A comparison of cognitive reappraisal, defusion and suppression as emotion regulation strategies in smokers: Effects on smoking behaviour, craving and affect.

Matthew Beadman

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University College London

UCL Doctorate in Clinical Psychology

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.

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Overview

This thesis is presented in three parts. The overall focus of the thesis is upon the application of interventions designed to improve 'psychological flexibility' to aid smoking cessation.

Part one presents a literature review which explored the findings of studies which have applied treatment elements consistent with the 'psychological flexibility model' of psychopathology to smoking cessation. The review aimed to understand the utility of this model in its integrated form (Acceptance and Commitment Therapy; ACT), as well as components derived either from ACT or other behavioural approaches consistent with the psychological flexibility model. The review concluded that interventions designed to increase psychological flexibility may offer substantial benefit to smoking cessation outcomes.

Part two is an empirical paper reporting a study which compared the effects of cognitive defusion, reappraisal and suppression on behavioural, affective and subjective correlates of smoking. The study found that both cognitive defusion and reappraisal were associated with similar benefits in terms of smoking-related behavioural outcomes. Defusion was associated with reduced experiential avoidance, reappraisal was associated with reduced craving and suppression was associated with lower credibility ratings.

Part three provides a critical appraisal of the experimental study reported in part two. The appraisal discusses how theoretical and philosophical differences between Acceptance and Commitment Therapy and Cognitive Behavioural Therapy informed the research process. Methodological limitations of the study are reviewed and recommendations are made for future researchers to consider.

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Part 1: Literature Review

Beyond craving reduction: A review of interventions for improving 'psychological flexibility' to aid smoking cessation

Abstract

Aim: To review the findings of studies which have applied treatment elements consistent with the 'psychological flexibility model' of psychopathology to smoking cessation. The objective was to understand the utility of this model in its integrated form (Acceptance and Commitment Therapy; ACT), as well as components derived either from ACT or other behavioural models based on or consistent with the psychological flexibility model. Therefore both clinical outcome studies as well as laboratory-based experimental studies are reviewed.

Method: A search of electronic databases including Medline, PsychInfo and Embase identified the studies that met the inclusion criteria.

Results: Nineteen studies consisting of nine laboratory-based component studies and ten treatment outcome studies met inclusion criteria. The studies included a total of 2094 participants (50.72% male; average age 38.43 years). Laboratory-based component studies provided inconsistent support for the application of the psychological flexibility model to smoking behaviour and craving outcomes, although a significant limitation of these studies was the use of theoretically inconsistent outcomes. Clinical trials more often assessed outcomes specifically targeted by interventions that aim to enhance psychological flexibility. Support for smoking cessation interventions based on or consistent with the psychological flexibility model was found in the clinical studies. These results are discussed in the context of common methodological strengths and weaknesses and implications for future research are considered.

Conclusion: Interventions designed to increase psychological flexibility may offer substantial benefit to smoking cessation outcomes.

Introduction

1.1 Prevalence and cessation rates

Smoking is the primary cause of preventable death in the world, with approximately five million deaths annually attributable to tobacco smoking (Mathers & Loncar, 2006). The number of smokers is forecast to rise to 1.6 billion from the current 1.1 billion by 2025 (Gadirian, 2002). However, smoking prevalence in Britain has declined steadily since the early 1960s when the Royal College of Physicians first published research evidencing the link between smoking and lung cancer (The Royal College of Physicians, 1962). At the time of that publication, 75% of men and 50% of women in the British population were regular smokers. Current UK smoking prevalence is at an all-time low of 18% with rates continuing to decrease by 0.5% annually (Brown, & West, 2014). These figures are impressive in light of the easily available and highly addictive nature of nicotine (US Department of Health and Human Services, 2014) and points to the extraordinary success of public health campaigns in this area.

However, despite these impressive rates of cessation and the fact that the majority of people who smoke wish to quit (Office of National Statistics, 2012), only three to six percent of those who attempt to quit unaided will succeed (Fiore et al., 2008). Of those who receive formal intervention, 50% resume smoking within 30 days and between 70% - 90% experience a relapse and return to smoking within one year of quitting (Fiore et al., 2008). Clearly these figures suggest substantial scope for improvement in outcomes.

1.2 Existing interventions for smokers

Alongside population-level government policy and public-health interventions which aim to reduce both the uptake and continued use of smoked tobacco, a key strategy for reducing smoking prevalence is to directly target help-seeking smokers who wish to quit (Fiore et al., 2008). Accordingly, a broad range of psychological, biological and pharmacological interventions for smoking cessation have been deployed. The current gold standard in smoking cessation interventions combines psychological therapy and pharmacology, leading to better outcomes than either in isolation (Fiore et al., 2008).

Many psychologically-informed interventions for smoking cessation incorporate strategies from Cognitive Behavioural Therapy (CBT; Perkins, Conklin & Levine, 2008), which emphasises the role of thoughts, emotions and physiological arousal in smoking maintenance and relapse. A focus on regulating internal experiences through *altering* thoughts and feelings (particularly cravings) is supported by theory (Balfour & Ridley, 2000) and evidence (Shiffman & Waters, 2004). External events within the environment (such as observing others smoke) increase the likelihood of smoking by triggering internal experiences (Otto, Powers & Fischmann, 2005). CBT therefore teaches people to reduce or avoid internal and external experiences associated with smoking. For example, people learn to avoid environments they associate with smoking, learn techniques to reduce cravings and to distract themselves when they experience thoughts about smoking (Perkins, Conklin & Levine, 2008).

Efficacy trials of CBT plus pharmacotherapy find thirty-day point prevalence abstinence rates (which refer to the number of people who have not smoked for the past 30 days at a given point of time) one year following treatment of between 14-19

percent across a range of delivery modalities including group, individual and telephone interventions (Fiore et al., 2008; Stead, Perera & Lancaster, 2006). While existing interventions clearly offer participants improved odds of a successful quit attempt, innovations in behavioural smoking cessation interventions are required in light of the continuing failure of existing interventions to help the majority of people who wish to quit (Niaura & Abrams, 2002).

One potential explanation for the limited efficacy of extant smoking cessation interventions is that they have paid insufficient attention to the role of negative affective states that accompany nicotine deprivation. Given the proposed central role of negative affect as a potent reinforcement signal in the maintenance of smoking (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004), its role will be considered here, along with its place in theoretical formulations that have informed newer smoking cessation interventions.

1.3 Avoidance of negative affect in smokers

Relief from negative affect is a powerful predictor of smoking (Brandon, Tiffany, Obremski, & Baker, 1990). The negative affect model of tobacco-use proposes that nicotine dependence is maintained by three primary attributes: a dispositional tendency to experience negative affective states (negative affectivity), difficulties tolerating these states, and an expectation that smoking will bring relief (Baker et al., 2004; Brown, Lejuez, Kahler, Strong & Zvolensky, 2005). Once associations between smoking and affective states have formed, cues triggering negative affect can subsequently trigger cravings. Mediated by the psychophysical effects of nicotine, positive affect (and the reduction of negative affect) is reinforcing, resulting in the creation of what Brewer, Elwafi and Davis (2013) refer to as ‘addictive loops’ (building on the work of Baker et al., 2004; Curtin, McCarthy,

Piper & Baker, 2006). Through repetition these loops lead to behaviours that reflect stimulus-response associations operating outside of conscious control (Figure 1).

