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*Exploring the association between emotion-driven impulsivity, motives to drink,
mindfulness and alcohol misuse*

Master's by Research, Trinity College Dublin.

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Declaration

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Abstract

Trait impulsivity is a reliable, robust predictor of alcohol misuse, although evidence increasingly supports a multifaceted model of impulsivity, whereby unique dimensions interact with emotional states, motives to drink, and mindfulness. Negative and positive urgency involve acting impulsively under the influence of negative and positive emotions. Drinking motives are characterised as the value that individuals place on the particular effects they want to achieve while consuming alcohol. While mindfulness is conceptualised as the present moment awareness of one's thoughts, emotions, bodily sensations, and surrounding environment. This study explored the association between emotion-driven impulsivity and alcohol misuse, and investigated the role of trait mindfulness and drinking motives in this relationship. A diverse online sample of participants ($n = 414$) completed a battery of demographic and alcohol related items, as well as self-report measures indexing facets of impulsivity, motives to drink, and mindfulness. Structural equation modelling was used to examine the utility of two models: the first, linking positive urgency to enhancement motives and mindfulness; the second, linking negative urgency to coping motives and mindfulness. Negative and positive emotion models of impulsivity provided satisfactory representations of alcohol misuse, explaining 33% and 20% of the variance in hazardous drinking, respectively. Negative urgency was not directly associated with alcohol misuse, but indirect effects were observed via coping motives and mindfulness. Positive urgency was directly related to alcohol misuse, but no indirect effects were observed via enhancement motives or mindfulness. This study highlights how unique motivational pathways of emotion-driven impulsivity are linked to alcohol misuse. Specifically, these findings identify drinking to cope and mindfulness as key mechanisms in the relationship between negative urgency and hazardous drinking.

Keywords: Alcohol misuse, impulsivity, drinking motives, mindfulness, online research

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Introduction

Alcohol misuse

Alcohol misuse is a major health risk. In 2012, it was estimated that nearly 6% of all global deaths were attributable to its consumption (World Health Organization, 2014). In the USA, alcohol is accountable for 3.5% of all deaths, and is the third largest preventable cause of death after tobacco use and being overweight (Center for Behavioral Health Statistics and Quality, 2016). In the UK, approximately 25% of the adults consume alcohol in ways that are potentially or actually harmful to their health (Day, Copello, & Hull, 2015). Heavy alcohol misuse exacerbates, or directly causes, several medical conditions including diabetes, cardiovascular disease, hypertension, liver disease, and depression (Grant et al., 2017). Combined with lost productivity and legal expenses, the health care costs of alcohol misuse in the USA is estimated at \$223 billion per year or \$746 per capita (Bollard, 2015). Despite its high prevalence, impact on health, and costs to the economy, many of the factors surrounding alcohol misuse are still unclear, most likely due to the complexity and comorbidity of this problematic behaviour (Smith & Randall, 2012).

The brain, like most body organs, is vulnerable to alcohol misuse, although the risk of brain damage and associated behavioural deficiencies varies from person to person (Oscar-Berman & Marinkovic, 2003). Regions of the brain most susceptible to alcohol misuse include the cerebral cortex (important for cognitive function), the limbic system (important for expressing emotions), the thalamus (important for communication within the brain), the hypothalamus (an important component of the stress response system), and the basal forebrain (involved in learning and memory) (Oscar-Berman, 2000).

Damage from alcohol misuse in the frontal cortical areas of the brain is of particular interest for the current thesis. This region is involved in executive functions such as abstract thinking, planning, attention, and inhibition of impulsive behaviour (Fulton Timm Crews & Boettiger, 2009). Broadly speaking, impulsiveness refers to premature and risky actions, as well as deficits in attention and lack of reflection, all of which occur in addiction (de Wit, 2009). Research suggests that alcohol misuse increases impulsive behaviour through cortical degeneration, which in turn, contributes to the persistence and severity of alcohol use disorders (Fulton Timm Crews & Boettiger, 2009). In contrast, abstinence from alcohol results in bursts of neurogenesis and brain regrowth (Crews & Nixon, 2009).

Alcohol misuse is associated with a range of psychological constructs including impulsivity (Padilla, O'Halloran, Bennett, Cao, & Whelan, 2017), drinking to cope (Watkins, Franz, DiLillo, Gratz, & Messman-Moore, 2015), drinking for self-enhancement (Oster, Arinell, & Nehlin, 2017), anxiety (Gimeno et al., 2017), depression (Danzo, Connell, & Stormshak, 2017), and negative emotions (Hogarth, Hardy, Mathew, & Hitsman, 2018). A large body of research has also revealed that mindfulness is both inversely associated, and effective, in treating alcohol misuse (Cavicchioli, Movalli, & Maffei, 2018; Enkema & Bowen, 2017; Li, Howard, Garland, McGovern, & Lazar, 2017), with trait mindfulness found to be associated with less problematic drinking patterns (Karyadi & Cyders, 2015). Each of these constructs are discussed below in detail.

Impulsivity

Impulsivity – the tendency to act prematurely without foresight (O'Halloran et al., 2018) – is a multifaceted construct that can be subdivided into several domains including

choice, motor, cognitive, and trait impulsivity (Caswell, Celio, Morgan, & Duka, 2016; Robbins & Dalley, 2017). Choice impulsivity involves preferentially selecting immediate smaller rewards over larger delayed rewards—and can be measured via questionnaires or behavioural tasks (Hamilton et al., 2015). Motor impulsivity is the tendency to *act* without thinking and is typically measured using Go/No-Go or stop-signal tasks, where individuals are required to inhibit an ongoing motor response (i.e. keyboard click). Cognitive impulsivity refers to impaired sustained attention (Sharma, Markon, & Clark, 2014), and can also be quantified by measuring response variability in task performance (Bellgrove, Hester, & Garavan, 2004). Finally, trait impulsivity relates to dispositional characteristics such as sensation seeking, non-planning, or boredom susceptibility and can be assessed using self-report questionnaires. Debate continues, however, as to what specific domains are most relevant to alcohol misuse and other divisions have been proposed (Gullo, Loxton, & Dawe, 2014).

Emotions can also interact with impulsive behaviour (Herman, Critchley, & Duka, 2018). Negative urgency is the tendency to act impulsively during negative emotional states (Cyders & Smith, 2007). For example, an individual might quickly decide to go for a drink because they feel stressed. Relatedly, positive urgency is the proneness to act out impulsively under conditions of positive emotional states (Cyders & Smith, 2007). That is, the same person might impulsively decide to go for a drink because they are in a good mood. VanderVeen et al. (2016) has described negative urgency as the most important impulsivity-related trait for alcohol-related issues, suggesting that negative urgency may intensify alcohol consumption through increased negative emotional reactivity to mood related events. Other research has found positive urgency to be related to alcohol misuse (Dinc & Cooper, 2015), with Banca et al. (2016) finding increased positive urgency in binge drinkers compared to healthy volunteers.

Drinking Motives

Drinking motives, characterised as the value that individuals place on the particular effects they want to achieve while consuming alcohol (Cox & Klinger, 2011), are important factors for predicting alcohol use (Kuntsche, Knibbe, Gmel, & Engels, 2005). Reported motives for consuming alcohol include 'fitting in with the crowd' (conformity motives), managing negative affect (coping motives), having fun (enhancement motives), and enjoying being with others (social motives) (Anderson, Garcia, & Dash, 2016). Different patterns of drinking also exist between these constructs. For instance, social motives are associated with increased frequency of alcohol consumption, enhancement typically relates to heavier drinking, and coping motives generally involve alcohol related problems (Cooper, Kuntsche, Levitt, Barber, & Wolf, 2015).

Drinking motives are often considered the most proximal factors underpinning alcohol consumption (Kuntsche, von Fischer, & Gmel, 2008), and have been found to constitute a mediating role between various aspects of impulsivity and alcohol misuse (Studer et al., 2016). For example, a longitudinal study by Watkins et al. (2015) examined whether impulse control issues while experiencing negative emotions increased the risk of hazardous alcohol use. Participants ($n = 490$) were assessed for emotion-driven impulsivity, drinking to cope, and alcohol misuse over the course 20 months. It was found that drinking to cope fully mediated the relationship between negative emotion-driven impulsivity and hazardous drinking. Similarly, Jones, Chrysanthakis, and Groom (2014) explored the inter-relationships between alcohol misuse (i.e., quantity and negative consequences), drinking motives, and four factors of trait impulsivity via the Urgency, Premeditation, Perseverance and Sensation Seeking Scale (UPPS; Whiteside & Lynam, 2001). Several direct effects of impulsivity on negative consequences of alcohol misuse

were observed via path analysis, and furthermore, drinking to cope mediated the effect of urgency. In terms of drink specificity (i.e. drink type), the effect of lack of premeditation (i.e. non-planning impulsivity) was mediated by enhancement motives and the consumption of wine and spirits. In contrast, the effect of sensation seeking was mediated by alcohol intake, regardless of drink type consumed.

Mindfulness

Although a general consensus has not been reached on how mindfulness should be defined, it is often conceptualised as the present moment awareness of one's thoughts, emotions, bodily sensations, and surrounding environment (Bishop et al., 2004; Zgierska et al., 2009). According to Kabat-Zinn, "Mindfulness emerges through paying attention on purpose, in the present moment, and non-judgmentally to the unfolding of experience moment by moment" (Kabat-Zinn & Hanh, 2003, p. 145). Mindfulness has also been differentiated into state and trait mindfulness. In contrast to state mindfulness which can be altered through mindfulness training, trait mindfulness points towards an individual's dispositional or baseline mindfulness (Siegling & Petrides, 2014).

