeking facet of extraversion; lack of premeditation represented the deliberation facet of consciousness; lack of perseverance represented self-discipline facet of conscientiousness; and urgency represented the impulsiveness facet of neuroticism. Based on their findings, Whiteside et al. (Whiteside, 2005) constructed a scale, the UPPS Impulsive Behavior Scale, with four subscales that corresponded to the four factors revealed in their analyses, which was found to have high internal consistency and validity (Whiteside, 2005).

Of the four scales of the UPPS, however, urgency stood out as an especially important factor to problematic risk-taking (Smith & Cyders, 2016). For example, in the case of alcohol use, it appears to be an important factor in the problematic use of alcohol (Coskunpinar, 2013; Fischer, Settles, Collins, Gunn, & Smith, 2012). Urgency, as identified by the UPPS, is described as the tendency to act rashly during the experience of heightened emotional states. By definition, it is a behavioral construct, e.g. the tendency to *act* rashly during heightened mood states. What urgency adds to the understanding of impulsivity is a "linking" between affective states and behavior or between internalizing and externalizing; it is not distress/elation itself, nor the tendency to experience distress/elation, but rather the tendency to act rashly when distressed or elated that is crucial to the prediction of externalizing behavior such as problematic alcohol or drug use (Cyders & Smith, 2008; Papachristou, Nederkoorn, & Jansen, 2016).

The original UPPS urgency scale did not differentiate between types of mood states that could precipitate rash behavior. Cyders et al. (2008) sought to correct this based on the observance that individuals are likely to drink to celebrate as much (if not more) than they are likely to drink in response to negative mood states. Thus, Cyders et al. sought to differentiate "positive" urgency, or the tendency to act rashly while experiencing positive mood states, from the idea of "negative" urgency, or a tendency to act rashly when experiencing negative mood states. The UPPS was revised (UPPS-P) so that the two forms of urgency could be distinguished from each other, adding a fifth scale which differentiated positive from negative urgency. In terms of substance use, one could understand negative urgency as propagating alcohol consumption that is motivated by attempts to cope with negative mood states (drinking to cope), while positive urgency could be viewed as an effort to regulate positive mood states (drinking to enhance). Further research on the two scales found that while negative urgency is closely related to positive urgency, they are discriminate from each other and tend to predict different externalizing behaviors. For example, negative urgency predicts behaviors thought to occur in negative moods such as binge eating, while positive urgency predicts behaviors thought to occur during positive moods, such as risky sex (Anestis, 2007; Zapolski, 2009).

1.3.1 Mechanisms behind Urgency and Problematic Alcohol Use

Urgency research has found significant support for its concurrent and predictive validity in regard to problematic alcohol use and AUDs. An extensive meta-analysis of 96 studies found that both negative and positive urgency were consistently related to drinking problems ($r = .32$ and $r = .34$, respectively; Coskunpinar, 2013). In a study examining binge drinking, negative urgency was the only UPPS-P domain to relate to bingeing after gender and age were taken into account (Bo, 2016). Likewise, negative urgency has been found to predict externalizing

behavior, drinking onset, and drinking problems in longitudinal studies among pre-adolescent and adolescent populations, regardless of race or gender (Pearson, Combs, Zapolski, & Smith, 2012; Smith & Cyders, 2016; Riley, 2015; Settles, Zapolski, & Smith, 2014). Furthermore, in a study which examined first-year college students at the beginning, and again at the end, of the school year, it was found that negative urgency was related to increases in negative mood-based rash action, while positive urgency was related to increases in positive mood-based rash action (Cyders & Smith, 2010).

The specific mechanisms by which urgency relates to negative SUD-related outcomes remains unclear. Two routes that connect intense affect to externalizing behavior as described by urgency theory have been posited; it is also possible that both of these routes may co-exist or even interact (Kaiser, Milich, Lynam, & Charnigo, 2012). The first route posits that urgency may reflect one's efforts to cope (or inability to cope) with strong emotions (Fischer, Anderson, & Smith, 2004). From this perspective, urgency can, in some respects, be seen as an extension of classical self-medication hypothesis; an individual uses a psychoactive substance with the expectation that it will maintain or modify a specific mood state (Khantzian, 1985). To have high trait urgency, however, implies that this type of behavior tends to occur more specifically during intense mood states, and that while some high-urgency individuals are more likely to use substances to maintain positive mood states (positive urgency), others are more likely to use to substances to alleviate negative mood states (negative urgency). Some individuals may also do both. In this first route, a certain expectancy of the substance's effects must be present, presumably through prior learning of the rewarding effects of the substance (Duncan, 1974). The concept of negative urgency, as opposed to positive urgency, has yielded better support in this context (Smith & Cyders, 2016). For example, negative urgency (but not positive urgency) has

been found to be related to stronger reinforcement efficacy (e.g., willingness to drink despite repercussions) among college student populations (Kiselica & Borders, 2013) as well as stronger reinforcement expectancies of alcohol in women with SUD than in eating disordered or healthy, non-disordered women (Fischer et al., 2012). Negative urgency has been related to drinking to cope in order to deal with distress (Adams, 2012; Settles et al., 2012). Negative urgency has also been related to higher nicotine craving (Billieux, 2007), especially in regard to negative affect craving (Doran, Cook, McChargue, & Spring, 2009) and greater craving after drink consumption (Menary, 2016). In another study, negative urgency was the only scale on the UPPS-P that was significantly associated with binge drinking (Bo, 2016).

A second route that connects intense affect to externalizing behavior as described by urgency theory is the notion that intense emotions may disrupt cognitive control, thereby disinhibiting impulsive behavior (Kaiser et al., 2012). Neurobiological approaches posit that disruption of cognitive control can occur either through increased activation of the initial, reactionary neural responses of limbic areas generated by negative emotional stimuli (bottom-up), or by decreased ability of higher level cortical areas to regulate these reactionary responses (top-down), or by both (Lieberman, 2007). Those with high negative urgency appear to have increased bottom-up responses to emotional cues. Specifically, negative urgency relates to increased activation in the amygdala while viewing negatively valenced images (Albein-Urios et al., 2013; Cyders et al., 2014). High negative urgency also appears to relate to decreased top-down control from higher cortical areas; a prior study found increased negative urgency scores were associated with reduced activation of the orbitofrontal cortex (OFC) and anterior cingulate cortex (ACC) in response to positively and negatively valence stimuli (Joseph, 2009). Another study found reduced activation of the intra-frontal gyrus during a response inhibition task

associated with high negative urgency (Wilbertz et al., 2014). Thus, it appears that cognitive control over emotional responses may be reduced in individuals high in negative urgency. This may be due not only to a stronger initial reaction toward emotional stimuli, but also a decreased ability to regulate emotional reactivity. However, these neural patterns have been observed only with negative urgency; to date, positive urgency has not been associated with significant neurological findings (Smith & Cyders, 2016).

1.3.2 Increased Urgency as a Result of Alcohol Use

The conceptualization of urgency as a personality trait suggests that it is a relatively stable characteristic that changes little of the course of an individual's lifespan, particularly throughout adulthood (Costa, 1980). However, the understanding of personality has been questioned in recent years, with some evidence has suggesting that it is malleable even in adulthood, and furthermore, that it can be influenced in adults by life experiences and environmental factors (Roberts & Mroczek, 2008). For example, longitudinal research has indicated that trait changes are more profound in late adolescence and emerging adulthood, but tend to become more stabilized by the mid-20s (Hopwood et al., 2011). Barlow et al. have suggested that the personality trait of neuroticism is not only malleable, but should also be a target of change in the therapeutic process for anxiety and depressive disorders (Barlow, 2014). Once more, dynamic changes in this trait may even be observed within a relatively short time span. In a sample of college undergraduate students, it was found that neuroticism predicted exposure to traumatic or adverse events throughout a school semester (about three months). However, the same study also found that neuroticism scores increased in response to these events, suggesting a bi-directional relationship (Boals, Southard-Dobbs, & Blumenthal, 2015).

Neuroticism has long been considered a risk factor for substance use and substance use problems (Kotov, 2010; Lahey, 2009). Some evidence suggests that negative urgency may mediate the relationship between neuroticism and problematic alcohol use (Papachristou et al., 2016). The subscale of Impulsiveness from the FFM (Costa & McCrae, 1977) in particular has been associated with SUDs and substance use problems (Terracciano, Lockenhoff, Crum, Bienvenu, & Costa, 2008) and, as described above, is analogous to urgency on the UPPS. If neuroticism, then, is susceptible to change during adulthood, could impulsivity – and specifically, urgency - also be dynamically influenced by environmental factors during adulthood?

No studies to date have examined urgency in this manner. However, prior evidence suggests that impulsivity may also change over time in response to life events and environmental factors (Joseph, 2009). One such environmental factor that may influence impulsivity appears to be ethanol consumption, particularly if the consumption is chronic and excessive (bingeing) in nature (Ehlers, Liu, Wills, & Crews, 2013; Ehlers, Wills, & Havstad, 2012; Mejia-Toiber, Boutros, Markou, & Semenova, 2014). Both animal and human models suggest that heavy alcohol exposure, particularly during times of growth in adolescence and early adulthood, may harm the developing brain in ways that lead to increased impulsivity. Animal evidence for this is found in rats who are exposed to adolescent intermittent binge ethanol (AIE) treatment in a laboratory setting. An AIE treatment consists of six binge intragastric doses of ethanol in an intermittent pattern across adolescence and is designed to mimic adolescent binge drinking patterns in humans. Use of AIE protocol appears to make rats less behaviorally inhibited, which persists after withdrawal (Ehlers et al., 2012). Furthermore, this effect was correlated with decreased hippocampus size (Ehlers et al., 2013). Another study found that rat acute AIE

exposure increased impulsivity, as measured by a delay discounting task (Mejia-Toiber et al., 2014).

Human evidence also supports the effect of chronic or binge alcohol use on impulsivity. Certainly, there is a well-established observation that impulsive behavior increases dramatically during alcohol intoxication. Alcohol intoxication at fairly low doses (blood alcohol concentrations or BACs of around .01-.06%) disrupts cognitive processes such as memory, divided attention, and planning as well as inhibitory control, e.g., the ability to inhibit a motor response that has already been initiated (de Wit, 2009; Field, Wiers, Christiansen, Fillmore, & Verster, 2010). Alcohol intoxication also increases the salience of alcohol related cues; taken together, these factors result in increased impulsive action, both in regard to further alcohol consumption itself and in regard to impulsive behavior such as risky sex or aggression (MacDonald, 2000). Importantly, one study revealed that UPPS urgency was the facet of impulsivity that best explained variance in response inhibition during a stop-signal task, suggesting that response inhibition may be an important factor in the urgency trait (Wilbertz et al., 2014).

Long-term chronic or binge use of drugs or alcohol in humans also appears to result in increased aspects of trait impulsivity. Heavy drinking, particularly during adolescence, leads to long-term reductions in executive functioning, thereby decreasing top-down regulation involved in impulse control (Giancola, Martin, Tarter, Pelham, & Moss, 1996; Squeglia, 2009). At present, however, only one known study has examined the impact of chronic and/or binge alcohol consumption on impulsivity over time. White et al. (2011) conducted a longitudinal study of adolescent males from ages 8 to 25 while monitoring impulsivity and drinking behavior. In this study, impulsivity was measured by a single item which was chosen from the higher

rating given by either the adolescent participants, or their primary caregiver: “Am I (or is the adolescent who you are the primary caregiver of) impulsive or acts without thinking?” with 0 = *not true*, 1 = *somewhat or sometimes true*, and 2 = *very true or often true*. The authors found that among boys who were moderately impulsive, increased impulsive behavior was observed if the participants had engaged in heavy drinking (as defined by number and severity of binge episodes) during the previous year above and beyond those who did not engage in heavy drinking. These findings suggest that impulsivity may not only lead to the tendency to drink, but that drinking may lead to increased impulsivity.

Urgency also appears to change over time, but to date, studies examining this have assessed urgency over long time spans (e.g., > 6 month intervals). Specifically, longitudinal data suggests that negative urgency scores appear to increase with pubertal onset, coinciding with the observed increases in emotional reactivity seen during this time of life (Boyle, 2014; Smith & Cyders, 2016). Some fluctuation in the presentation of traits such as urgency are not surprising given that neurobiological systems of individuals in adolescence/emerging adulthood are still in development, and thus are more greatly influenced by environmental factors at this time than during adulthood, or after the age of about 25 years (Giedd et al., 2009). This period of development also encompasses the median age of onset for SUDs (Medicine, 2009). However, while longitudinal data confirm that negative urgency appears to have a potentially dynamic nature during adolescence, no studies have yet examined how negative urgency may be affected by specific environmental factors during relatively shorter periods of time (e.g., on a monthly or yearly basis) in adulthood.

