

MINDFULNESS, CRAVING & COGNITION IN RELAPSE TO ALCOHOL:
AN ECOLOGICAL MOMENTARY ASSESSMENT STUDY

by

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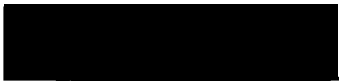
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DEDICATION

Similar to my master's thesis, I first dedicate this dissertation to every person who needs (and needed, will need) support for their specific set of challenges and wellbeing, but instead received care and reactions that ranged from miscalibrated, suboptimal, unjust, to persecutory. Particularly, I wish the 43 participants who enrolled in this study understand their contribution to our steps toward improving the human condition.

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November 3rd, 2017

ABSTRACT

Mindfulness, Craving, & Cognition in Relapse to Alcohol: An Ecological Momentary Assessment Study

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Hazardous alcohol use remains a significant global public health problem. A better understanding of relapse may assist the development of new interventions for alcohol use disorder. In an ecological momentary assessment (EMA) study, Dutch alcohol dependent patients ($N=43$) carried around a personal digital assistant for 4 weeks while trying to maintain abstinence. Participants completed assessments at random times three times per day, and when they felt a strong urge to drink or came to the brink of drinking without doing so. At each assessment, stress, negative affect, ratings of temptation to drink (“tempted now”), recent drinking, and attentional or approach bias were assessed. Trait mindfulness was assessed at baseline with the Mindful Attention Awareness Scale (MAAS).

Specific Aim 1 examined whether trait mindfulness was associated with tempted now ratings and relapse to alcohol. Results showed that more mindful individuals (higher MAAS scores) reported lower ratings on tempted now during EMA than less mindful individuals. Specific Aim 2 examined the mediating mechanisms linking MAAS (the predictor variable) and tempted now/drinking. The data revealed that there was no evidence that stress, negative affect, attentional bias, or approach bias mediated the

association between MAAS and tempted now. However, there was preliminary evidence for an indirect path from MAAS to drinking such that higher mindfulness leads to lower tempted now ratings that in turn leads to less drinking. Specific Aim 3 examined trait mindfulness as a moderator variable. There was no evidence that MAAS significantly moderated pertinent associations. In sum, more mindful recovering alcohol dependent patients reported lower tempted now ratings than less mindful patients, and this association appeared to be independent of stress/negative affect and cognitive biases. Further research should examine the efficacy of mindfulness-based interventions for this population.

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CHAPTER I: INTRODUCTION

Excessive or hazardous drinking of alcohol is a significant public health problem both in the US and worldwide. Relapse is the most common outcome of an attempt to limit drinking, even with the use behavioral or pharmacology therapies, and new interventions are needed. To develop more effective interventions, a better understanding of relapse and the predictors of relapse may be required. This ecological momentary assessment (EMA) study investigated craving and relapse in Dutch adults who were treated for alcohol dependence. The study focuses on the relationships between trait mindfulness, a possible risk factor for alcohol dependence, and craving and drinking.

Chapter 1 is organized as follows. First, the problem of hazardous drinking and relapse is described both in the US and the Netherlands. Second, the psychological processes underlying relapse are reviewed, to include the role of negative affect/stress, and cognitive biases. Third, the construct of mindfulness is described, to include the cultural and conceptual contexts of its development, the history of its adaptation within scientific journals, and the various ways it has been incorporated to treat clinical issues. Fourth, the conceptual model is described. Last, the use of EMA is described, along with a review of relevant evidence.

I.1 HAZARDOUS DRINKING AND RELAPSE

The World Health Organization (WHO; 2015) defines hazardous drinking as “a pattern of substance use that increases the risk of harmful consequences for the user.” In many clinical research fields, “harmful consequences” often emphasize the health domain, and less so the legal or financial domains. The current study operationalizes hazardous drinking as “high risk,” which is often associated with binge drinking, alcohol

abuse, and dependence. This operationalization covers both the proximal and distal outcomes on a probabilistic continuum, such as a currently sub-clinical threshold consumption level, but accompanied by the person's concerns for future deterioration.

The WHO (2015) defines excessive alcohol use as binge drinking, heavy drinking, any alcohol use by people under the minimum drinking age, and any alcohol use by pregnant women. In the US, studies using nationally representative samples have estimated that 23% and 4.7% of individuals over twelve years-old reported behaviors that met criteria binge drinking and alcohol abuse respectively (Substance Abuse and Mental Health Services Administration, 2014). The WHO (2014) reported that, in 2010, the 12-month prevalence of Alcohol Use Disorder (AUD) and alcohol dependence was 7.4% and 4.7%, respectively in the US. Data from the Centers for Disease Control (CDC) indicated that excessive alcohol use accounted for approximately 88,000 deaths per year during the period 2006 to 2010, and 10% of deaths in persons aged 20-64 (Centers for Disease Control and Prevention, 2015).

According to a report by the Institute of Medicine (IOM; 2013), rates of binge drinking are more alarming in the US military. In 2008, almost half of active duty personnel (47%) reported behaviors that qualified as binge drinking; about 20% of military personnel reported binge drinking every week in the past month, and this figure rose to 27% when sub-setting to military personnel with combat exposure (Institute of Medicine, 2013).

In addition to the effects of human health, excessive alcohol consumption (EAC) exerts a significant economic cost in the U.S., estimated as \$223.5 billion in 2006. This economic burden corresponds to \$1.90 per drink, or about \$746 per drinker. The cost was

primarily caused by losses in productivity (72% of total cost) and health care expenses (11%). Other costs (17%) accrued as a consequence of criminal justice proceedings, motor vehicle crashes, and damage to property (Division of Population Health, 2014). Moreover, in 2006 approximately 40% of the economic costs of excessive alcohol use were paid by local, state, and federal governments (Sacks et al., 2013). In sum, excessive and hazardous drinking clearly poses a large burden on American health and the economy (World Health Organization, 2015).

Unfortunately, the US is not the only country plagued by this preventable public health problem. According to the WHO (2014), 3.3 million deaths worldwide were attributable to harmful use of alcohol in 2012 alone. In that year, 139 million disability-adjusted life years (DALYs), corresponding to 5.1% of the worldwide burden of disease and injury, were attributable to alcohol consumption. Rates of alcohol-attributable deaths and DALYs differ over the WHO geographical regions, with the European Region having the highest proportion; such variability was likely due to the diverse attitudes and practices of producing and consuming different forms of alcohol (Rehm et al., 2009; World Health Organization, 2014)

One scientific consensus is that alcohol abuse, like substance abuse in general, can be characterized as a chronic disease (McKay, 2011). However, relapse processes likely differ from other chronic diseases due to the specific motivational and appetitive mechanisms involved in addiction (McKay, 2011). The WHO (2015) defines relapse as “a return to drinking [...] after a period, of abstinence, often accompanied by reinstatement of dependence symptoms.” Witkiewitz and Marlatt (2004) further elaborated: “Relapse has been described as both an outcome—the dichotomous view that

the person is either ill or well—and a process, encompassing an transgression in the process of behavior change.”

For many people, relapse is the most likely outcome of an attempt to abstain from drinking or limit drinking. One study reported that, within recently treated persons with AUD, 64% relapsed within a year, and of those who were abstinent at 1 year, 34% subsequently relapsed in the next two years (Dennis, Foss, & Scott, 2007). Other estimates of long term relapse rates ranged from 20 to 80% in individuals who were treated for AUD (Jin, Rourke, Patterson, Taylor, & Grant, 1998; Moyer & Finney, 2002; Weisner, Matzger, & Kaskutas, 2003). In people treated for AUD for the first time, the relapse rate at a 3-year follow-up was 43.4% and 62.4% in those who did and did not seek help respectively (Moos & Moos, 2006). For those were abstinent at the 3-year follow-up, the relapse rate at 16 years was 42.9% and 60.5% in those who did and did not seek help respectively (Moos & Moos, 2006). The relapse rate also varied as a function of number of psychosocial factors, from 22%, 45%, 70% and 86% for those with no psychosocial risk factors, one psychosocial risk factor, two psychosocial risk factors, and three or four risk factors respectively (Moos & Moos, 2006).

I.2 HAZARDOUS DRINKING AND RELAPSE IN THE NETHERLANDS

The current study, as indicated earlier, was conducted in the Netherlands. In 2010, the rates of Alcohol Use Disorder (AUD) and dependence in the Netherlands were 1.2% and 0.7%, respectively (World Health Organization, 2014). The Netherlands Mental Health Survey and Incidence Study-2 (NEMESIS-2), a nationally representative sample, provided prevalence estimates from 2007 to 2009 in 18 to 64 year-old Dutch adults (de Graaf, Ten Have, & van Dorsselaer, 2010). An estimated 5.4% and 4.4% of the

population qualified for AUD using the DSM-IV and DSM-5 criteria respectively (Tuithof, ten Have, van den Brink, Vollebergh, & de Graaf, 2014b).

In the NEMESIS 2.0 study, within those remitted of AUD under DSM-5 for more than 1 year at baseline, the retrospective relapse rates were 5.6%, 9.1%, and 12% at 5 years, 10 years, and 20 years since the last remission respectively (Tuithof, ten Have, van den Brink, Vollebergh, & de Graaf, 2014a). For those who met criteria for AUD under DSM-5 at baseline, the prospective rate of relapse was 29.5% (Tuithof et al., 2014a).

As described in Szeto (2016), findings from the NEMESIS 2.0 studies yielded two important implications for understanding hazardous drinking and its consequences. First, context is important. The Netherlands differs from the US in its approach to etiology and recovery at a cultural and scientific level. Many studies of substance abuse in the Netherlands reflect a harm reduction approach, rather than the abstinence-based approach typically employed in US studies. Second, the diagnosis of AUD is only partially predictive of outcomes. More attention to the specific drinking behaviors in the context of an individual's life is warranted. Drinking behaviors, whether hazardous or not, may predict occurrence and severity of clinical impairment (Rehm et al., 2003). Similarly, markers of clinical impairment related to alcohol use may be masked in everyday activities, or by cultural and individual differences (Rehm & Room, 2015). As stated by Szeto (2016): "One person's protective factor against relapse may be another's risk factor. For instance, having a glass of wine at a family dinner at home may invite supportive interactions. The same wine may invite craving in a crowded bar, or drinking motivated by self-medicating at a contentious high school reunion."

Conducting this current study in the Netherlands has some advantages (Szeto, 2016). In the U.S., roughly 25% of people with lifetime alcohol dependence seek treatment (Substance Abuse and Mental Health Services Administration, 2011, 2012, 2014), whereas in the Netherlands one third of people do (van Boekel, Brouwers, van Weeghel, & Garretsen, 2013). Therefore, in principle, it may be easier to obtain a more representative sample in the Netherlands than in the US. Moreover, results from a survey study revealed that respondents from the Netherlands held more sympathetic attitudes toward alcoholism than those from North America (Room, 2005). Heavy drinking may be less stigmatized in the Netherlands, meaning that individuals may be more willing to volunteer in the study and provide valid responses regarding their level of craving and drinking. For low income persons, perceived financial barriers to mental health treatment may be less significant in the Netherlands than in the US (Sareen et al., 2007). Finally, the availability of treatment approaches which are not restricted to abstinence is expected to increase the sample's representativeness and diversity with respect to this dissertation's target population.

I.3 TREATMENTS FOR ALCOHOL ABUSE AND DEPENDENCE

Most persons receiving alcohol use treatments are specifically diagnosed with alcohol abuse or dependence. As of 2016, there are several medications and talk therapies in the US that are empirically validated. Several common pharmaceutical and psychosocial modalities are briefly discussed below.

For medications, both the European Medicine Agency (2010) and the US Food and Drug Administration (National Institute on Alcohol Abuse and Alcoholism, 2008) have approved naltrexone, acamprosate, and disulfiram for treating alcohol dependence.

In 2013, the EU approved nalmefene for use in treating alcohol dependence; in 2014, France issued a 3-year temporary recommendation for baclofen as well (Rehm et al., 2013). The five drugs above target various phases of the alcohol addiction process. For instance, disulfiram disrupts the human body's metabolism of alcohol, inducing subjectively unpleasant sensations, which functions as positive punishment to discourage alcohol use ("aversion therapy"). Naltrexone attenuates the subjectively pleasant effects from consuming alcohol, which functions as negative punishment to discourage alcohol use.

Similar to the pharmaceutical modality, psychosocial treatments also target the causes and effects of drug use, such as craving, withdrawal, and tolerance. They also attempt to enhance protective factors such as problem-solving skills, emotion regulation skills, and spirituality, as well as mitigate the impact of risk factors such as environmental cues and life stressors. Psychosocial treatments are often more flexible and personalized than medications.

Each of the US, the Netherlands, and the European Union (EU) has their own national authority that publish consumer guides, or provider practice guidelines, for alcohol abuse/dependence treatment (GGZ Nederland, 2004; Substance Abuse and Mental Health Services Administration, 2016; US Department of Veteran Affairs & US Department of Defense, 2015). Briefly, the psychosocial treatments included in the guides and guidelines are provided below with select examples. Brief treatments typically include components of psychoeducation, and motivational interviewing/enhancement. Group-based treatments range from peer-facilitated, self-help, groups such as the 12-Step model, to professionals-facilitated intensive outpatient programs, and short- or long-term

residential rehabilitation or therapeutic communities. Common therapy models include behavioral therapies (e.g., Cognitive Behavioral Therapy; Behavioral Self-Control Training; Contingency Management; Cue Exposure Therapy; aversion therapy, etc.), psychodynamic therapies (e.g., short-term dynamic therapies; Supportive-Expressive Psychotherapy, etc.), marital and family therapies (e.g., Behavioral Couple Therapy; Functional Family Therapy; Multisystematic Therapy; Multidimensional Family Therapy, etc.), and social environmental therapies (e.g., Social Behavior and Network Therapy; Community Reinforcement Approach, etc.). Mindfulness-based therapies have also been developed (e.g., Mindfulness-based Relapse Prevention; Mindfulness-oriented Relapse Enhancement; Mindfulness-based Cognitive Therapy), which are discussed in more details later.

I.4 PSYCHOLOGICAL PROCESSES UNDERLYING ALCOHOL ADDICTION

As noted above, efficacious treatments are available. However, as also noted earlier, the most common outcome of attempts to quit alcohol is relapse and a return to former drinking patterns. Given the aforementioned societal and economic costs, it is crucial to understand the psychological processes underpinning relapse to alcohol so that new interventions can be developed.

A recent review of research of Alcohol Use Disorder proposed a three-stage process model of alcohol addiction (see Litten et al., 2015), comprised of binge-intoxication, withdrawal-negative affect, and preoccupation-anticipation. As described in more detail below, the current study assesses each of these components. First, it examines self-reported drinking behaviors, such as number of drinks, which underlie the binge-intoxication process. Second, the study examines the role of negative affect in the

withdrawal-negative affect process. Third, the study examines the role of craving and implicit cognitive biases, which are parts of the preoccupation-anticipation process.

I.4.1 Negative Affect

Affect is often used interchangeably with emotions, mood, and feelings in lay culture. In addition, affect and emotions are defined differently by different researchers, which has led to different lines of theories and methods (Gross, 2010). For example, one widely used conceptualization considers affect the *valence states* determined by three elements: attitudes (which are stable, dispositional, stimulus-specific), moods (which are less stable, less stimulus specific), and emotions (which are short-lived, interpreted responses to situations that the subject perceives as relevant to their current goals) (Gross, 2010). In addition to valence (unpleasant – pleasant), other concurrent dimensions of affect include intensity (not at all – a lot) and arousal (deactivating – activating). While researchers continue to debate what constitute affect, they largely use the term to denote an aggregate composite construct (Hussong, Hicks, Levy, & Curran, 2001). Therefore, the current study used an affect measure that captures multi-dimensional sources of affect that has been validated across macro-cultures (e.g., International PANAS - Short Form (I-PANAS-SF); Karim, Weisz, & Rehman, 2011; Thompson, 2007)

Theory and data suggest that stress and negative affect can provoke alcohol craving and consumption through multiple mechanisms (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004; Litten et al., 2015; Sinha, 2007). Baker et al. (2004) argued that “the escape and avoidance of negative affect is the prepotent motive for addictive drug use.” In addition, acute or chronic negative affect is thought to modulate information processing in a way that promotes motivation to use drugs, to include increased levels of

craving. Negative affect can also provoke craving through classical conditioning (Siegel, 1983; Wikler, 1948).

Most relevant to the current study, data from laboratory studies also suggest that negative affect can cause craving in persons with alcohol dependence. Studies have examined the effects of acute stress and negative affect, administered by laboratory stressors, on craving. Acute stress (vs. no stress) has been found to increase alcohol craving in alcohol-dependent patients (Fox, Bergquist, Hong, & Sinha, 2007; Sinha et al., 2008; Sinha & Li, 2007). In a field study, Krahn et al. (2005) assessed negative affect as well as craving (the latter with the Alcohol Urge Questionnaire (AUQ)). A cluster analysis revealed two clusters, a “low negative affect and low craving” cluster, and a “high negative affect and high craving” cluster (Krahn et al., 2005). This provides evidence that negative affect and craving are associated in the field.

Finally, studies have also compared negative affect reported by heavy drinkers and by social drinkers. Results from these studies have been generally mixed. One study reported that ex-drinkers and binge drinkers reported a higher frequency of depression than lifelong abstainers and drinkers without heavy drinking episodes (Manninen, Poikolainen, Vartiainen, & Laatikainen, 2006). However, other studies reveal cast doubt on the strength of the association between at-risk drinking and depression (Alati et al., 2005; Bellos et al.; Caldwell et al., 2002; Haynes et al., 2005; Heilig, Egli, Crabbe, & Becker, 2010; Manninen et al., 2006; Simons, Dvorak, Batien, & Wray, 2010).

I.4.2 Craving

Craving can be defined as “a strong desire or sense of compulsion to take the drug” by the International Classification of Diseases (ICD-10; Schmidt & Room, 1999).

Many Substance Use Disorder patients report frequent cravings when they attempt to abstain from or limit substance use (Epstein, Marrone, Heishman, Schmittner, & Preston, 2010; Epstein et al., 2009), and, as noted below, craving is associated with use and relapse. Therefore, craving is a target for intervention.

Recent advances in methodology and interdisciplinary collaboration have expanded the scope of the study of craving. In particular, two types of advances are important in this study, including assessing participants' craving *in the field* (vs. in a controlled laboratory setting), and recognizing the role of craving in *cue reactivity*.

Serre et al. (2015) systematically reviewed studies that examined the relationships between craving and substance use/relapse in participants' daily life. The review found that 84 of the 91 selected studies reported positive relationships between craving and substance use (Serre et al., 2015). For example, one EMA study of individuals undergoing substance abuse treatment found that those who reported a craving increase on one prompt were fourteen times more likely to report relapse on the next prompt, when compared to individuals who did not report a craving increase (Moore et al., 2014). However, only nine of the 91 studies examined alcohol use and/or relapse, and only five of these nine studies sampled alcohol-dependent populations (Cooney et al., 2007; Litt, Cooney, & Morse, 2000). Therefore, more data are needed on craving's association with use and/or relapse in alcohol dependent populations in the field. In addition, overall craving ratings are often low in alcohol-dependent participants, and exhibit little variability over time, compared with craving ratings in SUDs patients of other substances (Tiffany, 1990).

Another avenue of research has focused on reactivity to drug cues. Drug-related cues can provoke craving and other responses which maintain drug use and promote relapse (Niaura et al., 1988; Robinson & Berridge, 1993). Incentive-sensitization theory (IST; Robinson & Berridge, 2008) provided a detailed account for how drug cues might control behavior which is particularly relevant for the current study. IST suggests that chronic drug use causes changes in brain circuits that mediate the “attribution of incentive salience” to drug-related stimuli. In certain individuals, the levels of salience assigned to drugs, and drug-related cues, becomes excessive (“incentive-sensitization”). Robinson and Berridge (1993) argue that levels of incentive salience assigned to the mental representations of drug cues can become “pathological,” in which the attraction of drug cues far exceeds the pleasure obtained from drug taking. Berridge et al. (2009) capture this idea in the following:

“When attributed to a stimulus representation, incentive salience transforms the mere sensory shape, smell or sound into an attractive and attention-riveting incentive. Once attributed, the incentive percept becomes difficult to avoid noticing, the eyes naturally move toward the incentive, it captures the gaze and becomes motivationally attractive, and the rest of the body may well follow to obtain it. (p. 2)”

The statement above indicates that excessive attribution of incentive salience has at least two effects. First, drug users will preferentially attend to drug cues. An “attentional bias” to drug cues occurs when a person orients to, and sustains attention on, drug-related cues more than neutral cues (M. Field & Cox, 2008). Second, the statement indicated that drug users may not only automatically attend to drug cues but also automatically approach (move towards) drug cues. In this literature, an “approach bias” refers to the tendency to automatically approach drug-related stimuli more than neutral

stimuli. As is described in further detail later, in the current study both attentional bias and approach bias are assessed.

I.4.3 Implicit Cognition and Addiction

Many studies, in part inspired by IST, have examined cognitive processes underlying addiction, with the goal of identifying cognitive targets for intervention. One widely-used theory is the dual process theory of addiction (Wiers & Stacy, 2006). Dual process theory asserts that addiction (or any other behavior) is determined by two distinct types of cognitive process (Shiffrin & Schneider, 1977). Automatic or implicit processes are fast, concurrent, and effortless. They can occur outside of one's conscious awareness or intentional control. In contrast, non-automatic or explicit processes are slow, reflexive, and consecutive. They are often accessible to conscious awareness and intentional control (Kahneman, 2003).

Although dual process theory originated in cognitive psychology, recent research has emphasized the role of automatic processes in health behaviors (Marteau, Hollands, & Fletcher, 2012), and addiction (Wiers & Stacy, 2006). As noted above, this dissertation examines two cognitive biases, attentional bias and approach bias, which have been shown to be associated with craving and relapse.

Attentional bias is usually conceptualized as an automatic process. For example, a heavy drinker may attend to a drinking-related cue without making the conscious decision to do so (M. Field & Cox, 2008; M. Field, Duka, Tyler, & Schoenmakers, 2009). Of course, the drinker will be aware of the drinker-related cue when she attends to it. That is, she is aware of the “end product” of the automatic process. However, she will have no awareness of how the shift in attention occurred.

Many studies have investigated attentional bias (M. Field & Cox, 2008; Franken, 2003) and approach bias (M. Field, Wiers, Christiansen, Fillmore, & Verster, 2010) in drug addiction (see Tables 1 & 2 for review of studies of these two cognitive biases in alcohol, reviewed by Szeto (2016)).

Attentional bias can be assessed by reaction time tasks such as a Stroop task modified for a specific drug, e.g., alcohol-Stroop task. In a modified Stroop task, participants are asked to identify the color of neutral words and drug-related words. In some tasks, responses are made by pushing buttons on an electronic device. Participants are informed they can ignore the meaning of the words, and they can just focus on performing the color identification task. Slower responses on drug-related words (compared to neutral words) indicates cognitive interference in the color identification task. The interference indicates that the drug cues interfere more with the primary task (identifying the colors) than the neutral words. This interference is interpreted as an “attentional bias”, because the drug cues are thought to automatically attract attention.

Research has generally found attentional bias to drug cues is present in drug-users but absent in non-drug users (Cox, Pothos, & Hosier, 2007). Attentional bias to drug cues can also be found in non-drug users who are constantly exposed to drug cues (e.g., addiction treatment staff; Ryan, 2002). Some studies have reported that attentional bias to drug cues is correlated with drug use and relapse in studies of alcohol dependence (Cox, Brown, & Rowlands, 2003; Cox et al., 2007; Cox, Schippers, et al., 2002), cigarette smoking (Janes et al., 2010; Powell, Dawkins, West, Powell, & Pickering, 2010; H. Waters & Green, 2003), and cocaine use (Carpenter, Schreiber, Church, & McDowell, 2006). Most pertinent to the current study, a meta-analysis has revealed that attentional

bias is positively associated with craving. However, the effect size for this association is modest, and the magnitude of the association can be affected by various moderating factors (M. Field, Munafo, & Franken, 2009). Experience sampling methodology, such as ecological momentary assessment, has been recommended for further studying the clinical relevance of attentional bias (Christiansen, Schoenmakers, & Field, 2015).

Approach bias, like attentional bias, is also often assessed with computerized reaction time tasks (Cousijn, Goudriaan, & Wiers, 2011; Schoenmakers, Wiers, & Field, 2008). A number of tasks have been developed to assess approach bias. Some tasks, such as the Approach-Avoidance Task (AAT), require gross motor movements (e.g., move a joystick with a hand), whereas others, such as the Implicit Association Test (IAT), require fine motor movements. Studies of approach bias pertinent to the current study are reviewed in Table 2.

As noted earlier, Tables 1 and 2 review studies that examined attentional bias and approach bias, respectively, in people at-risk of hazardous drinking. As can be seen in Table 1, generally, studies found the presence of attentional bias to alcohol in heavy drinkers, but not in control groups (e.g., Sharma, Albery, & Cook, 2001). Similarly, some studies reported that presence of alcohol-approach bias was associated with alcohol use (yes/no), and consumption level (Ostafin, Marlatt, & Greenwald, 2008; Ostafin & Palfai, 2006; Ostafin, Palfai, & Wechsler, 2003; Peeters et al., 2012). However, as noted in Snelleman et al. (2015), the evidence for an association between approach bias and relapse in alcohol use is mixed (see also Table 2). As will become clear later, especially pertinent to the current study is that fact that a number of studies reported prospective associations between cognitive biases with craving (Duka, Townshend, Collier, &

Stephens, 2002) and subsequent alcohol consumption (Cox, Hogan, Kristian, & Race, 2002; Cox et al., 2007; Fadardi & Cox, 2006, 2009).

Moreover, some studies reported in Tables 1 and 2 used cognitive bias modification techniques to attempt to reduce these biases, in part to test the link between biases and outcome measures (e.g., Wiers, Rinck, Kordts, Houben, & Strack, 2010). One study reported that approach bias mediated the effect of cognitive bias modification on relapse rates (Eberl et al., 2013). The aggregate evidence indicates that cognitive biases are associated with various aspects of drinking behaviors, and effect sizes range from small to moderate (Eberl et al., 2013, 2014; Gladwin et al., 2015; Leeman, Bogart, Fucito, & Boettiger, 2014; Schoenmakers et al., 2010; Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011; Woud, Hutschemaekers, Rinck, & Becker, 2015).

Another area of investigation in the cognitive bias literature is the idea that the association between biases and drug use or relapse can be moderated by various factors. Stated another way, having a high attentional or approach bias may only be a risk factor for use or relapse under certain conditions. In particular, IST and dual process theory suggest that executive functions, such as working memory, can moderate the effect of cognitive biases on drinking behaviors (Houben & Wiers, 2006; Wiers et al., 2006). The idea is that when working memory is depleted, the association between cognitive biases and drug use behavior should become stronger. In a similar vein, the experience of negative affect does not always lead to drinking. Deficits in skills related to mindfulness, such as tolerance of negative emotions, may enhance the association between negative affect and alcohol consumption (Berking et al., 2011).

This dissertation examined a potential moderator variable, trait mindfulness. As elaborated later, theory suggests that more “mindful” individuals should be less likely to be influenced by automatic processes. As noted earlier, this study employed EMA, therefore, the role of mindfulness on alcohol dependence was examined using EMA.

The next section reviews the history and scientific investigation of mindfulness, and its current and potential application in substance addiction research.

I.5 MINDFULNESS IN SUBSTANCE ABUSE

I.5.1 Historical and Philosophical Background

The mindfulness known in the practice and science of psychology today mainly stems from the teachings of Siddhāttha Gautama, the founder of Buddhism, commonly known as the Buddha. Before reviewing mindfulness in the context of hazardous drinking and relapse, some historical context on mindfulness is provided.

It is important to first acknowledge the overlapping contexts of the English word “mindfulness” with *the* mindfulness concept in contemporary research informed by Buddhism. The English word can be traced back to the 16th century. Mapping a word from Buddhism to a pre-existing English word confounds their usages, functions, and sociolinguistic contexts. Practices and research concepts not influenced by Buddhism may also have the tradition, and the right, to name themselves mindfulness, such as prayers and meditation from the Abrahamic religions, contemplative practices in education, memory and attentional training, interpersonal awareness, observation of social propriety, to day-to-day vernacular reminders of “hey, look at where you’re going.” The implication for sciences involving mindfulness is simple: be mindful and explicit in communicating the “mindfulness” one thinks one is studying.

The second point relates to the lineage within Buddhism on which this dissertation is based. Most of the Buddha's teachings and subsequent commentaries were transmitted verbally from his death in 5th century BCE to 1st century BCE, as the region's weather made preserving written documents difficult (Schopen, 1997). The monks became increasingly concerned that the famine, war, and a new king who was less sympathetic to Buddhism may disrupt the preservation of the Buddha's teachings, and so they recorded them in writing in Pali at the Fourth Buddhist Council (Norman & Gonda, 1983). This Pali Canon also gave rise to the first canonical Buddhist tradition called Theravada. Other canonical traditions developed as Buddhism spread to other regions and languages, such as Sanskrit, Thai, Tibetan, Chinese, and Japanese (Wu & Chia, 2015).

For simplicity, this dissertation only draws from scriptures and concepts in the Pali Canon. For Buddhist concepts that are most relevant to this study, they were written in Pali. Some nuances warrant critical examination because they can be distorted or lost when transmitted between systems of epistemology (e.g., Buddhism and science), cultures (e.g., "East" and "West"), and languages (e.g., Pali, English). Of note, some sources or elaborations of important concepts in the Pali Canon were lost throughout the years. However, monks from the Indian subcontinent and China in the following centuries "preserved" the lost scripture when their translation written in Chinese were carefully guarded by China's temples and ruling regimes (Wu & Chia, 2015).

It is important to note the sources that the current project draws on, because Buddhism is a massive philosophical system with diverse traditions that differ in conceptual and practice approaches. The study's interpretation may vary if another Canon was chosen as a reference point (Olson, 2005). Below is a brief review of the

philosophical context that gave rise to mindfulness, which drew on several sources that provided general introductions to Buddhism (For example, Conze, 2012; Gethin, 1998; Hoffman & Mahinda, 2013; Humphreys, 2012). The consequences of not knowing these contexts—and one’s reference frame—are grave for scientists and practitioners alike; the discussion on this issue will follow after the brief review.

To prepare for the interpretation of findings in the current study, it is important to be mindful of how *sati* has been translated and adapted across epistemological frameworks i.e., from Buddhism to psychology and the scientific process.

To set the foundation for understanding mindfulness in hazardous drinking, the next section reviews the elements of *sati* that persisted from early scriptures to subsequent canons.

I.5.2 *Sati*: Concept and Context

Sati was central and pervasive in the Buddha’s teaching. The Buddha organized his teachings in hierarchy of topics and themes according to their breadth, from the Three Refuges on the broadest level (i.e., the Buddha, the *Dhamma*, and the *Sangha*), to more detailed levels such as the Thirty Seven Factors of Enlightenment. The Thirty Seven Factors of Enlightenment, which consists of seven-sets of core *dhamma* concepts, summarizes various teachings as a guide for moment-to-moment practices (see Fig. 1), and *sati* appeared in five of the seven sets.

The Buddha Refuge refers to the past, present, and future Buddhas, for their roles as teachers and guides of sentient beings on the path toward enlightenment. The *Sangha* Refuge refers to the monastic Buddhist communities of nuns and monks. Most research

and practices of mindfulness in the modern English speaking communities focus on the *Dhamma* Refuge.

The *Dhamma* Refuge denotes the Buddha's teachings, and subsequent teachings and commentaries in various canonical traditions. It is important to note that the word *Dhamma* is used by many religions in the Indian subcontinent to denote similar but distinct concepts. In Buddhism, the *Dhamma* Refuge refers to the Four Noble Truths, which is the Buddha's teaching about *dukkha* (commonly translated as suffering) in the contexts of existence (in the phenomenological experience of sentient beings), and reality such as its cosmic law and order (e.g., what it is; why it is; how it operates for sentient beings). Salient to psychological science is the Buddha's *methodical instructions* on how sentient beings, especially humans, can investigate existence and reality for themselves, and transcend the never-ending cycles of suffering (e.g., what to do with the knowledge of existence and reality). Thus, Buddhism is interested in what the ontological, ultimate reality may be like for those who attain enlightenment, as well as how to attain it.

The *Dhamma* is the Buddha's elaborate examination of the nature and alleviation of *dukkha* experienced by sentient beings. He organized the *Dhamma* into the step-wise Four Noble Truths (see Fig. 1).

The first Truth is the Truth of *Dukkha* (often translated as *pain*, *suffering*, and *unsatisfactoriness*), i.e., "this is *dukkha*". It describes what of sentient beings' experiences can be considered *dukkha*, categorizes them into three types (e.g., suffering of pain, of impermanence, and of all conditioned experiences), and explains that sentient beings are prone to experiencing it. There are theoretical and practical distinctions between the three translated terms, which roughly map on to the three types of *dukkha*.

These distinctions have significant implications for clinical sciences such as hazardous drinking, which may or may not be “lost in translation” as modern science examines Buddhist practices. This truth explains concepts such as the Five Aggregates and the Three Marks of Existence.

The second Truth is the Truth of the Origin of *Dukkha*, i.e., “*dukkha* has causes,” which focuses on the cyclically “arising” and “coming together” of *dukkha* in this life and across incarnations. The causes of *dukkha* are explained in the logic of Twelve Links of Interdependent Originations. A person’s propensity to experience *dukkha* begins with (1) not knowing *dukkha*, existence, and Existence (i.e., ignorance). The person goes through the next five relatively subtle and subconscious steps: (2) mental formations, (3) consciousness, (4) form, (5) the six senses, and (6) contact (between sense organs, sense objects, and sense consciousness). Contact then triggers (7) feeling, which emerges more and more into explicit awareness in subsequent steps: (8) craving, (9) clinging, (10) becoming, (11) rebirth, and (12) death. If the being does not disrupt or reverse the flow, the Links repeats itself, from death, rebirth, to ignorance, which subjects the being to another mass of *dukkha*.

This Truth contains a framework relevant to hazardous drinking research. In fact, the first ten Links address phenomenology in day-to-day life that overlap with topics that can be examined scientifically. The First Link resembles the diathesis-stress model. The extent of knowledge and capacity humans can develop depends on nature and nurture constraints. If one does not understand *dukkha*, one is limited in perspective, awareness, and resources to manage and regulate their pleasant, unpleasant, and neutral experiences. The Second to Sixth Links resemble the more subtle psychophysiology and psychology

of consciousness underlying drinking. The Seventh to Tenth Links resemble the more observable (to the subject and bystanders) behaviors of feelings, craving (to enhance positive experiences and reduce negative experiences), seeking alcohol, and intoxication. The Eleventh to Twelfth Links are specifically related to the Buddhist cosmology of realms and rebirth, and therefore presumably unrelated to hazardous drinking and relapse.

More readily accessible to psychological science is the Buddha's extension of the Twelfth Links, namely, the Three Poisons. The cyclic nature of *dukkha* is sustained by the three fundamental mechanisms: (1) the attachment and greed toward pleasant experiences, (2) the aversion and hatred against unpleasant experiences, and (3) the ignorance and delusion about reality.

The third Truth is the Truth of the Cessation of *Dukkha*, i.e., "*dukkha* can be ceased," which focuses on the causes and state of *nibbāna*, literally translated as "blowing out, extinguishing the fire", that sustains the positive feedback loop of *dukkha*.

The fourth Truth is the Truth of the Path to the Cessation of *Dukkha*, or "this is the path to liberation from *dukkha*." This Truth is the Noble Eightfold Path, which explicates the principles and practices in three areas leading to enlightenment: insight, virtue, and wisdom. The Path (see Fig. 1) includes the Right View, the Right Resolve, the Right Speech, the Right Action, the Right Livelihood, the Right Effort, the Right Mindfulness (*samma-sati*, often appears in the Pali Canon as simply *sati*), and the Right Concentration (Kumar, 2002; Teasdale & Chaskalson, 2011).

As one of the Noble Eightfold Path, its practice instructions and discussions were organized in the *Satipatthana* (commonly translated as "the Four Foundations of Mindfulness" or "the Ways of Attending to Mindfulness"). *Sati*'s sociolinguistic

meanings in Pali have been translated into English as the “right memory,” “right awareness,” or “right attention”. Research into the contextual usage of *sati* in Pali scriptures showed that it refers to a dutiful, recurring activity, and presence of mind, especially in remembering (Davids, 1881). There are two targets of such remembering, the *phenomenon* (e.g., “a book”), and the fullest *context* and *relatedness* to other phenomena around it (e.g., a hard-cover book in a library in New York in June, etc.).

Figure 1-(a) shows where *sati* is situated in the core Buddhist doctrine underlying the major canons. *Sati* was developed and elaborated within a particular worldview, for a particular goal, and in a particular array of experiential approaches. Buddha summarized the qualities conducive to enlightenment, elaborated throughout the Four Noble Truths, into the Thirty-seven Enlightenment Qualities (Fig. 1). The Qualities were grouped into seven sets. Historical commentaries in major canons agree that, generally, the sets are not ordered by importance or priority. Instead, these sets represent the distinct bio-psycho-social-spiritual domains that make up Buddha’s “salvation treatment manual.” The domain-ness has two important implications for translating and adapting *sati* in psychological science and practices.

The Qualities (Fig. 1) shows *sati* as a *simultaneously* multi-domain concept. First, *sati* is its own domain, the **Foundations** or Establishments of *sati* (of the body, mind (*citta* in Pali), senses, and *dharma*). Then, it is explicitly named as one of the **Faculties**, one of the **Powers**, one of the **Enlightenment Factors** (cognitive, emotional, and physiological states), and one of the **Noble Eightfold Path**.

The Four Bases of Power refers to the *Right Concentration* (the last of Noble Eight-fold Path) *toward* intention/purpose, effort/energy, consciousness/mind (*citta*), and

investigation/discrimination. The *citta* in the Four Bases of Power is also the *citta* in the Four Foundations of *Sati*, which implies their interrelated roles. Right Exertion asks one to prevent and eliminate unwholesome mental states and behaviors, as well as to generate and maintain wholesome ones. However, as Buddha and various scriptures elaborated, *sati* is a pre-requisite embedded in Right Exertion. Due to the Three Marks of Existence and Twelve Causes of suffering, it may be difficult and impossible to discern wholesomeness accurately across situations. *Sati* is fundamental to having such discernment, and the meta-insight of being aware of one's effort, energy, and exertion.

The *sati* expounded as a Foundation differs from the *sati* as a Power in terms of contents, functions, and goals. However, they are not distinct concepts, each from a distinct domain, and all labeled *sati*. They denote a coherent *sati* that is *simultaneously* a Foundation, a Base of Power, a Faculty, a Power, an Enlightenment Factor, part of a Path, and a guide to exert the self toward enlightenment.

As depicted in Fig 1-(b), Buddha taught that the sense of self in humans is a dynamic phenomenon involving the Five Aggregates, or form, perception, feeling, formation, and consciousness (Karunamuni, 2015). Buddha explained that such building blocks of existence give rise to eight types of *dukkha*, which fall into three groups: the *dukkha* of pain (esp. birth, aging, illness, death), the *dukkha* of change (i.e., instability, insecurity), and the *dukkha* of pervasive *unsatisfactoriness* (due to the wish for experiences to be a certain way). Here, *sati* is necessary for accepting, remembering, and appreciating that there are *dukkha* in existence, and is never ending unless one disrupts the cycle.

The Five Aggregates constantly aggregate and decompose due to cosmic laws such as the Twelve Interdependent Originations, karma, and rebirth. Here, *sati* is necessary for accepting, remembering, and appreciating that, due to the cosmic law and order, *dukkha* is ever-changing, never-ending, and constantly perpetuated by the sense of self that is conditional upon the Aggregates and Originations.

The Buddha also taught that, to unenlightened sentient beings, all existence has three features, or the Three Marks of Existence (impermanence, suffering, and non-self). Here, *sati* is necessary for accepting, remembering, and appreciating the Three Marks, because one's ignorance (i.e., not knowing, forgetting) and delusion (i.e., denying, self-deceit, misunderstanding) about the Three Marks actually deepen suffering.

The Buddha's quest to understand and alleviate suffering led him to believe that "alleviation" was futile, as the phenomenology of suffering was kaleidoscopically disorienting and overwhelming. Aiming for anything less than "blowing out the fire" prolongs one's suffering. It also stirs up more suffering for those around us via the Twelve Causes of Dependent Origination. Therefore, *sati* was developed to end, and not merely alleviate, suffering. Such worldview, knowledge, value, and intervention choice differ drastically from modern mainstream psychological science and practice. The next section briefly reviews the evolution of mindfulness science, and puts the current project in context.

I.5.3 Mindfulness in Psychological Empiricism

The motivation and structure of Buddhist principles are similar to modern clinical psychology. The Second Truth and the Fourth Truth map quite closely to the five domains in National Institute of Mental Health's Research Domain Criteria, i.e., negative

valence systems, positive valence systems, cognitive systems, social processes, and arousal and regulatory systems. The Wisdom, Virtue, and Mind in Noble Eightfold Path (see Fig. 1) maps on well to the modern bio-psycho-social paradigm of suffering. And, discussed below, the Right Effort resembles the concepts of reinforcement and punishment in behaviorist psychology.

It is therefore unsurprising that core concepts such as *sati* resonated with the science and practice of psychology in the West (Kelly, 2011; Kirmayer, 2015; McWilliams, 2012; C. J. Robins, 2002; Seiden & Lam, 2010). In the past two decades, mindfulness science and practices have surged into the mainstream of English-speaking communities.

Beginning around the 1960s, scientists began to study mindfulness in research and clinical settings. The history and current state of mindfulness science is informative for advancing substance hazardous drinking research. Researchers have addressed questions such as “What functions and roles does ‘engaging in mindfulness’ play for the person?” and “What are the bio-psycho-social-spiritual consequences of ‘engaging in mindfulness’?”

In recent years, various definitions of mindfulness have evolved. The frequently cited conceptualizations define mindfulness as: a self-regulated attention (Goleman & Schwartz, 1976), a skill-set (Linehan, 1993), a particular awareness (J Kabat-Zinn, 1994), a state of being attentive and aware (Brown & Ryan, 2003), a self-regulation of attention and an orientation to experiences (Bishop et al., 2004), a multifaceted mental-behavioral trait (R. A. Baer, Smith, & Allen, 2004; Ruth A. Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006; Ruth A. Baer et al., 2008), a cyclic process of intention, attention,

awareness (Shapiro, Carlson, Astin, & Freedman, 2006), and a tool to foster practical and transcendental insights (Karunamuni, 2015).

Many Western practitioners and researchers agree that mindfulness involves the psychological processes of attention and awareness (Bishop et al., 2004; Brown & Ryan, 2003; Brown, Ryan, & Creswell, 2007; Shapiro, Brown, Thoresen, & Plante, 2011; Shapiro et al., 2006). For instance, mindfulness was defined as “a receptive attention to and awareness of present events and experiences” (Brown & Ryan, 2003; Brown et al., 2007). Awareness has been described as the conscious registration of internal and external stimuli, while attention was referred to as the initial orientation of attention toward an object. Moreover, attention in mindfulness may also refer to the volitional deployment of attention during effortful processing. In addition to attention and awareness, mindfulness also can refer to other processes such as observing, describing, non-reacting, acting with awareness, non-judging, being curious, being open, accepting, and being intentionally mindful (Ruth A. Baer et al., 2008).

These evolving definitions demonstrate scientists’ attempts to expand their understanding of mindfulness. Such evolution reflects the themes that researchers thought can help tackle mindfulness, or *sati*, scientifically. Recall that the bulk of scientific and non-scientific research in mindfulness exploded in early 2000’s. However, it is also worth noting that two decades prior, as described below, a revolution in behaviorist psychology had already begun adapting *sati*.

The so-called “third wave of cognitive and behavioral therapies” shifted the clinical and research paradigm. The third wave emphasizes the context, function, and system of psychological phenomena, as well as the self-reflectiveness of particular

perspectives (e.g., client, client's social circles, clinician, etc.) that give rise to phenomena (Hayes, 2004; Kahl, Winter, & Schweiger, 2012). The paradigm shift was motivated by the desire to integrate approaches (Barnard, 2009; Hayes, Villatte, Levin, Hildebrandt, & Amrhein, 2011; Hofmann, Sawyer, & Fang, 2010), and was informed by clinical researchers' personal suffering and interests (Carey, 2011; Hayes, 2008; Hayes, 2014). Most relevant here, five of the seven well-studied third wave therapies specifically cited mindfulness as a core principle or strategy, e.g., Acceptance and Commitment Therapy, Dialectical Behavior Therapy, Metacognitive Therapy, Mindfulness-based Cognitive Therapy (Kahl et al., 2012), Mindfulness-based Relapse Prevention (Hsu, Grow, & Marlatt, 2008). More details about mindfulness-based interventions (MBIs) will be discussed later.

Recently, more researchers have highlighted that, to do mindfulness science rigorously, the scientific community ought to understand and account for the context in which it was developed (Brown & Ryan, 2004; Charters, 2013; M. S. Christopher, Woodrich, & Tiernan, 2014; Grossman & Van Dam, 2011; Kang & Whittingham, 2010; Monteiro, Musten, & Compson, 2015; Panaioti, 2015; Shonin, Van Gordon, & Griffiths, 2014b). The current study uses three terms to differentiate three shades of mindfulness: 1) *sati*, 2) Mindfulness (or accommodated-*sati*), and 3) "mindfulness" (or assimilated-*sati*). The current study uses *sati* to denote the original Buddhist concept and its context.

Mindfulness signifies the mindfulness concept after a non-Buddhist framework (e.g., psychology) *accommodated* the Buddhist *sati*. Here, accommodation means that, in translating *sati* from Buddhism to a non-Buddhist framework (e.g., psychology and the scientific process), the priority is to preserve *sati*'s wholeness, in original context, with

the goal of achieving formal and functional equivalence. Therefore, scientists who accommodate *sati* will modify their epistemological processes if necessary.

In contrast with mindfulness, “mindfulness” signifies the mindfulness concept after a non-Buddhist framework (e.g., psychology and the scientific process) *assimilated* or *appropriated* the Buddhist *sati*. Here, assimilation means that, in adapting *sati* from Buddhism to the scientific process, scientists do not prioritize such preservation, nor intentionally modify the epistemological process of science (Fung, 2015). Therefore, in assimilation, scientists may tend to selectively, partially, and/or non-systematically extract the forms of *sati*, the functions of *sati*, or the context of *sati*.

To this dissertation author’s knowledge, interventions that reported having adapted *sati* were all appropriately named Mindfulness-based, -oriented, -inspired. An example of incorrect and inappropriate claim, with respect to the current state-of-science, is to claim a *sati*-based mindfulness treatment is *samma-sati* (i.e., “Right Mindfulness”) (Lindahl, 2015).

Why should scientists interested in adapting *sati*-based mindfulness care about letting *samma* get lost in translation? The bottom line is *do no harm* (Jon Kabat-Zinn, 2017; Mikulas, 2015).

Harm can range from *ethical* (e.g., cultural appropriation of *sati* into mindfulness; explicit or implicit claims that mindfulness is equivalent to mindfulness; a lack of due diligence in scientifically deriving data and interpretations) (M. S. Christopher, Charoensuk, Gilbert, Neary, & Pearce, 2009; Davis, 2015; Grossman, 2008; Grossman & Van Dam, 2011), *experiential* (e.g., misguiding practitioners about the intents, processes, or degree of efficacy of mindfulness- and *sati*-based practices) (Joiner, 2017), to *financial*

(e.g., to stakeholders such as sources that gave rise to their work, fellow researchers, lay consumers of their research, funders, policy makers, etc.) (Hanley, Abell, Osborn, Roehrig, & Canto, 2016; Harrington & Dunne, 2015). Most importantly, there are *explicit and detailed* guidance and warnings in Buddhism relevant to these points.

The Buddha and subsequent canonical commentaries have explicitly emphasized the distinctions between *samma-magga* (“Right (Eightfold) Path”) and *miccha-magga* (“Wrong (Eightfold) Path”). The consequence is simple in Buddhism: practices such as *samma-sati* leads one closer to the cessation of *dukkha* (i.e., *nibbana*), whereas *miccha-sati* does not (and typically leads one away from *nibbana*) (Lindahl, 2015; Sharf, 2014).

Without the knowledge of *samma* (“Right”), one is unlikely to know *miccha* (“Wrong”). Buddhist practices involve the practitioner to calibrate their knowledge and experiences constantly with the *sutta* and other Buddhist practitioners. Practitioners who follow Buddhist instructions are likely to be aware of—and remember—that the *samma* (“Right”) specifier even if it is “dropped” in most *sutta*, or in communication with other practitioners. Therefore the importance of *samma* is constantly reinforced linguistically when reading the *sutta*, and experientially when working with other Buddhist practitioners (Mikulas, 2015). In contrast, those who are unfamiliar with Buddhist *sutta* or practices are unlikely to know—or remember—that *sati* almost always refers to *samma-sati*, unless discussed in the specific context of *miccha-sati* (for example, Joiner, 2017 discussed how the “corrupted mindfulness” perpetuates against the realization of the Non-Self precept).

Therefore the implication is grave for any sciences that attempt to adapt mindfulness from Buddhism (Monteiro et al., 2015; Purser, 2015). Divorcing *sati* from

samma-sati—or selectively extracting components of it—is akin to using a medication against its approved and intended use (Harrington & Dunne, 2015; Rosenbaum, 2009). Consider as an analogy that US pharmacies dispense medications with drug information pamphlets for health, legal, and ethical considerations. The Buddha’s bio-psycho-social-spiritual “salvation treatment manual” also comes with *explicit and detailed* “pamphlets” in the form of 2,500 years’ worth of *Dhamma*.

Such “pamphlets” may be daunting for scientists to sift through. However, a majority of them have now been digitized into databases and documents searchable by words, *and* cross-referenced between Pali, Sanskrit, and major languages such as Thai, Tibetan, Chinese, Japanese, and English). With the increasing ease to access primary sources and Buddhist practices in the West, scientists who wish to work with *sati*-based mindfulness should be mindful of their due-diligence to *do no harm*, in terms of their reasonable burden to mitigate the risks that their work may pose for their stakeholders (Van Gordon, Shonin, Griffiths, & Singh, 2015).

The research described above demonstrates scientists’ critical attempts to expand their understanding of mindfulness and apply it to research and clinical practice, especially in the context of mental and physical health (for example, Brach, 2012; Hanh, 2008; Kornfield, 2008; Miller, 2014). Pertinent to the present discussion, in the last ten years, researchers have started to examine dispositional mindfulness, as described below.

1.5.3.1 Assessment of Mindfulness

Most researchers believe that mindfulness may vary greatly between individuals and stay relatively stable within individuals. Trait, or dispositional, mindfulness refers to an individual’s general level of mindful tendencies (Brown & Ryan, 2003). (In the

current study the terms trait mindfulness and dispositional mindfulness and used interchangeably). As of 2016, self-report remains the only validated method of assessing mindfulness. As might be expected from the discussion above, conceptualizations of mindfulness vary greatly between self-report measures (Brown et al., 2007; Grossman & Van Dam, 2011). Self-report measures also suffer from the biases and errors common in accessing and assessing subjective experiences (Brown et al., 2007).

The Mindful Attention Awareness Scale (MAAS), used in the current study, focuses on assessing a single factor that captures the degree to which an individual is attentive and aware of his or her experiences or surroundings (e.g., “I tend to walk quickly to get to where I’m going without paying attention to what I experience along the way”). A low mindful state produces habitual, automatic, or injudicious patterns in thought and action (Brown & Ryan, 2003). Compared to Eastern societies where Buddhist practices and concepts may be more common and even permeated in daily vernacular, Western societies such as The Netherlands may have less formal training or informal exposure in mindfulness, thus the MAAS captures individuals’ “natural” (or “untrained”) levels of mindfulness.

The dissertation will use MAAS as a measure of mindfulness in the context of a study of alcohol dependent persons using Ecological Momentary Assessment (to be described later). Figure 2 illustrates the literatures reviewed in this dissertation.

1.5.3.2 Mindfulness as a Predictor Variable

Previous research, reviewed in Szeto (2016), has examined dispositional mindfulness in terms of its ability to predict drinking outcomes (see Table 3 & 4 for review of mindfulness studies that have used the MAAS to study alcohol dependence; see

Fig. 2 for an illustration of pertinent literatures for this dissertation). Table 3 shows that many studies (Pearson, Brown, Bravo, & Witkiewitz, 2015; Shorey, Brasfield, Anderson, & Stuart, 2014; Smith et al., 2011), but not all (Lyvers, Hinton, et al., 2014), have reported that higher scores of MAAS are associated with less drinking or alcohol dependence severity.

Taking another approach, one study examined interactions between trait mindfulness factors, assessed by the Five Facet Mindfulness Questionnaire (FFMQ), on substance abuse (Eisenlohr-Moul, Walsh, Charnigo, Lynam, & Baer, 2012). The FFMQ (Ruth A. Baer et al., 2006) assesses five factors of trait mindfulness: *observing*; *describing*; *acting with awareness*; *non-judging* of inner experience; and *non-reactivity* to inner experience.