It is plausible that alcohol related issues are negatively associated with particular facets of trait mindfulness. For instance, where mindfulness involves an ability to contact the present moment (Kabat-Zinn & Williams, 2013), addiction can be characterized as a loss of control, a habitual drive to attain temporary pleasure or relief, and an inability to accept the present moment (Sussman & Sussman, 2011; Witkiewitz, Bowen, Douglas, & Hsu, 2013). Indeed, a considerable body of literature has explored the link between mindfulness and various aspects of addiction, including alcohol misuse (Cavicchioli et al., 2018; Garland & Howard, 2018; Li et al., 2017). A study by Karyadi and Cyders (2015) explored how specific facets of trait mindfulness were related to particular aspects of alcohol misuse, and how craving for alcohol might mediate this relationship. Self-report

assessments with high risk drinkers revealed that trait mindfulness was inversely related to hazardous drinking, but not to alcohol consumption. Moreover, alcohol cravings mediated the negative associations between overall trait mindfulness and problematic alcohol use, suggesting that trait mindfulness provides a protective effect, or reduces acting, on those cravings. In another study, Brett, Leffingwell, and Leavens (2017) explored the mediating effect of Protective Behavioural Strategies (PBS; Martens et al., 2004), which reduces alcohol-related consequences, on the effect of mindfulness on drink-related issues. The moderating role of mindfulness on the association between PBS and alcohol misuse was also investigated. Participants (N = 239) completed self-report measures for alcohol use and consequences, use of PBS, and trait mindfulness. Higher levels of mindfulness predicted reduced alcohol misuse in terms of consumption and the severity of alcohol-related consequences, with PBS mediating this relationship. Mindfulness also moderated the association between PBS and drink-related consequences.

Leigh and Neighbors (2009) investigated the relationship between mindfulness and alcohol use among college undergraduates, and examined if coping and enhancement motives mediated this effect. Various facets of trait mindfulness, alcohol use, and motives to drink were assessed via path-analysis. Gender differences were also considered. Increased mind/body awareness was associated with more alcohol use in both male and female participants, while non-attachment to thoughts, a feature of trait mindfulness, was found to be associated with reduced alcohol consumption in male participants only. Interestingly, enhancement and not coping motives were found to mediate these effects, also only for men.

Relationship between mindfulness and impulsivity

An emphasis on the present moment is common not only to mindfulness, but also impulsivity, which appears to involve a powerful orientation to the present. That is, an individual's focus is reflected in a pull towards "living in the here and now" (Murphy & Mackillop, 2012). However, the relationship between these two constructs is not clearly understood. To explore the correlational relationship between trait mindfulness and impulsivity, Peters, Erisman, and Upton (2011) used multidimensional measures of both these constructs in relatively large samples ($n = 347$ and $n = 227$) of university students across two studies. Several components of mindfulness were negatively correlated with different facets of impulsivity. Although varying results were observed across sub-components in both strength and significance, these findings broadly suggest that trait mindfulness may be associated with a greater capacity to inhibit problematic impulsive behaviour.

Both mindfulness and impulsivity, as discussed above, have been separately linked to alcohol misuse. Several studies have investigated how mindfulness and impulsivity may be associated with various other maladaptive behaviours including impulse buying (Park & Dhandra, 2017), stress (Mantzios, 2014), and eating disorders (Lattimore, Fisher, & Malinowski, 2011; Mead, Malinowski, & Lattimore, 2012). Despite these strong conceptual associations, very little research exists that simultaneously investigates mindfulness and impulsivity in relation to addictive-based behaviour, including alcohol misuse. This is particularly important because mindfulness and impulsivity may be complementary to one another, with each construct uniquely contributing to antecedent factors associated with alcohol misuse. However, it is also important to note that mindfulness and impulsivity could equally be redundant to one another. In other words, they might measure parallel processes that constitute significant associations to different psychological constructs (Murphy & Mackillop, 2012). To

address these issues, Murphy and Mackillop (2012) investigated the association between mindfulness and impulsivity, whilst also exploring both in terms of their relationship to alcohol misuse. A sample of 116 young adults were assessed for alcohol use, mindfulness, and both trait and choice impulsivity. Negative urgency was most substantially related to alcohol misuse. Both negative and positive urgency were inversely related with the nonjudgment and non-reactivity aspects of mindfulness. Importantly, the relationship between alcohol misuse and mindfulness was found to be a function of impulsivity. That is, although alcohol misuse was significantly related to components of mindfulness, these associations were entirely accounted for by their relationship with specific facets of impulsivity. Generally speaking, these findings suggest that mindfulness and impulsivity are reciprocally related, but appear to be assessing divergent processes (Murphy & Mackillop, 2012). That is, some indices of impulsivity (e.g., positive urgency) predicted alcohol misuse whereas the indices of mindfulness (e.g. awareness), which was associated with positive urgency, did not. Consequently, research investigating mindfulness and alcohol misuse may potentially assign an effect to mindfulness, when in reality, impulsivity provides a more accurate account of this association. In sum, this research demonstrates the significance of simultaneously assessing impulsivity when exploring the impact of mindfulness on alcohol misuse.

Online research for addiction

The current research relies heavily on internet-based methods. Due to various methodological issues concerning addiction however, research in this domain has been quite limited. A brief account of online methods including the benefits and challenges, opportunities for understanding addiction, and how the present study overcame obstacles specific to addiction-based research will now be discussed.

Benefits and challenges of online research. The internet plays a crucial role in experimental research, especially for the behavioural sciences, impacting the way researchers collaborate, collect data, and disseminate their results (Kraut et al., 2004). Until recently, most researchers had to rely on samples comprised of undergraduate students as their principal source of recruitment (Litman, Robinson, & Abberbock, 2017). This method has several limitations. It is both time-consuming and labour-intensive which can negatively influence sample sizes, whilst generalizability to the general population is significantly reduced (Henrich, Heine, & Norenzayan, 2010).

Online methods on the other hand can counteract some of these issues (Gosling & Johnson, 2010). For example, online recruitment is far less labour-intensive, sample pools are typically more representative of the lay community (Kraut et al., 2004), and researchers can recruit large samples in short periods of time (Nosek, Banaji, & Greenwald, 2002). Relatedly, online research delivers a level of experimental control that is difficult to achieve in traditional laboratory experiments. That is, online experiments are necessarily fully automated and do not require a human experimenter to provide instructions or present experimental manipulations (Kraut et al., 2004). Demand characteristics are therefore reduced (Reips, 2002). Despite these advantages, online recruitment also has some limitations. This includes issues relating to data quality, ensuring consent, finding participants, incentivizing participation, and experimental control (Kraut et al., 2004; Litman et al., 2017).

Benefits specific to addiction. Specific to addiction research, online recruitment methods permit researchers to conduct large online experiments that can target either diverse or specialized groups (e.g. alcoholics) with minimal intervention (Nosek et al., 2002). Several other benefits have also been noted. For instance, online methods provide a level of anonymity for people who are unwilling to participate in face-to-face research,

which is typically due to embarrassment and stigma (Chebli, Blaszczynski, & Gainsbury, 2016; Gainsbury, Hing, & Suhonen, 2014). At the same time, online approaches can help people to overcome logistical barriers that prevent face-to-face participation, such as physical disability, transport issues, or geographical remoteness (Proudfoot et al., 2011). Online approaches also appear to diminish response bias in sensitive research areas such as substance use (Thornton, Harris, Baker, Johnson, & Kay-Lambkin, 2016). Moreover, research suggests that recruiting participants through social networking sites such as Facebook can facilitate the inclusion of low-incidence or hidden populations (Ramo & Prochaska, 2012; Temple & Brown, 2011). Indeed, young adult smokers (Ramo, Rodriguez, Chavez, Sommer, & Prochaska, 2014), individuals involved in alcohol related domestic violence (Crane, 2018), HIV positive men who have sex with men (Zlotorzynska, Sullivan, & Sanchez, 2017), low-income populations (Lohse & Wamboldt, 2013), and cannabis cultivators (Barratt et al., 2015) have all been successfully recruited through online methods.

Challenges specific to addiction. Despite the obvious advantages of Internet-based research, several concerns have been raised, especially in terms of addiction. First, data quality may be compromised through reduced experimental control. That is, controlling the context in which the data is acquired can be lost when people participate in online research (Kraut et al., 2004). This can be particularly problematic in addiction research whereby participants may be under the influence while participating in the study. Similarly, data quality may suffer because online participants are simply less motivated or inattentive. Indeed, two-thirds of psychology researchers revealed that data quality and inattentiveness was their primary concern when using online recruitment methods (Chandler, Mueller, & Paolacci, 2014). The treatment of participants is another area where concerns have been noted. Ensuring informed consent, conducting debriefing sessions, as

well as explaining and clarifying experimental instructions can be more problematic than in traditional laboratory settings (Finley & Penningroth, 2015; Kraut et al., 2004). Finally, issues such as higher attrition rates, repeated participation, malingering, and increased risk of self-selection appear to be more prevalent with online approaches (Birnbaum, 2004; Chandler et al., 2014).

Opportunities for understanding addiction. Online recruitment methods (commonly referred to as crowdsourcing) vary in use. They range from public social networking sites such as Twitter and Facebook to more research specific platforms such as Amazon's Mechanical Turk [www.mturk.com], TurkPrime [www.turkprime.com], and Prolific [www.prolific.ac], all of which have been used extensively as a fast and inexpensive way to collect data from diverse samples of participants (Cunningham, Godinho, & Kushnir, 2017). Utilizing these methods to acquire large samples of specialized groups has afforded researchers with a unique opportunity for understanding a range of maladaptive behaviours, including addiction. One such study by Thornton et al. (2016) assessed the feasibility of Facebook to recruit participants for addiction research. They successfully recruited 524 participants via Facebook at a cost of \$1.86 per participant, many of which had high-severity substance use and mental health issues. This enabled them to capture the more severe range of substance use behaviours. When compared with a non-Facebook sample, Facebook participants reported significantly more current use (including harmful use) of tobacco and cannabis. Higher percentages of high-severity cannabis users (Facebook = 24%, non-Facebook = 4%) were also found in the Facebook group who also reported significantly more severe depressive symptoms. Online methods have also been successfully used to acquire longitudinal addiction data. Strickland and Stoops (2018) explored the feasibility, acceptability, and validity of collecting longitudinal alcohol use data using Mechanical Turk. Alcohol and soda use (N

= 278) was recorded daily over 18 weeks. Response rates were high (64.1%-86.8%) across the 18-week period, and predicted associations between frequent and heavier drinking with higher scores on self-report measures for alcohol misuse also observed. Thus, online research appears to be a promising tool for addiction recruitment.