In the case of problematic alcohol consumption, the two proposed mechanisms describing the pathways from negative urgency to problematic substance use may be bi-directional. For

example, in the first route, where urgency traits are related to a tendency to use substances to temper emotional reactivity, having high negative urgency may lead an individual to binge drink because they use alcohol as a coping mechanism when in emotional distress; an individual may also be more likely to increase in this trait if, after an alcohol binge, they reinforce a learned association between alcohol intoxication and relief from negative affect. In the second route, decreased cognitive control characteristic of someone with negative urgency may lead to increased impulsive (bingeing) behavior; in turn, bingeing episodes may also degrade the top-down and bottom-up neuro-psychological processes associated with cognitive control, resulting in increased urgency.

Studies looking for bi-directional effects of negative urgency and problematic drinking are needed to clarify the true nature of negative urgency as a personality trait. If traits central to the development of substance use problems and disorders, such as negative urgency, are subject to influence from environmental factors, particularly during sensitive periods such as adolescence and young adulthood, the importance of targeted, personalized substance use intervention efforts at this age in development cannot be understated (Conrod, Stewart, Comeau, & Maclean, 2006; Conrod, Castellanos-Ryan, & Mackie, 2011; NIAAA, 2005). Furthermore, evidence of bi-directional relationships would have the ability to inform both environmental-level and individual-level interventions.

1.4 Summary of Review

The present study proposed that life experiences, specifically prolonged or binge alcohol use, may have an observable direct impact on negative urgency. Based on animal and human evidence as described above, binge/prolonged alcohol use appears to increase various facets of impulsivity; this suggests that instead of being viewed as a fixed, stable trait, impulsivity – or

urgency - may be better understood as a dynamic factor that can be causative and/or repercussive of genetic and environmental influence. Because of the strong association between urgency and problematic drinking (which includes binge and/or frequent alcohol consumption), urgency is a particularly relevant facet of impulsivity to examine in this context. However, while there exists few studies, as mentioned above, that have confirmed this for general impulsivity or for some specific facets of impulsivity, no research yet has examined urgency in this context in human models.

1.5 Purpose of the Study

It was hypothesized that negative and positive urgency would have a bi-directional relationship with binge/prolonged alcohol use. While individuals who initially have high urgency would be more likely to engage heavy drinking, episodes of binge drinking and/or periods of prolonged drinking were hypothesized to result in increased self-reported urgency across time. In sum, among a large ($n \geq 200$) sample of young adult individuals, it was expected that individuals that have higher urgency scores will be more likely to binge drink during a one-month period. Furthermore, it was expected that binge drinking would be associated with increases in urgency scores during this time span. The same model was examined with both negative and positive urgency.

1.6 Research Aims/Hypotheses

Aim 1: To examine whether there is a bi-directional relationship between negative urgency and binge and/or prolonged alcohol use across a 30-day period and 60-day period.

Hypothesis 1: Self-reported negative urgency at baseline, or Time 1 (T1), will be associated with higher alcohol use at T1, and will also predict higher self-reported

alcohol use during the subsequent 30 days, as reported at Time 2 (T2). However, among individuals that engage in alcohol use during this 30-day period, negative urgency scores will increase from T1 to T2; this same relationship will again be revealed in changes of negative urgency and drinking from T2 to Time 3 (T3), 60 days later.

Aim 2: To examine whether there is a bi-directional relationship between positive urgency and binge and/or prolonged alcohol use across a 30-day period and 60-day period.

Hypothesis 2: Self-reported positive urgency at T1 will be associated with higher alcohol use at T1, and will also predict higher self-reported alcohol use during the subsequent 30 days, as reported at T2. However, among individuals that engage in alcohol use during this 30-day period, positive urgency scores will increase from T1 to T2; this same relationship will again be revealed in changes of positive urgency and drinking from T2 to T3.

CHAPTER 2

METHODS

2.1 Participants

2.1.1 University Student Sample

A sample was collected from a pool of students enrolled in undergraduate psychology courses at the University of North Texas (UNT) using SONA systems®, a cloud-based subject pool software. Students enrolled in psychology courses were able to earn extra credit by participating in departmental research studies. Participation took place over a rolling time span of two months from the beginning of the spring semester (mid-January) to the end of the Spring semester (early May).

2.1.2 MTurk Workers

A second sample consisted of paid, voluntary "workers" or "Turkers" recruited from Amazon Mechanical Turk (MTurk) using the TurkPrime platform (Litman, Robinson, & Abberbock, 2017). Before MTurk workers began the first set of surveys (T1), they were asked to complete two screener questions that were embedded within the beginning of the survey. In order to avoid demand characteristics by the workers, no indication of what the study criteria were was notated in the MTurk posting. The first question asked participants "How old are you?" The categories were <18, 18-30, 30-40, 40-50, and >50 years old; only those who selected 18-30 were allowed to continue with the study. The purpose of this screener question was threefold: (1) It prevented minors (those who are 18 years and younger) from participation; (2) it allowed for targeted recruitment of an MTurk sample which would be more comparable to a typical university sample, thus decreasing potential age or generational confounders on the study variables; and (3) this targeted age range was hypothesized to show an increased effect of the

study due to developmentally-dependent neurobiological factors of individuals within this age group.

The second screener question asked about their country of residence. Although research on MTurk samples indicates that the majority of workers are in the United States, MTurk workers participate from across the globe (Ross, 2009). For the purposes of the current study, this screener question was used to ensure participation from American or Canadian citizens only. This was used in addition to specifying country of origin for eligible workers when setting up the MTurk survey description. Again, workers who answered with any other country outside of the U.S. or Canada were directed to an exit page which thanked them for their time.

After they completed the survey, Turkers were given a "dynamic completion code," e.g., a randomly-generated string of numbers, which could be copied/pasted into the MTurk site in order to receive financial compensation. This is done in order to prevent sharing of a fixed code between MTurk workers via discussion forums. Participant's randomized TurkPrime worker IDs were also collected, which allowed for contacting the participants for the second (T2) and third surveys (T3). Participation took place over a rolling time span of two months from the beginning of March to the middle of May.

2.1.3 Recruitment and Informed Consent

The study was listed on the MTurk website; the listing provided a brief description of the study and non-specific criteria for participation. Turkers were compensated $.75 for completion of T1, $.75 for completion of T2, and $.75 plus a $.50 bonus for completion of the final T3 surveys. In order to recruit university students, an identical description of the study was listed on the university SONA study site which offered university students three research participation credits for completing each round of surveys. All participants were asked to review an informed

consent approved by the University of North Texas Internal Review Board. The informed consent included a detailed explanation of the study rationale, criteria for inclusion, confidentiality procedures, and possible risks or benefits to the participant. It also informed participants that they were free to discontinue the study at any time, and included contact information for the National Suicide Prevention Lifeline, should they feel any discomfort as a consequence of the study.

2.2 Measures

The primary objective of this research project was to explore the potential bi-directional relationship between negative urgency and binge/prolonged drinking across time. To achieve this objective, self-report measures were used. All measures, excluding the demographics questionnaire, were randomized in order among participants in order to minimize possible order effects of test-taking. Throughout the survey, there were three items distributed throughout which requested a validation or attention check response from the participant (e.g., "Are you answering this survey honestly? Yes/No," and "We want to make sure you are reading this survey carefully. For the question below, please answer 'pen and paper.' Right now, I am completing this survey on (a) a laptop, (b) a smart phone or small mobile device, (c) a desktop, or (d) pen and paper.") All self-report measures were administered via Qualtrics® survey platform (Qualtrics, Provo, UT).

2.2.1 Demographics Questionnaire

A short demographics inventory was administered at the end of the survey for all three time points. This assessed for self-reported height, current weight in pounds, gender, age, self-identified race/ethnicity, and years of education.

2.2.2 The UPPS-P Impulsive Behavior Scale (UPPS-P)

The UPPS-P (Lynam, 2006) is a 59-item self-report questionnaire comprised of five sub-scales related to facets of impulsivity: Negative Urgency, (lack of) Premeditation, (lack of) Perseverance, Sensation-Seeking, and Positive Urgency. The UPPS-P uses a Likert-response format, with 1 = *Agree Strongly* to 4 = *Disagree Strongly*. Higher scores indicate more impulsive behavior. The UPPS-P has shown to have excellent external validity, correlating both with other self-report measures, as well as behavioral measures and manifestations of impulsivity (Berg et al., 2015). The factor structure of the UPPS-P has been replicated among undergraduate, community, and patient populations and across races, sexes, and ethnicities (Cyders, 2013; Magid, 2007; Miller, 2003; Whiteside, 2005). Estimates of internal reliability tend to be high, particularly for the urgency scales; Cyders & Smith (2008) found a coefficient alpha of .89 for negative urgency and .94 for positive urgency. For T1, the instructions of the UPPS-P asked the participant to report generally (e.g., “For each statement, please indicate how much you agree or disagree with the statement). For T2 and T3, participants were instructed to report for the past month (e.g., “For each statement, please indicate how much you agree or disagree with the statement **in the last month**).

2.2.3 The Alcohol Use Disorders Identification Test (AUDIT)

The AUDIT (Saunders, 1993) has been developed and evaluated over a period of two decades and has been found to provide an accurate measure of substance use risk across gender, age, and cultures (Allen, 1997), and it has been studied among a variety of subpopulations including university students, primary care patients, drug users, and those of low socio-economic status (Fleming, 1991; Isaacson, 1994; Skipsey, Burleson, & Kranzler, 1997; Volk, 1997). It consists of 10 questions about alcohol use within the past year and recently that assess for

dependence, symptoms, and problems. It is scaled on a Likert format from 0 = *Never* to 4 = *Four or more times a week*. Examples of questions include "How often do you have six or more drinks on one occasion?" and "How often during the last year have you been unable to remember what happened the night before because of your drinking?" This version of the AUDIT used in the present study classified heavy drinking as ≥6 drinks one occasion for female and ≥8 drinks on one occasion for males, e.g., "How often have you had 6 or more units if female, or 8 or more if male, on a single occasion in the last year?" The AUDIT contains three subscales: Hazardous Alcohol Use (questions 1-3), Dependence Symptoms (questions 4-6), and Harmful Alcohol Use (questions 7-10). Reported coefficient alphas have ranged from .74 to .94 across reported samples (Allen, 1997). For Time 1, the instructions of the AUDIT asked the participant to report during the last year. For Times 2 and 3, participants were instructed to report for the past month (which was in bold).

2.2.4 30-Day Timeline Follow Back (TLFB)

The TLFB (Sobell, 1978) is a standard self-report measure of alcohol consumption. It has been found to be appropriate for both adult and adolescent populations, and in both clinical and non-clinical settings (Dennis, 2004; Lewis-Esquerre et al., 2005; Pedersen, 2006). Studies have shown this measure to be highly reliable and accurate in collecting psychometrically sound information about substance use (Robinson, 2014). Additionally, the TLFB-30 day has been validated to be administered online (Pedersen, 2006; Rueger, Trela, Palmeri, & King, 2012).

Using a calendar, the TLFB utilized in the present study instructed participants on how to provide an estimate of their daily drinking from the previous 30 days retrospective from the interview date. A graphical chart specifying what are considered one standard drink (e.g., one beer, one shot of liquor) was displayed within reference to the test-taker, along with a calendar

showing the past month with notable holidays and events. The participant then identified how many standard alcohol drinks were consumed during each day of the prior 30 days, as well as asked to produce a general estimate of over how many hours the drinks were consumed at each drinking session.

2.2.4.1 Estimated Blood-Alcohol Level (EBAC)

The EBAC attained at each drinking episode was calculated from information obtained from the TLFB using a modified Widmark formula (Widmark, 1932/1981), similar to what was utilized in White et al. (2011). Each drink reported by the participant was estimated to contain approximately 14 liquid grams of alcohol. For each day an individual reported alcohol consumption on the TLFB, the number of drinks consumed was multiplied by 14, and then divided by the participants bodyweight in grams times a constant r (r = .55 for women, r = .68 for men). The product of this, multiplied by 100, gave the EBAC as a percentage without time as a factor. In order to factor in time, the number of hours over which the drink(s) are consumed is multiplied by the constant .015, which was then subtracted from the previously calculated EBAC as a percentage. See Figure 2.1 for a depiction of how EBAC was calculated in the present study.

