The Effects of Brief Mindfulness Strategy on Craving, Affect and Alcohol Consumption

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Thesis declaration form

I confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Signature:

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Overview

This thesis is comprised of three parts, with an overall focus on the application of brief third wave behavioural interventions for addictions in experimental settings.

Part one provides a literature review of laboratory-based component studies incorporating brief interventions consistent with third wave behavioural approaches, for addition-related outcomes. The aim is to explore the effects of such brief interventions and offer an assessment of the studies' methodological quality. The examination of 15 component studies revealed that methodological procedures and standards varied greatly. Findings suggested some benefits for brief third wave behavioural strategies for craving, negative affect and addictive behaviour, though their advantages over other therapeutic approaches remained questionable, partly due to the need to improve methodological standards.

Part two is an empirical paper employing a randomised control design, exploring the effects of brief mindfulness training (versus brief relaxation training) on subjective and physiological levels of acute craving and negative affect, as well as alcohol consumption at one-week follow-up. The empirical study was conducted with Damla Irez (Irez, 2016) as a joint thesis. Appendix 1 outlines each of our contributions. The study found that both mindfulness and relaxation were associated with a reduction in acute self-report craving and arousal, as well as craving at follow-up. However, only mindfulness was associated with a reduction in drinking behaviour at follow-up.

Part three provides a critical appraisal of the empirical study. It includes a discussion about theoretical and methodological considerations, challenges and limitations that arose through the process of the research. This critical reflection elicited insights that were used to provide recommendations for future research.

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Part 1: Literature Review

Laboratory-based component studies of brief interventions consistent with third wave behavioural approaches for addictions: literature review and assessment of methodological quality

Abstract

Aims: 1) To review the findings of laboratory-based component studies, which have applied treatment elements consistent with third wave behavioural approaches, for addictions. 2) To examine the methodological standards of such studies and assess their quality based on guidelines by Barnes-Holmes and Hayes (2003).

Method: A systemic literature search of the electronic databases PsychInfo, Medline and Embase identified 15 component studies, 11 examining nicotine and four investigating alcohol-related outcomes. Barnes-Holmes and Hayes's (2003) criteria were used to rate the studies that met eligibility criteria.

Results: The identified studies were heterogeneous in terms of methodological design and outcomes examined. There was some evidence for the benefit of strategies consistent with third wave approaches for addiction-related outcomes, namely craving, negative affect and substance use. However, there were mixed findings regarding their advantages over alternative therapeutic approaches. Several factors that may underlie the mixed findings have been identified, one of which is the need to improve methodological quality. Other factors and recommendations for future research are discussed.

Conclusions: Third wave behavioural interventions may offer benefits to addiction-related outcomes in experimental settings; however, more component studies using rigorous methodological procedures should be conducted in order to clarify some of the inconsistent results.

Introduction

1.1 Addictions: prevalence and public health impact

Addictions are prevalent and costly human conditions, impacting individuals' physical, mental and social health, as well as the public's economic health (Brewer, Elwafi, & Davis, 2013). In Great Britain, approximately 19% of adults aged 16 and over are smokers (Health and Social Care Information Centre [HSCIC], 2015). A study conducted by Oxford University estimated that in 2005/06 smoking cost the NHS in the UK £5.2 billion, roughly 5.5% of total health care costs (HSCIC, 2013). Smoking is a major cause of preventable death (Mathers & Loncar, 2006); 17% of deaths of people aged 35 and over are estimated to be caused by smoking (HSCIC, 2015). With regards to alcohol, about a quarter of the adult population in the UK are classified as hazardous drinkers and this costs the NHS approximately £3.5 billion every year (Eastwood, 2013). Substance misuse extends beyond alcohol and nicotine, with 3.1% of adults aged 16 to 59 in England and Wales being defined as frequent drug users in 2014 (Home Office, 2014; HSCIC, 2014).

Despite the negative health, social and functional consequences, many addicted individuals continue to use nicotine, alcohol and/or drugs in a compulsive manner. Consequently, many theories and models have been put forward to account for the mechanisms that underpin addictive behaviour, and guide the development of effective treatments for addiction.

1.2 Early and recent models

Early models focused on negative reinforcement as the central motive for consuming nicotine, alcohol and drugs. These models suggest that addictive behaviour results from the need to avoid stress or physiologically aversive internal states (Baker,

Piper, McCarthy, Majeskie, & Fiore, 2004). However, such accounts fail to explain several observed phenomena, such as individuals reporting an increase in craving immediately after consuming drugs and alcohol (Meyer, 1988), and people commonly relapsing after a long period of abstinence, when the withdrawal symptoms should have abated (Robinson & Berridge, 1993). Thus, while negative reinforcement mechanisms are important, they are not the sole determinants of addiction motivation.

More recent explanations of addictions focus on craving as one of the central mechanisms that underpins addictive behaviour (e.g. Brewer et al., 2013; Oslin, Cary, Slaymaker, Colleran, & Blow, 2009). Craving, which has been described as an urge that involves obsessive thoughts and physiological arousal, has been broadly theorised to involve three processes: an anticipation to positive feelings, the need to remove negative feelings and/or withdrawal symptoms, and a conditioned response to associated cues (Flannery et al., 2001). Craving has been suggested to be a maintaining factor in substance-misuse and the cause for relapse (e.g. Bagot, Heishman, & Moolchan, 2007; Petrakis et al., 2002). For instance, Bottlender and Soyka, (2004) used a sample of treatment-seeking, alcohol-dependent people, and found a positive relationship between subjective feeling of craving and relapse during the treatment phase. Oslin and colleagues (2009) conducted an observational study among dependent drinkers and found a negative relationship between craving and treatment responsiveness. The arguments above suggest that there is a need for psychological interventions that target processes that perpetuate craving (McDonald, Colwell, Backinger, Husten, & Maule, 2003; U.S. Department of Health and Human Services, 2008).

Cognitive Behavioural approaches argue that craving can be regulated through the alteration of thoughts and behaviours that are associated with it (Balfour & Ridley,

2000). People are guided to avoid behaviours that would trigger craving (Otto, Powers, & Fischmann, 2005), and distract themselves from, or reappraise, thoughts that are linked to craving (Perkins, Conklin, & Levine, 2008). CBT-based interventions increase the odds of successful attempts to quit (e.g. Hofmann, Asnaani, Vonk, Sawyer, & Fang, 2012; Penberthy, Wartella, & Vaughan, 2010). Nevertheless, it is necessary to continue incorporating other ideas into the research of psychological cessation interventions, as existing treatments have had a limited success in helping most people who are interested in quitting (Hughes, Lindgren, Connett, & Nides, 2004; Lemmens, Oenema, Knut, & Brug, 2008; Niaura & Abrams, 2002).

1.3 Addiction, craving and negative affect

Perhaps one of the reasons for the lack of success of many existing interventions is that they have not sufficiently emphasised the role of negative affect (NA) in the context of craving. NA and anxiety sensitivity have been repeatedly shown to be associated with problematic substance-use habits (e.g. Brown, Lejuez, Kahler, Strong, & Zvolensky, 2005; Zvolensky, Feldner, Eifert, & Brown, 2001), and are proposed to play a central role in the maintenance of craving and addictive behaviour (Baker et al., 2004). For instance, studies showed that craving and relapse susceptibility are enhanced by stress and NA (Kenford et al., 2002; Oslin et al., 2009; Piasecki, Kenford, Smith, Fiore, & Baker, 1997; Sinha et al., 2008). Highly addicted individuals often score highly on trait measures of anxiety sensitivity (Zvolensky et al., 2001), and relapse often occurs in situations that involve negative mood (Brown et al., 2005; Shiffman & Waters, 2004). Such examples suggest that the interaction between negative affective states and craving should be the focus of therapeutic interventions for addictions (Brewer et al., 2013).

The association between emotional tones and craving is explained in the 'addictive loop' model that was designed by Brewer and colleagues (2013) to describe associative learning in nicotine dependence. According to this model, people form associative memories between smoking and both positive and negative affective states (e.g. interacting with friends, and feelings stressed, respectively). Additionally, external or internal cues (e.g. arranging dinner with friends; thoughts about work) are appraised (consciously or not) as positive or negative affective states. The emerging affective tones then trigger craving. Using substances as a result of the craving then reinforces the associative memories between the affective states and the use of the substance (Brewer et al., 2013). Figure 1 illustrates the components that the loop consists of in a simplified manner.

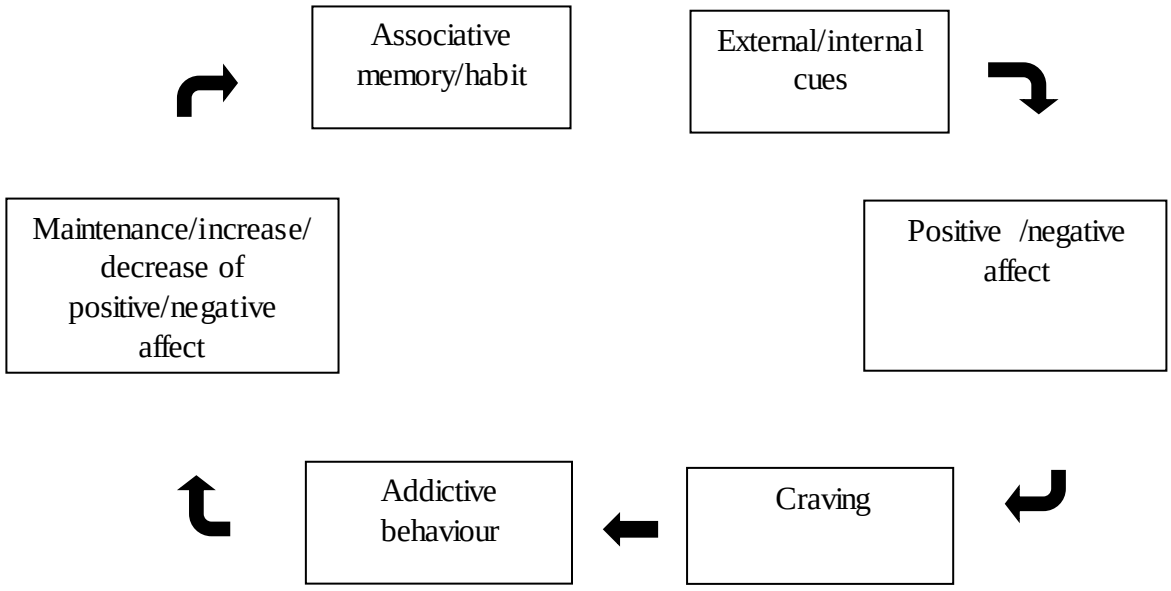

Figure 1. *The 'addictive loop' simplified*

Importantly, the habit of engaging in addictive behaviours due to the improvement of the affective states does not involve a cognitive construct, but rather a habitual response to an emotional experience. The critical idea is that craving does

not occur as a reaction to the cue, but as a reaction to an affective state that is associated with the cue (Brewer et al., 2013). This suggests that the complex but direct link between affective states and craving is crucial and needs to be targeted. Rather than encouraging avoidance of such cues or distraction from craving (which do not tackle the core link), psychological interventions can assist through helping people to see that the cue and its associated affective reaction are separated from the experience of craving (Brewer et al., 2013). Another crucial link is the one between craving and the habitual addictive behaviour. The automatic and dependable chain that originates in an affective tone, continues to craving, and terminates in a behavioural response (e.g. smoking), can be interrupted by the awareness and acknowledgement that these entities are separate and do not have to occur in a causal, automatic sequence. It is argued that mindfulness-based interventions can decouple the habitual relationship between these components by removing an affective bias (which underlies emotional distortions of cognitive processes; Elliot et al., 2011) that triggers such emotional reactivity (Brewer et al., 2013). Such interventions can also help people clearly see what is driving their behaviour and whether such behaviour is consistent with how they want to live.

1.4 Mindfulness and third wave approaches

Mindfulness involves adopting a curious and non-judgemental stance, and through this stance, paying attention to moment-by-moment internal and external experiences (Kabat-Zinn, 2003). Mindfulness-based interventions encourage people to increase their awareness of the present moment and notice aspects of their internal or external world. There is an emphasis on the transient nature of internal experiences that need not be judged as good or bad, but rather experienced as they are - mental events (Gaudiano & Herbert, 2006).

Third wave behavioural approaches are treatment methods that incorporate contextual paradigms, which emphasise the importance of the way individuals relate to their experiences (i.e. focus on context), as opposed to the actual experiences (i.e. focus on content). The aim of such paradigms is to increase psychological flexibility, which is the ability to contact the present moment fully and consciously whilst changing or continuing behaviour in the direction of a valued goal (Hayes, Strosahl, Bunting, Twohig & Wilson, 2004). Acceptance and Commitment Therapy (ACT) is an important psychological approach consistent with these ideas. In addition to promoting 'mindful being', it emphasises acceptance, defusion, and valued and committed action (Luoma, Hayes, & Walser, 2007). Acceptance refers to a stance of openness to human experiences. For instance, rather than trying to change uncomfortable feelings, one can try to accept that they are part of the repertoire of transient internal events that are sometimes experienced and that can be tolerated. Changing the relationship with such experiences involves observing them with a sense of curiosity, and noticing how they wax and wane, without having to react to them (Linehan, 1993).

Defusion refers to the idea that experiences such as thoughts and feelings do not have to be taken personally or literally (Luoma et al., 2007), but rather can be seen as transient mental experiences (e.g. the thought "I have to drink" is just a thought rather than something that is intrinsic and true about the person). In addition, in order to not get entangled in negative internal events, defusion helps people to create a psychological distance from their experiences (Hayes, Strosahl, & Wilson, 1999), and experience them as a detached observer (e.g. I notice that I am having a thought that "I have to drink").

Valued and committed action can be seen as the final stage of psychological flexibility. Once people are able to notice, observe non-judgementally and accept their internal experiences, they are potentially more able to behave in accordance with their values, rather than respond automatically to negative internal experiences (Hayes, Luoma, Bond, Masuda, & Lillis, 2006). This relates to Brewer et al.'s (2013) theory (discussed above in the context of the 'addictive loop' model) that suggests that through mindfulness people can be free from the automatic behavioural consequent of their unpleasant feelings.

To integrate the notions above: being more mindful of one's present internal experiences, noticing their transient nature, observing them with a sense of non-judgemental curiosity and acceptance, and creating a psychological distance from them, can help people to be conscious of their moment-by-moment decisions and decrease habitual and maladaptive reactions and behaviours.

Mindfulness and acceptance-based interventions have been studied extensively in recent years, and have been shown to improve general wellbeing and specific psychological conditions (e.g. Chambers, Gullone, & Allen, 2009; Powers, Zum Vörde Sive Vörding, & Emmelkamp, 2009). Levin and colleagues (2012) reported in their meta-analysis that interventions that target components of the psychological flexibility model are indeed helpful in increasing people's levels of acceptance, mindfulness, defusion and valued action (Levin, Hildebrandt, Lillis, & Hayes, 2012). It is important to note that an increase in psychological flexibility does not necessarily lead to a reduction in negative internal experiences (Hayes, Strosahl, & Wilson, 2011), but rather to increased willingness to experience uncomfortable internal events (Levin et al., 2012). This is supported by studies that have found that teaching mindfulness and acceptance leads to a greater ability to tolerate distress (Keogh, Bond, Hanmer, &

Tilston, 2005; Lillis, Hayes, Bunting, & Masuda, 2009). It is thus not surprising that distress tolerance is negatively associated with substance-misuse (Brown et al., 2013; Hsu, Collins, & Marlatt, 2013; Karyadi, Vanderveen, & Cyders, 2014; Luberto et al., 2014), as people who cannot tolerate unpleasant internal events may engage in behaviours that reduce such experiences.

Given the evidence that mindfulness and acceptance-based interventions are helpful in increasing tolerance of negative affective states (e.g. Keogh et al., 2005; Luberto et al., 2014), and the relationship between both NA and distress tolerance, and addictive behaviour (e.g. Brown, Lejuez, Kahler, & Strong, 2002; Zvolensky et al., 2001), it seems reasonable to incorporate such interventions into the research of addictions. For the purpose of this review, mindfulness, acceptance and related third wave approaches, will be referred to as contextual-based interventions due to the focus on context rather than content, in increasing psychological flexibility.

1.5 Contextual-based approaches and addiction

The theoretical rationale for applying contextual-based interventions for addictions relates to the idea that unpleasant craving and negative affective states can be accepted and tolerated rather than acted upon. Reflecting on Brewer et al.'s (2013) model, the sequence of changes in affective tone, craving and automatic addictive behaviour, can be interrupted by increasing awareness and acceptance of moment-by-moment experiences in the body and mind. If people become aware of the transient nature of their feelings and thoughts, and able to observe them non-judgementally, then they may be able to separate them from the feeling of craving. If they are then able to accept and defuse from the uncomfortable sensation of craving or withdrawal symptoms, then they may be able to tolerate them more and control how they then

decide to act (rather than habitually engage in addictive behaviour). This comes down to increasing awareness and changing people's relationship with their internal experiences to create greater psychological flexibility, as opposed to changing the experiences themselves (Levin et al., 2012; Teasdale, 1999b).

In recent years, research on contextual-based interventions for addictions has been extensive, with many treatment trials (e.g. Bowen et al., 2014; González-Menéndez, Fernández, Rodríguez, & Villagrá, 2014; Lanza, Garcia, Lamelas, & González-Menéndez, 2014) and laboratory experiments (discussed below) demonstrating their effectiveness and efficacy (Chiesa & Serretti, 2014; De Groot, Morrens, & Dom, 2013; de Souza et al., 2015; Lee, An, Levin, & Twohig, 2015). This review will focus on the latter; component studies investigating efficacy and mechanisms of change.

1.6 The current study

While treatment trials investigate the effectiveness and feasibility of interventions, experimental component studies are designed to test theories and examine processes through which changes take place (Keng, Smoski, & Robins, 2011; Levin et al., 2012). The first objective of this paper was to review laboratory-based component studies that examined the effects of brief contextual-based strategies on addiction-related outcomes.

One of the differences between such studies and treatment trials is that their strategies are usually more brief, often delivered in the form of written instructions or short audio recordings. While in lengthy treatment trials the constructs of contextual-based approaches (e.g. mindfulness) can be explained and practiced extensively, in short component studies such elements would be described and exercised more briefly.

As opposed to behavioural (e.g. avoidance) and cognitive (e.g. distraction) strategies that people are often familiar with, contextual-based constructs can appear more abstract (e.g. psychological distance from internal experiences) or counterintuitive (e.g. acceptance of suffering). Therefore, it is important to design such experiments thoughtfully and utilise several measures to ensure that the constructs are explained, understood and applied properly, and enable a meaningful examination of effects and mechanisms of change. It appeared difficult to establish methodological standards for laboratory-based experimental research examining contextual-based strategies for addictions (Beadman, 2014; Levin et al., 2012). Thus, the second aim of this review was to examine and rate the methodological quality of such studies, in order to clarify the nature of the reported findings, and create a consensus for the way future component studies of this kind should be designed, to maximise their validity. Barnes-Holmes and Hayes (2003) presented a list of features that specifies how to design ACT component studies; therefore, the rating of the identified studies was based on that list.

The review contains strategies that draw on contextual constructs, namely mindfulness, acceptance, defusion and body-scanning (mindfulness of bodily sensations). The addiction-related outcomes were divided into ones that are central to Brewer et al.'s (2013) 'addictive loop' model, and commonly measured across the studies (craving, NA and addictive behaviour), and additional outcomes that were not examined consistently across the studies (e.g. attentional bias).

To explore the impact of contextual-based strategies in comparison to other conditions, comparison groups were categorised as 'inactive' (conditions where participants were engaged in an activity that controlled for attention, time and demand characteristics, but which had no therapeutic or theoretically relevant components; e.g. reading an article from National Geographic) and 'active' (conditions where

participants engaged in a strategy that utilised a distinct theoretical rationale and/or provided adequate control for attentional effects, such as cognitive reappraisal, relaxation, distraction and suppression).

Table 1 illustrates the characteristics of the studies. It presents only quantitative treatment outcomes measures, as opposed to qualitative findings, trait measures and expectancy and manipulation checks (unless the manipulation checks were also treatment outcomes).

Method

2.1 Eligibility criteria

In order to be included in this review, manuscripts had to be English-language published, peer-reviewed laboratory-based studies, examining component conditions consistent with contextual approaches in comparison to alternative conditions. Studies that employed between-subjects designs had to be randomised, and experiments with within-subjects designs had to counterbalance their conditions. There had to be an experimental manipulation (e.g. not correlational studies), and an exploration of the effects of the conditions on at least one of the primary addiction-related outcomes (i.e. craving, NA and addictive behaviour), which had to be quantitative.

With the purpose of keeping the focus on brief laboratory-based experiments, studies were excluded if they involved a formal, extensive practice of the strategy at home. The rationale underlying this was that a lengthy and extensive practice at home could become comparable to a full treatment paradigm as opposed to a brief laboratory-based strategy. Two such studies were excluded. In one of them, the procedure involved a daily home practice, where participants listened to a 20-minute automated strategy that taught them something new each day, for five days (Ruscio,

Muench, Brede, & Waters, 2016). In the other study, Mermelstein and Garske (2015) requested their participants to practice a formal mindfulness meditation at least one hour per week for four weeks, using a CD. Studies were also excluded if substance-misuse was not the main problem or psychopathology (e.g. Adams et al., 2012, where the main focus was on body image). Furthermore, studies had to be laboratory-based as opposed to telephone, app or web-based (e.g. Bricker et al., 2014). Finally, if the focus of a report was on factors that moderate the response to a contextual-based strategy, rather than testing the actual response, then the study was excluded (e.g. Rogojanski, Vettese, & Antony, 2011b, tested the moderating role of anxiety sensitivity in responsiveness to mindfulness versus suppression).

2.2 Literature search

A systematic search of three databases (PsycInfo, Medline and Embase) was conducted in order to find relevant studies up to February 2016. For each database a separate search took place, involving the following keyword/text word search terms:

"Alcohol*" or "Addict*" or "Risk*" or "Hazard*" or "Abus*" or "Misus*" or "SUM" or "Substanc*" or "Dependen*" or "Rehab*" or "Heav*" or "Drink*" or "Smok*" or "Tobacco" or "Nicotine" or "Drug*" or "Cocaine" or "Opiate*" or "Marijuana" or "Cannabis" or "Methamphetamine"

AND

"Mindful*" or "Mindfulness based cognitive therapy" or "MBCT" or "Acceptance and commitment" or "Acceptance based" or "Acceptance-based" or "Acceptance oriented" or "Acceptance-oriented" or "Defus*" or "Meditat*" or "Vipassana"

These search parameters yielded a total of 4958 papers, which included 1939 from PsycInfo, 1012 from Medline and 2007 from Embase. Duplicates were removed

and the abstracts of the remaining studies were read for relevance by the author. Most of the latter studies were easily identified as irrelevant by meeting the exclusion criteria (e.g. pilot treatment trials, dissertation articles, etc.). Twelve studies were eligible following the above procedure. Through hand searching reference lists of the relevant papers and related reviews, three additional studies were identified (Ussher, West, Doshi, & Sampuran, 2006; Szasz, Szentagotai, & Hofmann, 2012; May, Andrade, Willoughby, & Brown, 2011). This made a total of 15 studies that were considered for eligibility and read in full by the author (Figure 2). Eleven studies examined nicotine-related outcomes, and four studies looked at alcohol-related outcomes. While many treatment trials exist for drug addictions (e.g. Twohig, Shoenberger, & Hayes, 2007), no component studies were identified for illicit drugs.

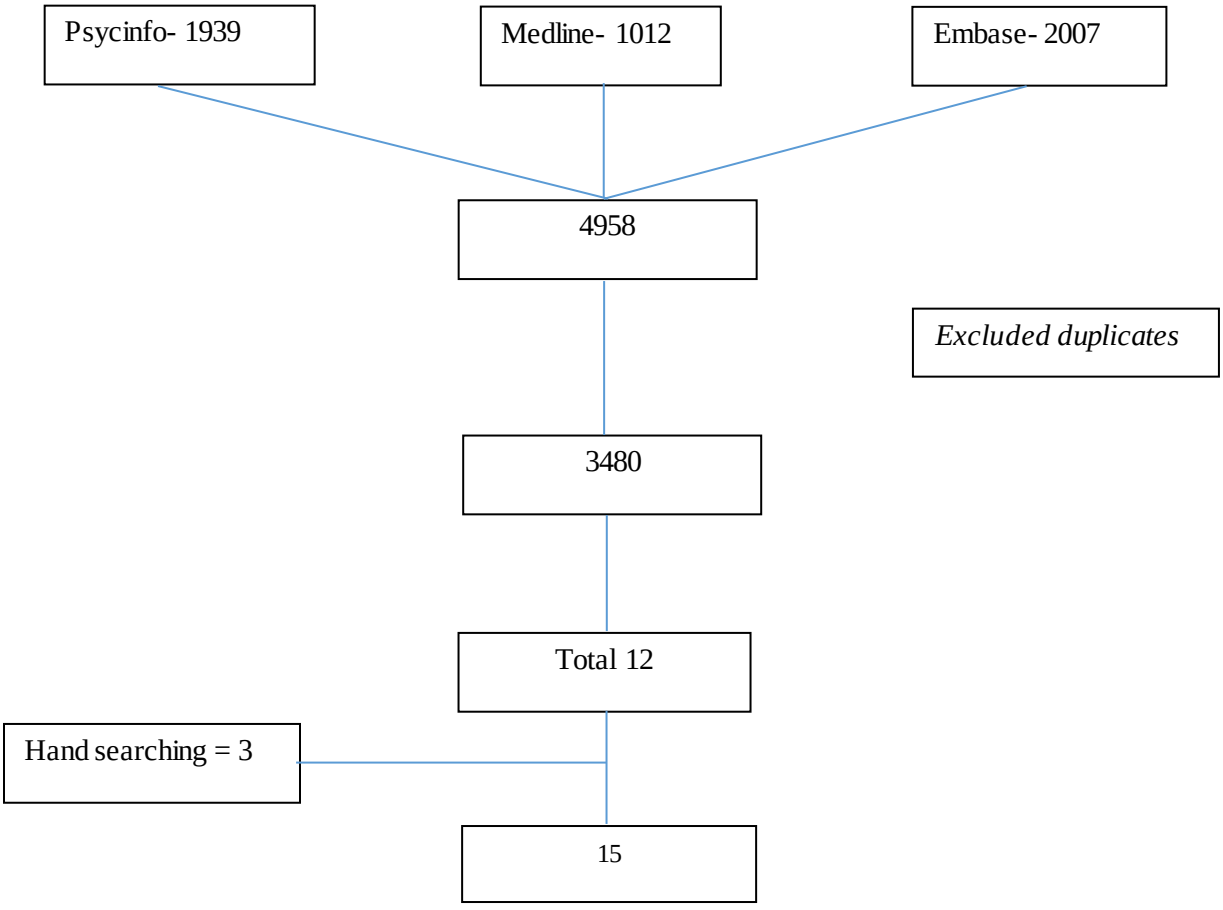

Figure 2. *Flowchart of search process*

2.3 Quality rating

In order to examine the methodological quality of the identified studies, their procedural designs were scrutinised. Barnes-Holmes and Hayes's (2003) list of features for the design of ACT component studies was used to guide the rating of the studies. However, several features were added or omitted, as described below. The criteria were as follows:

1) The assessor should be blind to the experimental conditions

2) The experimental conditions must be as homogeneous as possible for all factors apart from the critical difference that is being analysed

3) The strategies used in the different experimental conditions should be matched for: (a) length; (b) readability of the text; (c) key words; (d) engagement with the material; (e) delivery method

4) The features of criterion '3' should be checked and supported by independent raters

5) The strategy should be relevant and connected directly to the experimental challenge (e.g. in a study of mindfulness for craving, the strategy should focus on craving rather than pain, for instance. This does not mean that all the strategies had to target craving explicitly; it is acknowledged that craving involves NA and other unpleasant internal experiences, so targeting them is also relevant)

6) Independent raters should check the theme/quality of the strategy and its relevance to the experimental challenge (e.g. mindfulness strategy includes mindfulness constructs rather than just elements of relaxation)

7) Participants should verbally articulate their understanding of the strategy provided

8) Where appropriate, participants should be reminded briefly of the strategy's techniques prior to the presentation of any physical/psychological challenge (e.g. emotionally-provoking images, craving-induction)

9) The entire procedure should be automated

10) If relevant, at the end of the experiment participants should summarise the strategy they have applied (and independent raters should check the summaries)

11) Credibility checks should be used (e.g. likeability, believability, expectancy, relevancy)

12) Standardised manipulation checks should be employed, objectively and quantitatively measuring the extent to which participants understood and applied the strategy

13) Studies should be adequately powered to test the key hypotheses

14) Strategies should involve an active/experiential element rather than solely a rationale

Barnes-Holmes and Hayes's (2003) original list included several other criteria which were removed from the list above. Criteria were omitted either because the studies did not provide sufficient information to indicate whether the criteria were applied (e.g. experimenters' familiarity with the participants should be avoided or balanced across the conditions), or because they were irrelevant to the focus of the current review (e.g. features specific only to ACT and Relational Frame Theory).