A variety of issues have been raised about the quality of data from Internet-based research. These concerns include participant inattentiveness, demotivation, self-selection, malingering, increased drop-out rates, and repeated participation. Fortunately, however, steps can be taken to mitigate many of these issues. For instance, attrition rates and demotivation can be reduced by providing bonus payments on completion of the study, and by pretesting to avoid frustration caused by technical problems (Simcox & Fiez, 2014). To assess attentiveness, specific questions can be asked throughout the study (e.g., “Are you paying attention?”, if yes, select “no, I am not paying attention”). Similarly, malingering can be assessed by utilizing “faking bad” questionnaires such as the Minnesota Multiphasic Personality Inventory–2 Infrequency-Psychopathology scale (MMPI-2 F(p); Arbisi & Ben-Porath, 1995). This particular scale was designed to detect infrequent responding in individuals with reasonably high base-rates of psychological distress. Finally, repeated participation can be neutralized by tracking Internet Protocol (IP) addresses and rejecting the data from addresses that are duplicated. Moreover, participants on research specific platforms such as Prolific are given fixed ID codes which can be monitored by the researchers (Litman et al., 2017). Each of the mitigating steps above were either developed or utilized in the current study.

A potential issue specific to Internet-based addiction research concerns participants being under the influence. To assess the quality of online data in this population, Kim & Hodgins (2017) evaluated the validity and reliability of data obtained from Mechanical Turk. Current drinkers (N = 208), cannabis users (N = 200), and

gamblers (N = 200) completed a range of self-report measures associated with addiction including alcohol and cannabis use, addiction severity, and impulsivity, as well as measures for valid responding and motivations for participating in Mechanical Turk studies. Internal consistency ranged from $\alpha = .75$ to $.93$ on the addiction severity measures. Over 80% of participants provided valid responses, and financial motives were the most frequently reported motivation to participate. After the exclusion of invalid responding, significant differences were only observed in the cannabis sample, suggesting that the data obtained from alcohol and gambling populations were of high quality. Overall, this research indicates that online platforms provide a promising recruitment strategy for the majority of addictive behaviours.

Current study

Both replicating and extending existing research (Adams, Kaiser, Lynam, Charnigo, & Milich, 2012; Roos, Pearson, & Brown, 2015; Watkins et al., 2015), the primary aim of the current study was to investigate the associations between facets of impulsivity, mindfulness, drinking motives, and alcohol misuse. It was predicted that mindfulness would be inversely associated with all measures of impulsivity, drinking motives, and alcohol misuse. Given the complexity of the relationships between different aspects of impulsivity, drinking motives, and alcohol misuse, structural equation modelling (SEM) techniques were used to assess the potential predictive and mediating effects in two models. In the first model it was hypothesised that drinking to cope and mindfulness would mediate the indirect effect of negative urgency on alcohol misuse. In the second model, it was predicted that indirect paths would be observed for positive urgency on alcohol misuse with drinking for self-enhancement and mindfulness mediating this effect. In other words, it was predicted that the associations between

impulsivity and alcohol misuse would be mediated by drinking motives and (lack of) mindfulness.

Method

Participants

A final sample of 414 participants were recruited for the current study. The majority were recruited through online platforms Prolific and TurkPrime (Prolific = 300; TurkPrime = 27) while the remaining 87 were recruited through the undergraduate program in the School of Psychology. All undergraduate students conducted the study online and received course credits for participation. A total of 1,242 participants were initially screened to assess eligibility. To meet inclusion criteria, participants were required to report either high levels of alcohol use (i.e. ≥ 8) via the Alcohol Use Disorders Identification Test (AUDIT; Babor, Higgins-Biddle, Saunders, & Monteiro, 2001), and/or high scores for symptoms associated with attention-deficit/hyperactivity disorder (ADHD). This was assessed via the screening component of the World Health Organisation Adult ADHD Self-Report Scale (ASRS; Kessler et al., 2005), where a score of ≥ 19 was set as the threshold. The results of the ADHD assessment are part of a larger battery which are not discussed here. The study was approved by the Trinity College School of Psychology Research Ethics Committee (see Appendix I), and all participants were electronically provided with information sheets (see Appendix II), and informed consent forms (see Appendix III). Payments for online recruitment were designated as \$1.50 for the screening phase and \$6 for the second phase, which were paid through the TurkPrime and Prolific websites. Exclusion criteria included a visual impairment that was not corrected with lenses, or a history of seizures or photosensitive epilepsy. Participants were also advised not to take part if they felt uncomfortable answering questions related to their mental health. Sample characteristics are shown in Table 1.

Table 1. *Sample characteristics*

	<i>M (SD) or %</i>
	<i>N = 414</i>
Gender	
Male	51.9 %
Female	46.6 %
Other	1.5 %
Age	31.03 (11.23)
Relationship status	
Single	37.4 %
In a relationship	38.2 %
Married	22.2 %
Other	3 %
Education level	
Some high school or less	4.3 %
Some college	47.4 %
High school graduate	39.4 %
Trade/vocational training	8 %
Associate/bachelor's degree	34.5 %
Master's degree	10.4 %
Professional/doctoral degree	3.4 %

Ethical considerations

The current research was conducted in accordance with the ethical guidelines for research as set out by the School of Psychology in Trinity College Dublin. Prior to testing, each participant was required to read the information sheet (Appendix II) and consent form (Appendix III). To proceed to the online battery, participants were required to tick a box to say that they read the forms and were happy to proceed. Participants were also informed that their data would be kept confidential and that they were free to withdraw from the experiment at any time. Each participant was assigned a unique ID code under which all data was stored.

Materials

Measures. The *Alcohol Use Disorders Identification Test* (AUDIT; Saunders, Aasland, Babor, de la Fuente, & Grant, 1993) is a 10-item measure of hazardous alcohol use. Scores were created by taking the mean of all items where higher scores indicated greater hazardous drinking. Sample items included: “How often do you have a drink containing alcohol?” and “During the past year, how often have you had a feeling of guilt or remorse after drinking?” (See appendix IV). This scale demonstrates high test-retest reliability ($r=.86$) and high internal consistency, suggesting that the AUDIT is measuring a single construct in a reliable fashion (Hays, Merz, & Nicholas, 1995). Cronbach’s alpha for the current sample was .80. Descriptive statistics for all measures are displayed in Table 2.

The *SUPPS-P Impulsive Behavior Scale* (Cyders, Littlefield, Coffey, & Karyadi, 2014) is a 20-item inventory designed to measure 5 dimensions of trait impulsivity: negative urgency, positive urgency, lack of premeditation, lack of perseverance, and sensation seeking. It is a short version of the 59-item UPPS-P impulsive scale. A four-point Likert scale was used to indicate agreement with each statement where 4 denotes “Strongly agree” and 1 denotes “Strongly disagree”. Sample items included: “I tend to lose control when I am in a great mood” and “When I feel rejected, I will often say things that I later regret” (See Appendix V). This scale displays satisfactory internal consistency (0.74–0.88 across subscales) and is considered a valid and reliable alternative to the full UPPS-P in English-speaking non-clinical adult samples (Cyders et al., 2014). Cronbach’s alpha across subscales for the current sample ranged from .701 to .803.

The *Drinking Motives Questionnaire-Revised* (DMQ-R; Cooper, Frone, Russell, & Mudar, 1995) is a measure of drinking motives. That is, the particular effects that individual’s want to achieve while consuming alcohol. It is comprised of 20 items across four subscales: coping with negative affect (coping motives), having fun (enhancement

motives), fitting in with the crowd (conformity motives), and enjoying being with others (social motives). Using a five-point Likert scale where 1 denotes “almost never/never” and 5 denotes “almost always/always”, participants were asked how frequently their own drinking is motivated by the items listed. Sample items include: “Because it’s exciting” and “To forget about your problems.” (See Appendix VI). This scale demonstrates satisfactory reliability (i.e. $\alpha > .80$) (Arterberry, Martens, Cadigan, & Smith, 2012). Cronbach’s alpha across subscales for the current sample ranged from .786 to .918.

The *Mindful Attention Awareness Scale* (MAAS; Brown & Ryan, 2003) is a 15-item self-report measure of dispositional mindfulness. The MAAS uses a six-point Likert scale where 1 indicates “almost always” and 6 indicates “almost never”. Scoring involves calculating mean performance across the 15 items, with higher scores indicating greater mindfulness. Sample items include: “I find it difficult to stay focused on what’s happening in the present” (See Appendix VII). The MAAS demonstrates good reliability (Cronbach’s $\alpha = .89-.93$; test-retest $r = .35-.52$) and good convergent/discriminant validity, and explains additional variance in mental health measures beyond other psychological constructs (Black, Sussman, Johnson, & Milam, 2012). Cronbach’s alpha for the current sample was .887.

The *adult ADHD Self-Report Scale* (ASRS; Kessler et al., 2005) is the first 6 items (i.e. Part A) of the World Health Organization Adult ADHD Self-Report Scale V 1.1 (See Appendix VIII), and is predictive of symptoms consistent with ADHD. The ASRS uses a five-point Likert scale where 1 indicates “never” and 5 indicates “very often”. Scoring involves calculating mean performance across the 6 items, with higher scores indicating elevated symptoms of ADHD. Sample items include: “How often do you have problems remembering appointments or obligations?” This 6-item version of the ASRS has demonstrated moderate sensitivity of 68.7% and high specificity of 99.5%

(Kessler et al., 2005). High specificity has also been observed in populations with alcohol misuse issues (van de Glind et al., 2013). Additionally, the ASRS has demonstrated high internal consistency (Adler et al., 2006) and good test-retest reliability (Matza, Van Brunt, Cates, & Murray, 2011). Cronbach's alpha for the current sample was .659, which is acceptable for a screening measure.