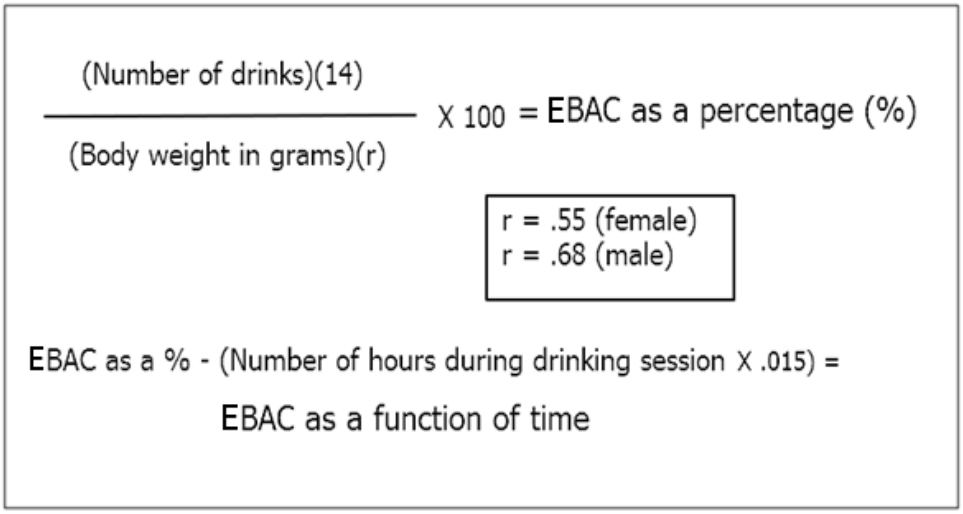

Figure 2.1. Depiction of the calculation of estimate blood alcohol level (EBAC) as a function of time.

Three facets of alcohol use were calculated from the 30-day TLFB which were representative of alcohol bingeing and frequency. The first was Average EBAC, which was calculated by adding all EBACs from the prior 30 days, and then dividing this by the number of days drinking. The second was EBAC Max, which was the value of the highest EBAC obtained during that month. The third was the number of days drinking during the prior month where the individuals exceeded ≥ .08 EBAC, or Bingeing Days.

2.3 Procedures

2.3.1 Data Collection

All study materials and procedures were by the University of North Texas Internal Review Board. Involvement of this study required three sessions of online assessment lasting approximately 45 minutes each. The three sessions, T1, T2, and T3, took place approximately 30 days apart from each other. The study was described as “A Study on Personality Variables” with no mention that alcohol use or problems would be assessed. All participants who met qualification criteria were allowed to register for the first time assessment. They were asked to complete the first session within five days of registering. For the second and third sessions, participants were emailed a notice on either their university email or through their MTurk account to complete the second session 30 days later, and the third session again, 60 days later. Participants had a five-day grace period to complete the second and third sessions. Participants who completed either the first or second session with significant missing responses, or indicated on the attention check items that they were not completing answers honestly or with attention, were not invited for the subsequent round of surveys. Only participants who completed all three sessions were included in the final sample.

Once the participant completed all three sessions, their data was case-matched from both time points via their MTurk worker identification numbers or with their SONA identification numbers. Collected data was stored in a password-protected account and all data downloaded from the account was stored in an encrypted memory stick. Once participant cases from T1, T2 and T3 were matched, identifying information (e.g. MTurk worker and SONA identification number) was deleted from the database.

2.3.2 Data Analytic Method

Prior to analysis, data was cleaned and examined for missing values. For items on the urgency scales and the AUDIT, multiple imputation was used to replace missing values. For variables such as weight and gender, responses across all three time periods were compared to each other; if a single value was unrealistic, for example, if a participant reported weighing 140 lbs at T1, 14 lbs at T2, and 145 lbs at T3, an average value of 142.5 would be entered into T2. For each case, Mahalanobis distance – a value indicating degree multivariate outlying – was calculated and examined with a chi-square distribution. Individual cases that met the $p<.001$ criteria were flagged and examined for their response patterns as well as their impact on the results of both primary and secondary analyses.

Prior to the primary analyses, study variables (negative and positive urgency, EBAC Max, EBAC Average, and Binge Days) were examined for their relationship with the AUDIT in order to cross-validate the drinking variables used in the primary analyses and confirm a relationship between high AUDIT scores and increased positive/negative urgency that has been found among other studies (Coskunpinar, 2013). Similarly, intercorrelations among urgency and study drinking variables were examined in order to understand the data and comprehend the results of the models later calculated in the primary analyses. In order to explore the antecedent

effects of drinking on urgency, a set of longitudinal cross-legged panel models was used for the primary analyses. See Figure 2.2 for the proposed statistical model for primary analysis examining drinking and negative urgency. An identical model examining positive urgency in place of negative urgency was also examined. The cross-lagged panel design is commonly used to detect bi-directional effects (Frees, 2004). While the crossed-lagged paths reveal the relationship of the antecedent effects of one variable change in another, the model also controls for stability over time (Duncan, Duncan, & Strycker, 2009). As can be seen in Figure 2, EBAC Average, EBAC Max, and Binge Days during the previous month were represented as the latent variables Alcohol Use (T1, T2, and T3), while negative and positive urgency total scores were manifest variables.

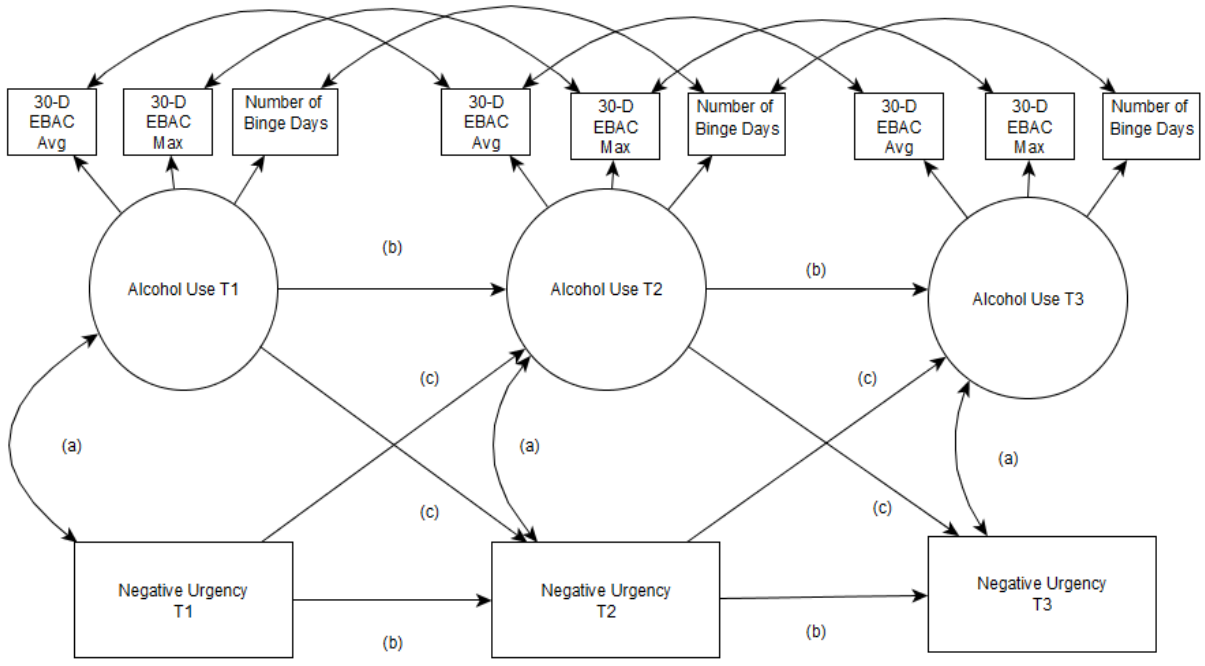

Figure 2.2. Proposed crossed lagged longitudinal model showing bi-directional effects of Alcohol Use and negative urgency. Relationships are defined as (a) concurrent correlations, (b) autoregression effects, and (c) cross-lagged effects. An identical model, with positive urgency in place of negative urgency, was also conceptualized.

All primary analyses were performed using structural equation modeling calculated using the Lavaan package in R (Rosseel, 2012) and IBM SPSS® Statistics, Version 22.0. Because drinking variables showed skewed distribution (as tends to be observed in substance use research), robust maximum likelihood estimator (MLR), which is robust to data with non-normality (Yuan, 1998), was used as the estimation method. Model fit was evaluated using conventional criteria including the chi-square statistic, CFI, RMSEA, and SRMR. RMSEA, SRMR, and CFI indices are indicators of model goodness of fit. Standard guidelines for cut-off values have been suggested for these indices; in general, CFI values greater than .90 are typically taken to reflect an acceptable fit to the data, while an RMSEA and SRMR of < .05 indicates good fit and < .08 indicates fair fit, with > .08 being poor fit (Marsh, Hau, & Grayson, 2005). Chi-square statistic tests refer to the ability of a model to reproduce the data; a good-fitting model is one that is reasonably consistent with the data and does not necessarily require re-specification and will yield a chi-square statistic that is non-significant. While the chi-square statistic tends to be biased towards large sample sizes (and thus, almost always resulting in statistical significance) for models with cases with over 400, the chi-square test is generally a reasonable measure of fit for models with < 400 cases (as utilized in the present study; Kline, 2016). When comparing models, the Akaike Information Criterion (AIC; Akaike, 1974) and Bayes Information Criterion (BIC; Raftery, 1995) were used to compare the ability of nested or non-nested models to replicate; lower AIC and BIC values indicate better ability to replicate the model.

Lastly, it is important to note that analytical strategies such as structural equation modeling are an approximation of reality, or an attempt to model complex real-world relationships; ultimately, parsimony is what must guide decisions (Thompson, 2000). Evaluation

of fit, therefore, included evaluation of multiple models. In the present study, a chi-square test of difference was used to examine the difference in model fit between Turkers and the university samples. Chi-square tests of difference can be computed from the chi-square value between two models as: $\chi^2_{difference} = \chi^2_s - \chi^2_l$ and $df_{difference} = df_s - df_l$, as long as the two models are nested. In sum, this test evaluates whether the proposed model fits the observed values from one population (e.g. university students) significantly more so than observed values from the other population (e.g. Turkers) against the null, which is that the model fits both populations approximately equally. In the present study, if results of the chi-square difference test were statistically significant, standardized path coefficients between models were examined in order to determine where specific differences lie. Similarly, another chi-square difference test examined the proposed models comparing females to males in order to determine if there were any gender effects.

CHAPTER 3

RESULTS

3.1 Participant Descriptives

Demographics of the university and MTurk samples were examined first as a combined sample, and then separately, in order to determine how their individual characteristics comprised the overall sample. Participants were examined on demographic variables as well as negative and positive urgency, and drinking variables including EBAC Max, EBAC Average, number of drinking days with EBAC > .80 (Binge Days) and AUDIT scores. See Table 3.1 for an overview of demographics. Retention from the MTurk sample was lower than retention rates from other studies utilizing longitudinal design in MTurk, which tend to range at around 60% for repeated assessments with intervals of one month or more (Berinsky, 2012; Stoycheff, 2016). Retention for the university sample was slightly lower than MTurk, at about 55% at each time point. Table 3.2 contains cross-sectional comparisons of retention rates for both the university and MTurk samples.

3.1.1 University Student vs. MTurk Final Sample

Of the 245 individuals who completed the first survey in the university sample, eight responses were incomplete and/or the attention check questions were incorrect and were not invited for T2; of the 127 responses from T2, three were incomplete and were not invited for T3. A final sample of 73 individuals was obtained from T3 for the university sample. Of this sample, seven individuals failed to complete at least 50% of the final survey, resulting in deletion of those cases. Of the remaining 66 respondents to complete all three surveys, non-response rate was low, with approximately < 5% of missing cases found across all three time points. Length of

time to complete the survey tended not to be an issue for the university sample; none of the responses retained by T2 or T3 were completed in impossible (e.g., <5 minute) time spans.