In persons recovering from alcohol dependence, those with high trait mindfulness (as assessed by the FFMQ) reported less craving than those with low trait mindfulness (Garland, 2011). Finally, studies that compared alcohol or drug-dependent participants with control participants have generally reported that the clinical group has lower MAAS scores (Table 3). In sum, there is good evidence for a negative association between MAAS scores and drinking behavior i.e., higher MAAS scores are associated with less drinking.

Few studies have examined the association between MAAS and cognitive biases. One study reported that trait mindfulness (assessed using the FFMQ) was negatively associated with alcohol attentional bias (Garland, Boettiger, Gaylord, Chandon, & Howard, 2012). Another study reported no association between trait mindfulness and attentional bias, though this study was conducted in smokers (Vidrine et al., 2009).

Trait mindfulness has been examined in other addictions. Research has reported associations between MAAS scores and nicotine dependence, such that smokers with higher MAAS scores had lower levels of nicotine dependence (Vidrine et al., 2009). In persons undergoing acute detoxification or intensive outpatient treatment for opioid abuse, those with lower levels of dispositional mindfulness used opioids more often to self-medicate negative emotions (Garland, Hanley, Thomas, Knoll, & Ferraro, 2015). In abstinent methamphetamine-dependent persons, childhood maltreatment was positively correlated with at-rest functional connectivity of amygdala and limbic structures, and such connectivity was positively associated with trait mindfulness (Dean, Kohn, Hellemann, & London, 2014).

1.5.3.3 Mindfulness as a Moderator Variable

Trait mindfulness can be examined as a moderator variable. A moderator variable is a variable that alters the strength of the causal relationship between an independent variable and a dependent variable (Baron & Kenny, 1986). For instance, scores on the FFMQ's *observing* sub-scale were negatively associated with substance use for participants with high levels of *non-reactivity* but positively associated for participants with lower levels of *non-reactivity* (Eisenlohr-Moul et al.). Observing seemed to protect against substance use only when one is not reactive, but there has been a failure to replicate this interesting finding (Bowen & Enkema, 2014).

As noted earlier, one hypothesis is that the association between cognitive biases (e.g., attentional and approach bias) and craving/drinking is weaker in individuals with higher levels of mindfulness. In one study, an elevated level of trait-acceptance was indeed found to weaken the association between approach bias and alcohol consumption

(Ostafin et al., 2008). The association between attentional bias and preoccupation with alcohol was attenuated in individuals with a high level of dispositional mindfulness and executive control (Ostafin, Kassman, & Wessel, 2013).

Adams et al. (2015) tested mindfulness as a moderator variable. They reported that mindfulness moderated the association between perceived stress and alcohol use. Stress increased alcohol use in participants with low levels of mindfulness but did not increase alcohol use in participants with high levels of mindfulness. In other words, stress had more “impact” in individuals with low levels of mindfulness. These findings underscore the utility of examining mindfulness as a moderator variable.

For this study, trait mindfulness will be examined as a predictor variable and as a moderator variable. Trait mindfulness will be measured using MAAS for two reasons. First, the MAAS is the most widely used assessment of mindfulness. Second, as noted later, it has been validated in Dutch.

1.5.3.4 Limitations of Contemporary Mindfulness Assessments

From the outset of the recent proliferation in mindfulness research, scholars have continually noted the philosophical and instrumentation challenges to capture an ineffable, multi-dimensional concept (R. A. Baer, 2003, 2010; Bishop et al., 2004; Brown & Ryan, 2004; M. S. Christopher et al., 2009; Crane et al., 2012; Sauer et al., 2013; Shapiro et al., 2006; Wright, Sadlo, & Stew, 2006). It is important to be mindful of the limitations of the science in measuring mindfulness.

Recently, the conceptualization and assessment of mindfulness have been criticized (Grossman, 2008). The nature and context of *sati* pose various challenges to the needs and processes of modern research, especially to those who wish to fully apply the

scientific method (R.A. Baer, 2015; Davis, 2015; Hanley et al., 2016; Joiner, 2017). The challenges are beyond the scope of this dissertation, but a brief review and discussion of select issues are noted here.

Pertinent to this current study, Grossman (2008) argued that paper-and-pencil measures of mindfulness, such as the MAAS, are of questionable validity. He argued that researchers developing mindfulness scales had different understandings and experiences of Buddhist meditative practices and thinking. As recently as late 2015, researchers and practitioners still debated how sciences have translated the Buddhist concept and practice of mindfulness. Grossman (2008) suggested greater emphasis on qualitative assessment and distal outcomes of meditation practice. In a second paper, Grossman (2011) identified various psychometric problems with mindfulness assessment research, such as the absence of any direct measure of mindful behaviors against which to validate measures of mindfulness.

However, despite these criticisms, the measurement science of mindfulness continues to grow rapidly, totaling 13 self-report instruments in 10 years, from MAAS in 2003, FFMQ in 2006, to the Child and Adolescent Mindfulness Measure, and the State Mindfulness Scale. The MAAS and FFMQ are the most widely used trait-measures by among research involving mindfulness. The Toronto Mindfulness Scale, and the Freiburg Mindfulness Inventory, are currently the most suitable measures to assess state-changes of mindfulness before and after an intervention, or to differentiate novice from experienced meditators. To the author's knowledge, as of 2017, mindfulness measures are all self-reports, and they conceptualize mindfulness as either a state or trait, and either

untrained or trained in intentional mindful practices. The current project focuses solely on mindfulness as a self-assessed untrained trait, which is presumed to differ from *sati*.

I.5.4 Mindfulness-based Interventions

As noted earlier, many MBIs have been developed for clinical purposes (Johanson, 2006; Kang & Whittingham, 2010; Khong, 2003; Kumar, 2002; McWilliams, 2012; Nilsson, 2014; O'Driscoll, 2009; C. J. Robins, 2002; Shonin, Van Gordon, & Griffiths, 2013, 2014a). MBIs may increase mindfulness in various populations. A number of evidence-based therapies use mindfulness as a primary technique. In particular, Chiesa & Serretti (2014) systematically reviewed MBIs in substance use and hazardous drinking that were published before December 2011. Compared to controls (waitlist, non-specific educational support groups, or specific controls), MBIs reduced more consumption of substances ranging from alcohol, cocaine, amphetamines, marijuana, cigarettes, to opiates (Chiesa & Serretti, 2014). As a whole, preliminary evidence also suggest that MBIs increase mindfulness and decrease craving (Chiesa & Serretti, 2014).

For example, Mindfulness-based Stress Reduction (MBSR), Acceptance and Commitment Therapy (ACT), and Dialectical Behavior Therapy (DBT) target the ability to regulate stress, emotions, and automatic tendencies (Hayes, Masuda, Bissett, Luoma, & Guerrero, 2004; Linehan et al., 1999). As reported in Szeto (2016), both “DBT and ACT have strong clinical evidence to support their effectiveness to treat symptoms related to mood (Feldman, Harley, Kerrigan, Jacobo, & Fava, 2009; Harley, Sprich, Safren, Jacobo, & Fava, 2008; Hayes et al., 2004; T. Lynch, Chapman, Rosenthal, Kuo, & Linehan, 2006; T. R. Lynch, Morse, Mendelson, & Robins, 2003), anxiety (Panos,

Jackson, Hasan, & Panos, 2014; Sarris et al., 2012; Swain, Hancock, Hainsworth, & Bowman, 2013), trauma (Bohus et al., 2013; Bohus, Dyer, Priebe, Kruger, & Steil, 2011; Steil, Dyer, Priebe, Kleindienst, & Bohus, 2011), personality disorders (T. R. Lynch et al., 2007), eating disorders (Juarascio, Forman, & Herbert, 2010), and substance abuse (De Groot, Morrens, & Dom, 2014; Lanza, Garcia, Lamelas, & Gonzalez-Menendez, 2014; Linehan et al., 1999; Luoma, Kohlenberg, Hayes, & Fletcher, 2012).”

More recently, research in substance abuse has shown that mindfulness-based modalities, such as Mindfulness-based Cognitive Therapy (MBCT), Mindfulness-based Relapse Prevention (MBRP), and Mindfulness-oriented Recovery Enhancement (MORE), are efficacious. MBRP aims to “foster increased awareness of triggers, destructive habitual patterns, and “automatic” reactions (Witkiewitz & Bowen, 2010; Witkiewitz, Marlatt, & Walker, 2005). MBRP, and its treatment components, has been effective in improving short- and long-term outcomes in craving/drug use (Bowen et al., 2006; Ostafin et al., 2006; Ostafin & Marlatt, 2008; Witkiewitz, Bowen, Douglas, & Hsu, 2013; Witkiewitz et al., 2005).

MBCT was originally developed to prevent relapse of depressive disorders (Bieling et al., 2012; Dimidjian et al., 2015; Rycroft-Malone et al., 2014; Teasdale et al., 2000), and MBCT may also be effective in treating co-occurring depression and substance abuse (Hoppes, 2006; Hosseinzadeh Asl & Barahmand, 2014). Additionally, MORE enhanced impulse control and self-awareness in alcohol dependence (Garland, Schwarz, Kelly, Whitt, & Howard, 2012). For persons with co-occurring chronic pain and opioid abuse, MORE led to decreased self-reported pain severity, decreased

functional interference in daily activities, and decreased craving for opioids (Garland, 2014; Garland & Howard, 2013).

I.5.5 Mechanisms of Mindfulness

The mechanisms linking mindfulness and addiction have not been widely examined. Nonetheless, candidate mechanisms can be proposed. For example, mindfulness may decrease craving or use by promoting a decentered perspective. Decentering is considered a component of mindfulness (Shapiro et al., 2006) and can be defined as “watching one’s thoughts and emotions in a non-judgmental way, or non-attachment to one’s thoughts, feelings, and emotions” (Fresco et al., 2007).

A multiple mediation analysis examined the mediators of the association between trait mindfulness and nicotine dependence (Ruscio, 2012). In addition to perceived stress, negative affect, and positive affect, a decentered perspective was administered using a depression IAT task (see Ruscio, 2012 for details). Both positive affect and decentering partially mediated the association between MAAS scores and dependence (Ruscio, 2012). Recent neurobiological studies of dispositional mindfulness reported that more mindful individuals exhibited elevated prefrontal activation and reduced amygdala activation during affect labeling tasks (Way, Creswell, Eisenberger, & Lieberman, 2010). The observed activity may be a brain mechanism of a decentered perspective.

Pertinent to the current dissertation, mindfulness may also reduce craving or use by reducing stress or negative affect. Adams et al. (2015) recently reported that the association between MAAS score and the likelihood of an AUD was mediated by perceived stress. That is, higher levels of mindfulness were associated with lower levels of perceived stress which in turn was associated with a lower likelihood of an AUD. As

noted earlier, and particularly relevant to the current dissertation, Adams et al. (2015) also tested mindfulness as a moderator. To recap, they reported that mindfulness moderated the association between perceived stress and alcohol use.

There is limited evidence that mindfulness may reduce cognitive biases. Garland et al. (2011) examined the relationship between mindfulness and attentional bias in alcohol dependent individuals. They reported that individuals with MAAS scores exhibited less attentional bias to alcohol cues. That is, more mindful individuals disengaged attention from alcohol cues more readily than less mindful individuals. Moreover, the heart rate (HR) and high-frequency heart rate variability (HFHRV) of participants was also assessed using a stress paradigm. The authors reported that those with higher MAAS scores exhibited greater HR and HFHRV recovery and that this association was partially mediated by attentional bias.

Finally, and not directly relevant for this study, research has examined the neurobiological and neurophysiological mechanisms underlying mindfulness (Chiesa, Calati, & Serretti, 2011; Chiesa & Serretti, 2010; Tang, Holzel, & Posner, 2016). Such meta-analyses and systematic reviews have concluded that the underlying neural mechanisms have remained unclear. Further research is needed using larger sample sizes, more detailed reports of procedures, and manipulation checks.

I.6 CONCEPTUAL MODEL

To capture the preceding material, a conceptual model for the study was developed (see Fig. 3). As shown in Figure 3, trait mindfulness was examined both as a predictor variable and as a moderator variable. According to this model, mindfulness may be protective in two ways. First, mindfulness may reduce drinking by reducing

stress/negative affect or cognitive biases that are themselves related to craving and drinking. Second, mindfulness may reduce reactivity to stress/negative affect when it does occur. Similarly, mindfulness may reduce the impact of cognitive biases and craving when they occur.

In sum, the main idea is as follows: More mindful individuals may be less likely to experience stress/negative affect and have cognitive biases in the first place, and if they do occur, their impact may be diminished in these individuals.

Mindfulness is assumed to involve many mechanisms, and the mediators assessed in this study are likely not exhaustive. For example, decentering is not included as a mediator. If it is true that the study does not include all “true” mediators, these pathways will show up as “direct” paths in our models (because they are not mediated). In this case, we would expect to observe direct paths from mindfulness to craving and drinking. Similarly, we would expect to observe a direct path between the mediators (stress/NA and cognitive biases) to drinking if there are pathways between these variables that are unmediated by craving.

The next section introduces the EMA methodology undertaken to investigate the conceptual model.

I.7 ECOLOGICAL MOMENTARY ASSESSMENT

Most research on the psychological processes involved in relapse and mindfulness has used assessments administered in the laboratory. Recently, researchers have used EMA to study both alcohol relapse (see Table 5 for review of studies, Szeto (2016)) and mindfulness (Brown & Ryan, 2003). EMA is the method of assessing phenomena at the moment they occur, or in the relatively recent past, in the participant’s natural

environment. Different types of assessments can be used. Assessments can be completed at random times each day (“random assessments”; RAs). Alternatively, assessments can be initiated by the participant. For example, participants can be asked to complete an assessment when they experience a heightened emotional or motivational state (e.g., a temptation to drink). In studies of addiction, a participant can also be asked to self-initiate an assessment immediately after smoking or drinking.

The emergence of mobile devices such as personal digital assistants (PDAs) and smartphones has made it easier to conduct EMA studies. Mobile devices can be programmed to prompt the participants at random times each day through sound and/or vibration. It is easy to monitor compliance using mobile devices (Stone, Shiffman, Schwartz, Broderick, & Hufford, 2003). Cognitive tasks, including the tasks reviewed earlier, can be administered on a PDA or smartphone (Shiffman, Paty, Gyns, Kassel, & Hickcox, 1996; A. J. Waters & Li, 2008; A. J. Waters, Marhe, & Franken, 2012; A. J. Waters, Miller, & Li, 2010). EMA studies of substance use yield highly detailed data over time for each individual (e.g., Epstein et al., 2009; A. J. Waters et al., 2004). For the study of alcohol dependence, EMA yields detailed data on participants’ mood, craving, and use in the natural environment (Cohn, Hunter-Reel, Hagman, & Mitchell, 2011; Freisthler, Lipperman-Kreda, Bersamin, & Gruenewald, 2014; Heron & Smyth, 2010; Morgenstern, Kuerbis, & Muench, 2014; Shiffman, 2009; Vahabzadeh, Lin, Mezghanni, Epstein, & Preston, 2009; Wray, Merrill, & Monti, 2014).

I.7.1 EMA in High Risk Drinking Research

As of late 2015, there were over 20 alcohol studies involving high risk drinkers that used EMA (see Table 5, reviewed in Szeto (2016)). As noted by Szeto (2016), this is

a relatively small number compared to over 60 EMA studies that examined cigarette smoking. The reasons for this difference are not clear. Szeto (2016) noted that it is possible that the acute effects of alcohol may reduce feasibility of EMA in high risk drinking populations. Moreover, very few EMA studies have been conducted in alcohol dependent populations. In fact, only two have used both participant-initiated assessments and random assessments (Cooney et al., 2007; Litt, Cooney, & Morse, 1998). No previous EMA study of alcohol dependent participants has used both random assessments and temptation assessments using a mobile device. Similarly, no EMA studies have used cognitive assessments. Furthermore, no EMA protocol of alcohol dependent participants has been of 4 weeks duration (the duration of the current study). The EMA protocol in Litt et al. (1998) was 14 days in duration and in Cooney et al. (2007) it was 21 days.

I.7.2 Compliance of Responses in-Field

As just noted, and as discussed by Szeto (2016), one may question whether EMA is a feasible methodology in alcohol dependent individuals over a 4-week duration. A number of indices of feasibility can be computed. One index is compliance on RAs, defined as the proportion of RAs that the participant has the opportunity to complete that are actually completed by that participant. If average compliance is low, the statistical power of the study and the generalizability of study findings are decreased. A review of the literature (see Table 6, not reported in Szeto (2016)) produced 23 EMA studies that recruited high risk drinkers. Of the 23 studies, RAs were administered in 12 (Table 6). Of the 12 studies, measures of compliance on RAs were reported in 11 studies (Collins et al., 1998; Cooney et al., 2007; Dvorak et al., 2014; Holt, Litt, & Cooney, 2012; Krahn et al., 2005; Litt et al., 1998, 2000; Ray, Miranda, et al., 2010; Tidey et al., 2008; Todd et

al., 2005; Witkiewitz et al., 2014). The median level of compliance in these 11 studies was 80%, and 9 of the 11 studies reported RA compliance >70%.

As reported in Szeto (2016), few studies have examined changes in compliance over time in alcohol dependence (Table 6). Holt et al. (2012) reported that compliance on RAs did not decline significantly over time for either lapsers or non-lapsers. Similarly, Serre et al. (2015) reported that compliance on assessments administered at fixed times each day did not significantly decline over time. Litt et al. (2000) investigated the effects of alcohol use/relapse on compliance in an EMA protocol. They reported that 19 of 26 participants lapsed, of which 3 were “non-compliant,” defined as responding to less than 50% of RAs for the three days after the first reported lapse during EMA. The other participants were determined to be compliant. In sum, there is little evidence that compliance significantly decreases over time. However, it should be noted that most studies have not reported whether compliance is reduced over time. Most pertinent to the current study, in a pilot study using a subset of the dataset used in the current study, Szeto (2016) examined compliance in eleven participants (the first 11 participants). This pilot study is described later in the preliminary study section.

It is important to note that, as stated above, EMA protocols often ask users to self-initiate assessments based on pre-specified conditions, for instance, “start a Temptation Assessment (TA) when you feel tempted to drink”. The data are then interpreted as an estimate of both how frequently people experience temptation episodes, and as representative of experience during temptation episodes. However, reports of participant-initiated assessments are difficult to validate. The number of times that participants felt consciously felt tempted, but elected not to enter a TA, is not known. Therefore, the

extent to which the number of TAs reported during EMA reflects the “true” number of temptation episodes is not known. In addition, the extent to which self-reported TAs in the field are representative of tempted moments is not known.

Another issue is whether the participation in EMA changes the value of variables being assessed (known as “reactivity” in the EMA literature). For example, it could be that responding to multiple assessments per day either increases or decreases craving and drinking. Litt et al. (1998) compared drinking levels of participants who completed an EMA protocol with those who did not. There was no difference in the drinking levels of the two groups. The author is not aware of any study that has investigated reactivity in alcohol use using an experimental design.

1.7.3 EMA Studies of High-Risk Individuals

As shown in Table 5, EMA has been used for a number of different purposes in this population. For example, studies have used EMA to examine the effects of drinking (Huntley et al., 2015), capture drinking phenotypes in behavioral genetic studies (Ray, Mackillop, & Monti, 2010), and to evaluate the effects of interventions, to include pharmacotherapy (J. M. Mitchell, Grossman, Coker, & Messing, 2012) and mobile interventions (Witkiewitz et al., 2014).

Most pertinent to the current dissertation, EMA has been used to examine relapse process (see studies with bolded entries in Table 5). Some studies (Fatseas et al., 2015; Litt et al., 2000) have reported associations between craving and drinking. For example, Litt et al. (2000) reported that the mean urge ratings during EMA were positively correlated with proportion of drinking-days. However, not all studies reported significant associations between craving and drinking (Cooney et al., 2007; Holt et al., 2012). Todd

et al. (2009) reported an association between negative affect and drinking. Negative affect assessed in the morning predicted time to first drink later the same day.

I.7.4 EMA Studies of Mindfulness

As described by Szeto (2016), a few studies have used EMA to study mindfulness. In the initial development of the MAAS, Brown and Ryan (2003) used EMA in two samples of college students. The study used pagers that alerted participants at quasi-random times each day. Participants were also required to carry a small note pad to record mindful behaviors at the moment when the pagers alerted them (Brown & Ryan, 2003). The main finding was that MAAS scores were associated with positive emotional states during EMA. Other EMA studies have reported that mindfulness was associated with increased self-reported inner peace (Liu et al., 2013), improved global emotional tone (Garland, Fredrickson, et al., 2010), and decreased emotional lability (Hill & Updegraff, 2012)

The studies reviewed above used EMA to study dispositional mindfulness. As described by Szeto (2016), other studies have used EMA to study MBIs. Ruscio and colleagues (2015) reported that brief mindfulness-based practice administered on a PDA reduced negative affect and craving assessed during EMA, and increased state (but not trait) mindfulness assessed, in smokers not seeking to quit (Ruscio et al., 2016). Mitchell and colleagues (2013) reported that an 8-week group-based mindfulness treatment improved self-reported emotion dysregulation in adults with Attention Deficit/Hyperactivity Disorder (ADHD). An EMA study found that MBCT led to enhanced responsiveness to pleasant daily-life activities, independent of decreased depression, in adults with a history of depression (Geschwind, Peeters, Drukker, van Os,

& Wichers, 2011). Another EMA study reported that MBCT's effect on positive affect was moderated by single-nucleotide polymorphisms underlying brain-derived neurotrophic factor (BDNF) (Bakker et al., 2014).

In sum, EMA has been used both to study mindfulness and alcohol dependence. The next section describes a preliminary study that used EMA to study both mindfulness and alcohol dependence in the same study.

I.8 STUDY RATIONALE AND SPECIFIC AIMS

I.8.1 Preliminary Studies

In a pilot EMA study reported by Szeto (2016), Dutch alcohol dependent patients ($n=11$) carried around a personal digital assistant for 4 weeks as they went about their daily lives while trying to maintain abstinence. The 11 participants were a subset of the participants examined in the dissertation study. Participants completed assessments at random times three times each day, and when they felt “a strong urge to drink or came to the brink of drinking without doing so”. At each assessment, stress, negative affect, “tempted now” ratings, recent drinking, and attentional or approach bias were assessed. Participants completed 70.2% of RAs, and compliance did not significantly decline over the study period. MAAS was significantly associated with tempted now. MAAS also moderated the association between tempted now and drinking, such that the association, present in low MAAS participants, was absent in high MAAS.

I.8.2 Study Rationale

To summarize, hazardous drinking has remained a significant public health and economic problem worldwide. Relapse rates for treatment of alcohol dependence remain high, and new treatment approaches are required.

A better understanding of the psychological processes underpinning relapse to alcohol may help to improve interventions. EMA has been extensively used to study relapse in other addictions, and cognitive tasks may be especially useful for assessing automatic processes underlying drug use. However, few studies have used EMA to study alcohol dependent populations.

Low dispositional mindfulness is a possible risk factor for dependence and relapse in addiction. However, the mechanisms of trait mindfulness have been little investigated in alcohol dependence, and no study has used EMA to investigate these mechanisms. The current study had three specific aims. The first aim examined whether trait mindfulness was associated with ratings of temptation to drink (termed “tempted now” ratings) and drinking. This aim therefore examined trait mindfulness as a predictor variable. The second aim examined the mediators linking trait mindfulness (the predictor variable) and tempted now/drinking (outcome variables). The third aim examined trait mindfulness as a moderator variable.

The specific aims and hypotheses were as follows:

Specific Aim 1: To examine whether trait mindfulness, assessed by the MAAS at the baseline visit, is associated with tempted now ratings and drinking alcohol assessed during EMA.

Hypothesis 1.1: More mindful individuals will report lower tempted now ratings during EMA.

Hypothesis 1.2: More mindful individuals will report less drinking during EMA

Specific Aim 2: To examine possible mediators of the effect of trait mindfulness (assessed using the MAAS) on tempted now ratings and drinking alcohol assessed during EMA

Hypothesis 2.1: More mindful individuals will report less stress/negative affect assessed during EMA which in turn will be associated with lower tempted now ratings and drinking alcohol assessed during EMA

Hypothesis 2.2: More mindful individuals will report lower attentional and approach biases assessed during EMA (alcohol Stroop task and IAT) which in turn will be associated with lower tempted now ratings and drinking alcohol assessed during EMA

Specific Aim 3: To examine trait mindfulness, assessed by the MAAS, as a moderator variable. Specifically, high trait mindfulness is expected to weaken the relationship between 1) stress/negative affect and tempted now, 2) cognitive biases and tempted now, and 3) tempted now and drinking.

Hypothesis 3.1: The association between stress/negative affect and tempted now ratings, assessed during EMA, will be weaker in participants with higher (vs. lower) trait mindfulness.

Hypothesis 3.2: The association between cognitive biases (assessed using the alcohol Stroop task and IAT) and tempted now ratings, assessed during EMA, will be weaker in participants with higher (vs. lower) trait mindfulness.

Hypothesis 3.3: The association between tempted now ratings and drinking, assessed during EMA, will be weaker in participants with higher (vs. lower) trait mindfulness.

CHAPTER II: METHOD

II.1 PARTICIPANTS

This study is a secondary analysis of data from a study that examined relapse in Dutch alcoholics undergoing treatment. Participants were 43 Dutch outpatients recruited at three sites of an addiction treatment facility in the Netherlands. As reported by Szeto (2016), the patients completed a 6-week residential addiction treatment. They were the screened and referred to the study by the treatment staff (e.g., nurses and psychiatrists). The inclusion criteria were: (a) at least 18 years old; (b) a diagnosis of alcohol dependence (current) as defined in the Diagnostic and Statistical Manual of Mental Disorders–Fourth Edition (DSM-IV; American Psychiatric Association, 2000) and Section J of the Composite International Diagnostic Interview (Dutch Version) (CIDI; L. N. Robins et al., 1988); (c) a literacy level of 8th grade level; and (d) reporting being abstinent for at least two weeks before the first study visit of the parent study (described later). The exclusion criteria were: (a) diagnosis with an Axis II disorder according to the DSM-IV; (b) diagnosis with a disorder in the psychotic spectrum; or (c) regular use of other addictive substances (except nicotine).

II.2 PROCEDURE

As noted above, and as described by Szeto (2016), this study was part of a larger parent study examining relapse (Figure 4). In the parent study, participants ($n = 59$) were recruited from three sites (Leiden, Zoetermeer, Hoofddorp) of a Dutch addiction treatment facility. Recruitment occurred in an outpatient detoxification program. In the six-week parent study, participants were scheduled to attend two group therapy sessions per week, in addition to pharmacotherapy. The group sessions used cognitive behavioral

therapy and motivational interviewing techniques. After the six-week program, patients either continued with group therapy or started an individual treatment program, and some participants elected to discontinue treatment. Individual and group therapy was comprised of a combination of cognitive behavioral therapy and motivational interviewing. Choice for group or individual therapy was determined by the participant after consultation with their counselor. In addition, with respect to pharmacotherapy, participants used disulfiram ($n=8$), acamprosate ($n=6$), naltrexone ($n=2$), or no medication ($n=27$).

As noted earlier, participants were required to be abstinent for a minimum of 2 weeks to be eligible for enrollment in the parent study. Subsequent to enrollment, the treatment goals could be modified, such that controlled drinking could be permitted. In the current study, 41 of the 43 participants were trying to maintain complete abstinence during the study period, and 2 were allowed to engage in controlled drinking.

Participants who were close to finishing their treatment were given the opportunity to volunteer for the EMA study. At the orientation visit for the EMA study, eligible participants first completed post-treatment assessments for the parent study. Participants also completed baseline assessments for the EMA study, which included the MAAS (Fig. 4). The researcher also trained the participant on how to use the personal digital assistant (PDA, model HP1920), and completed a practice assessment.

After the orientation session, the EMA study was initiated, which could last up to 4 weeks (Fig. 4). The PDA was programmed to signal the participants (with an audible beep) three times a day at random times (random assessment; RA). Participants were also instructed to complete a participant-initiated assessment whenever they experienced a

temptation, defined as “an acute increase in the urge to drink or an occasion when they felt that they came to the brink of drinking without actually doing so” (temptation assessment; TA).

At each assessment (RA or TA), participants completed items which assessed subjective variables (e.g., mood and craving) and drinking. After completing these items, participants completed either an alcohol Stroop task or an alcohol approach-avoidance IAT (described later). The current study does not report the effect of assessment type (TA vs. RA) on subjective or cognitive variable, which has been addressed elsewhere (Snelleman et al., under review).

As noted earlier, the PDA was programmed to present 3 RAs per day. RAs were presented between a “wake-up time” and a “bed-time”. The wake-up and bed times could be changed by the participant at any time. Participants could prevent the device from presenting RAs (e.g., if they had a meeting to attend) by pressing a “suspend” button on the PDA. RAs that were scheduled during a “suspend” were not presented by the PDA. RAs could also be lost if the bed-time was changed to an earlier time during the day. Finally, if the power on the PDA was low, or if the program malfunctioned, RAs were not presented.

During the EMA study, the researcher retrieved the data every week by during in-person visits with the participants (Fig. 4), and checked compliance with the protocol. In addition, the researcher asked the participants whether they had consumed any alcohol during the preceding week. When a participant indicated he or she had consumed alcohol, the researcher probed further and enquired when and in what quantities the participant had consumed alcohol. Participants were told they could continue in the study if they had

relapsed, which would lessen the incentive to misrepresent drinking behavior. After four weeks participants returned the PDA to the research and received compensation for their participation (€ 4.45 per day, max € 125). The study was approved by the Medical Ethical Committee of the Erasmus Medical Center, Rotterdam, The Netherlands. The study registration number was MEC-2012-346. Analyses reported in this dissertation were approved by the USUHS IRB (T0-MPS-72-9038-01).

II.3 MEASURES

II.3.1 Laboratory Assessment

Trait mindfulness. The Mindful Attention Awareness Scale (MAAS) is a self-report survey with 15 items that assessed trait mindfulness (Brown & Ryan, 2003). Each item was assessed on a 6-point (1-6) Likert scale. The MAAS has been validated and normed in both non-clinical and clinical samples, with a 1-factor structure. Cronbach's *alpha* have ranged from .80 to .90 (Brown & Ryan, 2003; Carlson & Brown, 2005). Evidence suggest that the MAAS is an appropriate measure of "...[the] attention, informed by a sensitive awareness of what is occurring in the present, simply observes what is taking place" (Brown & Ryan, 2003).

The MAAS has been translated into Dutch (MAAS-D), and the MAAS-D exhibits good reliability (*alpha* ranging from .81 to .87), and also has a one-factor structure (Schroevers, Nykliček, & Topman, 2008).

II.3.2 EMA Assessments

II.3.2.1 Stress, Negative Affect, & Temptation

Stress was assessed using a single item: “I feel stressed right now” (Stressed Now). Participants indicated whether they agreed with this statement on a 7-point scale (1=not at all to 7=extremely).

The International Positive Affect & Negative Affect - Short Form (I-PANAS-SF) (Karim et al., 2011; Thompson, 2007) is a 10-item assessment consisting of five negative (I-PANAS-SF-NA) and five positive (I-PANAS-SF-PA) affective states. Participants indicated whether they agreed with a statement (e.g. “I feel upset right now”) on a 5-point scale (1=not at all to 5=extremely). In the current dataset, Cronbach’s alpha was good for both I-PANAS-SF-PA ($\alpha = .90$) and I-PANAS-NA ($\alpha = .89$). Only I-PANAS-SF-NA was examined in the current study.

One item assessed participants’ current temptation to drink on a 7-point Likert scale: “I feel tempted to drink right now” (“Tempted Now”). Participants indicated to what degree they agreed with this statement on a 7-point scale (1=not at all to 7=very much). Craving was assessed using the item “I feel the urge to drink right now” (Craving) on a 7-point scale (1=not at all to 7=very much). Responses to Tempted Now ($M = 1.77$, $SD = 1.50$) and Craving ($M = 1.78$, $SD = 1.50$) were highly correlated ($r = .91$). The current dissertation will report results from Tempted Now.

II.3.2.2 Drinking

An item (“Drinking”) assessed number of drinks consumed since the previous assessment using the following 5-point scale: 1=no drinks; 2=1-2 glasses; 3=3-4 glasses; 4=5-6 glasses; 5=7 or more glasses. This item served as the primary drinking variable in the study.

Reports of binge drinking during EMA (defined as an alcohol consumption of 5 or more standard glasses (males) or 3 or more standard glasses (females) since the previous EMA assessment) were corroborated by reports at the weekly laboratory assessments. One participant reported a binge at a weekly laboratory assessment but not on a previous EMA assessment. A second participant reported a binge during EMA but not at one of the four laboratory assessments. These binge drinking reports were subsequently verified by participants. Overall, 16 participants were designated as having reported drinking during the study (this includes the two controlled drinkers) and 27 were designated as abstainers (described in more detail later). Both controlled drinkers reported that they drank 2-3 days per week, and consumed a maximum of three glasses during these days.

II.3.2.3 Cognitive Assessments

The Alcohol Stroop task assesses the degree to which a person's attention is captured by alcohol cues, which, as noted earlier, is termed an "attentional bias" to alcohol cues (Cox, Fadardi, & Pothos, 2006). When completing the alcohol Stroop task on the PDA, a participant was presented with words in different colors. The participant was required to respond by pressing one of three button on the PDA that corresponded to the color of the word (see A. J. Waters et al., 2012). He or she was instructed to respond as rapidly as possible to the color, and to ignore the meaning of the word. During each alcohol Stroop task, the participant completed a block of neutral words (33) and a block of alcohol words (33). On half the alcohol Stroop assessments, the neutral block preceded the alcohol block, and on the other half the alcohol block preceded the neutral block. As

reported in Szeto (2016), the Dutch words (neutral and alcohol) are listed in Table 7 with their English translation.

The Stroop task was scored as the median RT on alcohol words minus median RT on neutral words. This difference score is termed the alcohol Stroop effect. A positive difference score reflects slower responses on alcohol words than on neutral words, which indicates an attentional bias to alcohol words.

Previous research has shown that the drug Stroop effect has adequate internal reliability when assessed during EMA on a PDA. Using a split-half reliability measure (odd and even trials), the estimated internal reliabilities of the heroin and cocaine Stroop effects in heroin dependent participants (who also used cocaine) were $r = .72$ and $r = .68$ respectively (A. J. Waters et al., 2012). In the current dataset, the estimated internal reliability of the alcohol Stroop effect, computed using a split-half approach (odd and even trials), was $r = .62$.

The Approach-Avoidance Implicit Association Test (AA-IAT) is a computerized task that assesses the degree to which a person associates drug cues with the concept of approach. Participants were presented with words from four different categories, in this case: ALCOHOL, non-alcohol (NEUTRAL), approach, avoid. The Dutch stimulus words are listed in Table 8 with their English translation, as reported in Szeto (2016). All ALCOHOL and NEUTRAL words were presented in capital letters, whereas all approach and avoid words were presented in lower-case.

The AA-IAT involves two tasks. In Task 1, a participant is required to respond quickly by pressing a certain PDA key for items (words) relating to two concepts (e.g., ALCOHOL + approach), and with a second (different) PDA key for items (words) from

two other concepts (e.g., NEUTRAL + avoid). In Task 2, the assignment of one concept was switched such that “NEUTRAL” + “approach” shared the same key-response, and “ALCOHOL” + “avoid” shared the other response. The idea underlying the IAT is that it is easier to perform the IAT when the two concepts are strongly associated in memory than when the two concepts are unrelated (De Houwer, 2002). The IAT effect is the difference in response times (RTs) on Task 1 vs. Task 2. It can be interpreted as an index of the relative strength of mental associations. As described in Szeto (2016), “In the example above, it indicates whether associations are stronger between ALCOHOL and approach, and NEUTRAL and avoid, than between NEUTRAL and approach, and Alcohol and avoid. Higher (more positive) scores (i.e., faster responses when ALCOHOL is paired with “approach” compared to when ALCOHOL is paired with “avoid”) are interpreted as indicating an approach bias.”

On each trial, a stimulus (word) was presented on the PDA screen (in the center of the screen). Labels were on the top left and top right of the screen to remind the participant of the categories assigned to each key for the current task (Task 1 or Task 2). A participant was instructed to categorize each stimulus (word) into the appropriate category by pressing an “L” or “R” key on the PDA as quickly and as accurately as possible. If the participant responded correctly, the program presented the next trial, with a 150 ms interval between trials. If the participant made an error (pressed the wrong key), an “X” written in red appeared below the stimulus (word) until the participant responded correctly. The participant was instructed to correct his or her errors as quickly as possible.

At each AA-IAT assessment, participants completed two blocks of Task 1 and two blocks of Task 2 (see Waters et al. 2012). The AA-IAT was scored using the

algorithm described by Greenwald et al. (2003) to derive the IAT effect (“D score”). The scoring algorithm divides the difference score (difference in reaction times on Task 1 and 2) by the pooled standard deviation of response times of all trials from Tasks 1 and 2. The algorithm also eliminated assessments with RTs < 300 ms on more than 10% of the trials. In addition, trials with RT > 10,000 ms were excluded, and RTs on incorrect responses were replaced by the mean RT from the correct responses of the block, plus 600 ms (Greenwald et al., 2003).

Using a split-half reliability measure (IAT effect computed from blocks 1 & 3 vs. IAT effect computed from blocks 2 & 4) and the Spearman-Brown correction, the estimated internal reliabilities of heroin and cocaine IAT effects (D scores) in heroin dependent participants (who also used cocaine) assessed during EMA were $r = .72$ and $r = .77$ respectively (Waters et al, 2012). In the current dataset, the estimate internal reliability of the IAT effect (D score) was $r = .76$.

II.4 ANALYSIS PLAN

Linear Mixed Models (LMMs) were used to analyze all Specific Aims. SAS PROC MIXED was used for continuous outcomes assumed to be normally distributed in the population (conditional on model covariates), and SAS PROC GLIMMIX was used for binary, ordinal, or non-normal outcomes. LMM is commonly used to analyze EMA data, because LMMs can handle the fact that 1) assessments are nested within participants (i.e., data are clustered by participant), and 2) that participants have different numbers of assessments (Schwartz & Stone, 2007). Each LMM used a random intercept, and, for the R matrix, an autoregressive model of order 1 for the residuals within subjects

(continuous outcomes). All LMMs included Day of study (continuous variable) and Assessment Type (TA vs. RA) as level 1 covariates. For all models, the parameter estimate provides an (unstandardized) measure of effect size. All tests used $\alpha = .05$, and were 2-tailed.

II.4.1 Specific Aim 1

To test MAAS as a predictor variable (Specific Aim 1), MAAS was entered as an independent variable into a LMM. A significant parameter estimate for MAAS would reveal that it is associated with the outcome variable (Tempted Now or Drinking).

As noted, this analysis is conducted on multilevel data. Mindfulness is assessed at the upper level (level 2) because each participant has a sole MAAS score (assessed at baseline) (see Fig. 4). However, all EMA assessments are assessed at the lower level, level 1. Using the terminology of Preacher et al. (2010), an association between a level 2 variable (MAAS) and a level 1 variable (Tempted Now or Drinking) (“2→1”) must be solely a between-subject effect. For example, individuals with higher MAAS scores (more mindful individuals) may generally report lower Tempted Now ratings. The association cannot be a within-subject effect because there is no variation in MAAS scores across assessments within individuals.

II.4.2 Specific Aim 2

Figure 5 shows the model for testing mediation. Baron and Kenny’s causal steps (Baron & Kenny, 1986; Fritz & MacKinnon, 2007; D. MacKinnon, Fairchild, & Fritz, 2007) will be applied to multilevel data following the approach described by MacKinnon (2008). By convention, the “a path” represents the relationship between an independent variable (X) and a mediator (M), the “b path” represents the relationship between M and

the dependent variable (Y), and the “c’ path” represents the relationship between X and Y when controlling for M. The “c path” represents the total effect of X on Y. The equations for the multilevel models shown in Figure 5 are presented in Appendix A.

Focusing first on Tempted Now (Figure 5, upper graph), mediation at $\alpha = .05$ will be indicated if: a) the effect of MAAS (X) on a mediator (M) (Stress, Negative Affect, Stroop, IAT, or Tempted Now) is significant (using LMM) (a path); and b) the effect of a mediator on Tempted Now/Drinking is significant when controlling for MAAS (X) (b path). Complete mediation would be revealed if the effect of MAAS (c’ path) is reduced to non-significance in this model. Partial mediation would be revealed if the c’ path remained significant in this model. The magnitude of the “indirect effect” (the path from X to Y through M) can be computed by multiplying the parameter estimate for the a path by the parameter estimate for the b path. By convention, this indirect effect is denoted as “a.b”, with the period denoting “multiplication”. The significance of this indirect effect can be tested by dividing the indirect effect by its standard error (equation 3.6 in D. P. MacKinnon, 2008). Note that the total effect of X on Y (“c path”) is partitioned into an indirect effect (a.b) and a direct effect (c’). Figure 6 illustrates this partitioning with the use of Venn diagram notation.

Using the terminology of Bauer et al. (2006) and Preacher et al. (2010), the mediation model for Tempted Now (Fig. 5, upper model) constitutes a “2→1→1” model. An association between MAAS and a mediator has to be a between-subject effect. However, an association between two level 1 variables can reflect a between-subject effect and/or a within-subject effect (Preacher et al., 2010). For example, Stress and Tempted Now (b path) may be associated because individuals who report generally high

levels of stress report generally higher Tempted Now ratings (a between-subject association). Additionally, Stress and Tempted Now (b path) may be associated because individuals tend to report higher Tempted Now ratings when they feel more stressed than usual (a within-subject association).

The parameter estimate from mixed models between two level 1 variables combines (or “conflates” Preacher et al., 2010) the between- and within-subject effects into a single value. Therefore, we ran a model that includes subjects’ mean mediator (e.g., stress) score (a level 2 variable, *Mean Stress*) as well as a difference score (a level 1 variable) between the observed stress score at each assessment and the mean stress score (*Deviation Stress*) (Hedeker & Gibbons, 2006; Hedeker, Mermelstein, Berbaum, & Campbell, 2009). A significant effect for *Mean Stress* would indicate a between-subject effect. That is, individuals who report generally more stress generally report higher Tempted Now ratings during EMA. A significant effect for the deviation score (*Deviation Stress*) would reveal a within-subject effect. That is, individuals were more likely to report higher Tempted Now ratings when they felt more stressed than usual. As stressed by Preacher et al., in a “2→1→1” model mediation *has* to be a between-subject effect (because MAAS is a level 2 variable). Therefore, the appropriate parameter estimate for the b path is that for the between-subject effect (*Mean Stress*).

For conceptual simplicity, each mediator (Stress, Negative Affect, Stroop, IAT) is tested in a separate model. Note that the Stroop and IAT are each administered at every other assessment (Stress and Negative Affect are administered at every assessment). Stress and Negative Affect will be considered as separate mediators (rather than

combined into a single latent variable) in part because they were treated as such in the parent study (Snelleman et al., under review).

For Drinking (Fig 5, lower graph) we will use LMM to estimate all six paths. For this multiple mediator model, the total effect ($X \rightarrow Y$) can be decomposed into the three mediation (indirect) pathways and the direct effect ($c1'$). The three possible indirect effects are: $a1.a3.b2$, (e.g., $MAAS \rightarrow Stress \rightarrow Tempted\ Now \rightarrow Drinking$); $a1.b1$ (e.g., $MAAS \rightarrow Stress \rightarrow Drinking$); and $a2.b2$ (e.g., $MAAS \rightarrow Tempted\ Now \rightarrow Drinking$). This partitioning of the total effect into three indirect effects and the direct effect is illustrated in Figure 6 using Venn diagrams. Mediation in any pathway will be observed if all paths in a given pathway are significant. As with Tempted Now, the appropriate parameter estimate for a “1→1” relationship is that for the between-subject association. For conceptual simplicity, each mediator (Stress, Negative Affect, Stroop, IAT) will be tested in a separate model. Note that self-reported Drinking was assessed as the amount of drinking since the previous assessment, whereas Tempted Now ratings (and other mediators) were assessed “right now”. Therefore, Drinking occurred before the Tempted Now ratings. For this reason, Drinking will be lagged relative to the other measures, so that the Tempted Now rating occurs before any drinking.

II.4.3 Specific Aim 3

To test MAAS as a moderator variable (Specific Aim 3), MAAS was entered in a LMM, along with a second independent variable (Stress, Negative Affect, Stroop, IAT, or Tempted Now) and the interaction term between MAAS and the second independent variable. A significant parameter estimate (coefficient) for the interaction term would

indicate that MAAS scores significantly moderated the association between the second independent variable and the dependent variable.

In all cases, the moderation models involve a level 2 moderator influencing the relationship between two level 1 variables. This is known as a “cross-level interaction”. Using the terminology of Preacher et al. (2016), this constitutes a $2 \times (1 \rightarrow 1)$ moderation model. Following Preacher et al. (2016), the moderator, MAAS, may plausibly moderate the association by altering the between-subject association and/or the within-subject association. For example, the association between individuals’ general level of stress and their general level of Tempted Now ratings may be lower in individuals with high MAAS (vs. individuals with low MAAS). This would represent moderation of a between-subject association. In addition, the association between stress and Tempted Now ratings within individuals may be lower in individuals with high MAAS (vs. individuals with low MAAS). This would represent moderation of a within-subject association. Therefore, we will test interaction terms between MAAS and Mean scores (e.g., *Mean Stress*) as well as the interaction term between MAAS and Deviation Scores (e.g., *Deviation Stress*).

Aguinis et al. (2013) recommended treating the level 1 slope as random when testing a cross-level interaction (i.e., an interaction between a level 2 variable, MAAS, and a level 1 variable, Stress). In addition, Schwartz and Stone (2007) describe testing a cross-level interaction in EMA data using SAS PROC MIXED in which the level 1 variable is treated as random. Thus, level 1 variables will be treated as random (i.e., allowed to vary across subjects) in these analyses.

II.4.4 Covariates

Regarding level 2 covariates, as noted in Table 3 MAAS has been positively associated with age in an at-risk population in multiple studies (4 studies). Two studies have reported that women have higher MAAS scores than men. Therefore, age and gender were both included as level 2 covariates in all models.

In addition, we considered inclusion of education level and medication type as level 2 covariates. Education level was not associated with MAAS ($r = .11$, $p = .51$), Tempted Now ($PE = 0.07$, $SE = 0.17$, $p = .66$) or Drinking ($PE = -0.00$, $SE = 0.10$, $p = .97$), and was not included in the models. Medication type, coded as a multinomial variable with 4 levels (none, disulfiram, acamprosate, naltrexone), was also not associated with MAAS, $F(3, 39) = 0.81$, $p = .50$, Tempted Now, $F(3, 1976) = 2.16$, $p = .09$, or Drinking, $F(3, 1975) = 0.69$, $p = .56$. Similarly, when coded as a binary variable (0=no medication, 1=use of medication), medication was not associated with MAAS ($p = .95$), Tempted Now ($p = .22$), or Drinking ($p = .37$). Therefore, medication type was not included as a level 2 covariate.

As noted earlier, Day and Assessment Type were included as level 1 covariates. Regarding the former, Bolger and Laurenceau (2013, p. 71) recommend including Time as a covariate in analysis of intensive longitudinal data. As expected, Assessment Type is associated with Tempted Now ($PE = 0.98$, $SE = 0.24$, $p = .0002$) (Snelleman et al., under review). Assessment Type was not associated with MAAS ($p = .95$). Given that Day and Assessment Type were not a primary focus of analyses, following Schwartz and Stone (2007, p. 79) their coefficients were treated as fixed (rather than random).

It is well established that parameter estimates from LMMs may be biased if the missing data are not missing at random (denoted by “NMAR”). LMMs only provide

unbiased parameter estimates under two conditions. First, the parameter estimates are unbiased if the missing data are missing completely at random (“MCAR”). Second, parameter estimates are unbiased if missingness is fully explained by the independent variables, or by non-missing values of the dependent variable (known formally as “missing at random”, “MAR”). Therefore, it is prudent to examine whether baseline variables are related to missingness. Given that the primary independent variable was a level 2 variable, MAAS, we explored whether level 2 baseline variables were associated with the proportion of RAs completed (an index of missingness). None of the following variables were associated with missingness: Education level, location, medication type (multinomial or binary) and smoking status (all $ps > .12$). Age was associated with missingness ($r = .38$, $p = .01$), with older participants being more compliant. As noted above, Age was included as a level 2 covariate.

Note that if missingness is related to the value of the dependent variable in a manner that is not accounted for by study covariates there is no simple remedy, and parameter estimates may be biased.

II.4.5 Supplementary Analyses

The analyses described above test the conceptual model shown in Fig 5 in a piecemeal fashion using “single-equation methods” (Kline, 2015, p. 233) to test for mediation. It is also possible to test the “omnibus model” and estimate the path coefficients using path analysis (Kline, 2015). Using MPlus Version 8, we conducted a multilevel path analysis for the lower model in Fig. 5 and estimated each of the paths. The primary focus was on the statistical significance of the pertinent total effects and indirect effects. The expectation was that the parameter estimates derived from MPlus

would be similar to those using single-equation methods. Consistency of results across analytic methods will bolster confidence in the findings.

The mediation models (Fig. 5) are causal models. They assume that X causes M, and that M causes Y. They assume that Y does not cause M and that M does not cause X. To bolster the results of the primary analyses for Tempted Now, additional analyses will also be conducted when subsetting to data that occur *before* reported drinking. (This analysis ensures that scores on the mediators could not have been caused by drinking). Six subjects reported drinking at the outset of the study, and therefore these subjects will be procedurally excluded from these analyses.

Unless otherwise indicated, the analyses above will use all 2020 assessments from all 43 participants. Of the 43 participants, 39 provided data from all 4 weeks.

Given the multilevel data, we use multilevel path diagrams to illustrate the relationships (Figure 12, A) and to summarize the results.

II.5 POWER ANALYSIS

As noted by Field (2013, p. 829), power analyses for mixed models are as difficult to compute. Field (2013) also referred to the method described in Twisk (2006), which uses traditional methods (i.e., methods used on non-hierarchical data) while using a sample size that accounts for the correlated nature of the data. This was the approach taken to estimate power in the current dissertation.

Power analyses were computed using G*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007). All power analyses used $\alpha = .05$ and a 2-tailed test. The estimates of power accounted for the fact that repeated observations from the same person will generally be correlated, assessed by the intraclass correlation coefficient (ICC). To

compute the “effective sample size”, the total number of study assessments is divided by the VIF (Variance Inflation Factor) ($VIF = 1 + ((\text{average number of observations per person}) - 1) * ICC$), where ICC is the intraclass correlation coefficient for the dependent variable.

For Specific Aim 1, assuming 43 participants, 2020 assessments, and $ICC = .5$, the “effective sample size” is 84.2, and the study would have power = .80 to detect a correlation, $\rho = .30$ (i.e., a medium effect size), between MAAS (level 2 variable) and outcome variables (level 1 variables). If the $ICC = .3$ (i.e., the repeated measures EMA data are less correlated), then the effective sample size = 136.5, and power = .81 to detect a correlation, $\rho = .24$ (a small-to-medium effect size). If the $ICC = .1$ (i.e., the repeated measures EMA data are weakly correlated), then the effective sample size = 360.7, and power = .82 to detect a correlation, $\rho = .15$ (a small-to-medium effect size).

For Specific Aim 2, power analyses for the a path ($X \rightarrow M$) and the b path (Mean $M \rightarrow Y$) will be the same as those listed above, because they all involve associations between level 2 and level 1 variables.

Specific Aim 3 involves testing cross-level interactions, and computations of power become more complex. Kreft and de Leeuw (1998) provide some guidance. They note that when testing cross-level interactions one should have more than 20 contexts (level 2 units, or subjects in the current study), and that subject sizes “should not be too small.” The current study has 43 level units, each with an average of about 45 assessments. Thus, the current study appears to meet this informal criterion.

CHAPTER III: RESULTS

III.1 DESCRIPTIVE STATISTICS

All 43 participants provided at least one week of EMA data, and 39 (90.7%) completed all 4 weeks. Overall, the 43 participants provided PDA data on an average of 26.07 days ($SD = 7.09$) and initiated 2020 assessments (1870 RAs; 150 TAs). On average participants completed 43.5 ($SD=20.0$) RAs and 3.49 ($SD=4.66$) TAs. Thirty-five participants (81.4%) completed at least 1 TA; these participants completed an average of 4.29 TAs ($SD=4.82$, *Range* 1-21). The mean time of day for assessments was 3.38 PM ($SD = 4.61$ hours); 36.29% occurred before 1.00 pm; 27.67% occurred between 1.00 pm and 7.00 pm, and 36.04% occurred after 7.00 pm.