The *Minnesota Multiphasic Personality Inventory–2 Infrequency-Psychopathology (MMPI–2) F(p) scale* (Arbisi & Ben-Porath, 1995) is a 27-item measure developed to identify false responding in both normative and clinical samples. This scale is scored on a true/false scoring system in which 18 items are keyed as true and 9 as false. A score of 1 is received for incorrect responding and a score of 0 for correct responding. Participants are deemed to be malingering (i.e., faking) if their overall score is ≥ 8 . Sample items include: “I believe in law enforcement” (False = 1) and “Everything tastes the same” (True = 1) (See Appendix IX). This scale demonstrates good construct validity as well as incremental validity in terms of providing additional information to that produced by the MMPI–2 (*F*) scale (Archer, Handel, Greene, Baer, & Elkins, 2001).

Online methods. *Psytoolkit*, used to create the online battery, is a free internet-based service designed for creating, setting-up, conducting, and analysing online questionnaires and behavioural reaction-time experiments (Stoet, 2016). The website (www.psytoolkit.org) provides a vast array of documentation, videos, lessons, and libraries of free-to-use psychological self-report measures and behavioural experiments. Once a study is setup, a URL link is provided which enables users to recruit participants for online research purposes. These links are easily embedded in social media platforms for participant recruitment, including Amazon's Mechanical Turk, TurkPrime, and Prolific.

Prolific (www.prolific.ac) is an online recruitment platform that is specifically tailored for researchers (Palan & Schitter, 2018). It is cost efficient, has very good recruitment standards, and explicitly informs participants that they have been recruited for research purposes. To date, several thousand researchers have registered with Prolific, and it has been successfully used across several domains including psychology (Callan, Kim, Gheorghiu, & Matthews, 2016), food science (Simmonds, Woods, & Spence, 2018), and economics (Marreiros, Tonin, Vlassopoulos, & Schraefel, 2017). Detailed rules concerning participant treatment are also very well established.

TurkPrime (www.turkprime.com) is an online recruitment tool which was specifically designed as a research platform (Litman et al., 2017). It runs on any browser and does not require downloads or installation. TurkPrime enables researchers to exclude participants based on previous participation, conduct longitudinal research, and make changes to ongoing studies. TurkPrime has been successfully used in many psychological studies, including addiction (Dixon, Witcraft, McCowan, & Brodell, 2017; Lipkus & Mays, 2018; Skrzynski, Creswell, Bachrach, & Chung, 2018).

Procedure

All aspects of the current research was conducted online. The online battery was developed via Psytoolkit and was divided into two phases, the first of which was used as a screening tool. Participants recruited via Prolific and TurkPrime were enlisted in batches of 50. Undergraduate students participated as they were recruited. All participants were initially sent the Psytoolkit URL link for the screening phase of the study. Before proceeding, participants were required to read the information sheet (See Appendix II) and consent form (See Appendix III). These were embedded within the link. They were then required to tick a box to say they fully understood the information and were happy to continue. Participants were then requested to provide a unique ID code which was

matched to the second phase if they were eligible to continue. Undergraduate students were asked to use their student numbers while participants recruited via Prolific and TurkPrime supplied their ID codes (i.e. worker ID) specific to their respective platforms.

The screening phase, which was self-paced, took approximately 10 minutes to complete, and consisted of questions regarding demographic information and a range of psychological measures. In this order, they included the MMPI-2 F(p) scale, the ASRS, the AUDIT, and the SUPPS-P Impulsive Behavior Scale. To assess whether participants were paying attention, a question was inserted after the AUDIT: “Are you paying attention? If so, click 'I am not paying attention’”. Upon completion, participants were informed that they would be contacted within one week if they were eligible to complete the remainder of the study. A score of either (or both) ≥ 8 on the AUDIT or ≥ 19 on the ASRS was required to continue to the second phase. Additionally, participants with a score of ≥ 8 on the MMPI-2 F(p) scale were excluded.

Participants who were eligible for the second phase were sent a URL link within three days of completing the screening phase of the study. Participants were again asked to input their unique ID code so both phases could be matched for data analysis. Phase two consisted of measures of trait mindfulness (i.e. MAAS) and drinking motives (i.e. DMQR) as well as several other assessments that were part of the larger battery and are not be discussed here. Phase two was also self-paced and took approximately 30 mins to complete. In between the MAAS and the DMQR, participants were again asked: “Are you paying attention? If so, click 'I am not paying attention’”. Any data from participants who did not complete the study was discarded. Upon completion, participants were asked questions concerning distractions or potential factors that may have influenced how they responded. They were also asked if they consumed any alcohol or drugs within five hours of starting the study. To improve honest responding, participants were told that their

answers would not impact their payment. As previously mentioned, unique ID codes were used to reduce repeated participation. Internet Protocol addresses were also checked to ensure that repeated participation did not occur.

Analytic Strategy

Descriptive information and Spearman rank-order coefficients were calculated to assess the correlations among the primary study variables. Structural equation modelling (SEM) was used to test two hypothesised models. SEM is a multivariate statistical analysis technique used to analyse structural relationships. It is a combination of factor analysis and multiple regression analysis, and is used to assess the structural relationship between measured variables and latent (i.e. unobservable) constructs. This method was preferred over other techniques (e.g., regression) because it estimates the multiple and interrelated dependence in a single analysis.

Model 1 examined the relationship between negative urgency, coping motives, mindfulness, and alcohol misuse (see Figure 1). Model 2 assessed the relationship between positive urgency, enhancement motives, mindfulness, and alcohol misuse (see Figure 2). Negative and positive urgency, coping and enhancement motives, and mindfulness were modelled as latent (exogenous) variables in the structural model. Negative and positive urgency were assessed with four indicators (i.e., eight in total) each derived from the SUPPS-P scale; coping and enhancement motives were measured with five indicators (i.e., ten in total) each derived from the DMQ-R scale; and mindfulness was measured with fifteen indicators derived from the MAAS. The latent outcome variable, alcohol misuse was modelled as a latent (endogenous) variable measured with ten indicators derived from the AUDIT.

The validity of the structural components in the hypothesized models were evaluated via several fit indexes. This included chi-square, the root mean square error of

approximation (RMSEA; Steiger, 1990), the standardized root mean square residual (SRMR), the comparative fit index (CFI; Bentler, 1990), the Tucker Lewis Index (TLI; Schermelleh-Engel & Müller, 2003), and the ratio of chi-square to degrees of freedom (χ^2/df), with values < 3.0 considered acceptable (Kline, 2011). Standard recommendations for determination of model fit were followed: non-significant chi-square; CFI and TLI values $> .90$, and RMSEA and SRMR values $< .08$ (Hu & Bentler, 1999). In order to test for indirect effects in both models, the recommendations of Preacher and Hayes (2008) were followed and bias-corrected (BC) bootstrapping techniques were applied.

Bootstrapping is a non-parametric resampling technique that does not assume multivariate normality of the sampling distribution, and allows for the production of confidence intervals around the observed indirect effects. To produce confidence intervals for the indirect effects 1,000 bootstrap samples were used. There was no missing data. Analyses were conducted in Mplus version 7.4 (Muthén & Muthén, 2013).

Results

Descriptive statistics and correlational analysis

Correlations, means, and standard deviations for all variables considered for inclusion in each model are listed in Table 2 (see Appendix X for extended table). Consistent with hypotheses, positive urgency and drinking motives bore significant, positive relations to alcohol misuse. In contrast to what was predicted, negative urgency was not significantly associated with alcohol misuse. Mindfulness was inversely associated with both positive and negative urgency, and drinking to cope, but was not significantly associated with enhancement motives or alcohol misuse.

Table 2. *Intercorrelations, means, and standard deviations*

* *Significant at the .001 level (2-tailed)*

Measure	1	2	3	4	5	6	Mean	SD
1. Alcohol misuse	1.000						9.36	5.53
2. Negative Urgency	.083	1.000					9.96	2.59
3. Positive Urgency	.194*	.553*	1.000				7.72	2.59
4. Coping Motive	.498*	.273*	.259*	1.000			11.15	4.72
5. Enhancement Motive	.456*	.096	.138*	.550*	1.000		14.21	5.48
6. Mindfulness	.083	-.441*	-.353*	-.233*	-.026	1.000	54.68	12.29

Structural models

Negative urgency, coping motives, and mindfulness model of alcohol misuse

(NCM). SEM techniques were used to assess the potential predictive and mediating effects in two models. The NCM model was used to identify the associations between negative urgency, coping motives, mindfulness, and alcohol use. It was predicted that drinking to cope and mindfulness would mediate the indirect effect of negative urgency on alcohol misuse. The NCM model predicting alcohol misuse (see Figure 1) provided adequate fit ($\chi^2 = 1298.12$, $df = 652$, $p < .001$; $\chi^2 / df = 1.99$; CFI = .88; TLI = .87;

RMSEA = .05 [95% CI = .04–.05] SRMR = .06) and explained 33% of the variance in alcohol misuse. Parameter estimates indicated that negative urgency was associated with coping motives ($\beta = .37, p < .001$) and mindfulness ($\beta = -.56, p < .001$), but not with alcohol misuse ($\beta = .13, p = .086$). Coping motives ($\beta = .52, p < .001$) and mindfulness ($\beta = .17, p = .011$) were positively associated with alcohol misuse. The indirect relationship between negative urgency and alcohol misuse via (i) drinking to cope ($\beta = .19, SE = .04, 95\% CI (BC) = -.27 \text{ to } -.12, p < .001$) and (ii) mindfulness ($\beta = .10, SE = .04, 95\% CI (BC) = .02 \text{ to } .19, p < .016$) were statistically significant. It can be concluded therefore that increased levels of negative urgency are indirectly related to increased levels of alcohol misuse via coping motives and (lack of) mindfulness.