Table 3.1

Baseline Demographic and Study Variables in the MTurk, University, and Combined Samples

		MTurk (N = 179)	University Students (N = 66)	Combined Sample (N = 245)
		% or *M* (*SD*)	*% or M (SD)*	% or *M* (*SD*)
Female		70.8	77.3	73.5
Age in years		26.57 (2.73)	20.42 (3.25)	24.91 (3.96)
Race/Ethnicity	Hispanic	6.1	19.7	9.8
	Asian	5.0	10.6	6.5
	White	78.8	47.0	69.8
	Black	7.8	13.6	9.4
	Native Hawaiian/Pacific Islander	4.2	10.6	6.1
	American Indian/Alaska Native	1.1	1.5	1.3
	Multiracial or Other	1.1	7.6	2.8
Any College		61.2	100.0	76.15
Drinking	AUDIT	6.14 (6.91)	2.64 (3.41)	5.20 (6.35)
	Lifetime alcohol use (years)	7.86 (5.46)	2.51 (3.27)	4.36 (3.55)
	EBAC Average	.09 (.08)	.06 (.07)	.08 (.08)
	EBAC Max	.14 (.12)	.09 (.12)	.12 (.12)
	Total Drinking Days in Last 30 Days	7.63 (8.74)	3.50 (6.66)	6.51 (8.42)
	Binge Days in Last 30 Days	3.95 (5.52)	1.55 (2.88)	3.30 (5.10)
UPPS-P	Negative Urgency	26.17 (8.03)	27.20 (8.30)	25.38 (9.38)
	Positive Urgency	25.61 (9.50)	24.76 (9.09)	26.45 (8.10)
Other Drug Use in Past 6 Months	Marijuana	29.60	33.60	31.23
	Amphetamines/Methamphetamines	12.31	2.59	8.46
	Cocaine/crack	12.30	0.86	7.89
	Opiates	11.73	10.34	10.95
	Benzodiazepines	11.73	.86	6.29
	Psychedelic Substances	6.14	6.90	6.50

Note. AUDIT = Alcohol Use Disorders Identification Test; EBAC Estimated Average BAC reported in a 30-day timespan; EBAC Max = Estimated Maximum BAC reported in a 30-day timespan.

Table 3.2

Retention Rates across T1, T2, and T3 compared between Turkers and the University Student Pool

Participant Pool	T1 *N*	T2 *N* (% Retention from Previous Time)	T3 *N* (% Retention from Previous Time)	T1-T3 Overall % Retention
MTurk	402	223 (55.5%)	179 (80.3%)	44.5%
University Student Pool	237	124 (52.3%)	66 (53.3%)	27.8%

Among the 409 individuals who completed T1 for MTurk sample, seven were either incomplete or did not complete the attention check questions correctly and were not invited back for T2. At T2, the researcher also began excluding individuals for length of time taken to complete the survey; if total completion time was < 5 minutes, the participant was not invited back. Of the 245 individuals who completed T2, 22 individuals were either incomplete, did not complete the attention check questions correctly, or took too little time to complete and were not invited back. A final sample of 179 individuals completed all three surveys; none were removed at the final time point. Of this sample, missing values accounted for approximately 2% of the data. No single case contained greater than ten total missing values.

As can be seen in Table 3.1, compared to the university sample, Turkers were about six years older. They were also less racially diverse, with the university sample showing substantially more individuals identifying as Hispanic, Asian, Native Hawaiian/Pacific Islander, or mixed race. Turkers also reported significantly higher overall alcohol use and problems on all study variables, and endorsed about five more years of alcohol use on average. Overall, other drug use in the past six months, except for use of marijuana, opioid, and psychedelics, were higher in the MTurk sample. Both samples contained approximately an equal tendency to over-

represent women as a proportion of the sample. Negative and positive urgency were similar between the two samples.

3.1.2 Combined Sample

The combined sample consisted of 245 individuals who completed all three assessment periods. In the combined sample, negative and positive urgency were normally distributed and remained relatively stable across time points, ranging from *M* = 25.40 (*SD* = 8.29) to *M* = 26.45 (*SD* = 8.09) for negative urgency and *M* = 24.53 (*SD* = 9.12) to *M* = 25.38 (SD = 9.38) for positive urgency across time points. Drinking variables indicated a small, non-significant decrease in drinking behaviors over time points, with Binge Days decreasing from *M* = 3.30 (*SD* = 5.06) to *M* = 2.73 (*SD* = 4.33), EBAC Max decreasing from *M* = .12 (*SD* = .12) to *M* = .11 (*SD* = .11) and EBAC Average decreasing from *M* = .08 (*SD* = .07) to *M* = .07 (*SD* = .07) from T1 to T3. AUDIT Scores also decreased significantly from *M* = 5.20 (*SD* = 6.35) at T1 to *M* = 3.87 (*SD* = 4.91) at T3. As is typical in normative-population sampling of substance use, many of the drinking variables had a positive skew, particularly Binge Days (skew = 3.03), Drinking Days (skew = 2.08), and AUDIT scores (skew = 2.08). Negative and positive urgency were normally distributed. See Tables 3.3 and 3.4 for an overview of means and standard deviations of all drinking variables, negative urgency, and positive urgency, over time.

Gender was coded as males = 1 and females = 2; men tended to score significantly higher on drinking variables and positive urgency. Specifically, gender was significantly related to AUDIT scores ($r = -.28$, $p < .001$), EBAC Average ($r = -.19$, $p = .003$), EBAC Max ($r = -.22$, $p < .001$), Binge Days ($r = -.16$, $p = .014$), and positive urgency ($r = -.27$, $p < .001$). Gender was not related to negative urgency or total number of days drinking. Education level was not related to any drinking or urgency variable.

Table 3.3

Means and Standard Deviations for Negative Urgency and Positive Urgency across Time 1 (T1), Time 2 (T2), and Time 3 (T3) for Both the University Student and MTurk Samples

	T1 Negative Urgency *M (SD)*	T2 Negative Urgency *M (SD)*	T3 Negative Urgency *M (SD)*	T1 Positive Urgency *M (SD)*	T2 Positive Urgency *M (SD)*	T3 Positive Urgency *M (SD)*
University Students (N = 66)	27.2 (1.02)	26.59 (.97)	25.64 (1.10)	24.76 (1.12)	25.11 (1.20)	24.74 (1.18)
MTurk (N = 179)	26.17 (8.03)	25.57 (8.15)	25.32 (8.10)	25.61 (9.50)	24.84 (8.70)	24.46 (8.99)

Table 3.4

Means and Standard Deviations for 30-Day EBAC Average, EBAC Max, Binge Days, and AUDIT Scores for Both the University Student and MTurk Samples across T1, T2 and T3

	MTurk (N = 179)	University Students (N =66)
	% or M (SD)	% or M (SD)
T1 EBAC Avg	.09 (.08)	.06 (.07)
T2 EBA Avg	.09(.07)	.05 (.07)
T3 EBAC Avg	.09(.75)	.06 (.07)
T1 EBAC Max	.14 (.12)	.10 (.12)
T2 EBAC Max	.13 (.11)	.09 (.12)
T3 EBAC Max	.13 (.11)	.09 (.12)
T1 Binge Days	3.95 (5.52)	1.55 (2.88)
T2 Binge Days	3.58 (5.24)	1.60 (2.98)
T3 Binge Days	3.23 (4.78)	1.36 (2.31)
T1 AUDIT	6.14 (6.91)	2.64 (3.41)
T2 AUDIT	5.02 (6.00)	2.92 (3.54)
T3 AUDIT	4.48 (5.22)	2.20 (3.48)

Note. T1 = Time 1; T2 = Time 2; T3 = Time 3; EBAC Estimated Average BAC reported in a 30-day timespan; EBAC Max = Estimated Maximum BAC reported in a 30-day timespan; AUDIT = Alcohol Use Disorders Identification Test

3.1.3 Cross-Validation of Study Variables and the AUDIT

AUDIT total and subscale scores were also examined to determine if scores on the AUDIT (which is a commonly used assessment of alcohol problems often used in urgency research; see Coskinpar 2016) could be cross-validated with study drinking variables. AUDIT subscale scores include Hazardous alcohol use (e.g. frequency in consumption), Dependence symptoms (e.g. physical and psychological symptoms) and Harmful alcohol use (e.g., alcohol-related psychosocial problems). Because the Hazardous scale essentially assesses bingeing and frequency [e.g., "How often have you had 6 or more units if female, or 8 or more if male, on a single occasion in the last (month/year)?"], it would be expected that EBAC variables in the present study would show convergence with this subscale. Results found that the EBAC variables did indeed relate more highly to the Hazardous scale [r (245) .56-.74, $ps < .001$] and less so to the Dependence [r (245) = .28-.52, $ps < .001$] and Harmful use scales [r (245) =.32-.51, $ps < .001$].

High negative urgency was related to higher AUDIT scores, r (245) = .28, $p < .001$. Negative urgency was significantly related to the AUDIT Dependence scale [r (245) = .24, $p < .001$] and AUDIT Harmful Use scale [r (245) = .29, $p < .001$] but not the AUDIT Hazardous scale [r (245) = .10, $p = .12$]. Positive urgency, in turn, was significantly related to higher total AUDIT scores [r (245) = .45, $p < .001$] as well as the Dependence, Harmful Use, and Hazard subscales (r =.43, .43, and .30, respectively, $ps < .001$). In sum, while negative and positive urgency were related to alcohol physiological and psychological dependence symptoms (Dependence) and problems (Harmful Use), both urgency scales showed weaker or non-significant relationships to alcohol frequency (Hazardous Use).

3.2 Outlying Cases

Using all study variables, Mahalanobis distance was calculated and examined using a chi-square distribution; all cases that met the criteria of $p < .001$ were flagged as potential outliers. Analysis revealed 23 cases that met this criterion. The ratio of cases flagged as potential outliers to the total sample tended to be higher among MTurk participants than University participants (11.7% versus 3.0%, respectively). Additionally, outliers tended to be about three years older ($M = 27.65$, $SD = 2.68$ vs. $M = 24.63$, $SD = 3.97$), and tended to be proportionally overrepresented by males $X^2(1, 245) = 5.91$, $p = .015$). Most notably, these outliers were heavier drinkers on all study drinking variables, especially concerning the number of drinking days (outlier $M = 19.82$, $SD = 12.74$ vs. non-outlier $M = 5.14$, $SD = 6.46$). While these individuals were not significantly higher on negative urgency, a test of between-subjects effects showed that they were significantly higher on positive urgency across time [$F(1, 243) = 12.12$, $p < .001$] with a mean across time points averaging about seven points higher.

The responses of the Mahalanobis outliers were further examined in order to determine if they were valid. Importantly, there was not a tendency for identified outliers to answer less accurately on attention-check or validity questions. Among MTurk samples, the amount of time taken to complete a survey may present a concern as many Turkers tend to complete surveys in relatively small amounts of time (Litman et al., 2017). While the average time to complete the surveys tended to be significantly higher among the University sample ($M = 3{,}381$ seconds, $SD = 9{,}582$) than the MTurk sample ($M = 1{,}634$ seconds; $SD = 807$), the calculated Mahalanobis distance was not related to the duration in seconds [$r\ (245) = .02$, $p = .780$]. Due to the possibility that these identified outliers may represent a small, heavily drinking subset of the

population, they were both included and excluded in the primary analyses to determine their impact on the results.

3.3 Correlations among Urgency and Drinking Behaviors/Problems across Time Points

3.3.1 Negative Urgency and Drinking

Negative urgency was moderately to highly related to positive urgency across time points [r (245) = .48-.83, p < .001]. Cross-sectional correlations revealed that while negative urgency tended to be highly related to negative urgency assessed again on other time points [r(245)=.81-.82, p <.001], it tended to have a non-significant relationships to Binge Days [r(245) = -.04-.05, EBAC Max (r(245) =.08-.14, p =.234-.027], or EBAC Average [r(245) = .03-.08, p = .592-.231].

3.3.2 Positive Urgency and Drinking

Similarly, positive urgency showed a high intercorrelation with itself across time points [r(245) = .70-.74, p < .001]. There was a modest relationship with positive urgency and Binge Days [r(245) = .09-.20, p = .140-.002]. There were also significant relationships between higher positive urgency and higher EBAC Max [r(245) = .18-.27, p < .001] and higher EBAC Average [r(245) = .18-.28, p <.001]. See Table 3.5 for all study variables at all three time points.

3.4 Model Tests

The primary analyses were conducted in two steps. The first step examined the measurement model, which is the part of the model that relates the measured (or observed) variables to the latent variables. The measurement model in the proposed negative and positive urgency models consisted of the loadings of three observed variables calculated from the TLFB (EBAC Max, EBAC Average, and Binge Days), onto the latent variable Alcohol Use at each of the three time points. The second step examined the full standardized structural models, one for

negative urgency and an identical one for positive urgency, with the urgency variables as the "path" portion of the model.