Table 9 shows summary statistics for the sample. The mean MAAS score was 3.94 ($SD = 0.91$). Participants completed on average 71.3% RAs that were presented (*Range*: 24.1%-100.0%). Participants reported not drinking (since the previous assessment) on 89.95% of assessments. ICCs for self-report EMA measures (not shown in Table 9) were .49, .59, .51, and .69 for Tempted Now, Drinking, Stress, and Negative Affect respectively. ICCs for cognitive EMA measures were .03 and .52 for the Attentional Bias (Stroop task) and Approach Bias (IAT) respectively.

Of the 43 participants, 6 reported non-abstinence at baseline (Figure 7). Those 6 participants reported drinking during the study. Of the 37 who reported being abstinent at baseline, 35 had the goal of attempting to maintain complete abstinence during the study period, and 2 reported attempting to be “controlled drinkers”. Of the 35 participants attempting to remain abstinent, 8 reported at least one drink during the study, and 27

reported complete abstinence (Figure 7). Of the 8 participants who reported some drinking, 6 reported at least one binge episode, 2 reported occasional drinking.

III.2 SPECIFIC AIM 1

Hypothesis 1.1 tested whether more mindful individuals (assessed using the MAAS) reported lower Tempted Now ratings assessed during EMA. Results from LMMs examining associations between MAAS scores and Tempted Now ratings are shown in Table 10 (left side). As shown, the data supported this hypothesis. As MAAS scores increased by 1 unit, the predicted level of Tempted Now decreased by 0.40 units, when controlling for all other variables in the model (Table 10, Figure 8). Pearson's r (a standardized effect size measure) for the correlation between MAAS scores and *Mean* Tempted Now ratings was $-.34$ (when controlling for age and gender).

The analysis above includes all assessments in analysis, including assessments when individuals had been drinking. To examine whether the association between MAAS and Tempted Now was independent of drinking, we conducted supplementary analyses. First, we subset analyses to assessments in which participants reported no drinking. This analysis included data from all 43 participants and revealed a similar result to the primary analysis above, $PE = -0.31$, $SE = 0.14$, $p = 0.02$. Second, we subset analyses to assessments from the participants that occurred before reported drinking. This analysis involved 37 participants who completed at least 1 EMA assessment prior to drinking. The parameter estimate, $PE = -0.13$, $SE = 0.14$, was not significant in this analysis ($p = .37$). Last, we subset the analysis to include only the 27 participants who reported no drinking during EMA. This analysis revealed a similar result to the primary analysis

above $PE = -0.41$, $SE = 0.15$, $p = .007$. Taken together, two of the three analyses provided evidence that the association between MAAS and Tempted Now is independent of Drinking.

Hypothesis 1.2 tested whether more mindful individuals (assessed using the MAAS) reported less drinking assessed during EMA. Results from LMMs examining associations between MAAS scores and Drinking are shown in Table 10 (right side). The data did not support this hypothesis. As can be seen, as MAAS scores increased by 1 unit, the predicted level of Drinking decreased by 0.18 units, when controlling for all other variables in the model, and this association was not significant (Table 2, Figure 9). Pearson's r (a standardized effect size measure) for the correlation between MAAS scores and *Mean* Drinking ratings was $-.25$ (when controlling for age and gender).

The above analysis treated Drinking as a continuous variable (assuming normal distribution of residuals in the population). Given the low rate of Drinking (i.e., a large number of "0"s), this assumption would likely not hold. In a supplementary analysis using PROC GLIMMIX (using adaptive quadrature; method=quad), Drinking was treated as an ordered categorical variable. This analysis yielded a similar result to the primary analysis reported above, $PE = -1.02$, $SE = 0.84$, $p = .22$.

Because drinking data are derived from an underlying count distribution, in a second supplementary analysis using PROC GLIMMIX, the poisson distribution was used (dist=p, link=log). This analysis treats Drinking as count data (Atkins, Baldwin, Zheng, Gallop, & Neighbors, 2013), coded as 0=no drinks, 1=1-2 drinks, 3=3-4 drinks, 5=5-6 drinks, 7=7+ drinks. This analysis also yielded a non-significant finding, $PE = -0.69$, $SE = 0.58$, $p = .24$. Atkins et al. (2013) note that when data are "over-

dispersed” relative to the Poisson distribution (i.e., the variance of the count distribution is larger than the mean, as was the case in the current dataset), a negative binomial distribution is preferable. An analysis using the negative binomial distribution did not converge. However, Atkins et al. note that “selecting a Poisson model when the data are over-dispersed will yield overly liberal statistical tests”. This implies that if the analysis is not significant when assuming a poisson distribution, one can assume that it would not be significant when assuming a negative binomial distribution. Finally, an analysis which coded Drinking as a binary variable (0=No drinks, 1=1 or more drinks) also yielded a non-significant result ($p=.26$). In sum, whatever assumptions are made about the data, there is no evidence for a significant association between MAAS and Drinking.

III.3 SPECIFIC AIM 2

Hypothesis 2.1 tested whether more mindful individuals (assessed using the MAAS) reported less stress/negative affect assessed during EMA (1-7 scale) which in turn will be associated with lower Tempted Now ratings and Drinking alcohol assessed during EMA. Results of mediation analyses using the Baron and Kenny (1986) causal steps methods are reported in Table 11. Specifically, Table 11 reports the coefficients for the pertinent a paths, b paths, and c’ paths for the various indirect pathways (see also Figure 10).

Using the Baron and Kenny (1986) causal steps approach, in order for Stress or Negative to mediate the effect of MAAS on Tempted Now or Drinking, the association between MAAS and Stress or Negative Affect (the “a1 path” in Table 11) has to be significant. As can be seen, the a1 path for the association between MAAS and Stress is

not significant, and the same is true for the a1 path between MAAS and Negative Affect. Therefore, according to the Baron and Kenny (1986) approach, neither Stress nor Negative Affect can mediate the effect of MAAS on Tempted Now or Drinking.

When Tempted Now served as the dependent variable, we also examined the a1 path when subsetting to assessment in which no drinking had occurred (as described for Hypothesis 1.1 above). Using the three approaches above (for Hypothesis 1.1), there were no analyses in which the a1 path was significant.

Hypothesis 2.2 tested whether more mindful individuals (assessed using the MAAS) reported lower attentional and approach biases assessed during EMA (alcohol Stroop task and IAT) which in turn will be associated with lower Tempted Now ratings and drinking alcohol assessed during EMA. Using the Baron and Kenny (1986) causal steps approach, in order for the alcohol Stroop effect or the IAT effect to mediate the effect of MAAS on Tempted Now or Drinking, the association between MAAS and attentional bias or approach bias (the a1 path) has to be significant. As can be seen, the a1 path for the association between MAAS and attentional bias is not significant, and the same is true for the a1 path between MAAS and approach bias. Therefore, according to the Baron and Kenny approach, neither attentional bias nor approach bias mediates the effect of MAAS on Tempted Now or Drinking.

When Tempted Now served as the dependent variable, we also examined the a1 path when subsetting to assessments in which no drinking had occurred (as described above). Using the three approaches above, there were no analyses in which the a1 path was significant.

Figure 5 indicates there is one additional pathway by which MAAS scores may influence Drinking. MAAS may reduce Tempted Now ratings (as revealed by the results of Hypothesis 1.1), which in turn reduces Drinking. For mediation to occur via this pathway, the a2 path needs to be significant, as does the b2 path. The values for a2 and b2 vary according to which mediator (Stress, Negative Affect, Attentional Bias, Approach Bias) is included in the model. However, as shown by Table 11, in all four cases the a2 path is significant (or just misses significance), and the b2 path is also significant. Therefore, according to the Baron and Kenny (1986) causal steps approach, there is evidence that the indirect path from MAAS to Drinking via Tempted Now is significant. As discussed in more detail later, this is a case in which an indirect path (a2.b2) is significant in the absence of a total effect (c path). Stated another way, there was no significant association between MAAS and Drinking (Hypothesis 1.2), yet the indirect pathway (MAAS→Tempted Now→Drinking) was significant.

To examine this mediation pathway in further detail, we used multilevel path analysis in MPlus Version 8 to examine the significance of the a2.b2 path. The syntax used is reported in Appendix B, and key output is reported in Figure 11. The model specified exhibited a good fit (Chi Square ($df=6$) = 4.352, $p = .63$; *Comparative Fit Index* (CFI) = 1.000; *Tucker Lewis Index* (TLI) = 1.050; *Root Mean Square Error of Approximation* (RMSEA) = 0.00). Results confirmed that the indirect path a2.b2 was significant using this approach (*indirect effect* = -0.186, $SE = 0.074$, $t = -2.530$, $p = .011$). The results also confirmed that the indirect paths through the mediator (in this case, Stress) were not close to significance (see Figure 11).

III.4 SPECIFIC AIM 3

Specific Aim 3 examined MAAS as a moderator variable. As described earlier, in a 2 x (1→1) design, the moderator may plausibly moderate the association between the independent and dependent variable by influencing the between subject association and/or by influencing the within-subject association (Preacher et al., 2016). For example, as described earlier, the association between individuals' general level of stress and their general level of Tempted Now ratings may be lower in individuals with high MAAS (vs. individuals with low MAAS). This would represent moderation of a between-subject association. In addition, the association between stress and Tempted Now ratings within individuals may be lower in individuals with high MAAS (vs. individuals with low MAAS). This would represent moderation of a within-subject association. Therefore, Table 12 reports the results of the between-subject moderation and within-subject moderation separately.

Hypothesis 3.1 tested whether the association between stress/negative affect (assessed during EMA) and Tempted Now ratings, assessed during EMA, would be weaker in participants with higher (vs. lower) trait mindfulness (assessed using the MAAS). Table 12 reveals that the parameter estimate for the between-subject moderation (tested using the *Mean* score) was not significant for either Stress or Negative Affect. Similarly, the parameter estimate for the within-subject moderation (tested using the *Deviation* score) was not significant for either Stress or Negative Affect.

Hypothesis 3.2 tested whether the association between cognitive biases (assessed during EMA using the alcohol Stroop task and IAT) and Tempted Now ratings, assessed during EMA, would be weaker in participants with higher (vs. lower) trait mindfulness (assessed using the MAAS). Table 12 reveals that the parameter estimate for the

between-subject moderation (tested using the *Mean* score) was not significant for either Attentional Bias or Approach Bias. Similarly, the parameter estimate for the within-subject moderation (tested using the *Deviation* score) was not significant for either Attentional Bias or Approach Bias.

Hypothesis 3.3 tested whether the association between Tempted Now ratings and Drinking, assessed at the same assessment during EMA, would be weaker in participants with higher (vs. lower) trait mindfulness (assessed using the MAAS). Table 12 reveals that the parameter estimate for the between-subject moderation (tested using the *Mean* score) was not significant. Similarly, the parameter estimate for the within-subject moderation (tested using the lagged *Deviation* score) was not significant. An additional analysis examining moderation between Drinking at time *t* and Tempted Now at time *t* was also conducted (not shown in Table 12). This analysis revealed a significant within-subject moderation only when the coefficient for Drinking at time *t* was treated as fixed.

III.5 SUPPLEMENTARY ANALYSES

Additional Mediation Analyses

Results of mediation analysis reported earlier indicated that the indirect pathway from MAAS to Drinking via Tempted Now was significant (MAAS→Tempted Now→Drinking). As noted earlier, this is an example of between-subject mediation in a 2→1→1 model. That is, if the model is correctly specified, individuals with higher MAAS scores report generally lower Tempted Now ratings, which in turn causes lower levels of Drinking. Note that MAAS is assessed prior to assessment of Tempted Now and Drinking ratings. However, with respect to the b2 path, the analysis is essentially cross-sectional (because *Mean* Tempted Now served as the predictor), and does not provide

information as to whether Tempted Now ratings predict subsequent Drinking and/or whether Drinking predicts subsequent Tempted Now ratings.

To gain additional information on temporal sequence for the b2 path, additional analyses were conducted in which Tempted Now was assessed using data from the first half of a subject's data series (e.g., the first 14 days), and Drinking was assessed using data from the second half of a subject's sequence (e.g., the second 14 days). In this way, Tempted Now ratings were assessed prior to Drinking ratings. This analysis revealed mixed results. The association between MAAS scores and Tempted Now ratings during the first half of the study (a2 path) was reduced to marginal significance, $PE = -0.31$, $SE = 0.17$, $p = .08$. The association between Tempted Now ratings in the first half of the study and Drinking in the second half of the study (b2) was significant, $PE = 0.36$, $SE = 0.07$, $p < .001$, but this effect did not persist when controlling for Drinking in the first half of the study.

There was also little evidence for the specification that MAAS scores increase Drinking which then increase Tempted Now (MAAS→Drinking→Tempted Now). If this specification were correct, the association between MAAS scores and Drinking during the first half of the study (or over the whole study) would be significant. This association was not significant (either for the first half of the study, or the whole study), providing no support for the notion that MAAS could reduce Tempted Now ratings via an effect on Drinking.

Research using formal longitudinal mediation models is required to further investigate the casual relationships, preferably using larger datasets than the current dataset. MacKinnon (2008) describes a number of approaches for longitudinal mediation

models to include autoregressive mediation models. Moreover, to examine between-subject mediation in a $2 \rightarrow 1 \rightarrow 1$ design, larger samples sizes may be required. This issue is further addressed in the discussion.

III.5.1 Association between Tempted Now and Drinking

The association between Tempted Now ratings and Drinking is likely to be complex. For example, using lagged predictor variables, it is possible to examine within-subject associations for “Tempted Now $\rightarrow$ Drinking”, and “Drinking $\rightarrow$ Tempted Now”.

Deviation Tempted Now ratings at time t predict Drinking at the time $t+1$, when controlling *Mean* Tempted Now ratings and when controlling for Drinking at time t ($PE = 0.04$. $SE = 0.02$, $p = .02$). This finding suggests that when an individual experience higher Tempted Now ratings than usual they report more Drinking in the subsequent period. Conversely, *Deviation* Drinking ratings at time t predict Tempted Now ratings at time t , when controlling for *Mean* Drinking ratings ($PE = 0.38$. $SE = 0.18$, $p = .04$).

Although Tempted Now and Drinking are assessed at the same timepoint, t , in this analysis, Drinking refers to drinking since the last assessment, and therefore precedes the Tempted Now rating (which assesses experience “right now” at time t). *Deviation* Drinking ratings at time t do not predict Tempted Now at the time $t+1$, when controlling *Mean* Drinking ratings and when controlling for Tempted Now at time t ($p = .64$).

The above analyses are within-subject associations for “ $1 \rightarrow 1$ ” relationships. They are therefore not relevant to mediation in the current study, which must occur at the between-subject level (Preacher et al., 2010). Nonetheless, these analyses provide evidence for both the “Tempted Now $\rightarrow$ Drinking” and “Drinking $\rightarrow$ Tempted Now” specifications (at the within-subject level).

III.5.2 Compliance as Moderator Variable

As noted in Table 9, there was substantial variability in Compliance on RAs. We examined whether key associations were different as a function of Compliance. For the association between MAAS and Tempted Now, the parameter estimates were similar for participants with Compliance < 75% ($PE = -0.33$) and those with Compliance > 75% ($PE = -0.32$). Compliance did not moderate the association between MAAS and Tempted Now ($PE = 0.01$, $SE = 0.91$, $p = .12$). For the association between MAAS and Drinking, the parameter estimate for participants with Compliance < 75% was $PE = -0.02$, and the parameter estimate for those with Compliance > 75% was $PE = 0.09$. Compliance did not moderate the association between MAAS and Drinking ($PE = 0.006$, $SE = 0.004$, $p = .14$).

III.5.3 Specification of R Matrix

The analyses reported above used the SAS code “type = AR(1)” for the R-sided covariance structure (R matrix). Schwartz and Stone (2007) noted that this specification assumes equal intervals between assessments, which is not the case for EMA data. They suggest the code “type = SP(POW)(time) local” in the repeated statement permits time to be assessed on a continuous scale and is better suited to unequal intervals. The local command specifies that random error, conceptualized as measurement error, is added to the AR(1) structure (see Schwartz and Stone p. 88-89 for details). They refer to this specification as a “modified first order autoregressive”, or “AR(1) + Noise”, and argue from theory and data that it provides a better fit than the SAS default for time series data, AR(1). We therefore re-computed key results using this specification. None of the key

findings changed. For example, the association between MAAS and Tempted Now ratings was $PE = -0.41$, $SE = 0.17$, $p = .02$.

CHAPTER IV: DISCUSSION

The main findings of this study were as follows (Figure 12B). First, higher levels of dispositional mindfulness, assessed by the MAAS, were associated with lower levels of Tempted Now ratings, but not drinking, in the field, during an attempt to maintain abstinence. Second, there was no evidence that stress, negative affect, attentional bias, or approach bias mediated the relationship between mindfulness and tempted now or drinking. However, there was evidence for an indirect effect from mindfulness to tempted now to drinking, such that higher levels of mindfulness were associated with lower levels of tempted now which in turn were associated with lower levels of drinking. Last, there was no evidence that mindfulness moderated the association between stress/negative affect and tempted now, or between cognitive biases and tempted now. Each of these findings will be discussed in further detail.

IV.1 SPECIFIC AIM 1

Because MAAS significantly reduced tempted now but not drinking, one may wonder whether the effect of MAAS on craving is more robust than the effect of MAAS on drinking. If tempted now mediates the effect of MAAS on drinking (see later discussion), it would be likely that the effect of MAAS on tempted now should be larger than the effect of MAAS on drinking, because tempted now is more proximal to MAAS.

In addition, the low drinking rate may have made it more difficult to detect associations with drinking. For example, 27 subjects were designated as abstinent and therefore reported no drinking. As noted in Table 9, there was less variability in drinking data than tempted now data. For example, mean drinking scores had a standard deviation of 0.64, which is just over half the standard deviation of mean tempted now scores (1.15)

(data not shown in Table 9). The lower variability of the drinking variable may represent a “restricted range” problem, and may have made it more difficult to detect an association for drinking. Finally, one should not over-interpret the different pattern of data for tempted now and drinking in that the association between MAAS and drinking tended in the same direction (Figure 9).

IV.2 SPECIFIC AIM 2

As noted above, there was no evidence that stress, negative affect, attentional bias, or approach bias mediated the relationship between mindfulness and tempted now or drinking. Data on internal reliability of negative affect and the two cognitive biases reported earlier suggested that these assessments had adequate internal reliability. Moreover, both stress and negative affect were associated with tempted now and with drinking in the expected direction (Table 12). There was therefore evidence supporting the reliability of the assessment of the mediators, yet, as noted above, there was no evidence that they mediated the association between mindfulness and tempted now.

Indeed, it seems surprising that the data reveal that MAAS is associated with tempted now independently of stress, negative affect, and cognitive biases. The finding also begs the question as to how MAAS reduces Tempted Now independent of any effects on stress and negative affect. It is possible that there is some attribute of tempted now that is particularly sensitive to dispositional mindfulness. Speculatively, it may be easier for individuals to “detach” from urges than from negative stress. Stated another way, “urge-surfing” may be easier than “stress-surfing”.

Another issue is that Tempted Now ratings had more variability than Stress. The standard deviation of mean Stress scores was 0.67, which compares with the standard

deviation of the mean Tempted Now rating of 1.15. Therefore, the greater variability of Tempted Now (than Stress) may have made it easier to detect an association with MAAS scores. The greater variability of Tempted Now ratings may have been at least partly related to the use of temptation assessments. It would be interesting to conduct a study in which participants are required to enter “stress assessments” whenever they feel acutely stressed. Use of these participant-initiated assessments could increase variability of stress (and negative affect ratings) and may make it easier to detect an association with MAAS scores.

The data reveal some evidence of an indirect effect from MAAS to drinking via tempted now. Another interesting finding was the presence of an indirect effect (MAAS→Tempted Now→Drinking) in the absence of a total effect (MAAS→Drinking). Although counterintuitive, this pattern of data (i.e., presence of a significant indirect effect, a.b, with a non-significant total effect, c) can occur not infrequently. For example, on his website (<http://davidakenny.net/cm/mediate.htm>) Kenny has written (retrieved on 07.08.17) “It can easily happen, that a.b can be statistically significant but c is not.”

Kenny and Judd (2013) expand on this. They note that “power of the tests of the a and b paths are generally greater than that of the c (or c’ path)”. For example, if both a and b equal .3, both the indirect effect and the total effect equal .09 (.3 x .3), assuming the direct effect is zero. For the test of the null hypothesis for the total effect (c equals 0 in the population), power is influenced in part by the fact that .09 is relatively close to zero. In contrast, when one tests the null hypothesis that ab equals 0 in the population, according to Kenny and Judd (2013), it is as if two effects are being tested, with a and b both equal to .3, they also note that “Clearly, .3 is a lot further away from zero than is .09.

Thus, it is easier to obtain a statistically significant indirect than total effect in this case”. Kenny and Judd (2013) illustrate with this point with an analogy. They note that it is easier to throw a ball 70m with two separate throws of 35m, than a single throw of 70m (or two separate throws of 60m and 10m).

If Kenny and Judd’s (2013) argument is taken at face value, this means that the presence of the significant effect in the absence of significant total effect should not be seen as surprising, but may reflect different power of the different paths. This still leaves the question of how to interpret the data. One might argue that the absence of a total effect likely reflects lack of power and that the indirect effect should be taken at face value. This issue should be resolved in further research using larger sample sizes.

Another issue with interpretation of the data is that the temporal sequencing of the b path remains unclear, and the data do not provide strong evidence for either the “MAAS→Drinking→Tempted Now” pathway, or the “MAAS→Tempted Now→Drinking” pathway. We need to be open to the possibility that the MAAS increases tempted now (at a between-subjects level) but that tempted now does *not* increase drinking at a between-subject’s level. Further research using longitudinal mediation approaches in the context of a $2 \rightarrow 1 \rightarrow 1$ design is needed.

In fact, the optimal methodology for testing between-subject mediation in the context of $2 \rightarrow 1 \rightarrow 1$ design with intensive longitudinal data is not obvious. Although there are many research contexts involving intensive longitudinal data in which mediation hypotheses would be of interest, we are not aware of any publications dedicated to this issue. For example, if X is, say, treatment condition (active vs control), and M and Y are continuous variables assessed at every assessment (say, 40 assessments), one might want

to test whether an effect of X on Y is mediated by M. Any solution would also have to satisfy Preacher et al.'s (2010) admonition that the mediation must be entirely at the between-level, i.e., care would need to be taken to not conflate between- and within-effects for the M→Y path/s. Zhang et al. (in press) have recently published an article on Multilevel Autoregressive Mediation Models; however, their approach is only applicable to cases of evenly-spaced data and she states that “it would not be advisable to use the proposed mediation models for individuals with randomly sampled data”.

Preacher himself (personal communication, July 12, 2017) noted “I'm honestly not sure what to do about this problem, but it's not the first time it has come up.” One might consider use of a cross-lagged autoregressive mediation model of the type proposed by MacKinnon (2008), in which one could estimate the longitudinal mediation paths (Appendix C, bottom figure). But even this approach requires aggregation of the data into a relatively few number of units (to avoid a large number of paths) and the units will be relatively far apart in time (e.g., weeks). Thus, there would appear to be limitations with this approach.

IV.3 SPECIFIC AIM 3

The findings for the moderation analysis yielded no evidence for moderation either between- or within- subjects. For example, the relationship between tempted now and subsequent drinking (Tempted Now→Drinking) was not significantly weaker in higher MAAS in either between-subjects or within-subjects. For the within-subject moderation analyses, one should note that the use of random coefficients may have rather low power in cases where few subjects show variability in the IV or DV (e.g., drinking). As a case in point, the relationship between drinking and tempted now (Drinking→

Tempted Now) was (significantly) weaker in higher MAAS in within-subjects analysis when treated as a fixed effect (rather than a random effect). However, it seems to make more conceptual sense that the within-subject association between drinking and tempted now (and vice versa) is treated as a random effect in that this association might be expected to differ across subjects (see also Aguinis et al., 2013).

Szeto (2016) reported that MAAS scores did significantly moderate the association between tempted now and drinking in a small subset of the participants examined in the current dissertation. At first sight, this finding appears to conflict with the current results. The treatment of coefficients as random (rather than fixed) may in part account for the different finding reported here compared to those reported by Szeto (2016), which treated the coefficients as fixed. In addition, other methodological differences may account for the discrepant findings. As well as being conducted on a different set of participants, the analyses reported in Szeto (2016) were conducted prior to the publication of Preacher et al.'s (2016) article, which stressed the importance of separating between- and within- subject components in multilevel moderation analyses. Consequently, Szeto (2016) did not separate the between- and within-subject components, as was done in the current study. In general, further research is required to examine moderation of both "Tempted Now→Drinking" and "Drinking→ Tempted Now" in larger samples.

Recall that it was stated in the introduction that "more mindful individuals may be less likely to experience stress/negative affect and have cognitive biases in the first place, and if they do occur, their impact may be diminished in these individuals". As is evident from the results of Specific Aims 2 and 3, the study provided little support for this idea.

IV.4 LIMITATIONS

The study had a number of limitations. First, the relatively small sample size for level 2 units reduced power for between-subject associations, such as those for Specific Aims 1 and Aim 2. Given the focus on between-subject associations for these two aims, the study would have benefitted more from a larger number of level 2 units (subjects). For example, the association between MAAS and drinking tended in the same direction as the association between MAAS and tempted now, and may have become significant if a larger sample size were used. In addition, the use of random coefficients, while appropriate, may have resulted in low power for within-subject moderation analyses.

Second, as noted earlier, relatively low variability in some measures might have reduced power for some tests. For example, drinking had 27 complete abstainers, and there was relatively low variability in drinking at both a between- and within-subject level.

Third, for Specific Aim 2, the study would have benefitted from a more comprehensive formal longitudinal mediation analysis, especially for the relationship involving MAAS, tempted now, and drinking. Moreover, the use of bootstrapping approaches for computation of the indirect effects may have been useful to complement the reported analyses.

Fourth, the data are correlational. It is not known whether trait mindfulness causes lower tempted now ratings. This can only be achieved with a randomized control trial. Related to this point, it is possible that an unmeasured third (level 2) variable is responsible for the association between mindfulness and tempted now. For example, it would be interesting to investigate how variables such as social desirability bias and intelligence are associated with mindfulness and study outcomes. For example, it is

plausible that individuals who exhibit socially desirable responding may seek to present themselves as both highly mindful and as experiencing low craving, which could influence the association between these two variables (mindfulness and craving). In general, future research should examine the impact of additional third variables on study associations.

Fifth, as noted earlier, parameter estimates may be biased if data are not missing at random (MAR). It is difficult, if not impossible, to test whether the data are MAR. In the current study, the average compliance on RAs was 71%. As with all EMA studies with missing data, there is some uncertainty concerning the accuracy of the parameter estimates reported. Note, however, that degree of compliance did not moderate the association between MAAS and tempted now.

Sixth, a relatively large number of hypotheses were tested. This increases the probability of making a type I error when alpha is fixed at .05. Therefore, significant findings should be treated with caution.

Seventh, dispositional mindfulness was measured with a single-factor scale. As noted by Szeto (2016), MAAS was chosen because it is one of the earliest, most validated, and frequently used mindfulness assessments; it is also validated in Dutch. However, recent clinical studies involving trait mindfulness have increasingly recognized its multidimensional nature. Specifically, the Five-Facet Mindfulness Questionnaire (Ruth A. Baer et al., 2006; Ruth A. Baer et al., 2008) has generated consistent data to support the idea that different factors of mindfulness may have different predictive and treatment utilities in clinical conditions. A Dutch version of the FFMQ (FFMQ-NL) was also developed after this dissertation's data collection began (de Bruin, Topper, Muskens,

Bögels, & Kamphuis, 2012). Future studies that are focused on relations between mindfulness and negative affect could also measure other aspects of negative affect, such as the qualities of affective tone, compared to the I-PANAS-SF.

Eighth, the data only speak to dispositional mindfulness, and therefore may not reflect “trained” mindfulness, such as that attained by skilled practitioners. In other words, mindfulness that results from mindfulness training may have very different effects to dispositional mindfulness assessed in unselected individuals.

Last, and most conceptually, adaptation of *sati* challenges the scope and power of the scientific process as a method to generate knowledge. The most notable challenge is that many aspects of *sati* are ineffable (incapable of being expressed in words), which is problematic for how *sati* can be measured or transmitted. In other words, if *sati* is largely ineffable, how can it be defined or assessed using questionnaires? This issue is further addressed below.

IV.5 STRENGTHS

The strengths of the study included the following. First, this is an understudied population, and one of few EMA studies to be conducted in this population. A second strength was the inclusion of both self-report and cognitive assessments in the EMA assessments. Third, the examination of multilevel moderation is a strength in that it permits a comprehensive analysis of moderation hypotheses (Preacher et al., 2016).

IV.6 CHALLENGES IN ADAPTATION OF *SATI*

A crucial challenge to mindfulness researchers is how *sati* can be usefully examined in a scientific context. Since around 2008, both proponents and critiques of mindfulness science paid increasing attention to scientific rigor of the field. More

importantly, empirical and conceptual research in English, peer-reviewed journal articles began to address the scientific existential crisis: the scientific method necessitates mentalization (i.e., observe and collect data), but *sati* is both a process and the goal in reducing mentalization.

In the Buddhist teaching, believing that “doing X = being mindful” are at best an unreliable attempt to represent reality. The belief that one can sufficiently verbalize or mentalize reality is one of the three poisons that foster suffering – ignorance/delusion about reality. Much of the historical splitting of Buddhist canons and traditions happened because of this very debate: if notions like *sati* are ineffable past a certain point, what is the best way to observe it, communicate it, and learn it to achieve nirvana?

Buddhists approached it the way the scripture described Buddha did. The traditional practices of *gongan/koan* (“public cases”) in Chan and Zen traditions is one example. Many ineffable notions are communicated by refraining from observing or presenting them directly. Instead, they are communicated indirectly by contemplating and debating over *gongan/koan*, or stories and actions that embody a notion without naming it.

Common strategies include subverting conventional rules of mentalization (e.g., questions and/or responses that appear to be paradoxical or non-sequitur), triangulating a notion from the duality around it (e.g., meditate on the dialectics of good-bad to understand nonjudgment), and through the dynamic and relations captured in non-verbal interaction between persons and/or objects.

Many well-supported clinical MBIs that originated in the US (e.g., DBT, ACT, and MBRP) based their principles and techniques on such practices. Dialectical

Behavioral Therapy addresses emotional dysregulation through dialectics, i.e., investigating personal truths through opposites/contradictions, or the visceral dynamics and tension arisen from them. Since its inception, DBT has emphasized the importance of unexpected and humorous stimuli in eliciting therapeutic changes. Unexpected and humorous interactions are useful in circumventing mentalizations common in psychopathology. To name a few, at clinical severity, rumination, confirmatory bias, and thought rigidity, can all impair a person's capacity and flexibility to digest new information and update their adaption accordingly.

Acceptance and Commitment Therapy, which developed from a contextual experimental paradigm (Relational Frame Theory), targets the *implicit* learning of *implicit* relations (Hayes, 2004). Similarly, Mindfulness-based Relapse Prevention develops people's experiential skills to appreciate the impermanence of all experiences, the self's automatic impulses to approach/avoid experiences, and a baseline of never-ending craving for fulfillment (and how not to mistakenly address it with drug consumptions). Each of DBT, ACT, and MBRP has accumulated modest to strong bases of outcome research. However, similar to psychometric research, treatment mechanism and dismantling research have not always supported the predictions of psychological models of *sati*.

As of 2017, it seems that “doing mindfulness” and “being mindful” (i.e., treatment; measured against outcomes) are comparatively easier than “defining mindfulness” and “proving mindfulness happened” (i.e., psychometrics; measured against constructs that are un-observable or latent). The inevitable progress of technology and designs will one day expand the assessment modality of mindfulness, like it did

many other constructs. For instance, different domains of mindfulness may be measured by self-report, observer-report, implicit cognitive tasks, performance-based paradigms, psychophysiological markers, smart-sensors, verbal content & process analyses.

It is against this backdrop that the current project wished to contribute. This project explored how trait mindfulness relates to self-reports and implicit cognition data from the field. Sampling from a Dutch population in the Netherlands also adds diversity to representativeness of mindfulness research, as a large number of studies were conducted in the US.

IV.7 FUTURE DIRECTIONS

Although beyond the scope of this study, analysis of EMA data could result in the development of algorithms that could be used to determine when to intervene via mobile devices, “just in time.” If a unique constellation of changes in psychological processes, identified through EMA, tended to precede relapses, an intervention (mindfulness-based or otherwise) could be administered via mobile devices to target those processes. In this way, interventions could be delivered when the participant is most in need of the intervention, minimizing participant burden and perhaps reducing the risk of relapse.

Future studies can examine the utility of administering state mindfulness measures during EMA. As noted earlier, two state mindfulness measures have been developed for assessing the effects of MBI (e.g., Toronto Mindfulness Scale, Freiburg Mindfulness Inventory). In addition, although not widely used, there is a 5-item state version of the MAAS (Brown & Ryan, 2003; Osman, Lamis, Bagge, Freedenthal, & Barnes, 2016). It would be interesting to examine how much variability there is in state

mindfulness, as well as to test mediation and moderation hypotheses at the within-subject level.

Another approach to complement the current methodology would be the use of qualitative methods for the examination of relapse and the role of mindfulness in relapse. Indeed, Snelleman and colleagues completed a focus group study examining relapse in drinkers, the results of which motivated the assessments used in the current EMA study (Snelleman, email communication, 9/26/14).

Future studies could also examine the pattern of associations in populations who are likely to exhibit greater variability in study measures. As noted earlier, the relatively low variability in some study measures may have made it more difficult to detect associations between study variables, particularly given the relatively small sample size. The assessment of tempted now used in the current study was also limited (a single item) and future research would benefit from a richer assessment of craving, perhaps with the use of multidimensional assessment.

Future studies could also examine the effect of MBI on study variables. For example, it would be interesting to observe whether MBI (manipulated experimentally) moderates the association between tempted now ratings and drinking. In general, it would be interesting to compare the effects of “untrained” and “trained” mindfulness. Moreover, it would be particularly instructive to examine the moderators of the effect of MBIs. For example, one could test whether individuals who score low on mindfulness are more likely to benefit from MBI treatment.

Future studies could also continue to examine the prospective association between tempted now ratings and drinking, and drinking and tempted ratings, and their

moderation by mindfulness. Drinking may increase tempted ratings if alcohol primes the appetitive motivational system (Clarke, Sharma, & Salter, 2015; Duka & Townshend, 2004; Feldtkeller, Weinstein, Cox, & Nutt, 2001; Hicks, Schlegel, Friedman, & McCarthy, 2009; Ostafin et al., 2003; Palfai & Ostafin, 2003; Schoenmakers & Wiers, 2010; van den Wildenberg, Beckers, van Lambaart, Conrod, & Wiers, 2006; Wiers, van de Luitgaarden, van den Wildenberg, & Smulders, 2005), and, in heavy drinkers, “one drink often leads to another”.

Future mindfulness research could assess related constructs more comprehensively, such as coping behaviors, emotion regulation, religiosity and spirituality. For instance, trait mindfulness has similarities to spirituality but is distinct (Crescentini, Matiz, & Fabbro, 2015; Shorey, Gawrysiak, Anderson, & Stuart, 2015). Finally, the mechanisms of mindfulness may be intertwined with psychophysiological processes (Garland, 2011; Garland, Franken, & Howard, 2012; Garland, Gaylord, Boettiger, & Howard, 2010; Vernig & Orsillo, 2009), and future studies would benefit from assessment of psychophysiological variables.

Table 1. Review of Alcohol Stroop Task (A-ST) in Studies of Adults with High Risk Drinking

Study Country Design	Purpose of Study	Participants	Independent Variables	Dependent Variables	Main Findings
Cox et al. (2007) UK Correlational	To identify alcohol attentional bias (A-AB), motivational structure (MS), and readiness to change (RTC) in changing excessive drinking.	158 (61 F, 97 M) excessive drinkers (>14 units/week for F, >21 for M) completed all 3 waves of study	Readiness to change (RTCQ), A-AB (A-ST), MS (PCI), and family history of alcohol problems (FHAP)	Alcohol consumption (TLFB)	A-AB was prospectively associated with drinking . The greatest long-term drinking reductions occurred with adaptive MS + low A-AB.
Duka et al. (2002) UK Correlational	To examine anxiety, mood states, the urge to drink, and A-AB in detoxified alcoholic inpatient population.	42 (18 F, 24 M) persons in inpatient treatment for alcohol dependence, 43 (20 F, 23 M) social drinkers	Number of supervised medical detoxifications, number of all detoxifications; both from current medical notes	Drinking habits (AUQ), alcohol dependence (SADQ), craving ratings (DAQ), A-AB (A-ST)	A-AB was higher in the clinical vs. control group, and positively correlated with mild intentions and desires to drink.
Fadardi & Cox (2006) UK Correlational	To assess whether the heightened A-AB in alcohol dependence was independent of generally impaired cognitive functioning.	87 social drinkers (63% F, 37% M), 47 drinkers with alcohol dependence (28% F, 72% M)	Alcohol dependence (inpatient facility record), drinking level (AUQ)	Inhibitory processes and cognitive flexibility (classic ST), general intellectual functioning (SILS), A-AB (A-ST)	Those with alcohol dependence showed higher A-AB and poorer cognitive performance. ANCOVA showed that the A-AB was not an artifact of the reduced cognitive performance.
Fadardi & Cox (2009) UK Alcohol Attentional-Control Training Program (AACTP)	To (1) compare the A-AB of social, hazardous, and harmful drinkers, (2) assess the effects of alcohol attention-control training on A-AB.	40 social drinkers (86% F, 14% M), 89 hazardous drinkers (72% F, 28% M), and 92 harmful drinkers (13% F, 87% M)	Cognitive flexibility (classic ST), situational confidence (SCQ), motivation to change (RTCQ), positive and negative affect (PANAS)	Alcohol AB (alcohol ST), alcohol consumption (TAAD), drinking-related problems (SIP), drinking-related locus of control (DRIE)	Hazardous and harmful drinkers showed higher A-AB than social drinkers. A-AB prospectively predicted consumption after adjusting for covariates. AACTP reduced harmful drinkers' classic and A-AB, but not concern-related AB.
Field et al. (2013) UK	To examine the effect of alcohol craving on A-AB in recently abstinent persons	28 (10 F, 18 M) persons recently treated for alcohol dependence; 26 (16	Craving (VAS Urge to drink), drinking level (AUQ), dependence severity (SADQ)	Alcohol AB (A-ST and alcohol visual probe task)	Persons recently treated for alcohol dependence showed higher A-AB than social drinkers. Early dropout from treatment did not correlate with A-AB, but with dependence severity and craving.

Correlational	with history of alcohol dependence.	F, 10 M) social drinkers			
Flaudias et al. (2013)	To examine whether A-AB correlated with stages of hospitalization.	19 (4 F, 15 M) patients at admission, 23 patients at discharge (5 F, 18 M), 16 control (2 F, 14 M)	Stage of hospitalization (admission vs. discharge)	Alcohol AB (A-ST)	Only the patients measured at admission showed A-AB ($p = 0.075$; the study defined significance at $p = 0.10$) which was greater than A-AB assessed at discharge
France					
Correlational					
Fridrici et al., (2012)	To investigate the effects of personalized alcohol-related words on A-AB in persons with alcohol dependence and control participants.	39 (13 F, 26 M) abstinent patients undergoing a rehabilitation day-program, 33 (13 F, 20 M) control	Alcohol dependence (DSM-IV), A-ST words (neutral, negative affect, general-alcohol, personalized-alcohol), time of measurement (Day 1; Day 2, 1 – 5 days after Day 1)	Alcohol AB (A-ST)	Alcohol-dependent participants did not exhibit a greater attentional bias to personalized alcohol cues than general cues
Germany					
Correlational					
Fridrici et al., (2014)	To examine attentional and memory biases in recently treated and abstinent persons with (Alc) and without major depression (D-Alc).	28 (6 F, 22 M) Alc persons, (13 F, 15 M) D-Alc persons, and 28 (12 F, 16 M) persons with moderate alcohol consumption as control.	Alcohol dependence (DSM-IV), major depression disorder (DSM-IV), duration of abstinence	A-AB (A-ST), memory bias (Directed Forgetting)	A-AB did not differ between the clinical and control groups, regardless of depression comorbidity.
Germany					
Correlational					
Hallgren 2013	To examine the effects of A-ST word sequences on drinking levels and drinking-related problems in college students who binge-drink.	84 (59 F, 25 M) students with at least one binge drinking episode in past month (>3 units/episode for women, >4 for men)	A-ST (mixed design), drinking intensity (episodic consumption), drinking behavior (TLFB - 90 days), Drinking-related problems (RAPI)	A-AB (A-ST)	Overall, participants exhibited a significant A-AB. A-AB did not vary by drinking frequency or drinking-related problems, but did differ by drinking intensity.
Unspecified					
Correlational					
Johnsen 1994	To examine the difference of A-AB between control group and persons with alcohol dependence.	18 men undergoing residential treatment for alcohol dependence, 18 male control	A-ST words (color interference, neutral, alcohol)	Stroop interference and A-AB (A-ST)	The clinical group showed significant A-AB (alcohol vs. neutral) that was larger than that for controls.
Norway					
Correlational					

Lusher 2004	To test A-AB in persons with alcohol dependence, and the effects of possible covariates and alcohol dependence severity on A-AB.	64 (10 F, 54 M) persons currently treated for alcohol dependence, 64 (30 F, 34 M) control	Group (alcohol vs. control), age, sex, mood (POMS-SF), school leaving age, dependence severity (SADQ), years of drinking, age of first alcohol use and related problems	A-AB (A-ST)	A-AB was higher in clinical vs. control group. A-AB was only related to group (patient vs. control) after adjusting for non-equivalent group characteristics. Dependence level was not associated with A-AB.
UK					
Correlational					
Ryan (2002)	To examine the difference of A-AB between control group and abstinent persons undergoing alcohol dependence treatment.	32 problem drinkers, 33 staff from same clinic as control. (Sex was not reported)	Dependence severity (SADQ), hospital-related distress (HADS), drinking behaviors	A-AB (A-ST, neutral and alcohol each administered twice; physical cards)	Both clinic and control subjects exhibited A-AB. A-ST was significantly associated with dependence.
UK					
Correlational					
Sanchez-Lopez et al. (2015)	To validate the Spanish version of A-ST.	88 (24 F, 64 M) persons with alcohol dependence and 85 (25 F, 60 M) persons with low risk alcohol consumption	Alcohol dependence severity (AUDIT), alcohol dependence (SCID-I)	Stroop interference (classic ST), A-AB (A-ST)	A-AB was higher in clinical vs control group.
Spain					
Correlational					
Sharma 2001	To examine the A-AB of persons with problem drinking and undergraduates with non-problem drinking.	20 (5 F, 15 M) persons in-treatment for problem drinking, 40 controls (20 (17 F, 3 M) high-drinkers, 20 F low-drinkers)	Drinking group (AUDIT; low, high, problem), A-ST word order, A-ST word-type, A-ST blocks, anxiety (STAI)	A-AB (A-ST)	Both clinical and high-drinking groups showed significant A-AB. A-AB was higher in clinical vs. control group.
UK					
Correlational					
Snelleman et al. (2016)	To examine whether in-treatment AB and Approach Avoidance (AA) can predict relapse outcomes.	50 (14 F, 36 M) persons in outpatient detoxification who have been abstinent for >2 weeks.	Attentional bias (A-ST) and approach bias (R-SRC) measured twice 4 weeks apart	Relapse status (self-report), time to relapse	20 (40%) participants relapsed, the mean time-to-relapse was 40 days after the first session. Overall, participants showed attentional and approach biases for alcohol-related stimuli, but neither biases predicted relapse nor time-to-relapse.
Netherlands					
Correlational					
Stetter et al., (1994)	To examine whether persons with alcohol dependence have a	30 men with alcohol dependence	Alcohol dependence (DSM-III-R, ICD-10)	Stroop interference (classic ST) and A-AB (A-ST), both	Classic ST, but not A-ST, was higher in clinical vs. control group.

Germany	perceptual processing bias.	and 20 men as healthy controls.		measured with cards & stopwatches	
Correlational					
Stetter et al. (1995)	To compare the A-AB between men with alcohol dependence and healthy controls.	40 men in inpatient alcohol dependence treatment with >1-wk abstinence, 40 male controls (social drinkers, <40g/day).	Alcohol dependence (DSM-III-R, ICD-10), ST word types (color interference, neutral, alcohol)	Stroop interference (classic ST) and A-AB (A-ST), both measured with cards & stopwatches	Both groups showed classic Stroop interference, but only the patient group showed A-AB.
Germany					
Correlational					
Stormark et al. (2000)	To investigate alcoholic persons' selective attention to alcohol words.	23 persons with alcohol dependence (2 F, 21 M), 23 controls without alcohol dependence (2 F, 21 M)	Current ICD-9 alcoholism diagnosis (yes vs. no)	Stroop interference (classic ST), A-AB (A-ST), skin conductance, heart rate	Persons with alcohol dependence (vs. controls) showed higher classic Stroop interference, A-AB, skin conductance, and smaller heart rate acceleration to alcohol words (vs. other categories).
Norway					
Correlational					
Van den Wildenberg et al. (2006)	To examine the effects of an ethanol-induced cardiac change on alcohol-related implicit arousal and approach biases, and on A-AB in heavy drinkers.	48 men from community drinking at least 15 units/week and 1 binge episode in past 2 weeks	Implicit alcohol associations (IAT; neutral, pleasant/unpleasant, active/quiet, approach/avoidance), A-AB (A-ST; color interference, neutral, alcohol).	Pre-/post-alcohol induction: Heart rate, BAC, mood (BAES every 15-mins, POMS at 30/90-mins), craving (VAS)	A-AB (blocked Stroop) and approach-biases (IAT) were positively correlated. A-AB was not correlated with HR change following alcohol.
Netherlands					

Table 1 Note: Entries above were reported in Szeto (2016). Outcome of cognitive tasks are presumed to be reaction times unless otherwise note.

A-AB = Alcohol Attentional Bias; A-ST = Alcohol Stroop Task; A-VP = Alcohol Visual Probe; A-AAB = alcohol approach-avoidance bias; DAQ = Desires for Alcohol Questionnaire; DRIE = Drinking-Related Internal–External Locus of Control Scale; DSM-III-R = Diagnostic and Statistical Manual of Mental Disorders - III - Revised; DSM-IV = Diagnostic and Statistical Manual of Mental Disorders – IV; HADS = Hospital Anxiety and Depression Scale; HR = heart rate; IAT = Implicit Association Test; ICD-10 = International Classification of Diseases – 10; ICD-9 = International Classification of Diseases – 9; PANAS = Positive Affect and Negative Affect Schedule; POMS-SF = Short Form of Profile of Mood States (POMS-SF); RAPI = Rutgers Alcohol Problem Index; RTCQ = Readiness to Change Questionnaire; SADQ = Severity of Alcohol Dependence Questionnaire; SCID-1 = Structured Clinical Interview for DSM-IV Axis I Disorders; SCQ = Situational Confidence Questionnaire; SIP = Short Inventory of Problems; STAI = State-Trait Anxiety Inventory; TAAD = Typical and Atypical Alcohol Diary;

VAS = Visual Analog Scale; ST = Stroop Task

Studies were identified using the search terms below:

AB (alcoholic* OR (alcohol* N2 (addict* OR “use disorder” OR dependen* OR abuse* OR hazardous drinking OR #patient OR hospital* OR detox*))
OR (drink* N3 (problem* OR heavy OR hazard* OR excess* OR (los* N2 control)))) AND ((alcohol* OR modif* OR adjust*) N5 stroop)

Table 2. Review of Alcohol Approach-Avoidance Implicit Association Test (AA-IAT) Studies of Adults with High Risk Drinking

Study Country Design	Purpose of Study	Participants	Independent Variables	Dependent Variables	Main Findings
Cohn et al (2012) US	To examine the interaction effects of mood arousal and drinking restraint on alcohol AA-IAT.	70 (35 F, 35 M) hazardous drinkers (for female: >2 drinks per occasion twice monthly, or >6 drinks weekly; >3, >13 for male)	Mood induction assignment, affect (PANAS), drinking restraint (TRI)	Alcohol approach tendency (AA-IAT; vs. water), craving (AUQ)	Trait restriction was associated with higher alcohol AA after controlling for covariates.
den Uyl et al. (2015) Netherlands	To examine the effects of transcranial direct current stimulation (tDCS) on alcohol-approach bias and craving	41 (26 F, 15 M) college hazardous drinkers (AUDIT > 8)	tDCS groups (left dorsolateral prefrontal cortex (DLPFC), right inferior frontal gyrus (IFG), and sham stimulation)	Alcohol-AA bias (AA-IAT; words), alcohol-affective valence (valence IAT), Craving (AAAQ)	At baseline, all 3 groups showed alcohol-negative association, and no AA bias. For both AA-IAT and valence IAT, tDCS did not change bias.
Gladwin et al. (2015) Germany	To examine if the mediating effects of approach bias between a CBM and relapse outcomes were cue-specific	214 (51 F, 163 M) patients in a residential treatment for alcohol dependence. Follow-up of Wiers et al. (2011) below	Groups (2 CBM & 2 controls; see Wiers et al. 2011 below), AA-IAT cue type (alcohol, soft drink, approach, avoid)	Cognitive bias (to 4 cue types: alcohol, soft drink, approach, avoid; measured by response accuracy), relapse outcome (yes or no)	When bias was assessed using accuracy data (rather than reaction time), the effect of CBM on relapse was mediated by bias assessed on the IAT.
Lindgren et al. (2015) US	To examine the effects of a self-reference-based alcohol Approach Avoid Task on in social drinks and at-risk drinkers (Studies 1 & 2)	Study 1: 295 (161 F, 133 M, 1 no-response) college social drinkers with (>0 heavy drinking episode last month) Study 2: 288 (150 F, 138 M) college at-risk drinkers (AUDIT >7)	Group assignment (A-AAT, alcohol-general identity (AGI-AAT), alcohol-personal identity (API-AAT)), pre-/post-training (1-wk apart for Study 1, <1-wk for Study 2)	Alcohol biases (reaction time; <u>A-AAT</u> , alcohol/water images; <u>AGI-AAT</u> & <u>API-AAT</u> both use alcohol words; <u>AGI</u> uses general identity words, and <u>API</u> words are self-chosen), craving (ACQ), alcohol self-efficacy (DRSE)	For both studies, AATs did not change alcohol biases assessed by AAT or IAT, nor craving or intention to drink.

Palfai et al. (2003) US Correlational	To examine alcohol-action tendencies with hazardous drinkers.	48 (19 F, 29 M) hazardous drinkers (AUDIT =+8), age 21-35, final participant	A-AA (AA-IAT), craving	alcohol consumption (TLFB 30-days), drinking related problems (YAAPST), alcohol dependence (AUDIT), drinking restraint (TRI), behavioral activation and inhibition (BIS/BAS), Affect, Positive Expectancies	AA-IAT was positively associated with binge drinking, difficulty controlling use, and appetitive responses to alcohol cues
Van den Wildenberg et al. (2006)* Netherlands	To examine the effects of an ethanol-induced cardiac change on alcohol-related implicit arousal and approach biases, and on A-AB in heavy drinkers.	48 men from community drinking at least 15 units/week and 1 binge episode in past 2 weeks	Implicit alcohol associations (IAT; neutral, pleasant/unpleasant, active/quiet, approach/avoidance), A-AB (A-ST; color interference, neutral, alcohol).	Pre-/post-alcohol induction: Heart rate, BAC, mood (BAES every 15-mins, POMS at 30/90-mins), craving (VAS)	A-AB (blocked Stroop) and approach-biases (IAT) were positively correlated. Stronger implicit associations between alcohol and arousal were associated with lower alcohol-induced HR.
Wiers et al. (2010) Netherlands	To test whether automatic action-tendencies to approach alcohol can be modified, and whether this affects drinking behavior.	42 male students with hazardous drinking randomly assigned to approach or avoid condition	Alcohol-related problems (AUDIT), urges to drink, alcohol consumption, number of heavy drinking episodes	Pre/post AAT, pre/post AA-IAT (pictures and words), urges to drink, beer consumption during in-lab taste test	After training, the avoid-condition had lower approach-bias toward alcohol (but not soda) in AAT, and stronger avoidant-tendency in AA-IAT. The changes generalized to untrained pictures. Those in avoid-condition drank less alcohol in a taste test.
Wiers et al. (2011) Germany	To test the effects of a cognitive-bias modification (CBM) that targeted an approach bias for alcohol	214 (51 F, 163 M) patients receiving residential treatment for alcohol dependence	Group assignment (2 experimental groups: explicit & instructions; 2 controls: only train to pull on soft drink, no training at all)	Approach bias to alcohol (A-AAT, AA-IAT; measured by reaction time)	The experimental groups displayed a change from approach to avoidance bias toward alcohol. The effect generalized to untrained pictures, and to the AA-IAT. The experimental conditions also showed better treatment outcomes a year later.