Several points from Barnes-Holmes and Hayes's (2003) list were modified. With regards to criterion '3', which specifies that the strategies should be matched, Barnes-Holmes and Hayes's (2003) list provided the examples of length, engagement with the material and delivery method. However, in the current review, the readability of the scripts and the use of key words were also included as features that should be matched. Several studies described matching the strategies in terms of text readability (e.g. Beadman, et al., 2015) and the use of key words such as craving, smoking/drinking and cigarettes/alcohol (e.g. Bowen & Marlatt, 2009; Rogojanski, Vettese, & Antony, 2011). Given that such formal matching of strategies was considered especially important but was rarely reported, individual authors were contacted to obtain all instructions used in the described studies. All the authors provided the scripts apart from Nosen and Woody (2013) who declined the request. Readability was assessed using the Flesch-Kincaid readability ease grade level, as specified in Beadman et al. (2015). Differences in grade level of $\leq$2.5 were considered as a good match (rated -2-), between 2.5 and 4.5 as a moderate match (rated -1-), and $\geq$4.5 as an inadequate match (rated -0-). Each strategy's readability grade level and the corresponding rating of level of similarity are illustrated in appendix 2 With regards to engagement with the material, there was no way to quantify the extent to which each strategy demanded participants' engagement; therefore, it was estimated according to the level of active involvement required from the participants. For instance, while acceptance and distraction strategies may involve different ways of engaging with the material, they nevertheless require a similar level of participation with the task, in comparison to a condition that involves listening to a natural history passage.

It is important to distinguish between criteria '7' and '10'. In this review, the former relates to participants verbalising their comprehension of the strategy provided, and the latter relates to them verbalising any techniques they have applied during a physical/psychological challenge. This is important to distinguish because, for example, while participants may understand that the strategy required them to notice unpleasant feelings (relevant to criterion '7'), during a psychological challenge they may utilise additional, idiosyncratic coping mechanisms such as distraction. Thus, it is helpful to assess comprehension and implementation separately.

Regarding criterion '13', for the purpose of this review, studies that included a sample size of ≥25 per condition were considered as adequately powered. This was based on power calculations made by Beadman et al. (2015) and Murphy and MacKillop (2014).

Results

The results are divided into two sections in order to address the aims outlined in section 1.6. The first section concerns the review of the identified studies. It will include a general description of the studies with regards to their design and overall outcomes. The second section will address the quality of the studies' methodological designs. It will involve the ratings of the studies, and the creation of a quality rating scale which should guide future component studies in this realm.

3.1 Review of the identified studies

3.1.1 *Overview of the studies*

Table 1 illustrates the key characteristics of the 15 component studies that were identified in the search. The studies were carried out in the United Kingdom (5), United States (7), Netherlands (1), Canada (1) and Romania (1), and were published between

2007 and 2015. The majority of the studies (11) included nicotine-related outcomes, whereas four studies examined alcohol.

3.1.2 *Study designs*

Thirteen studies included mixed-group designs ('condition' being the between-subjects factor and 'time' being the within-subjects factor), and two studies used within-group designs.

3.1.3 *Sample characteristics*

The sample size of the studies ranged from 27 (May et al., 2011) to 176 (Nosen & Woody, 2013) with the total number of 1280 across all the studies. As the studies differed in the design and number of conditions, the focus was on the sample size of each condition rather than the overall sample size. Per condition, the sample size ranged from 15 to 62, with an average of 29.09. Further demographic information is presented in table 1.

Most of the nicotine studies used the Fagerstrom Test for Nicotine Dependence (FTND), and the average score on baseline was 4.35, indicating mild levels of dependence. Nosen and Woody (2013) and May et al. (2011) did not use it, though the former reported scores on the Cigarette Dependence Scale (Etter, Le Houezec & Perneger., 2003; score= 48.55, with no cut off scores outlined for this measure), whereas the latter did not provide information on baseline dependence. Apart from May et al. (2011), all the studies reported the number of cigarettes smoked per day during the baseline phase, with a mean of 15.99, and a range of 5.33 to 20.1. Notably, participants in Bowen and Matlatt's (2009) study smoked less per day (5.33), and had a lower nicotine dependence (FTND= 2.31), suggesting lower level of addiction.

Table 1. *Laboratory-based component studies: Characteristics of the identified studies*

Study	Design	Experimental conditions	Primary substance investigated	Comparison group type	Sample (gender, mean age, level of dependency)	Follow-up period	Outcomes related to addiction behaviour, craving and affect (and measures used)	Additional outcomes (and measures used)
Beadman et al, 2015	Mixed group design	1. Defusion strategy for coping with craving (n=25) 2. Reappraisal strategy for coping with craving (n=25) 3. Suppression strategy for coping with craving (n=23)	Nicotine	2. Active 3. Active	Adult daily smokers; interested to quit; 52% female; mean age 25 years; mean FTND 5.14; average cigarettes per day 12.99	24 hours & 7 days	<u>Compared to active (2)</u> Cigarettes smoked at follow-up [TLFB] ↔ Craving [QSU-Brief] ↔ Affect [IPANAS-SF]; ↔ <u>Compared to active (3)</u> Cigarettes smoked at follow-up [TLFB] ↑FU Craving [QSU-Brief] ↔ Affect [IPANAS-SF] ↔	<u>Compared to active (2)</u> Latency to smoke ↔ Smoking-specific experiential avoidance [AIS] ↑ Approach/avoidance behavioural bias [delivered via computer programme] ↔ <u>Compared to active (3)</u> Latency to smoke ↑FU Smoking-specific experiential avoidance [AIS] ↑ Approach/avoidance behavioural bias [delivered via computer programme] ↔

Bowen & Marlatt, 2009	Mixed group design	1. Mindfulness-based instructions for coping with craving (n=61) 2. No instruction (use of any personal strategy for coping with craving) (n=62)	Nicotine	2. Inactive	Adult smokers with some interest in quitting or reducing; 6.80% Female; mean age 20.33 years; mean FTND 2.31; average cigarettes per day 5.33	24 hours & 7 days	<u>Compared to inactive</u> Cigarettes smoked at follow-up [tracking sheet] ↑FU Negative affect [IPANAS] ↔ Craving [QSU-brief] ↔	<u>Compared to inactive</u> None
Cropley et al, 2007	Mixed group design	1. Body scan instructions (n= 15) 2. Natural history passage (n= 15)	Nicotine	2. Inactive	Adult smokers (at least 10 cigarettes per day, for at least three years); 40% female; mean age 25.5 years; mean FTND 4.75; average cigarettes per day 18.0	None	<u>Compared to inactive</u> - Desire to smoke ↑	<u>Compared to inactive</u> Smoking withdrawal symptoms [MPSS]: - Irritability ↔ - Tension ↔ - Restlessness ↔
Litvin et al, 2012	Mixed group design	1. Acceptance strategy for coping with craving (n= 54) 2. Suppression strategy for coping with craving (n= 54) 3. Control- neutral magazine article (n= 54)	Nicotine	2. Active 3. Inactive	Adult daily smokers (at least 10 cigarettes per day); intention to quit; 50% female; mean age 36.84 years; mean FTND 5.33; average cigarettes per day 20.10	3 days	<u>Compared to active</u> Cigarettes smoked at follow-up [tally sheets] ↔ Craving: - [QSU-4] ↔ - [1-Urge] ↔ - [ME] ↔ Affect [MF] ↔	<u>Compared to active</u> Latency to smoke [tally sheets] ↔ Smoking-related thought recording: - [with strategy use] ↓ - [without strategy use] ↔ Depletion [handgrip-squeezing task] ↔ Motivation to smoke [behavioural choice task] ↔ Self-efficacy:

								- [1-SE] ↔ - [SET] including Habitual/Craving Situations [HCS] ↔
							<u>Compared to inactive</u> Cigarettes smoked at follow-up [tally sheets] ↔ Craving: -[QSU-4] ↔ - [1-Urge] ↑ - [ME] ↑ Affect [MF] ↑	<u>Compared to inactive</u> Latency to smoke [tally sheets] ↔ Smoking-related thought recording ↔ Depletion [handgrip-squeezing task] ↔ Motivation to smoke [behavioural choice task] ↔ Self-efficacy: - [1-SE] ↔ - [SET] ↔ - [HCS] ↑
May et al, 2011	Within-group design	1. Body scanning instructions (n=27) 2. Instructions to let the mind wander (n=27)	Nicotine	2. Inactive	Adult daily smokers (=/>10 cigarettes per day); *59.26*% female; mean age 30 years; mean level of expired breath CO 9.00(ppm)	None	<u>Compared to inactive</u> Craving [Factor 1 of the QSU) ↑	<u>Compared to inactive</u> Smoking-related thought frequency [using thought probes] ↑

Murphy & MacKillop, 2013	Mixed group design	1. Mindfulness strategy for coping with craving (n=~28) 2. Distraction strategy for coping with craving (n=~28) 3. No strategy (n=~28)	Alcohol	2. Active 3. Inactive	Adults at-risk drinking; 50% female; mean age 22.43 years; mean of 24.59 drinks/wk; mean AUDIT score 15.85	7 days	<u>Compared to active</u> Alcohol consumption at follow-up [DDQ] ↔ Acute craving ↓ Acute urge distress ↓ Acute affect ↔ Craving [PACS] ↔ <u>Compared to inactive</u> Alcohol consumption at follow-up [DDQ] ↔ Acute craving ↔ Acute urge distress ↔ Acute affect ↔ Craving [PACS] ↔	<u>Compared to active</u> Perceived capacity to resist drinking [DRSEQ]↔ Heart rate [HR] ↔ <u>Compared to inactive</u> Perceived capacity to resist drinking [DRSEQ] ↔ Heart rate [HR] ↔
Nosen & Woody, 2013	Mixed group design	1. Mindfulness psychoeducation for craving (smoking n= ~29; abstaining n=~29) 2. Standard smoking cessation psychoeducation (smoking n= ~29; abstaining n=~29) 3. No psychoeducation [Completing	Nicotine	2. Active 3. Inactive	Adult daily smokers (=/>10 cigarettes per day); 35.23% Female; mean age 41.47 years; mean of CDS 48.55; average cigarettes per day 16.49	24 hours and four days	<u>Compared to active</u> Craving: [VAS- single item; QSU-brief single item] ↑ (for abstaining smokers only) <u>Compared to inactive</u> Craving: [VAS- single item; QSU-brief single item] ↑ (for abstaining smokers only)	<u>Compared to active</u> Metacognitive beliefs- ways of relating to craving experience [ACQ] (manipulation check) ↑ <u>Compared to inactive</u> Metacognitive beliefs- ways of relating to craving experience [ACQ] (manipulation check) ↑

		questionnaires] (smoking n= ~29; abstaining n=~29						
Ostafin et al., 2012	Mixed group design	1. Mindfulness (described as designed to develop attentional skills) (n=~21) 2. Research methodology textbook (described as designed to develop attentional skills (n=~20)	Alcohol	2. Inactive	Adult drinkers; 46.34% female; mean age 19.2 years; mean of drinking 1.9 days per week, and 7.8 drinks per occasion; mean of 1.2 binge drinking episodes per month	7-10 days	<u>Compared to inactive</u> Alcohol consumption at follow-up [calendar-based measure] ↔	<u>Compared to inactive</u> Automatic alcohol motivation [IAT] (Examination of condition as a moderator in the relation between IAT and amount of drinking) ↑FU State mindfulness (manipulation check) ↑
Rogojanski et al., 2011	Mixed group design	1. Mindfulness strategy for coping with craving (n=31) 2. Suppression strategy for coping with craving (n=30)	Nicotine	2. Active	Adult daily smokers (=/>10 cigarettes per day); interest in quitting; 41% female; mean age 40.34 years; mean level of expired breath CO 16.75(ppm); mean FTND 4.57; average cigarettes per day 16.42	7 days	<u>Compared to active</u> Cigarettes smoked at follow-up ↔ Craving [VAS] ↔ Negative affect [IPANAS] ↑, ↑FU	<u>Compared to active</u> Nicotine dependence [FTND] ↑, ↑FU Depression [DASS-21] ↑, ↑FU Self-efficacy [RSEQ] ↔
Szasz et al, 2012	Mixed group design	1. Acceptance strategy for coping with craving (n=31)	Nicotine	2. Active 3. Active	Adult daily smokers (=/>10 cigarettes per day); interest in quitting; 88.3% female; mean age 23.02 years; mean FTND	None	<u>Compared to active (2)</u> Craving [QSU-Brief] ↓ Negative affect [IPANAS] ↓	<u>Compared to active (2)</u> Distress tolerance [PASAT] ↓ Attentional biases [modified dot-probe task] ↓

		2. Reappraisal strategy for coping with craving (n=32) 3. Suppression strategy for coping with craving (n= 31)			3.14; average cigarettes per day 18.62		<u>Compared to active (3)</u> Craving [QSU-Brief] ↔ Negative affect [IPANAS] ↔	<u>Compared to active (3)</u> Distress tolerance [PASAT] ↔ Attentional biases [modified dot-probe task] ↔
Ussher et al, 2006	Mixed group design	1. Body scanning (n=20) 2. Isometric exercise (n=20) 3. Sitting passively (n=20)	Nicotine	2. Active 3. inactive	Adult daily smokers (=/>10 cigarettes per day); not making an attempt to quit; 45% female; mean age 32.2 years; mean FTND 3.92; average cigarettes per day 18.83	None	<u>Compared to active</u> Desire to smoke [single item] ↔ <u>Compared to inactive</u> Desire to smoke [single item] ↔	<u>Compared to active</u> Withdrawal symptoms [MPSS]: irritable ↓; tense ↓; restless ↓, stressed ↓, poor ↔ concentration; depressed ↔ <u>Compared to inactive</u> Withdrawal symptoms: irritable ↔; tense ↔; restless ↓, stressed ↔, poor concentration ↔; depressed ↔
Ussher et al, 2009	Mixed group design	1. Body scanning (n=18) 2. Isometric exercise (n=14) 3. Natural history passage (n= 16)	Nicotine	2. active 3. inactive	Adult daily smokers (=/>10 cigarettes per day); 35.4% female; mean age 27.8 years; mean FTND 5.0; average cigarettes per day 15.5	None	<u>Compared to active</u> Desire to smoke [single item] ↔ <u>Compared to inactive</u>	<u>Compared to active</u> Withdrawal symptoms [MPSS]: irritable ↔; tense ↔; restless ↔; stressed ↔; poor concentration ↔ <u>Compared to inactive</u>

							Desire to smoke [single item] ↑	Withdrawal symptoms: irritable ↑; tense ↔; restless ↑; stressed ↑; poor concentration ↑
Vernig & Orsillo, 2009	Mixed group design	1. Acceptance/mindfulness (n=19) 2. National Geographic article (n=19)	Alcohol	2. Inactive	Adults at-risk drinking; 56% female; mean AUDIT score 14.21; mean DAST-10 score 2.23	None	<u>Compared to inactive</u> Emotional reaction [SAM] ↔	<u>Compared to inactive</u> Skin conductance level (SCL) ↔
Vinci et al, 2014	Mixed group design	1. Mindfulness (n=67) 2. Relaxation (n=74) 3. Word search puzzle (n=66) [Mindfulness + negative affect (NA) (n= 39), Mindfulness + Neutral (n= 28), Relaxation + NA (n= 35), Relaxation + Neutral (n= 39), Control + NA (n= 39), and Control + Neutral (n= 27)]	Alcohol	2. Active 3. Inactive	Adults at-risk drinking; 76.3% female; mean age 20.13 years; mean AUDIT score 10.03	None	<u>Compared to active</u> Estimated amount of time between leaving the lab and the first alcoholic drink ↔ Urge to drink [single item] ↔ Negative affect [IPANAS] ↔ <u>Compared to inactive</u>	Mindfulness state [TMS] and Tension/Relaxation [single item] (manipulation checks) ↑ <u>Compared to active</u> Willingness to experience negative affect ↔ <u>Compared to inactive</u>

							Estimated amount of time between leaving the lab and the first alcoholic drink ↔ Urge to drink [single item] ↔ Negative affect [IPANAS] ↔	Willingness to experience negative affect ↔
Westbrook et al, 2013	Within-group design	1. Mindfulness-based instructions (n=54 self-report sample; n= 47 neuroimaging sample) 2. No instructions (look at images naturally (n=54 self-report sample; n= 47 neuroimaging sample)	Nicotine	2. Inactive	Adult smokers (at least 10 cigarettes per day) with a strong desire to quit; 31% female; mean age 45 years; mean FTND 5.03; average cigarettes per day 17.58; average years of smoking 25.78; mean CO level 13.94	None	<u>Compared to inactive</u> Craving [single item] ↑ Negative affect [single item] ↑	<u>Compared to inactive</u> Neural activity in craving-related regions [fMRI] ↑

Note.↑ = significantly improvement following manipulation; ↔ = no significant difference between groups following manipulation (or follow up); ↓ = significantly less improvement (at end or follow up); ↑ ^{FU} = improvement significant at follow-up. TLFB = Timeline Follow-Back (Brown, Burgess, Sales, Whiteley, Evans & Miller, 1998); AIS = The Avoidance and Inflexibility Scale (Gifford, Kohlenberg, Hayes, Antonuccio, Piasecki, Rasmussenhall, et al., 2004); QSU-Brief = Questionnaire of Smoking Urges-Brief (Cox, Tiffany & Christen, 2001); IPANAS-SF = The International Positive and Negative Affect Schedule-Short Form (Thompson, 2007); MPSS = Mood and Physical Symptoms Scale (West & Russell, 1985); QSU-4 = 4 items taken from the Questionnaire of Smoking Urges (Tiffany & Drobes, 1991); 1-Urge= a single item urge scale (Sayette, Martin, Wertz, Shiffman, & Perrott, 2001); ME= Magnitude Estimation of Urge (Sayette, Martin, Wertz, Shiffman, & Perrott, 2001); MF= Mood Form (Diener & Emmons, 1984); 1-SE= a single-item (0 –100) rating of confidence that they could quit for one year; SET= Self-Efficacy/Temptation Long Form (Velicer, Diclemente, Rossi, & Prochaska, 1990); HSC= Habitual/Craving Situations; AUDIT= Alcohol Use Disorders Identification Test (Babor et al., 1992); DDQ = Daily Drinking Questionnaire (Collins, Parks & Marlatt,1985); PACS = Penn Alcohol Craving Scale (Flannery, Volpicelli & Pettinati, 1999); DRSEQ = Drinking Refusal Self-Efficacy Questionnaire (Young, Hasking, Oeie & Loveday, 2007); IAT= Implicit Association Test (Greenwald, McGhee, & Schwartz, 1998); DASS-21= Depression Anxiety Stress Scales-21-item version (Lovibond & Lovibond, 1995); FTND = Fagerstrom Test of Nicotine Dependence (Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991); RSEQ =

Relapse Situation Efficacy Questionnaire (Gwaltney, Shiffman, Norman, Paty, Kassel, Gnys, et al., 2001); CEQ = Credibility/Expectancy Questionnaire (Devilly & Borkovec, 2000); VAS = Visual Analogue Scales; QSU = Questionnaire on Smoking Urges (Tiffany & Drobes, 1991); PASAT = The Paced Auditory Serial Addition Task (Diehr, Heaton, Miller, & Grant, 1998); MPSS = Mood and Physical Symptoms Scale (West & Hajek, 2004); SAM= The Self-Assessment Manikin (Bradley & Lang, 1994); DAST-10= Drug Abuse Screening Test (Gavin, Ross, & Skinner, 1989); TMS = The Toronto Mindfulness Scale (Lau, Bishop, Segal, Buis, Anderson, Carlson, & Devins, 2006); CDS = The Cigarette Dependence Scale (Etter, Le Houezec, Perneger, 2003); ACQ = Appraisals of Craving Questionnaire (Nosen & Woody, 2009)

Among the alcohol studies, three experiments used the Alcohol Use Disorders Identification Test (AUDIT) at baseline as a way of measuring level of alcohol misuse, with a mean of 13.36, indicating a medium-high level of alcohol problems (Babor, De La Fuente, & Saunders, 1992).

3.1.4 *Comparison conditions*

While four out of the 11 nicotine studies used inactive comparison conditions (e.g. irrelevant reading task), seven involved control conditions with active components. Six out of the seven had two comparison conditions, one being active and the other inactive, with only Beadman et al. (2015) involving two active control conditions. It is generally advantageous to use active control conditions, as comparisons to inactive conditions can yield positive effects due to placebo and expectancy factors, as opposed to therapeutic factors.

In terms of the alcohol studies, two experiments (Ostafin, Bauer, & Myxter, 2012; Vernig & Orsillo, 2009) involved inactive control conditions, and two (Murphy & MacKillop, 2014; Vinci et al., 2014) included both active (distraction and relaxation, respectively) and inactive (no strategy and word search puzzle, respectively) comparison conditions, being methodologically advantageous in this respect.

3.1.5 *Craving as an explicit versus implicit target of the strategy*

Among the nicotine studies, six experiments designed their contextual-based strategy to be specific to craving and smoking. For instance, participants in Litvin and colleagues' (2012) study were explicitly taught to use the strategy as a way of managing and coping with craving for smoking. Westbrook and colleagues' (2013) instructions did not include the key words 'craving' and 'smoking', but participants applied the strategies while watching smoking-related images. The remaining four

studies employed strategies that were not specific to craving, but rather generic mindfulness and body-scanning.

In the alcohol experiments, Murphy and MacKillop (2014) specified their strategies to craving and drinking. Ostafin et al. (2012) deliberately did not do so, but rather told participants that the strategy's aim is to develop attentional skills. Both Vernig and Orsillo (2009) and Vinci et al. (2014) used generic acceptance and mindfulness strategies in the context of observing emotional images.

3.1.6 *Follow up*

Five of the nicotine studies involved follow-up periods of up to a week, measuring smoking behaviour, craving and/or affect. Of the alcohol studies, Murphy and MacKillop (2014) included a 7-day follow-up period, measuring craving and alcohol consumption, and Ostafin et al. (2012) measured alcohol use 7-10 days after participation. The remaining studies did not include follow-up periods.

3.1.7 *Nicotine-related outcomes*

The most common outcomes examined in the nicotine studies were craving for cigarettes (11 studies), NA (6 studies) and amount of smoking at follow-up (4 studies). Six studies measured craving using the Questionnaire of Smoking Urges-Brief (QSU-brief) or certain items from it. Litvin et al. (2012) used this measure as well as the Magnitude Estimation of Urge (ME) and a single item urge scale. Two studies employed a visual analogue scale to measure craving, and four studies used single items to assess desire to smoke. As hypothesised, craving improved significantly in six studies, all of which used inactive control as comparison conditions. Only Nosen and Woody (2013), who used brief mindfulness, found craving reduction in comparison to an active condition (standard smoking cessation psychoeducation) in

addition to an inactive one. Contrary to the above, Szasz et al. (2012) found significantly less benefit for the contextual-based condition (acceptance) upon craving, compared to an active condition (reappraisal).

Among the six studies that examined NA, four used the International Positive and Negative Affect Schedule-Short Form (IPANAS-SF) to measure it. However, Litvin et al. (2012) used the Mood Form (MF) questionnaire, and Westbrook et al. (2013) used a single item, measuring strength of negative emotion. Three studies reported a significant improvement following the contextual-based strategy in comparison to control. While in Litvin et al.'s (2012) and Westbrook et al.'s (2013) experiments the control conditions were inactive, Rogojanski et al. (2011) compared mindfulness to an active control (suppression) and found an improvement in NA and depression at post-intervention and follow-up. In contrast, Szasz et al. (2012) found significantly less benefit for acceptance upon NA, compared to reappraisal.

Four studies used tracking sheets to report the amount of cigarettes smoked at follow-up. Litvin et al. (2012) and Rogojanski et al. (2011) reported no reduction in smoking. However, Bowen and Marlatt (2009; who examined brief mindfulness) found a significant reduction in smoking in comparison to inactive control, and Beadman et al. (2015; who used defusion) found a reduction in comparison to suppression, but not reappraisal.

Most studies examined additional outcomes, though it is beyond the scope of this review to explore them in detail. Briefly, latency to smoke (amount of time between leaving the laboratory and smoking the first cigarette) was measured in two studies (Beadman et al., 2015 and Litvin et al., 2012). The former reported that this improved in the defusion group compared to the suppression group, but not the

reappraisal. Withdrawal symptoms were examined in three studies. Cropley et al. (2007) reported no significant differences between the body-scan and inactive conditions. Ussher et al. (2006) found significantly less benefit for body-scan compared to an active condition (isometric exercise). In contrast, Ussher, Cropley, Playle, Mohidin and West (2009) found no significant differences between the body-scan and isometric exercise conditions, though a significant improvement compared to the inactive group. Self-efficacy to abstain from smoking was measured in two studies (Litvin et al., 2012; Rogojanski et al., 2011) and was found to be higher in habitual smoking situations in the acceptance condition compared to an inactive group, in one study (Litvin et al., 2012). The frequency of smoking-related thoughts was explored in two studies. Litvin et al. (2012) found no differences between the acceptance and inactive conditions, though they reported significantly less benefit for acceptance compared to the suppression group. In contrast, May et al. (2011) found a reduction in smoking-related thoughts in the body-scan group compared to an inactive condition. Additional factors that were examined, such as nicotine dependency, distress tolerance, avoidance and neural activity, are outlined in table 1.