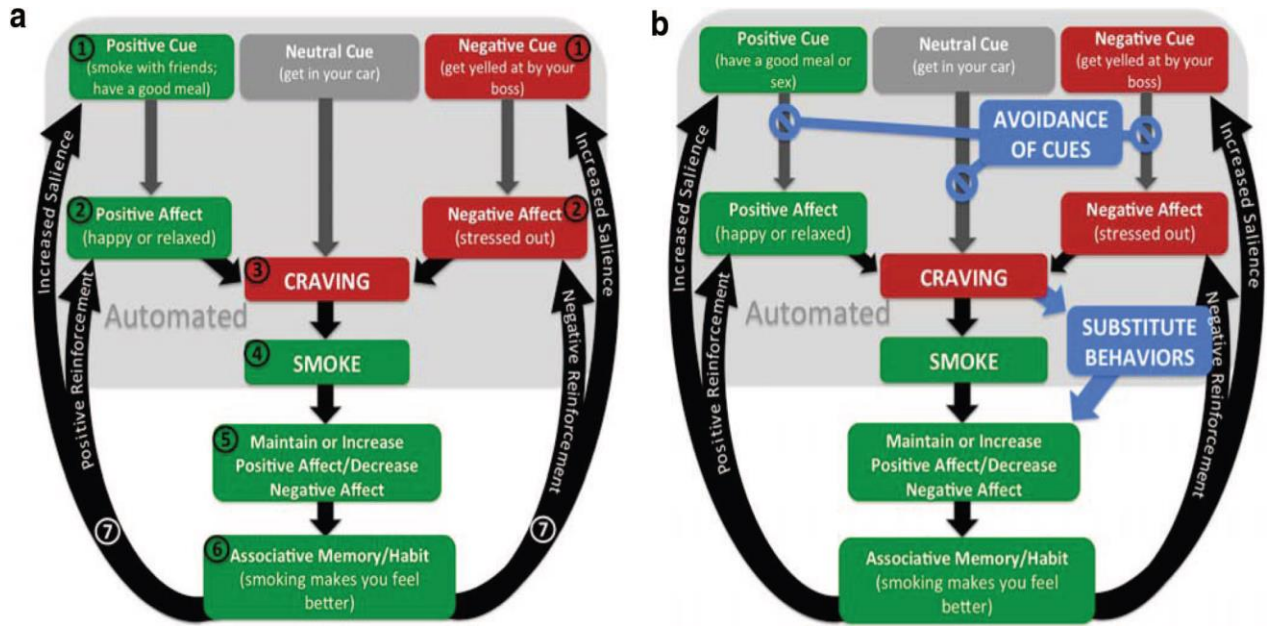

Figure 1. *The associative learning "addictive loop" for nicotine dependence. In figure (a), associations between smoking and both positive (green) and negative (red) affect maintain addiction. Grey arrows represent cues that trigger these affective states, leading to cue induced craving. Addictive loops are illustrated by black arrows. In figure (b), current treatment paradigms which encourage avoidance of cues or substitute behaviours are illustrated in blue. These tend to circumvent the addictive loops but fail to directly target them. (Copyright, 2011, Judson Brewer. Reprinted with permission of author).*

On this basis, behavioural interventions that encourage avoidance of cues are challenged by the range and frequency of environmental stimuli which become associated with negative (and positive) affective states. Furthermore, distraction techniques require substantial cognitive resources, which are compromised during periods of heightened affect (Muraven & Baumeister, 2000). Even if successful, these various strategies merely serve to temporarily interrupt the addictive loops (Brewer et al., 2013) rather than dismantling them, leaving abstinent smokers vulnerable to the effects of subsequent encounters with cues.

A recent innovation in behavioural psychology is the development of acceptance-focused interventions which are characterised by a scientific and clinical interest in acceptance and mindfulness as a route to wellbeing (Hayes, Follette & Linehan, 2004; Hayes, Strosahl & Wilson, 1999). In contrast to the 'second wave' of CBT which focuses primarily on changing the content of disorder-related thoughts and reducing negative affect, the 'third wave' of acceptance based behavioural therapies aims to cultivate willingness to accept all aspects of internal experience, whether positive or negative, desirable or unwanted (Hayes, 2004).

New acceptance-focused smoking cessation interventions may offer potential to directly target components of the addictive process described above. These approaches are associated with reduced negative affect, stress and low mood (Brown & Ryan, 2003), despite these not being the primary focus of the interventions. Furthermore, despite the inevitable discomfort associated with experiencing unwanted feelings (e.g. intense craving or associated negative affect), smokers seem keen to try these new approaches (Sood, Ebbert, Sood & Stevens, 2006). One model which integrates the central themes of third wave contextual CBTs (Hayes, Villatte, Levin & Hildebrandt, 2011) is the psychological flexibility model (Hayes, Strosahl & Wilson, 2012).

1.4 Psychological flexibility and Acceptance and Commitment Therapy

Psychological flexibility refers to 'the ability to contact the present moment fully as a conscious human being, and to change or persist in behaviour when doing so serves valued ends' (Hayes, Strosahl, Bunting, Twohig & Wilson, 2004, p.5). As such, it refers to both a process of opening up to and actively engaging with experience, as well as an outcome of optimal psychological development or treatment. Psychological flexibility underlies psychological well-being and is the

counterpoint to experiential avoidance (which refers to attempts to avoid feelings, thoughts, memories and other internal experiences, even when doing so creates harm in the longer term; Hayes et al., 1999) that characterises psychopathology (Kashden & Rottenberg, 2010).

As consideration of the above definitions will reveal, psychological flexibility as an outcome (especially the emphasis on present moment contact with experience), should be achievable through mindfulness-based interventions. Indeed, mindfulness is one of the six inter-related processes outlined in the comprehensive psychological flexibility model around which 'Acceptance and Commitment Therapy' (ACT; Hayes et al., 1999) is structured. These processes include contact with the present moment, acceptance, cognitive defusion, self-as-context, values and committed action. Acceptance refers to the ability to be open to unwanted internal experiences, in the service of moving towards values. Cognitive defusion is the ability to contact direct experience rather than becoming fused with the content of thoughts. Present-moment awareness is equivalent to certain aspects of mindfulness (the non-judgemental focusing of attention and awareness), while self-as-context describes the experience of a perspective from which we can be aware of internal experience yet neither be harmed nor defined by it. These four processes are broadly considered to be *mindfulness* and *acceptance* processes. The remaining two processes (values and committed action) are *behavioural activation* processes (Hayes et al., 2012). Values are freely chosen qualities that are reflected in the behaviour we define as important, while committed action refers to the ability to behave in a manner consistent with our values and to persist with this behaviour in the presence of difficulties (Hayes et al., 2012). While the psychological flexibility model emphasises the interactive nature of these six processes, beneficial outcomes are hypothesised when psychological

flexibility is enhanced by changing any one or more of these core processes (Hayes et al., 2012).

ACT aims to cultivate psychological flexibility using a range of techniques including acceptance, defusion, mindfulness and behavioural activation (Hayes, Luoma, Bond, Masuda & Lillis, 2006). However, the psychological flexibility model goes beyond the method of ACT (Hayes et al., 2012) and is increasingly being applied throughout other forms of contextual CBT (Hayes, Villatte, Levin & Hildebrant, 2011).

Evidence suggests that psychological flexibility holds considerable clinical utility across a wide variety of psychological disorders (Hayes et al., 2006; McCracken & Morley, 2014; Ruiz, 2010). Powers, Vording and Emmelkamp (2009) reported a medium effect size when ACT was compared to waiting lists and psychological placebos (g=0.68) and a small effect size when compared to treatment as usual (g=0.42). Small effect sizes of approximately d=0.3 favouring ACT are found when compared with a variety of comparison treatments with established efficacy (Levin & Hayes, 2009). Mediational analyses have provided evidence supporting the causal role of psychological flexibility processes in promoting beneficial outcomes (for example, Lundgren, Dahl & Hayes, 2008) and a meta-analysis of laboratory-based studies of psychological flexibility components supports the proposed mechanisms of change (Levin, Hildebrandt, Lillis & Hayes, 2012).

The effectiveness of ACT-based interventions across a range of disorders has encouraged researchers to examine its applicability in treating substance use disorders. Moreover, researchers approaching addiction treatment from other theoretical angles, which are nonetheless consistent with the psychological flexibility model, have applied mindfulness-based interventions to drug and alcohol treatment.

What is conspicuously absent from the existing literature is a review of the evidence reporting the application of the psychological flexibility model to smoking cessation interventions. This paper aims to provide such a review.

In the section below, we review in detail the studies examining the application of interventions *consistent with* the psychological flexibility model to smoking cessation.

1.5 The application of psychological flexibility to smoking cessation[1]

Based on theoretical accounts, interventions consistent with the components of the psychological flexibility model may prove especially useful as smoking cessation interventions (Baker et al, 2004; Brewer et al, 2013). If the internal or external context within which an individual experiences negative affect, cravings or triggers can be altered, this may provide a means to target the addictive loops (Brewer et al., 2013) directly. These interventions do not generally focus on directly changing the experiences themselves, but rather on noticing experiences such as cravings and negative affect and altering the individual's relationship to these experiences (Teasdale, 1999b). A useful metaphor is to imagine sitting next to a slow-moving stream watching leaves float by. When negative affect, cravings or triggers are experienced, individuals can be encouraged to notice these aspects of experience, gently place them on a leaf and watch them float slowly past. Rather than pushing these experiences away, changing them or allowing them to dictate behaviour, the metaphor encourages individuals to simply notice these experiences (Hayes, 2005).

[1] We use the term 'smoking cessation' to describe the intended *eventual* aim of clinical and experimental interventions regardless of whether they are applied to treatment seekers or non-treatment seekers.