*Also reported in Table 1

Table 2 Note: Entries above were reported in Szeto (2016). Outcome of cognitive tasks is presumed to be reaction times unless otherwise noted.

A-AA = alcohol approach-avoidance; A-AB = alcohol attentional bias; A-ST = Alcohol Stroop Task; A-AAT = Alcohol Approach-Avoidance Task; AAT = Approach-Avoidance Task; AAAQ = Approach and Avoidance of Alcohol Questionnaire; ACQ = Alcohol Craving Questionnaire; AUDIT = Alcohol

Use Disorders Identification Test; AUQ = Alcohol Use Questionnaire; BAES = Biphasic Alcohol Effects Scale; BIS/BAS = Behavioral Inhibition Scale/Behavioral Activation Scale; IAT = Implicit Association Test; PANAS = Positive Affect and Negative Affect Schedule; POMS = Profile of Mood States - Short Form; TRI = Temptation and Restraint Inventory; VAS = Visual Analog Scale; YAAPST = Young Adult Alcohol Problems Screening Test

Studies were identified using the search terms below:

AB (alcoholic* OR (alcohol* N2 (addict* OR “use disorder” OR dependen* OR abuse* OR hazardous drinking OR #patient OR hospital* OR detox*)) OR (drink* N3 (problem* OR heavy OR hazard* OR excess* OR (los* N2 control)))) AND (((implicit association) N15 approach) OR (implicit association) AND approach AND avoidance)) = 5 □ 14 (9 eligible)

Table 3. Review of Mindfulness Attention Awareness Scale (MAAS) in Alcohol Studies of Adults with High Risk Drinking

Study & Design	Purpose of Study	Participants	Relevant Independent Variables	Relevant Dependent Variables	Main Findings
Adams et al. (2015) U.S. Correlational	To examine whether stress mediated TM's relationship with alcohol-related problems, & to examine TM as a moderator variable	399 (203 F, unspecified M) smokers from a study for smoking cessation *Not sampled from at-risk drinkers.	TM (MAAS), perceived psychosocial stress (PHQ-PSS)	Alcohol consumption, binge frequency, AUD, perceived stress (PSS), alcohol use (AQFQ)	TM was correlated negatively with alcohol consumption , frequency of binge episodes, AUD likelihood, and perceived stress when controlling for demographic & smoking variables. Perceived stress mediated the relationship between TM and AUD likelihood. Perceived stress was positively correlated with consumption & binge frequency in the low, but not medium or high TM groups.
Christopher et al. (2013) U.S. Correlational	To examine whether impulsivity mediated TM's relationship with alcohol-related problems, & to examine TM as a moderator variable	125 (84 F, 41 M) college students. Recruitment criteria unspecified.	TM (MAAS), impulsivity (EIS), past-month life events (ICSRLE)	Impulsivity (EIS), past-month life events (ICSRLE), alcohol use and related problems (RAPI)	TM was correlated negatively with impulsivity, life event stress, and alcohol-related problems . Impulsivity completely mediated TM's relationship with alcohol-related problems. TM did not moderate the relationship between life event stress and alcohol-related problems.
DeWall et al. (2014) U.S. Correlational	To examine the association between TM/religiousness with substance use. (Study 5 of 7 in the article)	210 (157 F, unspecified M) undergraduates. Recruitment criteria unspecified. (mostly "moderate drinkers").	TM (MAAS), religiousness (RCI), self-control (SCS-B)	Self-control (SCS-B), 21-day alcohol use (TLFB)	Baseline TM and religiousness both predicted less alcohol consumption for the next 3 weeks after controlling for each other.
López-Maya et al. (2015) Mexico Correlational	To validate the psychometric properties of a Mexican Spanish translation of MAAS.	622 (402 F, 220 M) "healthy" Mexican adults during MBSR intake.	TM (MAAS), demographic covariates including alcohol use	Exploratory and confirmatory factor analyses, TM (MAAS; FFMQ for concurrent validity)	The Mexican MAAS exhibited a single-factor structure and showed good psychometric properties. Alcohol drinkers had lower MAAS scores.
Lyvers 2014a Australia	To compare social drinkers and recently abstinent (>13 days) inpatients on TM	100 (42 F, 58 M) inpatients (21 = alcohol as primary concern) without neuropsychiatric	Clinical status, substance dependence (AUDIT; DUDIT)	TM (MAAS), negative affect (DASS-21), reward sensitivity (SPSRQ), frontal systems	Compared to the non-clinical group, and adjusting for age, gender, education level and serious head injury history, the clinical group was lower on TM, and higher on alexithymia and all traits. The groups did not differ on TM after adjusting for negative affect states.

Correlational		comorbidities; 107 (64 F, 43 M) community social drinkers as control		dysfunction (FrSBe), impulsivity (BIS-11), alexithymia (TAS-20)	
Lyvers 2014b	To examine the relationships between TM and mood, executive functions, emotion regulation, and alcohol use	153 (87 F, 66 M) undergraduates with unspecified recruitment criteria and non-random sampling	TM (MAAS)	Same DVs as Lyvers et al. (2014a) minus SPSRQ, negative affect regulation expectancy (NMR), alcohol dependence (AUDIT)	TM was not associated with AUDIT . Alexithymia, state-stress, and frontal system dysregulation predicted TM.
Australia					
Correlational					
Ögel et al. (2014)	To examine TM's relationship to substance hazardous drinking, factors that affect TM, in clinical and non-clinical population	191 (20 F, 170 M, 1 missing) patients receiving substance dependence treatment; 100 controls	Dependence status (SCID-I)	TM (MAAS), thought suppression (WBSI), metacognition (MCQ-30), emotion regulation (ERO), impulsivity (MMPI)	Clinical and non-clinical groups did not differ in TM, but did differ on other variables (impulsivity, thought suppression, metacognition, emotional regulation, and general health). *abstract in English, rest in Turkish
Turkey					
Correlational					
Pearson et al. (2015)	To examine whether decentering and purpose in life mediated the relationship between TM and health outcomes.	1277 (874 F, 389 M, 6 missing) undergraduates who responded to an ad for online survey about "personal beliefs"	TM (MAAS), decentering (EQ), purpose in life (LET)	Depressive symptoms (CESD-R), anxiety symptoms (PSWQ), alcohol-related problems (B-YAACQ)	Using SEM, TM had a direct effect on alcohol-related problems as well as an indirect effect through Decentering and Purpose in Life.
Shorey et al. (2014)	To examine the TM level of patients with substance abuse, & TM correlated with comorbidity.	125 (41 F, 84 M) patients admitted for residential treatment of substance abuse.	TM (MAAS)	Alcohol dependence (ADS), drug use disorder (DUDIT), depression, PTSD	Overall, TM was negatively associated with alcohol dependence (ADS) and substance use (DUDIT), depression, and PTSD.
U.S.					
Correlational					
Shorey et al. (2015a)	To examine TM's relationship with aggression from treatment intake records.	116 male inpatients received substance dependence treatment (63 = alcohol as primary & sole diagnosis)	TM (MAAS), substance use (AUDIT; DUDIT)	Aggression (PAI; physical, verbal, attitude, composite)	TM was negatively associated with alcohol and drug use, and positively associated with age. After controlling for age and alcohol/drug use, TM was negatively associated with verbal, attitudinal, and composite aggression.
U.S.					
Correlational					

Shorey et al. (2015b)	To examine how TM and spirituality related to depressive symptom clusters, using treatment intake records.	105 male inpatients received substance dependence treatment (64 = alcohol as primary & sole diagnosis)	TM (MAAS), spirituality (DSES), substance use (AUDIT; DUDIT)	Depressive symptoms by affective, cognitive, and physiological clusters (PAI)	TM and spirituality negatively correlated with depressive symptoms. After controlling for age, alcohol/drug use, and spirituality, TM predicted depressive symptoms.
U.S.					
Correlational					
Smith et al. (2011)	To examine the association between mindfulness and health outcomes in urban firefighters.	124 (unspecified F, 115 M) firefighters with unspecified recruitment criteria	TM (MAAS), firefighter variables (# of calls, stress, years), optimism (LOT-R)	PTSD symptoms (PDS), depressive symptoms (BDI-II), physical symptoms (PHQ-15), alcohol problems (AUDIT)	TM negatively correlated with health outcomes (depressive, PTSD, physical symptoms, and alcohol-related problems) after controlling for resilience measures (optimism, personal mastery, social support), firefighter variables (calls attended, number of job-related stressors, years of service), and demographics.
U.S.					
Correlational					

Table 3 Note: Entries above were reported in Szeto (2016).

ATT = Attitudes Towards Treatment; BSI = Brief Symptom Inventory; FFMQ = Five Facet Mindfulness Questionnaire; HRV = Heart Rate Variability; IRISA = Impaired Alcohol Response Inhibition Scale; MORE = mindfulness-oriented recovery enhancement; PSS-10 = Perceived Stress Scale; SCQ = Situational Confidence Questionnaire; VAS = visual analogue scale; VPT = visual probe task,

Table 4. Review of Studies that Report MAAS Scores

Study & Design	Location MAAS Language	Participants	Other Variables	Baseline MAAS Mean (SD)	Correlates of MAAS
Adams et al. (2015)	U.S. English	399 AA smokers (ages 21-65) in a smoking cessation study	age, gender, partner status, income	All: 4.29 (1.03) High: 5.42 (0.48) Med: 4.30 (0.31) Low: 3.11 (0.56)	MAAS positively associated with age, partner status, income
López-Maya et al. (2015)	Mexico Mexican Spanish	“Healthy participants” from online (n=564) & in-person (n=63)	age, gender, education, partner status, employment status, practice sports, family, TV viewing, religion & practice, smoking, drinking	4.1 – 4.5 for 23 out of the 28 mean scores presented	MAAS scores differed by religion (“Christian” ~ “Catholic” > “none”), religious practice (“yes” > “no”), & drinking (“no” > “yes”).
Lyvers et al., 2014a	Australia English	Two groups per current substance dependence treatment: inpatients (n=100) and local social drinkers (n=107)	age, gender, education	Clinical: 3.36 Control: 3.91	MAAS positively associated with education
Lyvers et al., 2014b	Australia English	153 students from 1 university (n=46 with alexithymia & borderline-alexithymia)	age, gender, education	Clinical: 3.50 Control: 4.09	MAAS positively associated with age; women had higher MAAS
Ögel et al. (2014)	Turkey Turkish	2 groups by substance dependence: not dependent (n=100) vs. dependent (n=191)	age, gender, education	Clinical: 4.06 (0.99) Control: 4.16 (0.77)	Not presented
Shorey et al. (2014)	U.S. English	125 inpatients of substance abuse treatment	age, gender, race, ethnicity, education, prior mindfulness experience	All: 4.09 (1.03) Only MDD: 4.50 (1.03) Only PTSD: 4.11 (0.94) MDD + PTSD: 3.31 (0.89)	Women were higher on MAAS
Shorey et al. (2015a)	U.S. English	119 male inpatients of substance abuse treatment	age, spirituality	4.32 (0.99)	MAAS positively correlated with age
Shorey et al. (2015b)	U.S. English	105 of the sample from Shorey et al. (2015a)	Same as Shorey et al. (2015a)	4.32 (0.99)	MAAS positively correlated with age and spirituality

Smith et al. (2011)	U.S. English	124 metropolitan professional firefighters	age, education, income	4.40 (0.85)	Age, education, and income were not correlated with MAAS
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Table 5. Review of Ecological Momentary Assessment Studies of Adults with High Risk Drinking

Study & Country & Design	Purpose of Study	Participants	Relevant Independent Variables	Relevant Dependent Variables	EMA Protocol	Main Findings
Collins et al. (1998) U.S. Correlational	To assess predictors of self-reported excessive drinking (>5 drinks) in heavy drinkers	37 (15 F, 22 M) heavy drinkers (4 – 11, or ≥ 12 drinks per week) without prior substance use diagnoses or treatment	<u>Lab</u> : Treatment condition (moderation training/no); drinking history & pattern (GIQ), temptation & constraint (TRI) <u>EMA</u> : drinking episode, # of drinks, mood ratings, week-in-study	Mean # of drinks/week, excessive drinking	<u>Device</u> : PDA (Psion® LZ-64) <u>Interface</u> : Native app <u>Frequency</u> : <7/day, within-day timeframe unspecified, 8 wks <u>Trigger</u> : random time; self-initiated in morning, start & end of drinking episode	Drinking and post-drinking positive mood decreased in both groups over time. Excessive drinking was correlated with drinking history, age of drinking onset, and weekend drinking during treatment.
Cooney et al. (2007) U.S. Correlational	To examine the associations of alcohol and smoking craving with drinking and smoking relapse in individuals attempting to quit both	102 (15 F, 87 M) alcohol-dependent smokers	<u>EMA</u> : Nicotine dependence, smoking and drinking urges, mood, alcohol and cigarette consumption, drinking pattern	Smoking and drinking abstinence	<u>Device</u> : PDA (Psion® LZ-64) <u>Interface</u> : Native app <u>Frequency</u> : 4 RA/day; 14 days <u>Trigger</u> : random-time; self-initiated before smoking.	Alcohol craving was low and not different between smokers and non-smokers, and did not predict alcohol relapse .
Dulin et al. (2014) U.S. Correlational (all received intervention)	To assess the preliminary efficacy of Location-Based Monitoring and Intervention for Alcohol Use Disorders (LBMI-A)	28 (13 F, 15 M) drinkers meeting DSM-5 AUDs, motivated to change drinking (see article for more criteria.)	<u>Lab</u> : alcohol consumption (TLFB; pre/post-EMA); change motivation (URICA)	<u>EMA</u> : # of self-initiated craving & drink reports (“Tools”), craving & # drinks	<u>Device</u> : Smartphone (HTC Tilt 2®) <u>Interface</u> : Native app <u>Frequency</u> : N/A <u>Trigger</u> : Self-initiated info for psycho-ed info; alerts per self-defined geo-beacon	Overall, mean # of craving episodes was 12.1, and reductions were seen in days of heavy drinking (56% to 25%), drinks/day (by 52%), & drinks per drinking-day (by 14.6%). *Note: Unit of mean # of craving unclear; freq of geo-beacon trigger unreported.
Fatseas et al. (2015) France Correlational	To examine the association of substance-specific and	132 (42 F, unspecified M) outpatients with SUDS at	<u>Lab</u> : addiction severity (ASI; ISR); personal drug-cues	<u>EMA</u> : cue exposure, craving, drug use	<u>Device</u> : PDA <u>Interface</u> : Native app <u>Frequency</u> : 4/day; 8am-11pm; 2 weeks <u>Trigger</u> : fixed	Craving intensity elicited by person-specific cues mediated the relationship between cues and drug use on the same day.

	personal cues with craving and use	admission (39 AUDs)	<u>EMA</u> : cue type (drug-specific vs. person-specific)			
Holt et al. (2012) U.S. Correlational	To examine relapse to smoking and drinking in treatment for concurrent alcohol and tobacco use	48 (13 F, 35 M) with a least one smoking (n=32) and/or drinking lapse (n=29)	<u>EMA</u> : Smoking and drinking urges, abstinence self-efficacy in smoking and drinking	Smoking and drinking relapse status (14-day and 28-day EMA, respectively).	<u>Device</u> : Cell Phones <u>Interface</u> : Interactive voice response system <u>Frequency</u> : 5 RA/day; 14 and 28 days <u>Trigger</u> : random-time.	Smoking urge predicted smoking (but not drinking) lapses. Drinking urge did not predict lapses to either drug.
Huntley et al. (2015) U.S. Correlational	To examine the temporal relationships between drinking and hangovers, and how this varied by age and sex	274 (125 F, 149 M) non-treatment seeking drinkers from 4 studies. Sample 4 (Tidey et al. (2008)) = 172 binge drinkers	<u>Lab</u> : age, sex, alcohol consumption (90-days TLFB) <u>EMA</u> : alcohol consumption (past-day recall), hangover (AHS). Note: analysis included only 4 – 14 days; some studies were longer	<u>EMA</u> : alcohol consumption (past-day recall), hangover (AHS)	<u>Device</u> : PDA <u>Interface</u> : Native app <u>Frequency</u> : varied <u>Trigger</u> : varied	Prior-day alcohol consumption was correlated positively with hangover severity. Younger age and/or more consumption strengthened the relationship. Hangover severity predicted less consumption the same-day but only on drinking days.
Krahn et al. (2005) US Correlational	Cluster analysis of urges	45 male alcohol dependent outpatients	<u>EMA</u> : cluster membership	Craving, negative affect (NA), relapse status at 6-month follow-up	<u>Device</u> : PDA <u>Interface</u> : Native app <u>Frequency</u> : 4 RA/day; 14 days <u>Trigger</u> : random-time; self-initiated before and after alcohol use	Cluster analysis of Mean and SD of urges yielded 4 clusters. The largest cluster (n = 29) reported low mean and variability of urge.
Kuerbis et al. (2013) U.S. Intervention	To examine whether EMA measures of motivation & self-efficacy predict drinking levels	89 (47 F, unspecified M) problem drinkers without excluded psychiatric and life conditions	<u>EMA</u> : Confidence & commitment to reduce drinking (DDC) <u>Lab</u> : Group assignment (2 treatment, 1 control), Self-report measures	<u>Lab</u> : TLFB: drinks, drinking days, drinks per drinking day	<u>Device</u> : Toll-free number <u>Interface</u> : IVR (Interactive voice recording) <u>Frequency</u> : 1/day, 8 weeks <u>Trigger</u> : self-initiated during 4-10PM	Alcohol consumption, drinking days, and drinks per drinking-day at Week 8 were predicted by DDC at baseline & Week 8, and by change in lab self-report measures
Kuerbis et al. (2014) U.S. Intervention	Cluster analysis of confidence & commitment to change ratings during EMA	Same as Kuerbis et al. (2013)	<u>EMA</u> : Cluster analysis of confidence & commitment to change drinking (DDC)	<u>Lab</u> : TLFB: drinks, drinking days, drinks per drinking day	Same as Kuerbis et al. (2013)	Cluster analysis revealed 3 clusters for confidence & commitment to change (high, moderate, low). Rate of drink reduction was greatest in the high confidence & commitment cluster.

Litt et al. (1998) U.S. Correlational	To assess the feasibility of EMA, and to compare results from EMA and lab measures.	27 men treated for alcohol abuse in an inpatient program	EMA vs. “Non-EMA” (control) group (81 participants who did not complete EMA)	<u>Lab</u> : 2 cue exposure trials <u>EMA</u> : Craving, mood	<u>Device</u> : Watches, note cards, and pen <u>Interface</u> : Note cards <u>Frequency</u> : 8 RA/day; 21 days <u>Trigger</u> : random-time; self-initiated upon conscious drinking urge	Compliance rate was 81%. Mean urge was lower in EMA (0.67) than lab cue exposure sessions (4.48). Drinking level of EMA participants was not greater than control “Non-EMA” participants
Litt et al. (2000) U.S. Correlational	To search for predictors of alcohol craving in lab and field settings, and to examine cue-related craving and drinking after treatment.	26 male veterans recently treated for alcohol dependence in inpatient (n=5) or outpatient (n=21)	<u>Lab</u> : cued-craving to drinks & imagery (saliva, self-rated urge) <u>EMA</u> : date/time, urges (% & mean; non-0 rating in >10% of total RAs or >0 RA/day), mood, situation, drinking triggers	<u>EMA</u> : urge to drink (yes/no), self-reported alcohol consumption (drinking days & intensity)	<u>Device</u> : PDA (Psion LZ-64) <u>Interface</u> : Native app <u>Frequency</u> : 8 RA/day; 21 days <u>Trigger</u> : random-time	Cued-craving in lab accounted for 8-10% variance of drinking & urges in EMA. Proportion and mean of urges in EMA was positively correlated with proportion of drinking-days . Those who reported urges in EMA had higher dependence, and lab cue-reactivity.
Mitchell 2012 Canada Intervention	To examine the effects of Levetiracetam (Keppra) on moderate to non-treatment seeking heavy drinkers.	46 (sex not specified) persons who responded to recruitment of “heavy social drinkers”	<u>Lab</u> : Group assignment (placebo-low dose, placebo-moderate dose, low dose-placebo, moderate dose-placebo), alcohol hazardous drinking (AUDIT, DUSI, KMSK)	<u>EMA</u> : number of drinks	<u>Device</u> : PDA (Psion LZ-64) <u>Interface</u> : Native app <u>Frequency</u> : 1/day, 42 days <u>Trigger</u> : self-initiated recall of yesterday’s number of drinks, medications use, illnesses, adverse effect, any relevant notes	Levetiracetam did not change drinking in any group. Levetiracetam tended to increase in lower drinking subjects
Ray et al. (2010) U.S. Correlational	To examine how genotype relates to drinking urges and subjective response to alcohol.	112 (58 F, 44 M) non-treatment-seeking heavy drinkers (68 with alcohol dependence)	<u>EMA</u> : <i>before each drinking episode</i> eBAC, mood, urge <u>Lab</u> : Status of Asp40 allele of OPRM1 gene and L allele of DRD4 gene	<u>EMA</u> : <i>after drinking episode</i> : mood, urge; alcohol consumption (eBAC)	<u>Device</u> : PDA <u>Interface</u> : Native app <u>Frequency</u> : 5 RA/day; 5 days <u>Trigger</u> : random-time; self-initiated in the morning, and before and after the first two drinks of each episode	Genotype and eBAC were not associated. Asp40 allele carriers reported higher vigor and lower negative mood post-drinking than non-carriers.
Serre et al. 2012 France	To examine the feasibility and validity of computerized ambulatory	109 (34 F, unspecified M) outpatients with primary dependence in	<u>Lab</u> : addiction severity (ASI), anxiety (BAI), depression (BDI)	<u>Lab</u> : Acceptance rate <u>EMA</u> : drug use, mood,	<u>Device</u> : PDA <u>Interface</u> : Native app <u>Frequency</u> : 4 RAs during 8 AM and 11 PM; 2 weeks	ASI (lab) was correlated with drug use (EMA), BAI (lab) was correlated with anxious mood (EMA) & BDI (lab) was

Correlational	monitoring in outpatient setting	alcohol (38) & other drugs.		RA compliance & pattern	<u>Trigger</u> : randomized by time between participants,	correlated with sad mood (EMA)
Tidey et al. (2008)	RCT for Naltrexone (NTX) on drinking urge, consumption, time between drinks, and the moderators of NTX	180 (78 F, 102 M) heavy drinkers (113 with alcohol dependence). 88 in NTX and 85 in placebo groups	<u>Lab</u> : Group (NTX vs. placebo), moderators (family history of alcoholism, onset age of alcoholism, carrier statuses of DRD4-L and Asp40)	<u>EMA</u> : type and number of drinks from previous day, urge, and alcohol effects	<u>Device</u> : PDA <u>Interface</u> : Native app <u>Frequency</u> : 5 RA, morning, use-episode; 25 days, first 5 days were baseline <u>Trigger</u> : random-time; self-initiated (each morning, and before and after the first two drinks of each episode)	NTX group reported lower mean-percent of drinking days (57.2%) vs. the placebo group (65.1%) after adjusting for baseline. Naltrexone's effects were moderated by DRD4 (but not OPRM1), family history proportion, age of onset. About 78% of first drinks of the day involved a second drink.
Todd et al. 2005	To examine if dispositional coping motive to drink predicted and moderated EMA of DTC & drinking motives,	98 (49 F, unspecified M) heavy drinkers *See study for exclusion criteria	<u>Lab</u> : dispositional coping motives to drink survey (DTC)	<u>EMA</u> : mood, interpersonal problems, intensity (peak days) drinking to cope (yes/no),	<u>Device</u> : PDA <u>Interface</u> : Native app <u>Frequency</u> : 3 RAs; 21 days <u>Trigger</u> : random-time; self-initiated (before each drinking episode)	Dispositional DTC was positively correlated with EMA DTC. It generally did not moderate the within-day associations between mood, interpersonal problems, & drinking.
Todd et al. 2009	To examine how early day negative mood/stress affects time-to-next-drink that day.	97 (48 F, unspecified M) "potentially hazardous" drinkers	<u>EMA</u> : morning mood, interpersonal problems <u>Lab</u> : same as Todd et al. (2009)	<u>EMA</u> : same-day time-to-next-drink (TTND)	<u>Device</u> : PDA <u>Interface</u> : Native app <u>Frequency</u> : 3 RAs; 21 days <u>Trigger</u> : random-time; self-initiated (before each drinking episode)	Early day negative moods were generally correlated negatively with same day TTND . The relationships were generally strengthened by DTC.
Voogt et al. 2013	To assess the effect of a fully automated & self-administered web-based training ("What Do You Drink," WDYD) to curb drinking.	907 (547 M, unspecified F) young adult heavy drinkers	<u>Lab</u> . Group assignment: WDYD (single-session) vs. control	<u>EMA</u> : weekly alcohol consumption, binge drinking, heaving drinking	<u>Device</u> : Survey website ("Perseus Survey Solutions 6") <u>Interface</u> : Website <u>Frequency</u> : 1/Monday for 30 weeks (4 weeks = pre-intervention, 26 = post-intervention). <u>Trigger</u> : Email trigger with survey instructions	Treatment (vs. control) reduced alcohol consumption (weeks 1-4 & 7), frequency of binge drinking (weeks 1, 2, 7, 12), and heavy drinking status (weeks 1, 2, 7, 16).
Voogt et al. 2014a	To whether the effects of WDYD on drinking were sustained	Same as Voogt et al. (2013)				Treatment (vs. control) reduced alcohol consumption & binge drinking at 1, 3, 6 months.

Intervention						
Voogt et al. 2014b	To assess the effect of WDYD on drinking refusal self-efficacy (DRSE), and DRSE's correlation with drinking.	Same as Voogt et al. (2013)		<u>EMA</u> : weekly alcohol consumption, binge drinking, drinking refusal self-efficacy (DRSE)	Same as Voogt et al. (2013)	Treatment increased the social pressure aspect of SRSE for 6-mon. The social pressure of SRSE aspect was negatively correlated to binge drinking.
Netherlands						
Intervention						
Witkiewitz et al. 2014	To examine the effect of an ecological momentary intervention for heavy episodic drinking (HED) & smoking.	94 (26 F, 68 M) non-treatment seeking heavy drinking college students who smoke	<u>Lab</u> : Groups assignment (EMI & EMA (BASICS); EMA only; minimal assessment with neither)	<u>Lab</u> : smoking (DSQ), drinking (DDQ)	<u>Device</u> : Blackberry Smartphone PDA <u>Interface</u> : Native App <u>Frequency</u> : 3 RAs/day, 14 days. <u>Trigger</u> : Random triggers. Morning (10:00a-1:00p), afternoon (2:00p-5:00p) and evening (6:00p-9:00p)	BASICS & EMA (vs. minimal assessment) reduced reported smoking and drinking at 1-month
US						
Intervention						

Table 5 Note: Entries above were reported in Szeto (2016).

AHS = Acute Hangover Scale; ASI = Addiction Severity Index; AUD = Alcohol Use Disorders; AUDIT = Alcohol Use Disorders Identification Test; BAC = blood alcohol content; BDI = Beck Depression Inventory; GSR = galvanic skin response; HED = heavy episodic drinking; KMSK = Kreek-McHugh-Schluger-Kellogg Scale; NA = negative affect; PDA = personal digital assistant; RA = random assessment; TRI = Temptation and Restraint Inventory; TTND = time to next drink; URICA = University Rhode Island Change Assessment Scale

Studies were identified using the search terms below:

AB ((alcohol* N2 (addict* OR (use disorder) OR dependen* OR abuse* OR misuse)) OR (drink* N3 (problem* OR heavy OR hazard* OR excess* OR (los* N2 control)))) AND ((ecological W2 momentary) OR (experiential W2 sampling) OR (ambulatory W2 assessment) OR (electronic W2 diary) OR mobile OR (real W2 time) OR daily) = 30

Table 6. Review of Compliance in Ecological Momentary Assessment Studies of Adults with High Risk Drinking

Study Country Design	Compliance	Incentives	Compliance on Random Assessments (RAs)	Compliance on Fixed Time Assessments
Collins et al. (1998) U.S. Intervention	2 participants dropped due to poor compliance 4 dropped due to problems doing EMA	Study: Max \$120	84.4% (estimated)	N/A
Cooney et al. (2007) U.S. Intervention	16 participants dropped for non-completion of RAs	Day: \$5 Visits: \$15	73%*	N/A
Dulin et al. (2014) U.S. Intervention	Not mentioned.	Amount not specified	N/A	Compliance not reported
Fatseas et al. (2015) France Correlational	Same protocol as Serre et al. (2012), except excluded first/last EMA days	Study: Max €100 with compliance	85.9%*	N/A
Holt et al. (2012) (Sample 4) U.S. Correlational		RA: \$0.5 Bonus: each 5/5 RAs/day = \$5 Study: Max \$210	65%	N/A
Huntley et al. (2015) U.S. Correlational	Not mentioned. (Analysis pooled from 4 samples, Tidey et al. (2008) was 4 th)	N/A	N/A	N/A
Krahn et al. (2005) US Correlational	13.5% “non-compliant” (completed < 50% of RAs); 20.5% PDA malfunctioned	Not mentioned.	66% (includes non-compliant subjects)	N/A
Kuerbis et al (2013) U.S. Intervention	Not mentioned.	Not mentioned.	N/A	Compliance not reported (“at least 19 individuals missing some data at Week 8”)

Kuerbis et al (2014) U.S. Intervention	Same sample & protocol as Kuerbis et al. (2013), except this study excluded 4 of 84 persons with >3 missing data-days in 1 st week.	Not mentioned.	N/A	Compliance not reported
Litt et al. (1998) U.S. Correlational	UIA: # of UIA vs. # of events in end-of-day report or 3-week recall	Day: \$5	81%	
Litt et al. (2000) U.S. Correlational	RA: # of responses vs. # of prompts	Day: \$5 Contact: 1 reminder/week	90%	N/A
		(Total of 8 assessments/day)		
Mitchell 2012 Canada Intervention	Not mentioned.	Not mentioned.	N/A	N/A
Ray et al. (2010) U.S. Correlational	Subset of sample from Tidey et al. (2008), same protocol.		RA: Not specified.	Not mentioned.
Serre et al. 2012 France Correlational	SRA: average response rate to prompts. P-C = completed >75% of their own SRAs.	Study: Max €100 with compliance. Contact: 2 reminders.	81.2%*	N/A
Tidey et al. (2008) Netherlands Intervention	RA: P-C = 1. Completed >50% RAs/week. 2. Had not used the “sleep” function to suspend RAs >13hrs for >3 days/week. 3. Had not used the “suspending” function for >14 hrs/ week	Study: Not specified. (Total of 9 assessments/day. Max \$599 including incentive for medication adherence.)	79% (Removed 11% of total EMA data contributed by persons non-compliant with medication)	Morning Reports: 94% overall
Todd et al. (2005) U.S. Correlational	Not specified.	Study: Max \$450 (including visits, bonus, etc)..	RA: Not specified. (Est. from article 89.4% RAs + 7.1% make-up by paper-pencil).	N/A
Voogt et al. (2013) Netherlands Intervention	Not specified.	Not specified.	N/A	Monday Mornings: Not mentioned. (18% attrition rate)
Voogt et al. (2014) Netherlands	Same sample, protocol, data validation as Voogt et al. (2013)	FA: €100 for >27/30 FAs	Same sample, protocol, data	(11% responded 1-2 days late)

Intervention			validation as Voogt et al. (2013)	
Witkiewitz et al. (2014)	RA/UIA: Not specified.	RA: \$3 Bonus: \$21/week with >2/3 RAs/day UIA: none. Visits: \$50	83.5%.	N/A
US Intervention				

Table 6 Note: N/A = not applicable; NA = negative affect; RA = random assessment; TA = temptation assessment; UIA = user-initiated assessment

Studies were identified using the search terms below:

AB ((alcohol* N2 (addict* OR (use disorder) OR dependen* OR abuse* OR misuse)) OR (drink* N3 (problem* OR heavy OR hazard* OR excess* OR (los* N2 control)))) AND ((ecological W2 momentary) OR (experiential W2 sampling) OR (ambulatory W2 assessment) OR (electronic W2 diary) OR mobile OR (real W2 time) OR daily) = 30

Table 7. Stimuli Words for the Stroop Task (Szeto, 2016)

ALCOHOL WORDS		NEUTRAL WORDS	
<u>Dutch</u>	<u>English</u>	<u>Dutch</u>	<u>English</u>
BIER	BEER	LAMP	LAMP
WIJN	WINE	LIJM	GLUE
ALCOHOL	ALCOHOL	COMPUTER	COMPUTER
COCKTAIL	COCKTAIL	PLAKBAND	TAPE
TEQUILA	TEQUILA	POTLOOD	PENCIL
COGNAC	COGNAC	SCHAAR	SCISSORS
SHERRY	SHERRY	BUREAU	OFFICE
DRANKJE	DRINK	STIFT	MARKER
LIKEUR	LIQUEUR	PAPIER	PAPER
GIN	GIN	PEN	PEN
CAFÉ	CAFÉ	GUM	ERASER

Table 8. Stimuli Words for the Approach-Avoidance Implicit Association Test

“ALCOHOL” (ALCOHOL)		“NEUTRAAL” (NEUTRAL)		“benaderen” (approach)		“vermijden” (avoidance)	
<u>Dutch</u>	<u>English</u>	<u>Dutch</u>	<u>English</u>	<u>Dutch</u>	<u>English</u>	<u>Dutch</u>	<u>English</u>
WHISKEY	WHISKEY	COLA	COKE	grijpen	grab	verdwijnen	disappear
RUM	RUM	FANTA	FANTA ORANGE	aannemen	take	ontwijken	dodge
WODKA	VODKA	SINAS	ORANGE SODA	aanraken	touch	verwijderen	remove
BIER	BEER	APPELSAP	APPLEJUICE	verkrijgen	acquire	vluchten	flee
WIJN	WINE	WATER	WATER	toetreden	join	mijden	avoid
BORREL	LIQUOR	SAP	JUICE	bemachtigen	grasp	omzeilen	bypass
CHAMPAGNE	CHAMPAGNE	SEVEN-UP	7-UP	ophalen	pick up	ontduiken	evade
TEQUILA	TEQUILA	SIROOP	SYRUP DRINK	vastgrijpen	grip	ontlopen	outrun
COGNAC	COGNAC	CASSIS	BLACKCURRANT DRINK	beetnemen	capture	ontkomen	escape
SHERRY	SHERRY	IJSTHEE	ICED TEA	aankomen	arrive	ontsnappen	escape
CIDER	CIDER	FRISTI	FLAVORED MILK	naderen	approach	afwenden	avert

Table 8 Note: Words used each of the four categories, reported in Szeto (2016)

Table 9. Table Summary Statistics

	n1	n2	Mean/%	SD	Min	Max
Baseline Data						
Age (years)	n/a	43	48.47	10.82	25	56
Gender	n/a	43				
Male			69.77%			
Female			30.23%			
Education	n/a	43				
High School			25.58%			
Vocational Education			25.58%			
Community College			27.91%			
University			16.28%			
Other			4.65%			
Smoking						
Yes	n/a	43	65.12%			
No			34.88%			
Baseline MAAS (1-6)	n/a	43	3.94	0.91	1.73	6.00
Compliance Data*						
Number RAs Completed	n/a	43	43.99	20.03	3	75
Compliance on RAs (%)	n/a	43	71.29	20.95	24.14	100.00
Number TAs Completed	n/a	43	3.49	4.66	0	21
Total Number Assessments Completed	n/a	43	46.98	20.08	5	91

EMA Data

Tempted Now (1-7)	2020	43	1.77	1.50	1	7
Drinking (1-5)	2019	43	1.23	0.78	1	5
Stress (1-5)	2018	43	1.52	0.84	1	5
Negative Affect (1-5)	2019	43	1.41	0.67	1	5
Alcohol Stroop Effect (ms)	1044	43	14.99	105.37	-673.00	610.50
IAT (D Score)	931	43	-0.021	0.47	-1.48	1.40

Table Note: MAAS = Mindful Attention Awareness Scale; RA = Random Assessment; TA = Temptation Assessment. *N* = 43 reflects number of subjects; *Ns* for EMA data reflect number of assessments. *Four participants did not complete the 4-week protocol but provided partial data *n*₁ = no. assessments (level 1); *n*₂ = number of subjects (level 2). Participants were recruited from three locations, Leiden (*n*=19), Zoetermeer (*n*=14), and Hoofddorp (*n*=10).

Table 10. Results of LMMs for Specific Aim 1

DV →					Tempted Now					Drinking			
IV ↓	H	<i>n</i> ₁	<i>n</i> ₂	<i>df</i>	<i>PE</i>	<i>SE</i>	<i>F</i>	<i>P</i>	<i>df</i>	<i>PE</i>	<i>SE</i>	<i>F</i>	<i>P</i>
MAAS as Predictor													
MAAS	1.1	2020	43	1, 1975	-0.40	0.17	5.31	.02	n/a	n/a	n/a	n/a	n/a
MAAS	1.2	2019	43	n/a	n/a	n/a	n/a	n/a	1, 1974	-0.18	0.11	2.59	.11

Table Note: *n*₁ = no. assessments; *n*₂ = number of subjects. H = Hypothesis; *PE* = parameter estimate; *SE* = standard error; *F* = F value from LMM. Covariates were Age, Gender, Day, and Assessment Type (TA vs. RA) (Parameter estimates for covariates not shown). Coefficients for Day and Assessment Type were fixed, following the guidance of Schwartz & Stone (2007)

Table 11. Results of LMMs for Specific Aim 2

Path→ IV ↓	DV	H	Path	<i>n</i> ₁	<i>n</i> ₂	<i>df</i>	<i>PE</i>	a <i>SE</i>	<i>F</i>	<i>P</i>	<i>df</i>	<i>PE</i>	b <i>SE</i>	<i>F</i>	<i>p</i>
Mediation															
MAAS	Stress	2.1	a1	2018	43	1, 1973	-0.08	0.11	0.65	.42	n/a	n/a	n/a	n/a	n/a
MAAS	NA	2.1	a1	2019	43	1, 1974	-0.12	0.09	1.59	.21	n/a	n/a	n/a	n/a	n/a
MAAS	Stroop	2.2	a1	1044	43	1, 999	4.06	4.61	0.77	.38	n/a	n/a	n/a	n/a	n/a
MAAS	IAT	2.2	a1	931	43	1, 886	-0.05	0.06	0.56	.45	n/a	n/a	n/a	n/a	n/a
MAAS	Tempted Now		a2 ¹	2020	43	1, 1975	-0.33	0.16	4.37	.04	n/a	n/a	n/a	n/a	n/a
MAAS	Tempted Now		a2 ²	2020	43	1, 1974	-0.32	0.17	3.64	.06	n/a	n/a	n/a	n/a	n/a
MAAS	Tempted Now		a2 ³	2020	43	1, 1975	-0.39	0.18	4.81	.03	n/a	n/a	n/a	n/a	n/a
MAAS	Tempted Now		a2 ⁴	2020	43	1, 1975	-0.38	0.17	4.68	.03	n/a	n/a	n/a	n/a	n/a
Mean Stress	Tempted Now	2.1	a3	2020	43	1, 1975	0.80	0.23	12.1	.001	n/a	n/a	n/a	n/a	n/a
Mean NA	Tempted Now	2.1	a3	2020	43	1, 1974	0.69	0.28	6.17	.01	n/a	n/a	n/a	n/a	n/a
Mean Stroop	Tempted Now	2.1	a3	2020	43	1, 1975	-0.002	0.005	0.24	.62	n/a	n/a	n/a	n/a	n/a
Mean IAT	Tempted Now	2.1	a3	2020	43	1, 1975	0.44	0.45	0.94	.33	n/a	n/a	n/a	n/a	n/a
Mean Stress	Drinking	2.1	b1	2019	43	n/a	n/a	n/a	n/a	n/a	1, 1974	-0.24	0.12	4.34	.04
Mean NA	Drinking	2.1	b1	2019	43	n/a	n/a	n/a	n/a	n/a	1, 1973	-0.27	0.13	4.63	.03
Mean Stroop	Drinking	2.2	b1	2019	43	n/a	n/a	n/a	n/a	n/a	1, 1974	-0.001	0.002	0.14	.71
Mean IAT	Drinking	2.2	b1	2019	43	n/a	n/a	n/a	n/a	n/a	1, 1973	0.21	0.19	1.27	.26
Mean Tempted Now	Drinking	2.1, 2.2	b2 ¹	2019	43	n/a	n/a	n/a	n/a	n/a	1, 1974	0.52	0.07	55.28	.001

<i>Mean Tempted Now</i>	Drinking	2.1, 2.2	b2 ²	2019	43	n/a	n/a	n/a	n/a	n/a	1, 1973	0.49	0.06	59.69	.001
<i>Mean Tempted Now</i>	Drinking	2.1, 2.2	b2 ³	2019	43	n/a	n/a	n/a	n/a	n/a	1, 1974	0.46	0.07	48.18	.001
<i>Mean Tempted Now</i>	Drinking	2.1, 2.2	b2 ⁴	2019	43	n/a	n/a	n/a	n/a	n/a	1, 1973	0.45	0.07	47.32	.001
MAAS	Drinking	2.1, 2.2	c' ¹	2019	43	n/a	n/a	n/a	n/a	n/a	1, 1974	0.02	0.07	0.08	.78
MAAS	Drinking	2.1, 2.2	c' ²	2019	43	n/a	n/a	n/a	n/a	n/a	1, 1973	0.00	0.07	0.00	.96
MAAS	Drinking	2.1, 2.2	c' ³	2019	43	n/a	n/a	n/a	n/a	n/a	1, 1974	0.01	0.08	0.04	.85
MAAS	Drinking	2.1, 2.2	c' ⁴	2019	43	n/a	n/a	n/a	n/a	n/a	1, 1973	0.02	0.08	0.24	.81

Table Note: n₁ = no. assessments; n₂ = number of subjects. H = Hypothesis; PE = parameter estimate; SE = standard error; F = F value from LMM. Covariates were Age, Gender, Day, and Assessment Type (TA vs. RA) (Parameter estimates for covariates not shown).

¹When Stress is in the model; ²When NA is in the model; ³When Stroop is in the model; ⁴When IAT is in the model

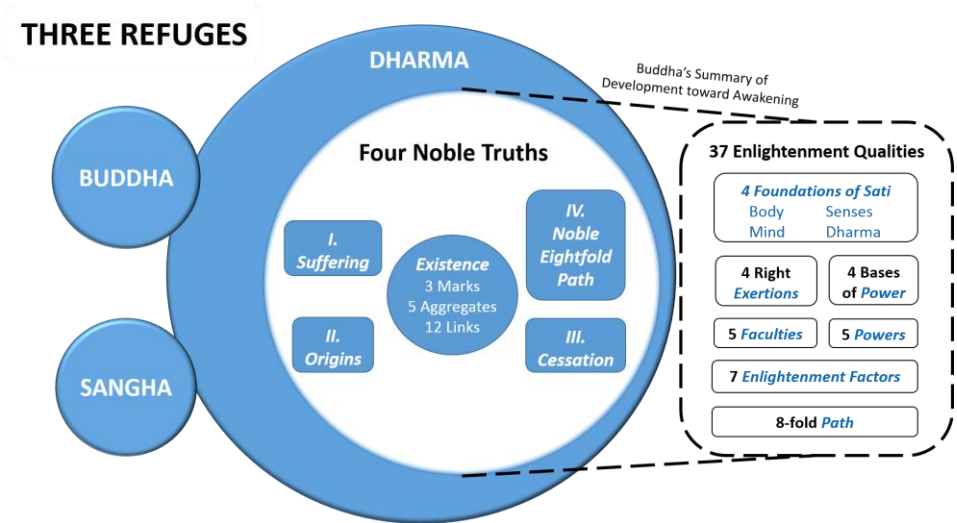
Table 12. Results of LMMs for Specific Aim 3

DV → IV ↓	H	<i>n</i> ₁	<i>n</i> ₂	<i>df</i>	Tempted Now					Drinking			
					<i>PE</i>	<i>SE</i>	<i>F</i>	<i>p</i>	<i>Df</i>	<i>PE</i>	<i>SE</i>	<i>F</i>	<i>p</i>
MAAS as Moderator													
MAAS x <i>Mean</i> Stress	3.1	2018	43	1, 1972	0.02	0.34	0.00	.95	n/a	n/a	n/a	n/a	n/a
MAAS x <i>Deviation</i> Stress	3.1	2018	43	1, 1971	-0.03	0.04	0.78	.38	n/a	n/a	n/a	n/a	n/a
MAAS x <i>Mean</i> NA	3.1	2019	43	1, 1972	-0.14	0.36	0.16	.69	n/a	n/a	n/a	n/a	n/a
MAAS x <i>Deviation</i> NA	3.1	2019	43	1, 1971	-0.08	0.06	1.82	.18	n/a	n/a	n/a	n/a	n/a
MAAS x <i>Mean</i> Stroop	3.2	1044	43	1, 997	0.006	0.004	2.22	.14	n/a	n/a	n/a	n/a	n/a
MAAS x <i>Deviation</i> Stroop	3.2	1044	43	1, 997	-0.0006	0.0003	3.19	.07	n/a	n/a	n/a	n/a	n/a
MAAS x <i>Mean</i> IAT	3.2	931	43	1, 885	-0.83	0.65	1.65	.20	n/a	n/a	n/a	n/a	n/a
MAAS x <i>Deviation</i> IAT	3.2	931	43	1, 884	-0.05	0.13	0.13	.72	n/a	n/a	n/a	n/a	n/a
MAAS x <i>Mean</i> Tempted Now	3.3	2019	43	n/a	n/a	n/a	n/a	n/a	1, 1897	-0.10	0.07	2.13	.14
MAAS x <i>Deviation</i> Tempted Now	3.3	2019	43	n/a	n/a	n/a	n/a	n/a	1, 1898	0.01	0.02	0.32	.57

Table Note: *n*₁ = no. assessments; *n*₂ = number of subjects. H = Hypothesis; PE = parameter estimate; SE = standard error; F = F value from LMM. Covariates are Age, Gender, Day, Assessment Type (TA vs. RA). Coefficients for Day and Assessment Type were fixed. Coefficients for the *Deviation* Scores were random. For Hypothesis 3.3, Tempted Now ratings were lagged such that they occurred before the Drinking ratings.

Figure 1. Mindfulness in Canonical Buddhist Teaching

(a) The Three Refuges form the basis of Buddhist teaching. The Dharma Refuge contains the Four Noble Truths, which Buddha re-organized into the Thirty-seven Enlightenment Qualities. Words in blue highlight signify topics in which *sati* was a significant concept.



(b) Relationships of the core concepts in the Four Noble Truths. Thin-red arrows signify Buddha's understanding of mechanisms underlying suffering. Thick-blue arrows signify proposed mechanisms underlying enlightenment.

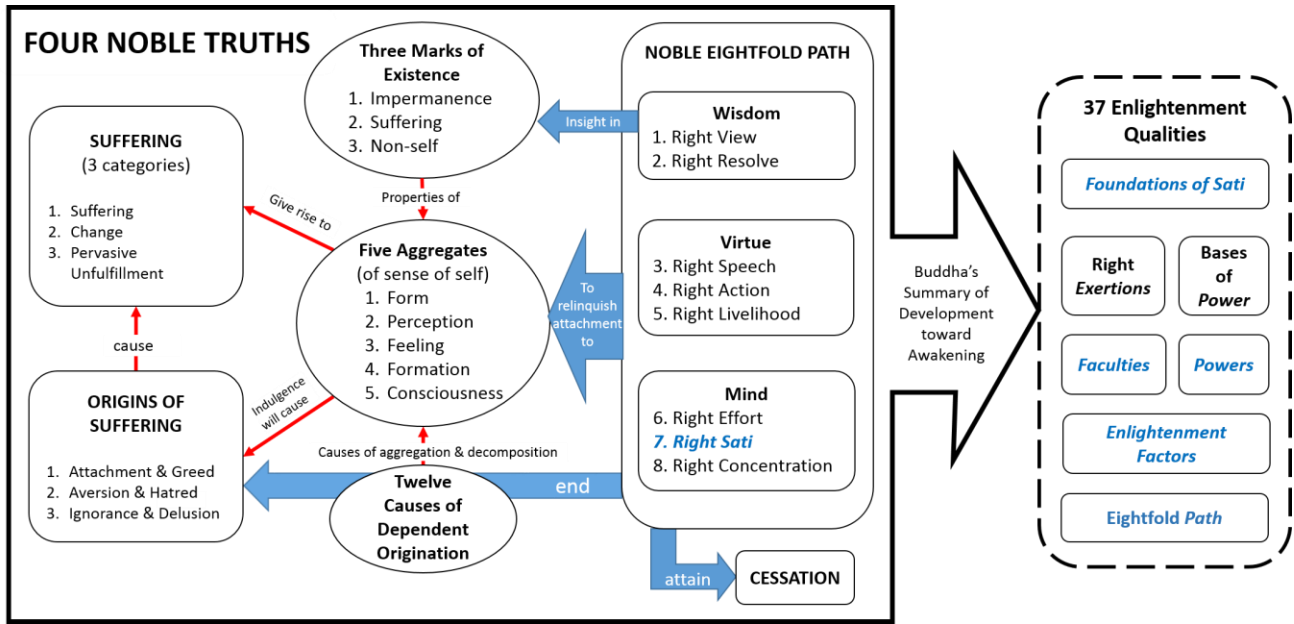


Fig 1. Notes:

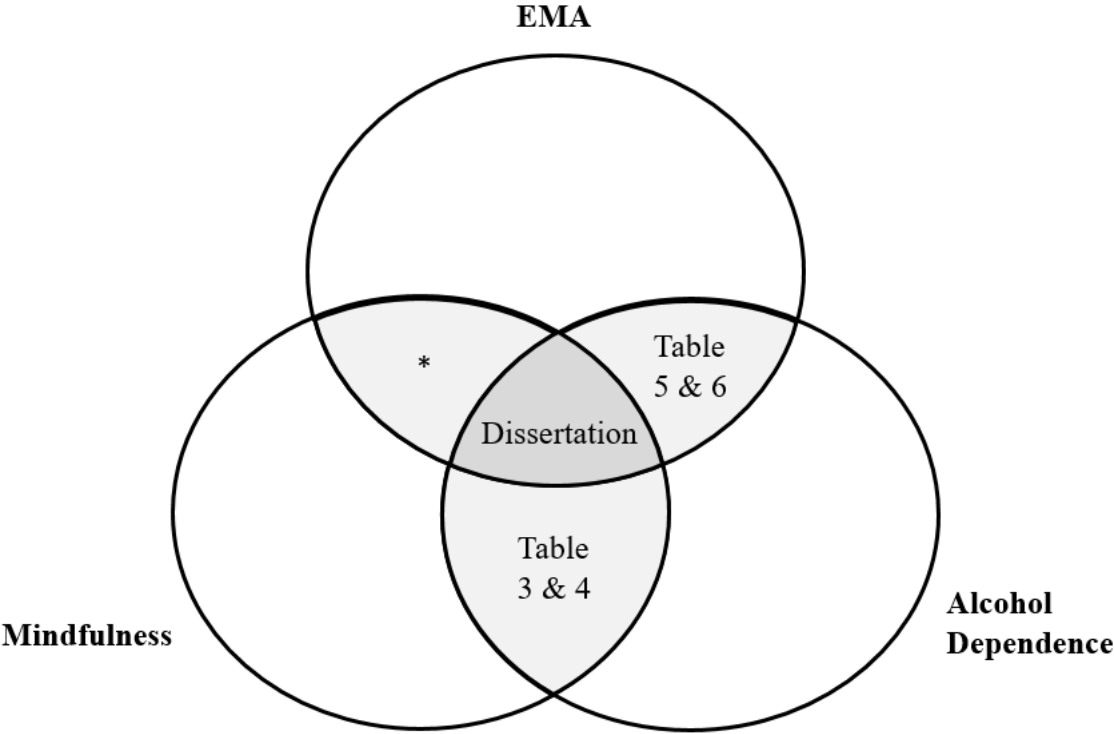
- Topics about “Existence” are grouped in a circle to signify that they are embedded throughout the Four Noble Truths, and not individual topics. They are isolated here in circles to denote that they address cosmic laws. The rectangles denote that the topics address how humans experience suffering, and their roles in their own suffering.
- The dashed lines indicate that the Thirty-seven Enlightenment Qualities is not a set of separate teachings, but Buddha’s re-organized summary of qualities conducive to enlightenment discussed in the Four Noble Truths.