3.1.8 *Alcohol-related outcomes*

The most common outcomes examined in the alcohol studies were craving (2 studies), NA (3 studies) and alcohol consumption (2 studies). Murphy and MacKillop (2014) measured craving at follow-up, using the Penn Alcohol Craving Scale (PACS), and found no significant reduction. They also measured acute craving and found significantly less benefit for brief mindfulness compared to an active condition (distraction). Vinci et al. (2014) used a single item to assess urge to drink, and found no differences between the mindfulness, active (relaxation) and inactive conditions.

Murphy and MacKillop (2014) also measured acute affect and acute 'urge distress' (craving-related distress). The only difference that they found was significantly less benefit for mindfulness upon urge distress compared to the distraction condition. Vernig and Orsillo (2009) measured emotional reactions to stimuli and found no differences between the brief acceptance/mindfulness and inactive conditions. Similarly, Vinci et al. (2014) tested NA using the IPANAS after presenting the participants with NA stimuli. They too found no differences between the groups.

Murphy and MacKillop (2014) and Ostafin et al. (2012) assessed the amount of alcohol consumption during the follow-up period, and found no significant differences between the contextual-based strategies and the active/inactive control conditions.

Most studies explored other outcomes such as perceived capacity to resist drinking, physiological reactions, willingness to experience NA, and automatic alcohol motivation, outlined in table 1.

3.2 Quality ratings

The studies were rated according to a modified list of recommended design features of laboratory-based component studies of contextually-based behavioural interventions. The ratings of the quality of the studies' methodologies are presented in table 2. The studies were divided into two sections; those that included active comparison conditions, and those that used inactive control groups. Some of the studies in the first section include a third, inactive condition (in addition to the active one), though the ratings were made in comparison to the active ones. The reason for this is that some elements are harder to match between active and inactive conditions

(e.g. engagement with the material). For instance, in Litvin et al.'s (2012) study, the contextual-based strategy was matched well with the active strategy, but not the inactive one. Since such studies are advantageous for including active and inactive comparison conditions, it would be unfair to penalise them for not matching the contextual-based strategy to the inactive condition as well as to the active one. Thus, a distinction was made between studies with only inactive comparison conditions, and studies that employed active controls.

Table 2. *Quality rating scale*

Study	Total	Q1	Q2	Q3(A)	Q3(B)	Q3(C)	Q3(D)	Q3(E)	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14
Studies involving active control conditions																			
Beadman et al, 2015	30	0	2	2	2	2	2	2	2	2	2	0	2	2	2	2	0	2	2
Murphy & MacKillop, 2013	28	2	2	2	2	2	2	2	0	2	0	0	2	2	0	2	2	2	2
Ussher et al, 2006	27	0	1	2	2	2	2	2	2	2	2	0	2	2	2	0	0	0	2
Ussher et al, 2009	25	0	2	2	2	2	2	2	0	2	1	0	2	2	2	2	0	0	2
Vinci et al, 2014	24	0	2	2	1	2	2	2	0	2	2	0	2	2	0	0	2	1	2
Rogojanski et al, 2011	23	0	2	2	2	2	2	2	0	2	0	0	2	2	0	2	0	1	2
Litvin et al, 2012	23	0	2	2	2	0	2	2	0	2	0	0	2	2	0	2	2	1	2
Nosen & Woody, 2013	21	0	2	?	?	?	2	2	0	2	0	0	2	2	2	2	2	1	2
Szasz et al. 2012	17	0	2	2	2	0	2	2	0	2	0	0	0	2	0	0	2	1	0
Item total		2	17	16	15	12	18	18	4	18	7	0	16	18	8	12	10	9	16
Studies involving inactive control conditions																			
Ostafin et al., 2012	24	2	2	2	0	2	0	2	0	2	0	0	2	2	2	2	2	0	2
Bowen & Marlatt, 2009	22	0	2	2	2	2	1	2	0	2	0	2	2	2	0	0	0	1	2
Vernig & Orsillo, 2009	22	0	2	2	2	2	0	2	0	2	0	0	2	2	0	2	2	0	2
May et al, 2011	20	0	2	2	1	2	0	2	0	2	0	0	2	2	2	0	0	1	2
Cropley et al, 2007	19	0	2	2	0	2	0	2	0	2	1	0	2	2	2	0	0	0	2
Westbrook et al, 2013	14	0	2	0	1	0	0	2	0	2	0	0	2	2	0	0	0	1	2
Item total		2	12	10	6	10	1	12	0	12	1	2	12	12	6	4	4	3	12

Note. Q1 = blinding of assessor; Q2 = experimental conditions homogeneous; Q3 = strategies matched [A= length; B= readability; C= key words; D= engagement with material; E= delivery method]; Q4 = criterion 3 supported by independent raters; Q5 = strategy relevant to experimental challenge; Q6 = themes/quality of strategy supported by independent raters; Q7 = verbal summary of understanding of strategy; Q8 = reminder of strategy prior to physical/psychological challenge; Q9 = procedure automated; Q10 = verbal summary of application of strategy; Q11 = credibility; Q12 = standardized manipulation check; Q13 = power calculation for group design; Q14 = experiential elements

3.2.1 *Studies with active comparison conditions*

Nine of the identified studies used active comparison conditions.

Sample size and characteristics

Group design studies should be adequately powered to conduct a group comparison and test the key hypotheses (criterion '13'). Most of the studies were powered (i.e. N≥25 per condition), though the majority of them did not conduct power calculations. Only Beadman et al. (2015) and Murphy and MacKillop (2014) did so, and were rated -2-. Ussher et al. (2006) and Ussher et al. (2009) had small sample sizes per condition (i.e. <25), and were rated -0-. The rest of the studies scored -1- as their sample per condition was large enough to be adequately powered, though they did not calculate power to verify this.

All the studies examined sample characteristics at baseline in order to explore any pre-existing differences between the groups (criterion '2'). Two studies found small, random differences. While Beadman et al. (2015) conducted a mediational analysis to account for the differences, Ussher et al. (2006) did not report taking these differences into account; hence scored -1-.

Procedure

All the studies used an automated procedure (criterion '9'), suggesting a good methodological design in this respect. However, only two studies (Murphy & MacKillop, 2014; Ostafin et al., 2012) reported that the experimenters (research assistants) were blind to the conditions (criterion '1'), suggesting an area of improvement for future studies of this kind.

Strategies

Criterion ‘3’ concerns the matching of the strategies. All the studies matched the strategies well in terms of length, delivery method (e.g. through audio recording) and level of engagement with the material. While some differences are inevitable, considering the different nature of the strategies, the level of engagement demanded from the participants was reasonably matched across the studies. With regards to the scripts’ readability, apart from Vinci et al. (2014) who scored -1- for a moderate match, all the studies matched the readability adequately. Most of the studies matched the scripts well in terms of use of key words (e.g. "craving", "smoking") apart from Litvin et al. (2012) and Szasz et al. (2012).

While the strategies were matched reasonably well, virtually none of the studies asked independent raters to check and support this (criterion ‘4’). Only Beadman et al. (2015) complied with this criterion and was rated -2-. Ussher et al. (2006) was also rated -2- as this criterion appeared non-applicable, considering that the strategies were presented in short bullet-points (e.g. focus of hands, focus on thighs), not requiring external raters to scrutinise descriptive contents.

Not only should the strategies match, but they should also have a similar level of credibility. Six studies included credibility checks (criterion ‘11’), successfully employing this important procedure.

Apart from Szasz et al. (2012), all the studies involved experiential/active elements rather than solely a rationale (criterion ‘14’), suggesting an adequate use of contextual-based strategies. All the strategies were also relevant to the experimental challenge (criterion ‘5’). While some studies addressed addiction-related constructs explicitly (e.g. acceptance of smoking-related thoughts), others encouraged generic awareness and acceptance of internal experiences, which can facilitate the

understanding that they are transient and tolerable, and are not required to be acted upon. However, most of the studies did not employ independent raters to examine the quality/theme of the strategy and its relevance to the experimental challenge (criterion '6'). Beadman et al. (2015) and Vinci et al. (2014) implemented this feature and scored -2-. Ussher et al. (2006) scored -2- as this criterion seemed non-applicable (similarly to criterion '4'), and Ussher et al. (2009) scored -1- as independent listeners supported the theme of the inactive condition (reporting the strategy to be neutral but relaxing), but none examined the contextual-based and active conditions.

Manipulation checks

Considering that contextual-based strategies can appear abstract to people not familiar with them, it seems particularly important to ensure participants' comprehension by asking them to verbally articulate the strategies they have been taught (criterion '7'). However, none of the studies contained this feature. In studies that involve a psychological/physical challenge, it is also helpful to ask participants to summarise the strategies they have applied during the challenge (criterion '10'). This feature was applicable to six studies, but only Beadman et al. (2015) employed this procedure.

Apart from verbalising the understanding and application of the strategy, it is important to use standardised manipulation checks, to objectively assess and compare the extent to which participants comprehended and implemented the strategies (criterion '12'). Five studies utilised this procedure. Additionally, to ensure the application and consolidation of the strategy, it is useful to remind participants to use the strategy prior to any physical/psychological challenge (criterion '8'). Among the

studies that this criterion was applicable to, they all successfully applied this procedure, apart from Szasz et al. (2012).

3.2.2 *Studies with inactive comparison conditions*

Six of the identified studies used only inactive control conditions.

Sample size and characteristics

In terms of studies being adequately powered, three studies were under-powered (small sample size per condition), scoring -0- (Cropley et al., 2007; Ostafin et al., 2012; Vernig & Orsillo, 2009), and three had large enough samples but lacked power calculations, scoring -1-.

All the studies successfully balanced the conditions, with no pre-existing differences between the participants at baseline.

Procedure

All the studies involved a fully automated procedure, implying a good methodological design. However, only one of them reported that the experimenters were blind to the conditions (Ostafin et al., 2012; through the use of a software that automatically presented the study's sequence).

Strategies

All the studies matched the strategies in terms of delivery method. Apart from Westbrook et al. (2013), they all also matched the length and use of key words. Matching readability was less successful, with only two studies matching well (Bowen & Marlatt, 2009; Vernig & Orsillo, 2009), two matching moderately well (May et al., 2011; Westbrook et al., 2013), and two matching inadequately (Cropley et al., 2007; Ostafin et al., 2012). With regards to engagement with the material, as expected,

having inactive comparison conditions, studies did not match the strategies well, with all of them scoring -0- except for Bowen and Marlatt (2009) who scored -1- for matching the strategies moderately well. Their control condition involved asking participants to use any strategy that they had found helpful throughout their lives to avoid smoking. While this may have demanded a different level of engagement with the material than practicing urge surfing in the contextual-based strategy, it still required a more similar involvement than procedures used in other inactive conditions, such as listening to a National Geographic article.

Only two studies (Ostafin et al., 2012; Vernig & Orsillo, 2009) used credibility checks. This was expected, as inactive control conditions (with no therapeutic or theoretically-relevant components) are unlikely to appear credible.

All the studies involved active/experiential elements in their contextual-based strategies, that were all also relevant to the experimental challenge, explicitly or implicitly aiming to increase psychological flexibility in the context of craving.

None of the studies employed independent raters to examine whether the conditions were matched, nor the quality/theme of the strategies. Cropley et al. (2007) scored -1- as independent listeners checked the theme of the inactive condition, but not the contextual-based condition.

Manipulation checks

Only Bowen and Marlatt (2009) asked participants to articulate their understanding of the strategy they had been taught. With regards to participants summarising the strategies they had employed during a physiological/psychological challenge, among the three studies that this procedure was applicable to, none of them implemented it. Only two studies (Ostafin et al., 2012; Vernig & Orsillo, 2009) used

standardised manipulation checks. In three studies participants were reminded to use the strategy prior to a physical/psychological challenge (scoring -2-), and in the other three this procedure was non-applicable (scoring -2-).

Discussion

The current paper reviewed laboratory-based component studies exploring the effects of brief contextual-based strategies on addiction-related outcomes, and assessed their methodological quality. Overall, a great methodological variation has been found, together with inconsistent outcomes regarding the utility of brief contextual-based training for addictions. The limited use of methodological control may account for some of the mixed findings. The sections below will be divided into a discussion about the overall design and outcomes of the identified studies, and an exploration of the quality of their design, suggesting a quality rating scale for the guidance of future component studies of this kind.

4.1 Overall design and outcomes

Among the component studies identified in this review, there has been a great variation in terms of the design, methodology (e.g. use of craving-induction, focus on craving versus emotional states, nature of the comparison conditions, use of follow-up) and outcomes examined. Thus, in order to understand the general impact of contextual-based strategies on addictions, the outcomes of all the studies (alcohol and nicotine) will be combined in this discussion.

Contextual-based strategies appeared somewhat helpful in reducing craving, with six out of the 13 studies measuring it reporting an improvement. However, these findings were inconsistent, with five studies reporting no changes, and two reporting significantly less benefits for contextual-based strategies in comparison to distraction

and reappraisal. Importantly, nearly all the studies that reported reductions in craving used inactive control conditions, suggesting that contextual-based strategies may not be advantageous over other therapeutic strategies. However, it is important to note that contextual-based strategies do not target reductions in symptoms, but rather greater willingness to experience them (e.g. Levitt, Brown, Orsillo, & Barlow, 2004; Litvin et al., 2012; Vernig & Orsillo, 2009). In fact, the hypothesis that contextual-based approaches can change the way people relate to their symptom (as opposed to reducing their symptoms) is more appropriate and was supported in some of the studies. For instance, Beadman et al. (2015) reported a reduction in smoking-specific experiential avoidance, compared to both the reappraisal and suppression strategies. Additionally, Nosen and Woody (2013) revealed an improvement in metacognitive beliefs about cravings compared to both standard smoking-cessation psychoeducation and no psychoeducation. However, Szasz et al. (2012) found a reduction in distress tolerance compared to a reappraisal strategy, and no differences compared to suppression. This contradiction and the fact that not many studies examined contextual processes (e.g. willingness, experiential avoidance, meta-cognitive beliefs), suggest that these should be emphasised in future studies, in addition to merely examining symptoms.

A mixed picture also appeared with regards to NA outcomes, with three out of nine studies assessing NA reporting an improvement (two in comparison to inactive conditions and one in comparison to suppression), five finding no changes, and one reporting significantly less benefit for contextual-based strategy compared to reappraisal. Similarly to the argument above, a more valid assessment of efficacy of contextual behaviour might be willingness to experience NA, as opposed to the actual extent of NA (e.g. frequency, severity). Only Vinci et al. (2014) employed such an assessment; while they reported an increased level of mindfulness state, they found no

evidence for increased willingness to experience NA. They suggested that a more extensive mindfulness intervention might have been necessary, though results of only one study should be taken cautiously.

Out of the six studies that measured addictive behaviour at follow-up, two found significant reductions (in comparison to inactive control and suppression), and four found no differences in smoking/drinking. The mixed findings suggest that more component studies of this kind should explore substance use at follow-up.

Other outcomes were examined, such as latency to smoke, self-efficacy to abstain from smoking, withdrawal symptoms, smoking-related thoughts, and physiological reactions. However, as these outcomes were not explored consistently across the studies (each being examined in only 2-3 studies), and due to the variation in findings, no conclusive inferences could be made.

4.1.2 *Consideration of outcomes*

Overall, there seem to be mixed findings regarding the helpfulness of brief contextual-based strategies for addiction-related outcomes. The most consistent outcome showing benefits of such strategies was craving. However, apart from one study that showed an improvement in comparison to an active condition (standard smoking-cessation psychoeducation), all the studies that reported a reduction in craving found this in comparison to inactive control groups. This, together with other outcomes, suggests that while contextual-based strategies might be helpful for addiction-related constructs, they are not necessarily better than other therapeutic techniques, particularly distraction and reappraisal. However, as suggested earlier, perhaps studies should focus on assessing the way participants relate to their symptoms, as opposed to the magnitude of the symptoms, as this is more consistent

with contextual-based approaches and psychological flexibility (Hayes et al., 2011; Levin et al., 2012). The main hypothesis is that despite experiencing craving, NA and substance-related thoughts, people would be willing to accept and tolerate them without acting on them (Brewer et al., 2013; Lillis et al., 2009). Thus, measuring constructs related to this hypothesis, such as distress-tolerance, willingness, metacognitive beliefs, and ways of relating to symptoms/experiences, may yield different understandings on contextual-based strategies for addictions.

It is important to consider the findings reported by Forman and colleagues (2007) and Litvin et al. (2012), according to which reactions to contextual-based strategies vary according to the level of dependency and susceptibility to craving. Forman et al. (2007) found that people with greater susceptibility to food (i.e. vulnerability/reaction to food-related cues) benefited more from acceptance strategy than those with lower susceptibility. Similarly, Litvin et al. (2007) showed that less dependent smokers derived more benefit from suppression than acceptance. This might be due to the idea that they have fewer smoking-related internal experiences, making the alternative active conditions (e.g. distraction, suppression) viable approaches (Forman et al., 2007; Litvin et al., 2007). Perhaps the contextual-based strategies in the identified studies were not advantageous over other therapeutic approaches because they tend to have a greater impact on heavy substance use, which was under-represented in the reviewed studies. Therefore, it would be interesting to explore the relationship between level of dependency and ability to benefit from contextual-based strategies in comparison to active controls. Future studies should examine this potential relationship, as well as conduct component studies with participants with higher dependency level.

The idea that brief contextual-based strategies may be more difficult to comprehend than other, more familiar strategies (Murphy & MacKillop, 2014), should be also taken into consideration as this may have impacted the outcomes discussed above. For instance, while distraction appeared more effective in reducing craving/NA than mindfulness in Murphy and MacKillop's (2014) study, it is worth noting that it was also perceived by participants to be more useful and less difficult, compared to the mindfulness strategy. As explained earlier, contextual-based strategies may appear abstract and counterintuitive compared to other strategies. While in long treatment trials concepts such as non-judgemental observation, acceptance and defusion can be explained and practiced thoroughly, brief strategies in component studies may be more difficult to comprehend and implement.

Considering the mixed findings and the reasons that may underlie them, it is important that future studies examine the effects of brief contextual-based strategies on addiction-related constructs, taking into account the factors discussed above. Moreover, due to difficulties that are specific to contextual-based approaches and to brief component-studies (discussed above), it is important to follow the quality rating scale discussed below.

4.2 Quality ratings

As argued above, component studies of all sorts need to employ various procedures to ensure that the right mechanisms are taking place, particularly if the studies involve contextual-based techniques, which can be difficult to understand. The identified studies varied in the extent to which they have applied rigorous methodological procedures, as indicated in the list in section 2.3.

Basic criteria that apply to all experimental research, such as ensuring homogeneity of the sample characteristics of the different conditions, conducting an automated procedure, and designing an intervention relevant to the experimental challenge, were applied successfully across the studies. However, other common experimental procedures, such as ensuring that the study is adequately powered and blinding the experimenters, were not applied consistently. While the latter can be more difficult to implement, sample size and power calculations are basic experimental practices. Only two studies calculated power, and a third of the studies were clearly under-powered (small sample size per condition), suggesting that their findings should be taken cautiously.

Component studies should ensure that the interventions in the different conditions are formally and closely matched apart from the critical difference. While the majority of the studies successfully matched the length, delivery method and use of key words of the different strategies, matching the scripts' readability and the level of demand of participants' engagement with the material was less successful. The latter two were applied well in studies that involved an active comparison condition, whereas most of the studies with only inactive controls used completely passive strategies (e.g. listening to a text from a magazine), not requiring a similar level of participants' involvement with the material, and not taking into account the texts' complexity. Although matching readability and engagement with the material is harder to do with inactive controls, it is not impossible. Studies that use such control conditions should try to improve the matching of the conditions in terms of these two dimensions. Although there are no therapeutic components in inactive conditions, they nevertheless need to control for attention, time and demand characteristics, and thus need to be matched in the best possible way.

Independent raters should ideally check that the strategies of the different conditions match, and examine their theme/quality and relevance to the experimental challenge. Although many of the identified studies adapted their strategies from reliable, well-known sources, it is important that independent people who are familiar with the approach examine the scripts, particularly due to the abstract nature of contextual-based approaches. The great majority of the studies did not apply such procedures, suggesting another area of improvement for future studies of this kind.

In addition to matching the strategies with regards to the elements discussed above, studies should also assess whether the strategies were perceived to be equally credible by the participants, as credibility can affect the extent to which participants implement and benefit from the strategies. About half of the studies applied this feature, and again, it was more common in studies with active comparison conditions as opposed to those with only inactive ones. It is not surprising that studies that implemented inactive controls (e.g. no strategy) did not check their credibility. However, if a more adequate matching of the conditions took place (as discussed above), assessment of credibility could appear more reasonable.

Manipulation tests are crucial in component studies as they can assess the extent to which participants understood and applied the strategies. For instance, if following a mindfulness strategy participants score highly on a relaxation scale but not on a mindfulness scale, this may suggest instructions have been misunderstood by some participants, who could be excluded from the analysis. Standardised manipulation checks, which can enable quantitative and objective comparisons between the conditions, were applied in only half of the identified studies. In addition to standardised manipulation checks, it is helpful to ask participants to articulate verbally their understanding of the strategy they had been taught, in order to provide a

clearer account on their comprehension of rather difficult concepts to grasp. Only one study involved such a procedure. Additionally, if studies include physical/psychological challenges (e.g. craving-induction, NA stimuli), during which participants are required to implement the strategy, then it is helpful to ask them to summarise the strategy they had employed at the end of the experiment. This can clarify whether they indeed utilised the relevant mechanisms of the strategy. Among the nine studies that this procedure was relevant to, only one implemented it. It appears that both standardised and non-standardised manipulation checks are areas that require substantial improvement in studies of this kind. In contrast, most of the studies that used a physical/psychological challenge successfully reminded the participants to use the strategy prior to the challenge. This is important in order to increase the likelihood of the techniques being implemented, instead of participants using other, idiosyncratic techniques, or no technique whatsoever.

Specifically to studies incorporating brief contextual-based approaches, it is incredibly important to include experiential/active elements, rather than merely a rationale (Barnes-Holmes & Hayes, 2003). All the studies apart from one applied this feature. Interestingly, the one study (Szasz et al., 2012) that found consistently less benefit for contextual-based strategy (acceptance) compared to reappraisal (upon craving, NA, distress tolerance and attentional bias), was the one that did not contain experiential elements. This, together with other observations of methodological limitations discussed above, suggests the importance of applying rigorous methodological procedures in order to obtain meaningful findings; studies that do not apply important procedural measures should be interpreted cautiously.

4.3 Conclusion, implications and recommendations

There are currently few component studies examining the effects of contextual-based strategies on addiction-related outcomes, and the ones that do exist are methodologically heterogeneous. Due to the difficulty of establishing methodological standards for this type of laboratory-based experimental research (Beadman, 2014; Levin et al., 2012), it was decided not only to review such studies, but to rate them and create a quality rating scale.

As discussed above, there are mixed findings regarding the benefits of contextual-based strategies for addiction-related constructs. Nevertheless, the usefulness of such approaches should not be ignored, considering some of the positive findings, particularly in studies that were designed rigorously. Several factors may underlie the lack of consistency and mixed findings. First, the emphasis on symptom reduction rather than tolerance may have compromised the advantage of contextual-based techniques over other approaches. Future studies should incorporate assessments of constructs that reflect psychological flexibility (e.g. willingness to experience aversive internal experiences) in addition to change in symptoms.

Second, the use of samples with mild substance dependency may have also limited the strength of contextual-based strategies in comparison to other therapeutic approaches. Future studies should try to recruit heavy substance users in order to establish the comparison between contextual-based approaches and other strategies on such a user group. Future research can also investigate the relationship between extent of dependency and degree of benefit from contextual-based and alternative therapeutic strategies, as Litvin et al. (2012) started to do.

Finally, contextual-based strategies can appear abstract, so they may be compromised in short component studies that cannot provide extensive explanations

and practice. Thus, it is important that such studies take all the necessary steps to ensure that the procedures are well designed, and that the strategy is understood and implemented properly. The identified studies varied in the extent to which they have applied rigorous methodological procedures, as outlined in the list of features in section 2.3, and this may underlie some of the mixed findings. Thus, it is important that future studies use the quality rating scale provided in this review. Not all of the criteria in the quality rating scale are necessary for all studies, but experimental research should maximise the use of the relevant criteria, as it would provide a much clearer and richer understanding of therapeutic benefits and mechanisms of change, which can inform future treatment trials.

4.4 Limitations

The current review was not comprehensive in the sense of examining all the addiction-related outcomes measured in the identified studies. It focused mainly on craving, NA and addictive behaviour, as these components were widely tested across the studies, and were the core component of Brewer et al.'s (2013) "addictive loop" model. However, most studies examined a variety of constructs, such as attentional bias, nicotine dependence, automatic alcohol motivation and so forth, which were not covered in this review but which may have important implications. Another limitation is that the quality assessment scale did not include some data from one study, as its intervention scripts were not accessible due to the authors declining to provide them. Finally, this review only included published studies and in the English language, due to practical constraints and the rationale that publication reflects methodological quality. However, this is likely to have increased the risk of bias within the results.

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Part 2: Empirical Paper

The Effects of Brief Mindfulness Strategy on Craving, Affect and Alcohol Consumption

Abstract

Background: Recent theories of addiction emphasise craving and negative affect as the central mechanisms that underpin alcohol abuse. Mindfulness-based interventions have been suggested to increase people's ability to manage craving and negative affect, and thereby reduce the habitual reaction of drinking as a result of the unpleasant feelings.

Aim: To examine the effect of brief mindfulness training on craving, affect and alcohol consumption, in comparison to brief relaxation training.

Method: Sixty-eight participants were randomly allocated to brief mindfulness or relaxation training. Participants underwent cue-reactivity procedures before and after the training. Dependent variables included subjective and physiological measures of craving and affect, and alcohol consumption at 7-day follow-up.

Results: Both mindfulness and relaxation reduced subjective cue-induced craving and arousal levels, as well as craving at follow-up. No effects were seen on pleasure during the cue-reactivity procedure. Mindfulness was also associated with a significant reduction in alcohol consumption at follow-up. The reduction in drinking in the mindfulness group was associated with acutely increased cue-induced physiological arousal.

Conclusions: The results support the notion that both mindfulness and relaxation can reduce craving and arousal during cue-reactivity, but only mindfulness can reduce alcohol consumption at follow-up. This study also offers insights regarding physiological arousal, being a potential mechanism involved in the reduction in drinking.

Introduction

1.1 Alcohol abuse: impact and cost

Alcohol Use Disorders are a pervasive problem, contributing 4% to the overall disease burden worldwide (Rehm et al., 2003), with higher figures in developed countries (Kaner et al., 2009). Alcohol is one of the primary causes of preventable ill health, and is ranked third in factors leading to morbidity and immature death (Ezzati, Lopez, Rodgers, Vander Hoorn, & Murray, 2002). In addition to individual health, the economic cost is vast. Tangible cost involves expenses in areas such as health, mortality, treatment, crime, accidents and unemployment. In 2003 this was estimated to cost the EU approximately €125 billion, 1.3% of the gross domestic product of the EU (World Health Organization [WHO], 2009). Equally, alcohol is associated with other less tangible costs including personal suffering and secondary suffering caused to others (WHO, 2009).