Table 3.5

Pearson's Correlational Coefficients between All Study Variables in Combined Sample at All Timepoints (N = 245)

	NU 1	NU 2	NU 3	PU 1	PU 2	PU 3	EBAC Avg 1	EBAC Avg 2	EBAC Avg 3	EBAC Max 1	EBAC Max 2	EBAC Max 3	Binge 1	Binge 2
NU 1														
NU 2	.81**													
NU 3	.82**	.82**												
PU 1	.65**	.50**	.56**											
PU 2	.55**	.66**	.60**	.70**										
PU 3	.60**	.55**	.73**	.72**	.74**									
EBAC Avg 1	.07	.08	.09	.26**	.25**	.21**								
EBAC Avg 2	.05	.03	.04	.21**	.21**	.16*	.72**							
EBAC Avg 3	.07	.07	.08	.24**	.22**	.17**	.70**	.72**						
EBAC Max 1	.08	.11	.09	.25**	.25**	.17**	.90**	.72**	.74**					
EBAC Max 2	.10	.09	.06	.22**	.20**	.13*	.65**	.88**	.68**	.77**				
EBAC Max 3	.14*	.13*	.12	.27**	.23**	.18**	.66**	.67**	.89**	.77**	.77**			
Binge 1	-.05	.01	-.03	.19	.20**	.06	.60**	.52**	.51**	.64**	.60**	.55**		
Binge 2	-.05	.01	-.01	.19	.14*	.05	.53**	.61**	.53**	.60**	.67**	.58**	.85**	
Binge 3	.00	.05	.04	.13*	.16*	.09	.55**	.55**	.63**	.58**	.59**	.67**	.76**	.83**

**Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed).

Note: 1= Time 1; 2 = Time 2; 3 = Time 3; NU = Negative Urgency; PU = Positive Urgency; EBAC Avg = Estimated Blood Alcohol Content Average; EBAC Max = Estimated Blood Alcohol Content Maximum; Binge = Number of Days of EBAC > .08

3.4.1 Measurement Model

Indices of model fit found the measurement model to be poor ($X^2(24) = 610$, $p < .001$, RMSEA = .32, 90% CI = .29-.34; SRMR = .12; CFI = .78). Standardized loadings ranged from .66-.70, *ps* < .001 for Binge Days, .90-.92, *ps* < .001 for EBAC Average, and from .96-.99, *ps*<.001 for EBAC Max across time points, indicating that the poor fit was due to redundancy in variance among the indicators. However, all three indicators were kept due to non-consequential

implications of high co-variance of the three items loading onto the Alcohol Use latent variable when examined in the context of the full model, as well as for the potential of losing information by using only one of the indicator variables (and thus converting the full model into a path model).

3.4.2 Negative Urgency Structural Model

In order to test the effect of Alcohol Use at T1 on change in negative urgency at T2, and Alcohol Use at T2 on change in negative urgency at T3, the full structural model for negative urgency was examined. The fit statistics of the negative urgency model revealed poor fit [X^2 Robust (46) = 287.83, $p < .001$; Robust RMSEA = .23, 90% CI = .21-.26; SRMR = .09, CFI = .81]. Results of the standardized path coefficients are depicted in Figure 3.1.

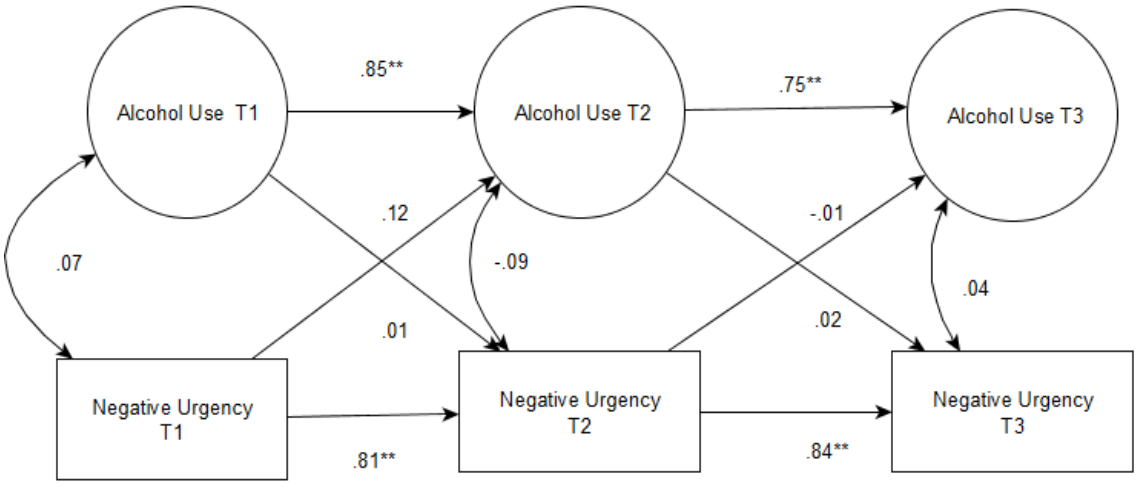

Figure 3.1. The standardized path coefficients of a crossed-lagged panel design model examining the bi-directional relationship between negative urgency and Alcohol Use over time for the full sample (N = 245).

These reveal that, when accounting for the variance between Alcohol Use across time, as well as cross-sectional variance between negative urgency and Alcohol Use at each time point, the relationship between Alcohol Use during T1 was not significantly predictive of negative urgency at T2 (β = .12, p = .24), nor was Alcohol Use at T2 significantly predictive of negative urgency at T3 (β = -.01, p = .99). While cross-sectional effects between urgency and Alcohol Use at each

time point were not significant, the autoregressive effects for negative urgency (e.g. the variance attributed to negative urgency T2 from negative urgency T1), as well as Alcohol Use, were statistically significant over time.

3.4.3 Positive Urgency Structural Model

In order to test the effect of Alcohol Use at T1 on change in positive urgency at T2, and Alcohol Use at T2 on change in positive urgency at T3, the full structural model for positive urgency was examined. Model fit statistics revealed that the positive urgency structural model, like negative urgency, was also a poor fit [X^2 Robust (46) = 294.49, $p < .001$; Robust RMSEA = .23, 90% CI = .21-.26; SRMR = .09; CFI = .80]. Results of the standardized path coefficients are depicted in Figure 3.2.

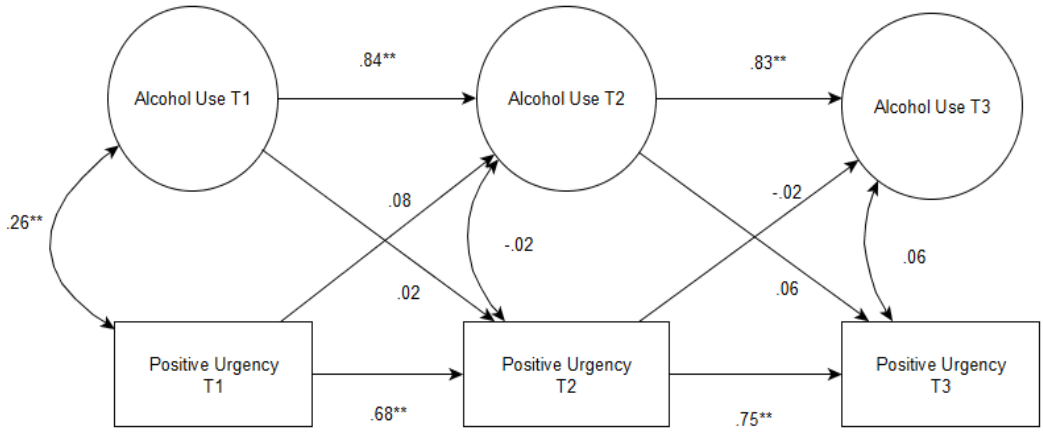

Figure 3.2. The standardized path coefficients of a crossed-lagged panel design model examining the bi-directional relationship between positive urgency and Alcohol Use over time for the full sample (N = 245).

These reveal that, when accounting for the variance between Alcohol Use across time, as well as cross-sectional variance between positive urgency and Alcohol Use at each time point, the relationship between Alcohol Use at T1 was not significantly predictive of positive urgency at T2 (β = .08, p = .09), nor was Alcohol Use at T2 significantly predictive of positive urgency at T3 (β = -.02, p = .69). Like the negative urgency model, the autoregressive effects for positive

urgency, as well as Alcohol Use, were statistically significant over time. In contrast to the negative urgency model, however, one concurrent correlation between positive urgency and Alcohol Use, at T1, was statistically significant, indicating that while positive urgency and Alcohol use were initially related at T1, this relationship did not appear to hold over time.

Comparison of model fit values between the negative and positive urgency models indicated that negative urgency (AIC = 4,227.15, BIC = 4,381.21) was a somewhat better overall model than positive urgency (AIC = 4,552.38, BIC = 4,706.43).

3.5 Evaluation of Model between Sub-Samples

3.5.1 Sample (University vs. MTurk)

A chi-square difference test was calculated between the university samples (N = 66) and MTurk samples (N = 179). Results of this test revealed that both the negative urgency model [X^2 (92) = 145.55, $p < .001$] and the positive urgency model [X^2 (92) =131.60, $p < .001$] were significantly different between groups. Individual coefficient paths were examined between MTurk and university samples to determine where the individual differences lied. This revealed that the cross-lagged effects of T1 Alcohol Use on T2 negative urgency and T2 Alcohol Use on T3 negative urgency were not substantially different for MTurk (β = .04, p = .422 and β = .01, p = .960, respectively) and university samples (β = .09, p = .069 and β = -.04, p = .492, respectively). Similar non-significant results were also found for the cross-lagged effects of T1 Alcohol Use on T2 positive urgency and T2 Alcohol Use on T3 positive urgency university samples (β = .01, p = .97 and β = -.05, p = .554, respectively). However, results showed that the relationship between T1 Alcohol Use and T2 positive urgency for the MTurk sample were significant (β = .14, p = .017), while the relationship between T2 Alcohol Use and T3 positive urgency were not (β = .01, p = .84). Notably, while the concurrent correlations among either

positive or negative urgency were all non-significant among the university sample, the MTurk sample had one instance of a significant concurrent correlation for positive urgency and Alcohol Use at T1 (β = .30, $p < .001$). See Figures 3.3-3.6 for a comparison of the beta path coefficients between the university and MTurk samples between both the negative urgency and positive urgency models.

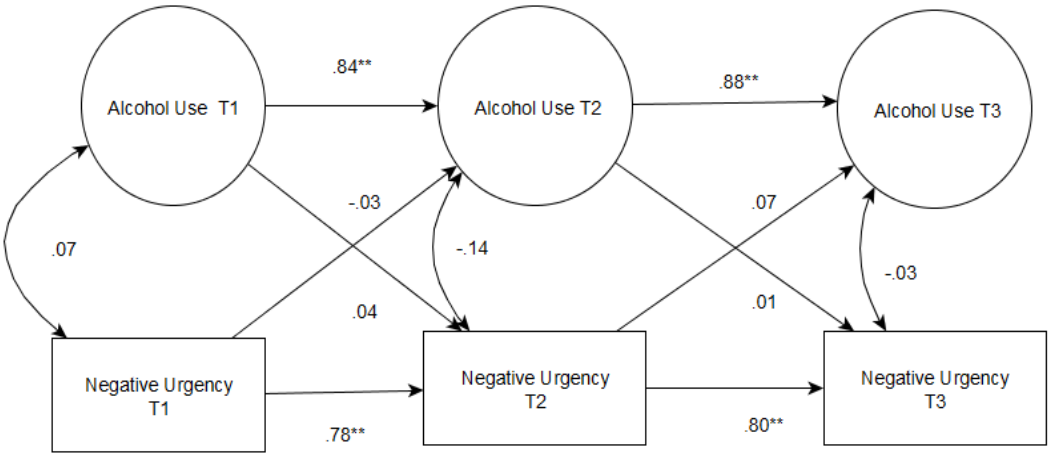

Figure 3.3. A comparison of the standardized path coefficients of a crossed-lagged panel design model examining the bi-directional relationship between negative urgency and Alcohol Use over time in the MTurk sample only (N = 180).