Figures are adapted by the author, Edwin Szeto, from:

https://upload.wikimedia.org/wikipedia/commons/f/fc/The_Relationship_between_the_Major_Components_of_Buddhism.png

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Figure 2. Overview of Literatures



*Brown & Ryan (2003); Ruscio et al. (2016). Tables 1 & 2 review literature on cognitive biases in alcohol dependence (not shown in Figure)

Figure 3. Study Conceptual Model

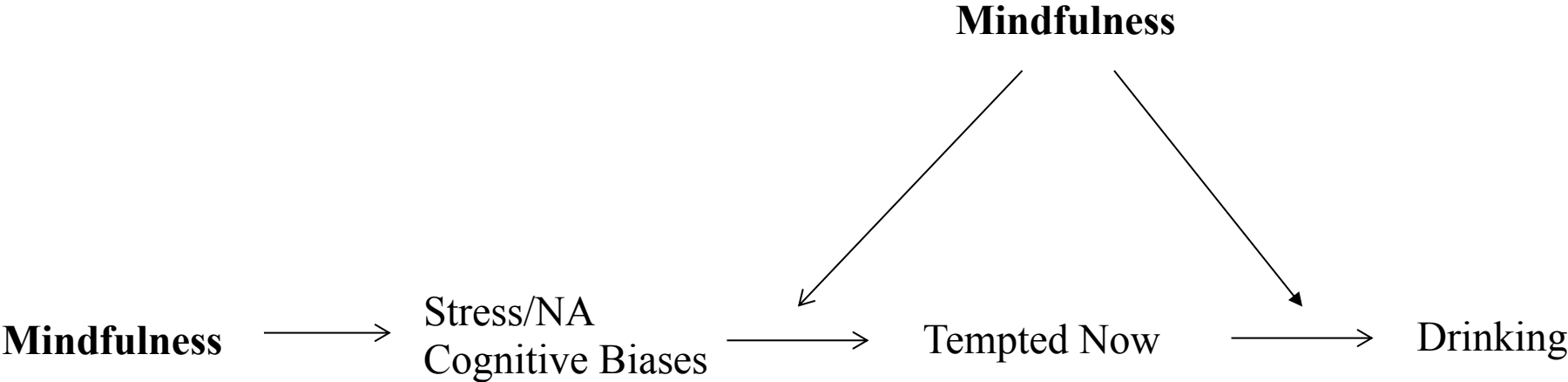


Figure 4. Study Timeline (Szeto, 2016)

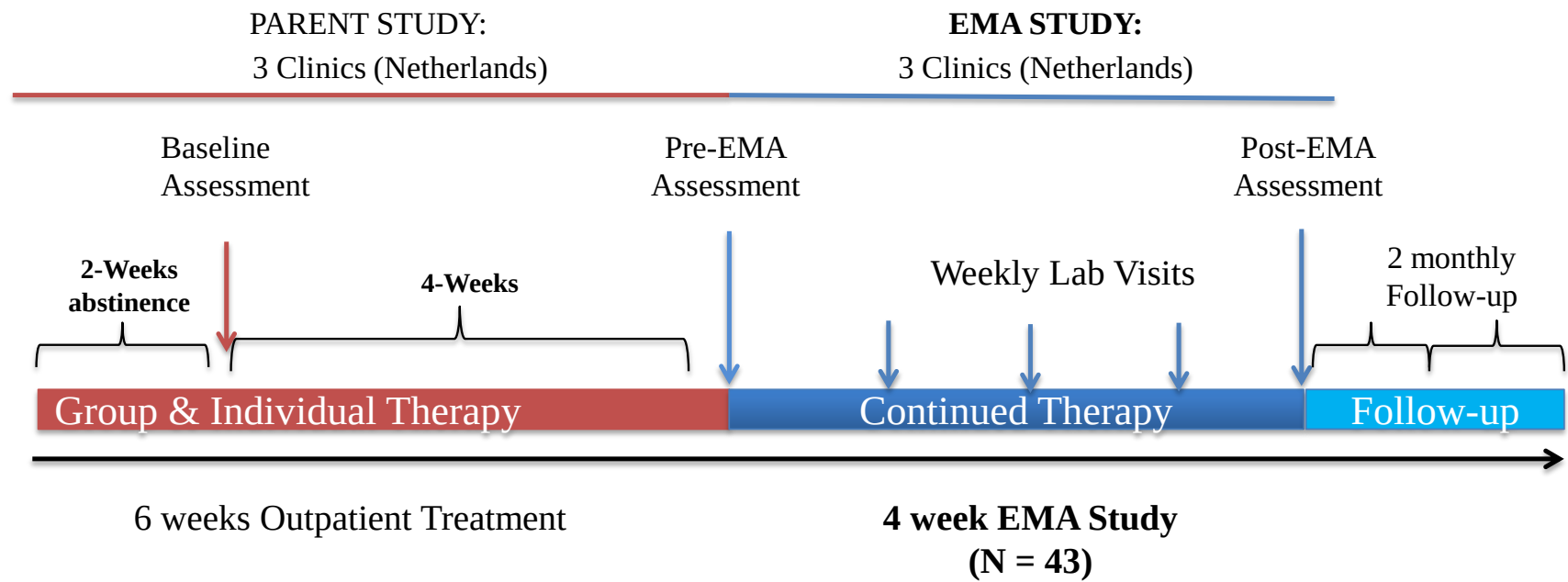


Figure 5. Mediation Models

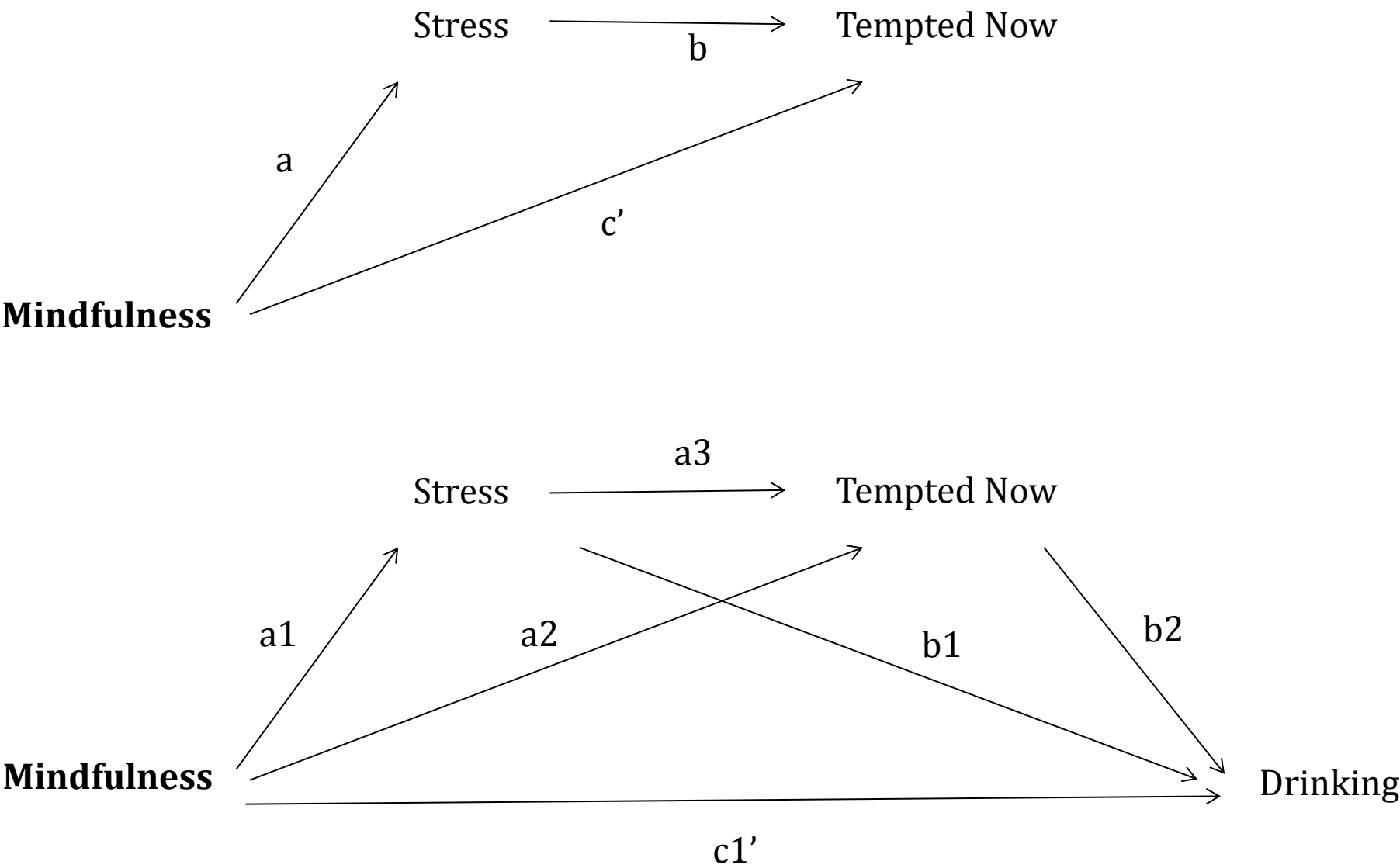
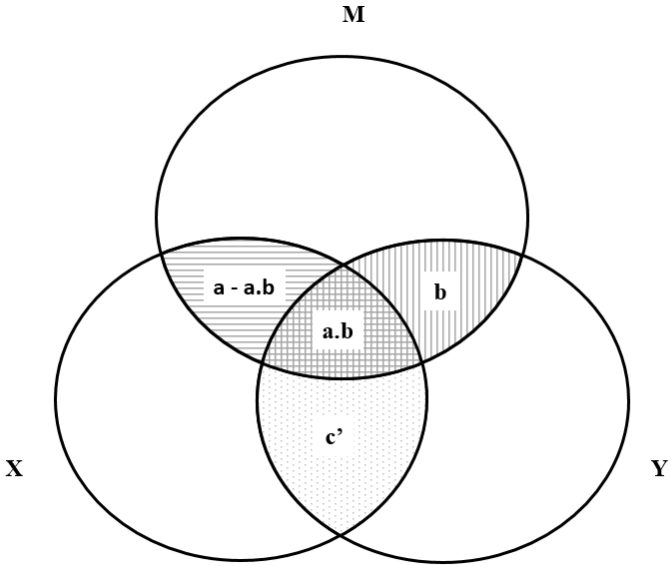
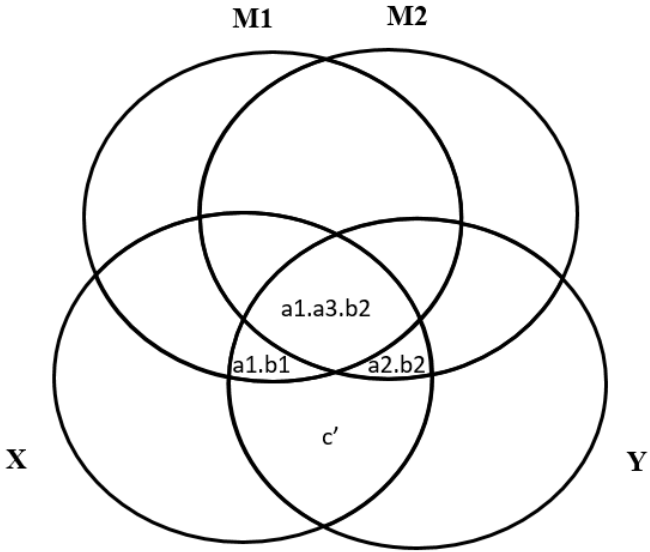


Figure 6. Illustration of Single and Multiple Mediation



$$c = c' + a.b$$



$$c = c' + a1.a3.b2 + a1.b1 + a2.b2$$

Figure 7. Study Flowchart

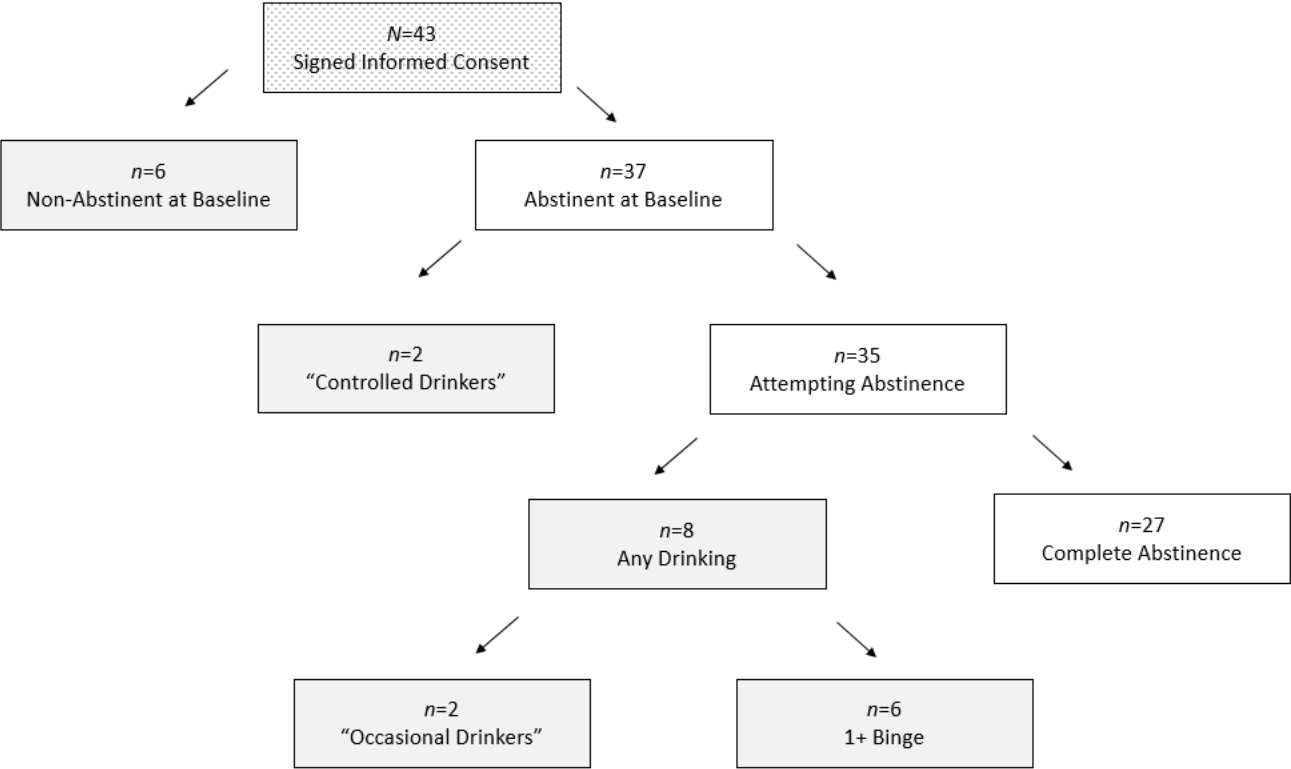


Figure 8. Association between MAAS & Tempted Now (Specific Aim 1, Hypothesis 1.1)

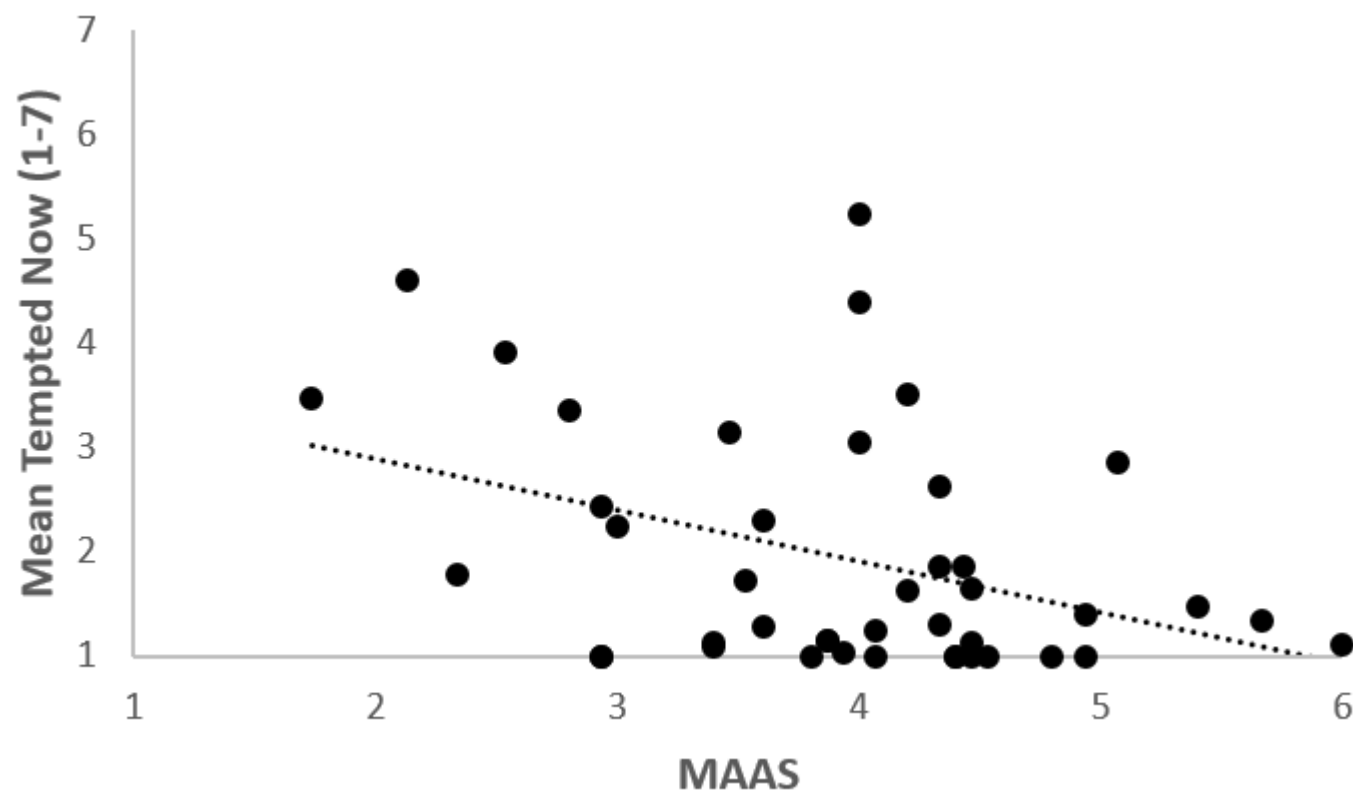


Figure 9. Association between MAAS & Drinking (Specific Aim 1, Hypothesis 1.2)

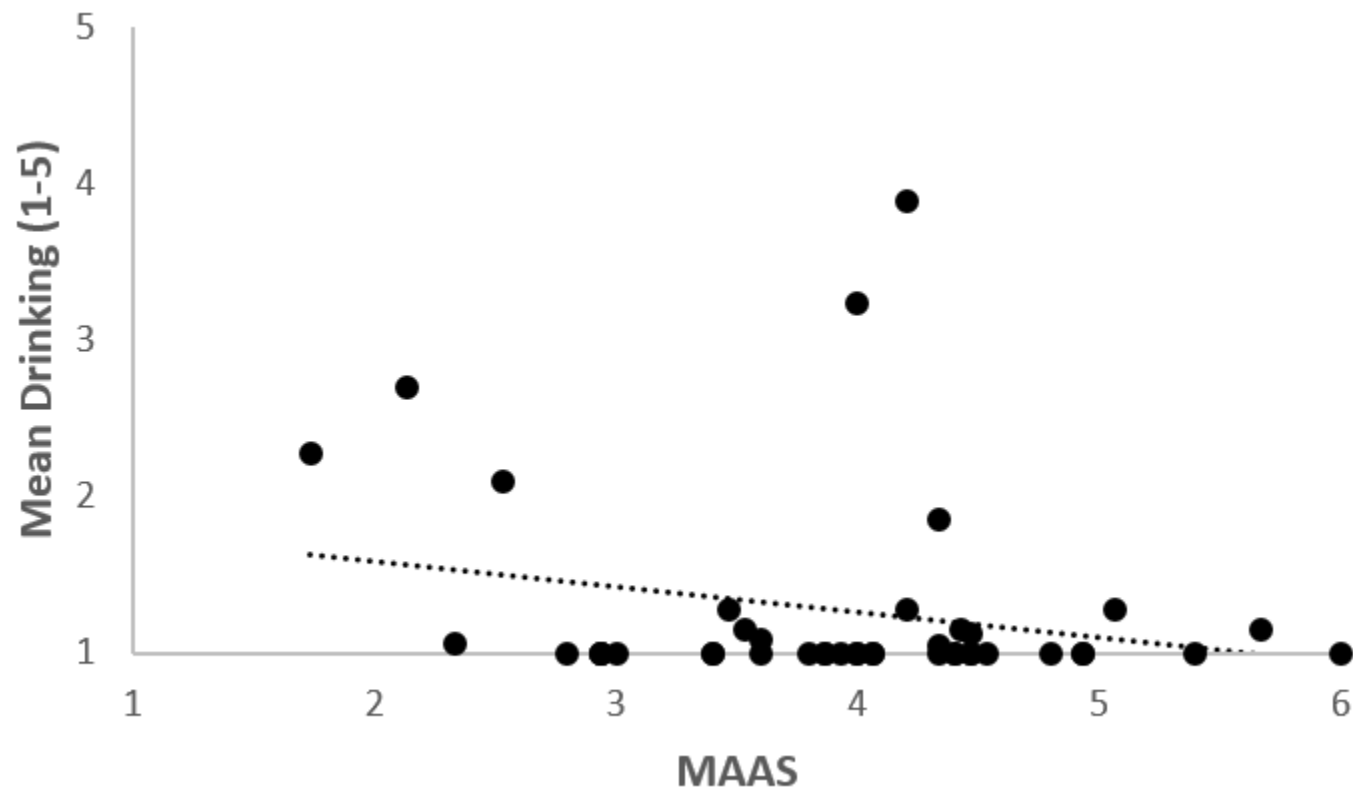


Figure 10. Results of Mediation models using single-equation approach (SAS) (Specific Aim 2)

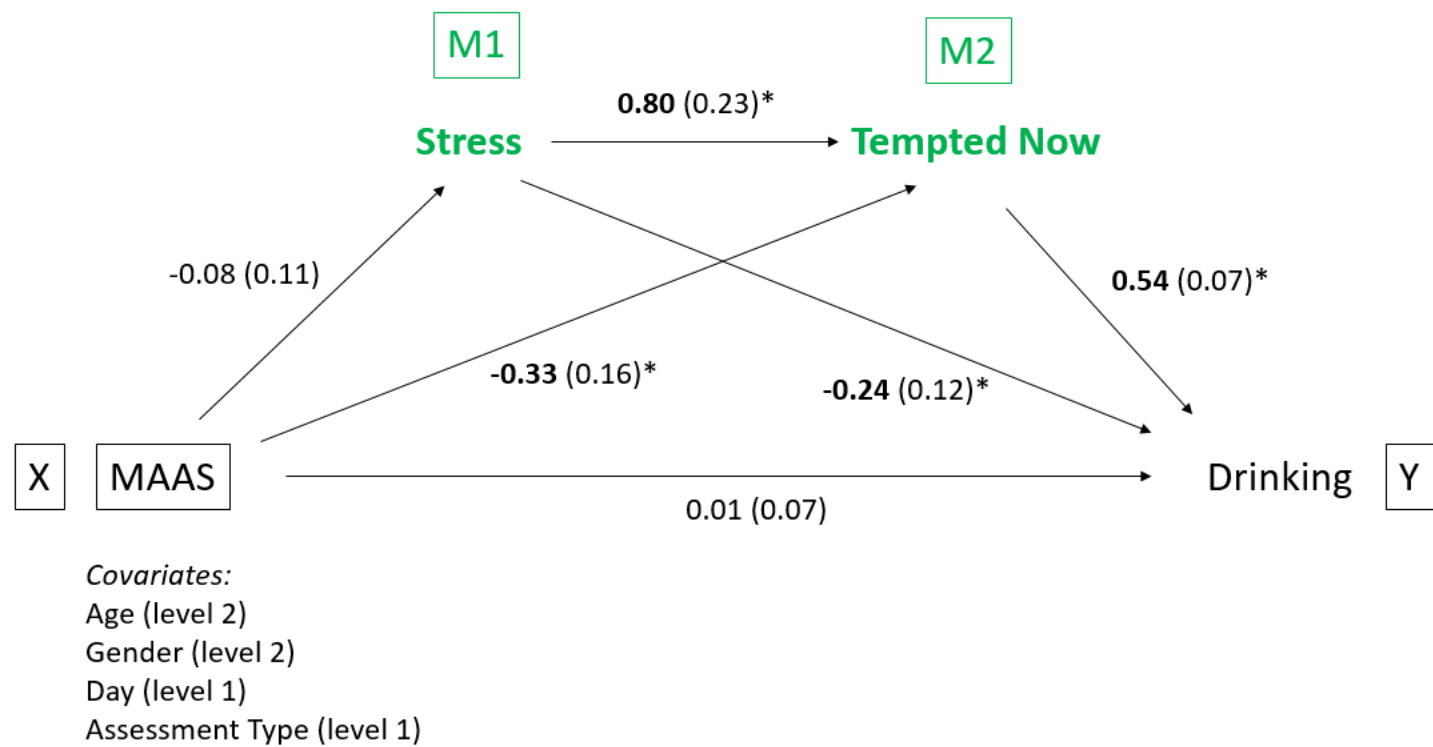
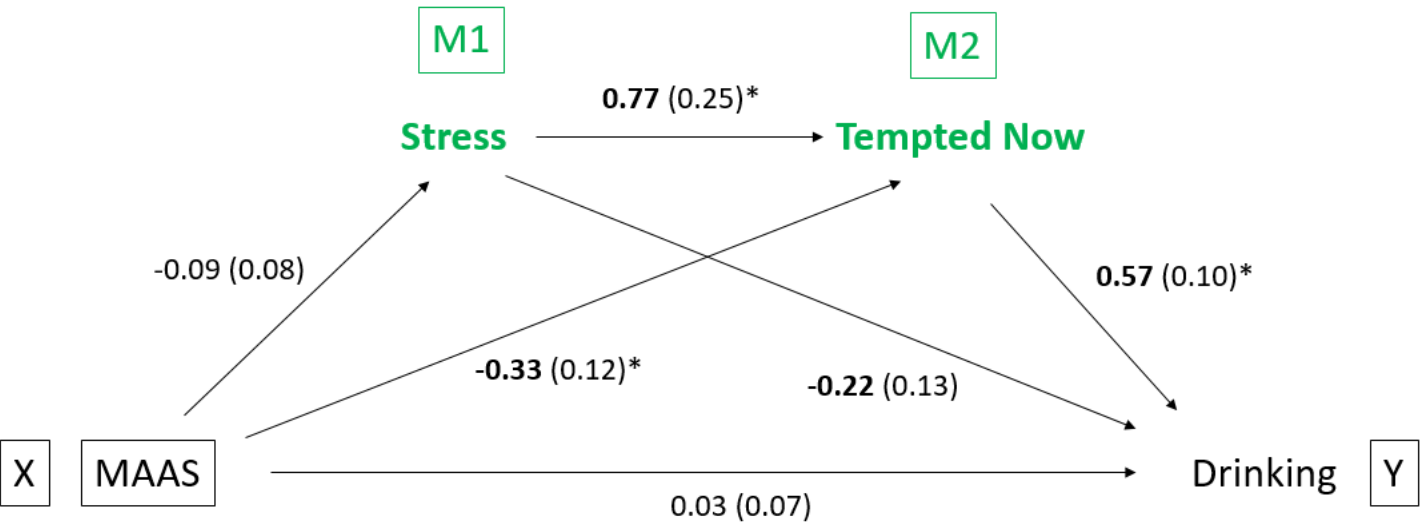


Figure 11. Results of Mediation models using multilevel path analysis (MPlus) (Specific Aim 2)



Covariates:
Age (level 2)
Gender (level 2)
Assessment Type (level 1)

Indirect Path	B	SE	t	p
a2.b2	-0.186	0.074	-2.530	.011
a1.b1	0.019	0.023	0.837	.402
a1.a3.b2	-0.039	0.038	-1.016	.309

a2.b2 = MAAS→Tempted Now→Drinking; a1.b1 = MAAS→Stress→Drinking; a1.a3.b2 = MAAS→Stress→Tempted Now →Drinking

Figure 12. Multilevel Path Diagram for Summarizing Study Results (Figure A) and Summary of Study Results (Figure B)

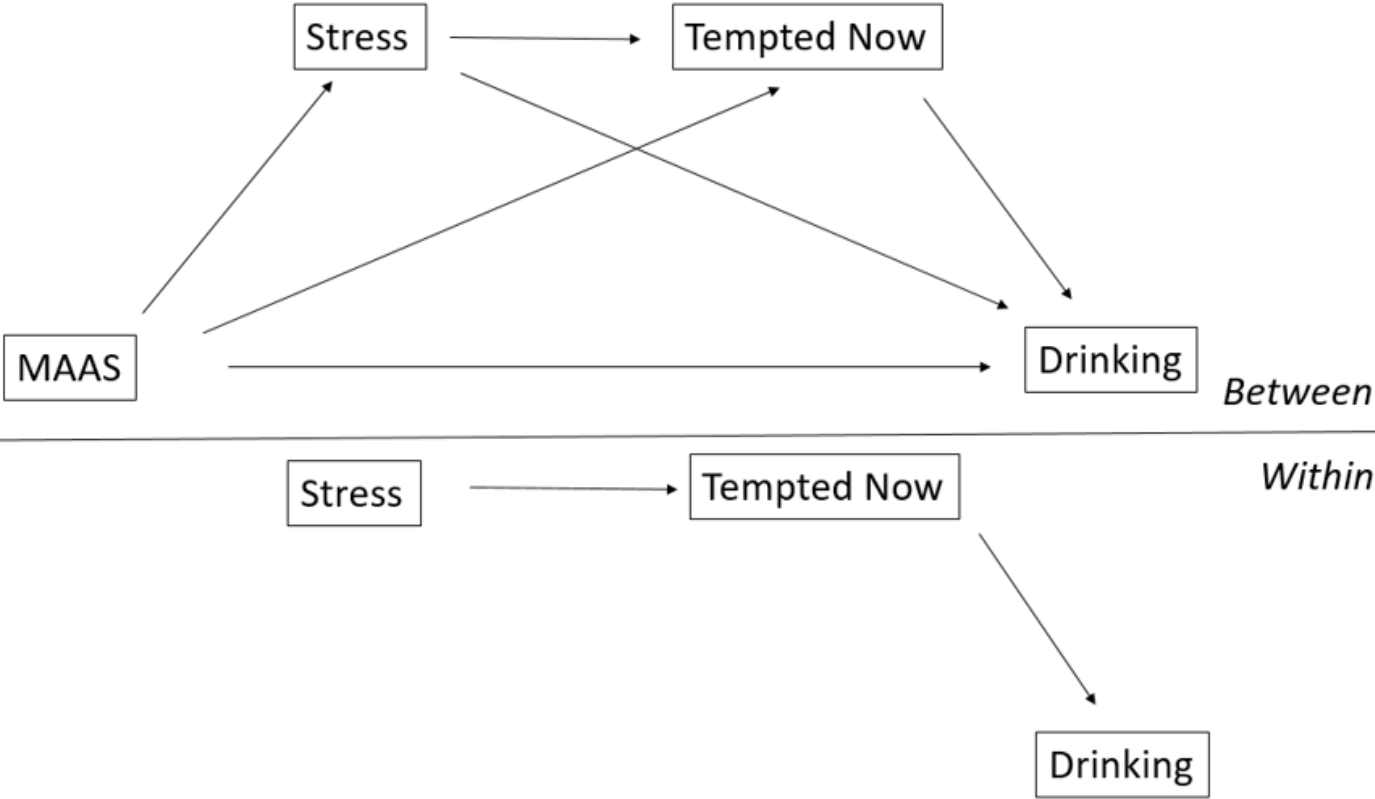


Figure 12A Note: Arrows above the line reflect between subject (level 2) relationships. Arrows below the line reflect within-subject (level 1) relationships. Specific Aims 1 and 2 deal are entirely concerned with between-subject associations.

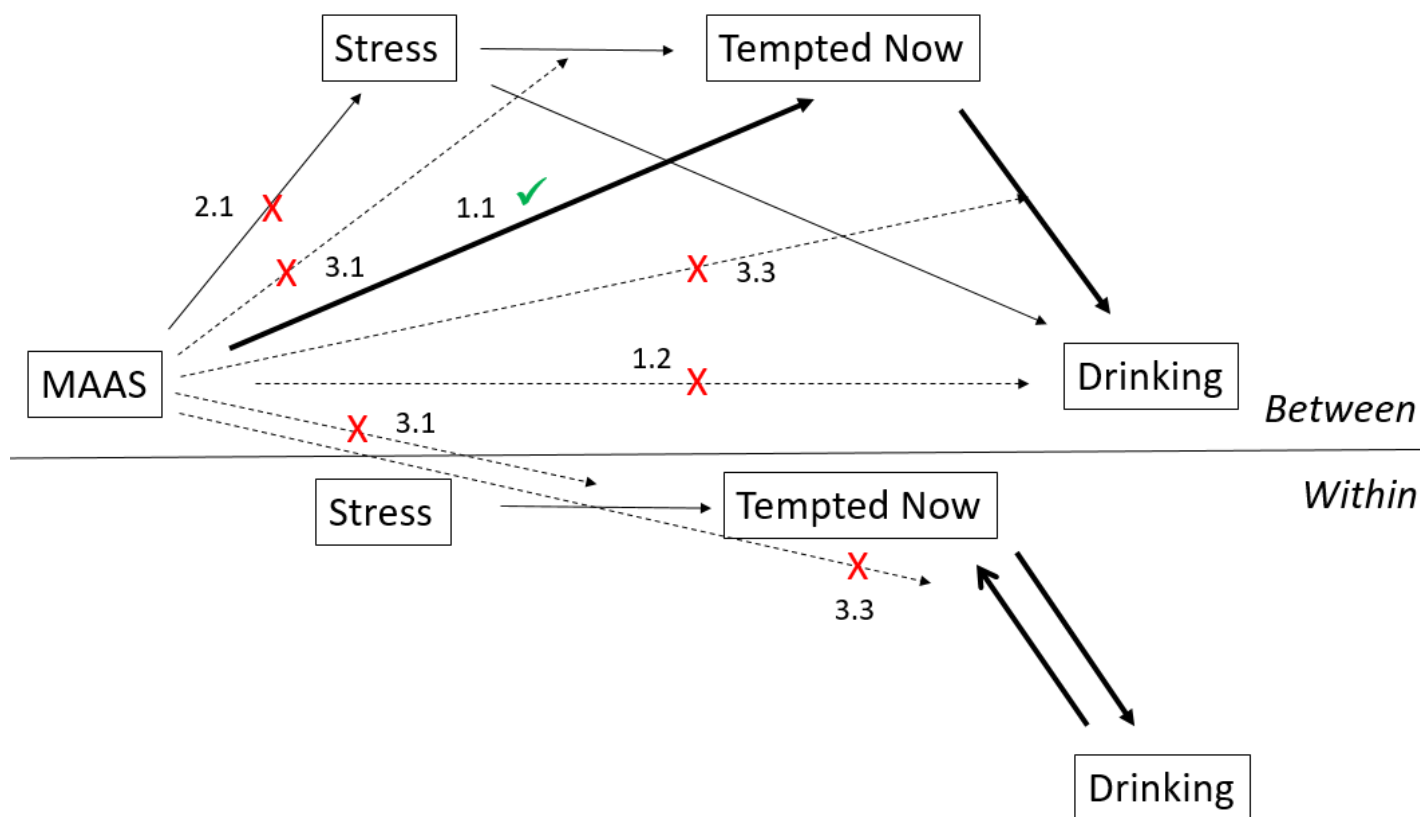


Figure 12B Note: Results for 2.2 and 3.2 not shown (both were negative). The arrows between Tempted Now and Drinking reflect evidence for causal relationships in both directions. The question mark denotes uncertainty regarding the direction of causality at the between-subject level

Appendices

Appendix A. Equations for Multilevel Models

The path diagrams in Figure 5 can be described by the following regression equations:

Upper Figure:

$$(1) \text{ Stress} = \text{Intercept} + a.\text{MAAS} + \varepsilon$$

$$(2) \text{ Tempted Now} = \text{Intercept} + b.\text{Stress} + c'.\text{MAAS} + \varepsilon$$

Lower Figure:

$$(1) \text{ Stress} = \text{Intercept} + a1.\text{MAAS} + \varepsilon$$

$$(2) \text{ Tempted Now} = \text{Intercept} + a3.\text{Stress} + a2.\text{MAAS} + \varepsilon$$

$$(3) \text{ Drinking} = \text{Intercept} + b1.\text{Stress} + b2.\text{Tempted Now} + c1'.\text{MAAS} + \varepsilon$$

Because multilevel models are used, subjects will have subject-specific intercepts (“random intercepts”). Following Field (2013), the equations can be rewritten as follows to capture this, where u_0 is the term that captures variability in intercepts across subjects:

$$(1) \text{ Stress}_{ij} = \text{Intercept}_j + \varepsilon_{ij}$$

$$\text{Intercept}_j = \text{Intercept} + a.\text{MAAS}_j + u_{0j}$$

$$(2) \text{ Tempted Now}_{ij} = \text{Intercept}_j + b.\text{Stress}_{ij} + \varepsilon_{ij}$$

$$\text{Intercept}_j = \text{Intercept} + c'.\text{MAAS}_j + u_{0j}$$

Regression coefficients for level 1 predictors (e.g., stress) can also be allowed to vary over subjects (“random slopes”). Following Field (2013), the equations can be rewritten as follows to capture this, where u_1 is the term that captures variability in slopes across subjects, and b_j denotes the slope of subject j . In addition, as described in the text, the b path is partitioned into between- (b_B) and within-subject (b_W) components. Thus, equation 2 can be rewritten as:

$$(3) \text{ Tempted Now}_{ij} = \text{Intercept}_j + b_{Wj}.\text{DEV_Stress}_{ij} + \varepsilon_{ij}$$

$$\text{Intercept}_j = \text{Intercept} + b_B.\text{MEAN_Stress}_j + c'.\text{MAAS}_j + u_{0j}$$

$$b_{Wj} = b_W + u_{1j}$$

In the equations above, the bolded items are those that are reported for the a and c' paths. The b_B coefficient is reported for the b path (see text for details). Note that the Intercept is the overall intercept.

Appendix B. Code for MPLUS Analysis, Specific Aim 2

INPUT INSTRUCTIONS

```
TITLE: Edwin Aim 2;
X (maas_1, L2),
M1 (Stress_1, L1),
M2 (Tempted, L1),
i (AssessmentNum),
j (Subject),
Y (Drinking, L1),
z1 (Assessment Type, L1),
Age (L2)
Gender (L2)
Day (L1);

DATA: File is emplus2d.dat;

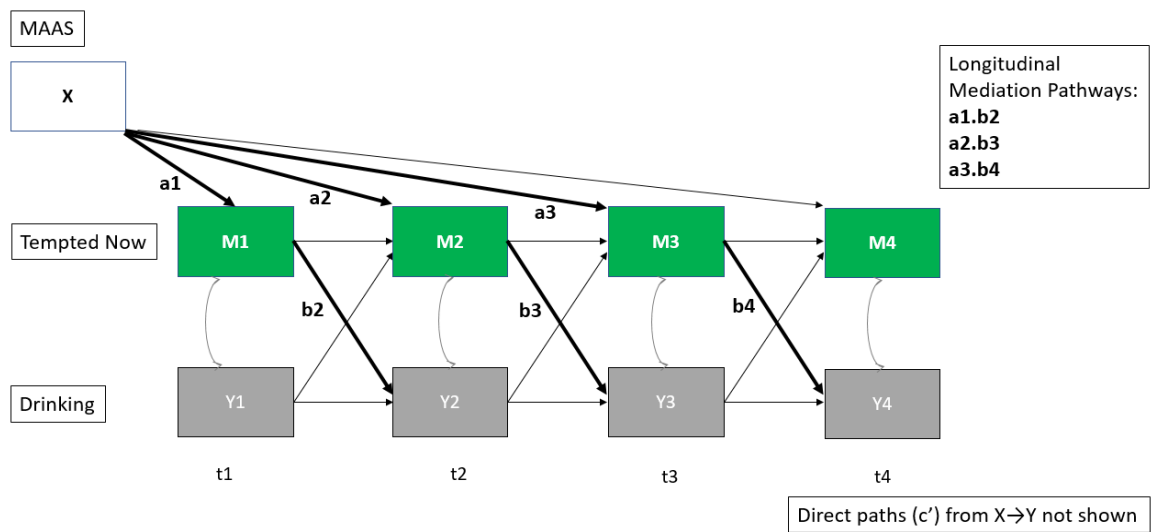
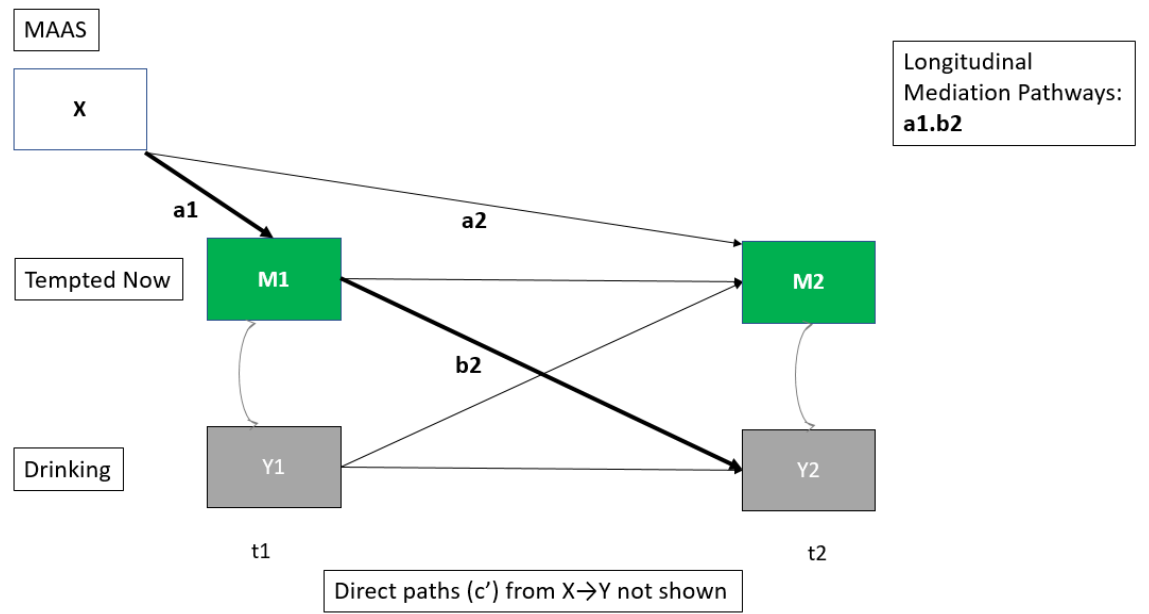
VARIABLE:
  Names are x m1 m2 y i j z1 age gender day;
  Usevariables are x m1 m2 y j z1 age gender;
  !Categorical are y;
  missing are .;
  Cluster is j;
  Between = x age gender;

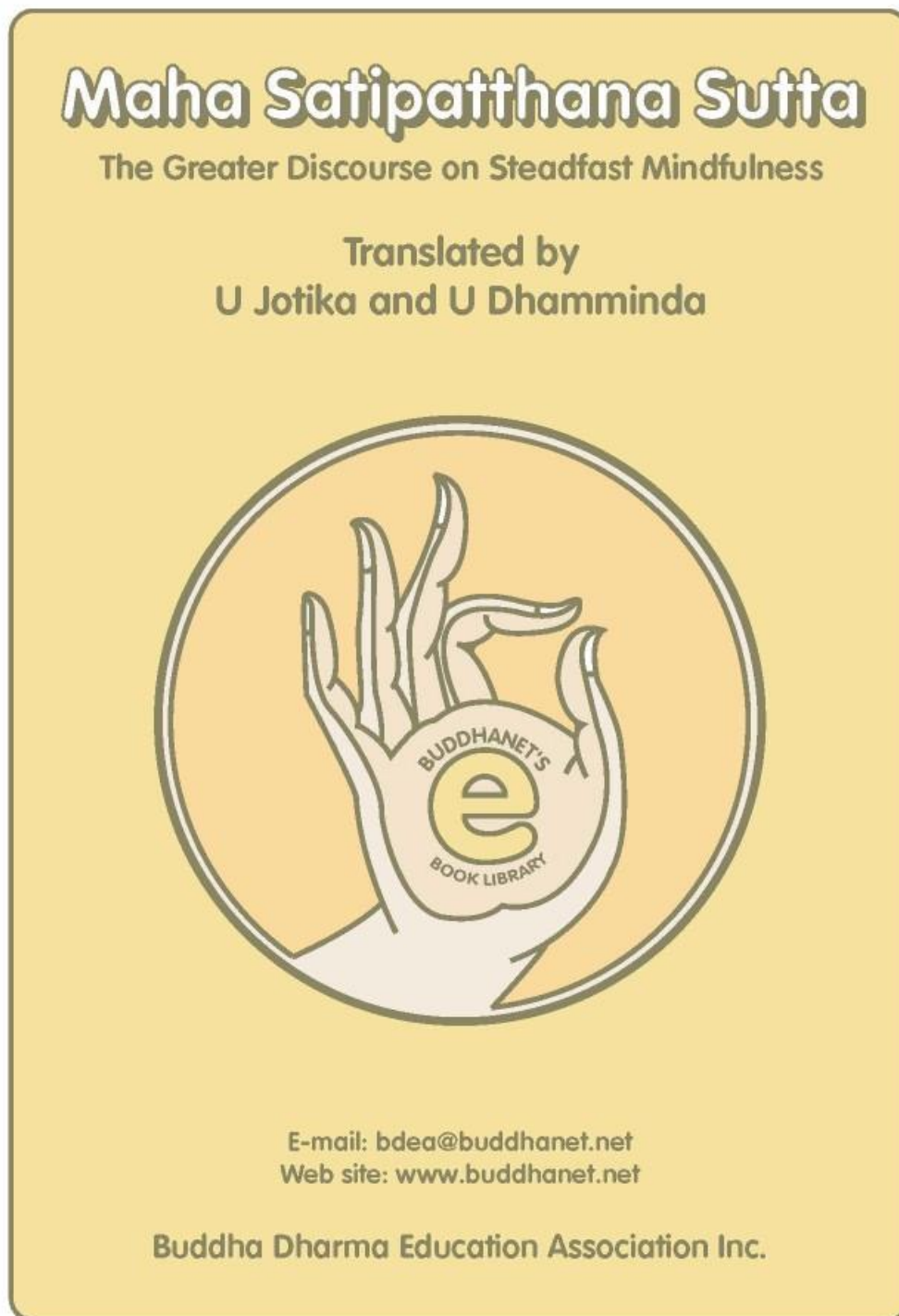
ANALYSIS:
  Type is Twolevel Random;
  Estimator is MLR;
```

MODEL:

```
%Within%
z1 m1 m2 y;
y on z1 m1 m2 ; ! Regress y on z1 m1 m2 ("within" slopes);
m2 on z1 m1 ; ! Regress m2 on z1 m1 ("within" slopes);
m1 on z1 ; ! Regress m1 on z1 ("within" slopes);
%Between%
x z1 m1 m2 y age gender;
m1 on x (a1) ; ! Regress m1 on x call the slope a1 (MAAS - Tempted Now);
m1 on age gender z1;
m2 on m1 (a3) ; ! Regress m2 on m1 call "between" slope a3 (Stress - Tempted Now);
m2 on x (a2) ; ! Regress m2 on x call "between" slope a2 (MAAS - Tempted Now);
m2 on age gender z1;
y on m1 (b1) ; ! Regress y on m1 call "between" slope b1 (Stress - Drinking);
y on m2 (b2) ; ! Regress y on m2 call "between" slope b2 (Tempted Now - Drinking);
y on age gender z1 x ;
Model Constraint:
New(ind2b2); ! Indirect effect a2.b2 (MAAS - Tempted Now - Drinking);
ind2b2 = a2 * b2;
New(ind1b1); ! Indirect effect a1.b1 (MAAS - Stress - Drinking);
ind1b1 = a1 * b1;
New(ind1a3b2); ! Indirect effect a1.a3.b2 (MAAS - Stress - Tempted Now - Drinking);
ind1a3b2 = a1 * a3 * b2;
```

Appendix C. Cross-Lagged Models





Mahāsatipaṭṭhāna Sutta

The Greater Discourse on Steadfast Mindfulness

Translated by

U Jotika and U Dhamminda

To our preceptor
the late Venerable Taungpulu Kaba-Aye Sayadaw
of Burma

SABBA DĀNAṂ DHAMMA DĀNAṂ JINATI

The Gift of Truth Excels All Other Gifts

Idaṃ te puññaṃ nibbānassa paccayo hotu

© U Jotika and U Dhamminda, Migadavun Monastery,
Ye Chan Oh Village, Maymyo, Burma. 1986.

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Introduction

Please practise in accordance with this *Mahāsatipaṭṭhāna Sutta* so that you can see why it is acknowledged as the most important *Sutta* that the Buddha taught.

Try to practise all the different sections from time to time as they are all useful, but in the beginning start with something simple such as being mindful while walking (see *Iriyāpatha Pabba*), or the mindfulness of in and out breathing (see *Anāpāna Pabba*). Then as you practise these you will be able to practise the other sections contained within this *Sutta* and you will find that all the four *satipaṭṭhānas* can be practised concurrently.

A *sutta* should be read again and again as you will tend to forget its message. The message here in this *Sutta* is that you should be mindful of whatever is occurring in the body and mind, whether it be good or bad, and thus you will become aware that all conditioned phenomena are impermanent, unsatisfactory and not-self.

The original Pāli text of this *Sutta* can be found in *Mahāvagga* of the *Dīgha Nikāya*.

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Mahāsatipaṭṭhāna Sutta

Thus have I heard¹. The *Bhagavā*² was at one time residing at the market-town called Kammāsadhamma in the Kuru country³. There the Bhagavā addressed the bhikkhus⁴ saying “O, Bhikkhus”, and they replied to him, “Bhadante,”⁵. Then the Bhagavā said:

Bhikkhus, this is the one and the only way⁶ for the purification (of the minds) of beings, for overcoming sorrow and lamentation, for the cessation⁷ of physical and mental pain⁸, for attainment of the Noble Paths⁹, and for the realization of *Nibbāna*¹⁰. That (only way) is the four *satipaṭṭhānas*¹¹.

What are these four?¹² Here (in this teaching), bhikkhus, a bhikkhu (i.e. a disciple) dwells perceiving again and again the body (*kāya*)¹³ as just the body¹⁴ (not mine, not I, not self, but just a phenomenon) with diligence,¹⁵ clear understanding,¹⁶ and mindfulness, thus keeping away covetousness and mental pain in the world;¹⁷ he dwells perceiving again and again feelings (*vedanā*)¹⁸ as just feelings (not mine, not I, not self but just as phenomena) with diligence, clear understanding, and mindfulness, thus keeping away covetousness and mental pain in the world; he dwells perceiving again and again the mind (*citta*)¹⁹ as just the mind (not mine, not I, not self but just a phenomenon) with diligence, clear understanding, and mindfulness, thus keeping away covetousness and mental pain in the world; he dwells perceiving again and again *dharmas*²⁰ as just dharmas (not mine, not I, not self but just as phenomena) with diligence, clear under-

standing, and mindfulness, thus keeping away covetousness and mental pain in the world.

I. Kāyānupassanā

i. Ānāpāna Pabba (Section on In and Out breathing)

And how, bhikkhus, does a bhikkhu dwell perceiving again and again the body as just the body? Here (in this teaching), bhikkhus, a bhikkhu having gone to the forest, or to the foot of a tree, or to an empty, solitary place;²¹ sits down cross-legged,²² keeping his body erect, and directs his mindfulness (towards the object of mindfulness).²³ Then only with keen mindfulness he breathes in and only with keen mindfulness he breathes out. Breathing in a long breath, he knows, “I breathe in a long breath”; breathing out a long breath, he knows, “I breathe out a long breath”; breathing in a short breath, he knows, “I breathe in a short breath”; breathing out a short breath, he knows, “I breathe out a short breath”, “Aware of the whole breath body, I shall breathe in”,²⁴ thus he trains himself; “Aware of the whole breath body, I shall breathe out”, thus he trains himself. “Calming the process of breathing, I shall breathe in”,²⁵ thus he trains himself; “Calming the process of breathing, I shall breathe out”, thus he trains himself.²⁶

Just as, bhikkhus, a skilful turner or a turner’s apprentice pulling a long pull (on the string turning the lathe), knows,

“I am pulling a long pull”; pulling a short pull, knows, “I am pulling a short pull”, just so, bhikkhus, a bhikkhu breathing in a long breath, knows, “I breathe in a long breath”; breathing out a long breath, knows, “I breathe out a long breath”; breathing in a short breath, knows, “I breathe in a short breath”; breathing out a short breath, knows, “I breathe out a short breath”. “Aware of the whole breath body, I shall breathe in,” thus he trains himself; “Aware of the whole breath body, I shall breathe out”, thus he trains himself. “Calming the process of breathing, I shall breathe in”, thus he trains himself; “Calming the process of breathing, I shall breathe out”, thus he trains himself.