The significant impact on individuals and society in terms of physical, mental and economic health has led to national and international movements towards reducing alcohol consumption levels (Kreitman, 1986). Such movements not only target people with severe alcohol dependency, but also include preventative approaches for hazardous drinkers (i.e. individuals whose alcohol consumption exceeds recommended drinking levels), who represent a larger and more harmful group of alcohol drinkers (Kaner et al., 2009) and are at risk of developing more severe alcohol use problems.

1.2 Mechanisms underpinning substance misuse

1.2.1 *Craving*

A substantial amount of research has been put forward to understand the mechanisms that make hazardous and dependent drinkers repeatedly consume alcohol and relapse, with the goal of creating more effective treatment packages. As discussed in the literature review (chapter one), early models of negative reinforcement motives have been insufficient in explaining the nature of addiction. People consume alcohol not only as a response to aversive withdrawal symptoms, but also due to a psychological desire, or craving (Hore, 1974). Craving for alcohol was described as a way of protecting the hazardous drinker from distress, alerting him/her to a source of relief (Ludwig & Wikler, 1974). According to cognitive and social learning theory (Marlatt & Gordon, 1985), craving occurs as a conditioned response to alcohol-related cues, and/or in response to withdrawal symptoms, lack of pleasure or a need to enhance pleasure (Wright, Beck, Newman, & Liese, 1993). The notion that craving maintains hazardous alcohol use (e.g. Bottlender & Soyka, 2004; Flannery, Volpicelli, & Pettinati, 1999; Flannery et al., 2001; Oslin, Cary, Slaymaker, Colleran, & Blow, 2009) and leads to relapse (Addolorato et al., 2005; Cibin, 1993) has been supported extensively by empirical research, and current psychosocial interventions for alcohol abuse focus on coping and management of craving (e.g. Addolorato et al., 2005; Jhanjee, 2014; Witkiewitz, Marlatt, & Walker, 2005).

1.2.2 *Negative affect*

In addition to craving, emotional states have been increasingly shown to be associated with alcohol abuse and relapse (Brown, Lejuez, Kahler, Strong, & Zvolensky, 2005; Zvolensky, Feldner, Eifert, & Brown, 2001). Negative affect (NA) has been defined as a subjective experience of distress or negative emotional state, such as anxiety, nervousness, sadness, fear and anger (Carmody, Vieten, & Astin, 2007; Watson, Clark, & Tellegen, 1988). NA can be understood as exceeding the

negative affective state characteristic of withdrawal symptoms (Myrsten, Elgerot, & Edgren, 1977), and it has been proposed by various theories to play an important role in addiction. For instance, the Affective Model of Drug Motivation suggests that drug use is maintained by an attempt to avoid NA, and the learning that this would be facilitated by the use of substances (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004). The Motivational Model of Alcohol Use suggests that alcohol use is motivated by a wish to enhance pleasant emotions, and cope with unpleasant ones (Cooper, Frone, Russell, & Mudar, 1995). The former has been demonstrated to predict frequency and quantity of alcohol use, and the latter has been shown to predict symptoms of pathologic alcohol use (Cooper, Russell, Skinner, & Windle, 1992; Woody, Urschel III, & Alterman, 1992).

These theories have been further supported by a study with treatment-seeking alcohol users, showing that relapse was related to higher NA (Witkiewitz & Villarroel, 2009). Furthermore, stressful life events are associated with alcohol consumption (Dawson, Grant, & Ruan, 2005; Garland, Gaylord, Boettiger, & Howard, 2010). Studies on nicotine addiction have also shown that negative affective states are associated with the onset of tobacco use, less successful quitting attempts and relapse (Anda et al., 1999; Brandon, Tiffany, Obremski, & Baker, 1990; Rogojanski, Vettese, & Antony, 2011). Research with people with substance use disorders generally suggests that individuals with addiction may be susceptible to engaging in coping strategies aimed at decreasing negative emotive experiences due to a greater sensitivity and arousal in response to emotional stimuli (de Arcos, Verdejo-García, Peralta-Ramírez, Sánchez-Barrera, & Pérez-García, 2005; Verdejo-García, Bechara, Recknor, & Perez-Garcia, 2006). Therefore, several intervention strategies have shifted the

focus on to developing skills to cope with NA among dependent drinkers (Vernig & Orsillo, 2009; Vinci et al., 2014).

1.2.3 *Craving and NA interaction*

As both craving and NA have been proposed to be maintaining factors in dependent drinking (e.g. Murphy & MacKillop, 2014; Petrakis et al., 2002), the interaction between these components has been an increasing focus of empirical attention. Craving and NA interact in numerous ways. Firstly, urge to drink and relapse susceptibility have been shown to increase when individuals experience stress and NA, suggesting that craving is associated with drinking in order to reduce anxiety (Cooney, Litt, Morse, Bauer, & Gaupp, 1997; Oslin et al., 2009; Sinha et al., 2008). Secondly, craving and urge to drink can be experienced as distressing and unpleasant (Brewer, Elwafi, & Davis, 2013; Murphy & MacKillop, 2014). According to Sinha et al (2008), increasing alcohol craving is associated with higher anxiety and negative emotion. In addition, highly addictive individuals often score highly on trait measures of anxiety sensitivity (Zvolensky et al., 2001).

As described in section 1.3 of the literature review, Brewer and colleagues (2013) outlined an 'addictive loop' which describes the complex interaction between NA, craving and addictive behaviour. Briefly, substance-related cues are associated with positive/negative emotive tones (potentially unconsciously), and the resulting affective state leads to craving. Substance use follows the experience of craving and acts as a reinforcer, eventually forming an associative and learned behaviour. Through the interaction of negative affective tone, craving and negatively reinforced behaviour, drug use becomes increasingly habitual (Brewer et al., 2013). This suggests that the link between these three components should be interrupted and potentially become the focus of psychological interventions for addiction.

1.3 Mindfulness for hazardous and dependent alcohol use: theory

A therapeutic approach that has increasingly gained theoretical and empirical attention in the context of addiction is mindfulness (e.g. Bowen et al., 2014; Zgierska et al., 2009). Mindfulness involves the regulation of attention by promoting awareness of internal and external experiences, as well as an orientation to non-judgemental acceptance of such awareness and experiences (Bishop et al., 2004; Hayes, Luoma, Bond, Masuda, & Lillis, 2006). Mindfulness may help to reduce addictive behaviour and alcohol dependency through various processes, three of which will be discussed below (NA, craving and habitual behaviour).

1.3.1 *Mindfulness for NA*

As affective factors are suggested to be an integral part of addictive behaviour, mindfulness may be helpful in reducing heavy alcohol use through management of NA. Management of difficult emotional states can be facilitated by an orientation to mindful observation, acceptance, detachment from, and tolerability of unpleasant feelings (Brown et al., 2005; Zvolensky et al., 2001). Mindful observation can enable people to notice the temporary nature of internal feelings and be willing to experience them without attempting to avoid, escape from or react to them, in a maladaptive manner (Arch & Craske, 2006; Baer, 2002; Breslin, Zack, & McMain, 2002; Rogojanski et al., 2011).

Reflecting back on the 'addictive loop' model, positive and negative affective states are triggered by substance-related or neutral cues, being appraised with accompanying emotional tone. The affective tone that underlies emotional distortions of cognitive appraisals of situations is called affective bias (Elliott, Zahn, Deakin, & Anderson, 2011). Brewer et al. (2013) suggested that mindfulness can both enable

people to notice what elicits their affective reactions, and remove the affective bias that leads to emotional reactivity to neutral and alcohol-related cues.

1.3.2 *Mindfulness for craving*

Mindfulness-based interventions aim to help people recognise cravings as temporary internal events that involve physiological and affective components (Brewer et al., 2013). Mindfulness may help people experience craving openly, accepting the unpleasant feeling and creating a psychological detachment ('defusion'; Luoma, Hayes, & Walser, 2007) from the distress associated with it. With regards to the 'addictive loop', Brewer et al. (2013) proposed that increased awareness of internal events and the present moment can help people notice that the cue and its associated affective tone are separated and separable from the experience of craving. The aim of mindfulness-based interventions is not to eliminate cravings, but to help people experience them in a different way, seeing them as temporary feelings and mental events that they are able and willing to experience, tolerate and accept rather than act upon. This may help people perceive and experience craving as less unpleasant (Bishop et al., 2004).

1.3.3 *Mindfulness for habitual behaviour*

Finally, mindfulness may help to reduce alcohol consumption as an automatic and habitual reaction to craving (Bishop et al., 2004). A curious, non-judgemental observation, and willingness to experience unpleasant internal events in a detached manner, may facilitate a decrease in reactive behaviour, and break the chain of craving followed, reflexively, by alcohol use (Witkiewitz, Marlatt, & Walker, 2005; Murphy & MacKillop, 2014). Greater awareness and acceptance of one's feelings, thoughts,

sensations and reactions can give people more freedom to choose how they want to respond to their internal experiences (Brewer et al., 2013).

1.4 Mindfulness for alcohol and drug use problems: empirical evidence

The use of mindfulness-based interventions for dependent drinking has been supported by various treatment trials with clinical populations. Bowen and colleagues (2014) examined Mindfulness Based Relapse Prevention (MBRP) for people with substance use disorder and found a reduction in alcohol consumption at 6-month follow-up compared to treatment as usual (TAU), and at 12-month follow-up compared to cognitive-behavioural relapse prevention. These findings suggest that mindfulness practices may help long-term addictive behaviour by facilitating mindful monitoring of one own alcohol consumption and coping with the distress associated with craving and NA (Bowen et al., 2014). Garland and colleagues (2010) provided alcohol dependent adults with a 'Mindfulness-Oriented Recovery Enhancement' (MORE) intervention, and found that it increased physiological recovery (decrease in heart rate variability) from alcohol cues, and reduced stress and thought suppression, in comparison to an Alcohol Dependence Support Group.

In addition to direct impact, various correlational studies of addiction found supportive results. For instance, in a study of Mindfulness-Based Stress Reduction (MBSR), adherence to mindfulness practice was positively correlated with nicotine abstinence (Davis, Fleming, Bonus, & Baker, 2007). Additionally, components of mindfulness such as ‘non-judging’ and ‘acting with awareness’ have been negatively associated with alcohol use and problematic consequences (Fernandez, Wood, Stein, & Rossi, 2010).

In terms of the moderating role of mindfulness, a study on MBRP showed that the intervention helped to attenuate the relation between post-treatment depression and craving, which was not the case in the control group (Witkiewitz & Bowen, 2010), suggesting that MBRP might target the link between emotional states and craving, as highlighted in the 'addictive loop' model. The moderating role of mindfulness was also shown in the relationship between craving and addictive behaviour (Elwafi, Witkiewitz, Mallik, Thornhill, & Brewer, 2013); mindfulness training resulted in an uncoupling of craving and cigarette use such that participants could experience craving without acting on it.

While the treatment trials above provide support for mindfulness-based interventions for substance misuse, dismantling and analogue research is still needed to identify the processes through which changes take place (Vernig & Orsillo, 2009). Shiffman (1993) and Piasecki and Baker (2001) highlighted that while multicomponent treatments offer statistical claims to efficacy, there should be a rededication to basic research examining therapeutic elements and mechanisms of change. Therefore, the current study aimed to enrich the understanding of mechanisms involved in drinking behaviour, and the potential therapeutic processes of mindfulness and relaxation for alcohol use.

1.5 The current study

This study was part of a programme of research on the effects of 'micro-interventions' on drug use behaviour and other outcomes relevant to the psychological flexibility model (e.g. Beadman et al., 2015). The overall aim of this two-part study (the other part of the study was conducted by a DClinPsy co-researcher- Damla Irez, which is presented separately; Irez, 2016) was to investigate the effects of mindfulness

on craving, affect and behaviour, incorporating a variety of robust experimental design features (Barnes-Holmes & Hayes, 2003; Levin, Hildebrandt, Lillis, & Hayes, 2012) that would enable valid conclusions about the *specific effects* of mindfulness. The rationale for examining a mindfulness micro-intervention is that if brief mindfulness has positive effects on acute and sub-acute drinking-relevant outcomes, then more intense training and regular practice could have similar effects over the long term in clinical, treatment seeking populations.

Although other studies (Murphy & MacKillop, 2014; Vinci et al., 2014) investigated the effects of mindfulness on acute craving and NA in heavy drinkers, there are limitations in these, which the current study sought to address in order to more clearly establish the effects of mindfulness on craving and NA, as potential mechanisms underlying alcohol abuse.

Given that mindfulness-based procedures have been shown to reduce craving and affect in some studies of drug and alcohol use (e.g. Cropley et a., 2007; May et al., 2011; Nosen & Woody, 2013; Westbrook et al., 2013) but not others (e.g. Bowem & Marlatt, 2009; Ussher et al., 2006; Vernig & Orsillo, 2009), this study aimed to determine the effects of mindfulness on affect and craving relative to a suitable control condition. It was hypothesised that mindfulness would be associated with a greater reduction in alcohol consumption at 1-week follow-up relative to the relaxation group, and that reduction in craving would predict a reduction in drinking in the relaxation group but, in line with Brewer et al. (2013), not in the mindfulness group.

Method

2.1 Design

The study employed a double-blind, placebo controlled design with participants randomly assigned to two groups matched for gender. 'Group' was an independent variable of mindfulness strategy versus a placebo control condition (relaxation strategy), and 'Time' was an independent variable of various time-points: baseline, pre-strategy (time-point 'T1'), post-strategy (time-point 'T2'), and follow-up.

2.2 Setting and apparatus

The study took place at the psychology department of University College London (UCL). Audio recordings were implemented for the craving-induction procedure and strategy training. Self-report measures were delivered via a computer. Physiological measures involved heart rate (HR) via electrocardiogram (ECG), and episodic blood pressure.

ECG signal was detected and recorded using a wearable heart rate monitor with a sampling rate of 1kHz (Firstbeat Bodyguard 2). ECG electrodes were attached below the right collar bone and bottom of the left ribcage at the start of the experiment and recording continued throughout. At the end of the experiment the device was detached and data uploaded onto a dedicated computer to which the device was time-locked. Key measurement time-points were during exposure to neutral and beer cues, in the cue-reactivity procedures. The inter-beat interval data were analysed using Kubios package (kubios.uku.fi). Blood pressure was measured following the water and beer exposure procedures (see section 2.6.3 below) using a commercial device.

2.3 Participants

Sixty-eight beer preferring participants were recruited from the general population through online advertisements (participants had to be beer drinkers in order to ensure that a single cue-reactivity procedure - exposure to a glass of beer - would be suitable for all participants). Criteria for participation included speaking fluent English, being aged between 18-50 years old, and having increased risk of alcohol dependency. The Alcohol Use Disorder Identification Test (AUDIT) was employed to assess the extent of alcohol consumption, with inclusion criteria being scoring overall ≥ 8, indicative of hazardous or harmful drinking (Saunders, Aasland, Babor, De la Fuente, & Grant, 1993), and consuming ≥ 14 (for females) or ≥ 21 (for males) units per week. Participants receiving treatment for mental health problems were not included, in order to avoid treatment interference.

2.4 Power analysis

Power analysis was informed by previous research about brief interventions for craving in the context of substance use. Szasz et al. (2012) explored the effects of different emotion regulation strategies (acceptance, reappraisal and suppression) on nicotine craving and affect, using a craving-induction procedure. They conducted an F-test for a mixed model ANOVA and found a significant main effect of strategy on craving with a large effect size ($\eta^2 = 0.13$). As alcohol and nicotine dependency and craving have been found to be associated and comparable (e.g. Batel, Pessione, Maitre, & Rueff, 1995; Bien & Burge, 1990), it seemed suitable to base the power calculation on their findings as their design and objectives were similar to the current study. Assuming similar group sizes, sample size was calculated (using GPower3) based on the above effect size, with alpha setting at 0.05 and power at 0.8, producing N = 72 (36 in each group).

2.5 Measures

Demographic information included gender, age, occupation, ethnicity and education.

2.5.*1* *Drinking behaviour and motives*

AUDIT is a well-established, 10 item self-report Likert-style scale measure of the World Health Organisation (Babor, De La Fuente, Saunders, & Grant, 1992), assessing the level of alcohol consumption and hazardous drinking behaviour (e.g. failing to remember the previous day, and function the following day). It was administered at the screening phase to determine eligibility.

Timeline Follow-back (TLFB) is a validated self-report drinking assessment method that obtains retrospective estimates of daily drinking (Sobell & Sobell, 1992). It is a calendar-like scale, measuring the number of days participants consumed alcohol over a specified period of time (seven days in this study), and the number of units drunk per occasion. It was used at baseline and follow-up to measure changes in alcohol consumption.

The Drinking Motives Questionnaire-Revised (DMQR) was used to assess subjects' motivation for drinking at baseline. It is a 20-item self-report measure, requesting subjects to indicate their reasons for drinking on a 5-point Likert scale, yielding four dimensions of drinking motivations: social reasons, coping strategy, enhancement of pleasurable feeling, and conformity with social pressure (Cooper, 1994). This multidimensional instrument is used widely to assess drinking motivation, and it has shown good to excellent test and re-test reliability (Grant, Stewart, O'Connor, Blackwell, & Conrod, 2007; Kuntsche, Knibbe, Gmel, & Engels, 2006).

2.5.2 *Craving*

The Alcohol Craving Questionnaire Short Form–Revised (ACQ-SF-R) is a 12-item Likert-style self-report measure of acute craving (e.g. "I could not stop myself from drinking if I had some alcohol here"). The ACQ-SF-R has moderate to strong reliability and validity (Drobes & Thomas, 1999; Raabe, Grüsser, Wessa, Podschus, & Flor, 2005). It was administered at four time points to assess the effects of the cue-reactivity procedure: after exposure to the neutral and alcohol cues, before the strategy was used (T1 neutral, T1 alcohol), and after exposure to the neutral and alcohol cues, after the strategy was used (T2 neutral, T2 alcohol). The aim was to examine whether acute cue-induced craving was altered as a result of mindfulness/relaxation strategy.

To assess longer-term effects of the strategies, the ACQ-SF-R was also used to measure craving in the absence of cues (tonic or background craving) at baseline and at follow-up.

2.5.3 *Affect and mood*

The Hospital Anxiety and Depression Scale (HADS) is an established 14-item self-report measure that identifies abnormal levels of anxiety and depression, with 7 items related to each construct (e.g. "I still enjoy the things I used to enjoy"; "I feel restless as I have to be on the move"; Zigmond & Snaith, 1983). The HADS was used as a trait measure at baseline.

State-Trait Anxiety Inventory (STAI) is a self-report measure that tests both state and trait anxiety levels (e.g. "I am a steady person"; "I feel nervous and restless"). It is a 20-item measure with responses made on a 4-point Likert scale, and it has strong reliability and validity levels (Speilberger & Vagg, 1984). The STAI was administered at baseline.

The Affect Grid is a two dimensional self-report scale designed as a quick means of assessing affective states on dimensions of pleasure-displeasure and arousal-sleepiness. This scale has an adequate level of reliability and validity in measuring a subjective state (Russell, Weiss, & Mendelsohn, 1989). The instructions were shortened for the purpose of this study (see Appendix 3). The time-points at which the Affect Grid was administered were the same as the ACQ-SF-R.

2.5.4 *Measures of mindfulness and relaxation*

Five Facets Mindfulness Questionnaire (FFMQ) is a well-established self-report trait measure of mindfulness with strong construct validity (Baer et al., 2008). It is a 39-item, 5-point Likert scale questionnaire, examining five mindfulness component skills: observing, describing, acting with awareness, non-judging of, and non-reactivity to, internal experiences (e.g. "I perceive my feelings and emotions without having to react to them"). The FFMQ was administered at baseline.

The Toronto Mindfulness Scale (TMS) is a reliable and valid 5-point Likert scale, self-report measure, assessing mindfulness as a state-like phenomenon (Lau et al., 2006). It was administered upon the completion of the strategy to compare the mindfulness level of participants from both groups. Participants were instructed to read each of the 13 items (e.g. "I was curious about each of the thoughts and feelings that I was having") while referring to their experience of listening to the strategy recording. Similarly, state relaxation was assessed upon the completion of the strategies. Using a single-item, participants were requested to rate their level of tension on a 9-point Likert scale (Vinci et al., 2014).

2.5.5 *Physiological/objective measures of arousal*

HR and blood pressure were examined during the cue-exposure procedures, in order to measure physiological reactions to cue-induced craving.

2.5.6 *Credibility and manipulation checks*

A credibility/expectancy questionnaire was administered to indicate whether there were any differences between the strategies on credibility (beliefs regarding the authenticity and logic of treatment, on a cognitive level) and expectancy (beliefs on whether improvement will be achieved, on an emotive level). The questionnaire was adapted from Devilly and Borkovec (2000). Using a 9-point Likert scale, participants answered questions such as "how successful do you think this will be in helping you to manage your cravings?"

A manipulation test was administered following the mindfulness/relaxation training, to determine the degree to which participants comprehended and used the instructions. The measure was adapted from Rood, Roelofs, Bögels and Arntz (2012), and Murphy and MacKillop (2014), and included six true/false questions such as "I was instructed to allow my craving to stay as it is *without* trying to change it" and "I was instructed to breathe calmly in order to reduce my craving".

An assessment of practice took place at follow-up, asking about the extent to which participants exercised and were engaged in the strategy during the follow-up period (e.g. "how many days have you practised the technique during this week?"). The credibility/expectancy questionnaire, manipulation test and assessment of practice are presented in the appendices.

2.6 Procedure

2.6.1 *Recruitment*

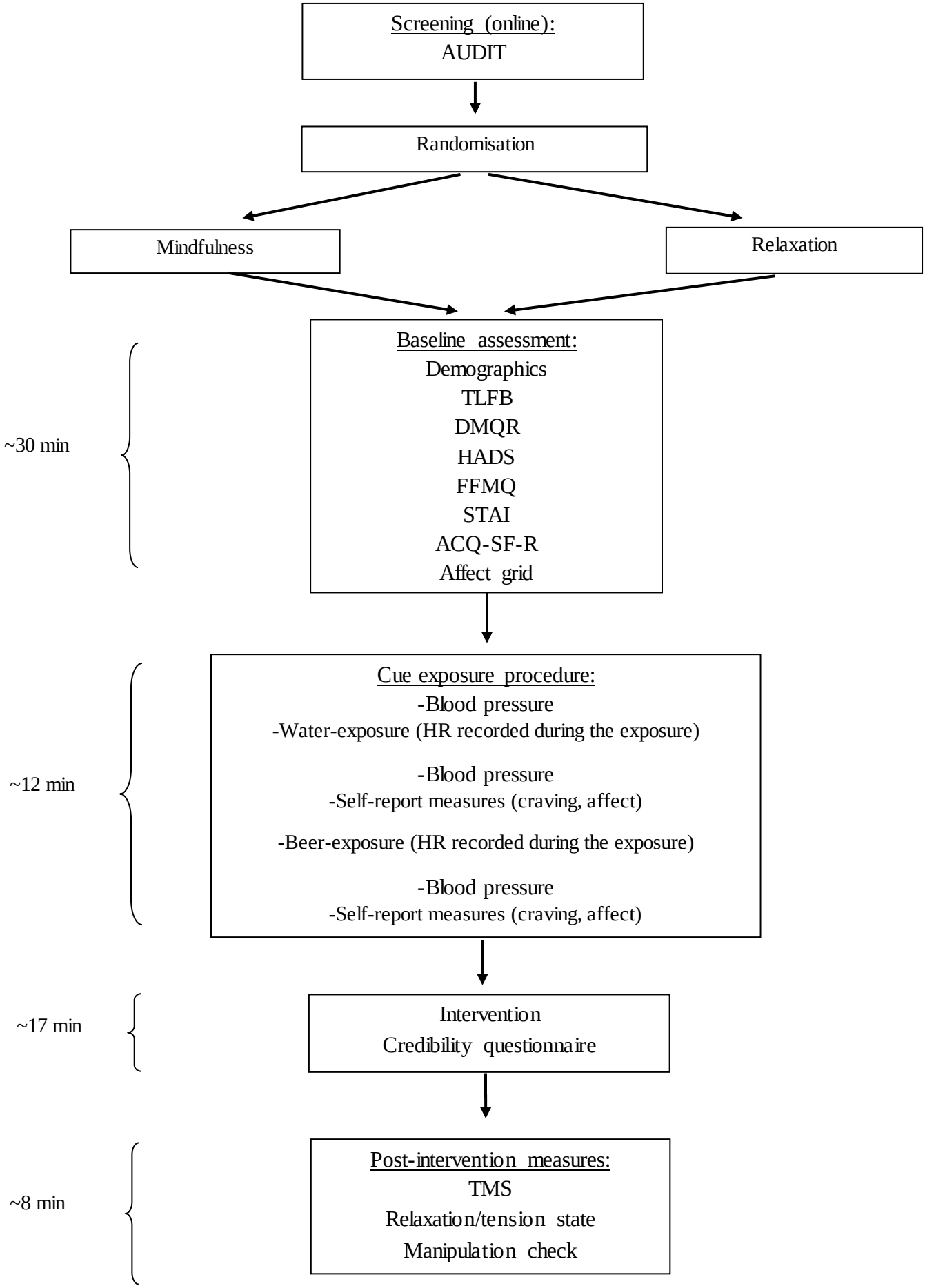
The research project was approved by the UCL Research Ethics Committee (Project ID 0760/002; Appendix 7). The study was advertised online through Gumtree, Experimatch, Call for Participants, Facebook and Sona system. The study was described as aiming to examine a psychological strategy for managing craving for alcohol. Participants were not aware of the inclusion of a comparison condition. Interested individuals were required to complete an online eligibility questionnaire. People who were not eligible were informed via email, and suitable individuals were emailed with more details about the study and their time allocation. Participants were asked not to consume alcohol on the day of the experiment, prior to arriving to the laboratory. The entire procedure is depicted in Figure 1.

2.6.2 *Baseline phase*

Testing each participant took approximately one and a half hours. Allocation to experimental groups was randomised (Random.org) and balanced by gender. To maintain blinding of the experimenters, the research supervisor retained two colour coded memory sticks (one containing the standardised instructions for mindfulness, and the other for relaxation). Upon arrival, participants underwent a breathalyser test to ensure breath alcohol levels of 0.00. They then provided written, informed consent (copies of the information sheet and consent form are presented in Appendix 8 and 9, respectively) and attached the ECG electrodes according to standard instructions. At that point they were administered with a battery of baseline measures.