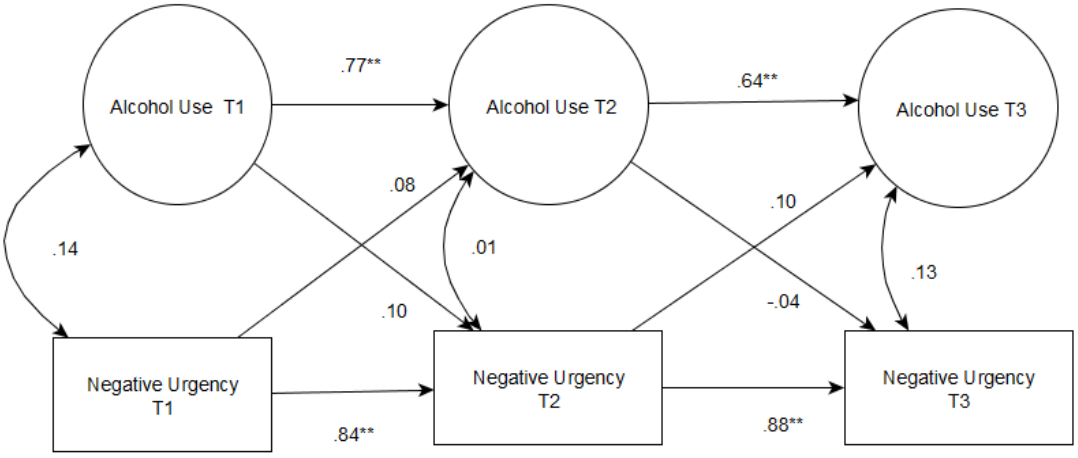

Figure 3.4. A comparison of the standardized path coefficients of a crossed-lagged panel design model examining the bi-directional relationship between negative urgency and Alcohol Use over time in the university sample only (N = 66).

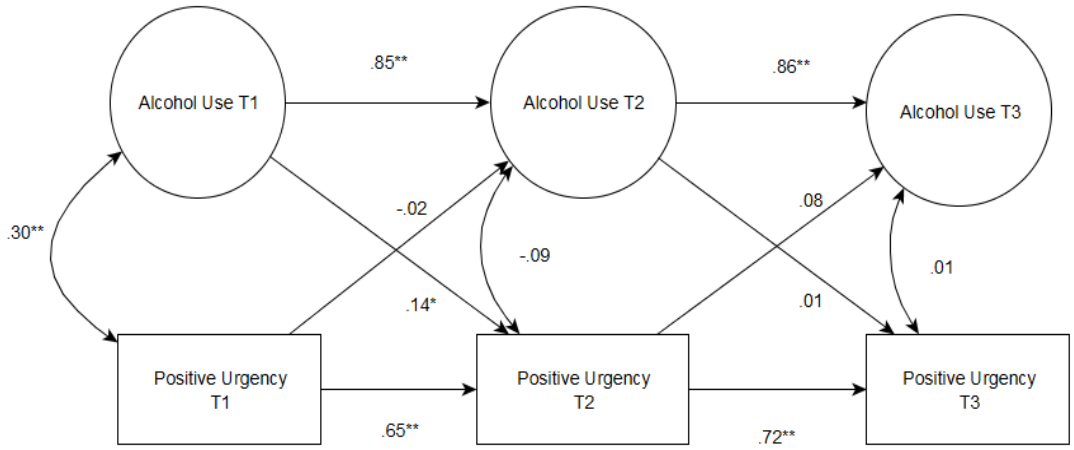

Figure 3.5. A comparison of the standardized path coefficients of a crossed-lagged panel design model examining the bi-directional relationship between positive urgency and Alcohol Use over time in the MTurk sample (*N* = 180).

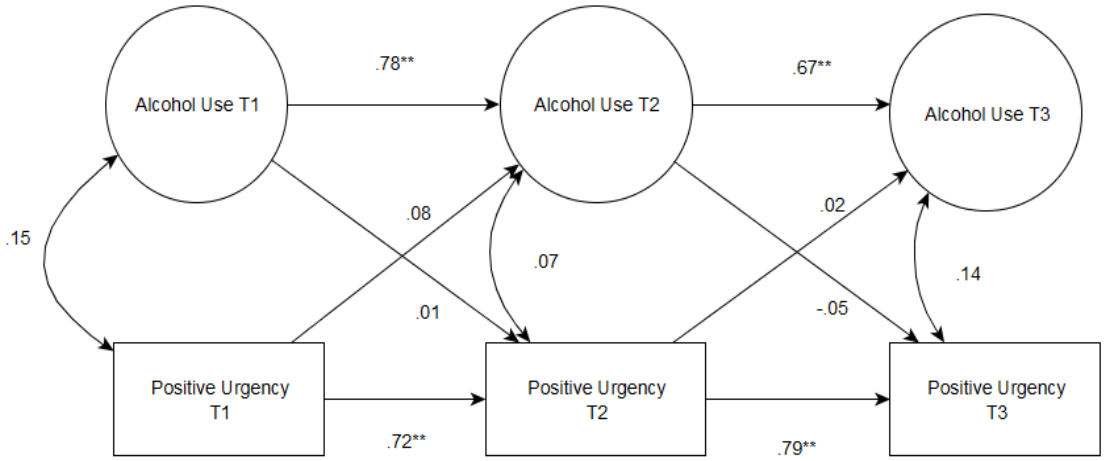

Figure 3.6. A comparison of the standardized path coefficients of a crossed-lagged panel design model examining the bi-directional relationship between positive urgency and Alcohol Use over time in the university sample (*N* = 66).

3.5.2 Gender

A chi-square difference test was calculated between the males (*N* = 65) and females (*N* = 180) and for both negative and positive urgency models. Results of this test revealed that both negative urgency [X^2 (92) = 176.24, $p < .001$] and positive urgency [X^2 (92) = 187.32, $p < .001$] models were significantly different between men and women. Cross-lagged effects of T1 Alcohol Use on T2 negative urgency and T2 Alcohol Use on T3 negative urgency revealed there

was a significant relationship between T1 Alcohol Use on T2 negative urgency for male samples (β = .21, *p* = .005) but this was not shown again for T2 Alcohol Use on T3 negative urgency in males (β = -.02, *p* = .848). However, neither T1 Alcohol Use on T2 negative urgency, nor T2 Alcohol Use on T3 negative urgency were significant for female samples (β = -.02, *p* = .613 and β = .02, *p* = .597, respectively). Notably, the concurrent correlation between Alcohol Use and negative urgency at T1, for males (but not for women), was approaching statistical significance (β = .21, *p* = .076).

Similar results were also found for the cross-lagged effects of T1 Alcohol Use on T2 positive urgency and T2 Alcohol Use on T3 positive urgency. Results showed that the relationship between T1 Alcohol Use and T2 positive urgency, for the male sample, was significant (β = .22, *p* = .009), while the relationship between T2 Alcohol Use and T3 positive urgency was not (β = -.11, *p* = .253). In female samples these were non-significant (β = .01, *p* = .84 and β = .02, *p* = .662, respectively). The concurrent correlations positive urgency and Alcohol Use at T1 approached significance for women (β = .15, *p* = .055) and were significant for men (β = .30, *p* = .027), but were not significant for T2 or T3 correlations for either women or men. See Figures 3.7-3.10 for a comparison of the beta path coefficients between men and women for both the negative urgency and positive urgency models.

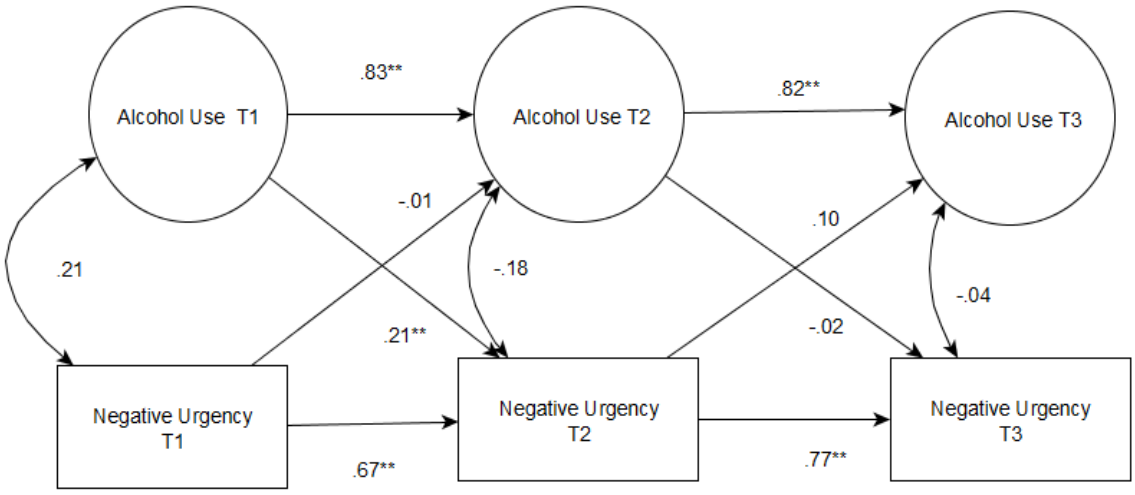

Figure 3.7. A comparison of the standardized path coefficients of a crossed-lagged panel design model examining the bi-directional relationship between negative urgency and Alcohol Use over time in men only (N = 65).

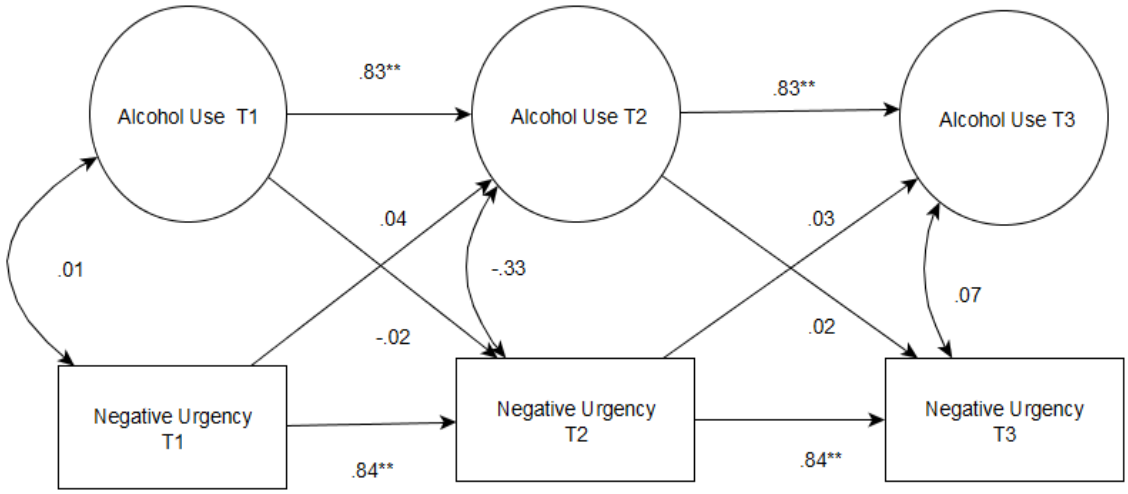

Figure 3.8. A comparison of the standardized path coefficients of a crossed-lagged panel design model examining the bi-directional relationship between negative urgency and Alcohol Use over time in women only (N = 180).

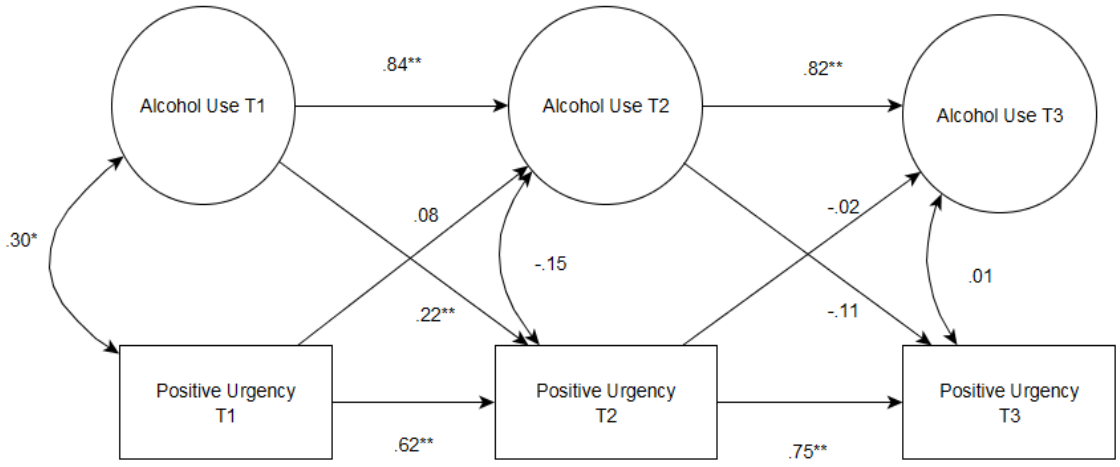

Figure 3.9. A comparison of the standardized path coefficients of a crossed-lagged panel design model examining the bi-directional relationship between positive urgency and Alcohol Use over time in men only (N = 65).