At the time of writing, interventions based on the psychological flexibility model are not recommended within smoking cessation treatment-guidelines (Bell, Bauld, McCullough, Greaves, Mulryne, Jategaonkar & DeVries, 2007; Centers for Disease Control and Prevention, 2014). However, recent work reporting its application (or that of its components) to addictive disorders suggests this is a promising avenue for treatment development. For example, a number of acceptance and mindfulness-based smoking cessation interventions have been tested (Brewer et al., 2011; Kelly, Latta & Gimmestad, 2012). Their mechanism of action has yet to be established (Carmody, Vieten & Astin, 2012) although one possibility is that they serve as a form of exposure to emotional and physiological sensations (Otto, Powers & Fischman, 2005) and facilitate emotional acceptance (Barlow, Allen & Choate, 2004). If an individual is encouraged to notice habitual responses to cues without implementing avoidance strategies (Baer 2002; Brewer, Elwafi & Davis, 2013), existing associations maybe extinguished and more adaptive responses conditioned (Breslin, Zack & McMain, 2002). Indeed, interventions which increase an individual's ability to notice their previously habitual and overlearned patterns of responding to conditioned internal and external cues may also help to disrupt memory-based smoking (Breslin, Zack & McMain, 2002).

In essence, if an individual is aware of a given conditioned stimulus, he/she can form a contingent association between a particular conditioned stimulus and the occurrence of an aversive outcome. This is consistent with the importance of awareness emphasised in models of classical conditioning (Lovibond & Shanks, 2002). Therefore, a focus on acceptance and noticing internal experience, such as craving and/or deprivation-associated negative affect may facilitate alternative, adaptive associations in smokers (Blackledge & Hayes, 2001; Breslin et al., 2002).

With increased practice of distress tolerance (defined as the ability to tolerate and persist in the presence of discomfort associated with negative affect and withdrawal symptoms (Brown, Lejuez, Kahler & Strong, 2002) and acceptance of unwanted internal experience, individuals become better able to manage negative experiences without smoking. Indeed, recent work has also reported the application of interventions specifically designed to increase distress-tolerance. While derived from an alternative theoretical direction to the psychological flexibility model, such interventions are entirely consistent with the model's emphasis on acceptance and committed action.

The clear theoretical delineation of components of the psychological flexibility model lends itself to component based studies which investigate treatment mechanisms (see Levin et al., 2012 for a general review of laboratory based psychological flexibility component research). In the current paper these are reviewed in the specific domain of smoking cessation. In addition however, controlled and uncontrolled clinical trials with treatment-seeking smokers are essential to demonstrate effectiveness/efficacy.

1.6 Aims

The current review examines the application of the psychological flexibility model to smoking behaviour. The review will contain interventions that are guided by the integrated psychological flexibility model, namely ACT interventions, targeting all of the constituent processes of the psychological flexibility model as well as those which are derived separately from the model, but are nonetheless consistent with it. A distinction is made between 'psychological flexibility targeted outcomes' (including behavioural outcomes and outcomes related to the smoker's relationship to internal experiences; Levin et al., 2012) and secondary outcomes

relating to the frequency and/or intensity of internal experiences, including craving. From a theoretical perspective, these secondary outcomes are not directly targeted by psychological flexibility model-based interventions, but may nevertheless change throughout the course of treatment. As such, we address two primary research questions:

1. What are the effects of interventions that are predicted to increase psychological flexibility on behavioural, metacognitive and acceptance-related outcomes?

2. What are the effects of such interventions upon outcomes related to the frequency and/or intensity of internal experience?

To explore the impact of psychological flexibility-based interventions compared to inactive or theoretically distinct comparison interventions (i.e. those based on an alternative theoretical conceptualisation of internal experiences or behaviour), comparison groups were categorised as either 'inactive', 'control context' or 'active' (replicating Levin et al., 2012). 'Inactive' here refers to conditions which engaged participants in an activity which controlled for time, attention and demand characteristics but would not be expected to have any salubrious effect. 'Control context' refers to conditions in which participants employed strategies designed to control, reduce or eliminate an aspect of their internal experience, for example suppression. 'Active' refers to any other comparison condition which required participants to engage in activities informed by distinct theoretical models of internal experience or behaviour, namely a bona fide

psychosocially-informed treatment for addiction. An example is cognitive restructuring or 'reappraisal[2]'.

In this review, while we will consider treatment outcome research and laboratory-based component research separately, we acknowledge the important reciprocal interaction of these two domains of research. Laboratory-based component studies rarely aim to establish clinical impact or to model treatment outcomes, but to inform treatments to optimise their efficacy. We also note however, that laboratory-based component research necessarily samples a small fragment of a complex intervention. As such we refer to the tested components as 'micro-interventions' to denote an experimental procedure which lasts mere minutes, compared to a complete clinical intervention which potentially lasts many hours and is delivered over weeks or months.

Method

2.1 Search methods for identification of studies

A systematic computer-assisted search of Embase, Medline and PsychInfo databases was conducted using the following search terms.

Title/abstract search: Acceptance and commitment therapy OR Acceptance* OR Defusion OR Present Moment OR Value directed behavio?r OR Self as context OR Commit* OR Psychological flexibility OR Mindful* OR Distress tolerance OR Relational frame* OR Behavio?ral OR Contextual Behavio?ral OR Metacognitive OR Third wave

[2] The cognitive therapy literature tends to use the term 'cognitive restructuring' whereas emotion regulation research, which is also relevant to this review, uses '[cognitive] reappraisal' to refer to the same process of attending to and consciously altering the content of consciously accessible (usually verbal) thoughts.

AND

Title/abstract search Smok* OR Nicotine* OR Tobacco* OR Cigarette?* OR Cessation OR Crav*

Search parameters included articles published in the English language from 1984 – current; articles published prior to 1984 were excluded since these publications were less likely to have been conceptualised within a psychological flexibility framework or contain its components (Hayes, 1984).

These search parameters yielded a total of 4236 hits, which included 1920 hits from Embase, 869 hits from PsychInfo and 1447 hits from Medline. Titles and/or abstracts of all studies identified were screened for relevance and duplicates removed. Full text articles were obtained for all potentially eligible studies.

2.2 Inclusion and exclusion criteria

2.2.1 Inclusion criteria

This review included efficacy studies (randomised controlled trials) as well as non-randomised studies and laboratory-based component studies. Studies were included if they tested the effects of an intervention consistent with the psychological flexibility model on smoking behaviour, meta-cognitive processes in relation to smoking related cognitions, or outcomes related to the frequency and/or intensity of internal experience. This included studies of the integrated psychological flexibility model (ACT), individual components of the psychological flexibility model and components of other therapeutic approaches from the contextual behavioural therapies tradition which are consistent with the psychological flexibility model (where attempts were made to study these effects in isolation, uncontaminated by

other psychological processes). As such, the review included studies involving mindfulness-based interventions and behavioural activation.

Further inclusion criteria required studies (1) to be published in peer reviewed journals, (2) to publish quantitative data including pre-post values, (3) to involve adult (≥18 years old) smokers, and (4) to use comparison/control group(s).

2.2.2 Exclusion criteria

Studies were not excluded on the basis of a lack of randomisation. However, single case designs or papers reporting only qualitative information were excluded.

Studies were also excluded if they (1) reported mediators of change from a previous study or presented the same data as an included trial, (2) if they failed to compare groups or pre-post values, for example in the case of some pilot or feasibility studies, or (3) if their focus was on factors which moderate an aspect of psychological flexibility rather than directly testing it within an intervention. For example, the moderating role of anxiety sensitivity in mindfulness interventions for smoking craving (Rogojanski, Vettese & Antony, 2011b). Studies were also excluded if they only investigated an outcome variable which is indirectly related to smoking behaviour or craving (for example, negative affect) or physiological correlates of the ability to resist smoking, such as high-frequency heart-rate variability (Libby, Worhunsky, Pilver & Brewer, 2012).

Studies were excluded if there was an absence of an explicit link to the objectives of the psychological flexibility model (i.e. to increase openness to experience/acceptance, and/or valued action). As such studies that examined 'values' in the context of ego threat (i.e. self-affirmation-based interventions; Crocker, Niiya & Mischkowski, 2008) were not included as they are based on a distinct social psychological model of threat processing rather than valued *action*.

2.3 Screening

Excluding duplicates, 31 papers were identified which potentially met the inclusion criteria. Three additional papers were identified by hand searching reference lists of retrieved papers and related reviews (Goldberg, Davis & Hoyt, 2013; Luberto, McLeish, Zvolensky & Baer, 2011; May, Andrade, Willoughby & Brown, 2011). Two papers were identified by contacting authors and leading researchers to request details of papers recently published or in press and to ask for feedback on the collated references (Davis, Goldberg, Anderson, Manley, Smith & Baker, 2014; Davis, Manley, Goldberg, Smith & Jorenby, in press).