2.6.3 *Craving induction (cue-reactivity) procedure*

Cue-reactivity involved exposing participants to an alcohol (beer) cue while listening to a set of guided cue-reactivity instructions designed to utilise perceptual cues (e.g. “smell the drink”, “feel the temperature of the glass in your hand”; see


Screening (online):
AUDIT
Randomisation
Mindfulness
Relaxation
Baseline assessment:
Demographics
TLFB
DMQR
HADS
FFMQ
STAI
ACQ-SF-R
Affect grid
~30 min
Cue exposure procedure:
-Blood pressure
-Water-exposure (HR recorded during the exposure)
-Blood pressure
-Self-report measures (craving, affect)
-Beer-exposure (HR recorded during the exposure)
-Blood pressure
-Self-report measures (craving, affect)
~12 min
Intervention
Credibility questionnaire
~17 min
Post-intervention measures:
TMS
Relaxation/tension state
Manipulation check
~8 min

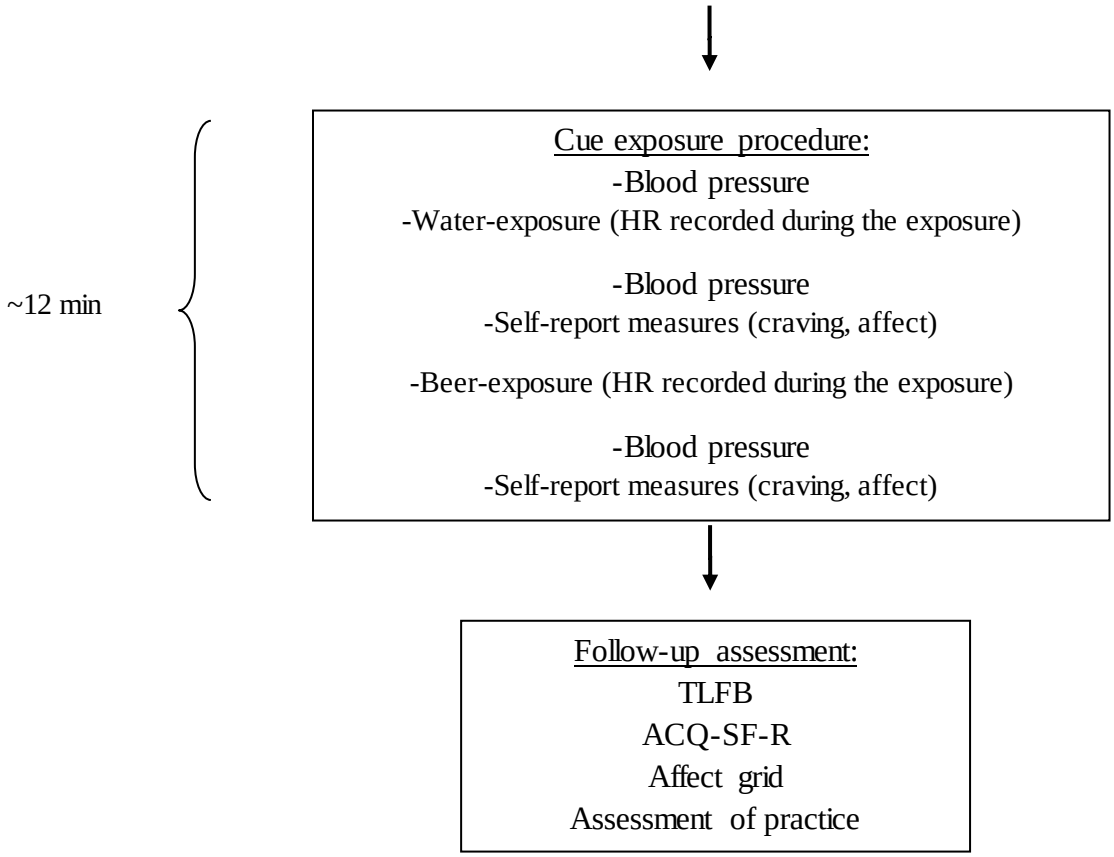


Figure 1. *Diagrammatic illustration of the procedure*

Appendix 10). The start and end of this procedure were marked for later analysis of HR data. Once the recording ended, blood pressure was taken and then participants completed the self-report state measures of craving and NA.

As an internal control, participants were exposed to a neutral drink (water) before the beer, using the exact same procedure. Counterbalancing the order of drink type can give rise to spurious results, as craving following alcohol-exposure tends to remain high and contaminate assessment of the neutral/control cue (Sayette, Martin, Hull, Wertz, & Perrott, 2003). Blood pressure was also measured prior to the water-exposure, in order to saturate any excitation as a response to seeing and using the blood pressure device.

The entire cue-reactivity procedure was repeated at the post-strategy phase.

2.6.4 *Strategy instructions*

Both strategies were delivered via an audio recording, using the same actor's voice. The instructions were matched to be as equal as possible in terms of number of words (mindfulness- 1581 words; relaxation- 1595 words) and duration (15 minutes), number of words related to craving and alcohol, sequence of components (i.e. the order and structure of the instruction components), and readability scores (Flesch-Kincaid grade level being 8.3 for both strategies; Kincaid, Fishburne, Rogers, & Chissom, 1975). These critical matching procedures (Barnes-Holmes & Hayes, 2003) address significant limitations of some previous component studies discussed in the literature review. The words 'mindfulness' and 'relaxation' were not mentioned in either instruction set, to avoid any bias or preconception about any of the strategies. Each strategy was reviewed by 10 clinical psychology trainees who rated how well they addressed mindfulness/relaxation and craving from one to ten. Ratings were high, with an average of 9.6 for mindfulness and 8.9 for relaxation.

Each instruction set was divided into three sections. The first part involved a short theoretical explanation about craving, using lay terms and linking it to practical, day-to-day examples, and a description of the strategy and its therapeutic rationale in the context of craving experiences. Immediately after part one, participants completed the credibility/expectancy questionnaire. The second part was a strategy practice, involving experiential elements where craving was mentally induced (via imagination of the participants' favourite alcoholic drink) and participants were instructed to apply the strategy's techniques to their current craving experiences. The final part was the main task, which was similar to the second part but was longer, more extensive and included relaxed/mindful breathing. Below is a brief explanation of the instructions (find the full scripts in Appendix 11).

Mindfulness instructions

The instructions were based on notions of mindfulness, acceptance and Marlatt's urge surfing (e.g. Bowen & Marlatt, 2009), and were influenced by mindfulness scripts/recordings by Kabat-Zinn (e.g. Segal & Kabat-Zinn, 2007). The core message was that by noticing the internal experiences that craving involves (e.g. sensations, feelings, thoughts) with a curious, non-judgemental and accepting stance, people can learn that they are transient and tolerable, and are not required to be acted upon. Participants were instructed to notice their breathing and physical sensations, and once craving was induced they were guided to mindfully observe their bodily feelings, describe them to themselves, and try not to change them but rather examine how they wax and wane with curiosity.

Relaxation instructions

The core message was that relaxation of the mind and release of tension in the body can reduce stress and craving. While the focus in the mindfulness condition was on managing craving experiences without attempting to change them, the emphasis here was on reducing the craving and its accompanied unpleasant feelings. The instructions were designed to be as similar as possible to the mindfulness instructions in a variety of dimensions (see above), though with a focus on 'calming' rather than noticing and accepting. For instance, rather than "noticing unpleasant bodily sensations and thoughts", participants were instructed to "loosen up any stiffness in their muscles and ease difficult thoughts". Breathing exercises were also matched but instead of encouraging awareness of breathing sensations, the emphasis was on calmness and tranquility of the breath, body and mind.

2.6.5 *Post-strategy assessments*

Following the strategy, mindfulness and relaxation state questionnaires were administered, together with the manipulation checks. Then the craving-induction procedure was repeated in order to examine any changes in physiological and subjective cue-reactivity after the implementation of the strategy.

At the end of the experimental procedure participants were asked to practice the relevant techniques for approximately 15 minutes every day for one week. They were given a cue card (see Appendix 12) with instructions relevant to their condition. The envelopes were sealed, with only the participant identification number and condition code on the front. Two and four days after the experiment participants were reminded to practice the strategy and use the cue card, via email.

2.6.6 *Follow-up assessment*

A week after participation, participants were emailed with a link to the final questionnaires and received payment consistent with UCL guidelines about appropriate compensation for research participants. Paying participants at the end of the follow-up assessment successfully resulted in no attrition.

2.6.7 *Additional procedures*

Two additional procedures (breath holding task and taste test) were employed and examined by the co-researcher; these will not be discussed in this paper.

2.7 Statistical analysis

Data were examined for skewness and outliers both statistically (using Kolmogorov-Smirnov tests) and with graphical methods. These showed no violations of the assumptions of parametric statistical analysis. Outliers were defined as scores greater than the upper quartile plus 1.5 times the interquartile range (Field, 2013) and

were replaced by the highest non-outlying value +1 unit of measurement, except for Affect Grid values, which were replaced with the highest non-outlying value due to the narrow range of scores and the fact that adding a unit to the highest non-outlying value simply replaced outliers with outliers.

The groups were compared on demographic characteristics, trait measures, baseline drinking behaviour and baseline measures on dependent variables, using independent sample t-tests. Primary outcome variables were analysed using mixed ANOVAs with time and drink as within-subjects factors, and group (strategy) as a between-subjects factor. The α level was 0.05 except for adjustments for multiple between-group comparisons (adjusted α=0.01), aiming to minimise type 1 errors. Since only a small proportion (1%) of data were missing (e.g. due to technical failure), this was deleted list-wise, as reflected in degrees of freedom that deviate from the expected values.

Results

3.1 Participant characteristics and group equivalence at baseline

Demographic information and key baseline alcohol-related and mood characteristics are presented separately for each group in table 1. As randomisation was conducted with gender as a factor, there was an equal number (17) of males and females in each condition. As can be seen in table 1, the groups were comparable in all aspects. There were no baseline differences between the groups in mindfulness trait (FFMQ: t [066] = .909, p = .367), alcohol craving state (ACQ-SF-R: t [66] = -1.506, p = .137) and affect state (Affect Grid Pleasure: t [58] = .450, p = .655; Affect Grid Arousal: t [58] = -.347, p = .729). The DMQR was used to obtain the characteristics of the sample overall, and check that it is an at-risk sample. DMQR subscale values

did not differ between the groups (F [3,198] = 0.356, p > 0.1) and their rank order (social [3.84 ± 0.77] ≈ enhancement [3.50 ± 0.82] > coping [2.61 ± 1.01] > conformity [1.73 ± 0.81]) was consistent with the intention to recruit an at-risk sample of drinkers.

Table 1. *Participant characteristics and key baseline information (except for ethnicity and occupation, all values are Mean + SD)*

Variable	Mindfulness (n=34)	Relaxation (n=34)	Statistic	p value
Demographics				
Age in years	24.59 (6.77)	23.09 (4.98)	t (66) = 1.041	0.302
	Range:18-47	Range: 19-42		
Years in education	15.53 (1.69)	15.47 (1.48)	t (66) = 0.152	0.879
	Range: 11-18+	Range: 13-18+		
Ethnicity: N (%)			X^2 [1, *N*= 68]= 2.138	0.144
White	29 (85.30%)	24 (70.60%)		
Other	5 (14.70%)	10 (29.40%)		
Occupation: N (%)			X^2 [1, *N*= 68]= 1.439	0.230
Student	25 (73.50%)	29 (85.30%)		
Employed	9 (26.50%)	5 (14.70%)		
Mood				
HADS (Depression)	3.91 (2.77)	3.65 (3.56)	t (66) = -0.342	0.733
HADS (Anxiety)	8.09 (3.86)	7.41 (4.55)	t (66) = -0.661	0.511
STAI	45.65 (12.68)	41.38 (11.98)	t (66) = -1.426	0.159
Alcohol				
AUDIT	17.21 (4.61)	16.41 (5.00)	t (66) = -0.681	0.498
TLBF*	23.94 (11.71)	27.66 (16.95)	t (66) = 1.053	0.296

* Number of alcohol 'units' (1 unit=8g pure alcohol) consumed over the previous 7 days

All *t*-tests were two-tailed

3.2 Effects of strategy on dependent variables

3.2.1 *Credibility and expectancy*

The groups did not differ in the extent to which participants perceived the strategy to be credible (Credibility: t[66] = .587, p = .560) and expected it to help reduce their alcohol craving (Expectancy: t[66] = .145, p = .885).

3.2.2 *Manipulation checks*

Testing the degree to which participants understood the strategy revealed no between-group differences (t[65] = .592, p = .556). In addition to examining comprehension of the strategy, acute mindfulness and relaxation were measured immediately after the strategy, as a way of examining its effectiveness in increasing mindfulness/relaxation states. Table 2 presents the means and standard deviations of the post-strategy mindfulness and tension states. No group differences were found in acute mindfulness (t[65] = 1.363, p = .178) and relaxation (t[65] = 1.351, p = .181) following the strategies.

Table 2. *Post-strategy mindfulness and relaxation states*

Variable	Mindfulness (n-=34) Mean (SD)	Relaxation (n=34) Mean (SD)
Mindfulness:		
'Decentering'	16.82 (4.33)	15.24 (4.27)
'Curiosity'	15.76 (4.32)	15.24 (4.65)
Overall score	32.59 (6.41)	30.48 (6.22)
Tension:	3.65 (2.60)	3 (1.73)

3.2.3 *Strategy practice at follow-up*

There were no between-group differences in the overall practice of the strategy during the follow-up period (t[65] = -.522, p = .603).

3.2.4 *Effects of strategy on cue-reactivity*

In order to assess whether the strategy affected acute reactions to craving-induction, 2 (group) x 2 (time; T1, T2) x 2 (drink; water, beer) mixed ANOVAs were conducted.

Self-report: craving

There were significant main effects of Time (F [1, 62] = 38.272, $p < .001$, η_p^2 = .382) and Drink (F [1, 62] = 21.940, $p < .001$, η_p^2 = .261) on ACQ-SF-R scores. Inspection of figures 2 and 3 indicates that across the groups craving was experienced more strongly at the beer-exposure compared to the water-exposure, and craving was overall lower after the strategy implementation. This pattern was also illustrated by the significant Time x Drink interaction (F [1, 62] = 17.214, $p < .001$, η_p^2 = .217). However, there was no 3-way interaction of Group x Time x Drink (F [1, 62] = .241, p = .625, η_p^2 = .004), suggesting that mindfulness and relaxation did not differ in their effect on cue-induced craving.

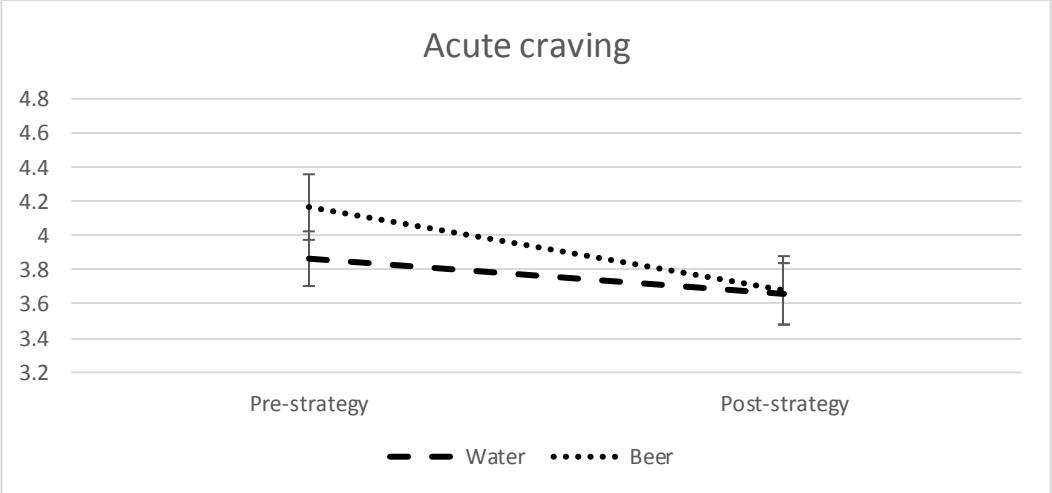


Figure 2. *Mindfulness: cue-induced craving*

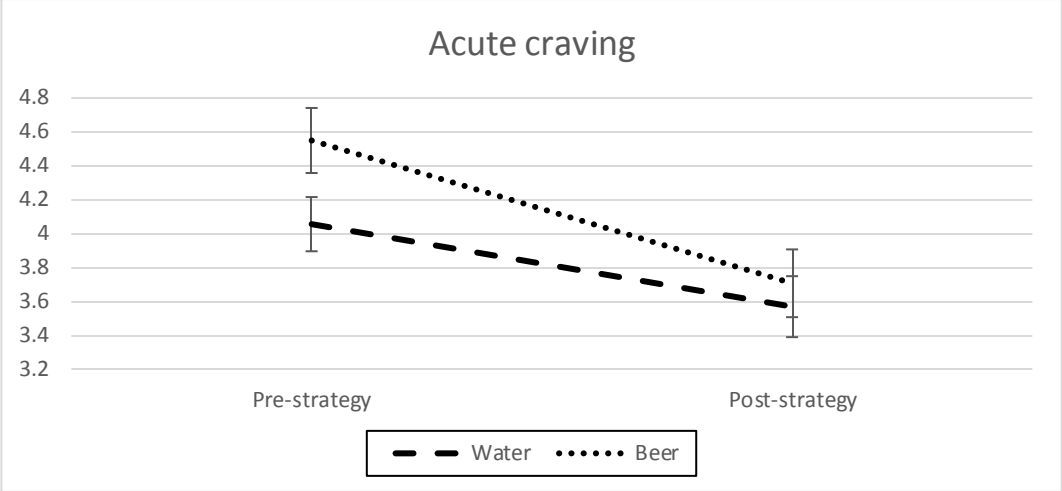


Figure 3. *Relaxation: cue-induced craving*

Self-report: affect (pleasure)

The analysis revealed no main effects of Time (F [1, 57] = .338, p = .563, η_p^2 = .006), Drink (F [1, 57] = 1.293, p = .260, η_p^2 = .022) and Group (F [1, 57] = 1.926, p = .171, η_p^2 = .033), and no 2-way interactions on ratings of pleasure. However, there was a significant 3-way interaction of Group x Time x Drink (F [1, 57] = 4.768, p = .033, η_p^2 = .077). Decomposing the 3-way interaction into two 2 (Time) x 2 (Drink) repeated measures ANOVAs revealed no significant main effects and no interaction effects, for either the mindfulness or relaxation groups. Examination of figures 4 and 5 shows that in the relaxation group, pleasure was slightly lower at beer-exposure, post-strategy compared to pre-strategy, and this was less the case with water-exposure in the relaxation group, and water- and beer-exposures in the mindfulness group.

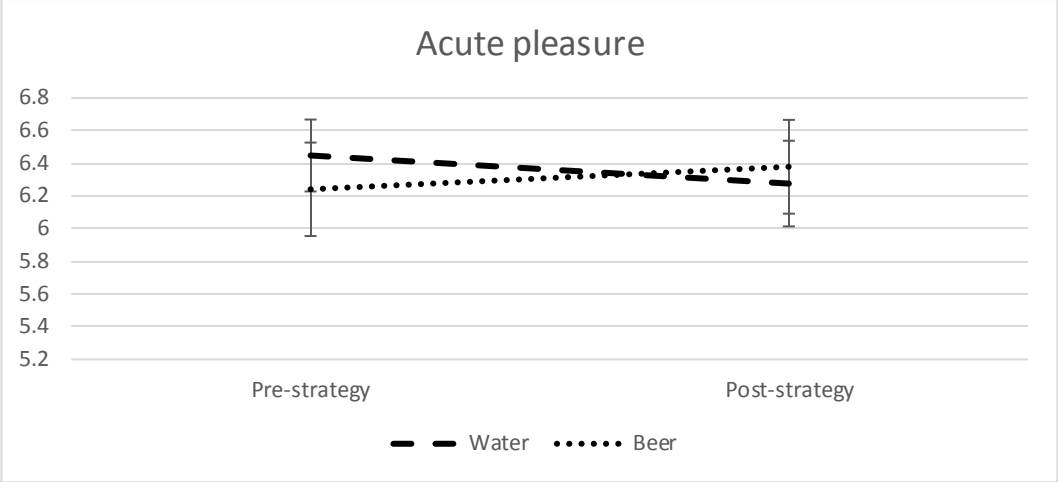


Figure 4. *Mindfulness: cue-induced pleasure*

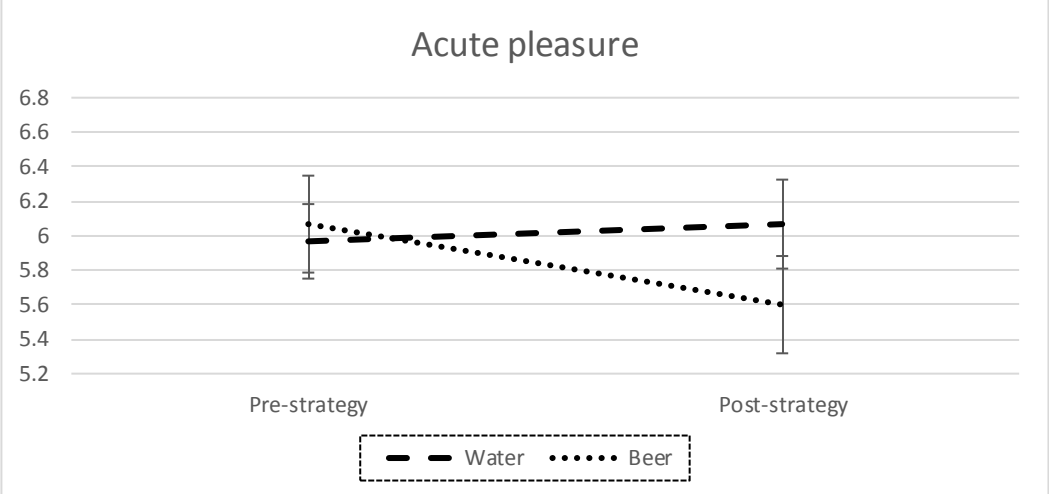


Figure 5. *Relaxation: cue-induced pleasure*

Self-report: affect (arousal)

There were significant main effects of Time (F [1, 57] = 7.513, p = .008, η_p^2 = .116) and Drink (F [1, 57] = 13.284, p < .001, η_p^2 = .189) on cue-induced arousal. Inspection of figures 6 and 7 indicates that across the groups, arousal was greater at beer-exposure compared to water-exposure. Additionally, cue-induced arousal was overall lower after the implementation of the strategies. However, there was no Group x Time x Drink interaction effect (F [1, 57] = .056, p = .814, η_p^2 = .001), suggesting

that mindfulness and relaxation did not differ in their effect on cue-induced arousal levels.

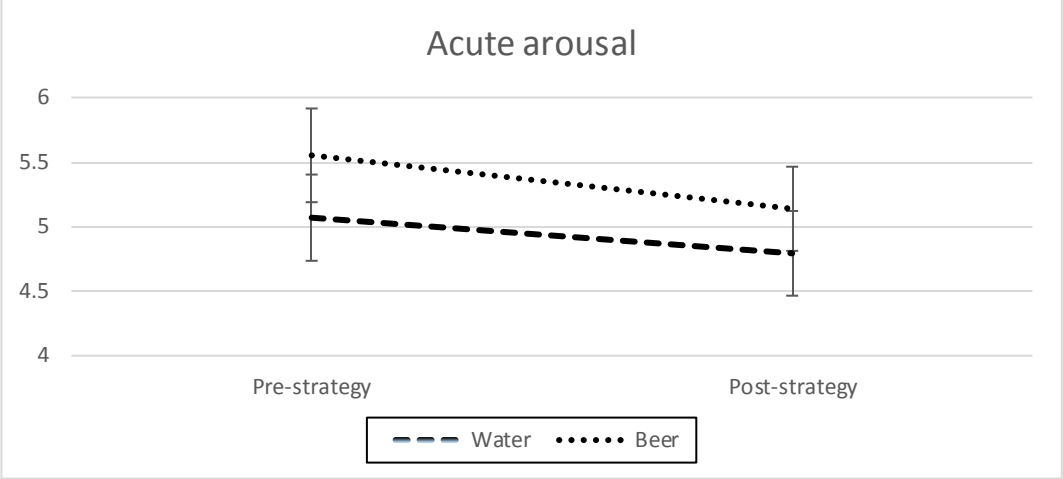


Figure 6. *Mindfulness: cue-induced arousal*

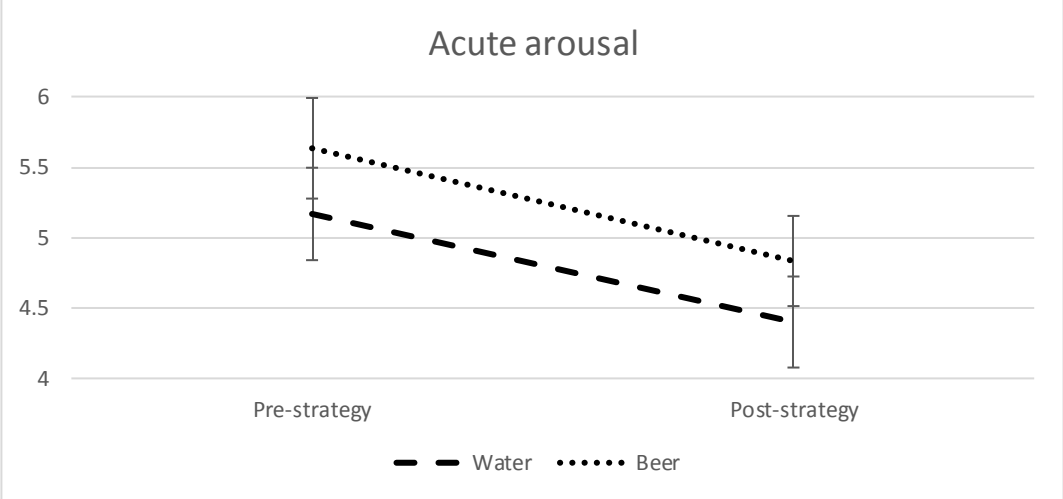


Figure 7. *Relaxation: cue-induced arousal*

Physiological: systolic blood pressure, diastolic blood pressure and HR

There were no main effects of Group (F [1, 66] = 1.160, p = .285, η_p^2 = .017), Time (F [1, 66] = 2.590, p = .112, η_p^2 = .038) or Drink (F [1, 66] = .294, p = .590, η_p^2 = .004) and no 3-way interaction effect (Group x Time x Drink: F [1, 66] = .522, p = .472, η_p^2 = .008) on systolic blood pressure. Similar results were found for diastolic

blood pressure (Group: F [1, 66] = .294, p = .590, η_p^2 = .004; Time: F [1, 66] = 2.832, p = .097, η_p^2 = .041; Drink: F [1, 66] = .070, p = .792, η_p^2 = .001; Group x Time x Drink: F [1, 66] = 2.651, p = .108, η_p^2 = .039).

The analysis revealed no main effects of Time (F [1, 55] = .487, p = .488, η_p^2 = .009) and Drink (F [1, 55] = .485, p = .489, η_p^2 = .009) on HR. There was a main effect of Group (F [1, 55] = 4.307, p = .043, η_p^2 = .073) with HR being overall higher in the relaxation group, across both time-points and for both types of drink. However, there was no 3-way interaction (Group x Time x Drink: F [1, 55] = 1.236, p = .271, η_p^2 = .022).

The findings above suggest that the kind of drink (water versus beer) was not associated with a different physiological reaction. It is thus not surprising that the strategies (mindfulness versus relaxation) also did not affect physiological cue-reactivity.

3.2.5 *Effects of strategy on craving, affect and alcohol-use at follow-up*

In order to assess the effects of the strategy on craving, affect and amount of drinking at follow-up, 2 (group) x 2 (time; baseline, follow-up) mixed ANOVAs were conducted. The means and standard deviations of craving and affect at baseline and follow-up are presented in table 3.

Tonic craving

There was a significant main effect of Time on craving level (F [1, 66] = 54.564, p < .001, η_p^2 = .453), with reduced levels at follow-up. There was, however, no interaction between Time and Group (F [1, 66] = .004, p = .953, η_p^2 < .001).