Positive urgency, enhancement motives, and mindfulness model of alcohol misuse (PEM). The PEM model was used to identify the associations between positive urgency, self-enhancement motives, mindfulness, and alcohol use. It was predicted that indirect paths would be observed for positive urgency on alcohol misuse with drinking for self-enhancement and mindfulness mediating this effect. The PEM model predicting alcohol misuse (see Figure 2) provided adequate fit ($\chi^2 = 1352.41, df = 652, p < .001; \chi^2/df = 2.07; CFI = .87; TLI = .86; RMSEA = .05 [95\% CI = .05–.05] SRMR = .07$) and explained 20% of the variance in alcohol misuse. Parameter estimates indicated that positive urgency was not associated with enhancement motives ($\beta = .10, p = .08$), but was associated with mindfulness ($\beta = -.41, p < .001$) and alcohol misuse ($\beta = .25, p = .001$). Enhancement motives ($\beta = .34, p < .001$) were positively associated with alcohol misuse, but not mindfulness ($\beta = .07, p = .279$). The indirect relationship between positive urgency and alcohol misuse via (i) enhancement motives ($\beta = -.04, SE = .02, 95\% CI (BC) = -.08 \text{ to } .00, p = .107$) and (ii) mindfulness ($\beta = .03, SE = .03, 95\% CI (BC) = -.03 \text{ to } .09, p = .293$) did not reach statistical significance. It can be concluded therefore that

increased levels of positive urgency are not indirectly related to increased levels of alcohol misuse via enhancement motives and (lack of) mindfulness. Positive urgency is however directly related to alcohol misuse in this model

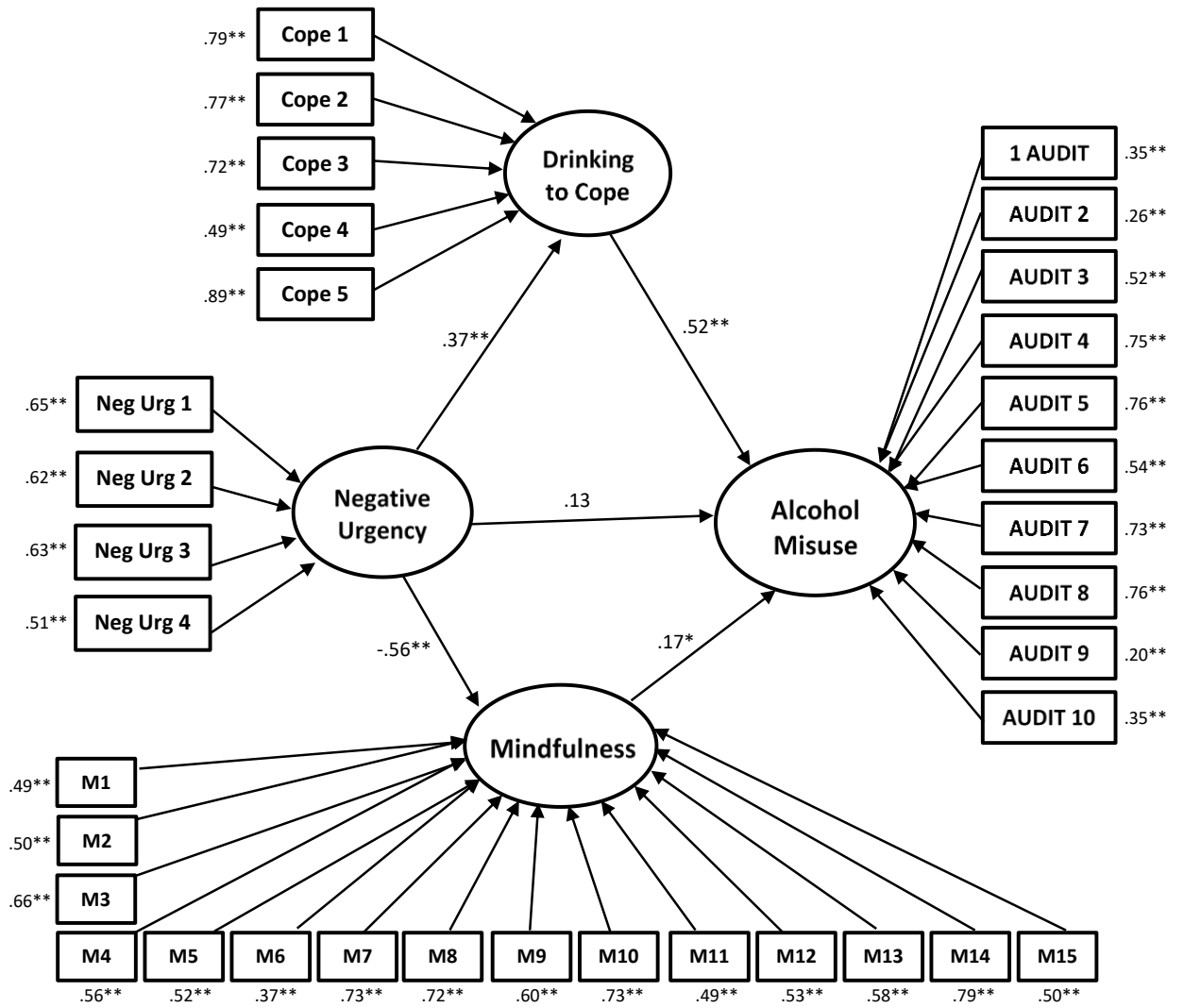


Figure 1. Negative urgency, coping, and mindfulness model of alcohol misuse.

*Note: AUDIT = Alcohol Use Disorders Identification Test; Cope = Coping Motives subscale of the Drinking Motives Questionnaire-Revised; Neg Urg = Negative Urgency subscale of the UPPS-P Impulsive Behaviours Scale (short version); M = Item measures of the Mindful Attention Awareness Scale.

Statistical significance, *indicates $p < .05$, **indicates $p < .001$

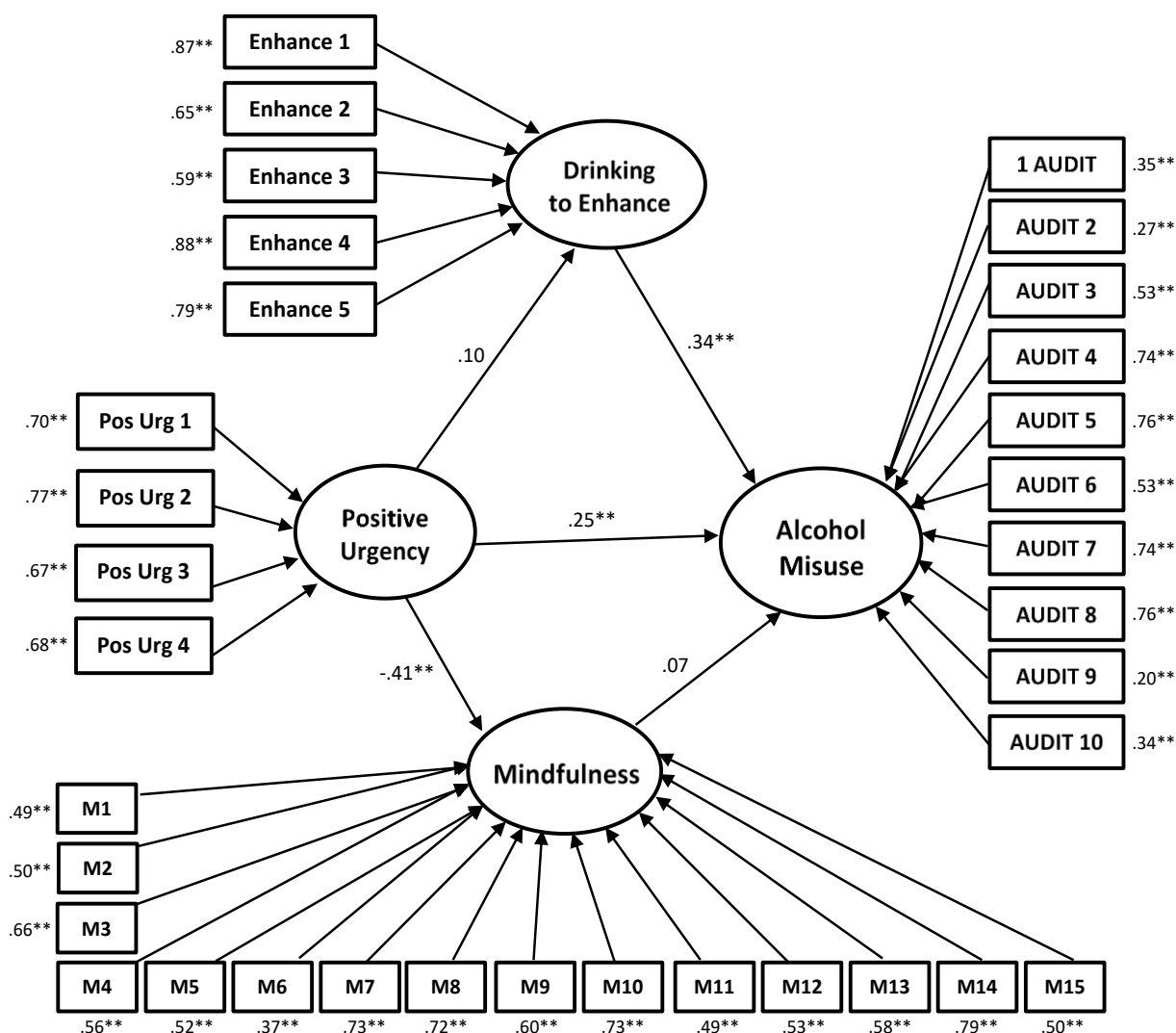


Figure 2. Positive urgency, enhancement, and mindfulness model of alcohol misuse.