This made a total of 36 papers which were read in full and considered for inclusion. Each paper was considered for inclusion by the author and the supervisor; disagreement was resolved through discussion. Following application of the inclusion/exclusion criteria 17 papers were removed. These papers included Bricker, Mann, Marek, Liu & Peterson (2010) who conducted a single arm study and Singh, Lancioni, Winton, Singh, Singh and Singh (2011) who developed and trialled a mindfulness-based smoking cessation programme with a man with mild learning disabilities.

This left a total of nineteen studies identified for selection, including nine laboratory based component studies and ten treatment outcome studies (Figure 2).

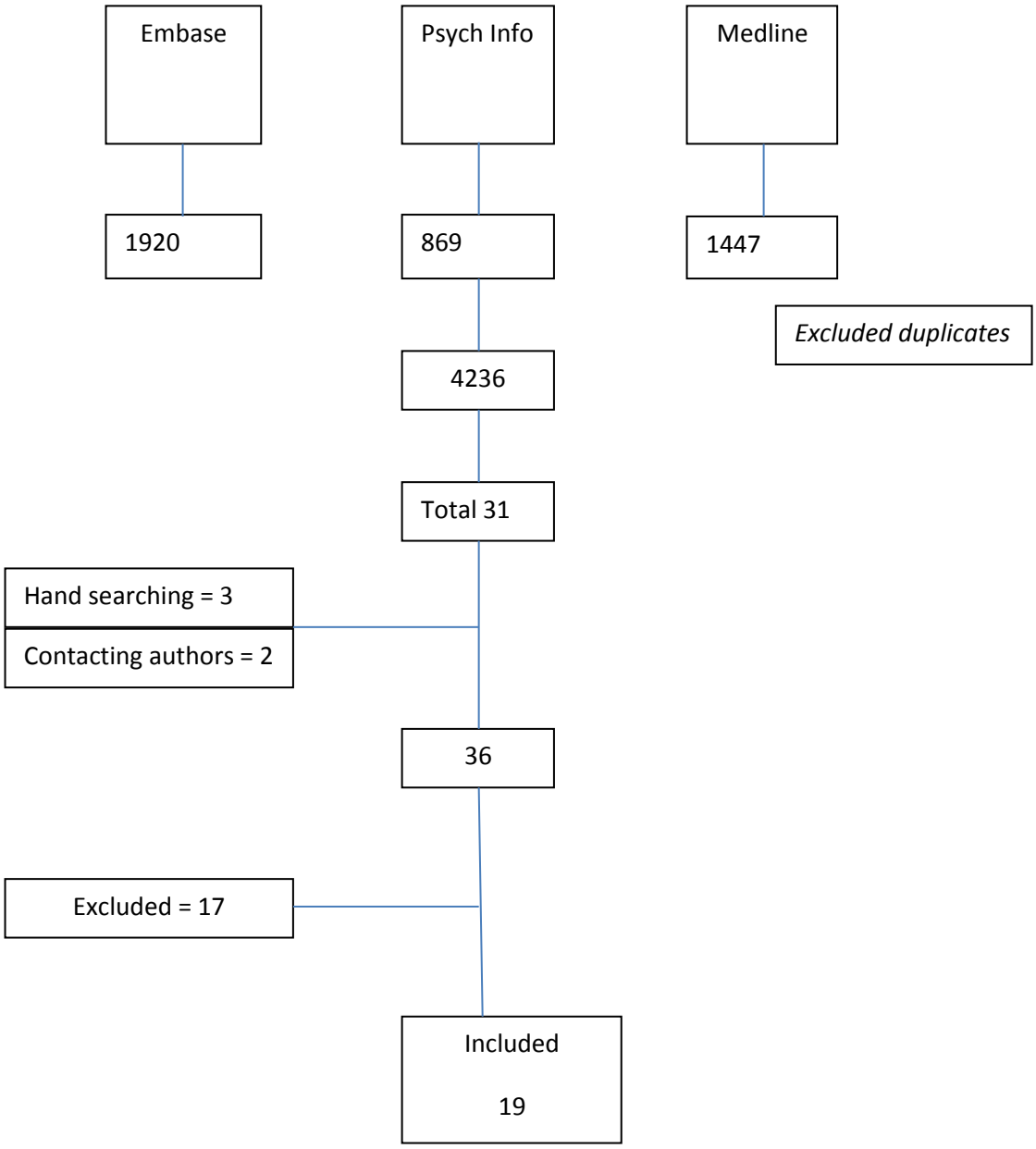

Figure 2. *Flowchart of search process*

2.4 Quality assessment

The methodological quality of the treatment outcome studies was rated using an adapted version of a comprehensive quality assessment tool for alcohol treatment research (Moncrieff and Drummond, 1998). We refer to this adapted version of the original tool as the '*Quality Assessment Tool for Smoking Interventions' (QATSI).*

While some researchers have criticised such assessment tools because of low validity and reliability (for example, Crowe & Sheppard, 2011) the original tool possesses good test-retest reliability (r = .88) and internal consistency (α = .87). Moreover, recommended alternatives to the use of such assessment tools only sample a limited range of dimensions related to study quality (Higgins & Green, 2006). Nonetheless we recognised the potential for bias in this approach to quality assessment, which we intended to reduce through the use of two reviewers. The QATSI was initially piloted by the author on two of the treatment outcome studies (Brewer et al., 2011; Brown, Reed, Bloom, Minami, Strong, Lejeuz & Hayes, 2013) which indicated some adaptations were required. Item 2 (relating to adequacy of sample size) was omitted to avoid duplication of item 4 (concerned with power) and item 14 was changed from 'alcohol behaviour' to 'smoking behaviour'. In the case of ambiguity the corresponding author of the publication was contacted to request clarification. Alternatively, failure to report the required methodological detail resulted in a lower overall quality score.

All treatment outcome studies were assessed for methodological quality independently by the author and the supervisor using the QATSI tool. Involvement in the initial screening of articles meant that blind assessment was not possible in the case of the author. However, the supervisor rated all articles blind. Discrepancies in scoring were resolved through discussion to reach consensus. A Spearman's Rank

Order correlation showed that prior to discussion there was a strong, positive correlation between the independent quality ratings from the author and the supervisor (r_s =0.84, N = 280, p < 0.001).

2.5 Analysis

Effect sizes for abstinence (the primary outcome measure in the treatment studies) were calculated for all studies that reported odds ratios. Odds ratios were used due to the frequent use of logistic regression within the included studies and the dichotomous nature of point prevalence abstinence outcome measures. Effect sizes were calculated for abstinence at post intervention and at six months follow-up, the time-point at which achieving abstinence is considered a robust indicator of treatment effectiveness (West, Hajek, Stead & Stapleton, 2005).

Weighted mean effect sizes were analysed using the Cochrane Collaboration software Review Manager. Two studies were excluded from the six month analyses because follow-up data was missing (Bricker, Wyszynski, Comstock & Heffner, 2013; Davis, Mills, Stankevitz, Manley, Majeskie & Smith, 2013). Rosenthal (1996) provides qualitative size categories for odds ratios; 1.5 to 1 represents a small effect, 2.5 to 1 represents a moderate effect, 4 to 1 represents a large effect and 10 to 1 a very large effect.

Although there was considerable variability, all comparison groups within the treatment outcome studies were considered national standards in smoking cessation and therefore were grouped together as treatment as usual comparison groups. This was with the exception of Davis et al., (2013) who used an inactive comparison group (non-directed walking). The abstinence effect size from this study was therefore not included within the abstinence weighted effect size. Given the variability between comparison groups and other sources of heterogeneity within the

included studies, analyses were conducted using a random-effects model. This makes the assumption that individual studies are estimating different treatment effects (Higgins & Green, 2006).

Heterogeneity was assessed using the I^2 statistic (Higgins, Thompson, Deeks, & Altman, 2003). The statistic is expressed as a percentage, with higher values corresponding to higher degrees of heterogeneity. Higgins et al. (2003) propose thresholds of 25%, 50% and 75% which indicate small, moderate and large degrees of heterogeneity respectively.

Results

The results are organised in two main sections to reflect the two types of studies reviewed here (laboratory-based component research and treatment outcome research). The first part of each section will be a general description of the studies in terms of their methodological features and quality whereas the second part will be a more focused description of the outcomes of the reviewed studies, enabling the review questions outlined in section 1.6 to be addressed.

3.1 Laboratory based component research methodological features

3.1.1 Overview of studies

Table 1 presents the key characteristics of the nine laboratory based 'component' studies, which were published between 2006 and 2013 and took place in various countries including the United States (3), Canada (1), Romania (1) and United Kingdom (4).