Table 3. *Baseline versus follow-up: craving and affect*

Variable	Mindfulness (n-=34) Mean (SD)		Relaxation (n=34) Mean (SD)	
	Baseline	Follow-up	Baseline	Follow-up
Craving	3.70 (1.00)	2.91 (0.92)	4.03 (0.81)	3.23 (0.90)
Affect: Pleasure	6.48 (0.91)	6.21 (1.47)	6.35 (1.25)	6.10 (0.87)
Affect: Arousal	4.55 (1.72)	5.00 (1.79)	4.71 (1.79)	5.19 (1.60)

Affect (pleasure)

There were no main effects of Time (F [1, 58] = 2.258, p = .138, η_p^2 = .037) and Group (F [1, 58] = .249, p = .620, η_p^2 = .004), and no interaction effect (F [1, 58] = .003, p = .960, η_p^2 < .001) on background pleasure ratings.

Affect (arousal)

Similarly to Pleasure, there were no main effects of Time (F [1, 58] = 2.476, p = .121, η_p^2 = .041) and Group (F [1, 58] = .277, p = .601, η_p^2 = .005) on arousal levels, and no interaction effect (F [1, 58] = .004, p = .952, η_p^2 < .001), suggesting that the strategies did not alter the level of affect at follow-up in comparison to baseline.

Alcohol use

In line with the a priori prediction, there was a significant main effect of Time on the amount of alcohol consumption (F [1, 66] = 19.699, p < .001, η_p^2 = .230), indicating a reduction in drinking over time. In addition, there was a significant Time x Group interaction (F [1, 66] = 5.175, p = .026, η_p^2 = .073) showing that reduction in drinking differed between the groups. Figure 8 indicates that in line with the expectation, the reduction in alcohol consumption was significantly greater in the

mindfulness group compared to the relaxation group. Post hoc t-tests further revealed that there was no reduction in drinking in the relaxation group (t [33] = 1.596, p = .120), but there was a significant reduction in the mindfulness group (t [33] = 4.565, p < .001).

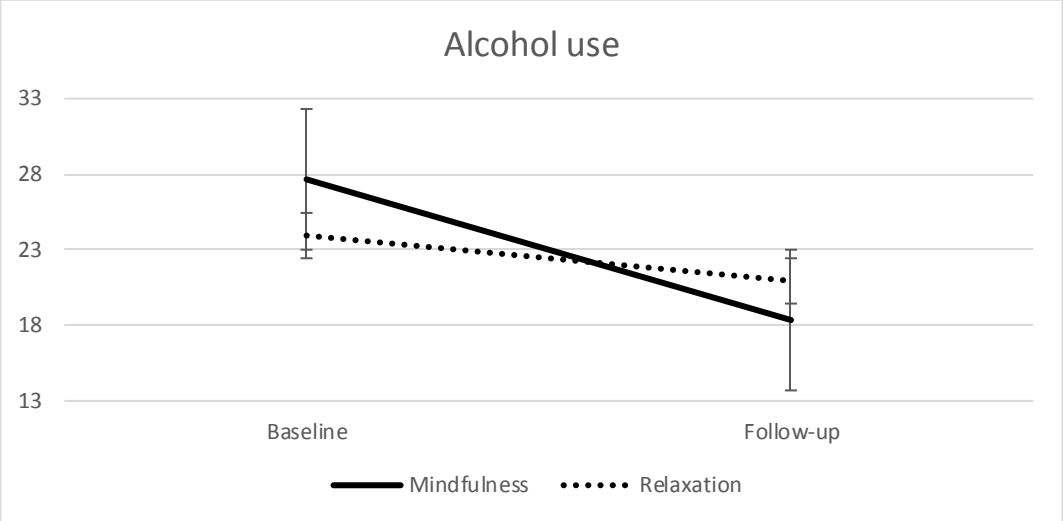


Figure 8. *Alcohol use*

3.3 Predictors of change in alcohol use

In order to examine the potential mechanisms of change in drinking behaviour, the relationship between acute processes during craving-induction and alcohol consumption at follow-up was explored. Correlational analyses were conducted to examine the association between change scores in cue-reactivity variables and change scores in TLFB (which assesses the amount of alcohol consumption by units per week) from baseline to follow-up.

No associations were seen between changes in cue-induced craving and changes in alcohol consumption (Mindfulness: r = .111, N = 33, p = .539; Relaxation: r = -.100, N = 33, p = .579). Similarly, no associations were found between changes in cue-induced pleasure (Mindfulness: r = -.048, N = 30, p = .803; Relaxation: r = .169,

N = 31, *p* = .362) and arousal (Mindfulness: *r* = -.072, *N* = 30, *p* = .705; Relaxation: *r* = -.020, *N* = 31, *p* = .913), and changes in alcohol consumption.

Similar findings were found for diastolic blood pressure (Mindfulness: *r* = -.044, *N* = 34, *p* = .803; Relaxation: *r* = .113, *N* = 34, *p* =.523) and HR (Mindfulness: *r* = .039, *N* = 31, *p* = .834; Relaxation: *r* = .046, *N* = 26, *p* =.824). However, the analysis revealed a significant negative association between changes in systolic blood pressure and changes in alcohol consumption in the mindfulness group (*r* = -.460, *N* = 34, *p* = .006), such that an increase in systolic blood pressure is associated with reduction in drinking. Such association was non-significant in the relaxation group, but there was a trend in the same direction (Relaxation: *r* = -.311, *N* = 34, *p* = .073). It is worth noting that the '*r*' values for systolic blood pressure and alcohol consumption correlations, for the mindfulness and relaxation groups, are not significantly different from one another (*p* = 0.332), suggesting that change in systolic blood pressure may be a common mechanism.

Discussion

The aim of the current study was to examine the effects of brief mindfulness and relaxation training on cue-induced craving, affect and alcohol consumption. Although previous studies have examined the effects of mindfulness on addictive behaviours, and alcohol-use outcomes in particular (e.g. Murphy & MacKillop, 2014; Ostafin, Bauer, & Myxter, 2012; Vinci et al., 2014), all of these studies have methodological limitations which limit the strength of the conclusions that can be drawn from them. In the current study, recommendations on research design for component studies (Barnes-Holmes & Hayes, 2003; Levin et al., 2012) were implemented in order to minimise bias and increase internal validity. The primary

findings were that both strategies were associated with an acute reduction in subjective, but not physiological, cue-induced craving, a reduction in tonic craving at follow-up, and a reduction in cue-induced arousal, but not pleasure. Only the mindfulness group, however, also showed a significant reduction in drinking from baseline to follow-up. Finally, cue-induced increase in systolic blood pressure was associated with a reduction in drinking in the mindfulness group.

4.1 Consideration of the findings

4.1.1 *Baseline characteristics and methodological control*

The randomisation of the conditions appeared successful as there were no baseline differences between the groups. Several measures were utilised to ensure the reliability and validity of the findings. Credibility and expectancy checks confirmed that the groups did not differ in the extent to which participants perceived the strategy to be logical and helpful. This is in contrast with other similar studies (Murphy & MacKillop, 2014) where such differences were present, suggesting that their outcomes may have been related to these differences as well as differences in the 'active' components of the interventions in question. The manipulation test also revealed no between-group differences in terms of the comprehension of the strategy, further increasing the validity of the findings. Finally, assessment of practice at follow-up demonstrated no group differences, suggesting that any effects on drinking behaviour at follow-up were unlikely to be explained by the extent of practice. The arguments above propose that, overall, the findings were likely to result from constructs specific to mindfulness and relaxation, as opposed to non-specific therapy elements (e.g. expectancy, strategy practice; Kazdin, 1979).

4.1.2 *Acute effects: cue-reactivity*

Similar findings were seen for both self-report cue-induced craving and arousal. It is important to note that significant differences were found between water-exposure and beer-exposure, with both craving and arousal being higher at beer-exposure. This indicates a good internal control and expected differential cue-reactivity to alcohol (Monti et al., 1993). There was a significant reduction in craving and arousal following the implementation of the strategies, suggesting that participants were able to use mindfulness and relaxation to help them acutely manage these internal experiences. While effects of relaxation on arousal (and secondary arousal-mediated effects on craving) might be expected in the relaxation group, it is less clear that such effects would occur following deployment of mindfulness, given that the emphasis is not on eliminating or reducing the intensity or frequency of internal experiences such a craving (Hayes, Strosahl, & Wilson, 2011; Litvin, Kovacs, Hayes, & Brandon, 2012; Vernig & Orsillo, 2009). Indeed, Vinci et al. (2014), who used these strategies, showed no significant effects on urge to drink. However, they did not incorporate craving-induction; any changes in craving ratings in the absence of craving-induction may not be robust (Carter & Tiffany, 1999). While the aim of mindfulness-related strategies is not necessarily to reduce the frequency and intensity of internal events, experiencing them within the context of acceptance can change their subjective meaning and make them less unpleasant (Bishop et al., 2004). Thus, the decrease in cue-induced craving and arousal in the mindfulness group, observed in this study, might be attributed to greater acceptance and willingness to experience them.

One potential explanation for the similarities between the effects of the strategies in the current study could be that, acutely, the relaxation strategy promoted awareness of bodily sensations, similarly to the mindfulness strategy. The relaxation instructions included sentences such as “wherever you experience craving in your

body, just loosen that region… see if there is another part of your body where you're experiencing any difficult feelings and simply tell yourself to calm that part of your body". Such guidance could have increased awareness of bodily sensations and illustrated to participants in the relaxation group that such feelings are temporary and tolerable, accidentally tapping into processes specific to mindfulness. However, it is difficult to note similar promotion of non-judgemental acceptance in the relaxation instructions used here.

Unlike craving and arousal, there was no significant change in pleasure in response to the cue-exposure. This is consistent with Murphy and MacKillop (2014) who found no changes in cue-induced positive and negative affect. Although participants reported differences in their level of arousal, this seemed to be largely independent of pleasure/displeasure ratings. This suggests that participants recognised that their level of arousal had increased, without a proportional decrease in pleasure. Accordingly, these findings provide support for arousal as a novel and advantageous index of motivation for drinking. Perhaps experiential ratings of positive/negative mood (i.e. pleasure) do not capture craving-related affect as well as self-report arousal, as indicated by the Affect Grid.

As experiential pleasure was not affected by the cue-exposure, it is not surprising that the strategies also had no effects on pleasure. There was no adverse mood reaction to beer-interaction, so there was nothing for the participants to manage, making the strategy "unnecessary" in this respect.

Similarly to self-report pleasure, psychophysiological factors were not affected by cue-exposure. This appears inconsistent with the experiential arousal which increased with the beer-interaction. However, physiological cue-reactivity has been

shown to have a smaller effect size than subjective cue-reactivity (Carter & Tiffany, 1999), suggesting that it is less sensitive and/or reliable, which may explain such discrepancy. Failing to find changes in physiological cue-reactivity seems consistent with some addiction studies that found no relationship between physiological reactivity and addictive behaviour (e.g. Shadel et al., 1998). In fact, Perkins (2009) has emphasised the inconsistencies in the relationship between physiological cue-reactivity and addiction-related outcomes. In addition, it is possible that among dependent drinkers, psychophysiological markers are more dominant than among people who have hazardous drinking patterns but who are not alcoholics (Rajan, Murthy, Ramakrishnan, Gangadhar, & Janakiramaiah, 1998).

4.1.3 *Craving and drinking behaviour at follow-up*

Although craving was lower seven days after the experiment compared to baseline across both groups, a significant reduction in alcohol consumption was only seen in the mindfulness group. Following on from the interpretation above, the reduction in craving in the relaxation group could have been related to mindfulness-specific constructs. The instructions in the relaxation condition directed participants to untense regions in their body that feel uncomfortable due to craving, possibly enhancing their awareness of physical sensations, and consequently, their transient nature. This unintended and indirect consequence may, at least partially, explain the between-group equivalence in mindfulness state post-strategy. Nevertheless, other constructs specific to psychological flexibility (e.g. openness, defusion), which have only been promoted in the mindfulness condition, may have further facilitated the reduction in drinking behaviour in the mindfulness group.

4.1.4 *Potential mechanisms of action*

A secondary objective of the current study was to examine the potential mechanisms by which mindfulness affected drinking behaviour. Correlational analyses were conducted to explore possible relationships between acute cue-induced processes and alcohol consumption at follow-up in the two groups. These revealed a negative relationship between systolic blood pressure and alcohol use in the mindfulness condition, such that an increase in physiological cue-induced arousal (systolic blood pressure) was associated with a decrease in drinking at follow-up. This suggests that mindfulness actually enhanced participants' physiological arousal, possibly as a result of increased attention to and awareness of bodily states during cue-reactivity (at T2). As this change in physiological reaction correlated with a decrease in alcohol consumption, it is possible that mindfulness tapped into the connection between arousal and craving, and automatic drinking behaviour, as suggested by Brewer et al.'s (2013) 'addictive loop' model. However, the correlations between the change in systolic blood pressure and change in alcohol consumption ('*r*' values) in the mindfulness and relaxation groups did not significantly differ from one another, suggesting that the observed change in systolic blood pressure may be a general mechanism, rather than specific to mindfulness.

4.2 Methodological considerations

4.2.1 *Methodological strengths*

The current study extended previous laboratory-based experimental research about brief mindfulness for alcohol abuse, and accounted for some of the limitations. Firstly, it used a comparison condition which appeared more appropriate than previous studies. While Murphy and MacKillop (2014) used a distraction strategy which was perceived to be more beneficial than mindfulness, the current study used a very well

matched relaxation strategy, which was rated as being equally credible and helpful as mindfulness, allowing differential effects to be more confidently attributed to unique processes activated by mindfulness instructions. Secondly, drinking behaviour was measured at follow-up, extending studies that only measured acute, self-report craving and/or affect without behavioural indications of change (e.g. Vernig & Orsillo, 2009; Vinci et al., 2014). Thirdly, several of Barnes-Holmes and Hayes's (2003) and Levin et al.'s (2012) recommendations for component studies of third wave behavioural approaches, which were not applied in some of the previous studies (as noted in section 3.2 of the literature review), were implemented in this study. These included blinding the assessors, rigorous matching between the strategies (e.g. text complexity and engagement with the material), and use of credibility checks. Double blinding was of particular importance as only two component studies using third wave approaches for addictions, out of the 15 discussed in the literature review, applied this important procedure.

Additional methodological strengths were related to the cue-reactivity procedure. The results indicated that arousal was greater at beer-exposure compared to water-exposure, suggesting that the craving-induction involved a good internal control. Furthermore, changes in the arousal dimension of the Affect Grid independent of the pleasure dimension, indicated that the use of Affect Grid as a measure of affective state was advantageous. Perhaps integrating pleasure/displeasure and arousal into one measure (e.g. The International Positive and Negative Affect Schedule-Short Form [IPANAS-SF]) would have yielded no significant findings or meaningful understandings about affect, as occurred in previous research (e.g. Beadman et al., 2015; Murphy & MacKillop, 2014). However, using the Affect Grid, which

differentiates arousal from pleasure/displeasure, informed that self-report arousal might reflect craving-related affect more accurately than self-report pleasure.

4.2.2 *Methodological limitations*

Although using relaxation in the comparison condition had several methodological advantages (discussed above), the potential disadvantage was that it may have involved some key mindfulness-related constructs, making the strategies difficult to disentangle. This proved more problematic due to the deliberate attempt to match the strategies well. With the aim of making the strategies as similar as possible apart from the critical difference, there were various sections where participants in both groups were guided to focus on areas of their bodies and physical sensations; in mindfulness they were instructed to notice and accept such sensations non-judgementally, whereas in relaxation they were instructed to untense such regions. While the guidance and mental activity differed, in both strategies there was an increased focus on bodily sensations and processes. When people pay attention to unpleasant sensations in their body, as opposed to avoiding them, they often notice their temporary and transient nature (Ivanovski & Malhi, 2007). Thus, some of the therapeutic effects of the relaxation strategy in this study may have been related to constructs linked to psychological flexibility (Hayes, Strosahl, Bunting, Twohig, & Wilson, 2004).

The point above highlights an additional limitation, linked to the difficulty in disentangling differential therapeutic processes. The literature review stressed the importance of conducting qualitative manipulation checks as well as quantitative, something that the current experiment has failed to incorporate. It is helpful to ask participants to articulate their understanding of the strategy as well as the techniques

they have applied during the challenge (i.e. craving-induction). Examination of such verbal summaries could highlight the constructs that have been utilised, and consequently, the active therapeutic processes. Implementing qualitative manipulation checks could have shed light on the overlap and differences between the therapeutic processes of mindfulness and relaxation in the current study.

Another disadvantage is that there was no inactive comparison condition (relaxation is an 'active' control). While it is important to use active comparison groups as opposed to only inactive control, it would have been helpful to include a 'no training' condition as well. Adding an inactive control group could have highlighted whether the reductions in craving, arousal and alcohol use in both the mindfulness and relaxation groups were a beneficial effect of the training, or simply a practice effect unrelated to the training at all.

4.3 Clinical and research implications

4.3.1 *Clinical applications*

The current study is a component experimental research that explores the isolated effects of mindfulness (versus relaxation) without the additional factors that are involved in multicomponent treatment packages (Piasecki & Baker, 2001; Shiffman, 1993). It sheds light on therapeutic processes, and should inform treatments for alcohol abuse. Brief mindfulness training seemed helpful in guiding people how to manage their craving effectively (which was maintained seven days later), and reducing their alcohol consumption. If brief training had such effects over a week, then more extensive training could have a long term impact.

Another clinical implication relates to the new understanding about cue-induced arousal being responsive to mindfulness. Clinically, emphasising affective

arousal, in addition to pleasure/displeasure, could prove advantageous. For instance, directing people's attention to the feelings of arousal involved in craving, and their ability to manage them, can facilitate and enhance therapeutic processes.

Finally, the current study used a sample of hazardous drinkers, which are an important clinical group as they currently experience risk, and are also more likely to go on to develop more severe alcohol problems. The findings suggest that mindfulness-based strategies could be helpfully incorporated into preventative programmes that target at-risk drinkers (Kaner et al., 2009).

4.3.2 *Research implications*

With regards to research implications, several limitations and insights from this experiment should be taken into account by future studies. Firstly, it would be helpful if component studies investigate the similarities and differences between relaxation and mindfulness strategies. While there might be some overlap, laboratory-based experimental research can try and identify the specific and shared effects of such interventions on addiction-related outcomes. One way of doing so could be to incorporate qualitative manipulation checks to examine mechanisms of change. Furthermore, incorporating a third, inactive condition could further highlight specific and non-specific therapeutic effects.

Additionally, the current study provided a novel assessment of craving-related affect which proved informative. Most of the component studies that examined the effects of brief mindfulness/acceptance on addiction-related outcomes used measures of affect that either only assessed pleasure/displeasure (e.g. single item; Westbrook et al., 2013), or assessed both pleasure/displeasure and arousal but yielded a single, combined score (e.g. IPANAS-SF; Rogojanski et al., 2001; Szasz, Szentagotai, &

Hofmann, 2012; Mood Form; Litvin et al., 2012). The current study is the first one that assessed experiential arousal as a dimension of affect separately from pleasure/displeasure (Russell et al., 1989). Arousal, but not pleasure, was affected by the cue-exposure across the groups. Additionally, arousal, but not pleasure, was affected by the strategies. These findings suggest that an assessment of subjective arousal might capture craving-related emotive states more accurately than an assessment of affect as indicated by pleasure/pleasantness. Future studies should continue using the Affect Grid (as it distinguishes both aspects of affect) or other measures that assess arousal and pleasantness/pleasure separately, in order to examine whether the insights suggested in the current experiment are of research and clinical significance.

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Part 3: Critical appraisal

1. Overview

The following paper provides a critical reflection on the current study, with a focus on two broad elements that arose through the process of the research: (1) theoretical and hypothetical considerations, and (2) practical and methodological considerations. Some of the ideas have been highlighted in the discussion section of the empirical study, though the reflection below will expand such discussion and include the thoughts, considerations, challenges and decision-making that were involved in the development and progression of the research. Before reflecting upon the main considerations, there will be a brief description of my background experience which stimulated my initial interest in mindfulness and its therapeutic mechanisms.

2. Background

My interest in mindfulness and its therapeutic processes began when I performed as an assistant psychologist at a research trial for Acceptance and Commitment Therapy (ACT) for Psychosis (Jolley, Submitted). Part of my role in the project was to interview the participants and conduct thematic analysis, in order to investigate mechanisms of change. This introduced me to the ACT model and provided me with an in-depth understanding of its therapeutic components. In addition to research experience, I have had an extensive clinical experience with mindfulness, using it as a treatment tool in my various DClinPsy placements: psychosis, health, and secondary care settings. I applied mindfulness as a means of facilitating people to manage unpleasant symptoms which they did not like, such as psychotic experiences, anxiety and depression. However, in addictions, people employ their idiosyncratic tool for managing unpleasant experiences (e.g. cravings, NA) - substance misuse.

Therefore, in addictions, mindfulness can be seen not just as a tool for managing unpleasant experiences, but as a replacement for an existing tool which addicted individuals often find helpful (e.g. drinking to alleviate emotional pain; Cooper, Russell, Skinner, & Windle, 1992; Shiffman & Waters, 2004; Woody, Urschel III, & Alterman, 1992). As I have found mindfulness to be an effective emotion regulation technique, I was curious to investigate how it would work as a replacement for hazardous drinkers' own emotion regulation technique - alcohol use.

3. Theoretical and hypothetical considerations

The process of designing the study, collecting data, conducting the literature review, and analysing and writing up the empirical research, has stimulated thoughts, insights and considerations, which would not have arisen without going through such processes. Some of the main considerations will be discussed below.

3.1 *Mindfulness versus relaxation strategies*

Designing the strategies proved difficult and challenging. The aims were to convey their theoretical rationale, include experiential elements, link the strategies to the experience of craving, and keep them brief. However, an additional methodologically-relevant aim was to ensure that the strategies were matched for length, use of key words related to craving and alcohol, order and structure of the instruction components, readability scores (Flesch-Kincaid grade level; Kincaid, Fishburne, Rogers, & Chissom, 1975) and engagement with the material (Barnes-Holmes & Hayes, 2003; Beadman, et al., 2015; Bowen & Marlatt, 2009; Rogojanski, Vettese, & Antony, 2011). The relaxation instructions were designed to be as similar as possible to the mindfulness instructions, though with a focus on calming rather than noticing and accepting, and reducing craving and unpleasant feelings rather than

managing them without attempting to reduce them. The matching was so explicit in the design of the strategies that every time the instructions in the mindfulness strategy emphasised the mind and/or body, there was an attempt to emphasise those things in the relaxation group, though with the focus on unwinding rather than increasing awareness.

While conducting the relaxation instruction set and matching it to the mindfulness instructions, it became clear that many processes overlap. Unlike studies that compared mindfulness/acceptance to distraction, suppression or reappraisal (Litvin, Kovacs, Hayes, & Brandon, 2012; Murphy & MacKillop, 2014; Rogojanski et al., 2011; Szasz, Szentagotai, & Hofmann, 2012), the physical and mental processes involved in mindfulness and relaxation can be similar. In progressive muscle relaxation, for instance, people are guided to focus on each area of their body at a time and contract and then relax the muscles in that area (Bracke, 2010), inevitably drawing attention to physical processes in the body. In a study conducted by Vinci et al. (2014), who examined the effects of brief mindfulness and relaxation on drinking-related outcomes, the relaxation instructions also emphasised physical elements extensively (e.g. focus on relaxing each area of the body at a time). Although thorough relaxation of the body does not aim to promote psychological flexibility, it does inevitably increase awareness of the body in the present moment, which is one aspect of mindfulness (Ussher et al., 2014). The aim is to relieve stress and tension from the body, but one of the consequences might be the realisation that unpleasant sensations are temporary and tolerable.

The current empirical study avoided such thorough scanning of the body; nevertheless, both strategies involved directing the attention to physical sensations and areas of the body associated with craving. It is thus likely that the relaxation strategy

also promoted awareness of bodily processes, sensations and experiences, possibly, accidentally, illustrating to participants how they wax and wane. The difference between the groups was the linguistic guidance, promoting a very different mental effort for managing internal experiences (e.g. relaxing anxiety in the body versus adopting an orientation of non-judgemental acceptance and embracement of transient unpleasant internal experiences). However, the focus on physical feelings related to craving was similar in both groups.

The manipulation test in the empirical paper indicated that most people understood their specific strategy. However, the post-strategy mindfulness state measure (Toronto Mindfulness Scale [TMS]) indicated that participants in the relaxation group had a similar level of mindfulness as those in the mindfulness condition. Similarly, Vinci et al. (2014; discussed above) found that both the relaxation and mindfulness strategies increased the 'decentering' element of mindfulness (subscale of the TMS), though the mindfulness strategy had a greater influence. The points above suggest that brief relaxation may also, to a degree, affect acute mindfulness states. This does not mean that mindfulness and relaxation are equivalent; relaxation is aimed at reducing tension and stress and inducing relaxation (Bracke, 2010; Davis, Eshelman, & McKay, 2008), and mindfulness is broadly aimed at promoting psychological flexibility (Kashdan & Rottenberg, 2010; Levin, Hildebrandt, Lillis, & Hayes, 2012). However, perhaps when mindfulness and relaxation techniques are delivered in a short training session, the similarities between the approaches are highlighted more than the differences. Applying brief mindfulness and relaxation may not allow the differences between these emotion regulation strategies to be appreciated and utilised in the same way as longer and more

comprehensive treatments, where constructs underlying such approaches are explained, practiced and experienced thoroughly (Vinci et al., 2014).

3.2 *Therapeutic processes of mindfulness*

A secondary objective of the empirical study was to explore the potential processes by which mindfulness affected alcohol consumption. The results suggested that mindfulness was helpful in reducing drinking behaviour, potentially through increasing participants' awareness of their physiological arousal. However, as the correlations between the change in systolic blood pressure and change in alcohol consumption ('*r*' values) in the mindfulness and relaxation groups did not significantly differ from one another, it is unclear whether this effect is specific to mindfulness or rather related to a more general mechanism.

Additionally, the empirical study did not reveal the specific mindfulness constructs that may have been active in facilitating the observed changes. For instance, it could not be determined whether it was more the realisation that unpleasant sensations are transient that facilitated a change, or whether it was psychological detachment (i.e. defusion) from internal experiences that was more powerful. Although elements such as mindful observation, non-judgemental acceptance, and defusion interact in facilitating psychological flexibility (e.g. Levin & Hayes, 2009), it could be helpful to identify which elements were more/less active in yielding the observed findings.

One way of examining the differential effects of mindfulness and its specific therapeutic processes more closely is to conduct qualitative analysis (Higginson & Mansell, 2008; Meier, Boivin, & Meier, 2008). While component studies are helpful in examining theories and mechanisms of change, qualitative data can further highlight

specific processes that cannot always be captured quantitatively. Incorporating participants' own articulation of the strategy they have been taught, and the techniques they have applied during the psychological challenge (i.e. craving-induction), could have more specifically highlighted the precise mindfulness-related elements that participants found helpful (Barnes-Holmes & Hayes, 2003; Beadman, et al. 2015; Bowen & Marlatt, 2009). This could have also helped in more clearly distinguishing the similarities and differences between the mindfulness and relaxation strategies, both of which appeared effective in reducing craving and arousal (as discussed above).