*Note: AUDIT = Alcohol Use Disorders Identification Test; Enhance = Enhancement Motives subscale of the Drinking Motives Questionnaire-Revised; Pos Urg = Positive Urgency subscale of the UPPS-P Impulsive Behaviours Scale (short version); M = Item measures of the Mindful Attention Awareness Scale.

Statistical significance, *indicates $p < .05$, **indicates $p < .001$

Summary results. In the NCM model, negative urgency was not directly associated with alcohol misuse, but indirect effects were observed via coping motives and mindfulness. Coping motives and mindfulness were directly associated with both negative urgency and alcohol misuse. These findings reveal that while coping motives were the most important factor in the indirect relationship between negative urgency and alcohol misuse, mindfulness also mediated this indirect effect. In the PEM model,

positive urgency was directly associated with alcohol misuse, but indirect effects were not observed via enhancement motives or mindfulness. Enhancement motives were directly associated with alcohol use, but not with positive urgency. Mindfulness was inversely associated with positive urgency, but was not significantly related to alcohol misuse. Interestingly, mindfulness did not mediate the indirect relationship between positive urgency and alcohol misuse. Moreover, while mindfulness was inversely associated to both positive and negative urgency, as well as drinking to cope, it was not associated with enhancement motives. These results suggest that mindfulness and impulsivity are reciprocally related, but appear to be assessing divergent processes.

Discussion

The current study extended prior research by investigating associations between facets of impulsivity (i.e., negative and positive urgency), drinking motives (coping and enhancement), mindfulness, and alcohol misuse. Two separate models were used to identify these associations. The NCM model included negative urgency, coping motives, mindfulness, and alcohol use, and the PEM model comprised of positive urgency, enhancement motives, mindfulness, and alcohol misuse. In the NCM model, negative urgency was not directly associated with alcohol misuse, but indirect effects were observed via coping motives and mindfulness. Coping motives and mindfulness were directly associated with both negative urgency and alcohol misuse. In the PEM model, positive urgency was directly associated with alcohol misuse, but indirect effects were not observed via enhancement motives or mindfulness. Enhancement motives were directly associated with alcohol use, but not with positive urgency. Mindfulness was inversely associated with positive urgency, but was not significantly related to alcohol misuse.

These results have important theoretical and clinical implications which are discussed below.

Negative and positive urgency are the impulsivity-related traits most consistently linked with alcohol misuse (McCarty, Morris, Hatz, & McCarthy, 2017), although findings on the nature of the relationship are mixed. Individuals demonstrating high levels of negative urgency may misuse alcohol in order to avoid emotional distress (Tran, Teese, & Gill, 2018), while individuals with higher scores on positive urgency might drink to increase positive emotions (Anthenien, Lembo, & Neighbors, 2017). The study found that positive urgency was directly related to alcohol misuse whereas negative urgency was not. These findings might be explained by differential associations between negative and positive urgency with various alcohol problem domains (Coskunpinar, Dir, & Cyders, 2013). McCarty et al (2017) found that negative urgency was associated to problems relating to specific drinking episodes, whereas positive urgency was associated with alcohol issues concerning longer-term trends. In contrast, it was found that AUDIT question 3 (How often do you have six or more drinks on one occasion?) correlated only with positive urgency (Spearman's $Rho = .152$, $p = .002$) and not negative urgency (Spearman's $Rho = .009$, $p = .850$). Stojek and Fischer (2012) found that negative urgency but not positive urgency predicted increased alcohol consumption three months later, but only in women. Conversely, a longitudinal study by Kaiser, Bonsu, Charnigo, Milich and Lynam (2016) found that only positive urgency predicted alcohol consumption rates one year later in 525 college students, an effect that was bi-directional (Kaiser et al., 2016). It is possible that the relationship between alcohol use and positive/negative urgency is sample-dependant (e.g., differs according to gender or age). Here, the study found a nuanced relationship between urgency and alcohol misuse in a large sample of primarily young adults with gender balance.

The current study was motivated, in part, by previous findings suggesting that coping motives play an important role in the association between emotion-driven impulse control and alcohol misuse (Adams, Kaiser, Lynam, Charnigo, & Milich, 2012; Jones, Chryssanthakis, & Groom, 2014; Watkins, Franz, DiLillo, Gratz, & Messman-Moore, 2015). Consistent with these findings, coping motives mediated the association between negative urgency and alcohol misuse in the current study, thus providing further evidence that drinking to cope is key mechanism in this relationship. This is in line with research by Adams et al. (2012) which indicates that individuals with high negative urgency consume alcohol to cope with short-term distress. Relatedly, Jones et al. (2014) suggest that individuals may misinterpret their drinking as a positive coping style, unaware of the potential long-term risks. It is this lack of awareness that appears consistent with the current study, as this also mediated the association between negative urgency and alcohol misuse. That is, low levels of mindfulness mediated the positive association between negative urgency and alcohol misuse. Future research should therefore explore the moderating role mindfulness on the relationship between coping motives and alcohol misuse.

Research shows that positive urgency and enhancement motives are both associated with alcohol misuse (Anderson, Garcia, & Dash, 2016; Dinc & Cooper, 2015). Enhancement motives involve drinking to enhance positive affect (Studer et al., 2016), while positive urgency involves acting impulsively under the influence of positive emotions (Cyders & Smith, 2007). Due to the conceptual links between these constructs, it was hypothesised that enhancement motives would indirectly mediate the association between positive urgency and alcohol misuse. While alcohol misuse was associated with both enhancement and positive urgency, unexpectedly the latter two constructs were not associated with each other and no indirect effect was observed. To account for these

findings, it was suggested that enhancement motives might be related to a different dimension of impulsivity such as sensation seeking. Indeed, Studer et al. (2016) investigated the contribution of drinking motives on the relationship between facets of impulsivity and alcohol use disorder in a representative sample of 5,362 young Swiss men. They found that enhancement motives partially mediated the relationship of fun seeking with risky single-occasion drinking and alcohol use disorder. Research by Adams et al. (2012) explored how different impulsivity-related traits may predispose college students ($N = 432$) to drink for different reasons (e.g., to enhance pleasure) which in turn, may influence drinking behaviour. Similar to Studer et al., indirect effects of sensation seeking on problematic drinking were observed through enhancement motives. In light of this research, an exploratory analysis was conducted to investigate the mediating role of enhancement in the association between sensation seeking and alcohol misuse. However, no effect was found.

Mindfulness has been linked to alcohol misuse, impulsivity and affect regulation (Guendelman, Medeiros, & Rampes, 2017; Karyadi & Cyders, 2015; Murphy & Mackillop, 2012), yet the relationship between these constructs is poorly understood. In the current study, mindfulness mediated the association between negative urgency and alcohol misuse in the NCM model, but not the association between positive urgency and alcohol misuse in the PEM model. Consistent with these models in terms of positive and negative affect, correlational analyses revealed that mindfulness was related to coping motives (i.e. coping with negative affect) but not enhancement motives (i.e. drinking to enhance positive affect). These findings suggest that mindfulness may moderate the impact of negative emotions but not positive emotions in attempting to predict hazardous drinking. Research by Roos et al. (2015) appears to both support and counteract these claims. They explored whether mood regulatory drinking motives (i.e., enhancement and

coping) mediated the relationship between mindfulness and alcohol misuse. Although negative reinforcement motives (i.e., coping) played a particularly important role, they found both coping and enhancement motives mediated the negative associations between facets of mindfulness and alcohol misuse. In contrast to the current findings, Leigh and Neighbors (2009) investigated the mediating role of coping and enhancement motives on the relationship between mindfulness and alcohol use. They found that enhancement and not coping motives mediated these effects, but only in men. Additionally, mindfulness was inversely associated with measures of urgency in both models. Consistent with research by Murphy and MacKillop (2012), these results suggest that mindfulness and impulsivity are reciprocally related, but appear to be assessing divergent processes.

The future of online addiction research

Online research is particularly useful for recruiting participants with addiction issues. It provides a level of anonymity for people unwilling to participate in face-to-face research, (Chebli, Blaszczynski, & Gainsbury, 2016; Gainsbury, Hing, & Suhonen, 2014), it can overcome logistical barriers that prevent face-to-face participation (Proudfoot et al., 2011), and recruiting participants through social networking sites can facilitate the inclusion of hidden populations (Ramo, Rodriguez, Chavez, Sommer, & Prochaska, 2014). Online methods have also been successfully used to acquire longitudinal addiction data.

Despite these benefits, concerns for online addiction research exist in terms reduced experimental control and reliability (Litman, Robinson, & Abberbock, 2017). However, various methods can be implemented to counter these issues. Malingering can be assessed by utilizing “faking bad” questionnaires such as the Minnesota Multiphasic Personality Inventory–2 (MMPI–2) *F(p)* scale (Arbisi & Ben-Porath, 1995). Attrition rates and

demotivation can be reduced by providing bonus payments on completion of the study, and by pretesting to avoid frustration caused by technical problems (Simcox & Fiez, 2014). Finally, repeated participation can be neutralized by tracking Internet protocol (IP) addresses and rejecting the data from the same address. Moreover, participants on research specific platforms such as Mechanical Turk are given fixed ID codes that can be monitored by the researcher (Litman et al., 2017).

Overall, online-based research provides a great opportunity for addiction researchers to collect data, especially when recruiting large participant pools. Online methods are less time-consuming, less labor-intensive, permit much larger sample sizes and provide greater generalizability when compared to traditional laboratory-based studies. With appropriate controls for reliability and validity, online research may even be superior to traditional methods. Finally, online-based interventions have also emerged as a viable new approach for addiction treatment, and the scalability of this approach means that interventions can reach a wide range of individuals. Online research, therefore, appears to provide a promising platform for the future of addiction research.