Table 1. *Laboratory based component research: Characteristics of included studies*

Study	N	Experimental Conditions	Comparison group type	Sample (gender, mean age, level of dependency, length of abstinence)	Follow up period (% sample retained at follow up)	Psychological flexibility model-consistent outcomes (and measures used)	Outcomes relating to the frequency and/or intensity of internal experiences(and measures used)	Any other outcomes (and measures used)
Bowen & Marlatt, 2009	123	1. Brief mindfulness-based instructions group 2. No instruction control group	2. Inactive	Undergraduate smokers, 73.2% male, mean age 20.33 years, mean FTND 2.31, average cigarettes per day 5.33, mean abstinence 17.20 hours	24 hours (94.3%) and 7 day (90.2%)	<u>Compared to inactive</u> Number of cigarettes smoked (telephone administered questionnaire) ↑^{FU}	<u>Compared to inactive</u> Negative affect (PANAS) ↔ Urges (QSU-brief) ↔	None
Cropley, Ussher & Charitou, 2007	30	1. Ten minute body scan audio instructions 2. Ten minutes listening to natural history passage	2. Inactive	60% male, mean age 25.5 years, FTND average 4.75, average cigarettes per day 18.0, overnight abstinence	None	None	<u>Compared to inactive</u> Smoking withdrawal symptoms (7 items from the MPSS) ↑	None
Litvin, Kovacs, Hayes & Brandon, 2012	162	1. Acceptance instructions 2. Suppression instructions 3. Control –	2. Control context 3.Inactive	50% female, mean age 36.84 years, FTND average 5.33, average cigarettes per day 20.10, three hours abstinence	3 day (69.73%)	<u>Compared to control context</u> Latency to smoke at follow-up ↔ Cigarettes smoked at follow up ↔ <u>Compared to inactive</u>	<u>Compared to control context</u> Craving (QSU-4 and the ME) ↔ Affect (MF) ↔ Instances of thoughts about smoking ↑ Depletion (hand-grip task) ↔ Motivation to smoke (behavioural choice task) ↔	Memory and understanding of the instructions' content Manipulation check Expected usefulness

		reading an article				Latency to smoke at follow-up ↔ Cigarettes smoked at follow up ↔	Self-efficacy (1-SE and SET) ↔ <u>Compared to inactive</u> Craving (QSU-4 and the ME) ↑ Affect (MF) ↑ Instances of thoughts about smoking ↔ Depletion (hand-grip task) ↔ Motivation to smoke (behavioural choice task) ↔ Self-efficacy (1-SE and HCS) ↑[FU]	
May, Andrade, Willoughby & Brown, 2011	27	1. Audio instructions to let mind wander only 2. Audio body scanning instructions	1. Inactive	40.74% male, mean age 30 years, two hours abstinence	None	None	<u>Compared to inactive</u> Thought frequency (using thought probes) ↑ Craving (Factor 1 of the QSU) ↑	None
Nosen & Woody, 2013	176	1. Mindfulness psycho-education 2. Standard smoking cessation psycho-education 3. No psycho-education	2. Active 3. Inactive	64.77% male, average age 41.47 years, mean CDS score 48.55, average cigarettes per day 16.49 Sample split into continuing and abstaining smokers	24 hours and four days (89%)	<u>Compared to active</u> Metacognitive beliefs – strength of belief in smoking and craving related thoughts (ACQ) ↑ <u>Compared to inactive</u> Metacognitive beliefs – strength of belief in smoking and craving related thoughts (ACQ) ↑	<u>Compared to active</u> Craving (single item VAS and QSU-brief) ↑(for abstaining smokers only) <u>Compared to inactive</u> Craving (single item VAS and QSU-brief) ↑(for abstaining smokers only)	<u>Covariates</u> Negative affect (DASS) Concern about consequences of anxiety (ASI-R)

Rogojanski, Vettese & Antony, 2011	61	1. Mindfulness-based strategy for coping with cravings 2. Suppression strategy for coping with cravings	2. Control context	41% female, mean age 40.34 years, FTND average 4.57, average cigarettes per day 16.42, no abstinence period (participants instructed to smoke 30mins before attending)	7 day (80.33%)	<u>Compared to control context</u> Number of cigarettes smoked (TLFB) ↔	<u>Compared to control context</u> Self efficacy (RSEQ) ↔ Craving (VAS) ↔ Negative affect (PANAS) ↑, $\uparrow^{FU}$ Depression (DASS) ↑, $\uparrow^{FU}$ Nicotine dependence (FTND) ↑, $\uparrow^{FU}$	Credibility (CEQ) ↔ Baseline mindfulness (CAMS-R) ↔
Szasz, Szentagotai & Hofmann, 2012	94	1. Reappraisal instructions 2. Acceptance instructions 3. Suppression instructions	1. Active 3. Control context	88.3% female, mean age 23.02 years, FTND average = 3.14, average cigarettes per day 18.62, one hour abstinence	None	<u>Compared to active</u> Distress tolerance (PASAT) ↓ <u>Compared to control context</u> Distress tolerance (PASAT) ↔	<u>Compared to active</u> Craving (QSU-brief) ↓ Negative affect (PANAS) ↓ Attentional bias (modified dot-probe task) ↓ <u>Compared to control context</u> Craving (QSU-brief)↔ Negative affect (PANAS)↔ Attentional bias (modified dot-probe task) ↔	Manipulation check (ASQ) Nicotine dependence (FTND)
Ussher, Cropley, Playle, Mohidin & West, 2009	48	1. Isometric exercise 2. Body scanning 3. Reading a natural history	1. Active 3. Inactive	35.4% female, mean age 27.8 years, FTND average 5.0, average cigarettes per day 15.5, overnight abstinence,	None	None	<u>Compared to active</u> Desire to smoke (single item) ↔ Withdrawal symptoms (MPSS)↔ <u>Compared to inactive</u>	Credibility of intervention (CEQ)

		passage					Desire to smoke (single item) ↑ Withdrawal symptoms (MPSS) ↑	
Ussher, West, Doshi & Sampuran, 2006	60	1. Isometric exercise 2. Body scanning 3. Sitting passively	1. Active 3. Inactive	45.0% female, mean age 32.2 years, FTND average 3.92, average cigarettes per day 18.83,	None	None	<u>Compared to active</u> Desire to smoke (single item) ↔ Withdrawal symptoms (MPSS)↓ <u>Compared to inactive</u> Desire to smoke (single item) ↔ Withdrawal symptoms (MPSS) ↓	Manipulation checks (via observation)

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. PANAS = Positive and Negative Affect Schedule (Watson, Clark & Tellegen, 1988); QSU = Questionnaire of Smoking Urges (Tiffany & Drobes, 1991); MPSS = Mood and Physical Symptoms Scale (West & Hajek, 2004); ME = Magnitude of Estimation of Urge (Sayette, Martin, Wertz, Shiffman & Perrott, 2001); MF = The Mood Form (Diener & Emmons, 1984; 1-SE = Single Item Rating of Confidence (Litvin et al., 2012); SET = Self-Efficacy/Temptation Long Form (Velicer, Diclemente, Rossi & Prochaska, 1990); HCS = Habitual/Craving Situations subscale of the SET (Velicer et al., 1990); VAS = Visual-Analogue Scale Single Item (Dols, Hout, Kindt & Willems, 2002); DASS = Depression, Anxiety and Stress Scales (Lovibond & Lovibond, 1995); ACQ = Appraisals of Craving Questionnaire (Nosen & Woody, 2009); CDS = The Cigarette Dependence Scale (Etter, Le Houezec & Perneger, 2003); FTND = Fagerström Test for Nicotine Dependence (Heatherton, Kozlowski, Frecker & Fagerström, 1991); ASI-R = The Anxiety Sensitivity Index-Revised (Peterson & Reiss, 1993); TLFB =

Timeline Follow-Back (Brown, Burgess, Sales, Whiteley, Evans & Miller, 1998); RSEQ = Relapse Situation Efficiency Questionnaire (Gwaltney, Shiffman, Norman, Paty, Kassel & Gnys, 2001) ; CEQ = Credibility/Expectancy Questionnaire (Devilley & Borkovec, 2000); ASQ = Affective Style Questionnaire (Hofmann & Kashdan, 2010); CAMS-R = Cognitive Affective Mindfulness Scale-Revised (Feldman, Hayes, Kumar, Greeson & Laurenceau, 2007); PASAT = Paced Auditory Serial Addition Task (Diehr, Heaton, Miller & Grant, 1998)

3.1.2 Study designs

Mixed group designs were the norm with 'condition' the between-group and 'time' the within-group independent variables. One study used a within-group design (May et al., 2011). Participants were randomly allocated to groups or condition in all studies.