3.3 *Mechanisms underlying drinking behaviour*

Craving and NA have been argued to be central mechanisms that underpin substance misuse (e.g. Baker, Piper, McCarthy, Majeskie, & Fiore, 2004; Bottlender & Soyka, 2004; Cooper, Frone, Russell, & Mudar, 1995; Flannery et al., 2001), and mindfulness has been suggested to facilitate a reduction in addictive behaviour through tackling such mechanisms (Bowen et al., 2014; Elwafi, Witkiewitz, Mallik, Thornhill IV, & Brewer, 2013; Witkiewitz & Bowen, 2010). Both the literature review and empirical paper emphasised Brewer and colleagues' (2013) 'addictive loop' model which focuses on the sequential and dependent connections between affect, craving and substance use. The empirical paper was informative in that it highlighted that the strategies may have uncoupled these habitual connections.

Another insight that emerged from the study regarding drinking-related mechanisms is that pleasure/displeasure (as a construct of NA) may not be a craving-related active process; only the arousal dimension of NA was affected by cue-exposure and was reactive to mindfulness. Previous component studies of brief mindfulness for alcohol consumption used measures that either only capture pleasure/displeasure (e.g.

single-item affect measure) or incorporate dimensions of pleasure/displeasure and arousal to yield a single score (e.g. International Positive and Negative Affect Schedule-Short Form [I-PANAS-SF]; Watson, Clark, & Tellegen, 1988). Such studies found that these affect measures were impacted by an emotional challenge (e.g. unpleasant images; e.g. Vernig & Orsillo, 2009; Vinci et al., 2014), but not by craving-induction (Murphy & MacKillop, 2014). The findings of the previous studies together with the ones of the current empirical paper suggest that, at least with hazardous drinkers whose drinking motives are not predominantly for coping with negative feelings, craving-related affect might be captured more accurately by assessment of arousal rather than pleasure/displeasure.

The empirical study was novel in employing the Affect Grid which distinguishes between the arousal and pleasure dimensions, and yields two separate scores (Russell, Weiss, & Mendelsohn, 1989). Future studies in this realm should use the Affect Grid (or another measure that yields separate scores for arousal and pleasure) in order to establish whether the findings of the empirical study are consistent and have a research and clinical value. Furthermore, it would be helpful to examine whether assessments of pleasure versus arousal differ based on the extent of alcohol/substance dependence. Perhaps people who drink predominantly to cope with negative feelings would indicate subjective changes in pleasure/displeasure. It has been extensively suggested that craving and addictive behaviour relate to NA; however, new insights may emerge regarding the specific dimensions of NA (i.e. pleasure and arousal) that may be active among hazardous versus dependent drinkers.

4. Practical and methodological considerations

Methodological considerations emerged through the process of conducting and analysing the research. Some of the practical decisions and limitations, and thoughts about how they could have been addressed or should be taken into account in future studies, are noted below.

4.1 *Methodological limitations*

One of the objectives of the literature review was to examine the procedural quality of component studies that applied brief mindfulness-related strategies for addiction-related outcomes, based on Barnes-Holmes and Hayes's (2003) criteria. The empirical study was theoretically and methodologically similar to the experiments that were reviewed and rated. In line with the arguments made in the literature review for the need to design a rigorous methodology, the empirical study applied most of the criteria outlined in the review (and would have been rated '30'). However, there were three features that were not incorporated. Participants were not reminded to use the strategy prior to the psychological and physical challenges (i.e. craving-induction and breath holding task, examined by the co-researcher). The reason for this was that in the current study the challenges occurred twice (before and after being taught the strategy), and it seemed appropriate to maintain the post-strategy instructions and procedures exactly the same as the pre-strategy ones. Prior to the strategy, participants were not told that they were going to face a challenge, so informing them what is going to happen and asking them to employ the techniques they have been taught, at the post-strategy phase, seemed methodologically flawed. On the other hand, instructing them to use the strategies during the post-strategy challenge could have increased the likelihood of them applying them and making use of the experimental manipulation.

Participants were also not requested to summarise their understanding of the strategy, and the techniques they implemented during the challenge (i.e. craving-induction). Articulating the strategy in their own words could have shed light on their comprehension as well as mechanisms of change (as discussed in section 3.2 above). However, the entire experimental procedure was long (approximately 1.5 hours) and adding further demands on the participants seemed excessive. Furthermore, standardised manipulation checks were employed and this seemed sufficient at the time. Nevertheless, reflecting back with my enhanced knowledge about methodological requirements for component studies of this kind, I do think that it would have been helpful to incorporate a qualitative exploration by asking participants to summarise their understanding and use of the strategy. It could have (a) consolidated their comprehension of the strategy, (b) helped the researchers examine the participants' understanding and implementation of the strategy and thereby increased the validity of the findings, and (c) potentially highlighted differential therapeutic processes and mechanisms of change.

4.2 *Manipulation test*

As described above, the study employed a quantitative manipulation test to examine whether participants comprehended the strategy that they had been taught. The test included true/false questions, where 'true' for one condition automatically meant 'false' for the other (apart from the first question that was true for both). This was largely based on Murphy and MacKillop's (2014) manipulation test which involved true/false questions. However, their study involved mindfulness versus distraction strategies which theoretically involve quite opposing ideas. Mindfulness is about guiding people to notice and accept their internal experiences as they are without trying to change them, and distraction is about removing them by thinking about other

things (i.e. changing them). Thus, such contrasting ideas lend themselves well to opposing, true/false answers for each group.

On reflection, the above paradigm of the manipulation test is less suitable for the comparison of mindfulness and relaxation, as these emotion regulation strategies do not promote opposing ideas. Although the results in section 3.3.2 of the empirical paper illustrate that the groups significantly differed from one another, with participants from each group scoring higher on the questions relevant to their group, a closer look at the items suggests some limitations. Generally, items that were true for the relaxation condition were answered correctly in both groups. For instance, the number of correct responses to "I was instructed to breathe calmly in order to reduce my craving" was 33 in the relaxation group (answering 'true') and 28 in the mindfulness group (answering 'false'). However, there seemed to be some confusion among participants in the relaxation group about items that were true for the mindfulness condition. For instance, the number of correct responses to "I was instructed to accept my thoughts without trying to get rid of them" was 32 in the mindfulness group (answering 'true') and 6 in the relaxation group (answering 'false'), indicating that most of the participants in the relaxation group thought that this was relevant to their strategy (answering 'true').

The examples above indicate that a correct response for one strategy, particularly mindfulness, was not obviously incorrect for the other. Using true/false questions in the assessment of participants' comprehension of mindfulness versus relaxation strategies may not accurately reflect their understanding. Asking about a technique that was not mentioned in a strategy can get participants confused. For instance, asking participants in a relaxation condition if they were guided to notice their feelings, when the word "notice" was never mentioned, can make some people

unsure about the answer. This may not be a problem with opposing techniques (e.g. mindfulness versus distraction; acceptance versus suppression), where pushing away or changing are in contrast to accepting and embracing. For instance, even if the word 'distraction' is not mentioned in a hypothetical mindfulness strategy, a question such as "were you instructed to distract yourself…" would be obviously wrong to a mindful participant, as it is theoretically contrasting what s/he had been taught. Such contrast would be less explicit or obvious in the comparison of mindfulness and relaxation. Therefore, in studies that explore the impact of mindfulness versus relaxation, it might be helpful to incorporate Likert-scale type questions (e.g. "how much were you noticing/calming your urges…") in the manipulation tests, in addition to true/false questions (Murphy & MacKillop, 2014).

4.3 *Psychological flexibility measures*

Being familiar with therapeutic elements consistent with third wave behavioural approaches, I was aware that mindfulness interventions do not necessarily aim to reduce symptoms, but help people manage them better and change their relationship with them. However, as explained in sections 1.3.2 and 4.1.2 of the empirical paper, experiencing negative feelings or craving within the context of acceptance can change their subjective meaning and make them less unpleasant (Bishop et al., 2004). Additionally, reflecting back on Brewer et al.'s (2013) 'addictive loop' model, it is theorised that orientation to mindfulness could help people recognise what has triggered their emotions, and separate the affective reaction (e.g. NA) from the experience of craving. Furthermore, adopting a sense of curiosity over the craving experiences, creating a psychological detachment from them, and shifting the way they are observed, could help people experience them less strongly and with reduced negative emotional tone (Brewer et al., 2013). Therefore, incorporating subjective and

objective measures of craving and NA was important, and was applied in most studies of this sort (e.g. Beadman et al., 2015; Bowen & Marlatt, 2009; Litvin et al., 2012; Murphy & MacKillop, 2014; Rogojanski et al., 2011; Szasz et al., 2012; Vernig & Orsillo, 2009; Vinci et al., 2014; Westbrook et al., 2013).

Despite the argument above, through the process of conducting the literature review and writing up the empirical paper, it became apparent that an additional measure of contextual processes should have been incorporated (e.g. willingness to experience or meta-cognitive beliefs; Nosen & Woody, 2013; Vinci et al., 2014). Measuring only the extent of subjective experiences of craving and NA, without contextual processes, is inconsistent with the theory and not necessarily recommended (Beadman, 2014). Unpleasant internal experiences are part of a functional process so their existence does not imply something maladaptive (Masuda, Feinstein, Wendell, & Sheehan, 2010); therefore, they should be measured within the context of people's relationship with them.

Although contextual processes were not measured by a self-report assessment, behavioural outcome measures (i.e. alcohol consumption at baseline versus follow-up) were helpfully included. In Bowen and Marlatt's (2009) and Beadman et al.'s (2015) studies there were no reductions in subjective craving and NA, but there was a decrease in smoking, suggesting that behavioural changes can occur without changes in internal experiences. This indicates psychological flexibility and is consistent with the theory that suggests that craving/NA can be decoupled from habitual addictive behaviour (i.e. people can experience unpleasant internal events and yet not engage in maladaptive behaviour to reduce them). Similarly to the studies above, in the current empirical paper there was no reduction in NA at follow-up, and yet alcohol consumption decreased. These examples indicate the benefit of measuring behavioural changes in

addition to subjective craving and NA. Thus, unlike other studies that only used self-report measures (e.g. Nosen & Woody, 2013; Vernig & Orsillo, 2009; Vinci et al., 2014), the current empirical study was methodologically advantageous in this respect.

In addition to behavioural outcome measures, the co-researcher used an implicit measure of contextual processes. As explained in the method section and appendix 1 of the empirical paper, this study was part of a joint thesis and the co-researcher investigated other aspects, one of which was distress tolerance, through a procedure called the breath-holding task. Measures of distress tolerance enable the examination of people's ability to experience unpleasant feelings, sensations or pain, without acting on them (Brown, Lejuez, Kahler, Strong, & Zvolensky, 2005; Simons & Gaher, 2005). Distress tolerance has been associated with increased mindfulness and acceptance (Keogh, Bond, Hanmer, & Tilston, 2005; Lillis, Hayes, Bunting, & Masuda, 2009), and reduced substance misuse (Brown et al., 2013; Hsu, Collins, & Marlatt, 2013; Karyadi, Vanderveen, & Cyders, 2014; Luberto et al., 2014). Thus, the breath-holding task was used as an implicit assessment of contextual processes and psychological flexibility. This suggests that the overall protocol was more comprehensive and theoretically adequate than the above empirical paper alone. Nevertheless, it would have been helpful and methodologically advantageous to incorporate a self-report measure of contextual processes to examine people's subjective ability and willingness to experience uncomfortable internal events.

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Appendix 1

Trainees' contribution to the joint thesis

The empirical study was conducted jointly with Damla Irez. My empirical paper focused on the effects of mindfulness (versus relaxation) on subjective (self-report) and physiological (heart rate and blood pressure) cue-reactivity (i.e. cue-induced craving and negative affect), and her empirical paper focused on the effects of mindfulness (versus relaxation) on immediate drinking rates (taste test), distress tolerance (breath holding task) and physiological components (during the mindfulness training). Both our studies examined alcohol consumption, craving and negative affect at follow-up.

Joint work:

- Design of the methodological procedure of the entire protocol
- Construction of the mindfulness and relaxation strategies
- Construction of the experiment's instructions, information sheet, consent form and advertisement
- Application for UCL ethics approval
- Design of the web-based research and survey software Qualtrics
- Recruitment and data collection
- Data entry and analysis

Individual work:

- Research proposal
- Background research on cue-reactivity paradigms
- Statistical analyses relevant solely to my paper
- Writing up of the empirical paper

Damla Irez's individual work:

- Research on breath holding task as a measure of distress tolerance, taste test as an objective measure of alcohol acute consumption, and the physiological components of mindfulness practice.

Our individual and joint work was guided by Dr Sunjeev Kamboj and Dr Tom Freeman.

Appendix 2

Similarities/differences in readability grade level

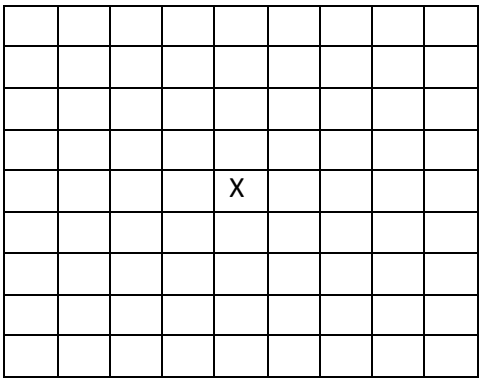
Study	Readability grade Level	Readability grade Level	Readability grade Level	Difference between groups	Match
Beadman et al, 2015	Defusion: 10	Reappraisal: 11	Suppression: 10	1	Yes
Bowen & Marlatt, 2009	Urge surfing: 6.7	Inactive control: 8.6		1.9	Yes
Cropley et al, 2007	Body scan: 4	Inactive control: 14.2		10.2	No
Litvin et al, 2012	Acceptance: 7.9	Suppression: 9.9	Inactive control: 4.5	2	Yes (active) No (inactive)
May et al, 2011	Body scan: 6.9	Mind wandering: 3.4		3.5	Moderately
Murphy & MacKillop, 2013	Mindfulness: 5.5	Distraction: 7.3		2.2	Yes
Nosen & Woody, 2013	No access to the script	No access to the script		?	?
Ostafin et al., 2012	Mindfulness: 11.3	Inactive control: no access to the script but it is extracted from a research methodology textbook so likely to be a difficult read		?	No
Rogojanski et al., 2011	Urge surfing: 8.4	Suppression: 8.3		0.1	Yes
Szasz et al, 2012	Reappraisal: 9.8	Acceptance: 10.5	Suppression: 8.4	2.1	Yes
Ussher et al, 2006	Body scan: 5 bullet points (focus on certain body parts)	Isometric exercise: 5 bullet points (clench and loosen up certain body parts)			Yes
Ussher et al, 2009	Body scan: 4	Isometric exercise: 4.8	Inactive control: 14.2	0.8	Yes (active) No (inactive)
Vernig & Orsillo, 2009	Acceptance: 8.1	Inactive control: 10.2		2.1	Yes

Vinci et al, 2014	Mindfulness: 8.7	Relaxation: 4.4		4.3	Moderately
Westbrook et al, 2013	Mindfulness: attend: 7.7	Inactive control: 4.8		2.9	moderately

Appendix 3

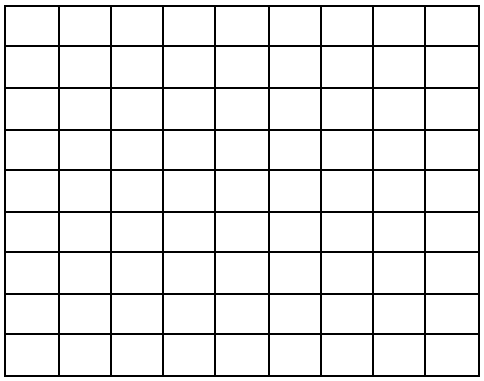
Affect grid

The grid below is used to describe feelings. It is like a map for feelings. The centre of the square (marked by X in the grid below) represents a neutral, average, everyday feeling. It is neither positive nor negative.



The right half of the grid represents pleasant feelings. The farther to the right the more pleasant. The left half represents unpleasant feelings. The farther to the left, the more unpleasant.

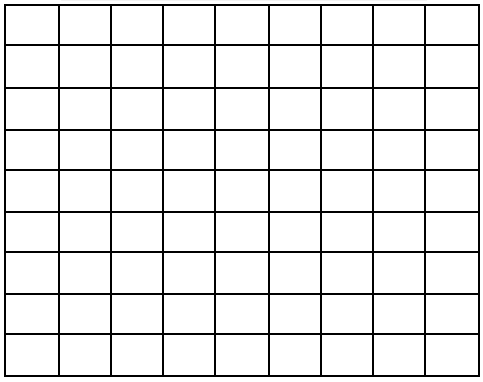
Extremely unpleasant feelings



Extremely pleasant feelings

In addition to the horizontal dimension that represents how pleasant/unpleasant one feels, the vertical dimension represents how alert ones feels (level of arousal). It has to do with how wide awake, alert, or activated a person feels- independent of whether the feeling is positive or negative. The bottom represents sleep, and the higher you, the more awake a person feels. At the top of the square is maximum arousal. If you imagine a state we might call frantic excitement (remembering that it could be either positive or negative), then this feeling would define the top of the grid.

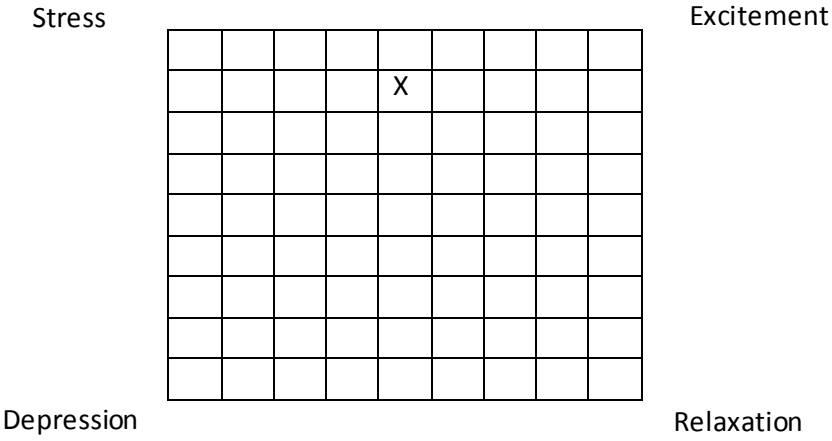
Extremely high arousal



Extremely sleepiness

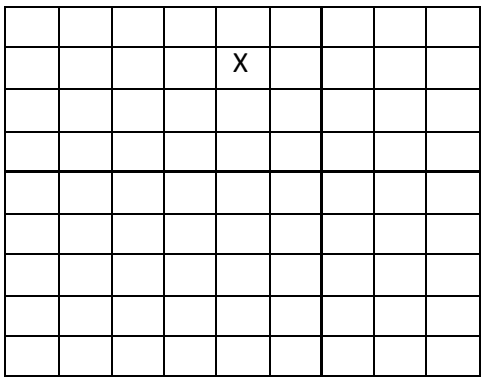
If the "frantic excitement" was positive, it would fall around the top right part of the grid. The more positive, the farther to the right. If the "frantic excitement" was negative it would fall around the top left part of the grid. The more negative, the farther to the left. If the "frantic excitement" was neither positive nor negative, then it would fall in the middle square of the top row.

You can think of the grid in a way that up and to the right are feelings of ecstasy, excitement, joy. Opposite these, down and to the left, are feelings of depression, melancholy, sadness and gloom. Up and to the left are feelings of stress and tension. Opposite these, down and to the right, are feelings of calm, relaxation, serenity.

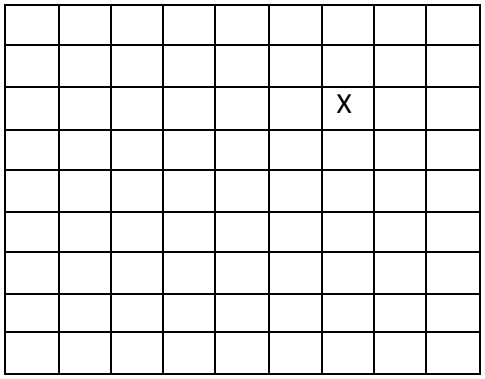


Feelings are complex. They come is all shades and degrees. The labels above are merely landmarks to help you understand how to use such grid. When we ask you to complete it, please put an X anywhere in the grid to indicate the exact shade and intensity of your feeling in the exact moment of completing it. Please look over the entire grid to get a feel for the meaning of the various areas.

For instance, suppose you were just surprised and the surprise was neither pleasant nor unpleasant. Probably you would feel more aroused than average. You might put your mark as shown.



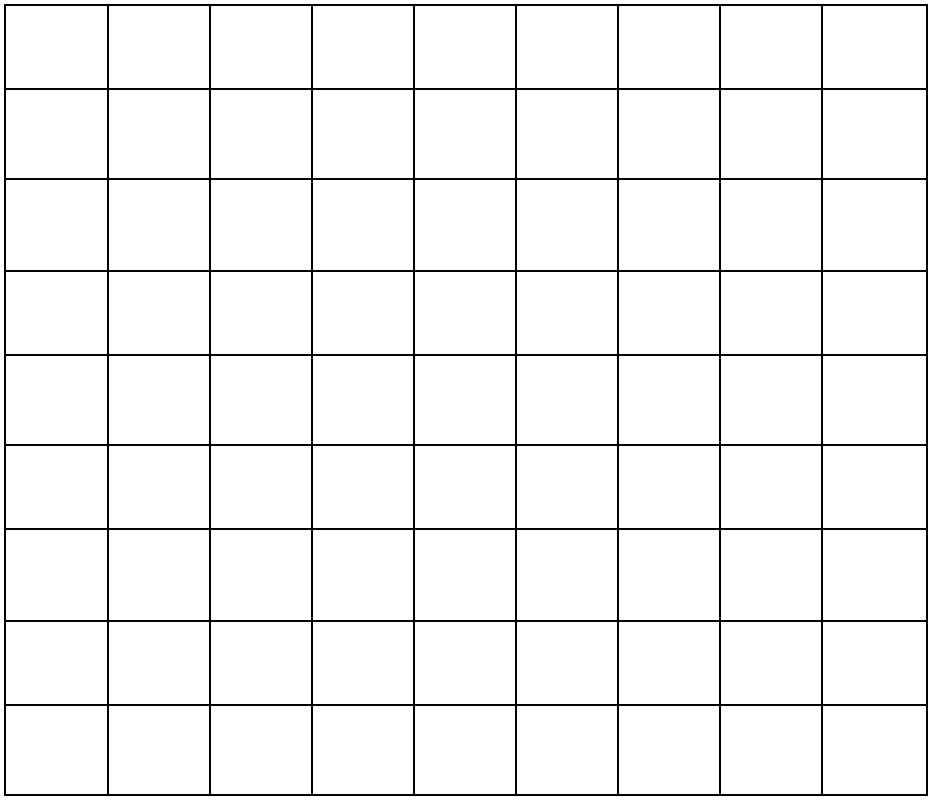
Or, suppose, instead, that you were only mildly surprised but that the surprise was a mildly pleasant one. You might put your mark as shown below.



Please indicate how you feel right now

EXTREMELY HIGH AROUSAL

EXTREMELY UNPLEASANT FEELINGS



EXTREMELY PLEASANT FEELINGS

EXTREME SLEEPINESS

Appendix 4

Credibility/expectancy questionnaire

We would like you to indicate below how much you believe, right now, that the strategy that you have just heard about will help you to manage alcohol cravings. Please answer the questions below.

1. At this point, how logical does this strategy seem to you if it was to be used as a way of helping people to cut down/stop drinking?

Not at all logical			Somewhat logical			Very logical		
1	2	3	4	5	6	7	8	9

2. At this point, how successful do you think this will be in helping *you* to manage your cravings?

Not at all useful			Somewhat useful			Very useful		
1	2	3	4	5	6	7	8	9

3. How *confident* would you be in recommending this to a friend who wants to cut down or stop drinking?

Not at all confident			Somewhat confident			Very confident		
1	2	3	4	5	6	7	8	9

4. At this point, how much do you really *feel* that this strategy will help you to reduce your cravings?

Not at all			Somewhat			Very much		
1	2	3	4	5	6	7	8	9

Appendix 5

Manipulation check

Thinking about the strategy you have just taken part in, please circle the appropriate answer.

In the strategy:

I was given a specific strategy to use to cope with cravings	True/False
I was instructed to breathe calmly in order to reduce my craving	True/False
I was instructed to try to allow my craving to stay as it is *without* trying to change it	True/False
I was instructed to unwind my mind when I feel craving	True/False
I was instructed to accept my thoughts without trying to get rid of them	True/False
I was instructed to release tension in my muscles when I feel craving	True/False

Appendix 6

Assessment of practice

We are interested in your most accurate responses. Your responses will not affect the payment that you will receive.