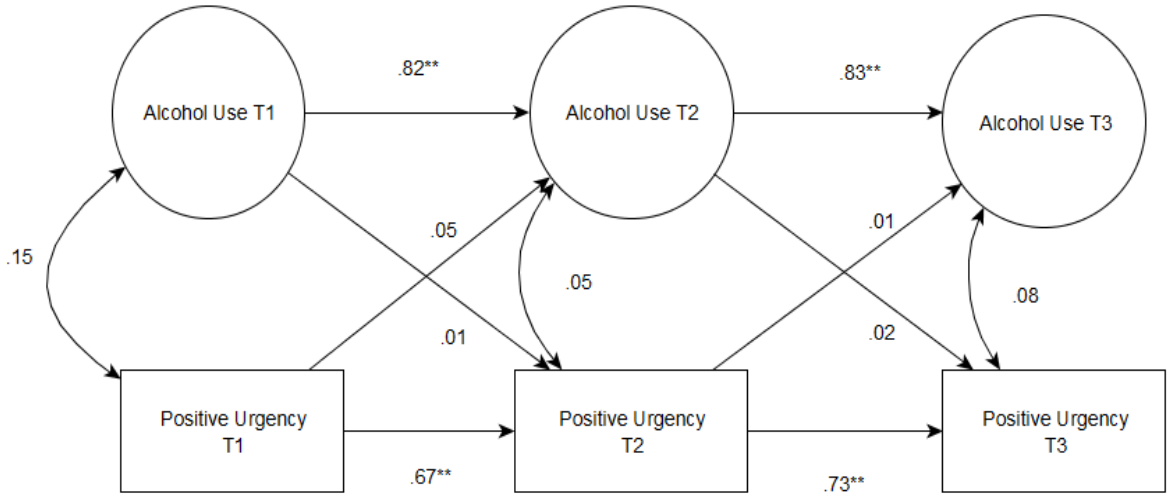

Figure 3.10. A comparison of the standardized path coefficients of a crossed-lagged panel design model examining the bi-directional relationship between positive urgency and Alcohol Use over time in women only (N = 180).

3.6 Exploration of a Subsample

The above models were re-examined with the 23 individuals identified as Mahalanobis outliers removed; in these models, the paths found between T1 Alcohol Use and T2 positive urgency in Turkers and males (β = .07, p = .274 and β = .11, p = .273, respectively), and T1 Alcohol Use and T2 negative urgency in males (β = .08, p = .338), were no longer significant. As

mentioned previously, individuals identified as Mahalanobis outliers tended to be slightly older, male, and in the MTurk sample. Further examination of this specific sub-set of individuals revealed that there was a mean drop in alcohol consumption from the first to the second assessment, particularly for Binge Days (T1 *M* = 9.52, *SD* = 9.89 vs. T2 *M* = 7.87, *SD* = 9.40) and EBAC Max (T1 *M* = .25, *SD* = .14 vs. T2 *M* = .12, *SD* = .10). While these differences between T1 and T2 did not reach statistical significance for these individuals, they may have contributed to potential variance in the differences observed during the same time period for both negative (T1 *M* = 28.70, *SD* = 7.44 vs T2 *M* = 29.35, *SD* = 8.37) and positive urgency (T1 *M* = 19.78, *SD* = 10.29 vs. T2 *M* = 21.04, *SD* = 9.45) in the male and MTurk models. Furthermore, all drinking and urgency variables changed relatively little from T2 to T3 for this sub-sample, indicating a plausible explanation for the lack of any significant results for any model during these time points. A final re-analysis of all tests was conducted removing all individuals who were non-drinkers; the results were unchanged.

In order to further examine this sub-sample, drinking variables were standardized and an overall drinking score was calculated from the product of EBAC Max, EBAC Average, and Drinking Days. This score was used to divide the sample into quartiles of drinkers. Correlations between men and women among study variables were examined. Among the top quartile, women accounted for 37 of the 62 individuals in this quartile. Among these female individuals, there weren't any correlations that showed significance between positive or negative urgency and study drinking variables. Among the 25 male individuals in the uppermost quartile, there were mostly non-significant relationships with negative urgency and drinking variables. However, relationships with positive urgency ranged from non-significant to moderate, with EBAC average and positive urgency being the highest [r (25) = .40, p = .047]. In sum, these correlations

pointed towards a possible gender effect in the relationship between positive urgency and heavy drinking for these men. However, small representation of this sub-sample within the greater sample limited more sophisticated analyses.

CHAPTER 4

DISCUSSION

The aim of the current research project was to examine if there was a bi-directional relationship between positive and negative urgency and binge/prolonged drinking behavior across time. Results of the current study indicated that for the full sample, there was not an effect for the influence of binge/prolonged drinking on either negative or positive urgency during the subsequent month. However, when examined separately by sample (Turkers vs. university) and gender, significant effects for individuals who were Turkers, male, and/or heavy drinkers were found. These findings suggest that increases in positive and negative urgency at T2 could be partially explained by variance in drinking patterns at T1 for this subgroup. However, these relationships were not replicated again between T2 and T3 most likely due to a decrease in all drinking behaviors at T2 and T3. Lastly, the study found that while urgency scores were related to psychosocial problems and dependence symptoms associated with drinking, there was not evidence from the overall sample to support that negative urgency scores had significant relationships to specific frequency and/or bingeing behavior. Positive urgency, however, did find some support for a relationship with bingeing, particularly among heavily-drinking men. Thus, while the primary findings did not indicate any effects for a general sample of young adults, the effects observed among heavy male drinkers in the present study add to a growing body of literature indicating potential for interactive effects between personality, environmental, and sociobiological factors across the trajectory of the human lifespan. Future research that continues to examine how urgency relates to alcohol use in longitudinal contexts, while utilizing diverse samples, is warranted.

4.1 Null Effects for a Bi-Directional Relationship

The primary analyses failed to yield evidence that negative or positive urgency can be influenced by drinking behavior. In other words, the "feedback" loop of impulsivity-drinking-impulsivity hypothesized in the present study did not appear to occur over short periods of time (e.g., monthly intervals) for the study sample. Our study sample was generally similar to the demographic and drinking characteristics described in other studies examining alcohol use and urgency among national/collegiate samples of young adults. For example, a national survey of 19-30 year olds revealed that 45% of men and 27% of women reported heavy (> 5 drinks on a single occasion) within the two weeks prior (Young, et al., 2004). This may be compared to the number of days within the previous 30 days that BAC was > .08 (Binge Days) endorsed by the present sample; 69.2% of the males and 52.7% of females reported at least one Binge day in the first month of data collection. However, scores on the AUDIT obtained in the first month were comparable to scores typically observed in young adults when a cutoff criteria of six or greater is used as an indication of alcohol problems [34% as reported in a college samples (Kokotailo, et al., 2004) vs 28.5% in the present study at T1] or when observing the mean values of number of drinks per day [M = 7.65 as reported in Kaiser et al., (2012) vs. M = 6.41 in the present study]. Negative urgency scores [M = 26.76 in Kaieser et al., (2012) vs. M = 25.38 in the present study] and positive urgency scores [M = 23.04 found in Fossati, et al., (2014) vs. M = 26.45 in the present study] also remained comparable to other young adults samples. In sum, while the present sample appeared comparable to a population of young adults from North American, the hypothesized effect was not evident at observed levels of alcohol intake among the overall sample, or among women. Whether the hypothesized feedback loop may be observed for a non-

clinical, young adult population over longer periods of time utilizing a larger sample size remains to be explored in future studies.

While it is certainly true that these effects may simply not exist for the overall sample used in the present study, other possibilities exist to explain the emergence of null findings. For example, there exists the possibility that there may have been measurement error for the alcohol use variables. Specifically, as with any survey-based assessment methodology, it could be that the lack of findings may have been due to inaccuracy in self-reporting drinking behavior throughout the month prior. Although the TLFB is generally a well-validated measure (Sobell, 1978) and has been validated for online use as well (Pedersen, 2006; Rueger et al., 2012), it is possible that this specific sample did not tend to report substance use very accurately. However, it may be argued that the use of the TLFB in the present study offers an improvement on the methodology of urgency studies that have tended to assess alcohol frequency and bingeing more generally, such as the Drinking Styles Questionnaire (Smith, McCarthy, & Goldman, 1995), which contains drinking frequency items that ask about non-specific occasion drinking patterns [e.g., "On any given occasion, (0) *I don't drink alcohol at all* to (4) *I usually drink a lot of alcohol (more than 9 beers or drinks)"*] (Coskunpinar, 2013). Use of innovative alcohol-use monitoring technologies such as Ecological Momentary Assessment (EMA) and/or dermal alcohol sensors may provide more accurate accounts of drinking behavior. Additionally, there certainly exists potential for other drug use to also influence impulsivity; other studies may consider examining use of other drugs as well as alcohol in these contexts.

Additionally, it is possible that overall results were not found due to selection biases in the samples. For example, data for the university sample was collected across the course of a school semester; in order to participate in the entirety of the study, only individuals who initiated

their participation in collecting research credits early in the semester could have participated in the study. It may have been that students who began research participation early in the semester and completed all three time intervals were qualitatively different in variables such as impulsivity and conscientiousness than students who initiate participation later in the school year and/or did not complete all three time intervals. These factors, as well as the issue that the majority of the participants were under 21 years old and not legally allowed to drink in the university sample – thus limiting access to alcohol - may have, in turn, limited ability to find significant results among these individuals. Similarly, individuals who completed all three time points among the MTurk sample could have possessed different qualities as well, in turn affecting the power of the study. These limitations, while typical of longitudinal design, may be addressed in future studies by continuing to emphasize recruitment of non-student samples (such as MTurk, as used in the present study) using paid incentives as well as emphasizing efforts on participant retention. Examination of drinking in underage young adults also continues to present a challenge in substance use research; perhaps the utilization of samples from outside the U.S., in countries with lower legal drinking ages, can address this difficulty.

4.2 Significant Effects for Heavy Male Drinkers

Secondary analyses examining the proposed models and correlations separately between males and females suggested a possible effect of alcohol use at T1 on both positive and negative urgency at T2 for a sub-sample group that was comprised of individuals who tended to be heavily drinking males. These results are in partial support of a previous longitudinal study which found increased impulsive behavior was reported if the participants had engaged in heavy drinking during the previous year above and beyond those who did not engage in heavy drinking (White, 2011). Interestingly, the individuals in the present study appeared to drink heavily and

frequently at baseline and, like the White study, were male and reported higher baseline impulsivity/urgency. Furthermore, the present study demonstrated this effect may be relevant for a somewhat older sample of individuals (ages 18-30) than the White study (ages 14 -25). Future research is needed to clarify whether these effects can be attributed to either a) a learning effect of alcohol intoxication to relieve or enhance mood states or by b) decreasing top-down inhibitory control, or both, as were reviewed as possible mechanisms of action in the present study. Examination of other variables at each time point, such as alcohol use motives, alcohol reward expectancies, or cognitive functioning, may help in clarifying this.

Inconsistency in replication of these effects from T2 to T3 is concerning, however. Of the possibilities for why this occurred, the downward trend in alcohol use from T1 to T3 that was observed in the overall sample (particularly for Turkers) may be culprit. Reasons for the decreases in alcohol use over the three time points could be contributed to a number of possibilities. For example, because all participants began assessment in late-Winter or early-Spring, and ended the final assessments in late-Spring or early-Summer, there may have been time or seasonal effects, representing population variation in drinking patterns depending on time-of-year. However, this is unlikely given that, to the author's knowledge, significant seasonal effects of alcohol consumption have not been found in prior studies. Similarly, no significant national or world-wide events occurred within the data collection timeframe of the study.

A second, more likely possibility is that decreases in drinking may have been caused by heightened self-awareness of one's own drinking behavior induced by self-monitoring while completing TLFB during the months prior. This may have, in turn, resulted in the inability to demonstrate a significant relationship between urgency variables at T2 on Alcohol Use T3, as

well as concurrent correlations between urgency and Alcohol Use at T2 or T3 because urgency variables were no longer reflective of naturalistic drinking behavior. Indeed, tracking alcohol consumption has been used as an effective intervention strategy; in a prior study, problem drinkers completed an intervention by sending back surveys regarding drinking habits via mail (which included the TLFB and the AUDIT) and were either given personalized feedback or simply mailed informatory pamphlets on alcohol use (Sobell, et al., 1996). Results of this study found that even among participants who did not receive personalized feedback regarding the consequences of their drinking habits, there was an approximately 30% reduction in the amount of problem drinking reported on follow up on year later. The possibility that the self-monitoring of alcohol consumption provided an inadvertent "intervention" among heavy drinkers in the present study represents a common difficulty with frequent assessment of drinking; fewer, longer-interval assessments, while less accurate (Hoeppner, Stout, Jackson, & Barnett, 2010), may also yield less risk of influencing drinking behavior over time. It is also possible that if the present study were to assess drinking over the span of more months, the influence of self-awareness may have become less of issue over time. Future studies wishing to measure drinking behavior on a monthly basis are encouraged to increase the number of assessment periods. If less frequent measurement is needed concerning drinking episodes, it may be advisable to increase the time length between assessments to bi-monthly or longer.