Strengths, Limitations, future directions, and clinical implications

Several distinct strengths should be noted in the current study. First, the relatively large sample size was recruited from a worldwide pool of participants. As a result, the sample was ethnically diverse, thus increasing generalizability to the general population. Second, the online nature of the study provided a level of anonymity which may have captured participants who are unwilling to participate in laboratory research due to embarrassment and stigma. Third, demand characteristics were significantly reduced as the study was fully automated and did not require a researcher to provide instructions. Fourth, although online data quality can suffer through participant demotivation, inattention, self-selection, malingering, and repeated participation, the current study

mitigated many of these issues by utilizing specific attention related questions and a malingering scale. Whereas repeated participation was avoided by rejecting duplicated IP addresses.

The present study had several limitations that should be addressed in future research. First, the design of this study was cross-sectional, so the question of whether drinking motives or mindfulness precede impulsivity, or vice versa, cannot be disentangled with these data. Future studies using prospective, longitudinal data will be crucial to address the issue of antecedents and consequences. Second, given that negative and positive urgency have differential associations with various alcohol problem domains (McCarty et al., 2017), future research may consider using measures such as Time-Line Follow Back (Sobell & Sobell, 1992) to assess drink quantity and frequency across time. Third, to specifically assess how participants felt in the moment (i.e., levels of present moment positive and negative affect), future research might use the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) to explore the correlations between emotion-driven impulsivity and drinking motives related to present-moment affect. The PANAS is associated with measures of depression, state anxiety, and general distress (Crawford & Henry, 2004), all of which have also been associated with alcohol misuse (Gimeno et al., 2017; Hogarth et al., 2018). Finally, the MAAS is a unitary measure mindfulness, and as a result, the current study was unable to explore the various relationships among facets of trait mindfulness, trait impulsivity, and alcohol misuse. Future studies should build on research by Murphy and MacKillop (2012) and utilize the Five-Facet Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006), which provides a more comprehensive measure of this construct.

By identifying distinct motivational pathways of emotion-driven impulsivity, several clinical implications have been noted in the current study. First, it would appear

that mindfulness-based interventions would better serve populations where negative affect was a defining variable, especially when combined with high levels of impulsivity (i.e. negative urgency), and a tendency to use alcohol as a coping mechanism. Second, the data show that positive urgency was directly associated with alcohol misuse, while negative urgency was not. This suggests that interventions targeting alcohol misuse should focus on the impact of positive emotions in this population. Overall, this research demonstrates separate motivational pathways of emotion-driven impulsivity, thus enabling clinicians in applied create more targeted interventions for individuals demonstrating both high levels of impulsivity and alcohol misuse.

Conclusions

The current study adds to the literature by investigating the relationship between emotion-driven impulsivity, emotion-based motives to drink, mindfulness, and alcohol misuse. While coping motives were the most important factor in the indirect relationship between negative urgency and alcohol misuse, mindfulness also mediated this indirect effect. Interestingly, mindfulness did not mediate the indirect relationship between positive urgency and alcohol misuse. Moreover, while mindfulness was inversely associated to both positive and negative urgency, as well as drinking to cope, it was not associated with enhancement motives. These results suggest that mindfulness and impulsivity are reciprocally related, but appear to be assessing divergent processes. Finally, the predicted association between positive urgency and enhancement, as well as their synergistic effect on alcohol misuse, was not observed. This is perhaps surprising given that they are both influenced by positive affect, however; it would appear that enhancement motives to drink may be influenced by other dimensions of impulsivity including both fun and sensation seeking. In sum, by utilizing sophisticated statistical analyses, innovative online methods, and a large sample size, this study provides a

roadmap for future researchers seeking to demonstrate robust and novel findings in the area of addiction.

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Appendices

Appendix I:	Ethical approval form
Appendix II:	Information sheet
Appendix III:	Informed consent
Appendix IV:	Alcohol Use Disorders Identification Test (AUDIT)
Appendix V:	SUPPS-P Impulsive Behavior Scale
Appendix VI:	Drinking Motives Questionnaire-Revised (DMQ-R)
Appendix VII:	Mindful Attention Awareness Scale
Appendix VIII:	ADHD Self-Report Scale
Appendix IX:	<i>MMPI-2</i>) <i>F(p)</i> scale
Appendix X:	Descriptive statistics (Extended table)

Appendix I: Ethical approval form



Coláiste na Tríonóide, Baile Átha Cliath
Trinity College Dublin
Ollscoil Átha Cliath | The University of Dublin

F.A.O. Hanni Kiiski and Marc Bennett

School of Psychology Research Ethics Committee

31st January 2017

The School of Psychology Research Ethics Committee has reviewed your application entitled "Neurobehavioural investigation of life-span ADHD symptoms" and I am pleased to inform you that it was approved.

Please note that you will be required to submit a completed **Project Annual Report Form** on each anniversary of this approval, until such time as an **End of Project Report Form** is submitted upon completion of the research. Copies of both forms are available for download from the Ethics section of the School website.

Adverse events associated with the conduct of this research must be reported immediately to the Chair of the Ethics Committee.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Richard Carson'.

Richard Carson
Chair,
School of Psychology Research Ethics Committee

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Appendix II: Information Sheet

Important information

- The current study can only be completed on a laptop or desktop computer (i.e. smartphones will not work).
- This study will be conducted over two phases. The screening section of this study will last approximately 15 minutes. If eligible, we will aim to contact you within one week for the remainder of the study which will take approximately a further 30 mins.
- You will need to be connected to the internet throughout the duration of the study.
- If you start the study, you must complete it in one attempt (i.e. you cannot go back to where you left off).
- You will be required to concentrate and read each section of the study carefully. It is therefore important that you turn off all other windows/tabs on the computer and avoid all possible distractions (e.g. TV, phone, conversing with friends).

Study details

This research is being conducted by Brian Pennie, a postgraduate research student at Trinity College Dublin, under the supervision of Prof. Rob Whelan. The current phase (screening section) of the study will utilize self-report questionnaires to assess a range of cognitive processes in individuals who do and do not drink alcohol.

Who can participate?

You must be over 18 years of age and be fluent in English. You are advised not to participate if you have a visual impairment that is not corrected with lenses, or if you have a history of seizures or photosensitive epilepsy. Additionally, during the second phase of the study you will be required to complete a series of forms concerning questions about your mental health. You are advised not to take part if you feel uncomfortable answering questions.

What are my rights if I join the study?

Participation in the study is entirely voluntary and if you agree to participate you have the following rights:

1. The information from this study will be kept strictly confidential. Your name will not be recorded so your data cannot be identified by name at any stage.
2. Published results in scientific journals will be completely anonymous.
3. You are free to withdraw from the study at any time. However, once you leave the study you can no longer withdraw your data as it will not be identifiable by name.

Appendix III: Consent form

Terms of Consent

Upon proceeding with this study, I hereby give my informed consent to:

- Complete a series of questionnaires to assess a range of cognitive processes.

Once I have signed this consent I understand that:

- I am confirming that I have read and understood this form.
- I will be assigned a unique ID code, under which all of my data will be stored.
- I understand that I can decline to provide some or all of the information requested.
- Any data obtained through my participation in this research will be treated as confidential and processed only in accordance with the Data Protection Acts, and that they will be used only for the purposes of research.
- I may withdraw my participation at any time during the study.
- I understand that no clinical judgement can be made of me on the basis of my participation or performance during this research.

Appendix IV: Alcohol Use Disorders Identification Test (AUDIT)

AUDIT

PATIENT: Because alcohol use can affect your health and can interfere with certain medications and treatments, it is important that we ask some questions about your use of alcohol. Your answers will remain confidential, so please be honest.

For each question in the chart below, place an X in one box that best describes your answer.

NOTE: In the U.S., a single drink serving contains about 14 grams of ethanol or “pure” alcohol. Although the drinks below are different sizes, each one contains the same amount of pure alcohol and counts as a single drink:

=
 =
 =

Questions	0	1	2	3	4	
1. How often do you have a drink containing alcohol?	Never	Monthly or less	2 to 4 times a month	2 to 3 times a week	4 or more times a week	
2. How many drinks containing alcohol do you have on a typical day when you are drinking?	1 or 2	3 or 4	5 or 6	7 to 9	10 or more	
3. How often do you have 5 or more drinks on one occasion?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
4. How often during the last year have you found that you were not able to stop drinking once you had started?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
5. How often during the last year have you failed to do what was normally expected of you because of drinking?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
7. How often during the last year have you had a feeling of guilt or remorse after drinking?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
8. How often during the last year have you been unable to remember what happened the night before because of your drinking?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
9. Have you or someone else been injured because of your drinking?	No		Yes, but not in the last year		Yes, during the last year	
10. Has a relative, friend, doctor, or other health care worker been concerned about your drinking or suggested you cut down?	No		Yes, but not in the last year		Yes, during the last year	
					Total	

Note: This questionnaire (the AUDIT) is reprinted with permission from the World Health Organization. To reflect drink serving sizes in the United States (14g of pure alcohol), the number of drinks in question 3 was changed from 6 to 5. A free AUDIT manual with guidelines for use in primary care settings is available online at www.who.org.

Appendix V: SUPPS-P Impulsive Behavior Scale

Below are twenty statements that you may agree or disagree with. Using the scale below, indicate your agreement with each item by clicking the appropriate selection.

		Strongly Agree	Agree some	Disagree some	Strongly disagree
1	I generally like to see things through to the end (Lack_Pers) R				
2	My thinking is usually careful and purposeful (Lack_Premed)				
3	When I am in great mood, I tend to get into situations that could cause me problems (Pos_Urg)				
4	Unfinished tasks really bother me (Lack_Pers) R				
5	I like to stop and think things over before I do them (Lack_Premed) R				
6	When I feel bad, I will often do things I later regret in order to make myself feel better now (Neg_Urg)				
7	Once I get going on something I hate to stop (Lack_Pers) R				
8	Sometimes when I feel bad, I can't seem to stop what I am doing even though it is making me feel worse (Neg_Urg)				
9	I quite enjoy taking risks (Sen_Seek)				
10	I tend to lose control when I am in a great mood (Pos_Urg)				
11	I finish what I start (Lack_Pers)				
12	I tend to value and follow a rational, "sensible" approach to things (Lack_Premed) R				
13	When I am upset I often act without thinking (Neg_Urg)				
14	I welcome new and exciting experiences and sensations, even if they are a little frightening and unconventional (Sen_Seek)				
15	When I feel rejected, I will often say things that I later regret (Neg_Urg)				
16	I would like to learn to fly an airplane (Sen_Seek)				
17	Others are shocked or worried about the things I do when I am feeling very excited (Pos_Urg)				
18	I would enjoy the sensation of skiing very fast down a high mountain slope (Sen_Seek)				
19	I usually think carefully before doing anything (Lack_Premed) R				
20	I tend to act without thinking when I am really excited (Pos_Urg)				

Appendix VI: Drinking Motives Questionnaire-Revised (DMQ-R)

DMQR Scale (image from Psytoolkit)**INSTRUCTIONS:**

Listed below are 20 reasons people might be inclined to drink alcoholic beverages.