3.1.3 Participants

The studies included a total of 781 participants (53.22% male) with an average age of 32.1 years. Table 1 provides further demographic information. Sample size varied considerably across the studies from 27 (May et al., 2011) to 176 (Nosen & Woody, 2013). The average baseline Fagerström Test for Nicotine Dependence (FTND) score across the seven studies that used this measure was 4.15 (*SD* = 1.09) indicating mild levels of dependence. One study (Nosen & Woody, 2013) used the Cigarette Dependence Scale (Etter et al., 2003; score = 48.55, no cut off scores for dependence are specified for this measure) while another provided no information on levels of dependence (May et al., 2011). Participants in Bowen and Marlatt's (2009) sample had notably lower (~2 *SDs*) levels of nicotine dependence (FTND score: 2.31) than participants in other studies, suggesting the majority of participants in that study were non-dependent smokers.

The mean number of cigarettes smoked daily by participants in the eight studies that provided this information (except May et al., 2011) was 16.16 (*SD* = 4.63). However, with the exception of Rogojanski et al. (2011) who report use of the Timeline Follow-back method (TLFB; Robinson et al., 2014), the method for assessing daily smoking was generally poorly specified across the studies.

All studies state that participants received either monetary compensation or course credit for participation except Cropley et al., (2007) who do not provide this information.

3.1.4 Reporting of inclusion and exclusion criteria

All studies specified inclusion criteria, while only three provided exclusion criteria (Nosen & Woody, 2013; Ussher et al., 2006; Ussher et al., 2009). The number of exclusions and refusals was not reported in any study, although such reporting is relatively uncommon in non-clinical trials since participants are not usually required to be treatment-seeking.

Consent to a period of temporary abstinence prior to participation was a common requirement across the studies and the abstinence periods ranged from one hour (Szasz et al., 2012) to 15 hours (Ussher et al., 2006). This was verified using CO measures by four studies (Cropley et al., 2007; Nosen & Woody, 2013; Ussher et al., 2006; Ussher et al., 2009). One study (Rogojanski et al., 2011) specified that participants should smoke a cigarette 30 minutes prior to participation to avoid ceiling levels of craving which would obscure cue reactivity effects. However, this was not verified biologically or through observation of smoking.

None of the laboratory studies report whether participants were included or excluded on the basis of current use of nicotine replacement therapy (NRT). Motivational criteria relating to the desire to quit were not consistently reported. Bowen and Marlatt (2009) specified that participants should have ‘some interest’ in reducing their smoking, while Szasz et al., (2012) targeted smokers who “want[ed] to quit, but still smoke[ed]”. Other studies did not specify motivational criteria related to the desire to quit.

Relatedly, the requirement to have an intention to quit was applied variably across studies. Litvin et al. (2012) specified that participants should be intending to quit within six months, while Nosen and Woody (2013) required participants to be willing to commit to a quit date specified by the researchers. Other studies did not measure intention.

3.1.5. Use of cue induced craving

The majority of studies used cues to trigger cravings (Bowen & Marlatt, 2009; Litvin et al., 2012; May et al., 2011; Rogojanski et al., 2011; Szasz et al., 2012) which involved exposure to *in-vivo* cues. The remaining studies did not use cues to trigger cravings.

3.1.6 Experimental manipulations

Various components of psychological flexibility were applied to smoking behaviour and craving outcomes. Three studies examined a mindfulness intervention lasting either 11 minutes (Bowen & Marlatt, 2009), 20 minutes (Rogojanski et al., 2011) or 60 minutes (Nosen & Woody, 2013). Four studies applied a specific body-scanning technique - a component of mindfulness-based stress reduction (MBSR, Grossman, Niemann, Schmidt & Walach, 2004) - to smoking behaviour or cravings (Cropley et al., 2007; May et al., 2011; Ussher et al., 2006; Ussher et al., 2009) lasting approximately ten minutes. Two further studies examined the effects of providing brief instruction in emotion regulation strategies including acceptance (Litvin et al., 2012; Szasz et al., 2012).

All experimental manipulations were delivered in a standardised format (via audio or written instructions). Instructions developed by Bowen and Marlatt (2009) based on ‘urge surfing’ were adopted by two studies (Rogojanski et al., 2011; Szasz

et al., 2012) while three studies used a body scanning audio recording (Cropley et al., 2007; Ussher et al., 2006; Ussher et al., 2009).

Only three studies report matching manipulations between groups for variables such as length of the instructions and frequency of smoking related words (Bowen and Marlatt, 2009; May et al., 2011; Rogojanski et al., 2011). Two studies incorporated an assessment of understanding of and memory for the manipulation (Litvin et al., 2012; Nosen & Woody, 2013). Importantly, Litvin et al., (2012) found that participants in the acceptance group had a poorer understanding of the manipulation than participants in the control groups. Only two studies included a manipulation check, consisting of a measure of individual differences in emotional regulation (Szasz et al., 2012) or a self-report measure of use of strategy (Litvin et al., 2012). Only two studies included a measure of credibility or expectancy (Rogojanski et al., 2011; Ussher et al., 2009).

3.2 Laboratory based component research measures and outcomes

Variables such as craving and nicotine dependence were generally measured pre-manipulation and differences were controlled for in subsequent analyses. Generally studies reported results clearly. Only one study (Litvin et al., 2012) reported the use of the Bonferroni correction to adjust for multiple testing. Table 1 provides information regarding dependent variables and measures.

3.2.1 What are the effects of interventions that are predicted to increase psychological flexibility on behavioural, metacognitive and acceptance-related outcomes?

Only five of the nine studies measured smoking behaviour and cognitive-affective outcomes that would be considered 'primary' outcomes based on theoretical

predictions of the psychological flexibility model. These included behavioural outcomes such as number of cigarettes smoked within a post manipulation follow-up period (Bowen & Marlatt, 2009; Litvin et al., 2012; Rogojanski et al., 2011) and response latency to smoke (Litvin et al., 2012). Nosen & Woody (2013) measured metacognitive beliefs about cravings while Szasz et al. (2012) measured distress tolerance (see Table 1 for details of measures used). Reductions in smoking at follow up were assessed either via self-report or using standardised measures such as the Timeline Follow-back technique (TLFB; Robinson et al., 2014), but were not verified using biological markers.

One study found benefits for interventions consistent with the psychological flexibility model on the number of cigarettes smoked at seven day follow-up (Bowen & Marlatt, 2009) compared to an inactive comparison group. Another study found benefits for meta-cognitive beliefs about cravings compared to both active and inactive comparison groups (Nosen & Woody, 2013).

Other studies study found no benefits for interventions consistent with the psychological flexibility model on number of cigarettes smoked (Litvin et al., 2012; Rogojanksi et al., 2011), latency until first cigarette following participation (Litvin et al., 2012) or distress tolerance (Szasz et al., 2012) compared to various comparison groups.

Four of the nine studies reported follow-up data (Bowen & Marlatt, 2009; Litvin et al., 2012; Nosen & Woody, 2013; Rogojanski et al., 2011). Follow up periods varied from between 24 hours (Bowen & Marlatt, 2009; Nosen & Woody, 2013) to seven days (Bowen & Marlatt, 2009; Rogojanski et al., 2011). Retention at these various follow-up points had a range of 69% - 94% (see Table 1). At follow-up, benefits were found for psychological flexibility on the number of cigarettes smoked

after seven days (Bowen & Marlatt, 2009) and self-efficacy beliefs about achieving a year of abstinence (Litvin et al., 2012) compared to inactive comparisons. Rogojanski et al. (2011) found that both mindfulness and control context conditions led to reduced smoking and self-efficacy at seven day follow-up.

In summary, the experimental component studies do not find consistent support for the psychological flexibility model and its constituent parts upon psychological flexibility targeted outcomes relative to inactive and theoretically distinct interventions.

3.2.2 What are the effects of such interventions upon outcomes related to the frequency and/or intensity of internal experience?

Seven studies assessed the frequency and/or intensity of craving using the Questionnaire of Smoking Urges (Bowen & Marlatt, 2009; Litvin et al., 2012; May et al., 2011; Nosen & Woody, 2013; Szasz et al., 2012) or a single item visual analogue scale (VAS: Nosen & Woody, 2013; Rogojanski et al., 2011). Other measures of 'internal experience' included symptoms of smoking withdrawal (measured using the Mood and Physical Symptoms Scale [West & Hajek, 2004]: Cropley et al., 2007; Ussher et al., 2006; Ussher et al., 2009), desire to smoke (single item; Ussher et al., 2006; Ussher et al., 2009) and frequency of thoughts about smoking (Litvin et al., 2012; May et al., 2011).

Most studies additionally measured other outcomes indirectly related to smoking behaviour and cravings which will not be commented upon; refer to Table 1 for more details.