4.3 Examining Urgency and Alcohol Bingeing

The present study is the first, to the author's knowledge, to examine urgency in relation to specific drinking behaviors as reported on the Timeline Follow Back (as opposed to more general frequency/bingeing recall measures). Results of the present study suggest that negative urgency has low or non-significant relationships to drinking assessments that are representative

of specific drinking frequency and bingeing episodes. Past examination of negative urgency and specific drinking behaviors remain conflicting in current literature. For example, a meta-analysis by Coskunpinar (Coskunpinar, 2013) revealed that negative urgency has tended to be somewhat low in its relationship to bingeing (r^2 = .13, 95% CI = .07-.19). In the same meta-analysis, negative urgency was moderately related to overall alcohol use (r^2 = .29, 95% CI = .20-.39) as was positive urgency (r^2 = .29, 95% CI = .15-.43). However, the authors noted that when looking at impulsivity variables and general alcohol consumption, the effect size has varied significantly across studies, suggesting that perhaps there are either methodology differences among existing studies and/or population differences that may affect the consistency of findings.

In turn, findings are in contrast to Bo et al. (Bo, 2016), who found that negative urgency was the only facet of the UPPS-P that was related to alcohol bingeing. In the Bo study, which included a sample of 266 university students, participants were evaluated on bingeing using three items on the Alcohol Use Questionnaire (Mehrebian & Russell, 1978) which asked them their general weekly alcohol consumption based on: (10) Number of drinks per hour, (11) Number of times intoxicated by alcohol, and (12) Percentage of time drunk when going out drinking. Results found that while bingeing was initially associated with high sensation seeking, the association with negative urgency emerged after controlling for age, gender and global alcohol consumption. In contrast to the present study, which generally found a stronger relationships between positive urgency and bingeing, no effect was found for positive urgency in the Bo study. The authors theorized that sensation seeking-related behaviors are generally higher among males; thus, controlling for gender allowed for variance to be attributed to non-gender related facets of impulsivity, e.g. negative urgency. While sensation-seeking was not examined in the present analysis, it is not apparent as to why Bo et al. did not find any effects for positive

urgency, which appeared to have a slightly increased relationship to bingeing among males in current study as compared to negative urgency. While differences in results between the present study and Bo et al. are not entirely clear, it is notable that the methods of assessing bingeing are more general in Bo et al. as compared to the present study.

It is possible that because positive urgency has emerged as a separate construct from negative urgency more recently, there is lack of research on how it relates to specific drinking behaviors such as bingeing, particularly among differential populations. To illustrate, the Cockunpinar meta-analysis did not include examination of positive urgency and binge drinking due to lack of relevant studies. While the Bo et al., referenced above did not find positive urgency to related to binge drinking, one study, conducted by Cyders et al. did link positive urgency (but not negative urgency) to drinking frequency and quantity for college students during their first year (Cyders, Flory, Rainer, & Smith, 2009). Indeed, a majority of studies examining urgency thus far have been conducted on college or grade-school students (Smith & Cyders, 2016). The present study - which utilized a combined university and MTurk sample - only found one occasion of a significant cross-sectional correlation between Alcohol Use latent variable and positive urgency, which was found only in heavily-drinking men, and was not consistent over time. Furthermore, the gender differences in the present study which revealed that positive urgency was related to bingeing, but only in males, conflict somewhat with previous studies. For example, a study examining 1,372 undergraduate university students indicated that while positive urgency was higher in males, there were not differences in risk outcomes (such as alcohol use) between genders (Cyders, 2013). Conflicting results of the current literature imply that examination of urgency should include more diverse samples - perhaps utilizing non-student adults that are assessed repeatedly over time - in future research. In light of findings from the

present study, future studies are advised to over-sample for heavily drinking males in order to determine if there are true gender interactions present.

4.4 Examining Urgency and Alcohol Problems

The present study was consistent with the Coskunpinar meta-analysis which found support for a relationship between alcohol-related problems and urgency (negative urgency r^2 = .34, 95% CI = .30-.38; positive urgency r^2 = .34, 95% CI = .28-.40). The present study assessed alcohol problems with scores from the AUDIT. Throughout prior literature, the relationship between urgency and increased AUDIT scores (Dir, Karyadi, & Cyders, 2013; Kaiser et al., 2012), as well as other general measures of problematic alcohol use including the Drinking Styles Questionnaire (DSQ; Smith, et al., 1995) [which measures both consumption frequency/quantity and physical effects (Boyle, 2014; Cyders et al., 2009; Settles et al., 2014; Spillane, Cyders, & Maurelli, 2012)] and the Brief Young Adult Alcohol Consequences Questionnaire (B-YAACQ; Kahler, Hustad, Barnett, Strong, & Borsari, 2008) [which measures alcohol problems (Emery, Simons, Clarke, & Gaher, 2014; Gonzalez, 2011)], have been largely supported. In the present study, correlations among AUDIT subscales and positive/negative urgency suggests that urgency scales tend to have less of a relationship with the AUDIT subscale measuring bingeing and frequent use (Hazardous Use), as well as the EBAC bingeing/frequency variables, while being more related to the Dependence and Harmful Use scales, which measure consequences of problematic drinking, e.g., “How often in the past year have you failed to do what was expected from you because of your drinking?” and “How often during the last year have you been unable to remember what happened the night before because you had been drinking?” In sum, negative and positive urgency were less related to specific behavioral measures of drinking amount or duration, and more related to problems associated with alcohol.

Examining specific items on these inventories may provide some explanation. Specifically, when comparing negative urgency items on the UPPS-P (e.g., “When I feel bad, I will often do things I later regret in order to make myself feel better now,” and “I often get involved in things I later wish I could get out of”) to items from the Dependence and Harmful Use scales of the AUDIT, it is noteworthy that while the urgency items tend to measure general propensity towards emotionally rash actions and consequences, the Dependence and Harmful Use scales tends to measure rash actions and consequences as a result of drinking. While the Dependence and Harmful Use subscales on the AUDIT and negative urgency certainly measure different constructs, both appear to assess more for rash actions and consequences of alcohol use or heightened emotional states, as opposed to behaviors such as bingeing that may serve as a vector for negative psychosocial consequences to manifest.

These findings for negative urgency may, at face value, appear to cast doubt on the two proposed routes from negative urgency to problematic drinking, implying that there are not observable differences in drinking patterns between individuals with high or low urgency, but that there are different, more negative psychosocial consequences for high-urgent individuals when they do drink. For example, the route that suggests that negative urgency may be related to intense emotions that disrupt cognitive control, thereby disinhibiting impulsive behavior (Kaiser et al., 2012) could imply that one would observe greater alcohol bingeing and overall consumption among high negative urgency individuals because they are not able to disinhibit themselves from bingeing episodes. This was further indirectly suggested by prior findings showing that UPPS urgency was the facet of impulsivity that best explained variance in response inhibition during a stop-signal task (Wilbertz et al., 2014). Here, the authors suggested that lack of response inhibition may be an important factor in the urgency trait; importantly, decreased

response inhibition has been related to bingeing in prior studies (Parada et al., 2012; Montgomery, Fisk, Murphy, Ryland, & Hilton, 2012; Mullan, Wong, Allom, & Pack, 2011). The second route, that negative urgency may reflect one's efforts to cope (or inability to cope) with strong emotions (Fischer et al., 2004), also may appear to support the idea that high-urgency individuals may have greater bingeing/frequency behavior. Specifically, it could be implied that individuals with high urgency are more emotional, lack the ability to emotionally cope with distress, and in turn tend to use substances to control emotional responses. In sum, one would again expect to observe a direct relationship between high urgency and binge/prolonged drinking.

However, an important caveat to the lack of strong findings between negative urgency and bingeing/frequency may be that there are interactive variables that have not been accounted for. Urgency theory explicitly states that the trait of urgency is the tendency to act rashly while in heightened emotional states; thus, there could be an interaction effect with depression or mood. Specifically, only individuals who tend to be high in depressive symptoms or experiencing low mood states may show an observable relationship between negative urgency and binge/prolonged drinking because it necessitates a negative mood state. Furthermore, Cyders and Smith (2008) argued that acting rashly to alleviate distress may, in fact, be reinforcing and thus, over time, rash actions such as binge drinking may become more likely. In sum, one would again expect to observe a direct relationship between high urgency and binge/prolonged drinking, particularly among older individuals. Because the current study excluded individuals over the age of 30, it may be possible that the relationship between negative urgency and bingeing may be higher among those in older age groups who have had time to strengthen binge drinking as a learned response to states of distress. It may also help explain why there were stronger findings

for positive urgency in these regards; in the case of negative urgency, a negative mood state must be induced while positive urgency can be observed in the presence of a normal (e.g., non-depressed or neutral) mood state. In sum, future research which clarifies if there are potential interactive effects that are obscuring the relationship between negative urgency and binge/frequent drinking in the present study. Additionally, future research may be advised to concisely differentiate between alcohol-related physical or psychosocial consequences, as opposed to specific measures of alcohol use when considering problematic alcohol use and urgency. This may include examining sub-scales of the AUDIT, as opposed to the total AUDIT score.

4.5 Limitations and Conclusion

In sum, the present study found mixed support for the hypothesis that personality traits such as negative or positive urgency could be influenced over time by environmental/behavioral factors such as drinking. It was one of the first studies to examine urgency at monthly intervals in relation to specific drinking episodes. Negative and positive urgency were chosen as the facets of interest from the broader construct of impulsivity due to the concurrent and predictive relationships that have been consistently observed with problematic alcohol use in prior literature. The findings suggest that while urgency is certainly a highly relevant facet of impulsivity to examine in the context of interaction with drinking, it may be relevant for a specific subset of the general population only. Nevertheless, the results of the study – in context with other urgency literature – emphasize the relevance of taking emotional factors into account while examining the complex relationships between the trait of impulsivity and impulsive behaviors.

However, the present study contained a number of limitations that can be addressed with future studies. Research examining any potential bi-directional relationships urgency and binge/frequent drinking relationships are advised focus recruitment efforts on obtaining a sample with a higher representation of males and heavier drinkers. They may also want to consider different methods of repeated assessments for frequency/bingeing that are frequent enough to be accurate while overcoming the effect of potentially influencing drinking behavior by causing participants to become self-conscious. Future studies are also advised to make certain to differentiate between alcohol frequency and alcohol problems, as urgency appears to be differentially related to these variables. Ideally, a study wishing to expand on this approach may want to recruit a large (N > 1,000) sample of individuals of varying age ranges (14 to >70 years old) and include analyses on substances besides alcohol. This study would over-recruit for males to ensure that genders were equal in number, as well as over-recruit for heavy drinkers, and ideally contain racial and ethnic diversity. Because of the potential for influencing self-awareness by tracking substance use, such a study would contain a much higher number of follow up periods, perhaps tracking participants on a monthly basis for over a year.

Future research may also want to consider examining urgency in the laboratory. Efforts have been undertaken in recent years to examine urgency variables in context of experimental design and have related negative urgency to fMRI data as well as increased reactivity to alcohol cues, emotion-based risk-taking, and expectancies of reinforcement from addictive behaviors (Chester, et al., 2016; Coskunipar & Cyders, 2013; Cyders, et al., 2014; Cyders, et al.,. 2015; Joseph, et al., 2009; Pearson, et al., 2012). In sum, these studies have sought to cross-validate urgency with related constructs. However, a considerable limitation that persists in urgency literature is that urgency has only been assessed via self-report measures. Furthermore, items

assessing urgency on the UPPS-P tend to have high face validity and thus could increase response bias from participants. Likewise, self-report items assessing impulsivity may also require a degree of self-insight which some individuals may not possess. While other facets of impulsivity have been assessed via laboratory tasks [e.g. go/no-go, stop-signal reaction time tasks, and the Stroop test], there exists no laboratory protocol that has been validated as a measure of negative or positive urgency. In these regards, future research is encouraged to continue to expand on negative and positive urgency outside of the personality/self-report theory that it was conceptualized in.

In toto, the present study emphasizes that while urgency literature has progressed substantially since its conception in the early 2000s, there still remains many unanswered questions in the field concerning the nature of urgency over time, its relationships to alcohol use, and how these factors may differ between populations. While the present research project may serve to provide a small contribution to the growing field of urgency literature, there exists extensive opportunity for further examination of urgency theory in various contexts in the years to come.

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