Thus he dwells perceiving again and again the body²⁷ as just the body (not mine, not I, not self, but just a phenomenon) in himself; or he dwells perceiving again and again the body as just the body in others;²⁸ or he dwells perceiving again and again the body as just the body in both himself and in others.²⁹ He dwells perceiving again and again the cause and the actual appearing of the body; or he dwells perceiving again and again the cause and the actual dissolution of the body; or he dwells perceiving again and again both the actual appearing and dissolution of the body with their causes.³⁰ To summarize, he is firmly mindful of the fact that only the body exists (not a soul, a self or I). That mindfulness is just for gaining insight (*vipassanā*) and mindfulness progressively. Being detached from craving and wrong views³¹ he dwells without clinging to anything in the world.³² Thus, bhikkhus, this is a way in which a bhikkhu dwells perceiving again and again the body as just the body.

ii. Iriyāpatha Pabba (Section on Postures)

And again, bhikkus, a bhikkhu while walking³³ knows “I am walking”;³⁴ while standing, he knows, “I am standing”; while sitting, he knows, “I am sitting”; while lying down he knows, “I am lying down.”³⁵

To summarize, a bhikkhu should know whatever way his body is moving or placed.³⁶

Thus he dwells perceiving again and again the body³⁷ as just the body (not mine, not I, not self, but just a phenomenon) in himself; or he dwells perceiving again and again the body as just the body in others; or he dwells perceiving again and again the body as just the body in both himself and in others. He dwells perceiving again and again the cause and the actual appearing of the body or he dwells perceiving again and again the cause and the actual dissolution of the body; or he dwells perceiving again and again the actual appearing and dissolution of the body with their causes.³⁸ To summarize, he is firmly mindful of the fact that only the body exists (not a soul, a self or I). That mindfulness is just for gaining insight (*vipassanā*) and mindfulness progressively. Being detached from craving and wrong views he dwells without clinging to anything in the world. Thus, bhikkhus, this is also a way in which a bhikkhu dwells perceiving again and again the body as just the body.

iii. Sampajañña Pabba **(Section on Clear Understanding)**

And again, bhikkhus, a bhikkhu, while going forward or while going back does so with clear understanding;³⁹ while looking straight ahead or while looking elsewhere he does so with clear understanding; while bending or stretching his limbs he does so with clear understanding; while carrying the alms bowl and while wearing the robes he does so with clear understanding; while eating, drinking, chewing, and savouring he does so with clear understanding; while urinating or defecating he does so with clear understanding; while walking, standing, sitting, falling asleep, waking, speaking or when remaining silent, he does so with clear understanding.

Thus he dwells perceiving again and again the body, as just the body in himself... Thus, bhikkhus, this is also a way in which a bhikkhu dwells perceiving again and again the body as just the body.

iv. Paṭikulamanasika Pabba **(Section on Contemplation of Impurities)**

And again, bhikkhus, a bhikkhu examines and reflects closely upon this very body, from the soles of the feet up and from the tips of the head hair down, enclosed by the skin and full of various kinds of impurities,⁴⁰ (thinking thus) "There exists in this body: hair of the head, hair of the body, nails, teeth, skin, flesh, sinews, bones, marrow, kidneys,

heart, liver, membranes (including the pleura, the diaphragm and other forms of membrane in the body), spleen, lungs, intestines, mysentery, gorge, fæces, brain, bile, phlegm, pus, blood, sweat, solid fat, tears, liquid fat, saliva, mucus, synovic fluid (i.e. lubricating oil of the joints) and urine.”

Just as if, bhikkhus, there were a double-mouthed provision bag filled with various kinds of grain such as: hill-paddy, paddy, green-gram, cow pea, sesamum, and husked rice; and a man with sound eyes, having opened it, should examine it thus: “This is hill-paddy, this is paddy, this is green-gram, this is cow pea, this is sesamum, and this is husked rice.” Just so, bhikkhus, a bhikkhu examines and reflects closely upon this very body, from the soles of the feet up and from the tips of the head hair down, enclosed by the skin and full of various kinds of impurities, (thinking thus) “There exists in this body: hair of the head, ... and urine.”

Thus he dwells perceiving again and again the body as just the body in himself.... Thus, bhikkhus, this is also a way in which a bhikkhu dwells perceiving again and again the body as just the body.

v. Dhātumanasika Pabba **(Section on Contemplation on Elements)**

And again, bhikkhus, a bhikkhu examines and reflects closely upon this very body however it be placed or dis-

posed as composed of (only) primary elements⁴¹ thus: "There exists in this body the earth element, the water element, the fire element, and the air element."⁴²

Just as if, bhikkhus, a skillful butcher or his apprentice, having slaughtered a cow and divided it into portions were sitting at the junction of four high roads,⁴³ just so, a bhikkhu examines and reflects closely upon this body however it be placed or disposed as composed of (only) the primary elements thus: "There exists in this body the earth element, the water element, the fire element and the air element."

Thus he dwells perceiving again and again the body as just the body in himself.... Thus bhikkhus, this is also a way in which a bhikkhu dwells perceiving again and again the body as just the body.

vi. Navasivathika Pabba **(Section on Nine Stages of Corpses)**

Part 1

And again, bhikkhus, if a bhikkhu should see a body, one day dead, or two days dead, or three days dead, swollen, blue and festering, discarded in the charnel ground, he then compares it to his own body thus: "Truly this body is of the same nature, it will become like that and cannot escape from it."⁴⁴

Thus he dwells perceiving again and again the body as just the body in himself.... Thus, bhikkhus, this is also a way in

which a bhikkhu dwells perceiving again and again the body as just the body.

Part 2

And again, bhikkus, if a bhikkhu should see a body discarded in the charnel ground, being devoured by crows, being devoured by hawks, being devoured by vultures, being devoured by herons, being devoured by dogs, being devoured by tigers, being devoured by leopards, being devoured by jackals, or being devoured by various kinds of worms, he then compares it to his own body thus: "Truly this body is of the same nature, it will become like that and cannot escape from it."

Thus he dwells perceiving again and again the body as just the body in himself.... Thus, bhikkhus, this is also a way in which a bhikkhu dwells perceiving again and again the body as just the body.

Part 3

And again, bhikkhus, if a bhikkhu should see a body discarded in the charnel ground, that is just a skeleton held together by the tendons, with some flesh and blood still adhering to it, he then compares it to his own body thus: "Truly this body is of the same nature, it will become like that and cannot escape from it."

Thus he dwells perceiving again and again the body as just the body in himself.... Thus, bhikkhus, this is also a way in

which a bhikkhu dwells perceiving again and again the body as just the body.

Part 4

And again, bhikkhus, if a bhikkhu should see a body, discarded in the charnel ground, that is just a skeleton held together by the tendons, blood-besmeared, fleshless, he then compares it to his own body thus: "Truly this body is of the same nature, it will become like that and cannot escape from it."

Thus he dwells perceiving again and again the body as just the body in himself.... Thus, bhikkhus, this is also a way in which a bhikkhu dwells perceiving again and again the body as just the body.

Part 5

And again, bhikkhus, if a bhikkhu should see a body, discarded in the charnel ground, that is just a skeleton held together by the tendons without flesh and blood, he then compares it to his own body thus: "Truly this body is of the same nature, it will become like that and cannot escape from it."

Thus he dwells perceiving again and again the body as just the body in himself.... Thus, bhikkhus, this is also a way in which a bhikkhu dwells perceiving again and again the body as just the body.

Part 6

And again, bhikkhus, if a bhikkhu should see a body, discarded in the charnel ground, that is just loose bones scattered in all directions; at one place bones of a hand, at another place bones of a foot, at another place ankle-bones, at another place shin-bones, at another place thigh-bones, at another place hip-bones, at another place rib-bones, at another place spinal-bones, at another place shoulder-bones, at another place neck-bones, at another place the jawbone, at another place the teeth, and at another place the skull, he then compares it to his own body thus: "Truly this body is of the same nature, it will become like that and cannot escape from it."

Thus he dwells perceiving again and again the body as just the body in himself.... Thus, bhikkhus, this is also a way in which a bhikkhu dwells perceiving again and again the body as just the body.

Part 7

And again, bhikkhus, if a bhikkhu should see a body, discarded in the charnel ground, that is just white bones of conch-like colour, he then compares it to his own body thus: "Truly this body is of the same nature, it will become like that and cannot escape from it."

Thus he dwells perceiving again and again the body as just the body in himself.... Thus, bhikkhus, this is a way in

which a bhikkhu dwells perceiving again and again the body as just the body.

Part 8

And again, bhikkhus, if a bhikkhu should see a body, discarded in the charnel ground, that is bones more than a year old, lying in a heap, he then compares it to his own body thus: "Truly this body is of the same nature, it will become like that and cannot escape from it."

Thus he dwells perceiving again and again the body as just the body in himself.... Thus, bhikkhus, this is also a way in which a bhikkhu dwells perceiving again and again the body as just the body.

Part 9

And again, bhikkhus, if a bhikkhu should see a body, discarded in the charnel ground, that is just rotted bones, crumbling to dust, he then compares it to his own body thus: "Truly this body is of the same nature, it will become like that and cannot escape from it."

Thus he dwells perceiving again and again the body as just the body (not mine, not I, not self, but just a phenomenon) in himself; or he dwells perceiving again and again the body as just the body in others; or he dwells perceiving again and again the body as just the body in both himself and in others. He dwells perceiving again and again the cause and the actual appearing of the body or he dwells

perceiving again and again the cause and the actual dissolution of the body; or he dwells perceiving again and again both the actual appearing and dissolution of the body with their causes. To summarize, he is firmly mindful of the fact that only the body exists (not a soul, a self or I). That mindfulness is just for gaining insight (*vipassanā*) and mindfulness progressively. Being detached from craving and wrong views he dwells without clinging to anything in the world. Thus, bhikkhus, this is also a way in which a bhikkhu dwells perceiving again and again the body as just the body.

II. Vedanānupassanā

And how, bhikkhus, does a bhikkhu dwell perceiving again and again that feelings (*vedanā*)⁴⁵ are just feelings (not mine, not I, not self but just as phenomena)?

Here (in this teaching), bhikkhus, while experiencing a pleasant feeling,⁴⁶ a bhikkhu knows, “I am experiencing a pleasant feeling”; or while experiencing an unpleasant feeling,⁴⁷ he knows, “I am experiencing an unpleasant feeling”; or while experiencing a feeling that is neither pleasant nor unpleasant,⁴⁸ he knows, “I am experiencing a feeling that is neither pleasant nor unpleasant.”

While experiencing a pleasant feeling associated with sense pleasures,⁴⁹ he knows, “I am experiencing a pleasant feeling associated with sense pleasures”; or while experiencing a

pleasant feeling not associated with sense pleasures,⁵⁰ he knows, "I am experiencing a pleasant feeling not associated with sense pleasures."

While experiencing an unpleasant feeling associated with sense pleasures,⁵¹ he knows, "I am experiencing an unpleasant feeling associated with sense pleasures"; or while experiencing an unpleasant feeling not associated with sense pleasures,⁵² he knows, "I am experiencing an unpleasant feeling not associated with sense pleasures."

While experiencing a feeling, that is neither pleasant nor unpleasant that is associated with sense pleasures,⁵³ he knows, "I am experiencing a feeling that is neither pleasant nor unpleasant that is associated with sense pleasures"; or while experiencing a feeling that is neither pleasant nor unpleasant that is not associated with sense pleasures, he knows, "I am experiencing a feeling that is neither pleasant nor unpleasant that is not associated with sense pleasures."

Thus he dwells perceiving again and again feelings as just feelings (not mine, not I, not self, but just as phenomena) in himself; or he dwells perceiving again and again feelings as just feelings in others; or he dwells perceiving again and again feelings as just feelings in both himself and in others. He dwells perceiving again and again the cause and the actual appearing of feelings; or he dwells perceiving again and again the cause and the actual dissolution of feelings; or he dwells perceiving again and again both the actual appearing and dissolution of feelings with their causes.⁵⁴ To

summarize, he is firmly mindful of the fact that only feelings exists (not a soul, a self or I). That mindfulness is just for gaining insight (*vipassanā*) and mindfulness progressively. Being detached from craving and wrong views he dwells without clinging to anything in the world. Thus, bhikkhus, in this way a bhikkhu dwells perceiving again and again feelings as just feelings.

III. Cittānupassanā

And how, bhikkhus, does a bhikkhu dwell perceiving again and again the mind (*citta*) as just the mind (not mine, not I, not self but just a phenomenon)?

Here (in this teaching), bhikkhus, when a mind with greed (*rāga*)⁵⁵ arises, a bhikkhu knows, "This is a mind with greed"; or when a mind without greed⁵⁶ arises, he knows, "This is a mind without greed"; when a mind with anger (*dosa*)⁵⁷ arises, he knows, "This is a mind with anger"; or when a mind without anger⁵⁸ arises, he knows, "This is a mind without anger"; when a mind with delusion (*moha*)⁵⁹ arises, he knows, "This is a mind with delusion"; or when a mind without delusion⁶⁰ arises, he knows, "This is a mind without delusion"; or when a lazy, slothful mind (*saṃkhittacitta*)⁶¹ arises, he knows, "This is a lazy, slothful mind"; or when a distracted mind (*vikkhittacitta*)⁶² arises, he knows, "This is a distracted mind"; or when a developed mind (*mahagattacitta*)⁶³ arises, he knows, "This is a developed mind"; or when an undeveloped mind (*amahagattacitta*)⁶⁴ arises, he knows, "This is an undeveloped mind"; or when

an inferior mind (*sauttaracitta*)⁶⁵ arises, he knows, "This is an inferior mind"; or when a superior mind (*anuttaracitta*)⁶⁶ arises, he knows, "This is a superior mind"; or when a concentrated mind (*samāhitacitta*)⁶⁷ arises, he knows, "This is a concentrated mind"; or when an unconcentrated mind (*asamāhitacitta*)⁶⁸ arises, he knows, "This is an unconcentrated mind"; or when a mind temporarily free from defilements (*vimutticitta*)⁶⁹ arises, he knows, "This is a mind temporarily free from defilements"; or when a mind not free from defilements (*avimutticitta*) arises, he knows, "This is a mind not free from defilements".

Thus he dwells perceiving again and again the mind as just the mind (not mine, not I, not self but just a phenomenon) in himself; or he dwells perceiving again and again the mind as just the mind in others; or he dwells perceiving again and again the mind as just the mind in both himself and in others. He dwells perceiving again and again the cause and the actual appearing of the mind; or he dwells perceiving again and again the cause and the actual dissolution of the mind; or he dwells perceiving again and again both the actual appearing and dissolution of the mind with their causes.⁷⁰ To summarize, he is firmly mindful of the fact that only the mind exists (not a soul, self or I). That mindfulness is just for gaining insight (*vipassanā*) and mindfulness progressively. Being detached from craving and wrong views he dwells without clinging to anything in the world. Thus, bhikkhus, in this way a bhikkhu dwells perceiving again and again the mind as just the mind.

IV. Dhammānupassanā

i. Nīvaraṇa Pabba (Section on Hindrances)

And how, bhikkhus, does a bhikkhu dwell perceiving again and again dhammas as just dhammas (not mine, not I, not self, but just as phenomena)? Here (in this teaching), bhikkhus, a bhikkhu dwells perceiving again and again the five hindrances (*nīvaraṇa dhamma*) as just the five hindrances⁷¹ (not mine, not I, not self, but just as phenomena).

And how, bhikkhus, does a bhikkhu dwell perceiving again and again the five hindrances as just the five hindrances? Here (in this teaching), bhikkhus, while sense-desire (*kāmachanda*) is present in him, a bhikkhu knows, “There is sense-desire present in me”; or while sense-desire is not present in him, he knows, “There is no sense-desire present in me”. He also knows how the sense-desire which has not yet arisen comes to arise; he knows how the sense-desire that has arisen comes to be discarded; and he knows how the discarded sense-desire will not arise in the future.⁷²

While ill-will (*byāpāda*) is present in him he knows, “There is ill-will present in me”; or while ill-will is not present in him, he knows, “There is no ill-will present in me.” He also knows how the ill-will which has not yet arisen comes to arise; he knows how the ill-will which has arisen comes to be discarded; and he knows how the discarded ill-will will not arise in the future.⁷³

While sloth and torpor are present in him, he knows, "There are sloth and torpor present in me"; or while sloth and torpor are not present in him, he knows "There is no sloth and torpor present in me." He also knows how the sloth and torpor which has not yet arisen comes to arise; he knows how the sloth and torpor that has arisen comes to be discarded; and he knows how the discarded sloth and torpor will not arise in the future.⁷⁴

While distraction and worry (*uddhacca-kukkucca*) are present in him, he knows, "There are distraction and worry present in me"; or while distraction and worry are not present in him, he knows, "There are no distraction and worry present in me." He knows how the distraction and worry which has not yet arisen comes to arise, he knows how the distraction and worry that has arisen comes to be discarded; and he knows how the discarded distraction and worry will not arise in the future.⁷⁵

While doubt or wavering of the mind (*vicikicchā*) is present in him, he knows, "There is doubt or wavering of the mind present in me"; or while doubt or wavering of the mind is not present in him, he knows, "There is no doubt or wavering of mind present in me." He also knows how the doubt or wavering of mind which has not yet arisen comes to arise; he knows how the doubt or wavering of mind that has arisen comes to be discarded; and he knows how the discarded doubt or wavering of mind will not arise in the future.⁷⁶

Thus he dwells perceiving again and again dhammas as just dhammas (not mine, not I, not self, but just as phenomena) in himself; or he dwells perceiving again and again dhammas as just dhammas in others; or he dwells perceiving again and again dhammas as just dhammas in both himself and in others. He dwells perceiving again and again the cause and the actual appearing of dhammas; or he dwells perceiving again and again the cause and the actual dissolution of dhammas; or he dwells perceiving again and again both the actual appearing and dissolution of dhammas with their causes.⁷⁷ To summarize, he is firmly mindful of the fact that only dhammas exist (not a soul, a self or I). That mindfulness is just for gaining insight (*vipassanā*) and mindfulness progressively. Being detached from craving and wrong views he dwells without clinging to anything in the world. Thus, bhikkhus, in this way a bhikkhu dwells perceiving again and again the five hindrances as just the five hindrances.

ii. Khanda Pabba **(Section on Aggregates)**

And again, bhikkhus, a bhikkhu dwells perceiving again and again the five aggregates of clinging (*upādāna-kkhandha*)⁷⁸ as just the five aggregates of clinging (not mine, not I, not self but just as phenomena).

And how, bhikkhus, does a bhikkhu dwell perceiving again and again the five aggregates of clinging as just the five aggregates of clinging?

Here (in this teaching), bhikkhus, a bhikkhu perceives thus: “This is the corporeal body (*rūpa*); this is the cause and the actual appearing of the corporeal body; this is the cause and the actual dissolution of the corporeal body. This is feeling (*vedanā*) this is the cause and the actual appearing of feeling; this is the cause and the actual dissolution of feeling. This is perception (*saññā*); this is the cause and the actual appearing of perception; this is the cause and the actual dissolution of perception. These are mental formations (*saṅkhāra*); this is the cause and the actual appearing of mental formations; this is the cause and the actual dissolution of mental formations. This is consciousness (*viññāṇa*); this is the cause and the actual appearing of consciousness; this is the cause and the actual dissolution of consciousness.”⁷⁹

Thus he dwells perceiving again and again dhammas as just dhammas (not mine, not I, not self, but just as phenomena) in himself; or he dwells perceiving again and again dhammas as just dhammas in others; or he dwells perceiving again and again dhammas as just dhammas in both himself and others. He dwells perceiving again and again the cause and the actual appearing of dhammas; or he dwells perceiving again and again the cause and the actual dissolution of dhammas; or he dwells perceiving again and again both the actual appearing and dissolution of dhammas with their causes.⁸⁰ To summarize, he is firmly mindful of the fact that only dhammas exist (not a soul, a self or I). That mindfulness is just for gaining insight (*vipassanā*) and mindfulness

progressively. Being detached from craving and wrong views he dwells without clinging to anything in the world. Thus, bhikkhus, in this way a bhikkhu dwells perceiving again and again the five aggregates of clinging as just the five aggregates of clinging.

iii. *Āyatana Pabba* (Section on Sense Bases)

And again, bhikkhus, a bhikkhu dwells perceiving again and again the six internal and external sense bases (*āyatana*)⁸¹ as just the six internal and external sense bases (not mine, not I, not self, but just as phenomena). And how, bhikkhus, does a bhikkhu dwell perceiving again and again the six internal and external sense bases as just the six internal and external sense bases?

Here (in this teaching), bhikkhus, a bhikkhu knows the eye and the visible objects and the fetter that arises dependent on both. He also knows how the fetter which has not yet arisen comes to arise; he knows how the fetter that has arisen comes to be discarded; and he knows how the discarded fetter that has arisen comes to be discarded; and he knows how the discarded fetter will not arise in the future.⁸²

He knows the ear and sounds and the fetter that arises dependent on both. He also knows how the fetter which has not yet arisen comes to arise; he knows how the fetter that

has arisen comes to be discarded; and he knows how the discarded fetter will not arise in the future.

He knows the nose and odours and the fetter that arises dependent on both. He also knows how the fetter which has not yet arisen comes to arise; he knows how the fetter that has arisen comes to be discarded; and he knows how the discarded fetter will not arise in the future.

He knows the tongue and tastes and the fetter that arises dependent on both. He also knows how the fetter which has not yet arisen comes to arise; he knows how the fetter that has arisen comes to be discarded; and he knows how the discarded fetter will not arise in the future.

He knows the body and tactile objects and the fetter that arises dependent on both. He also knows how the fetter which has not yet arisen comes to arise; he knows how the fetter that has arisen comes to be discarded; and he knows how the discarded fetter will not arise in the future.

He knows the mind and mind objects (dhamma) and the fetter that arises dependent on both. He also knows how the fetter which has not yet arisen comes to arise; he knows how the fetter that has arisen comes to be discarded; and he knows how the discarded fetter will not arise in the future.

Thus he dwells perceiving again and again dhammas as just dhammas (not mine, not I, not self, but just as phenomena) in himself⁸³.... Being detached from craving and wrong

views he dwells without clinging to anything in the world. Thus, bhikkhus, in this way a bhikkhu dwells perceiving again and again the six internal and external sense bases as just the six internal and external sense bases.

iv. Bojjhaṅga Pabba (Section on Enlightenment Factors)

And again, bhikkhus, a bhikkhu dwells perceiving again and again the seven factors of enlightenment (*bhojjaṅga*) as just the seven factors of enlightenment (not mine, not I, not self, but just as phenomena). And how, bhikkhus, does a bhikkhu dwell perceiving again and again the seven factors of enlightenment as just the seven factors of enlightenment?

Here (in this teaching), bhikkhus, while the enlightenment factor of mindfulness (*sati-sambojjhaṅga*)⁸⁴ is present in him, a bhikkhu knows, "The enlightenment factor of mindfulness is present in me"; or while the enlightenment factor of mindfulness is not present in him, he knows, "The enlightenment factor of mindfulness is not present in me." He also knows how the enlightenment factor of mindfulness which has not yet arisen comes to arise; and he knows how the complete fulfillment in developing the arisen enlightenment factor of mindfulness comes to be.⁸⁵

While the enlightenment factor of investigation of phenomena (*dhammavicaya-bhojjaṅga*)⁸⁶ is present in him, he knows,

“The enlightenment factor of investigation of phenomena is present in me”; or while the enlightenment factor of investigation of phenomena is not present in him, he knows, “The enlightenment factor of investigation of phenomena is not present in me.” He also knows how the enlightenment factor of investigation of phenomena which has not yet arisen comes to arise; and he knows how the complete fulfillment in developing the arisen enlightenment factor of investigation of phenomena comes to be.

While the enlightenment factor of effort (*virīya-sambojjhaṅga*)⁸⁷ is present in him, he knows, “The enlightenment factor of effort is present in me”; or while the enlightenment factor of effort is not present in him, he knows, “The enlightenment factor of effort is not present in me.” He also knows how the enlightenment factor of effort which has not yet arisen comes to arise; and he knows how the complete fulfillment in developing the arisen enlightenment factor of effort comes to be.

While the enlightenment factor of rapture (*pīti-sambojjhaṅga*)⁸⁸ is present in him, he knows, “The enlightenment factor of rapture is present in me”; or while the enlightenment factor of rapture is not present in him, he knows, “The enlightenment factor of rapture is not present in me.” He also knows how the enlightenment factor of rapture which has not yet arisen comes to arise; and he knows how the complete fulfillment in developing the arisen enlightenment factor of rapture comes to be.

While the enlightenment factor of tranquility (*passadhi-sambojjhaṅga*)⁸⁹ is present in him, he knows, "The enlightenment factor of tranquility is present in me"; or while the enlightenment factor of tranquility is not present in him, he knows, "The enlightenment factor of tranquility is not present in me." He also knows how the enlightenment factor of tranquility which has not yet arisen comes to arise; and he knows how the complete fulfillment in developing the arisen enlightenment factor of tranquility comes to be.

While the enlightenment factor of concentration (*samādhī-sambojjhaṅga*)⁹⁰ is present in him, he knows, "The enlightenment factor of concentration is present in me"; or while the enlightenment factor of concentration is not present in him, he knows, "The enlightenment factor of concentration is not present in me." He also knows how the enlightenment factor of concentration which has not yet arisen comes to arise; and he knows how the complete fulfillment in developing the arisen enlightenment factor of concentration comes to be.

While the enlightenment factor of equanimity (*upekkhā-sambojjhaṅga*)⁹¹ is present in him, he knows, "The enlightenment factor of equanimity is present in me"; or while the enlightenment factor of equanimity is not present in him, he knows, "The enlightenment factor of equanimity is not present in me." He also knows how the enlightenment factor of equanimity which has not yet arisen comes to arise; and he knows how the complete fulfillment in developing the arisen enlightenment factor of equanimity comes to be.

Thus he dwells perceiving again and again dhammas as just dhammas (not mine, not I, not self, but just as phenomena) in himself⁹².... Being detached from craving and wrong views he dwells without clinging to anything in the world. Thus, bhikkhus, in this way a bhikkhu dwells perceiving again and again the seven factors of enlightenment as just the seven factors of enlightenment.

v. Sacca Pabba
(Section on Noble Truths)

And again, bhikkhus, a bhikkhu dwells perceiving again and again the Four Noble Truths as just the Four Noble Truths (not mine, not I, not self, but just as phenomena). And how, bhikkhus, does a bhikkhu dwell perceiving again and again the Four Noble Truths as just the Four Noble Truths? Here, (in this teaching), bhikkhus, a bhikkhu knows as it really is, "This is dukkha"; he knows as it really is, "This is the cause of dukkha"; he knows as it really is, "This is the cessation of dukkha"; he knows as it really is, "This is the path leading to the cessation of dukkha."

a. *Dukkhasacca Pabba*
(Section on the Noble Truth of Dukkha)

And what, bhikkhus, is the Noble Truth of dukkha? Birth⁹³ is dukkha, ageing is also dukkha, death is also dukkha; sorrow, lamentation, physical pain, mental pain and anguish are also dukkha; to have to associate with those (persons or things) one dislikes is also dukkha; to be separ-

ated from those one loves or likes is also dukkha; wishing for what one cannot get is also dukkha; in short, the five aggregates of clinging are dukkha.⁹⁴

And what, bhikkhus, is birth (*jāti*)? The birth, the being born, the origination, the conception, the springing into existence, the manifestation of the aggregates, and the acquisition of the sense-bases of beings in this or that class of beings — this, bhikkhus, is called birth.

And what, bhikkhus, is ageing (*jarā*)? It is the ageing, the getting frail, the loss of teeth, the greying of hair, the wrinkling of skin; the failing of the vital force, the wearing out of the sense faculties of beings in this or that class of beings — this, bhikkhus, is called ageing.

And what, bhikkhus, is death (*marāṇa*)? The departing and vanishing, the destruction, the disappearance, the death, the completion of the life span, the dissolution of the aggregates (*khandha*), the discarding of the body, and the destruction of the physical life-force of beings in this or that class of beings — this, bhikkhus, is called death.

And what, bhikkhus, is sorrow (*soka*)?⁹⁵ The sorrow, the act of sorrowing, the sorrowful state of mind, the inward sorrow and the inward overpowering sorrow that arise because of this or that loss (of relatives, or possessions) or this or that painful state that one experiences — this, bhikkhus, is called sorrow.

And what, bhikkhus is lamentation (*parideva*)? The crying and lamenting, the act of crying and lamenting, and the state of crying and lamentation that arises because of this or that loss (of relatives, or possessions) or this or that painful state that one experiences — this bhikkhus, is called lamentation.

And what, bhikkhus, is physical pain (*dukkha*)? The bodily pain and bodily unpleasantness, the painful and unpleasant feeling produced by bodily contact — this, bhikkhus, is called physical pain.

And what, bhikkhus, is mental pain (*domanassa*)? The pain in the mind and the unpleasantness in the mind, the painful and unpleasant feeling produced by mental contact — this, bhikkhus, is called mental pain.

And what, bhikkhus, is anguish (*upāyāsa*)? The distress and anguish and the state of distress and anguish that arises because of this or that loss (of relatives, or possessions) or this or that painful state that one experiences — this, bhikkhus, is called anguish.

And what, bhikkhus, is the dukkha of having to associate with those (persons or things) one dislikes (*appiyehi sampayogo dukkho*)?

Having to meet, remain with, be in close contact, or intermingle, with sights, sounds, odours, tastes, tactile objects, and dhammas in this world which are undesirable, un-

pleasant or unenjoyable, or with those who desire one's disadvantage, loss, discomfort, or association with danger — this, bhikkhus, is called the dukkha of having to associate with those (persons or things) one dislikes.

And, bhikkhus, what is the dukkha of being separated from those one loves or likes (*piyehi vippayogo dukkho*)? Not being able to meet, remain with, be in close contact, or intermingle, with sights, sounds, odours, tastes, tactile objects, and dhammas in this world which are desirable, pleasant or enjoyable, or with mother or father or brothers or sisters or friends or companions or maternal and paternal relatives who desire one's advantage, benefit, comfort or freedom from danger — this, bhikkhus, is called the dukkha of being separated from those one loves or likes.

And what, bhikkhus, is the dukkha of wishing for what one cannot get? Bhikkhus, in beings subject to birth and rebirth the wish arises: "Oh that we were not subject to birth and rebirth! Oh that birth and rebirth would not happen to us!" But this cannot happen by merely wishing. This is the dukkha of wishing for what one cannot get. Bhikkhus, in beings subject to ageing the wish arises: "Oh that we were not subject to ageing! Oh that ageing would not happen to us!" But this cannot happen merely by wishing. This also is the dukkha of wishing for what one cannot get. Bhikkhus, in beings subject to illness the wish arises: "Oh that we were not subject to illness! Oh that illness would not happen to us!" But this cannot happen merely by wishing. This also is the dukkha of wishing for what one cannot get. Bhikkhus,

in beings subject to death the wish arises: "Oh that we were not subject to death! Oh that death would not happen to us!", But this cannot happen merely by wishing. This also is the dukkha of wishing for what one cannot get. Bhikkhus, in beings subject to sorrow, lamentation, physical pain, mental pain and anguish the wish arises: "Oh that we were not subject to sorrow, lamentation, physical pain, mental pain and anguish! Oh that sorrow, lamentation, physical pain, mental pain, and anguish would not happen to us!" But this cannot happen merely by wishing. This also is the dukkha of wishing for what one cannot get.⁹⁶

And what, bhikkhus, is (meant by) "In short, the five aggregates of clinging are dukkha"? They are the aggregate of corporeality, the aggregate of feeling, the aggregate of perception, the aggregate of mental formations, and the aggregate of consciousness. These, bhikkhus, are what is meant by "In short, the five aggregates of clinging are dukkha."

Bhikkhus, this is called the Noble Truth of dukkha.

b. *Samudayasacca Pabba*
(Section on the Noble Truth of the Cause of Dukkha)

And what, bhikkhus, is the Noble Truth of the cause of dukkha? It is that craving which gives rise to fresh rebirth; and which together with delight and clinging, (accepts, enjoys, and) finds great delight in this or that (existence or

sense pleasure that happens to arise). Namely, craving for sense pleasures (*kāmatanāhā*), craving for (better) existences (*bhavatanāhā*), and craving for non-existence (*vibhavatanāha*).⁹⁷

When this craving arises, bhikkhus, where does it arise? When it establishes itself,⁹⁸ where does it establish itself? When this craving arises and establishes itself, it does so in the delightful and pleasurable characteristics of the world.⁹⁹

What are the delightful and pleasurable characteristics of the world? In the world, the eye has the characteristic of being delightful and pleasurable. When this craving arises, it arises there (i.e. in the eye); when it establishes itself, it establishes itself there. In the world, the ear.... In the world, the nose.... In the world, the tongue.... In the world, the body.... In the world, the mind has the characteristic of being delightful and pleasurable. When this craving arises it arises there; when it establishes itself, it establishes itself there.

In the world, visible objects.... In the world, sounds.... In the world, odours.... In the world, tastes.... In the world, tactile objects.... In the world, dhammas have the characteristic of being delightful and pleasurable. When this craving arises it arises there; when it establishes itself, it establishes itself there.

In the world, eye-consciousness.... In the world, ear-consciousness.... In the world, nose-consciousness.... In the world, tongue-consciousness.... In the world, body-consciousness.... In the world, mind-consciousness has the

characteristic of being delightful and pleasurable. When this craving arises it arises there; when it establishes itself, it establishes itself there.

In the world, eye-contact.... In the world, ear-contact.... In the world, nose-contact.... In the world, tongue-contact.... In the world, body-contact.... In the world, mind-contact has the characteristic of being delightful and pleasurable. When this craving arises it arises there; when it establishes itself, it establishes itself there.¹⁰⁰

In the world, the feeling born of eye-contact.... In the world, the feeling born of ear-contact.... In the world, the feeling born of nose-contact.... In the world, the feeling born of tongue-contact.... In the world, the feeling born of body-contact.... In the world, the feeling born of mind-contact has the characteristic of being delightful and pleasurable. When this craving arises it arises there; when it establishes itself, it establishes itself there.

In the world, the perception of visible objects.... In the world, the perception of sounds.... In the world, the perception of odours.... In the world, the perception of tastes.... In the world, the perception of tactile objects.... In the world, the perception of dhammas has the characteristic of being delightful and pleasurable. Then this craving arises it arises there, when it establishes itself, it establishes itself there.

In the world, the volition towards visible objects.... In the world, the volition towards sounds.... In the world, the

volition towards odours.... In the world, the volition towards tastes.... In the world, the volition towards tactile objects.... In the world, the volition towards dhammas has the characteristic of being delightful and pleasurable. When this craving arises it arises there; when it establishes itself, it establishes itself there.¹⁰¹

In the world, the craving for visible objects.... In the world, the craving for sounds.... In the world, the craving for odours.... In the world, the craving for tastes.... In the world, the craving for tactile objects.... In the world, the craving for dhammas has the characteristic of being delightful and pleasurable. When this craving arises it arises there; when it establishes itself, it establishes itself there.

In the world, the initial thinking about visible objects.... In the world, the initial thinking about sounds.... In the world, the initial thinking about odours.... In the world, the initial thinking about tastes.... In the world, the initial thinking about tactile objects.... In the world, the initial thinking about dhammas has the characteristic of being delightful and pleasurable. When this craving arises it arises there; when it establishes itself, it establishes itself there.¹⁰²

In the world, the continued thinking about visible objects.... In the world, the continued thinking about sounds.... In the world, the continued thinking about odours.... In the world, the continued thinking about tastes.... In the world, the continued thinking about tactile objects.... In the world, the continued thinking about dhammas has the character-

istic of being delightful and pleasurable. When this craving arises it arises there; when it establishes itself, it establishes itself there.

This, bhikkhus, is called the Noble Truth of the cause of dukkha.

c. *Nirodhasacca Pabba*

(Section on the Noble Truth of the Cessation of Dukkha)

And what, bhikkhus, is the Noble Truth of the cessation of dukkha? It is the complete extinction and cessation of this very craving, its abandoning and discarding, the liberation and detachment from it. Bhikkhus, when this craving is abandoned, where is it abandoned? When it ceases, where does it cease? When this craving is abandoned or ceases it does so in the delightful and pleasurable characteristics of the world.¹⁰³

What are the delightful and pleasurable characteristics of the world? In the world, the eye has the characteristic of being delightful and pleasurable. When this craving is abandoned, it is abandoned there (i.e. in the eyes); when it ceases, it ceases there. In the world, the ear.... In the world, the nose.... In the world, the tongue.... In the world, the body.... In the world, the mind has the characteristic of being delightful and pleasurable. When this craving is abandoned it is abandoned there; when it ceases, it ceases there.

In the world, visible objects.... In the world, sounds.... In the world, odours.... In the world, tastes.... In the world, tact-

ile objects.... In the world, dhammas have the characteristic of being delightful and pleasurable. When this craving is abandoned, it is abandoned there; when it ceases, it ceases there.

In the world, eye-consciousness.... In the world, ear-consciousness.... In the world, nose-consciousness.... In the world, tongue-consciousness.... In the world, body-consciousness.... In the world, mind-consciousness has the characteristic of being delightful and pleasurable. When this craving is abandoned, it is abandoned there; when it ceases, it ceases there.

In the world, eye-contact.... In the world, ear-contact.... In the world, nose-contact.... In the world, tongue-contact.... In the world, body-contact.... In the world, mind-contact has the characteristic of being delightful and pleasurable. When this craving is abandoned, it is abandoned there; when it ceases, it ceases there.

In the world, the feeling born of eye-contact.... In the world, the feeling born of ear-contact.... In the world, the feeling born of nose-contact.... In the world, the feeling born of tongue-contact.... In the world, the feeling born of mind-contact has the characteristic of being delightful and pleasurable. When this craving is abandoned, it is abandoned there; when it ceases, it ceases there.

In the world, the perception of visible objects.... In the world, the perception of sounds.... In the world, the per-

ception of odours.... In the world, the perception of tastes.... In the world, the perception of tactile objects.... In the world, the perception of dhammas has the characteristic of being delightful and pleasurable. When this craving is abandoned, it is abandoned there; when it ceases, it ceases there.

In the world, the volition towards visible objects.... In the world, the volition towards sounds.... In the world, the volition towards odours.... In the world, the volition towards tastes.... In the world, the volition towards tactile objects.... in the world, the volition towards dhammas has the characteristic of being delightful and pleasurable. When this craving is abandoned, it is abandoned there; when it ceases, it ceases there.

In the world, the craving for visible objects.... In the world, the craving for sounds.... In the world, the craving for tastes.... In the world, the craving for tactile objects.... In the world, the craving for dhammas has the characteristic of being delightful and pleasurable. When this craving is abandoned, it is abandoned there; when it ceases, it ceases there.

In the world, the initial thinking about visible objects.... In the world, the initial thinking about sounds.... In the world, the initial thinking about odours.... In the world, the initial thinking about tastes.... In the world, the initial thinking about tactile objects.... In the world, the initial thinking about dhammas has the characteristic of being delightful

and pleasurable. When this craving is abandoned, it is abandoned there; when it ceases, it ceases there.

In the world, the continued thinking about visible objects.... In the world, the continued thinking about sounds.... In the world, the continued thinking about odours.... In the world, the continued thinking about tastes.... In the world, the continued thinking about dhammas has the characteristic of being delightful and pleasurable. When this craving is abandoned, it is abandoned there; when it ceases, it ceases there.

This, bhikkhus, is the Noble Truth of the cessation of dukkha.

- d. *Maggasacca Pabba*
(Section on the Noble Truth of the Path leading to the cessation of Dukkha)

And what, bhikkhus, is the Noble Truth of the path leading to the cessation of dukkha?

It is the Noble Eightfold Path, namely, Right View (*Sammā-ditṭhi*), Right Thought (*Sammā-saṅkappa*), Right Speech (*Sammā-vācā*), Right Action (*Sammā-kammanta*), Right Livelihood (*Sammā-ājīva*), Right Effort (*Sammā-vāyāma*), Right Mindfulness (*Sammā-sati*), and Right Concentration (*Sammā-samādhi*).

And what, bhikkhus, is **Right View**? The understanding of dukkha; the understanding of the cause of dukkha; the understanding of the cessation of dukkha; the under-

standing of the path leading to the cessation of dukkha. This, bhikkhus, is called Right View.¹⁰⁴

And what, bhikkhus, is **Right Thought**? Thoughts directed to liberation from sensuality; thoughts free from ill-will; and thoughts free from cruelty. This, bhikkhus, is called Right Thought.¹⁰⁵

And what, bhikkhus, is **Right Speech**? Abstaining from lying, from tale-bearing,¹⁰⁶ from abusive speech, and from vain and unbeneficial talk.¹⁰⁷ This, bhikkhus, is called Right Speech.

And what, bhikkhus, is **Right Action**? Abstaining from killing living beings,¹⁰⁸ from stealing¹⁰⁹ and from wrongful indulgence in sense pleasures.¹¹⁰ This, bhikkhus, is called Right Action.

And what, bhikkhus, is **Right Livelihood**? Here (in this teaching), bhikkhus, the noble disciple completely abstains from a wrong way of livelihood and makes his living by a right means of livelihood. This, bhikkhus, is called Right Livelihood.¹¹¹

And what, bhikkhus, is **Right Effort**? Here (in this teaching), bhikkhus, a bhikkhu generates an intention, makes effort, rouses energy, applies his mind, and strives ardently to prevent the arising of evil, unwholesome states of mind that have not yet arisen. He generates an intention, makes effort, rouses energy, applies his mind, and strives ardently to abandon evil, unwholesome states of mind that have

arisen. He generates an intention, makes effort, rouses energy, applies his mind, and strives ardently to attain wholesome states of mind that have not yet arisen. He generates an intention, makes effort, rouses energy, applies his mind, and strives ardently to maintain the wholesome states of mind that have arisen, to prevent their lapsing, to increase them, to cause them to grow, and to completely develop them. This, bhikkhus, is called Right Effort.

And what, bhikkhus, is **Right Mindfulness**? Here (in this teaching), bhikkhus, a bhikkhu dwells perceiving again and again the body as just the body with diligence, clear understanding, and mindfulness, thus keeping away covetousness and mental pain in the world; he dwells perceiving again and again feelings as just feelings with diligence, clear understanding and mindfulness, thus keeping away covetousness and mental pain in the world, he dwells perceiving again and again the mind as just the mind with diligence, clear understanding, and mindfulness, thus keeping away covetousness and mental pain in the world; he dwells perceiving again and again dhammas as just dhammas with diligence, clear understanding and mindfulness, thus keeping away covetousness and mental pain in the world. This, bhikkhus, is called Right Mindfulness.

And what, bhikkhus, is **Right Concentration**? Here (in this teaching), bhikkhus, a bhikkhu being detached from sensual desire and unwholesome states attains and dwells in the first *jhāna* which has *vitakka* and *vicāra*; and rapture (*pīti*) and *sukha* born of detachment (from the hindrances).¹¹² With

the subsiding of vitakka and vicāra, a bhikkhu attains and dwells in the second jhāna, with internal tranquility and one-pointedness of mind, without vitakka and vicāra, but with rapture and sukha born of concentration. Being without rapture, a bhikkhu dwells in equanimity with mindfulness and clear understanding, and experiences sukha in mind and body. He attains and dwells in the third jhāna; that which causes a person who attains it to be praised by the Noble Ones¹¹³ as one who has equanimity and mindfulness, one who abides in sukha. By becoming detached from both sukha and dukkha and by the previous cessation of gladness and mental pain, a bhikkhu attains and dwells in the fourth jhāna, a state of pure mindfulness born of equanimity. This, bhikkhus, is called Right Concentration.

This, bhikkhus, is called the Noble Truth of the path leading to the cessation of dukkha.

Thus he dwells perceiving again and again dhammas as just dhammas (not mine, not I, not self, but just as phenomena) in himself; or he dwells perceiving again and again dhammas as just dhammas in others; or he dwells perceiving again and again dhammas as just dhammas in both himself and in others. He dwells perceiving again and again the cause and the actual appearing of dhammas; or he dwells perceiving again and again the cause and the actual dissolution of dhammas; or he dwells perceiving again and again both the actual appearing and dissolution of dhammas with their causes.¹¹⁴ To summarize, he is firmly mindful of the fact that only dhammas exist (not a soul, a

self or I). That mindfulness is just for gaining insight (*vipassanā*) and mindfulness progressively. Being detached from craving and wrong views he dwells without clinging to anything in the world. Thus, bhikkhus, in this way a bhikkhu dwells perceiving again and again the Four Noble Truths as just the Four Noble Truths.

Indeed, bhikkhus, whosoever practises these four satipaṭṭhānas in this manner for seven years, one of two results is to be expected in him: Arahatsip in this very existence, or if there yet be any trace of clinging, the state of an Anāgāmi.¹¹⁵

Let alone seven years, bhikkhus, whosoever practises these four satipaṭṭhānas in this manner for six years, five years, four years, three years, two years, or one year.

Let alone one year, bhikkhus, whosoever practises these four satipaṭṭhānas in this manner for seven months, one of two results is to be expected in him: Arahatsip in this very existence, or if there yet be any trace of clinging, the state of an Anāgāmi.

Let alone seven months, bhikkhus, whosoever practises these four satipaṭṭhānas in this manner for six months, five months, four months, three months, two months, one month, or half a month.

Let alone half a month, bhikkhus, whosoever practises these four satipaṭṭhānas in this manner for seven days, one of two results is to be expected in him: Arahatsip in this very

existence or if there yet be any trace of clinging, the state of an Anāgāmi.

This is what I meant when I said: “Bhikkhus, this is the one and the only way for the purification (of the minds) of beings, for overcoming sorrow and lamentation, for the cessation of physical and mental pain, for attainment of the Noble Paths, and for the realization of Nibbāna. That only way is the four satipaṭṭhānas”.

This is what the Bhagavā said. Delighted, the bhikkhus rejoice at the Bhagavā’s words.

Sādhu! Sādhu! Sādhu!

Notes

1. The words of Ānanda Mahāthera who was the Buddha's attendant monk. He recited the texts of the Dhamma, as he had heard them from the Buddha, at the First Council of monks (approx. 544 B.C.).
2. This is a polite form of address which was used when monks spoke to the Buddha. It means "Blessed One".
3. The Kuru country was located in North West India near New Delhi.
4. A *bhikkhu* is a Buddhist monk who has received full ordination.
5. "*Bhadante*" is a polite answer to an elder or superior. Its approximate meaning would be "Yes, Venerable Sir".
6. The one and the only way: *ekāyano*, this means that this is: the only way which surely leads to the benefits listed, there is no other way, and this way leads to nowhere else. This statement does not need to be believed in blindly, but as a meditator practises he can verify it by his own experience.
7. Cessation (*atthaṇamāya*) is generally translated as "destruction" which might wrongly imply an active attack on the physical and mental pain. However, the physical and mental pain cease due to lack of craving, just as a fire is extinguished due to lack of fuel.

8. Physical and mental pain (*dukkha-domanassa*) is a compound word which denotes the whole spectrum of physical and mental pain. Here, *dukkha* (du = bad, painful, + kha = empty, space) refers to all types of physical pain, and *domanassa* (du = bad, painful + mana = mind) refers to all types of mental pain including frustration, grief, fear and various types of phobias and neuroses.
9. Here *ñāya* means the four Noble Paths (*ariya magga*). The Noble Path is the name for the consciousness that has Nibbāna for its object. The Four Noble Paths are the path of a Stream Enterer (*sotāpatti magga*), the path of the Once-returner (*sakadāgāmi magga*), the path of a Non-returner (*anāgāmi magga*), and the path of an Arahant (*arahatta magga*).
10. *Nibbāna* (Skt. Nirvāna), is a reality experienced by a mind totally free from greed, hatred, and delusion.
11. *Satipaṭṭhāna* (Sati = mindfulness, awareness of what is occurring + paṭṭhāna = that which plunges into and penetrates continuously, again and again) is the type of mindfulness that penetrates repeatedly into the body, feelings, mind, and dhammas, and sees the actual reality that is occurring. This is in contrast to the normal unmindful state in which the mind bounces or skips over these phenomena. “The four satipaṭṭhānas” might therefore be translated as the “four steadfast mindfulnesses”.

12. The Four *satipaṭṭhānas* in Pāli are *kāyānupassanā*, *vedanānupassanā*, *cittānupassana* and *dhammānupassanā*.
13. *Kāya* is the aggregate of physical phenomena. Here it refers to the corporeal body.
14. The phrases, “body as just the body”, “feelings as just feelings”, show that the body, feelings, mind, and dhammas are not to be seen as mine, I or self. This is the natural knowledge that arises from observing the body, feelings, mind and dhammas with steadfast mindfulness. It is not a belief. Normally this knowledge is absent due to lack of steadfast mindfulness.
15. Diligence (*ātapi*) means bringing the mind back to the object of meditation again and again no matter how many times it slips away.
16. Clear understanding (see Note 39)
17. World (*loka*) refers to anything that arises and passes away, i.e. the five aggregates of clinging.
18. Feelings (*vedanā*) (see Note 45)
19. Mind (*citta*) is that which knows, is aware, or is conscious (see *Cittānupassanā* Section).
20. The word *dhamma* has a number of meanings according to the context in which it is used. It can mean: natural phenomena, mental objects, a state, truth, reality, wisdom, actions, good actions, practice, cause and

offence. Also, in English usage *Dhamma* (there are no capital letters in the Pāli language) can mean the Teachings of the Buddha or the texts which contains those teachings.

Here, in this context *dhamma* is any natural phenomenon that is not a concept and it is specifically referring to the five hindrances, the five aggregates of clinging, the six internal and external sense bases, the seven factors of enlightenment and the Four Noble Truths.

21. The main point here is that the place for meditation should be as quiet and free from people and distractions as possible.
22. If sitting cross-legged is too painful the meditator will not be able to sit for very long. The main point is to sit in a comfortable and alert way. Therefore, a chair may be used. Mindfulness of breathing can also be developed while standing, walking or lying down.
23. The mindfulness should be directed to the place at which the breath makes contact with the upper lip or the tip of the nose depending on where it is felt in each individual.
24. The whole breath body (*sabbakāya*) means the whole breath from the beginning to the end.
25. As the mind calms down the breath will also calm down without exerting any conscious control over it.

26. It is not necessary to repeat all the above phrases in the mind, but the essential point is to be aware of the actual phenomena. These phrases are all examples to show that the meditator has to be aware of the breath in whichever condition it is in and does not need to control the breath in any way.
27. Here “body” means the process of breathing.
28. The meditator knows by inference that in others, just as in himself, there is no I or self that breathes but just breathing exists. This cuts out delusion concerning external phenomena.
29. This cannot be done at the same time but is done alternately.
30. The causes of the appearing and the dissolution of the breath are the existence or the non-existence of the body, the nasal apertures, and the mind. The actual appearing and the actual dissolution refer to the actual phenomena of the breath arising and passing away. The main point here is to be aware of the actual appearing and the actual dissolution of the breath so as to perceive its impermanent, unsatisfactory and soul-less nature.
31. Wrong view refers to thinking that there is a permanent self or I who is breathing. If the meditator sees the breath as impermanent, unsatisfactory, and

not self then there will be no craving or wrong view at that time.

- 32. See Note 17.
- 33. While walking (*gacchanto*) lit. means while going.
- 34. I am walking: Here as elsewhere in this discourse the use of the term “I” is only a grammatical usage and does not mean that an “I” really exists. In Pāḷi language it is impossible to construct a verb without an ending showing a subject, for example,

gaccha + mi = gacchāmi, I am going

gaccha + ma = gacchāma, we are going

A similar situation occurs in English where sometimes we have to make up a subject to make a sentence i.e. “It’s raining”. Clearly the “It” does not exist and there is only raining. Similarly there is only walking and no “I” who is walking.

- 35. When the meditator is aware of the actual motion of the legs and body, that is the sensation of touch and motion, he can be said to “know”, “I am walking”. In all the postures he should be aware of what is actually happening in a similar way.
- 36. The meditator should even be aware of movements of the body within a posture, e.g. while sitting he moves an arm or while lying down he rolls over.

37. Body here means the positions, postures, and movements of the body.
38. The causes of the appearing and the dissolution of the body here and in subsequent sections are the existence or non-existence of ignorance of the Four Noble Truths, craving, kamma, and nutriment.
39. Clear understanding (*sampajañña*) is of four types: *satt-haka-sampajañña*, *sappāya-sampajañña*, *gocara-sampajañña* and *asammoha-sampajañña*.

Before a meditator does any action he should first consider whether that action is or is not a beneficial action. This prior consideration is called *satt-haka-sampajañña*.

If it is a beneficial action then the meditator should next consider whether it is suitable or proper. This is called *sappāya-sampajañña*. For example, if the meditator wishes to go to a pagoda to meditate this is a beneficial action. However, if at the time he wishes to go to the pagoda there is a large crowd gathered for a pagoda festival and there would be many disturbances because of that, then it would not be suitable.