Using the five-point scale below, decide how frequently your own drinking is motivated by each of the reasons listed.

YOU DRINK ...

Item	almost never/never	some of the time	half of the time	most of the time	almost always/always
To forget about your problems.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Because your friends pressure you to drink.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
So you won't feel left out.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To cheer up when you are in a bad mood.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Because you like the feeling.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Because it makes social gatherings more fun.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Because it improves parties and celebrations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Because it's exciting.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Because you feel more self-confident and sure of yourself.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Because it helps you enjoy a party.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To forget your worries.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Because it gives you a pleasant feeling.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To get high.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To fit in with a group you like.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
So that others won't kid you about not drinking	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Because it helps you when you feel depressed or nervous.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To be sociable.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To be liked.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Because it's fun.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To celebrate a special occasion with friends.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Appendix VII: Mindful Attention Awareness Scale

The Mindful Attention Awareness Scale (MAAS)

The trait MAAS is a 15-item scale designed to assess a core characteristic of mindfulness, namely, a receptive state of mind in which attention, informed by a sensitive awareness of what is occurring in the present, simply observes what is taking place.

Brown, K.W. & Ryan, R.M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology*, 84, 822-848.

Carlson, L.E. & Brown, K.W. (2005). Validation of the Mindful Attention Awareness Scale in a cancer population. *Journal of Psychosomatic Research*, 58, 29-33.

Instructions: Below is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what really reflects your experience rather than what you think your experience should be. Please treat each item separately from every other item.

- | | 1 | 2 | 3 | 4 | 5 | 6 |
|--|------------------|--------------------|------------------------|--------------------------|----------------------|--------------|
| | almost
always | very
frequently | somewhat
frequently | somewhat
infrequently | very
infrequently | almost never |
- _____ 1. I could be experiencing some emotion and not be conscious of it until some time later.
 - _____ 2. I break or spill things because of carelessness, not paying attention, or thinking of something else.
 - _____ 3. I find it difficult to stay focused on what's happening in the present.
 - _____ 4. I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.
 - _____ 5. I tend not to notice feelings of physical tension or discomfort until they really grab my attention.
 - _____ 6. I forget a person's name almost as soon as I've been told it for the first time.
 - _____ 7. It seems I am "running on automatic," without much awareness of what I'm doing.
 - _____ 8. I rush through activities without being really attentive to them.
 - _____ 9. I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.
 - _____ 10. I do jobs or tasks automatically, without being aware of what I'm doing.
 - _____ 11. I find myself listening to someone with one ear, doing something else at the same time.
 - _____ 12. I drive places on 'automatic pilot' and then wonder why I went there.
 - _____ 13. I find myself preoccupied with the future or the past.
 - _____ 14. I find myself doing things without paying attention.
 - _____ 15. I snack without being aware that I'm eating.

Scoring: To score the scale, simply compute a mean (average) of the 15 items.

Appendix VIII: ADHD Self-Report Scale

**Adult ADHD Self-Report Scale (ASRS-v1.1) Symptom Checklist
Instructions**

The questions on the back page are designed to stimulate dialogue between you and your patients and to help confirm if they may be suffering from the symptoms of attention-deficit/hyperactivity disorder (ADHD).

Description: The Symptom Checklist is an instrument consisting of the eighteen DSM-IV-TR criteria. Six of the eighteen questions were found to be the most predictive of symptoms consistent with ADHD. These six questions are the basis for the ASRS v1.1 Screener and are also Part A of the Symptom Checklist. Part B of the Symptom Checklist contains the remaining twelve questions.

Instructions:**Symptoms**

1. Ask the patient to complete both Part A and Part B of the Symptom Checklist by marking an X in the box that most closely represents the frequency of occurrence of each of the symptoms.
2. Score Part A. If four or more marks appear in the darkly shaded boxes within Part A then the patient has symptoms highly consistent with ADHD in adults and further investigation is warranted.
3. The frequency scores on Part B provide additional cues and can serve as further probes into the patient's symptoms. Pay particular attention to marks appearing in the dark shaded boxes. The frequency-based response is more sensitive with certain questions. No total score or diagnostic likelihood is utilized for the twelve questions. It has been found that the six questions in Part A are the most predictive of the disorder and are best for use as a screening instrument.

Impairments

1. Review the entire Symptom Checklist with your patients and evaluate the level of impairment associated with the symptom.
2. Consider work/school, social and family settings.
3. Symptom frequency is often associated with symptom severity, therefore the Symptom Checklist may also aid in the assessment of impairments. If your patients have frequent symptoms, you may want to ask them to describe how these problems have affected the ability to work, take care of things at home, or get along with other people such as their spouse/significant other.

History

1. Assess the presence of these symptoms or similar symptoms in childhood. Adults who have ADHD need not have been formally diagnosed in childhood. In evaluating a patient's history, look for evidence of early-appearing and long-standing problems with attention or self-control. Some significant symptoms should have been present in childhood, but full symptomology is not necessary.

Adult ADHD Self-Report Scale (ASRS-v1.1) Symptom Checklist

Patient Name	Today's Date						
Please answer the questions below, rating yourself on each of the criteria shown using the scale on the right side of the page. As you answer each question, place an X in the box that best describes how you have felt and conducted yourself over the past 6 months. Please give this completed checklist to your healthcare professional to discuss during today's appointment.			Never	Rarely	Sometimes	Often	Very Often
1. How often do you have trouble wrapping up the final details of a project, once the challenging parts have been done?							
2. How often do you have difficulty getting things in order when you have to do a task that requires organization?							
3. How often do you have problems remembering appointments or obligations?							
4. When you have a task that requires a lot of thought, how often do you avoid or delay getting started?							
5. How often do you fidget or squirm with your hands or feet when you have to sit down for a long time?							
6. How often do you feel overly active and compelled to do things, like you were driven by a motor?							
Part A							
7. How often do you make careless mistakes when you have to work on a boring or difficult project?							
8. How often do you have difficulty keeping your attention when you are doing boring or repetitive work?							
9. How often do you have difficulty concentrating on what people say to you, even when they are speaking to you directly?							
10. How often do you misplace or have difficulty finding things at home or at work?							
11. How often are you distracted by activity or noise around you?							
12. How often do you leave your seat in meetings or other situations in which you are expected to remain seated?							
13. How often do you feel restless or fidgety?							
14. How often do you have difficulty unwinding and relaxing when you have time to yourself?							
15. How often do you find yourself talking too much when you are in social situations?							
16. When you're in a conversation, how often do you find yourself finishing the sentences of the people you are talking to, before they can finish them themselves?							
17. How often do you have difficulty waiting your turn in situations when turn taking is required?							
18. How often do you interrupt others when they are busy?							
Part B							

Appendix IX: Minnesota Multiphasic Personality Inventory–2 (MMPI–2) F(p) scale

1. I do not read every editorial in the newspaper every day. – False 1
2. It would be better if almost all laws were thrown away. – True 1
3. Once in a while I put off until tomorrow what I ought to do today. - False 1
4. I love my father, or (if your father is dead) I loved my father. - False 1
5. Sometimes when I am not feeling well I am irritable. - False 1
6. I get angry sometimes. - False 1
7. Sometimes I am so strongly attracted by the personal articles of others, such as shoes, gloves, etc., that I want to handle or steal them, though I have no use for them. – True 1
8. I believe in law enforcement. - False 1
9. Someone has been trying to poison me. - True 1
10. My mother is a good woman, or (if your mother is dead) my mother was a good woman. - False 1
11. In walking I am very careful to step over sidewalk cracks. - True 1
12. Someone has been trying to rob me. - True 1
13. There are persons who are trying to steal my thoughts and ideas. - True 1
14. Everything tastes the same. - True 1
15. It does not bother me particularly to see animals suffer. - True 1
16. I love my mother, or (if your mother is dead) I loved my mother. - False 1
17. I have been told that I walk in my sleep. - True 1
18. I have never been in love with anyone. - True 1
19. My neck spots with red often. - True 1
20. I am afraid of using a knife or anything very sharp or pointed. - True 1
21. Sometimes I enjoy hurting persons I love. - True 1
22. Sometimes has control over my mind. - True 1
23. I have often wished I was a member of the opposite sex. - True 1
24. I can express my true feeling only when I drink. - True 1
25. I hate my whole family. - True 1
26. Talking over problems and worries with someone is often more helpful than taking drugs or medicine. - False 1
27. I can't go into a dark room alone even in my own home. - True 1

Appendix X: Descriptive statistics (Extended table)

	<i>Mean (95% Confidence Intervals)</i>	<i>Median</i>	SD	Range
Alcohol Misuse	9.36(8.83-9.90)	9.00	5.53	0-33
Negative Urgency	10.04(9.79-10.30)	10.00	2.60	4-16
Positive Urgency	12.28(12.03-12.53)	12.00	2.60	4.00-16.00
Coping Motives	11.16(10.70-11.61)	10.00	4.73	5-25
Enhancement Motives	14.22(13.69-14.74)	14.00	5.50	5-25
Mindfulness	54.70(53.50-55.90)	55.00	12.30	15-89