1. Have you practised the techniques and exercises that you were taught during the past week? _____
2. If so, how many days have you practised during this week? _____
3. If so, for how long on *average* have you practised each day? _____
4. If so, when you have practised the exercises, did you feel that you were fully engaged with the exercise? _____

1	2	3	4	5
Not at all	A little	Somewhat	Quite a bit	Very much

Appendix 7

Ethics approval

Amendment Approval Request Form

1	**Project ID Number:** 0760/002	**Name and Address of Principal Investigator:** Dr Sunjeev Kamboj, Research Dept Clinical, Educational and Health Psychology
2	**Project Title:** Craving changes? How do verbal and visuospatial strategies modify craving experiences in heavy smokers and drinkers	
3	**Type of Amendment/s (tick as appropriate)** ☒ Research procedure/protocol (including research instruments) ☐ Participant group ☐ Sponsorship/collaborators ☒ Extension to approval needed (extensions are given for one year) To July 2016. ☒ Information Sheet/s ☐ Consent form/s ☐ Other recruitment documents ☐ Principal researcher/medical supervisor* ☐ Other * *Additions to the research team other than the principal researcher, student supervisor and medical supervisor do not need to be submitted as amendments but a complete list should be available upon request.	
4	**Justification** (give the reasons why the amendment/s are needed) We request adding an experiment to enable two DClinPsy students to examine how craving - and its physiological correlates - is affected by mindfulness instructions in heavy social drinkers. The instructions to participants are only slightly different from the currently-used 'distancing' instructions. However, the main amendment relates to the use of physiological measures and a 'breath-holding task'. Specifically, we aim to incorporate objective measures of addiction-related behaviour as outcome measures. Firstly, 'distress tolerance (DT)' which will be assessed using the breath-holding task (see below). In smokers, performance on this procedure is associated with relapse, such that those with low levels distress tolerance (shorter breath-holding times) relapse more quickly after a quit attempt (Hajek et al., 1987). On the other hand, interventions that aim to enhance distress tolerance in smokers may reduce the tendency to relapse (Brown et al., 2008). Our understanding of the role of DT in addiction remains in its infancy however, with few studies demonstrating its impact on outcomes other than relapse in smokers. For example, it is possible that mindfulness, which involves simple, non-judgemental attention directed at ongoing bodily experience, may enhance DT and have secondary effects on addictive behaviours, cognition and craving (e.g. Brown et al., 2008). Moreover, DT may have relevance to addictive-behaviours other than smoking (e.g. heavy drinking). Secondly, we aim to record continuous ECG from participants, to assess how (i) heart rate variability (HRV) indices differ in response to relaxation and mindfulness and (ii) how these indices change when participants are exposed to alcohol cues before and after the relaxation/mindfulness procedures. Thirdly, blood pressure will be recorded before and after exposure to beer cues and before and after mindfulness/relaxation using a Beurer BM40 unit, which has a cuff that attaches to the upper arm. The overall aim in the current study is to examine the relationship between (i) effectiveness of mindfulness as a strategy for coping with alcohol craving and (ii) changes in physiology and DT before and after mindfulness (or relaxation control). By adding these objective measures of distress tolerance (breath holding) and physiological indices or affect regulation (HRV and blood pressure), this study will examine mechanism of change for procedures that may reduce alcohol craving. As in our previous studies, participants (n=100) will be healthy volunteers who are at risk of developing	

	alcohol problems. However, unlike our previous studies we do not aim to exclude participants on the basis of scores ≥ 20 on the Alcohol Use Disorder Identification Test (AUDIT; Babor et al, 2001) as we have found the prevalence of such scores is very high among respondents, especially students. Nonetheless, we will continue to exclude participants with likely alcohol dependence (as assessed by high scores on the dependency items on the AUDIT). These participants will be offered information on potential sources of help for moderating drinking. An additional primary exclusion criterion is the presence of acute or chronic respiratory illnesses (see breath holding task below). Mindfulness and relaxation instructions: Mindfulness instructions will involve asking participants to pay attention to their moment-to-moment experience and will be based on existing, widely available instructions. Primarily, participants will be asked to focus on all bodily sensations (the 'breath and body exercise' as described in Kabat Zinn, 2006; Williams and Penman, 2011) in an accepting, non-judgemental way and to approach craving sensations in a similar manner. As with our previous studies, relaxation instructions will closely match to mindfulness instructions (e.g. in complexity of language, use of craving terms, length of script), using the term "relax [body part]" to replace "attend to [body part]." Breath-holding task: Prior to and after mindfulness or relaxation, participants will be asked to perform the breath-holding task (BHT; Brown et al., 2002) as a behavioural index of distress tolerance. In the task participants are seated and asked to hold their breath for as long as possible after a full, normal exhalation (Sütterlin et al., 2013). While holding their breath they will be asked to keep their eyes closed and instructed to hold their breath for as long as possible, even when they have an initial urge to breathe (Sütterlin et al., 2013). The duration of breath holding will be recorded from the time of normal exhalation to subsequent first inhalation. Physiological recording: Heart rate (inter-beat interval) will be recorded continuously using a FirstBeat portable ECG device. Participants will attach the electrodes underneath their clothing themselves, with printed instructions provided by the experimenter. One electrode is attached directly to the FirstBeat unit, which is itself attached under the right collar bone; the other electrode is attached by a short wire to the FirstBeat unit and is attached under the left ribcage. This is a completely painless procedure. In our existing experiments we find that participants are able to do this with ease and without inconvenience. ECG recordings will be taken from the start of the experiment, although the key periods of interest will be (i) before and during exposure to verbal and visual beer cues and (ii) before and during mindfulness/relaxation. .
5	**Details of Amendments** (provide full details of each amendment requested, state where the changes have been made and attach all amended and new documentation) As in our previous studies, participants (n=100) will be healthy volunteers who are at risk of developing alcohol problems. However, unlike our previous studies we do not aim to exclude participants on the basis of scores ≥ 20 on the Alcohol Use Disorder Identification Test (AUDIT; Babor et al, 2001) as we have found the prevalence of such scores to be very high among respondents, especially students. Many respondents who have a high total score on the AUDIT simultaneously have low scores on the alcohol dependence items of the AUDIT. We propose continuing to exclude participants with likely alcohol dependence, but will base this exclusion on high scores on the dependency items of the AUDIT rather than the total score. Those identified with likely dependence will be offered information on potential sources of help for moderating drinking. An additional primary exclusion criterion is the presence of acute or chronic respiratory illnesses (see breath holding task below). Mindfulness and relaxation instructions: Mindfulness instructions will involve asking participants to pay attention to their moment-to-moment experience and will be based on existing, widely available instructions. Primarily, participants will be asked to focus on all bodily sensations (the 'breath and body exercise' as described in Kabat Zinn, 2006; Williams and Penman, 2011) in an accepting, non-judgemental way and to approach craving sensations in a similar manner. As with our previous studies, relaxation instructions will closely match to mindfulness instructions (e.g. in complexity of language, use of craving terms, length of script), using the term "relax [body part]" to replace "attend to [body part]." Breath-holding task: Prior to and after mindfulness or relaxation, participants will be asked to perform the breath-holding task (BHT; Brown et al., 2002) as a behavioural index of distress tolerance. In the task participants are seated and asked to hold their breath for as long as possible after a full, normal exhalation (Sütterlin et al., 2013). While holding their breath they will be asked to keep their eyes closed and instructed to hold their breath for

	as long as possible, even when they have an initial urge to breathe; this will increase the distress levels (Sütterlin et al., 2013). The duration of breath holding will be recorded from the time of normal exhalation to subsequent first inhalation. Physiological recording: Heart rate (inter-beat interval) will be recorded continuously using a FirstBeat portable ECG device. Participants will attach the electrodes underneath their clothing themselves, with printed instructions provided by the experimenter. One electrode is attached directly to the FirstBeat unit, which is itself attached under the right collar bone; the other electrode is attached by a short wire to the FirstBeat unit and is attached under the left ribcage. This is a completely painless procedure. In our existing experiments we find that participants are able to do this with ease and without inconvenience. ECG recordings will be taken from the start of the experiment, although the key periods of interest will be (i) before and during exposure to verbal and visual beer cues and (ii) before and during mindfulness/relaxation.
6	**Ethical Considerations** (insert details of any ethical issues raised by the proposed amendment/s) Previous research and our own consultation with a cardiopulmonary physician at UCH suggests that the breath holding task is a very low risk procedure if participants have no respiratory problems and are seated during the task. The task is designed to cause some distress in order to assess tolerance for distress. Participants will be made aware of this at screening and before the experiment starts, and reminded that they are free to withdraw from the experiment at any time. It should be noted however that the duration of the breath holding, and by extension the distress, is necessarily very timelimed and ultimately very largely determined by the participant's choice.
7	**Other Information** (provide any other information which you believe should be taken into account during ethical review of the proposed changes)
	Declaration (to be signed by the Principal Researcher) • I confirm that the information in this form is accurate to the best of my knowledge and I take full responsibility for it. • I consider that it would be reasonable for the proposed amendments to be implemented. • For student projects I confirm that my supervisor has approved my proposed modifications. Signature: [redacted] Date: 20/03/2015
	FOR OFFICE USE ONLY: Amendments to the proposed protocol have been approved by the Research Ethics Committee. Signature of the REC Chair, Professor John Foreman: [redacted] Date: 24/3/2015.

Appendix 8

Information sheet

Information Sheet for Craving for Alcohol? The Effect of a Brief Strategy on Craving Experience and Alcohol Use

You will be given a copy of this information sheet.

Title of Project: Craving for alcohol? The effect of a brief strategy on craving experience and alcohol use

This study has been approved by the UCL Research Ethics Committee (Project ID Number): 6520/001

Name Shirley Serfaty

Damla Irez

Work address Research Department of Clinical, Educational and Health Psychology
University College London, Gower Street, London. WC1E 6BT

Contact details Email: [redacted] Telephone:

[redacted] Telephone:

Details of Study: This study examines strategies for managing craving experiences associated with alcohol use. These experiments will help us discover more about the psychological processes that underpin the experience of craving, which in the long-term, may help in the development of psychological treatments for addictions.

Who can take part? If you are generally healthy and regularly drink twice as much as the government recommended guidelines for alcohol consumption (which are 14 units for women and 21 units for men) and are between 18-50 years old, fluent in English, have no current psychological and physical illness that requires ongoing treatment. You must also have healthy lung functioning to take part as we require participants to hold their breath as part of the experiment.

What will happen to me if I take part?

The experiment involves taking part in a brief strategy that is delivered through audio recording. You will be given some questionnaires to measure your cravings, mood and alcohol consumption. You will be asked about your reactions to alcohol stimuli before and after listening to some audio instructions. We will also measure various bodily reactions. These include blood pressure, which will be assessed using a standard blood pressure cuff and monitor. Heart rate will be measured

using two sticky probes which you attach to your skin beneath your clothes (the experimenter will show you instructions on how to do this). The probes will be attached under the right collar bone and under the left ribcage.

To measure taste reactions to different beverages, we will ask you to consume a drink (which may be beer or a soft drink) and a measure of lung functioning will be taken by asking you to hold your breath for as long as possible while seated.

We expect all of the procedure above will take up to one and a half hours. We will ask you to practice the techniques taught in the experiment for a week, every day, for approximately 15 minutes. In 2 and 4 days from now we will remind you to use the technique. We will contact you a week later, asking about your experience of practicing the techniques, as well as requesting you to complete 4 questionnaires online (regarding cravings and alcohol consumption). You may contact the researcher at any time after the study if you experience any difficulties.

You will be paid £20 once you complete the last set of questionnaires, a week after attending the laboratory at UCL.

Are there any risks in taking part?

There are no known risks in completing the questionnaires or procedures except for potentially experiencing mild discomfort with holding your breath.

Are there any benefits to taking part?

You may find the strategies helpful for managing craving experiences. However, this is not certain. Nevertheless, your participation will help us gain a better understanding of the experience of craving and people acting on craving, which may lead to better strategies for managing these challenging experiences. In addition, some people find the tasks involved in the experiment can be interesting and enjoyable.

Please discuss the information above with others if you wish, or ask us if there is anything that is not clear or if you would like more information.

It is up to you to decide whether to take part or not; choosing not to take part will not disadvantage you in any way. If you do decide to take part, you are still free to withdraw at any time and without giving a reason.

All data will be collected and stored in accordance with the Data Protection Act 1998.

All information which is collected about you during the course of the research will be kept strictly confidential and will be securely stored electronically, using a numbered code so that you cannot be identified. Only researchers directly involved in the study will have access to the data. All data will be stored in accordance with the Data Protection Act 1998. The data will be used only for informing the research question in this study and the results of the research will be disseminated in peer-reviewed scientific journals, but you will in no way be identifiable from such publications.

Appendix 9

Consent form

Informed Consent for Craving for Alcohol? The Effect of a Brief Strategy on Craving Experience and Alcohol Use

Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research.

Title of Project: **Craving for alcohol? The effect of a brief strategy on craving experience and alcohol use**

This study has been approved by the UCL Research Ethics Committee (Project ID Number): 6520/001

Thank you for your interest in taking part in this research. Before you agree to take part, the person organising the research must explain the project to you.

If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you to decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

Participant's Statement

I

- have read the notes written above and the Information Sheet, and understand what the study involves
- understand that if I decide at any time that I no longer wish to take part in this project, I can notify the researchers involved and withdraw immediately.
- consent to the processing of my personal information for the purposes of this research study.
- understand that such information will be treated as strictly confidential and handled in accordance with the provisions of the Data Protection Act 1998.
- agree that the research project named above has been explained to me to my satisfaction and I agree to take part in this study.

Signed: Date:

Appendix 10

Cue-reactivity instructions

"Look at the drink in front of you [pause]. Pick up the glass and notice how it feels in your hand [pause]. Feel the temperature of the glass and notice the colour of the beverage [pause]. Notice the movement of the drink in the glass and any sounds that may accompany these movements [pause]. Now take 5 deep breaths, inhaling the smell of the drink with each breath [longer pause]. Notice what is going through your mind while holding the drink and whether you feel certain sensations in your body [pause]. Imagine taking a sip from the drink and the sensation of the beverage going down your throat [pause]. Notice whether you are feeling any craving and an urge to drink it [pause]. You can put the drink down now".

Appendix 11

Strategies

Mindfulness

(Introduction)

In this recording you will learn about a strategy for managing craving or urges to drink alcohol. This strategy can be used whenever you experience a difficult feeling, but here we are thinking specifically about how to manage craving for alcohol. First there will be an explanation about what this strategy involves and then you'll have a chance to practice it briefly before the main task.

(An explanation of the strategy)

When we notice a strong desire for something, like a favourite food or drink, especially if it's right in front of us, it is often the case that we will simply eat or drink it without too much thought. This is a kind of automatic response. We do not notice how full or hungry we are but just respond to stimuli automatically. A similar thing can happen with alcohol, leading to over-drinking and occasionally to more serious alcohol problems. We may be responding automatically to external events such as seeing someone drinking, or we may be responding automatically to internal negative feelings in our bodies.

A craving or urge to drink alcohol is generally experienced as a feeling in the body that can be accompanied by thoughts like "I could really do with a drink right now". Craving is often related to stress and negative feelings, like anxiety. Experiencing craving, stress and uncomfortable bodily sensations can lead automatically to drinking. Being in touch with and aware of your feelings and bodily sensations can help you experience craving in a different way.

Noticing what sensations are currently being felt in your body can help you experience craving as temporary events in the body. Paying attention to the exact experiences and processes that are going through your body can help you tolerate them without having to act on them.

Some people find that noticing, paying attention to and accepting what's going on inside their minds and bodies without trying to change these experiences - can help them experience craving in a different way – in a way that does not lead to automatic drinking.

The main benefits of noticing and focusing on your thoughts and bodily sensations are believed to lie in a greater ability to accept that unpleasant and strong feelings and thoughts wax and wane, like waves.

You begin to realise that you do not have to get caught up in them – you can just allow unpleasant feelings to come, to stay for as long as they will, and eventually, change or even disappear.

The key thing is allowing yourself to fully experience bodily reactions and thoughts without trying to get rid of them and without automatically responding to them. This can be achieved by the simple method of observing your thoughts and feelings with curiosity without analysing or judging them. This leads to greater acceptance of difficult feelings.

(Expectancy/credibility questionnaire)

(Strategy practice)

Let's see how this approach might work in practice.

Start by letting your eyes gently close or fix them on a point on the floor in front of you. Take a moment and notice the sensations of sitting on the chair. Maybe notice the parts of your body in contact with the chair [pause].

Notice the sensations in those parts of your body. Notice the sensations in your legs and in your feet where they make contact with your shoes and the floor [pause 5 seconds]. Notice sensations in other parts of your body.

Now imagine that there is a drink in front of you: your favourite alcoholic drink. Please really concentrate on this image of your favourite drink, get caught up in it, bring it to life as if it's right in front of you, and give it your full attention. Imagine holding the drink; the smell of the drink; its colour. Now imagine bringing it to your lips and taking a sip. Imagine how it feels in your mouth and throat as you swallow. Immerse yourself in this experience and the different sensations [pause].

As you keep this image in mind you may notice some craving or urges to drink. As you notice these feelings, focus your attention inward on those feelings. Allow your attention to wander throughout your body.

Notice where in your body you experience the craving or any difficult feeling and what the sensations are like. Notice each area where you experience the urge and any difficult feeling, and simply tell yourself what you are experiencing. For example, you might say "I feel my craving in my abdomen" or "I feel my craving in my chest".

Try to focus on the area in your body where you are experiencing the craving most strongly. Notice the exact sensations in that area. How does it feel? Is it hot, cold, tingly, or numb? Perhaps there is another word to describe the feeling that you are noticing? Are your muscles tense or relaxed? How large an area of your body is involved?

Notice the sensations, stay with them and describe them to yourself. [pause] Notice how the sensations change in your body: how they change in shape or location or intensity. Do not struggle against the feelings; allow them and follow the way they shift and change.

The purpose of this exercise is not to make the craving go away but to experience craving in a different way and learn that these feelings can be accepted and tolerated rather than acted upon.

(Main task)

Now we are going to practice the strategy again with a bit more detail and depth.

While doing this exercise, your attention will probably wander from time to time, as you get caught up in different, unrelated thoughts. This is quite normal and it may happen repeatedly [pause]. Each time you notice your mind wandering; take a second to notice this and bring yourself back to the task at hand [pause 5 seconds].

To start, let your eyes gently close, or fix them on a point in front of you. Try to sit in a way that ensures that you are awake and alert. The idea is not necessarily to become relaxed. The main idea is to be awake and attentive. This will enable you to fully notice and focus on the body.

As before, take a moment now to notice the sensation of sitting in the chair [pause].Try to notice where parts of your body contact the chair, and your feet on the ground [pause 5 seconds].

Now take a slow and deep breath and direct your attention to focus on the physical sensations of your breath [pause 5 seconds]. You don't need to do anything special with your breathing. Simply notice the rise and fall of your chest or abdomen with each breath [pause 5 seconds]. As you breathe in notice the cool air coming into your nostrils [pause], and the warm air as you breathe out.

Now again, imagine that there is a drink in front of you: your favourite alcoholic drink. Concentrate on the image, get caught up in it and bring it to life as if it's right in front of you. Imagine the smell and sight of your favourite drink. Now imagine bringing it to your lips and taking a drink. Immerse yourself in this experience and the different sensations [pause].

Be aware of whatever you are experiencing at the moment as you imagine this scene, even if it is difficult or unpleasant sensations, thoughts or emotions.

In fact it is important especially in such moments to be open hearted and non-reactive as you notice the sensations the best you can [pause].

Let go of the tendency that we all have to want things to be different from how they are right now, and allow things to be exactly as you find them [5 seconds pause].

As you keep this image in mind you may start to feel some craving or urges to drink. As you notice these feelings, focus your attention inward on those feelings. Allow your attention to wander through your body.

Notice where in your body you experience the craving or any difficult feelings and what the sensations are like. Notice each area where you experience the urge and any difficult feelings and simply tell yourself what you are experiencing. For example, you might say to yourself "I feel my craving in my abdomen" or "I feel my craving in my chest".

Focus on one area where you are experiencing the urge most vividly. Notice the exact sensations in that area. How does it feel? Is it hot, cold, tingly, or numb? Perhaps there is another word to describe the feeling you are noticing? Are your muscles tense or relaxed? How large an area of your body is involved?

Notice the sensations, stay with them and describe them to yourself. [pause] Notice also how the sensations change in your body: how they change in shape or location or intensity. Do not struggle against the feelings; allow them and follow the way they shift and change.

Repeat the focusing with each part of your body that experiences the craving. Pay attention to and describe to yourself the changes that occur in the sensations. Notice how the urges come and go. Remember, the purpose of this exercise is not to make the craving go away but to experience it in a different way and learn that these feelings can be accepted and tolerated rather than acted upon [30 secs].

And now bring your attention back to the room, open your eyes if they were closed. Notice what you can see, notice what you can hear [pause].

Relaxation

(Introduction)

In this recording you will learn about a strategy for managing craving or urges to drink alcohol. This strategy can be used whenever you experience a difficult feeling, but here we are thinking specifically about how to manage craving for alcohol. First there will be an explanation about what this strategy involves and then you'll have a chance to practice it briefly before the main task.

(An explanation of the strategy)

When we notice a strong desire for something, like a favourite food or drink, especially if it's right in front of us, it is often the case that we will simply eat or drink it without too much thought. This is a kind of automatic response. We do not notice how full or hungry we are but just respond to stimuli automatically. A similar thing can happen with alcohol, leading to over-drinking and occasionally to more serious alcohol problems. We may be responding automatically to external events such as seeing someone drinking, or we may be responding automatically to internal negative feelings in our bodies.

A craving or urge to drink alcohol is generally experienced as a feeling in the body that can be accompanied by thoughts like "I could really do with a drink right now". Craving is often related to stress and negative feelings, like anxiety. Experiencing craving, stress and uncomfortable bodily sensations can lead automatically to drinking. Softening the muscles in your body and calming and unwinding your mind can help you reduce your craving. Releasing tension in your body can help you reduce the intensity of your stress, anxiety and cravings.

Easing-up and de-stressing the tension in your body, and reaching a state of tranquillity can help you to control them without having to act on them.

Some people find that calming and unwinding what's going on inside their minds, and releasing and easing up the tension from their bodies, can help them to reduce their craving levels in a way that does not lead to automatic drinking.

The main benefits of easing-up and de-stressing your mind and the tension in your body are believed to lie in a greater ability to calm the unpleasant and strong feelings and thoughts.

You begin to develop the ability to release tension from your body and mind and find that unpleasant feelings gradually change and decrease, and eventually they maybe even disappear.

The key thing is transforming your bodily reactions and thoughts to more calming experiences so that they are less unpleasant and you do not have to automatically respond to them. This can be achieved by the simple method of soothing your thoughts and loosening up any tension from your muscles. This leads to changing difficult feelings into less unpleasant ones.

(Expectancy/credibility questionnaire)

(Strategy practice)

Let's see how this approach might work in practice.

Start by letting your eyes gently close or fix them on a point on the floor in front of you. Take a moment to adopt a calm state of mind and a relaxed posture. Make sure you are sitting in a comfortable position in the chair and unwind your mind [pause].

Loosen up any stiffness that you feel in your body. Start by releasing tension from the muscles in your legs and feet and then ease and soften other parts in your body [pause 5 seconds].

Now imagine that there is a drink in front of you: your favourite alcoholic drink. Please really concentrate on this image of your favourite drink, get caught up in it, bring it to life as if it's right in front of you, and give it your full attention. Imagine holding the drink; the smell of the drink; its colour. Now imagine bringing it to your lips and taking a sip. Imagine how it feels in your mouth and throat as you swallow. Immerse yourself in this experience and the different sensations [pause].

As you keep this image in mind you may start feeling craving and urges to drink. As you have these feelings, focus on calming your body. Allow your body to feel more and more loose and at ease.

Wherever you experience craving or any difficult feeling in your body, just loosen and untense that region….. Now see if there is another part of your body where you're experiencing an urge and simply tell yourself to loosen that part of your body. For example, you might say "I am managing my craving by calming my abdomen" or "I am managing my craving by loosening any tension in my chest".

Try to untense the area in your body where you are experiencing the craving most strongly. Start by taking a few slow and deep breaths….. Breathe in through your nostrils and breathe out from your mouth. As you breathe out, release any tension that you may be experiencing. Allow the muscles to feel more and more loose and floppy in other parts of your body.

Calm each area where you experience tension and difficult feelings [pause]. Continue to take slow and deep breaths… As you breathe out unwind your mind and release any further tension felt in your body. Allow any feelings to change to more calming and less unpleasant ones.

The purpose of this exercise is to reduce the craving and change the feelings of the craving into less unpleasant ones, through releasing tension all over the muscles in the body and calming the mind.

(Main task)

Now we are going to practice the strategy again with a bit more detail and depth.

While doing this exercise, your attention will probably wander from time to time, but as long as you continue to relax, this is fine. In fact, this is quite normal and it may happen repeatedly [pause]. Just allow your body to continue to be calm and your mind to continue to unwind [pause 5 seconds].

To start, let your eyes gently close, or fix them on a point in front of you. Try to sit in a way that ensures that you are comfortable and tranquil. The idea is not necessarily to be awake and attentive. The main idea is to be calm and at ease. This will enable you to fully release tension from your body and unwind your mind.

As before, take a moment now to adopt a calm state of mind [pause]. Make sure you sit in a comfortable position in the chair, and loosen up any tension that you feel in your body [pause 5 seconds].

Now take a slow and deep breath. As you breathe in, allow your belly to rise, and to fall as you breathe out, if that feels comfortable [pause 5 seconds]. You don't need to do anything special with your breathing. Simply breathe in from your nostrils and breathe out from your mouth [pause 5 seconds.] Calm as the cool air comes into your nostrils [pause], and as you breathe out warm air.

Now again, imagine that there is a drink in front of you: your favourite alcoholic drink. Concentrate on this image, get caught up in it and bring it to life as if it's right in front of you. Imagine the smell and sight of your favourite drink. Imagine bringing it to your lips and taking a drink. Immerse yourself in this experience and the different sensations [pause].

As you imagine this scene you may experience difficult or unpleasant sensations, thoughts or emotions. Try to wind down your mind and release any tension from your body completely.

It is important especially in such moments to ease any stiffness in your muscles and any thoughts that may be distressing in your mind [pause].

If you feel tension try and calm down and make yourself feel more at ease and de-stressed, in order to allow things to be less unpleasant. [5 seconds pause].

As you keep this image in mind you may start to feel some craving and urges to drink. As you have these feelings, focus on calming your body. Allow your body to feel more and more loose and at ease.

Wherever you experience craving or any difficult feelings in your body, just loosen and untense that region….. See if there is another part of your body where you're experiencing an urge or any difficult feelings and simply tell yourself to calm that part of your body. For example, you might say to yourself "I am managing my craving by calming my abdomen" or "I am managing my craving by loosening my chest".

Untense the area where you are experiencing the urge most vividly. Take taking a few slow and deep breaths…..As you breathe out, release any tension that you may experience. Allow your muscles to feel more and more loose and floppy in other parts of your body.

Calm each area where you experience tension and difficult feelings [pause]. Continue to take slow and deep breaths… As you breathe out continue to unwind your mind and release any further tension felt in your body. Allow any feelings to change to more calming and less unpleasant ones.

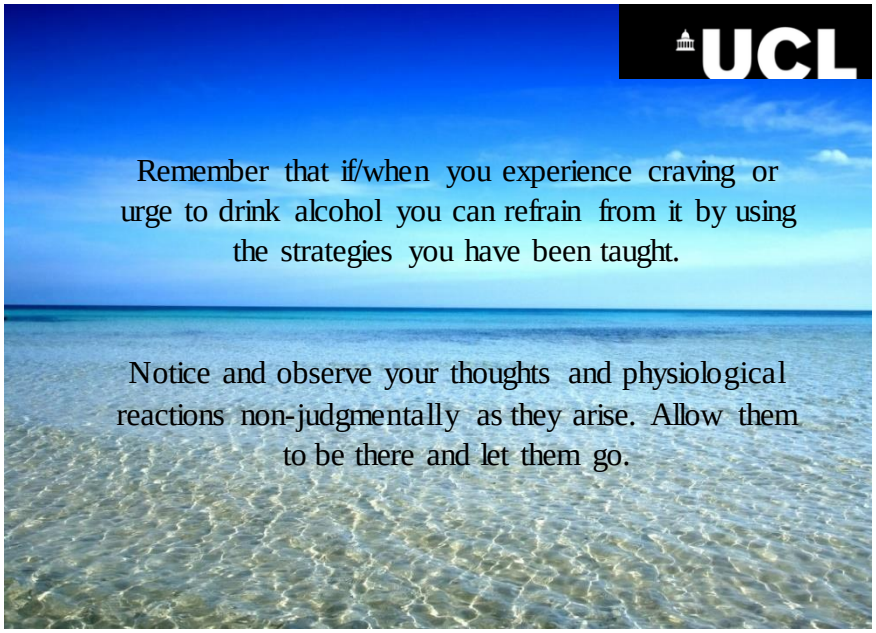
Repeat releasing the tension from each part of your body that experiences the craving. Calm down your entire body and let the muscles loosen up gradually. Take a few more deep breaths in order to reduce the urge. Remember, the purpose of this exercise is to reduce the craving and change the feelings of craving into less unpleasant ones, through releasing tension all over the muscles in the body and calming the mind [30 secs].

And now bring your attention back to the room, open your eyes if they were closed. You can stretch the different parts of your body [pause].

Appendix 12

Cue cards

Mindfulness



Relaxation