The understanding of the proper field for the mind is *gocara-sampajañña*. If the meditator is practising the four *satipatthānas* this is the proper field for the mind. If he is thinking about or indulging in sense pleasures this is not the proper field for the mind.

The understanding that sees that all conditioned phenomena are impermanent and unsatisfactory and that sees all phenomena (including Nibbāna) are not-self is *asammoha-sampajañña*.

40. This meditation can be practised in either of two ways. The first way is to see each part as repulsive and the second way is to see that as parts or collectively the body is not-self.

To develop the perception of the repulsiveness of the body it is very helpful to view an autopsy of a corpse as this will make it easier to truly see that each part is repulsive. This method of meditation is very effective for cutting out lust.

To develop the perception of not-self the meditator should reflect on each part and see that they are devoid of consciousness e.g. the hair on the head does not know it has hair growing on it; what is it that thinks “This is my hair”? By meditating in this way the meditator will clearly see the difference between the mind and the body. Also he will see for himself that it is deluded to view the body as me, as mine or as self.

41. Only primary elements (*dhātu*) and no being or soul.
42. The primary elements (*dhātu*) are the natural qualities of matter. The earth element (*paṭhavī-dhātu*) is the quality of hardness and softness or the degree of solidity. The water element (*āpo-dhātu*) is the quality of

fluidity and cohesion. The fire element (*tejo-dhātu*) is the quality of heat and cold. The air element (*vāyo-dhātu*) is the quality of motion, vibration and support.

All four primary elements are present in any given substance but one is more prominent. The quality of hardness and softness is called earth element because that is the prominent quality of earth, but, earth also has the qualities of cohesion, heat and motion. The parts from the hair of the head up to the brain, in the Paṭikulamanasika Pabba, are examples of bodily parts in which the earth element is prominent. The parts from bile up to urine are examples in which the water element is prominent. Heat and cold in the body are examples of the fire element. The breath is an example of the wind element.

43. In this simile the four high roads represent the four postures. The butcher or his apprentice represents a meditator who sees the body as only elements, just as the cow having been divided is no longer seen as a cow but is seen only as meat.
44. The meditations based on corpses are best done while or after actually seeing a corpse. By seeing the reality that the body will one day be a corpse too, the mind becomes free from attachment to the body.
45. *Vedanā* (feelings) is not used here in the sense of “emotions”, but refers only to the pleasant, the unpleasant, and the neither pleasant nor unpleasant

feelings that arise, only one at a time, with every consciousness, (i.e eye-consciousness, ear-consciousness, nose-consciousness, tongue-..., body-..., and mind-consciousness). It is important to see these feelings clearly as they are the cause of craving. Also, if the meditator does not see these clearly then he may think that there is a being experiencing feeling.

46. E.g., bodily comfort and mental happiness.
47. E.g., bodily pain and mental pain.
48. Neither pleasant nor unpleasant feeling is the hardest to perceive as its characteristic is the absence of pleasure and pain. E.g., the neutral feeling that is normally present on the surface of the eye and the feeling in the mind when it is neither happy nor unhappy.
49. E.g., the normal type of pleasure and happiness based on sense pleasures.
50. E.g., the happiness experienced while seeing the true nature of body and mind.
51. E.g., the unpleasant feeling experienced when one does not obtain the sense pleasures one wants to obtain.
52. E.g., the unhappiness experienced by a meditator reflecting on his lack of progress towards realizing *Nibbanā*.

53. E.g., the neutral feeling experienced when the mind is calm and detached from sense pleasures.
54. The causes of the appearing and the dissolution of feelings are the existence or non-existence of contact (*phassa*), ignorance of the Four Noble Truths, craving and kamma.
55. Greed (*rāga*) does not just mean strong passion but refers to the whole range of lust, craving, and attachment to sense pleasures from the weakest sensual desire to the strongest lust. It can produce only unwholesome actions.
56. The mind without greed is the wholesome opposite of greed and is the cause of renunciation, generosity, charity, and giving.
57. Anger (*dosa*) always occurs together with mental pain (*domanassa*). Therefore, if mental pain is present the meditator should know that anger is also present. Aversion, ill-will, frustration, fear, and sadness are all included in this term. Anger can produce only unwholesome actions.
58. The mind without anger is the wholesome opposite of anger and is the cause of loving-kindness (*mettā*), friendliness, and goodwill.
59. Delusion (*moha*) is the mental concomitant that clouds and blinds the mind making it unable to discern

between right and wrong actions, unable to perceive the characteristics of impermanence, unsatisfactoriness, and soullessness, and unable to perceive the Four Noble Truths. It is common to all unwholesome types of consciousness but here it refers specifically to those types of consciousness associated with doubt, uncertainty, restlessness, distraction, and confusion.

60. The mind without delusion is the wholesome opposite of delusion. It is the wisdom that perceives the impermanent, unsatisfactory and soulless nature of conditioned phenomena, perceives the Four Noble Truths, and is able to discern between right and wrong actions.

Greed, anger, delusion and their opposites all have a wide range of intensity from weak to strong. In insight meditation it is important to be aware of whatever is present in the mind no matter how weak or strong it appears to be.

61. This is the shrunken mind that is lethargic, indolent, and lacks interest in anything.
62. A diffused, restless state of mind that goes here and there is therefore not concentrated.
63. The type of mind experienced in the *rūpa jhānas* and *arūpa jhānas*.
64. The mind as generally found in the sensuous (*kāma-vacara*) realms (i.e. without *jhānas*).

65. As above (Note 64.)
66. The *rūpa jhānas* and *arūpa jhānas*. Amongst these two the *arūpa jhānas* are superior to the *rūpa jhānas*.
67. The mind with either proximate concentration (*upacāra samādhi*) or absorption concentration (*appanā samādhi*). A meditator who has no experience of *jhāna* will not need to be mindful of the concentrated mind, the superior mind or the developed mind.
68. The mind without proximate or absorption concentration.
69. The mind temporarily free from defilements due to insight or *jhāna*. There are ten defilements (*kilesa*), namely: greed, anger, delusion, conceit, wrong views, doubt, sloth, distraction, lack of moral shame, lack of moral dread (*lobho, doso, moho, māno, diṭṭhi, vicikicchā, thinam, uddhacam, ahirikaṃ, anottapaṃ*).
70. The causes of the appearing and the dissolution of the mind are the existence or non-existence of ignorance of the Four Noble Truths, craving, kamma, body and mind (*nāma* and *rūpa*).
71. The five hindrances are unwholesome mental concomitants that confuse the mind and obstruct it from achieving wholesome states such as insight or *jhāna*.
72. Sense desire is the craving for any of the five types of sense-objects (i.e. sights, sounds, smells, tastes and

tactile objects). It arises due to unwise attention to the pleasant aspect of an object. It is discarded due to the wise attention to the perception of either impermanence, unsatisfactoriness or soullessness or to the unpleasant aspect of an object. It is totally eradicated by the path of an *Anāgāmi* (anāgāmi magga).

73. Ill-will is the same as anger (see Note 57). It arises due to the unwise attention to the unpleasant aspect of an object. It is discarded due to wise attention to the perception of either impermanence, unsatisfactoriness, or soullessness or to the development of loving-kindness. It is totally eradicated by the path of *Anāgāmi*.
74. Sloth and torpor refer to the state of indolence, dullness of mind and dullness of mental concomitants. They arise due to unwise attention to lack of interest, lazy stretching of the body, drowsiness after meals, and mental sluggishness. They are mental concomitants and do not refer to physical tiredness. They are discarded due to wise attention to the perception of either impermanence, unsatisfactoriness, or soullessness or to the development of energy and exertion. They are totally eradicated by the path of an *Arahat* (arahatta magga).
75. Distraction (*uddhacca*) refers to the agitated, restless, and unconcentrated mind. Worry (*kukkucca*) refers to worrying about past actions that one has or has not

done. They arise due to unwise attention to the things that cause distraction and worry. They are discarded by wise attention to the perception of either impermanence, unsatisfactoriness, or soullessness or to the development of calmness of mind. Distraction is totally eradicated by the path of an Arahant. Worry is totally eradicated by the path of an Anāgāmi.

76. Doubt or wavering refers to doubts such as “Is the Buddha really fully enlightened?”; “Does this practice really lead to the cessation of dukkha?”; “Have the disciples of the Buddha really attained enlightenment by this practice?”; “Is there a future life?”; “Was there a past life?”. Doubt or wavering arises due to unwise attention to things that cause doubt. It is discarded due to wise attention to the perception of either impermanence, unsatisfactoriness, or soullessness or to the Dhamma. It is totally eradicated by the path of a *Sotāpanna* or Streamwinner (*sotāpatti magga*).
77. The cause of the appearing of the hindrances is unwise attention (*ayoniso manasikāra*). The cause of the dissolution of the hindrances is wise attention which removes them temporarily and the Four Noble Paths (*ariyamagga*) which permanently discards them (See also Notes 71 to 76).
78. The five aggregates of clinging are the objects depending on which the four types of clinging arise. The four types of clinging are the clinging to sense pleasures,

the clinging to wrong views, the clinging to the belief that there are other paths and practices that can lead to happiness and liberation besides the Eightfold Noble Path, and the clinging to the view that there is a Self or Soul.

79. The word *rūpa* refers to everything made of the four primary elements (i.e. the earth element, the water element, the fire element, and the air element). But here it refers mostly to the corporeal body which arises together with the remaining four aggregates of clinging.

Feeling is described in Note 45.

Perception recognizes or perceives an object by means of a mark. It enables one to recognize colours such as blue, white or red. It can also wrongly recognize a rope as a snake.

Mental formations include faith, energy, intention, greed, hatred, delusion, non-greed, non-hatred, non-delusion, and mindfulness which prepare, arrange, or accomplish actions. There are fifty mental formations.

Consciousness is that which is aware of an object. Here it refers only to sensuous, *rūpa* and *arūpa* types of consciousness and does not include path or fruition consciousness (*magga-phala citta*) which are not objects of clinging.

80. For the causes of the appearing and the dissolution of the corporeal body see Note 38; of feelings, perception and mental formations see Note 54; and of consciousness see Note 70.
81. Sense bases are those things which extend and expand the range of the mind. The six internal sense bases are the eye, ear, nose, tongue, body and mind. The six external sense bases are sights, sounds, smells, tastes, tactile objects and mental objects.
82. The fetters (*saṃyojana*) are those things which bind one to the rounds of rebirth. They are: 1. craving for sense pleasures (*kāmarāga*); 2. anger (*paṭigha*), 3. pride or conceit (*māna*), 4. wrong view (*diṭṭhi*) 5. doubt or wavering (*vicikicchā*), 6. the belief that there are other paths and practices that can lead to happiness and liberation besides the Eightfold Noble Path (*sīlabbataparāmāsa*), 7. craving for rebirth in the sensuous, *rūpa* or *arūpa* worlds (*bhavarāga*), 8. envy or jealousy (*issā*), 9. meanness or stinginess (*macchariya*), 10. ignorance of the Four Noble Truths (*avijjā*).

These fetters arise due to unwise attention which regards the sense bases as permanent, satisfactory and as Self or belonging to a Self. They are discarded temporarily by wise attention to the impermanent, unsatisfactory, and soulless characteristics of the sense bases. They are totally discarded by the four Noble Paths (i.e. *diṭṭhi*, *vicikicchā*, *sīlabbataparāmāsa*, *issā*, and *macchariya*

by sotāpatti magga; *kāmarāga* and *paṭigha* by *anāgāmi magga*; and the remaining fetters by arahatta magga).

83. For the causes of the appearing and dissolution of the physical sense bases see Note 38; of the mind see Note 70; and of mental objects see Note 54.
84. Mindfulness is that which watches what is occurring at the present moment in the body and mind. (Also see Note 11).
85. All the factors of enlightenment arise due to wise attention and come to complete development due to the path of an Arahāt (arahatta magga).
86. This is the wisdom or insight that can differentiate the corporeal body and the mind and perceives both as impermanent, unsatisfactory and not-self.
87. This is the balanced mental effort that is generated while being mindful.
88. This is the interest and lack of boredom that arises due to seeing things as they really are. It is often associated with a feeling of lightness, lifting of the body or a thrill of joy that can make the hair on the body stand up.
89. With the arising of rapture the mind becomes calm and peaceful. This is called tranquility.
90. With the arising of tranquility the mind is not distracted and no longer wanders here and there but is

aware of each object that appears in the mind. This is concentration.

91. With the arising of concentration the mind sees each object in a detached and calm way. It feels neither aversion to pain nor is overpowered by pleasure but it is calmly and effortlessly observant of the impermanence, unsatisfactoriness or soullessness of every constituent of body and mind. This is called equanimity.
92. The cause of the appearing of the seven factors of enlightenment is wise attention (*yoniso-manasikāra*) which views phenomena as impermanent, unsatisfactory and not-self. The cause of the dissolution of the seven factors of enlightenment is unwise attention (*ayoniso-manasikāra*) which views phenomena as permanent, satisfactory and as a soul or self.
93. Birth (*jāti*) refers to both birth and repeated rebirth.
94. Here *dukkha* does not just refer to painful feelings but has a wide range of meaning. Birth, ageing and death are *dukkha* because they are painful. Pleasant feelings are *dukkha* because they are subject to change. The rest of the five aggregates of clinging are *dukkha* because they are oppressed by ceaseless arising and dissolution.
95. Sorrow, lamentation and anguish are different intensities of mental pain that arise due to loss or painful states such as loss of a good reputation, the passing

away of relatives or the loss of possessions through fire, flood, or theft. Sorrow is the weakest and is felt internally with little outward expression. Lamentation is more intense and results in outbursts of wailing and crying. Anguish is the most intense and although one cries and wails there is still deep inexpressible pain that makes one look exhausted and hopeless.

96. These things cannot be gained by wishing or prayer. They can only be gained by attaining the Noble Paths.
97. The craving for pleasurable sights, sounds, smells, tastes and tactile objects is *kāmatan̥hā*. The craving to be born in any sensual; *rūpa* or *arūpa* worlds, and the attachment to *rūpa* or *arūpa* *jhānas*, and the craving associated with the belief in an eternal and indestructible Self or Soul are all included in the term *bhavatan̥hā*. The craving that associated with the wrong view that at death one is annihilated and hence that there is no rebirth or results of good or bad actions is *vibhavatan̥hā*.
98. The word establishes (*nivisati*) has two aspects. Firstly, the craving arises at that place and secondly because of happening again and again it establishes itself there so that it arises habitually whenever the same object is met or thought about.
99. The world (*loka*) refers to the five aggregates of clinging.
100. Contact (*phassa*) refers not to the contact of an object with the body but to the contact of an object with the

mind. Thus, when an object, a sense base and consciousness appear together it is called contact.

101. Volition (*cetanā*) is the mental concomitant that causes actions of body, speech, and mind.
102. Initial thinking (*vitakka*) searches for, introduces, and moves towards a new sensual object. Continued thinking (*vicāra*) stays with the same object and repeatedly thinks about, ponders, and examines that object in greater detail. They have different meanings when they are associated with the *jhānas*, which are all free from craving.
103. It is important to note that craving arises and is discarded in the same place and that craving is removed by mindfully observing each object as it arises at one of the six sense doors and not by mere intellectual understanding.
104. Right View (*sammā diṭṭhi*) develops through several stages. At first one understands that good actions produce good results, and that bad actions produce bad results. Next, one understands the impermanent, unsatisfactory and soulless nature of conditioned phenomena which deepens the understanding of cause and effect so that only cause and effect are seen. The last stage is to understand the Four Noble Truths and to see that if the cause (craving) ceases the result (*dukkha*) will also cease.

105. If one has Right View then depending on that Right Thought (*sammā saṅkappa*) will arise. Also if one has Right Thought then Right Speech (*sammā vācā*) and Right Action (*sammā kammanta*) will arise because one's actions are dependent on one's thoughts.
106. Tale bearing refers to taking stories from one person to another in order to create a split between those two people and also to make oneself liked by the second person, e.g. person A hears person B saying bad things about person C. Then A goes to C and tells him what B has said in order to create discord between B and C and to make C like A.
107. This refers to idle chatter or gossip that is of no benefit to anyone. Nowadays it is worth considering if this applies to reading and writing certain types of books.
108. Only the intentional killing of living beings is meant here and not unintentional killing such as accidentally stepping on an insect. Something is called a living being if it possesses consciousness and does not include plants, bacteria, amœbæ, and viruses which according to Buddhism are without consciousness.
109. Stealing does not just mean simple theft but also includes smuggling, tax evasion, and using false weights or measures.
110. This refers to sexual misconduct (i.e. adultery, rape), drinking alcohol, and taking drugs.

111. This refers to obtaining one's livelihood by wrong speech or wrong action. It includes trading in weapons, in animals for slaughter, in slaves, in liquor, in drugs, and in poisons.
112. The word *jhāna* comes from the root *jha* = to stare. Here it is used to refer to a degree of concentration in which the mind stares at an object with such concentration that one is unaware of sights, sounds, smells, tastes, or tactile objects. There are four types of *jhānas* mentioned here which are characterized or differentiated by the mental concomitants present in each. As mental concomitants of *jhāna*, *vitakka* and *vicāra* refer to the initial and sustained application of the mind to a single object. Just like a man first puts his hand on a shaking object and then keeps his hand on the shaking object, *vitakka* puts the mind on the object and *vicāra* keeps the mind there. At this stage the mind is still not perfectly calm. In the second *jhāna* the mind is so still that it stays on one object without any *vitakka* and *vicāra*. Rapture (*pīti*) is the same as the enlightenment factor of rapture (see Note 88). *Sukha* refers to ease and comfort of body and mind.
113. The Buddha and his enlightened disciples are Noble Ones (*ariya*).
114. The causes of the appearing of *dukkha* are ignorance of the Four Noble Truths, craving and *kamma*. The cause of the dissolution of *dukkha* is the Eightfold Noble

Path. The cause of the appearing of craving is Feeling. The cause of the dissolution of craving is the Eightfold Noble Path. The cessation of dukkha, which is Nibbāna, has no arising or passing away and is therefore not included here.

The path leading to the cessation of dukkha is of two kinds: supramundane (*lokuttara*) and mundane (*lokiya*). Both appear due to the four factors of stream entry. (i.e. associating with virtuous men, hearing the true Dhamma, wisely considering the Dhammas one has heard, and practising in accordance with that Dhamma). The lokuttara path cannot pass away once it has been attained but the lokiya path can pass away due to not wisely considering the Dhamma one has heard and not practising in accordance with that Dhamma.

115. An *Anāgāmī* is an enlightened individual who has eradicated *diṭṭhi*, *vicikicchā*, *sīlabbataparāmāsa*, *issā*, *macchhariya*, *kāmarāga* and *paṭigha* (see Note 82) and consequently at death will be reborn in the Pure Abode (*Suddhāvāsa*) where he will attain Arahantship. He is called a Non-returner because he will never be reborn again in the sensuous realm (*kāmaloka*). This last section is meant to encourage the meditator with the knowledge that if he practises in a really diligent and consistent way in accordance with this sutta he can expect to attain the total eradication of greed, hatred and delusion, in this very life.

Sādhu! Sādhu! Sādhu!

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REFERENCES

- Adams, C. E., Cano, M. A., Heppner, W. L., Stewart, D. W., Correa-Fernández, V., Vidrine, J. I., . . . Wetter, D. W. (2015). Testing a Moderated Mediation Model of Mindfulness, Psychosocial Stress, and Alcohol Use among African American Smokers. *Mindfulness (N Y)*, 6(2), 315-325. doi: 10.1007/s12671-013-0263-1
- Aguinis, H., Gottfredson, R. K., & Culpepper, S. A. (2013). Best-Practice Recommendations for Estimating Cross-Level Interaction Effects Using Multilevel Modeling. *Journal of Management*, 39(6), 1490-1528. doi: 10.1177/0149206313478188
- Alati, R., Lawlor, D. A., Najman, J. M., Williams, G. M., Bor, W., & O'Callaghan, M. (2005). Is there really a 'J-shaped' curve in the association between alcohol consumption and symptoms of depression and anxiety? Findings from the Mater-University Study of Pregnancy and its outcomes. *Addiction*, 100(5), 643-651. doi: 10.1111/j.1360-0443.2005.01063.x
- American Psychiatric Association. (2000). *Diagnostic and Statistical Manual of Mental Disorders*. (4th, text rev. ed.). Washington, DC: American Psychiatric Association.
- Atkins, D. C., Baldwin, S. A., Zheng, C., Gallop, R. J., & Neighbors, C. (2013). A tutorial on count regression and zero-altered count models for longitudinal substance use data. *Psychology of Addictive Behaviors*, 27(1), 166-177. doi: 10.1037/a0029508
- Baer, R. A. (2003). Mindfulness training as a clinical intervention: A conceptual and empirical review. *Clinical Psychology: Science and Practice*, 10(2), 125-143.
- Baer, R. A. (2010). *Assessing mindfulness and acceptance processes in clients: illuminating the theory and practice of change*. Oakland, CA: Context Press.
- Baer, R. A. (2015). Ethics, Values, Virtues, and Character Strengths in Mindfulness-Based Interventions: a Psychological Science Perspective. *Mindfulness*, 6(4), 956-969. doi: 10.1007/s12671-015-0419-2
- Baer, R. A., Smith, G., & Allen, K. (2004). Assessment of mindfulness by self-report: The Kentucky Inventory of Mindfulness Skills. *Assessment*, 11. doi: 10.1177/1073191104268029
- Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment*, 13(1), 27-45. doi: 10.1177/1073191105283504
- Baer, R. A., Smith, G. T., Lykins, E., Button, D., Krietemeyer, J., Sauer, S., . . . Williams, J. M. G. (2008). Construct validity of the Five Facet Mindfulness Questionnaire in meditating and nonmeditating Samples. *Assessment*, 15(3), 329-342. doi: 10.1177/1073191107313003
- Baker, T. B., Piper, M. E., McCarthy, D. E., Majeskie, M. R., & Fiore, M. C. (2004). Addiction Motivation Reformulated: An Affective Processing Model of Negative Reinforcement. *Psychological Review*, 111(1), 33-51. doi: 10.1037/0033-295x.111.1.33
- Bakker, J. M., Lieveise, R., Menne-Lothmann, C., Viechtbauer, W., Pishva, E., Kenis, G., . . . Wichers, M. (2014). Therapygenetics in mindfulness-based cognitive

- therapy: do genes have an impact on therapy-induced change in real-life positive affective experiences? *Translational Psychiatry*, 4, e384. doi: 10.1038/tp.2014.23
- Barnard, P. J. (2009). Depression and attention to two kinds of meaning: A cognitive perspective. *Psychoanalytic Psychotherapy*, 23(3), 248-262. doi: 10.1080/02668730903227123
- Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51(6), 1173-1182.
- Bauer, D. J., Preacher, K. J., & Gil, K. M. (2006). Conceptualizing and testing random indirect effects and moderated mediation in multilevel models: new procedures and recommendations. *Psychological Methods*, 11(2), 142-163. doi: 10.1037/1082-989x.11.2.142
- Bellos, S., Skapinakis, P., Rai, D., Zitko, P., Araya, R., Lewis, G., . . . Mavreas, V. Cross-cultural patterns of the association between varying levels of alcohol consumption and the common mental disorders of depression and anxiety: Secondary analysis of the WHO Collaborative Study on Psychological Problems in General Health Care. *Drug and Alcohol Dependence*, 133(3), 825-831. doi: 10.1016/j.drugalcdep.2013.08.030
- Berking, M., Margraf, M., Ebert, D., Wupperman, P., Hofmann, S. G., & Junghanns, K. (2011). Deficits in emotion-regulation skills predict alcohol use during and after cognitive-behavioral therapy for alcohol dependence. *Journal of Consulting and Clinical Psychology*, 79(3), 307-318. doi: 10.1037/a0023421
- Berridge, K. C., Robinson, T. E., & Aldridge, J. W. (2009). Dissecting components of reward: 'liking', 'wanting', and learning. *Current Opinion in Pharmacology*, 9(1), 65-73. doi: 10.1016/j.coph.2008.12.014
- Bieling, P. J., Hawley, L. L., Bloch, R. T., Corcoran, K. M., Levitan, R. D., Young, L. T., . . . Segal, Z. V. (2012). Treatment-specific changes in decentering following mindfulness-based cognitive therapy versus antidepressant medication or placebo for prevention of depressive relapse. *Journal of Consulting and Clinical Psychology*, 80(3), 365-372. doi: 10.1037/a0027483
- Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., . . . Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice*, 11(3), 230-241. doi: 10.1093/clipsy.bph077
- Bohus, M., Dyer, A. S., Priebe, K., Kruger, A., Kleindienst, N., Schmahl, C., . . . Steil, R. (2013). Dialectical Behaviour Therapy for post-traumatic stress disorder after childhood sexual abuse in patients with and without borderline personality disorder: a randomised controlled trial. *Psychotherapy and Psychosomatics*, 82(4), 221-233. doi: 10.1159/000348451
- Bohus, M., Dyer, A. S., Priebe, K., Kruger, A., & Steil, R. (2011). Dialectical Behavior Therapy for posttraumatic stress disorder in survivors of childhood sexual abuse. *Psychotherapie, Psychosomatik, Medizinische Psychologie*, 61(3-4), 140-147. doi: 10.1055/s-0030-1263162
- Bowen, S., & Enkema, M. C. (2014). Relationship between dispositional mindfulness and substance use: findings from a clinical sample. *Addictive Behaviors*, 39(3), 532-537. doi: 10.1016/j.addbeh.2013.10.026

- Bowen, S., Witkiewitz, K., Dillworth, T. M., Chawla, N., Simpson, T. L., Ostafin, B. D., . . . Marlatt, G. A. (2006). Mindfulness meditation and substance use in an incarcerated population. *Psychology of Addictive Behaviors*, 20(3), 343-347. doi: 10.1037/0893-164X.20.3.343
- Brach, T. (2012). *Radical Acceptance: Awakening the Love that Heals Fear and Shame*: Ebury Publishing.
- 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(4), 822-848.
- Brown, K. W., & Ryan, R. M. (2004). Perils and Promise in Defining and Measuring Mindfulness: Observations From Experience. *Clinical Psychology: Science and Practice*, 11(3), 242-248. doi: 10.1093/clipsy.bph078
- Brown, K. W., Ryan, R. M., & Creswell, J. D. (2007). Mindfulness: Theoretical Foundations and Evidence for its Salutory Effects. *Psychological Inquiry*, 18(4), 211-237. doi: 10.1080/10478400701598298
- Caldwell, T., Rodgers, B., Jorm, A., Christensen, H., Jacomb, P., Korten, A., & Lynskey, M. (2002). Patterns of association between alcohol consumption and symptoms of depression and anxiety in young adults. *Addiction*, 97(5), 583-594. doi: <http://dx.doi.org/10.1046/j.1360-0443.2002.00092.x>
- Carey, B. (2011). Expert on Mental Illness Reveals Her Own Fight. Retrieved July 6, 2016, from <http://www.nytimes.com/2011/06/23/health/23lives.html>
- Carlson, L. E., & Brown, K. W. (2005). Validation of the Mindful Attention Awareness Scale in a cancer population. *Journal of Psychosomatic Research*, 58(1), 29-33. doi: 10.1016/j.jpsychores.2004.04.366
- Carpenter, K. M., Schreiber, E., Church, S., & McDowell, D. (2006). Drug Stroop performance: relationships with primary substance of use and treatment outcome in a drug-dependent outpatient sample. *Addictive Behaviors*, 31(1), 174-181. doi: 10.1016/j.addbeh.2005.04.012
- Centers for Disease Control and Prevention. (2015). Alcohol. Retrieved August 18, 2015, from <http://www.drugabuse.gov/drugs-abuse/alcohol>
- Charters, W. L. (2013). The essence and mechanisms of mindfulness in therapeutic context. *Canadian Journal of Counselling and Psychotherapy*, 47(3), 342-360.
- Chiesa, A., Calati, R., & Serretti, A. (2011). Does mindfulness training improve cognitive abilities? A systematic review of neuropsychological findings (Structured abstract). *Clinical Psychology Review*, 31(3), 449-464. <http://onlinelibrary.wiley.com/o/cochrane/cldare/articles/DARE-12011005476/frame.html>
- <http://www.sciencedirect.com/science/article/pii/S027273581000173X>
- Chiesa, A., & Serretti, A. (2010). A systematic review of neurobiological and clinical features of mindfulness meditations. *Psychological Medicine*, 40(8), 1239-1252. doi: 10.1017/S0033291709991747
- Chiesa, A., & Serretti, A. (2014). Are mindfulness-based interventions effective for substance use disorders? A systematic review of the evidence. *Substance Use and Misuse*, 49(5), 492-512. doi: 10.3109/10826084.2013.770027

- Christiansen, P., Schoenmakers, T. M., & Field, M. (2015). Less than meets the eye: reappraising the clinical relevance of attentional bias in addiction. *Addictive Behaviors*, 44, 43-50. doi: 10.1016/j.addbeh.2014.10.005
- Christopher, M., Ramsey, M., & Antick, J. (2013). The role of dispositional mindfulness in mitigating the impact of stress and impulsivity on alcohol-related problems. *Addiction Research & Theory*, 21(5), 429-434. doi: 10.3109/16066359.2012.737873
- Christopher, M. S., Charoensuk, S., Gilbert, B. D., Neary, T. J., & Pearce, K. L. (2009). Mindfulness in Thailand and the United States: a case of apples versus oranges? *Journal of Clinical Psychology*, 65(6), 590-612. doi: 10.1002/jclp.20580
- Christopher, M. S., Woodrich, L. E., & Tiernan, K. A. (2014). Using cognitive interviews to assess the cultural validity of state and trait measures of mindfulness among Zen Buddhists. *Mindfulness (N Y)*, 5(2), 145-160. doi: 10.1007/s12671-012-0160-z
- Clarke, S. P., Sharma, D., & Salter, D. (2015). Examining fast and slow effects for alcohol and negative emotion in problem and social drinkers. *Addiction Research & Theory*, 23(1), 24-33. doi: 10.3109/16066359.2014.922961
- Cohn, A. M., Hunter-Reel, D., Hagman, B. T., & Mitchell, J. (2011). Promoting behavior change from alcohol use through mobile technology: The future of ecological momentary assessment. *Alcoholism: Clinical and Experimental Research*, 35(12), 2209-2215. doi: 10.1111/j.1530-0277.2011.01571.x
- Collins, R. L., Morsheimer, E. T., Shiffman, S., Paty, J. A., Gnys, M., & Papandonatos, G. D. (1998). Ecological momentary assessment in a behavioral drinking moderation training program. *Experimental and Clinical Psychopharmacology*, 6(3), 306-315.
- Conze, E. (2012). *Buddhism: Its Essence and Development*. Dover Publications.
- Cooney, N. L., Litt, M. D., Cooney, J. L., Pilkey, D. T., Steinberg, H. R., & Oncken, C. A. (2007). Alcohol and tobacco cessation in alcohol-dependent smokers: analysis of real-time reports. *Psychology of Addictive Behaviors*, 21(3), 277-286. doi: 10.1037/0893-164X.21.3.277
- Cousijn, J., Goudriaan, A. E., & Wiers, R. W. (2011). Reaching out towards cannabis: approach-bias in heavy cannabis users predicts changes in cannabis use. *Addiction*, 106(9), 1667-1674. doi: 10.1111/j.1360-0443.2011.03475.x
- Cox, W. M., Brown, M. A., & Rowlands, L. J. (2003). The effects of alcohol cue exposure on non-dependent drinkers' attentional bias for alcohol-related stimuli. *Alcohol and Alcoholism*, 38(1), 45-49. doi: <http://dx.doi.org/10.1093/alcalc/agg010>
- Cox, W. M., Fadardi, J. S., & Pothos, E. M. (2006). The addiction-stroop test: Theoretical considerations and procedural recommendations. *Psychological Bulletin*, 132(3), 443-476. doi: 10.1037/0033-2909.132.3.443
- Cox, W. M., Hogan, L. M., Kristian, M. R., & Race, J. H. (2002). Alcohol attentional bias as a predictor of alcohol abusers' treatment outcome. *Drug and Alcohol Dependence*, 68(3), 237-243. doi: 10.1016/S0376-8716(02)00219-3
- Cox, W. M., Pothos, E. M., & Hosier, S. G. (2007). Cognitive-motivational predictors of excessive drinkers' success in changing. *Psychopharmacology*, 192(4), 499-510. doi: 10.1007/s00213-007-0736-9

- Cox, W. M., Schippers, G. M., Klinger, E., Skutle, A., Stuchlikova, I., Man, F., . . . Inderhaug, R. (2002). Motivational structure and alcohol use of university students across four nations. *Journal of Studies on Alcohol*, 63(3), 280-285.
- Crane, R. S., Kuyken, W., Williams, J. M. G., Hastings, R. P., Cooper, L., & Fennell, M. J. V. (2012). Competence in teaching mindfulness-based courses: Concepts, development and assessment. *Mindfulness*, 3(1), 76-84. doi: 10.1007/s12671-011-0073-2
- Crescentini, C., Matiz, A., & Fabbro, F. (2015). Improving personality/character traits in individuals with alcohol dependence: The influence of mindfulness-oriented meditation. *Journal of Addictive Diseases*, 34(1), 75-87. doi: 10.1080/10550887.2014.991657
- Davids, T. W. R. (1881). *Buddhist suttas*. Oxford: Clarendon Press.
- Davis, J. H. (2015). Facing Up to the Question of Ethics in Mindfulness-Based Interventions. *Mindfulness*, 6(1), 46-48. doi: 10.1007/s12671-014-0374-3
- de Bruin, E. I., Topper, M., Muskens, J. G. A. M., Bögels, S. M., & Kamphuis, J. H. (2012). Psychometric Properties of the Five Facets Mindfulness Questionnaire (FFMQ) in a Meditating and a Non-meditating Sample. *Assessment*, 19(2), 187-197. doi: 10.1177/1073191112446654
- de Graaf, R., Ten Have, M., & van Dorsselaer, S. (2010). The Netherlands Mental Health Survey and Incidence Study-2 (NEMESIS-2): design and methods. *International Journal of Methods in Psychiatric Research*, 19(3), 125-141. doi: 10.1002/mpr.317
- De Groot, F., Morrens, M., & Dom, G. (2014). Acceptance and commitment therapy (ACT) en verslaving: een literatuuroverzicht [Acceptance and commitment therapy (ACT) and addiction: a literature review]. *Tijdschrift Voor Psychiatrie*, 56(9), 577-585.
- De Houwer, J. (2002). The Implicit Association Test as a tool for studying dysfunctional associations in psychopathology: strengths and limitations. *Journal of Behavior Therapy and Experimental Psychiatry*, 33(2), 115-133.
- Dean, A. C., Kohno, M., Helleman, G., & London, E. D. (2014). Childhood maltreatment and amygdala connectivity in methamphetamine dependence: a pilot study. *Brain and Behavior*, 4(6), 867-876. doi: 10.1002/brb3.289
- den Uyl, T. E., Gladwin, T. E., & Wiers, R. W. (2015). Transcranial direct current stimulation, implicit alcohol associations and craving. *Biological Psychology*, 105, 37-42. doi: 10.1016/j.biopsycho.2014.12.004
- Dennis, M. L., Foss, M. A., & Scott, C. K. (2007). An eight-year perspective on the relationship between the duration of abstinence and other aspects of recovery. *Evaluation Review*, 31(6), 585-612. doi: 10.1177/0193841X07307771
- DeWall, C. N., Pond, R. S., Carter, E. C., McCullough, M. E., Lambert, N. M., Fincham, F. D., & Nezlek, J. B. (2014). Explaining the relationship between religiousness and substance use: self-control matters. *Journal of Personality and Social Psychology*, 107(2), 339-351. doi: 10.1037/a0036853
- Dimidjian, S., Goodman, S. H., Felder, J. N., Gallop, R., Brown, A. P., & Beck, A. (2015). An open trial of Mindfulness-Based Cognitive Therapy for the prevention of perinatal depressive relapse/recurrence. *Archives of Women's Mental Health*, 18(1), 85-94. doi: 10.1007/s00737-014-0468-x

- Division of Population Health, N. C. f. C. D. P. a. H. P. (2014). Binge drinking. from <http://www.cdc.gov/alcohol/data-stats.htm>
- Duka, T., & Townshend, J. M. (2004). The priming effect of alcohol pre-load on attentional bias to alcohol-related stimuli. *Psychopharmacology*, 176(3-4), 353-361. doi: <http://dx.doi.org/10.1007/s00213-004-1906-7>
- Duka, T., Townshend, J. M., Collier, K., & Stephens, D. N. (2002). Kindling of withdrawal: A study of craving and anxiety after multiple detoxifications in alcoholic inpatients. *Alcoholism: Clinical and Experimental Research*, 26(6), 785-795. doi: <http://dx.doi.org/10.1097/00000374-200206000-00007>
- Dulin, P. L., Gonzalez, V. M., & Campbell, K. (2014). Results of a pilot test of a self-administered smartphone-based treatment system for alcohol use disorders: Usability and early outcomes. *Substance Abuse*, 35(2), 168-175. doi: 10.1080/08897077.2013.821437
- Dvorak, R. D., Sargent, E. M., Kilwein, T. M., Stevenson, B. L., Kuvaas, N. J., & Williams, T. J. (2014). Alcohol use and alcohol-related consequences: associations with emotion regulation difficulties. *American Journal of Drug and Alcohol Abuse*, 40(2), 125-130. doi: 10.3109/00952990.2013.877920
- Eberl, C., Wiers, R. W., Pawelczack, S., Rinck, M., Becker, E. S., & Lindenmeyer, J. (2013). Approach bias modification in alcohol dependence: do clinical effects replicate and for whom does it work best? *Developmental Cognitive Neuroscience*, 4, 38-51. doi: 10.1016/j.dcn.2012.11.002
- Eberl, C., Wiers, R. W., Pawelczack, S., Rinck, M., Becker, E. S., & Lindenmeyer, J. (2014). Implementation of approach bias re-training in alcoholism-how many sessions are needed? *Alcoholism, Clinical and Experimental Research*, 38(2), 587-594. doi: 10.1111/acer.12281
- Eisenlohr-Moul, T. A., Walsh, E. C., Charnigo, R. J., Jr., Lynam, D. R., & Baer, R. A. (2012). The "what" and the "how" of dispositional mindfulness: Using interactions among subscales of the Five-Facet Mindfulness Questionnaire to understand its relation to substance use. *Assessment*, 19(3), 276-286. doi: 10.1177/1073191112446658
- Epstein, D. H., Marrone, G. F., Heishman, S. J., Schmittner, J., & Preston, K. L. (2010). Tobacco, cocaine, and heroin: Craving and use during daily life. *Addictive Behaviors*, 35(4), 318-324. doi: 10.1016/j.addbeh.2009.11.003
- Epstein, D. H., Willner-Reid, J., Vahabzadeh, M., Mezghanni, M., Lin, J. L., & Preston, K. L. (2009). Real-time electronic diary reports of cue exposure and mood in the hours before cocaine and heroin craving and use. *Archives of General Psychiatry*, 66(1), 88-94. doi: 10.1001/archgenpsychiatry.2008.509
- European Medicine Agency. (2010). Guideline on the development of medicinal products for the treatment of alcohol dependence (pp. 6).
- Fadardi, J. S., & Cox, W. (2006). Alcohol attentional bias: Drinking salience or cognitive impairment? *Psychopharmacology*, 185(2), 169-178. doi: <http://dx.doi.org/10.1007/s00213-005-0268-0>
- Fadardi, J. S., & Cox, W. (2009). Reversing the sequence: Reducing alcohol consumption by overcoming alcohol attentional bias. *Drug and Alcohol Dependence*, 101(3), 137-145. doi: <http://dx.doi.org/10.1016/j.drugalcdep.2008.11.015>

- Fatseas, M., Serre, F., Alexandre, J. M., Debrabant, R., Auriacombe, M., & Swendsen, J. (2015). Craving and substance use among patients with alcohol, tobacco, cannabis or heroin addiction: A comparison of substance- and person-specific cues. *Addiction, 110*(6), 1035-1042. doi: 10.1111/add.12882
- Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175-191.
- Feldman, G., Harley, R., Kerrigan, M., Jacobo, M., & Fava, M. (2009). Change in emotional processing during a Dialectical Behavior Therapy-based skills group for major depressive disorder. *Behaviour Research and Therapy, 47*(4), 316-321. doi: 10.1016/j.brat.2009.01.005
- Feldtkeller, B., Weinstein, A., Cox, W. M., & Nutt, D. (2001). Effects of contextual priming on reactions to craving and withdrawal stimuli in alcohol-dependent participants. *Experimental and Clinical Psychopharmacology, 9*(3), 343-351.
- Field, A. (2013). *Discovering Statistics Using IBM SPSS Statistics*: SAGE Publications.
- Field, M., & Cox, W. M. (2008). Attentional bias in addictive behaviors: A review of its development, causes, and consequences. *Drug and Alcohol Dependence, 97*(1-2), 1-20. doi: <http://dx.doi.org/10.1016/j.drugalcdep.2008.03.030>
- Field, M., Duka, T., Tyler, E., & Schoenmakers, T. M. (2009). Attentional bias modification in tobacco smokers. *Nicotine and Tobacco Research, 11*(7), 812-822. doi: 10.1093/ntr/ntp067
- Field, M., Munafo, M. R., & Franken, I. H. (2009). A meta-analytic investigation of the relationship between attentional bias and subjective craving in substance abuse. *Psychological Bulletin, 135*(4), 589-607. doi: 10.1037/a0015843
- Field, M., Wiers, R. W., Christiansen, P., Fillmore, M. T., & Verster, J. C. (2010). Acute alcohol effects on inhibitory control and implicit cognition: implications for loss of control over drinking. *Alcoholism, Clinical and Experimental Research, 34*(8), 1346-1352. doi: 10.1111/j.1530-0277.2010.01218.x
- Fox, H. C., Bergquist, K. L., Hong, K. I., & Sinha, R. (2007). Stress-induced and alcohol cue-induced craving in recently abstinent alcohol-dependent individuals. *Alcoholism, Clinical and Experimental Research, 31*(3), 395-403. doi: 10.1111/j.1530-0277.2006.00320.x
- Franken, I. H. (2003). Drug craving and addiction: integrating psychological and neuropsychopharmacological approaches. *Progress in Neuro-Psychopharmacology and Biological Psychiatry, 27*(4), 563-579. doi: 10.1016/S0278-5846(03)00081-2
- Freisthler, B., Lipperman-Kreda, S., Bersamin, M., & Gruenewald, P. J. (2014). Tracking the when, where, and with whom of alcohol use: Integrating ecological momentary assessment and geospatial data to examine risk for alcohol-related problems. *Alcohol Research: Current Reviews, 36*(1), 29-38.
- Fresco, D., Moore, M., Dulmen, M., Segal, Z., Ma, S., Teasdale, J., & Williams, J. M. G. (2007). Initial psychometric properties of the Experiences Questionnaire: validation of a self-report measure of decentering. *Behavior Therapy, 38*. doi: 10.1016/j.beth.2006.08.003
- Fridrici, C., Driessen, M., Wingenfeld, K., Kremer, G., Kissler, J., & Beblo, T. (2014). Investigating biases of attention and memory for alcohol-related and negative

- words in alcohol-dependents with and without major depression after day-clinic treatment. *Psychiatry Research*, 218(3), 311-318. doi: 10.1016/j.psychres.2014.03.041
- Fridrici, C., Leichsenring-Driessen, C., Driessen, M., Wingenfeld, K., Kremer, G., & Beblo, T. (2013). The individualized alcohol Stroop task: no attentional bias toward personalized stimuli in alcohol-dependents. *Psychology of Addictive Behaviors*, 27(1), 62-70. doi: 10.1037/a0029139
- Fritz, M. S., & MacKinnon, D. P. (2007). Required Sample Size to Detect the Mediated Effect. *Psychological Science*, 18(3), 233-239.
- Fung, K. (2015). Acceptance and Commitment Therapy: Western adoption of Buddhist tenets? *Transcultural Psychiatry*, 52(4), 561-576. doi: 10.1177/1363461514537544
- Garland, E. L. (2011). Trait mindfulness predicts attentional and autonomic regulation of alcohol cue-reactivity. *Journal of Psychophysiology*, 25(4), 180-189. doi: <http://dx.doi.org/10.1027/0269-8803/a000060>
- Garland, E. L. (2014). Disrupting the downward spiral of chronic pain and opioid addiction with mindfulness-oriented recovery enhancement: a review of clinical outcomes and neurocognitive targets. *Journal of Pain & Palliative Care Pharmacotherapy*, 28(2), 122-129. doi: 10.3109/15360288.2014.911791
- Garland, E. L., Boettiger, C. A., Gaylord, S., Chanon, V. W., & Howard, M. O. (2012). Mindfulness is inversely associated with alcohol attentional bias among recovering alcohol-dependent adults. *Cognitive Therapy and Research*, 36(5), 441-450. doi: <http://dx.doi.org/10.1007/s10608-011-9378-7>
- Garland, E. L., Franken, I. H. A., & Howard, M. O. (2012). Cue-elicited heart rate variability and attentional bias predict alcohol relapse following treatment. *Psychopharmacology*, 222(1), 17-26. doi: 10.1007/s00213-011-2618-4
- Garland, E. L., Fredrickson, B., Kring, A. M., Johnson, D. P., Meyer, P. S., & Penn, D. L. (2010). Upward spirals of positive emotions counter downward spirals of negativity: Insights from the broaden-and-build theory and affective neuroscience on the treatment of emotion dysfunctions and deficits in psychopathology. *Clinical Psychology Review*, 30(7), 849-864. doi: <http://dx.doi.org/10.1016/j.cpr.2010.03.002>
- Garland, E. L., Gaylord, S. A., Boettiger, C. A., & Howard, M. O. (2010). Mindfulness training modifies cognitive, affective, and physiological mechanisms implicated in alcohol dependence: Results of a randomized controlled pilot trial. *Journal of Psychoactive Drugs*, 42(2), 177-192. doi: <http://dx.doi.org/10.1080/02791072.2010.10400690>
- Garland, E. L., Hanley, A. W., Thomas, E. A., Knoll, P., & Ferraro, J. (2015). Low dispositional mindfulness predicts self-medication of negative emotion with prescription opioids. *Journal of Addiction Medicine*, 9(1), 61-67. doi: 10.1097/ADM.0000000000000090
- Garland, E. L., & Howard, M. O. (2013). Mindfulness-Oriented Recovery Enhancement reduces pain attentional bias in chronic pain patients. *Psychotherapy and Psychosomatics*, 82(5), 311-318. doi: 10.1159/000348868
- Garland, E. L., Schwarz, N. M., Kelly, A., Whitt, A., & Howard, M. O. (2012). Mindfulness-Oriented Recovery Enhancement for alcohol dependence:

- Therapeutic mechanisms and intervention acceptability. *Journal of Social Work Practice in the Addictions*, 12(3), 242-263. doi: 10.1080/1533256X.2012.702638
- Geschwind, N., Peeters, F., Drukker, M., van Os, J., & Wichers, M. (2011). Mindfulness training increases momentary positive emotions and reward experience in adults vulnerable to depression: a randomized controlled trial. *Journal of Consulting and Clinical Psychology*, 79(5), 618-628. doi: 10.1037/a0024595
- Gethin, R. (1998). *The Foundations of Buddhism*: OUP Oxford.
- GGZ Nederland. (2004). Richtlijn Detox: Verantwoord ontgiften door ambulante of intramurale detoxificatie [Detox Directive: Guideline for outpatient and inpatient detoxification]. In C. A. J. de Jong, A. F. M. van Hoek & M. Jongerhuis (Eds.). Amersfoort, Netherlands: GGZ Nederland.
- Gladwin, T. E., Rinck, M., Eberl, C., Becker, E. S., Lindenmeyer, J., & Wiers, R. W. (2015). Mediation of cognitive bias modification for alcohol addiction via stimulus-specific alcohol avoidance association. *Alcoholism: Clinical and Experimental Research*, 39(1), 101-107. doi: 10.1111/acer.12602
- Goleman, D. J., & Schwartz, G. E. (1976). Meditation as an intervention in stress reactivity. *Journal of Consulting and Clinical Psychology*, 44(3), 456-466.
- Greenwald, A. G., Nosek, B. A., & Banaji, M. R. (2003). Understanding and using the implicit association test: I. An improved scoring algorithm. *Journal of Personality and Social Psychology*, 85(2), 197-216. doi: 10.1037/0022-3514.85.2.197
- Gross, J. J. (2010). The Future's So Bright, I Gotta Wear Shades. *Emotion Review*, 2(3), 212-216. doi: 10.1177/1754073910361982
- Grossman, P. (2008). On measuring mindfulness in psychosomatic and psychological research. *Journal of Psychosomatic Research*, 64(4), 405-408. doi: 10.1016/j.jpsychores.2008.02.001
- Grossman, P., & Van Dam, N. T. (2011). Mindfulness, by any other name...: trials and tribulations of sati in western psychology and science. *Contemporary Buddhism*, 12(1), 219-239. doi: 10.1080/14639947.2011.564841
- Hallgren, K. A., & McCrady, B. S. (2013). Interference in the alcohol Stroop task with college student binge drinkers. *Journal of Behavioral Health*, 2(2), 112-119. doi: 10.5455/jbh.20130224082728
- Hanh, T. N. (2008). *Transformation and Healing: Sutra on the Four Establishments of Mindfulness*: ReadHowYouWant.com, Limited.
- Hanley, A. W., Abell, N., Osborn, D. S., Roehrig, A. D., & Canto, A. I. (2016). Mind the Gaps: Are Conclusions About Mindfulness Entirely Conclusive? *Journal of Counseling & Development*, 94(1), 103-113. doi: 10.1002/jcad.12066
- Hanley, A. W., & Garland, E. L. (2014). Dispositional mindfulness co-varies with self-reported positive reappraisal. *Personality and Individual Differences*, 66, 146-152. doi: 10.1016/j.paid.2014.03.014
- Harley, R., Sprich, S., Safren, S., Jacobo, M., & Fava, M. (2008). Adaptation of Dialectical Behavior Therapy skills training group for treatment-resistant depression. *Journal of Nervous and Mental Disease*, 196(2), 136-143. doi: 10.1097/NMD.0b013e318162aa3f
- Harrington, A., & Dunne, J. D. (2015). When mindfulness is therapy: Ethical qualms, historical perspectives. *American Psychologist*, 70(7), 621-631. doi: 10.1037/a0039460

- Hayes, S. C. (2004). Acceptance and commitment therapy, relational frame theory, and the third wave of behavioral and cognitive therapies. *Behavior Therapy*, 35(4), 639-665. doi: [http://dx.doi.org/10.1016/S0005-7894\(04\)80013-3](http://dx.doi.org/10.1016/S0005-7894(04)80013-3)
- Hayes, S. C. (2008). Climbing Our Hills: A Beginning Conversation on the Comparison of Acceptance and Commitment Therapy and Traditional Cognitive Behavioral Therapy. *Clinical Psychology: Science and Practice*, 15(4), 286-295. doi: 10.1111/j.1468-2850.2008.00139.x
- Hayes, S. C. (2014). Career Influences and a Brief Intellectual Autobiography. Retrieved July 6, 2016, from <http://www.stevenhayes.com/about-steve/career-influences-and-a-brief-intellectual-autobiography/>
- Hayes, S. C., Masuda, A., Bissett, R., Luoma, J. B., & Guerrero, L. F. (2004). DBT, FAP, and ACT: How empirically oriented are the new behavior therapy technologies? *Behavior Therapy*, 35, 35-54.
- Hayes, S. C., Villatte, M., Levin, M., Hildebrandt, M., & Amrhein, P. C. (2011). Open, aware, and active: Contextual approaches as an emerging trend in the behavioral and cognitive therapies. *Annual Review of Clinical Psychology*, 7(1), 141-168. doi: 10.1146/annurev-clinpsy-032210-104449
- Haynes, J. C., Farrell, M., Singleton, N., Meltzer, H., Araya, R., Lewis, G., & Wiles, N. J. (2005). Alcohol consumption as a risk factor for anxiety and depression. *The British Journal of Psychiatry*, 187(6), 544-551.
- Hedeker, D., & Gibbons, R. D. (2006). *Longitudinal Data Analysis*: John Wiley & Sons, Inc.
- Hedeker, D., Mermelstein, R. J., Berbaum, M. L., & Campbell, R. T. (2009). Modeling mood variation associated with smoking: an application of a heterogeneous mixed-effects model for analysis of ecological momentary assessment (EMA) data. *Addiction*, 104(2), 297-307. doi: 10.1111/j.1360-0443.2008.02435.x
- Heilig, M., Egli, M., Crabbe, J. C., & Becker, H. C. (2010). REVIEW: Acute withdrawal, protracted abstinence and negative affect in alcoholism: are they linked? *Addiction Biology*, 15(2), 169-184. doi: 10.1111/j.1369-1600.2009.00194.x
- Heron, K. E., & Smyth, J. M. (2010). Ecological momentary interventions: Incorporating mobile technology into psychosocial and health behaviour treatments. *British Journal of Health Psychology*, 15(1), 1-39. doi: 10.1348/135910709X466063
- Hicks, J. A., Schlegel, R. J., Friedman, R. S., & McCarthy, D. M. (2009). Alcohol primes, expectancies, and the working self-concept. *Psychology of Addictive Behaviors*, 23(3), 534-538. doi: 10.1037/a0016259
- Hill, C. L., & Updegraff, J. A. (2012). Mindfulness and its relationship to emotional regulation. *Emotion*, 12(1), 81-90. doi: 10.1037/a0026355
- Hoffman, F., & Mahinda, D. (2013). *Pali Buddhism*: Taylor & Francis.
- Hofmann, S. G., Sawyer, A. T., & Fang, A. (2010). The Empirical Status of the "New Wave" of CBT. *The Psychiatric clinics of North America*, 33(3), 701-710. doi: 10.1016/j.psc.2010.04.006
- Holt, L. J., Litt, M. D., & Cooney, N. L. (2012). Prospective analysis of early lapse to drinking and smoking among individuals in concurrent alcohol and tobacco treatment. *Psychology of Addictive Behaviors*, 26(3), 561-572. doi: 10.1037/a0026039