Compared to inactive comparison groups (defined in section 1.6), five studies found reductions in cravings (Litvin et al., 2012; May et al., 2011; Nosen & Woody, 2013), withdrawal symptoms (Cropley et al., 2007; Ussher et al., 2009), desire to

smoke (Ussher et al., 2009) and negative affect (Litvin et al., 2012) in response to the active intervention. Other studies found no benefits for cravings (Bowen & Marlatt, 2009), withdrawal symptoms (Ussher et al., 2009), desire to smoke (Ussher et al., 2009) or affect (Bowen & Marlatt, 2009) compared to inactive comparisons.

Compared to control context comparison groups (see section 1.6), one study found benefits for the active intervention on negative affect and nicotine dependence (Rogojanski et al., 2011) while another study found no benefits for craving or affect (Litvin et al., 2012). Nosen & Woody (2013) found benefits for psychological flexibility interventions on cravings while other studies found no benefits for craving (Szasz et al., 2012), affect (Szasz et al., 2012), desire to smoke (Ussher et al., 2009) or withdrawal symptoms (Ussher et al., 2009). Two studies found significantly less benefit for interventions contained within the psychological flexibility model upon craving, negative affect, attentional bias (Szasz et al., 2012) and withdrawal symptoms (Ussher et al., 2006) compared to active comparison conditions, which were cognitive restructuring and isometric exercise respectively.

In sum, support for the psychological flexibility model and its constituent parts upon outcomes relating to the frequency and/or intensity of internal experience was inconsistent.

3.3 Treatment outcome studies methodological features

3.3.1 Overview of studies

Table 2 presents the key characteristics of the ten treatment outcome studies. Studies were published between 2004 and 2014, with one article in press at the time of writing (Davis et al., *in press)*. All studies were conducted in the USA with the exception of Hernandez-Lopez et al., (2009) which took place in Spain.

Objectives were clearly presented across the studies; however hypotheses were explicitly stated in only three studies (Brewer et al., 2011; Brown et al., 2013; MacPherson et al., 2010). Primary outcomes were specified in all studies, except Gifford et al., (2004) and Gifford et al., (2011).

3.3.2 Study designs

All studies used random assignment with the exception of Hernandez-Lopez et al., (2009), who used a quasi-experimental design and assigned participants to groups based on geographical location. Participants were assessed on a range of empirically-supported predictors of smoking cessation (such as positive expectations about improving in treatment and stage of change). Between-group differences were controlled for in the statistical analyses across all studies.

All studies used a mixed-group design with 'condition' the between-group and 'time' the within-group independent variables. One study compared a psychological flexibility intervention with an inactive comparison group (non-directed walking; Davis et al., 2013) but all other studies used active comparison groups only, which were informed by various national standards in smoking cessation interventions.

In most studies (with the exception of Davis et al., *in press*; Davis et al., 2014) participants were either blind to study hypotheses or efforts were made to equalise expectations. The RCTs all ensured that treatment allocation was concealed from those who recruited participants. One study (Bricker et al., 2013) also blinded the assessors as a consequence of testing a web-based intervention which was completed remotely.

Table 2. *Treatment outcome research: Characteristics of included studies*

Study	N	Study type	Sample (gender, mean age, level of dependency, length of abstinence)	Psychological flexibility component(s)	Treatment description	Follow up period (% sample retained at follow up)	Psychological flexibility-consistent outcomes (and measures used)	Outcomes relating to the frequency and/or intensity of internal experiences(and measures used)	Additional outcomes (and measures used)
Brewer et al., 2011	88	RCT	63% male, mean age 46 years, average cigarettes per day 20, mean average of 5.2 previous quit attempts, 55% Caucasian	Present moment focus	1. Mindfulness training 2. Freedom from smoking treatment (CBT based)	Week 6 (85%), 12 (86%) and 17 (87.5%) following treatment initiation	Expired-air carbon monoxide-confirmed 7-day point prevalence abstinence ↑, ↑^{FU} Number of cigarettes per day at end of 4 week treatment period ↑, ↑^{FU}	None	None
Bricker, Wyszynski, Comstock & Heffner, 2013	222	Pilot RCT	38% male, mean age 45 years, mean average of 1.45 quit attempts in the past year, 92.5% Caucasian	Comprehensive psychological flexibility model (ACT)	1. Web-based ACT for smoking cessation 2. National Cancer Institute's 'Smokefree' intervention	3 months (53.6%)	30 day point prevalence cessation outcome (self-report) ↑^{FU} Experiential avoidance (AIS) ↑^{FU}	None	Nicotine dependence (2 items from the FTND) Utilisation and satisfaction ↑ Duration of each login↑

Brown et al., 2013	49	Preliminary RCT	51% male, mean age 47.68 years, mean FTND score 6.3, mean cigarettes per day 21.65, 90% Caucasian	ACT elements (acceptance, defusion and values)	1. Multiple components of ACT (Distress Tolerance) 2. Standard smoking cessation treatment	Week 8 (96%), 13 (96%) and 26 (92%) post quit	Week 4 abstinence (7-day point prevalence) ↑ Week 8, 13 and 16 abstinence (7-day point prevalence, after nicotine patch) ↔ <u>On the quit date</u> Experiential avoidance (AAQ) ↔ Smoking specific experiential avoidance (AIS) ↑	<u>On the quit date</u> Negative affect (POMS) ↑ Withdrawal symptoms (MNWS) ↑	Recovery from early smoking lapse in first week↔ Treatment adherence (ACT Tape Rating Scale) ↔
Davis, Manley, Goldberg, Smith & Jorenby, in press	175	RCT	53.3% male, mean age 44.5 years, mean FTND score 4.78, mean cigarettes per day 17.67, mean average of 10.1 previous quit attempts, 88.1% Caucasian	Present moment focus	1. Mindfulness training 2. The American Lung Association's Freedom From Smoking	4 weeks (63.8%), 24 weeks (43.7%)	4 weeks abstinence (Biochemically confirmed and TLFB) ↔ 24 weeks abstinence (Biochemically confirmed and TLFB) ↔ Mindfulness (FFMQ) ↑^{FU} Experiential avoidance (AAQ) ↑^{FU}	Urges (single item) ↑^{FU} Perceived stress (PSS) ↑^{FU}	Class attendance ↔ Compliance to daily meditation of relaxation (Calendar) ↔
Davis, Mills, Stankevitz, Manley, Majeskie & Smith, 2013	55	Pilot randomised trial	70.9% male, mean age 21.9 years, mean cigarettes per day 13.75, 90.9% Caucasian	Present moment focus	1. Mindfulness training for smokers 2. Interactive Learning for Smokers (non-directed walking)	None	7-day point prevalence abstinence rates at 2 weeks post-quit (TLFB, biochemically verified)↔ Number of days abstinent in first 2 weeks ↑	Stress (PSS)	Class attendance ↔ Intervention completion ↔ Practice compliance (daily telephone calls) ↔

Davis, Goldberg, Anderson, Manley, Smith & Baker, 2014	196	Randomized trial	50% male, mean age 41.65 years, mean cigarettes per day 15.75, mean average of 6.51 previous quit attempts, 77.0% Caucasian	Present moment focus	1. Mindfulness training for smokers 2. TAU (telephone quit line)	4 weeks (53.1%) and 24 weeks (28.1%)	4 weeks abstinence (TLFB, biochemically verified) ↑[FU] 24 weeks abstinence (TLFB, biochemically verified) ↑[FU] Mindfulness (FFMQ) ↑	Emotional control (DERS) ↑	Attentional Control Scale (ACS) ↑
Gifford, Kohlenberg, Hayes, Antonnuccio, Piasecki, Rasmussen-Hall & Palm, 2004	76	Pilot study	59% female, mean age 43 years, mean cigarettes per day 21.40, mean average of 4 previous quit attempts, 77% Caucasian	Comprehensive psychological flexibility model (ACT)	1. NRT 2. ACT	6 months 1 year (72.4%)	Post-treatment 24-hour point prevalence abstinence ↔ 6 months 24-hour point prevalence abstinence ↔ 1 year 24-hour point prevalence abstinence ↑[FU] Smoking specific experiential avoidance ↑	Affect (POMS) ↔ Withdrawal symptoms (STWS) ↔	Satisfaction (CSQ-3) ↔ Self-efficacy (TCQ) ↔ Measure of the treatment relationship (WAI)↑ FTND
Gifford, Kohlenberg, Hayes, Pierson, Piasecki, Antonuccio & Palm, 2004	303	RCT	58.7% female, mean age 45.99 years, mean average cigarettes per day 24, Caucasian 89%,	Acceptance	1. Bupropion only 2. Bupropion plus an acceptance and relationship focused behavioural intervention	26 weeks (52.6%) 52 weeks (47.1%	10 weeks post-quit abstinence (biochemically verified and 7-day point prevalence abstinence) ↑ 26 weeks abstinence ↔ 52 weeks abstinence ↑[FU] Experiential avoidance (AAQ) ↔ Smoking specific experiential avoidance (AIS)**Med ↑	Withdrawal ↔symptoms (STWS) Affect (POMS) ↔	Satisfaction with treatment (CSQ-3) ↑, ↑[FU] Working alliance (WAI) **Med ↑