- Hoppes, K. (2006). The application of mindfulness-based cognitive interventions in the treatment of co-occurring addictive and mood disorders. *CNS Spectrums*, 11(11), 829-851.
- Hosseinzadeh Asl, N., & Barahmand, U. (2014). Effectiveness of Mindfulness-Based Cognitive Therapy for co-morbid depression in drug-dependent males. *Archives of Psychiatric Nursing*, 28(5), 314-318. doi: 10.1016/j.apnu.2014.05.003
- Houben, K., & Wiers, R. W. (2006). Assessing implicit alcohol associations with the Implicit Association Test: fact or artifact? *Addictive Behaviors*, 31(8), 1346-1362. doi: 10.1016/j.addbeh.2005.10.009
- Hsu, S. H., Grow, J., & Marlatt, G. A. (2008). Mindfulness and addiction. *Recent Developments in Alcoholism*, 18, 229-250.
- Humphreys, C. (2012). *Exploring Buddhism*: Taylor & Francis.
- Huntley, G., Treloar, H., Blanchard, A., Monti, P. M., Carey, K. B., Rohsenow, D. J., & Miranda, R. (2015). An event-level investigation of hangovers' relationship to age and drinking. *Experimental and Clinical Psychopharmacology*, 23(5), 314-323. doi: 10.1037/pha0000037
- Hussong, A. M., Hicks, R. E., Levy, S. A., & Curran, P. J. (2001). Specifying the relations between affect and heavy alcohol use among young adults. *Journal of Abnormal Psychology*, 110(3), 449-461.
- Institute of Medicine. (2013). Substance use disorders in the U.S. Armed Forces. In C. P. O'Brien, M. Oster & E. Morden (Eds.). Washington, DC: National Academies Press.
- Janes, A. C., Pizzagalli, D. A., Richardt, S., de, B. F. B., Chuzi, S., Pachas, G., . . . Kaufman, M. J. (2010). Brain reactivity to smoking cues prior to smoking cessation predicts ability to maintain tobacco abstinence. *Biological Psychiatry*, 67(8), 722-729. doi: 10.1016/j.biopsych.2009.12.034
- Jin, H., Rourke, S. B., Patterson, T. L., Taylor, M. J., & Grant, I. (1998). Predictors of relapse in long-term abstinent alcoholics. *Journal of Studies on Alcohol*, 59(6), 640-646.
- Johanson, G. (2006). A survey of the use of mindfulness in psychotherapy. *Annals of the American Psychotherapy Association*, 9(2), 15-24.
- Johnsen, B. H., Laberg, J. C., Cox, W. M., Vaksdal, A., & Hugdahl, K. (1994). Alcoholic subjects' attentional bias in the processing of alcohol-related words. *Psychology of Addictive Behaviors*, 8(2), 111-115. doi: 10.1037/0893-164x.8.2.111
- Joiner, T. (2017). *Mindlessness: The Corruption of Mindfulness in a Culture of Narcissism*: Oxford University Press.
- Juarascio, A. S., Forman, E. M., & Herbert, J. D. (2010). Acceptance and Commitment Therapy versus Cognitive Therapy for the treatment of comorbid eating pathology. *Behavior Modification*, 34(2), 175-190. doi: 10.1177/0145445510363472
- Kabat-Zinn, J. (1994). *Wherever you go, there you are: Mindfulness meditation in everyday life*. New York: Hyperion.
- Kabat-Zinn, J. (2017). Too Early to Tell: The Potential Impact and Challenges—Ethical and Otherwise—Inherent in the Mainstreaming of Dharma in an Increasingly Dystopian World. *Mindfulness*. doi: 10.1007/s12671-017-0758-2

- Kahl, K. G., Winter, L., & Schweiger, U. (2012). The third wave of cognitive behavioural therapies: What is new and what is effective? *Current Opinion in Psychiatry*, 25(6), 522-528.
- Kahneman, D. (2003). A perspective on judgment and choice: mapping bounded rationality. *American Psychologist*, 58(9), 697-720. doi: 10.1037/0003-066X.58.9.697
- Kang, C., & Whittingham, K. (2010). Mindfulness: A dialogue between Buddhism and clinical psychology. *Mindfulness*, 1(3), 161-173. doi: 10.1007/s12671-010-0018-1
- Karim, J., Weisz, R., & Rehman, S. U. (2011). International positive and negative affect schedule short-form (I-PANAS-SF): Testing for factorial invariance across cultures. *Procedia - Social and Behavioral Sciences*, 15, 2016-2022. doi: <http://dx.doi.org/10.1016/j.sbspro.2011.04.046>
- Karunamuni, N. D. (2015). The Five-Aggregate Model of the Mind. *SAGE Open*, 5(2).
- Kelly, B. D. (2011). Self-immolation, suicide and self-harm in Buddhist and Western traditions. *Transcultural Psychiatry*, 48(3), 299-317. doi: 10.1177/1363461511402869
- Kenny, D. A., & Judd, C. M. (2013). Power Anomalies in Testing Mediation. *Psychological Science*, 25(2), 334-339. doi: 10.1177/0956797613502676
- Khong, B. S. L. (2003). Buddhism and psychotherapy: Experiencing and releasing disease. *Constructivism in the Human Sciences*, 8(2), 37-56.
- Kirmayer, L. J. (2015). Mindfulness in cultural context. *Transcultural Psychiatry*, 52(4), 447-469. doi: 10.1177/1363461515598949
- Kline, R. B. (2015). *Principles and Practice of Structural Equation Modeling, Fourth Edition*: Guilford Publications.
- Kornfield, J. (2008). *The Wise Heart: A Guide to the Universal Teachings of Buddhist Psychology*: Random House Publishing Group.
- Krahn, D. D., Bohn, M. J., Henk, H. J., Grossman, J. L., & Gosnell, B. (2005). Patterns of urges during early abstinence in alcohol-dependent subjects. *American Journal on Addictions*, 14(3), 248-255. doi: 10.1080/10550490590949424
- Kreft, I. G. G., Kreft, I., & de Leeuw, J. (1998). *Introducing Multilevel Modeling*: SAGE Publications.
- Kuerbis, A., Armeli, S., Muench, F., & Morgenstern, J. (2013). Motivation and self-efficacy in the context of moderated drinking: Global self-report and ecological momentary assessment. *Psychology of Addictive Behaviors*, 27(4), 934-943. doi: 10.1037/a0031194
- Kuerbis, A., Armeli, S., Muench, F., & Morgenstern, J. (2014). Profiles of confidence and commitment to change as predictors of moderated drinking: A person-centered approach. *Psychology of Addictive Behaviors*, 28(4), 1065-1076. doi: 10.1037/a0036812
- Kumar, S. M. (2002). An introduction to buddhism for the cognitive-behavioral therapist. *Cognitive and Behavioral Practice*, 9(1), 40-43. doi: [http://dx.doi.org/10.1016/S1077-7229\(02\)80038-4](http://dx.doi.org/10.1016/S1077-7229(02)80038-4)
- Lanza, P. V., Garcia, P. F., Lamelas, F. R., & Gonzalez-Menendez, A. (2014). Acceptance and Commitment Therapy versus Cognitive Behavioral Therapy in the treatment of Substance Use Disorder with incarcerated women. *Journal of Clinical Psychology*, 70(7), 644-657. doi: 10.1002/jclp.22060

- Leeman, R. F., Bogart, D., Fucito, L. M., & Boettiger, C. A. (2014). "Killing Two Birds with One Stone": Alcohol Use Reduction Interventions with Potential Efficacy in Enhancing Self-Control. *Current Addiction Reports*, 1(1), 41-52. doi: 10.1007/s40429-013-0008-1
- Lindahl, J. R. (2015). Why Right Mindfulness Might Not Be Right for Mindfulness. *Mindfulness*, 6(1), 57-62. doi: 10.1007/s12671-014-0380-5
- Lindgren, K. P., Neighbors, C., Wiers, R. W., Gasser, M. L., & Teachman, B. A. (2015). Evaluating implicit drinking identity as a mediator of drinking motives and alcohol consumption and craving. *Addictive Behaviors*, 43, 33-38. doi: 10.1016/j.addbeh.2014.12.004
- Linehan, M. M. (1993). Dialectical Behavior Therapy for treatment of Borderline Personality Disorder: Implications for the treatment of substance abuse. *NIDA Research Monograph*, 137, 201-216.
- Linehan, M. M., Schmidt, H., 3rd, Dimeff, L. A., Craft, J. C., Kanter, J., & Comtois, K. A. (1999). Dialectical Behavior Therapy for patients with Borderline Personality Disorder and drug-dependence. *American Journal on Addictions*, 8(4), 279-292.
- Litt, M. D., Cooney, N. L., & Morse, P. (1998). Ecological momentary assessment (EMA) with treated alcoholics: methodological problems and potential solutions. *Health Psychology*, 17(1), 48-52.
- Litt, M. D., Cooney, N. L., & Morse, P. (2000). Reactivity to alcohol-related stimuli in the laboratory and in the field: predictors of craving in treated alcoholics. *Addiction*, 95(6), 889-900.
- Litten, R. Z., Ryan, M. L., Falk, D. E., Reilly, M., Fertig, J. B., & Koob, G. F. (2015). Heterogeneity of Alcohol Use Disorder: Understanding Mechanisms to Advance Personalized Treatment. *Alcoholism: Clinical and Experimental Research*, 39(4), 579-584. doi: 10.1111/acer.12669
- Liu, X., Xu, W., Wang, Y., Williams, J. M., Geng, Y., Zhang, Q., & Liu, X. (2013). Can inner peace be improved by mindfulness training: A randomized controlled trial. *Stress Health*. doi: 10.1002/smi.2551
- López-Maya, E., del Rocío Hernández-Pozo, M., Méndez-Segundo, L., Gutiérrez-García, J. J., Araujo-Díaz, D., Nuñez-Gazcón, A., . . . Hölzel, B. (2015). Propiedades psicométricas de la version mexicana de la Mscala de Atención plena (MAAS). [Psychometric properties of the Mexican version of the Mindful Attention Awareness Scale (MAAS)]. *Psychologia: Avances de la Disciplina*, 9(1), 13-27.
- Luoma, J. B., Kohlenberg, B. S., Hayes, S. C., & Fletcher, L. (2012). Slow and steady wins the race: a randomized clinical trial of acceptance and commitment therapy targeting shame in substance use disorders. *Journal of Consulting and Clinical Psychology*, 80(1), 43-53. doi: 10.1037/a0026070
- Lusher, J., Chandler, C., & Ball, D. (2004). Alcohol dependence and the alcohol Stroop paradigm: evidence and issues. *Drug and Alcohol Dependence*, 75(3), 225-231. doi: 10.1016/j.drugalcdep.2004.03.004
- Lynch, T., Chapman, A., Rosenthal, M., Kuo, J., & Linehan, M. (2006). Mechanisms of change in dialectical behavior therapy: theoretical and empirical observations. *Journal of Clinical Psychology*, 62, 459.
- Lynch, T. R., Cheavens, J. S., Cukrowicz, K. C., Thorp, S. R., Bronner, L., & Beyer, J. (2007). Treatment of older adults with co-morbid personality disorder and

- depression: A Dialectical Behavior Therapy approach. *International Journal of Geriatric Psychiatry*, 22(2), 131-143. doi: 10.1002/gps.1703
- Lynch, T. R., Morse, J. Q., Mendelson, T., & Robins, C. J. (2003). Dialectical behavior therapy for depressed older adults: a randomized pilot study. *American Journal of Geriatric Psychiatry*, 11(1), 33-45.
- Lyvers, M., Hinton, R., Gotsis, S., Roddy, M., Edwards, M. S., & Thorberg, F. A. (2014). Traits linked to executive and reward systems functioning in clients undergoing residential treatment for substance dependence. *Personality and Individual Differences*, 70, 194-199. doi: <http://dx.doi.org/10.1016/j.paid.2014.07.004>
- Lyvers, M., Makin, C., Toms, E., Thorberg, F. A., & Samios, C. (2014). Trait mindfulness in relation to emotional self-regulation and executive function. *Mindfulness*, 5(6), 619-625. doi: 10.1007/s12671-013-0213-y
- MacKinnon, D., Fairchild, A., & Fritz, M. (2007). Mediation analysis. *Annual Review of Psychology*, 58. doi: 10.1146/annurev.psych.58.110405.085542
- MacKinnon, D. P. (2008). *Introduction to Statistical Mediation Analysis*. New York, New York: Taylor and Francis Group.
- MacKinnon, D. P., & Fairchild, A. J. (2009). Current Directions in Mediation Analysis. *Current Directions in Psychological Science*, 18(1), 16-20. doi: 10.1111/j.1467-8721.2009.01598.x
- Manninen, L., Poikolainen, K., Vartiainen, E., & Laatikainen, T. (2006). Heavy drinking occasions and depression. *Alcohol and Alcoholism*, 41(3), 293-299. doi: 10.1093/alcalc/agh246
- Marteau, T. M., Hollands, G. J., & Fletcher, P. C. (2012). Changing human behavior to prevent disease: the importance of targeting automatic processes. *Science*, 337(6101), 1492-1495. doi: 10.1126/science.1226918
- McKay, J. R. H.-S., Susanne, (2011). Treating alcoholism as a chronic disease: Approaches to long-term continuing care. *Alcohol Research & Health*, 33(4), 356-360.
- McWilliams, S. A. (2012). Mindfulness and extending constructivist psychotherapy integration. *Journal of Constructivist Psychology*, 25(3), 230-250. doi: 10.1080/10720537.2012.679130
- Mikulas, W. L. (2015). Ethics in Buddhist training. *Mindfulness*, 6(1), 14-16. doi: 10.1007/s12671-014-0371-6
- Miller, L. D. (2014). *Effortless Mindfulness: Genuine Mental Health Through Awakened Presence*: Taylor & Francis.
- Mitchell, J. M., Grossman, L. E., Coker, A. R., & Messing, R. O. (2012). The anticonvulsant levetiracetam potentiates alcohol consumption in non-treatment seeking alcohol abusers. *Journal of Clinical Psychopharmacology*, 32(2), 269-272. doi: 10.1097/JCP.0b013e318248ba69
- Mitchell, J. T., McIntyre, E. M., English, J. S., Dennis, M. F., Beckham, J. C., & Kollins, S. H. (2013). A pilot trial of mindfulness meditation training for ADHD in adulthood: Impact on core symptoms, executive functioning, and emotion dysregulation. *Journal of Attention Disorders*. doi: 10.1177/1087054713513328
- Monteiro, L. M., Musten, R. F., & Compson, J. (2015). Traditional and Contemporary Mindfulness: Finding the Middle Path in the Tangle of Concerns. *Mindfulness*, 6(1), 1-13. doi: 10.1007/s12671-014-0301-7

- Moore, T. M., Seavey, A., Ritter, K., McNulty, J. K., Gordon, K. C., & Stuart, G. L. (2014). Ecological momentary assessment of the effects of craving and affect on risk for relapse during substance abuse treatment. *Psychology of Addictive Behaviors*, 28(2), 619-624. doi: 10.1037/a0034127
- Moos, R. H., & Moos, B. S. (2006). Rates and predictors of relapse after natural and treated remission from alcohol use disorders. *Addiction*, 101(2), 212-222. doi: 10.1111/j.1360-0443.2006.01310.x
- Morgenstern, J., Kuerbis, A., & Muench, F. (2014). Ecological Momentary Assessment and Alcohol Use Disorder Treatment. *Alcohol Research*, 36(1), 101-109.
- Moyer, A., & Finney, J. W. (2002). Outcomes for untreated individuals involved in randomized trials of alcohol treatment. *Journal of Substance Abuse Treatment*, 23(3), 247-252.
- National Institute on Alcohol Abuse and Alcoholism. (2008). *Helping Patients Who Drink Too Much: A Clinician's Guide*. (NIH Publication 07-3769). Bethesda, MD.
- Niaura, R. S., Rohsenow, D. J., Binkoff, J. A., Monti, P. M., Pedraza, M., & Abrams, D. B. (1988). Relevance of cue reactivity to understanding alcohol and smoking relapse. *Journal of Abnormal Psychology*, 97(2), 133-152.
- Nilsson, H. (2014). A four-dimensional model of mindfulness and its implications for health. *Psychology of Religion and Spirituality*, 6(2), 162-174. doi: 10.1037/a0036067
- Norman, K. R., & Gonda, J. (1983). *A history of Indian literature: Buddhist and Jaina literature. Pāli literature : including the canonical literature in Prakrit and Sanskrit of all the Hīnayāna schools of Buddhism*: Otto Harrassowitz.
- O'Driscoll, A. (2009). The growing influence of mindfulness on the work of the counselling psychologist. A review. *Counselling Psychology Review*, 24(3-4), 16-25.
- Ögel, K., Sarp, N., Gürol, D. T., & Ermağan, E. (2014). Bağımlı olan ve olmayan bireylerde farkındalık (mindfulness) ve farkındalığı etkileyen etkenlerin incelenmesi. = Investigation of mindfulness and affecting factors of mindfulness among substance users and non users. *Anadolu Psikiyatri Dergisi*, 15(4), 282-288.
- Olson, C. (2005). *The Different Paths of Buddhism: A Narrative-Historical Introduction*: Rutgers University Press.
- Osman, A., Lamis, D. A., Bagge, C. L., Freedenthal, S., & Barnes, S. M. (2016). The Mindful Attention Awareness Scale: Further Examination of Dimensionality, Reliability, and Concurrent Validity Estimates. *Journal of Personality Assessment*, 98(2), 189-199. doi: 10.1080/00223891.2015.1095761
- Ostafin, B. D., Chawla, N., Bowen, S., Dillworth, T. M., Witkiewitz, K., & Marlatt, G. A. (2006). Intensive mindfulness training and the reduction of psychological distress: A preliminary study. *Cognitive and Behavioral Practice*, 13(3), 191-197. doi: 10.1016/j.cbpra.2005.12.001
- Ostafin, B. D., Kassman, K. T., & Wessel, I. (2013). Breaking the cycle of desire: Mindfulness and executive control weaken the relation between an implicit measure of alcohol valence and preoccupation with alcohol-related thoughts. *Psychology of Addictive Behaviors*, 27(4), 1153-1158. doi: 10.1037/a0032621

- Ostafin, B. D., & Marlatt, G. A. (2008). Surfing the urge: Experiential acceptance moderates the relation between automatic alcohol motivation and hazardous drinking. *Journal of Social and Clinical Psychology, 27*(4), 404-418. doi: 10.1521/jscp.2008.27.4.404
- Ostafin, B. D., Marlatt, G. A., & Greenwald, A. G. (2008). Drinking without thinking: An implicit measure of alcohol motivation predicts failure to control alcohol use. *Behaviour Research and Therapy, 46*(11), 1210-1219. doi: 10.1016/j.brat.2008.08.003
- Ostafin, B. D., & Palfai, T. P. (2006). Compelled to consume: the Implicit Association Test and automatic alcohol motivation. *Psychology of Addictive Behaviors, 20*(3), 322-327. doi: 10.1016/j.psychadd.2006.10.011
- Ostafin, B. D., Palfai, T. P., & Wechsler, C. E. (2003). The accessibility of motivational tendencies toward alcohol: approach, avoidance, and disinhibited drinking. *Experimental and Clinical Psychopharmacology, 11*(4), 294-301. doi: 10.1037/1064-1297.11.4.294
- Palfai, T. P., & Ostafin, B. D. (2003). The influence of alcohol on the activation of outcome expectancies: the role of evaluative expectancy activation in drinking behavior. *Journal of Studies on Alcohol, 64*(1), 111-119.
- Panaioti, A. (2015). Mindfulness and personal identity in the Western cultural context: A plea for greater cosmopolitanism. *Transcultural Psychiatry, 52*(4), 501-523. doi: 10.1177/1363461515573106
- Panos, P. T., Jackson, J. W., Hasan, O., & Panos, A. (2014). Meta-analysis and systematic review Assessing the efficacy of Dialectical Behavior Therapy (DBT). *Research on Social Work Practice, 24*(2), 213-223. doi: 10.1177/1049731513503047
- Pearson, M. R., Brown, D. B., Bravo, A. J., & Witkiewitz, K. (2015). Staying in the moment and finding purpose: The associations of trait mindfulness, decentering, and purpose in life with depressive symptoms, anxiety symptoms, and alcohol-related problems. *Mindfulness, 6*(3), 645-653. doi: 10.1007/s12671-014-0300-8
- Peeters, M., Wiers, R. W., Monshouwer, K., van de Schoot, R., Janssen, T., & Vollebergh, W. A. (2012). Automatic processes in at-risk adolescents: The role of alcohol-approach tendencies and response inhibition in drinking behavior. *Addiction, 107*(11), 1939-1946. doi: 10.1111/j.1360-0443.2012.03948.x
- Powell, J., Dawkins, L., West, R., Powell, J., & Pickering, A. (2010). Relapse to smoking during unaided cessation: clinical, cognitive and motivational predictors. *Psychopharmacology, 212*(4), 537-549. doi: 10.1007/s00213-010-1975-8
- Preacher, K. J., Zhang, Z., & Zyphur, M. J. (2016). Multilevel structural equation models for assessing moderation within and across levels of analysis. *Psychological Methods, 21*(2), 189-205. doi: 10.1037/met0000052
- Preacher, K. J., Zyphur, M. J., & Zhang, Z. (2010). A general multilevel SEM framework for assessing multilevel mediation. *Psychological Methods, 15*(3), 209-233. doi: 10.1037/a0020141
- Purser, R. E. (2015). Clearing the Muddled Path of Traditional and Contemporary Mindfulness: a Response to Monteiro, Musten, and Compson. *Mindfulness, 6*(1), 23-45. doi: 10.1007/s12671-014-0373-4

- Ray, L. A., Mackillop, J., & Monti, P. M. (2010). Subjective responses to alcohol consumption as endophenotypes: advancing behavioral genetics in etiological and treatment models of alcoholism. *Substance Use and Misuse*, 45(11), 1742-1765. doi: 10.3109/10826084.2010.482427
- Ray, L. A., Miranda, R., Jr., Tidey, J. W., McGeary, J. E., MacKillop, J., Gwaltney, C. J., . . . Monti, P. M. (2010). Polymorphisms of the μ -opioid receptor and dopamine D₄ receptor genes and subjective responses to alcohol in the natural environment. *Journal of Abnormal Psychology*, 119(1), 115-125. doi: 10.1037/a0017550
- Rehm, J., Mathers, C., Popova, S., Thavorncharoensap, M., Teerawattananon, Y., & Patra, J. (2009). Global burden of disease and injury and economic cost attributable to alcohol use and alcohol-use disorders. *The Lancet*, 373(9682), 2223-2233. doi: 10.1016/s0140-6736(09)60746-7
- Rehm, J., Rehm, M., Alho, H., Allamani, A., Aubin, H.-J., Bühringer, G., . . . Heather, N. (2013). Alcohol dependence treatment in the EU: A literature search and expert consultation about the availability and use of guidelines in all EU countries plus Iceland, Norway, and Switzerland. *International Journal of Alcohol and Drug Research*, 2(2), 15. doi: 10.7895/ijadr.v2i2.89
- Rehm, J., Rehn, N., Room, R., Monteiro, M., Gmel, G., Jernigan, D., & Frick, U. (2003). The global distribution of average volume of alcohol consumption and patterns of drinking. *European Addiction Research*, 9(4), 147-156. doi: 72221
- Rehm, J., & Room, R. (2015). Cultural specificity in alcohol use disorders. *Lancet*. doi: 10.1016/S0140-6736(15)00123-3
- Robins, C. J. (2002). Zen principles and mindfulness practice in dialectical behavior therapy. *Cognitive and Behavioral Practice*, 9(1), 50-57. doi: 10.1016/S1077-7229(02)80040-2
- Robins, L. N., Wing, J., Wittchen, H. U., Helzer, J. E., Babor, T. F., Burke, J., . . . et al. (1988). The Composite International Diagnostic Interview. An epidemiologic Instrument suitable for use in conjunction with different diagnostic systems and in different cultures. *Archives of General Psychiatry*, 45(12), 1069-1077.
- Robinson, T. E., & Berridge, K. C. (1993). The neural basis of drug craving: an incentive-sensitization theory of addiction. *Brain Research: Brain Research Reviews*, 18(3), 247-291. doi: 10.1016/0165-0173(93)90013-P
- Robinson, T. E., & Berridge, K. C. (2008). The incentive sensitization theory of addiction: Some current issues. *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, 363(1507), 3137-3146. doi: 10.1098/rstb.2008.0093
- Room, R. (2005). Stigma, social inequality and alcohol and drug use. *Drug Alcohol Rev*, 24(2), 143-155. doi: 10.1080/09595230500102434
- Rosenbaum, R. (2009). Empty Mindfulness in Humanistic Psychotherapy. *The Humanistic Psychologist*, 37(2), 207-221. doi: 10.1080/08873260902892196
- Ruscio, A. C. (2012). *Mindfulness and Tobacco Dependence in Cigarette Smokers: Mediating Mechanisms*. (Dissertation/Thesis). Retrieved from http://usuhs.summon.serialssolutions.com/2.0.0/link/0/eLvHCXMwdV1LSwMxE B4EL0UPSnlryR-obFPbJB5tLVLCHmwP3spuMsGg3T1s9_93Ji66iL0FApkwTGYyr28AhvI-6f_RCXKM2hskYbJeOe1HqFC5zOTKPZghcoJ38SaXr6P3J53-

xt9qph9C1Nj_owqVLVQhTa4EY9UwALfRCUv9Yp4wXnVVfIQtszE7gaNpK919CgdYdCFNyQ329RfrGEF-vFjRk7K2FNNmHq1FEQoxCXEA7RbFclN-0iftUcTB91ymTCtu2A3VpjQD3ux5NXnpR-rrJhqz_rmKPIfjKvYi23sdnOXIJDMf0KMMQy6TpYzVwM_xkzmZqB97uwVXOw57Xrvzg10yMjL77DBLRx6Emu8a5iyA6JHfRA

- Ruscio, A. C., Muench, C., Brede, E., MacIntyre, J., & Waters, A. J. (2016). Administration and Assessment of Brief Mindfulness Practice in the Field: a Feasibility Study Using Ecological Momentary Assessment. *Mindfulness*, 7(4), 988-999. doi: 10.1007/s12671-016-0538-4
- Ruscio, A. C., Muench, C., Brede, E., & Waters, A. J. (2015). Effect of brief mindfulness practice on self-reported affect, craving, and smoking: A pilot randomized controlled trial using ecological momentary assessment. *Nicotine Tob Res.* doi: 10.1093/ntr/ntv074
- Ryan, F. (2002). Attentional bias and alcohol dependence: A controlled study using the modified Stroop paradigm. *Addictive Behaviors*, 27(4), 471-482. doi: <http://dx.doi.org/10.1016/S0306-4603%2801%2900183-6>
- Rycroft-Malone, J., Anderson, R., Crane, R. S., Gibson, A., Grading, F., Owen Griffiths, H., . . . Kuyken, W. (2014). Accessibility and implementation in UK services of an effective depression relapse prevention programme - Mindfulness-Based Cognitive Therapy (MBCT): ASPIRE study protocol. *Implement Sci*, 9, 62. doi: 10.1186/1748-5908-9-62
- Sacks, J. J., Roeber, J., Bouchery, E. E., Gonzales, K., Chaloupka, F. J., & Brewer, R. D. (2013). State costs of excessive alcohol consumption, 2006. *American Journal of Preventive Medicine*, 45(4), 474-485. doi: 10.1016/j.amepre.2013.06.004
- Sánchez-López, A., Quinto-Guillen, R., Pérez-Lucas, J., Jurado-Barba, R., Martínez-Grass, I., Ponce-Alfaro, G., & Rubio-Valladolid, G. (2015). Validación de la version española del Test Stroop de Alcohol. [Validation of the Spanish version of the alcohol Stroop Test]. *Anales de Psicología*, 31(2), 504-523.
- Sareen, J., Jagdeo, A., Cox, B. J., Clara, I., ten Have, M., Belik, S. L., . . . Stein, M. B. (2007). Perceived barriers to mental health service utilization in the United States, Ontario, and the Netherlands. *Psychiatric Services*, 58(3), 357-364. doi: 10.1176/appi.ps.58.3.357
- Sarris, J., Moylan, S., Camfield, D. A., Pase, M. P., Mischoulon, D., Berk, M., . . . Schweitzer, I. (2012). Complementary medicine, exercise, meditation, diet, and lifestyle modification for anxiety disorders: a review of current evidence. *Evidence-Based Complementary and Alternative Medicine*, 2012, 809653. doi: 10.1155/2012/809653
- Sauer, S., Walach, H., Schmidt, S., Hinterberger, T., Lynch, S., Büssing, A., & Kohls, N. (2013). Assessment of mindfulness: Review on state of the art. *Mindfulness*, 4(1), 3-17. doi: 10.1007/s12671-012-0122-5
- Schmidt, L., & Room, R. (1999). Cross-cultural applicability in international classifications and research on alcohol dependence. *Journal of Studies on Alcohol*, 60(4), 448-462.
- Schoenmakers, T. M., de Bruin, M., Lux, I. F., Goertz, A. G., Van Kerkhof, D. H., & Wiers, R. W. (2010). Clinical effectiveness of attentional bias modification

- training in abstinent alcoholic patients. *Drug and Alcohol Dependence*, 109(1-3), 30-36. doi: <http://dx.doi.org/10.1016/j.drugalcdep.2009.11.022>
- Schoenmakers, T. M., & Wiers, R. W. (2010). Craving and attentional bias respond differently to alcohol priming: a field study in the pub. *European Addiction Research*, 16(1), 9-16. doi: 10.1159/000253859
- Schoenmakers, T. M., Wiers, R. W., & Field, M. (2008). Effects of a low dose of alcohol on cognitive biases and craving in heavy drinkers. *Psychopharmacology*, 197(1), 169-178. doi: <http://dx.doi.org/10.1007/s00213-007-1023-5>
- Schopen, G. (1997). *Bones, Stones, and Buddhist Monks: Collected Papers on the Archaeology, Epigraphy, and Texts of Monastic Buddhism in India*: University of Hawai'i Press.
- Schroevers, M., Nykliček, I., & Topman, R. (2008). Validatie van de nederlandstalige versie van de Mindful Attention Awareness Scale (MAAS). [Validation of the Dutch version of the Mindful Attention Awareness Scale (MAAS)]. *Gedragstherapie*, 41(3), 225-240.
- Schwartz, J. E., & Stone, A. A. (2007). The analysis of real-time momentary data: A practical guide. In A. Stone, S. Shiffman, A. Atienza & L. Nebeling (Eds.), *The Science of Real-Time Data Capture: Self-Reports in Health Research* (pp. 76-113): Oxford University Press.
- Seiden, D. Y., & Lam, K. (2010). From Moses and monotheism to Buddha and behaviorism: Cognitive behavior therapy's transpersonal crisis. *Journal of Transpersonal Psychology*, 42(1), 89-113.
- Serre, F., Fatseas, M., Swendsen, J., & Auriacombe, M. (2015). Ecological momentary assessment in the investigation of craving and substance use in daily life: a systematic review. *Drug and Alcohol Dependence*, 148, 1-20. doi: 10.1016/j.drugalcdep.2014.12.024
- Shapiro, S. L., Brown, K. W., Thoresen, C., & Plante, T. G. (2011). The moderation of Mindfulness-Based Stress Reduction effects by trait mindfulness: Results from a randomized controlled trial. *Journal of Clinical Psychology*, 67(3), 267-277. doi: 10.1002/jclp.20761
- Shapiro, S. L., Carlson, L. E., Astin, J. A., & Freedman, B. (2006). Mechanisms of mindfulness. *Journal of Clinical Psychology*, 62(3), 373-386.
- Sharf, R. H. (2014). Is mindfulness Buddhist? (and why it matters). *Transcultural Psychiatry*, 52(4), 470-484. doi: 10.1177/1363461514557561
- Sharma, D., Albery, I. P., & Cook, C. (2001). Selective attentional bias to alcohol related stimuli in problem drinkers and non-problem drinkers. *Addiction*, 96(2), 285-295. doi: 10.1046/j.1360-0443.2001.96228512.x
- Shiffman, S. (2009). Ecological momentary assessment (EMA) in studies of substance use. *Psychological Assessment*, 21(4), 486-497. doi: 10.1037/a0017074
- Shiffman, S., Paty, J. A., Gyns, M., Kassel, J. A., & Hickcox, M. (1996). First Lapses to Smoking: Within-Subjects Analysis of Real-Time Reports. *Journal of Consulting and Clinical Psychology*, 64(2), 366-379.
- Shiffrin, R. M., & Schneider, W. (1977). Controlled and automatic human information processing: II. Perceptual learning, automatic attending and a general theory. *Psychological Review*, 84(2), 127-190. doi: 10.1037/0033-295X.84.2.127

- Shonin, E., Van Gordon, W., & Griffiths, M. D. (2013). Buddhist philosophy for the treatment of problem gambling. *Journal of Behavioral Addictions*, 2(2), 63-71. doi: 10.1556/JBA.2.2013.001
- Shonin, E., Van Gordon, W., & Griffiths, M. D. (2014a). Current trends in mindfulness and mental health. *International Journal of Mental Health and Addiction*, 12(2), 113-115. doi: 10.1007/s11469-014-9493-2
- Shonin, E., Van Gordon, W., & Griffiths, M. D. (2014b). The emerging role of Buddhism in clinical psychology: Toward effective integration. *Psychology of Religion and Spirituality*, 6(2), 123-137. doi: 10.1037/a0035859
- Shorey, R. C., Brasfield, H., Anderson, S., & Stuart, G. L. (2014). Mindfulness deficits in a sample of substance abuse treatment seeking adults: A descriptive investigation. *Journal of Substance Use*, 19(1-2), 194-198. doi: 10.3109/14659891.2013.770570
- Shorey, R. C., Gawrysiak, M. J., Anderson, S., & Stuart, G. L. (2015). Dispositional mindfulness, spirituality, and substance use in predicting depressive symptoms in a treatment-seeking sample. *Journal of Clinical Psychology*, 71(4), 334-345. doi: 10.1002/jclp.22139
- Siegel, S. (1983). Classical conditioning, drug tolerance, and drug dependence. In R. G. Smart, F. B. Glaser, Y. Israel, H. Kalant, R. E. Popham & W. Schmidt (Eds.), *Research Advances in Alcohol & Drug Problems*. New York: J. Wiley.
- Simons, J. S., Dvorak, R. D., Batien, B. D., & Wray, T. B. (2010). Event-level associations between affect, alcohol intoxication, and acute dependence symptoms: Effects of urgency, self-control, and drinking experience. *Addictive Behaviors*, 35(12), 1045-1053. doi: 10.1016/j.addbeh.2010.07.001
- Sinha, R. (2007). The role of stress in addiction relapse. *Current Psychiatry Reports*, 9(5), 388-395. doi: 10.1007/s11920-007-0050-6
- Sinha, R., Fox, H. C., Hong, K. A., Bergquist, K., Bhagwagar, Z., & Siedlarz, K. M. (2008). Enhanced Negative Emotion and Alcohol Craving, and Altered Physiological Responses Following Stress and Cue Exposure in Alcohol Dependent Individuals. *Neuropsychopharmacology*, 34(5), 1198-1208.
- Sinha, R., & Li, C. (2007). Imaging stress- and cue-induced drug and alcohol craving: Association with relapse and clinical implications. *Drug and Alcohol Review*, 26(1), 25-31. doi: <http://dx.doi.org/10.1080/09595230601036960>
- Smith, B. W., Ortiz, J., Steffen, L. E., Tooley, E. M., Wiggins, K. T., Yeater, E. A., . . . Bernard, M. L. (2011). Mindfulness is associated with fewer PTSD symptoms, depressive symptoms, physical symptoms, and alcohol problems in urban firefighters. *Journal of Consulting and Clinical Psychology*, 79(5), 613-617. doi: <http://dx.doi.org/10.1037/a0025189>
- Snelleman, M., Schoenmakers, T. M., & van de Mheen, D. (2015). Attentional bias and approach/avoidance tendencies do not predict relapse or time to relapse in alcohol dependency. *Alcoholism: Clinical and Experimental Research*, 39(9), 1734-1739. doi: 10.1111/acer.12817
- Snelleman, M., Waters, A. J., Schoenmakers, T. M., Szeto, E., Franken, I. H. A., Hendriks, V. M., & van de Mheen, D. (under review). Craving and affect among alcohol-dependent patients trying to maintain abstinence: An Ecological Momentary Assessment study. (Under review.).

- Steil, R., Dyer, A., Priebe, K., Kleindienst, N., & Bohus, M. (2011). Dialectical behavior therapy for posttraumatic stress disorder related to childhood sexual abuse: a pilot study of an intensive residential treatment program. *Journal of Traumatic Stress*, 24(1), 102-106. doi: 10.1002/jts.20617
- Stetter, F., Ackermann, K., Bizer, A., Straube, E. R., & Mann, K. (1995). Effects of disease-related cues in alcoholic inpatients: results of a controlled "Alcohol Stroop" study. *Alcoholism, Clinical and Experimental Research*, 19(3), 593-599.
- Stetter, F., Chaluppa, C., Ackerman, K., & Straube, E. R. (1994). Alcoholics' selective processing of alcohol related words and cognitive performance on a Stroop task. *European Psychiatry*, 9(2), 71-76.
- Stone, A. A., Shiffman, S., Schwartz, J. E., Broderick, J. E., & Hufford, M. R. (2003). Patient compliance with paper and electronic diaries. *Controlled Clinical Trials*, 24(2), 182-199.
- Stormark, K. M., Laberg, J. C., Nordby, H., & Hugdahl, K. (2000). Alcoholics' selective attention to alcohol stimuli: automated processing? *Journal of Studies on Alcohol*, 61(1), 18-23.
- Substance Abuse and Mental Health Services Administration. (2011). Results from the 2010 National Survey on Drug Use and Health: Summary of National Findings. Retrieved Dec 12, 2011, from <http://oas.samhsa.gov/NSDUH/2k10NSDUH/2k10Results.pdf>
- Substance Abuse and Mental Health Services Administration. (2012). Results from the 2011 National Survey on Drug Use and Health: Summary of national findings. Rockville, MD: Substance Abuse and Mental Health Administration.
- Substance Abuse and Mental Health Services Administration. (2014). Results from the 2013 National Survey on Drug Use and Health: Summary of national findings *National Survey on Drug Use and Health (NSDUH)*. Rockville, MD: US Department of Health and Human Services.
- Substance Abuse and Mental Health Services Administration. (2016, February 23, 2016). Laws, Regulations, and Guidelines. Retrieved July 6, 2016, from <http://www.samhsa.gov/laws-regulations-guidelines>
- Swain, J., Hancock, K., Hainsworth, C., & Bowman, J. (2013). Acceptance and commitment therapy in the treatment of anxiety: a systematic review. *Clinical Psychology Review*, 33(8), 965-978. doi: 10.1016/j.cpr.2013.07.002
- Szeto, E. (2016). *Mindfulness, Craving, & Cognition in Relapse to Alcohol: A Pilot Ecological Momentary Assessment*. (Master of Science), Uniformed Services University of the Health Sciences, Bethesda, MD.
- T, M., R, K., & C, R. (2009). Behavioral activation treatments for depression in adults: a meta-analysis and review. *Clin. Psychol. Sci. Pract.*, 16, 383.
- Tang, Y.-Y., Holzel, B. K., & Posner, M. I. (2016). Traits and states in mindfulness meditation. *Nature Reviews: Neuroscience*, 17(1), 59-59. doi: 10.1038/nrn.2015.7
- Teasdale, J. D., & Chaskalson, M. (2011). How does mindfulness transform suffering? I: the nature and origins of dukkha. *Contemporary Buddhism*, 12(1), 89-102. doi: 10.1080/14639947.2011.564824
- Teasdale, J. D., Segal, Z. V., Williams, J. M. G., Ridgeway, V. A., Soulsby, J. M., & Lau, M. A. (2000). Prevention of Relapse/Recurrence in Major Depression by

- Mindfulness-Based Cognitive Therapy. *Journal of Consulting and Clinical Psychology*, 68(4), 615-623.
- Thompson, E. R. (2007). Development and Validation of an Internationally Reliable Short-Form of the Positive and Negative Affect Schedule (PANAS). *Journal of Cross-Cultural Psychology*, 38(2), 227-242. doi: 10.1177/0022022106297301
- Tidey, J. W., Monti, P. M., Rohsenow, D. J., Gwaltney, C. J., Miranda, R., Jr., McGeary, J. E., . . . Paty, J. A. (2008). Moderators of naltrexone's effects on drinking, urge, and alcohol effects in non-treatment-seeking heavy drinkers in the natural environment. *Alcoholism, Clinical and Experimental Research*, 32(1), 58-66. doi: 10.1111/j.1530-0277.2007.00545.x
- Tiffany, S. T. (1990). A cognitive model of drug urges and drug-use behavior: role of automatic and nonautomatic processes. *Psychological Review*, 97(2), 147-168.
- Todd, M., Armeli, S., & Tennen, H. (2009). Interpersonal problems and negative mood as predictors of within-day time to drinking. *Psychology of Addictive Behaviors*, 23(2), 205-215. doi: 10.1037/a0014792
- Todd, M., Armeli, S., Tennen, H., Carney, M. A., Ball, S. A., Kranzler, H. R., & Affleck, G. (2005). Drinking to Cope: A Comparison of Questionnaire and Electronic Diary Reports. *Journal of Studies on Alcohol*, 66(1), 121-129.
- Tuithof, M., ten Have, M., van den Brink, W., Vollebergh, W., & de Graaf, R. (2014a). Alcohol consumption and symptoms as predictors for relapse of DSM-5 alcohol use disorder. *Drug and Alcohol Dependence*, 140, 85-91. doi: 10.1016/j.drugalcdep.2014.03.035
- Tuithof, M., ten Have, M., van den Brink, W., Vollebergh, W., & de Graaf, R. (2014b). The Relationship Between Excessive Alcohol Consumption and Alcohol Use Disorders According to DSM-IV and DSM-5. *Alcoholism: Clinical and Experimental Research*, 38(1), 249-256. doi: 10.1111/acer.12248
- Twisk, J. W. R. (2006). *Applied Multilevel Analysis: A Practical Guide for Medical Researchers*: Cambridge University Press.
- US Department of Veteran Affairs, & US Department of Defense. (2015). VA/DoD Clinical Practice Guideline for the Management of Substance Use Disorders (SUD) (2015).
- Vahabzadeh, M., Lin, J. L., Mezghanni, M., Epstein, D. H., & Preston, K. L. (2009). Automation in an addiction treatment research clinic: computerised contingency management, ecological momentary assessment and a protocol workflow system. *Drug Alcohol Rev*, 28(1), 3-11. doi: 10.1111/j.1465-3362.2008.00007.x
- van Boekel, L. C., Brouwers, E. P., van Weeghel, J., & Garretsen, H. F. (2013). Public opinion on imposing restrictions to people with an alcohol- or drug addiction: a cross-sectional survey. *Social Psychiatry and Psychiatric Epidemiology*, 48(12), 2007-2016. doi: 10.1007/s00127-013-0704-0
- van den Wildenberg, E., Beckers, M., van Lambaart, F., Conrod, P. J., & Wiers, R. W. (2006). Is the strength of implicit alcohol associations correlated with alcohol-induced heart-rate acceleration? *Alcoholism: Clinical and Experimental Research*, 30(8), 1336-1348. doi: <http://dx.doi.org/10.1111/j.1530-0277.2006.00161.x>
- Van Gordon, W., Shonin, E., Griffiths, M. D., & Singh, N. N. (2015). There is only one mindfulness: Why science and Buddhism need to work together. *Mindfulness*, 6(1), 49-56. doi: 10.1007/s12671-014-0379-y

- Vernig, P. M., & Orsillo, S. M. (2009). Psychophysiological and self-reported emotional responding in alcohol-dependent college students: The impact of brief acceptance/mindfulness instruction. *Cognitive Behaviour Therapy*, 38(3), 174-183. doi: <http://dx.doi.org/10.1080/16506070902767563>
- Vidrine, J. I., Businelle, M. S., Cinciripini, P., Li, Y., Marcus, M. T., Waters, A. J., . . . Wetter, D. W. (2009). Associations of Mindfulness with Nicotine Dependence, Withdrawal, and Agency. *Substance Abuse*, 30, 318-327.
- Voogt, C., Kuntsche, E., Kleinjan, M., Poelen, E., & Engels, R. (2014). Using ecological momentary assessment to test the effectiveness of a web-based brief alcohol intervention over time among heavy-drinking students: Randomized controlled trial. *Journal of Medical Internet Research*, 16(1), 15-28. doi: 10.2196/jmir.2817
- Voogt, C. V., Kuntsche, E., Kleinjan, M., & Engels, R. C. M. E. (2014). The effect of the 'What Do You Drink' web-based brief alcohol intervention on self-efficacy to better understand changes in alcohol use over time: Randomized controlled trial using ecological momentary assessment. *Drug and Alcohol Dependence*, 138, 89-97. doi: 10.1016/j.drugalcdep.2014.02.009
- Voogt, C. V., Kuntsche, E., Kleinjan, M., Poelen, E. A., Lemmers, L. A., & Engels, R. C. (2013). Using ecological momentary assessment in testing the effectiveness of an alcohol intervention: a two-arm parallel group randomized controlled trial. *PloS One*, 8(11), e78436. doi: 10.1371/journal.pone.0078436
- Waters, A. J., & Li, Y. (2008). Evaluating the utility of administering a reaction time task in an ecological momentary assessment study. *Psychopharmacology*, 197(1), 25-35. doi: 10.1007/s00213-007-1006-6
- Waters, A. J., Marhe, R., & Franken, I. H. A. (2012). Attentional bias to drug cues is elevated before and during temptations to use heroin and cocaine. *Psychopharmacology*, 219(3), 909-921. doi: 10.1007/s00213-011-2424-z
- Waters, A. J., Miller, E. K., & Li, Y. (2010). Administering the Implicit Association Test in an ecological momentary assessment study. *Psychological Reports*, 106(1), 31-43. doi: 10.2466/PR.106.1.31-43
- Waters, A. J., Shiffman, S., Sayette, M. A., Paty, J. A., Gwaltney, C. J., & Balabanis, M. H. (2004). Cue-provoked craving and nicotine replacement therapy in smoking cessation. *Journal of Consulting and Clinical Psychology*, 72(6), 1136-1143. doi: 10.1037/0022-006X.72.6.1136
- Waters, H., & Green, M. W. (2003). A demonstration of attentional bias, using a novel dual task paradigm, towards clinically salient material in recovering alcohol abuse patients? *Psychological Medicine*, 33(3), 491-498. doi: <http://dx.doi.org/10.1017/S0033291702007237>
- Way, B. M., Creswell, J. D., Eisenberger, N. I., & Lieberman, M. D. (2010). Dispositional mindfulness and depressive symptomatology: correlations with limbic and self-referential neural activity during rest. *Emotion*, 10(1), 12-24. doi: 10.1037/a0018312
- Weisner, C., Matzger, H., & Kaskutas, L. A. (2003). How important is treatment? One-year outcomes of treated and untreated alcohol-dependent individuals. *Addiction*, 98(7), 901-911.
- Wiers, R. W., Cox, W., Field, M., Fadardi, J. S., Palfai, T. P., Schoenmakers, T., & Stacy, A. W. (2006). The Search for New Ways to Change Implicit Alcohol-Related

- Cognitions in Heavy Drinkers. *Alcoholism: Clinical and Experimental Research*, 30(2), 320-331. doi: <http://dx.doi.org/10.1111/j.1530-0277.2006.00037.x>
- Wiers, R. W., Eberl, C., Rinck, M., Becker, E. S., & Lindenmeyer, J. (2011). Retraining automatic action tendencies changes alcoholic patients' approach bias for alcohol and improves treatment outcome. *Psychological Science*, 22(4), 490-497. doi: 10.1177/0956797611400615
- Wiers, R. W., Rinck, M., Kordts, R., Houben, K., & Strack, F. (2010). Retraining automatic action-tendencies to approach alcohol in hazardous drinkers. *Addiction*, 105(2), 279-287. doi: 10.1111/j.1360-0443.2009.02775.x
- Wiers, R. W., & Stacy, A. W. (2006). *Handbook of implicit cognition and addiction* (R. W. Wiers & A. W. Stacy Eds.). Thousand Oaks, CA: Sage Publications.
- Wiers, R. W., van de Luitgaarden, J., van den Wildenberg, E., & Smulders, F. T. (2005). Challenging implicit and explicit alcohol-related cognitions in young heavy drinkers. *Addiction*, 100(6), 806-819. doi: 10.1111/j.1360-0443.2005.01064.x
- Wikler, A. (1948). Recent progress in research on the neurophysiologic basis of morphine addiction. *American Journal of Psychiatry*, 105(5), 329-338. doi: 10.1176/ajp.105.5.329
- Witkiewitz, K., & Bowen, S. (2010). Depression, craving, and substance use following a randomized trial of Mindfulness-Based Relapse Prevention. *Journal of Consulting and Clinical Psychology*, 78(3), 362-374. doi: 10.1037/a0019172
- Witkiewitz, K., Bowen, S., Douglas, H., & Hsu, S. H. (2013). Mindfulness-based relapse prevention for substance craving. *Addictive Behaviors*, 38(2), 1563-1571. doi: 10.1016/j.addbeh.2012.04.001
- Witkiewitz, K., Desai, S. A., Bowen, S., Leigh, B. C., Kirouac, M., & Larimer, M. E. (2014). Development and evaluation of a mobile intervention for heavy drinking and smoking among college students. *Psychology of Addictive Behaviors*, 28(3), 639-650. doi: 10.1037/a0034747
- Witkiewitz, K., Marlatt, G., & Walker, D. (2005). Mindfulness-Based Relapse Prevention for Alcohol and Substance Use Disorders. *Journal of Cognitive Psychotherapy*, 19(3), 211-228. doi: <http://dx.doi.org/10.1891/jcop.2005.19.3.211>
- Witkiewitz, K., & Marlatt, G. A. (2004). Relapse Prevention for Alcohol and Drug Problems: That Was Zen, This Is Tao. *American Psychologist*, 59(4), 224-235. doi: 10.1037/0003-066x.59.4.224
- World Health Organization. (2014). Global Status Report on Alcohol and Health 2014. Retrieved August 18, 2015, from http://apps.who.int/iris/bitstream/10665/112736/1/9789240692763_eng.pdf?ua=1
- World Health Organization. (2015). Lexicon of alcohol and drug terms. Retrieved August 15, 2015, from http://www.who.int/substance_abuse/terminology/who_lexicon/en/
- Woud, M. L., Hutschemaekers, M. H. M., Rinck, M., & Becker, E. S. (2015). The manipulation of alcohol-related interpretation biases by means of Cognitive Bias Modification—Interpretation (CBM-I). *Journal of Behavior Therapy and Experimental Psychiatry*, 49(Part A), 61-68. doi: 10.1016/j.jbtep.2015.03.001
- Wray, T. B., Merrill, J. E., & Monti, P. M. (2014). Using Ecological Momentary Assessment (EMA) to Assess Situation-Level Predictors of Alcohol Use and Alcohol-Related Consequences. *Alcohol Research*, 36(1), 19-27.

- Wright, J. J., Sadlo, G., & Stew, G. (2006). Challenge-skills and mindfulness: An exploration of the conundrum of flow process. *OTJR: Occupation, Participation and Health*, 26(1), 25-32. doi: 10.1177/153944920602600104
- Wu, J., & Chia, L. (2015). *Spreading Buddha's Word in East Asia: The Formation and Transformation of the Chinese Buddhist Canon*: Columbia University Press.
- Zhang, Q., Wang, L., & Bergeman, C. S. (in press). Multilevel Autoregressive Mediation Models: Specification, Estimation, and Applications. *Psychological Methods*.