Hernández-López, Bricker, Roales-Nieto & Montesinos, 2009	81	Controlled preliminary trial	64% female, mean age 42.43 years, mean FTND score 5.68, mean cigarettes per day 23.9	Comprehensive psychological flexibility model (ACT)	1. ACT 2. CBT	3 months (56.8%) 6 months (51.9%) 12 months (53.1%)	Abstinence (biochemically verified and point prevalence) 3 months ↔ 6 months ↔ Primary outcome: 12 months $\uparrow^{FU}$ Experiential avoidance (AAQ)	None	Treatment acceptability and adherence ↔
MacPherson, Tull, Matusiewicz, Rodman, Strong, Kahler, Hopko, Zvolensky, Brown & Lejuez, 2010	68	RCT	51.5% male, mean age 43.8 years, mean FTND score 5.95, mean cigarettes per day 18.05, 27.3% Caucasian,	Values and committed action	1. Behavioural activation treatment for smoking plus standard treatment 2. Standard treatment	1 week (78.6%) 4 weeks (83.3%) 16 weeks (61.9%) 26 weeks (64.3%)	1, 4, 16 & 26 weeks abstinence (biochemically verified and 7 day point prevalence) ↑, $\uparrow^{FU}$	Depressive symptoms (BDI-II) ↑, $\uparrow^{FU}$ Enjoyment from daily activities (EROS) ↔	

Note: ↑ = significantly improvement following manipulation; ↔ = no significant difference between groups following manipulation (or follow up); ↓ = significantly less improvement (at end or follow up); $\uparrow^{FU}$ *= improvement significant at follow-up; RCT = Randomised Controlled Trial; AIS = Avoidance and Inflexibility Scale (Gifford et al., 2004); AAQ = Acceptance and Action Questionnaire (Bond et al., 2011); POMS = Profile of Mood States (McNair, Lorr, & Droppleman, 1971); MNWS = Minnesota Nicotine Withdrawal Scale (Hughes & Hatsukami, 1986); FFMQ = The Five Facet Mindfulness Questionnaire (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006); PSS = The Perceived Stress Scale-10 (Leung, Lam, & Chan, 2010); DERS = Difficulty in Emotional Regulation Scale (Gratz & Roemer, 2004); ACS = Attentional Control Scale (Derryberry & Reed, 2002); TAU = Treatment as usual; NRT = Nicotine Replacement Therapy; STWS = Shiffman Tobacco Withdrawal Scale (Shiffman & Jarvik, 1976); CSQ-3 = The Client Satisfaction*

Questionnaire-3 (Nguyen, Attkisson, & Stegner, 1983); TCQ = Treatment Confidence Questionnaire (Condiotte & Lichtenstein, 1981); WAI = Working Alliance Inventory (Horvath & Greenberg, 1989); BDI-II = Beck Depression Inventory-II (Beck, Steer, & Brown, 1996); EROS = Environmental Reward Observation Scale (Armento & Hopko, 2007); FAP = Functional Analytic Psychotherapy (Kohlenberg & Tsai, 1991)

3.3.3 Quality assessment

Table 3 presents quality rating scores from the QATSI. The last column contains the total quality score for each study following discussion and agreement within the two assessors. Higher scores indicate increasing methodological rigour within a study and the maximum achievable score was 56. The scores along the bottom row each indicate the total score across studies for a certain aspect of quality. Higher scores per item indicate a tendency towards the corresponding aspect of quality being present across the treatment outcome studies. The maximum achievable score was 20 for each item.

Table 3. *Quality assessment ratings of the QATSI tool*

	Quality rating item																													
Study	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16[a]**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**Total**
A	2	1	2	2	2	0	0	2	2	2	2	2	2	2	0		1	2	2	2	2	2	2	2	2	2	2	2	2	48
B																														
C	2	2	0	0	2	2	0	2	2	2	2	2	0	2	0		1	2	2	2	2	2	2	2	2	2	2	2	2	45
D	2	2	0	2	2	2	0	2	2	2	2	2	2	2	0		2	2	2	2	2	2	2	2	2	0	2	2	2	48
E	2	1	2	2	2	2	2	2	1	0	2	1	2	2	2		1	2	2	0	0	2	2	2	2	0	2	2	2	44
F	2	1	0	2	2	2	0	2	2	2	2	2	2	2	2		1	2	2	2	2	2	2	2	2	2	2	2	2	50
G	2	1	0	2	2	2	2	2	2	2	2	1	2	2	2		2	2	2	2	2	2	2	2	2	2	2	2	2	52
H	2	0	0	2	2	2	0	2	2	2	2	2	1	2	0		2	2	2	0	2	2	2	2	2	2	2	2	1	44
I	2	2	2	2	2	0	0	2	2	2	2	1	2	2	0		2	2	2	2	2	2	2	2	2	2	2	2	2	49
J	2	1	0	2	2	0	0	2	2	2	2	1	2	2	0		2	2	2	2	2	2	2	0	2	2	2	2	2	44
K	2	1	2	2	2	2	0	2	2	2	2	1	2	2	0		2	2	2	2	2	2	2	2	2	2	2	2	2	50
Total	20	12	8	18	20	14	4	20	19	18	20	15	17	20	6		16	20	20	16	18	20	20	18	20	16	20	20	19	

[a] Item 16 from the original quality assessment tool (Moncrieff and Drummond, 1998) was excluded.

3.3.4 Participants

The studies included a total of 1313 participants (50.7% female; average age 42.2 years, *SD* = 7.36) who smoked an average of 19.6 cigarettes per day (*SD* = 3.55). Sample size ranged considerably from 49 (Brown et al., 2013) to 333 (Gifford et al., 2011) (*M* = 131.3, *SD* = 86.84). Only four studies explicitly report use of power analysis to determine sample size (Bricker et al., 2013; Brown et al., 2013; Davis et al., *in press*; Gifford et al., 2011).

Generally, sample demographic information was described in detail across the studies with information regarding ethnicity, employment and education level provided. Two studies provided only basic information on age and gender (Davis et al., 2014; Hernandez-Lopez et al., 2009). Studies varied in terms of the diversity of their sample. The majority of participants identified their ethnicity as Caucasian (72.2%) with five studies recruiting more than 88% of their sample who identified as Caucasian. Table 2 provides further demographic information.

Most studies provided information regarding pre-treatment smoking level. In four studies standardised measures of smoking level were utilised (Brown et al., 2013; Davis et al., *in press;* Hernandez-Lopez et al., 2009; MacPherson et al., 2010) such as the FTND (Heatherton et al., 1991). In other studies the number of cigarettes smoked per day was quoted, without stating whether this was based on estimate or on the use of standardised and validated self-report measures. All studies verified smoking status using a carbon monoxide (CO) breathalyser. CO levels were also used to verify abstinence in all studies.

Clear information regarding the recruitment and selection process was provided in all studies. Participants were recruited using a range of advertising formats including posters, radio and newspaper adverts and websites. In addition to

direct recruitment through adverts, referrals were also received from local physicians in two studies (Gifford et al., 2004; Gifford et al., 2011). Five of the ten studies sought participants with specific characteristics. These were: history of early lapse (Brown et al., 2013), low socio-economic status (Davis et al., 2014; Davis et al., in press), binge drinking (Davis et al., 2013) and mild depressive symptoms (Macpherson et al., 2010). Four of the ten studies paid participants for their time (Brewer et al., 2011; Brown et al., 2013; Davis et al., 2013; Davis et al., *in press*).

3.3.5 Inclusion and exclusion criteria of reviewed studies

Generally studies presented inclusion and exclusion criteria clearly and reported the number of exclusions made on the basis of each criteria. In two studies over 40% of the eligible population was excluded (Brown et al., 2013; Davis et al., 2013). These high levels are in line with the more specific inclusion criteria used by Brown et al., (2013) and Davis et al., (2013). Since these studies did not intend to generalise their findings beyond smokers with early relapse histories (Brown et al., 2013) or those with binge drinking patterns (Davis et al., 2013) high levels of exclusion cannot be said to adversely affect generalisability of the findings. Ratings on the QATSI reflect this consideration. Participant refusals were reported clearly and constituted more than 20% of the eligible population in five studies (Bricker et al., 2013; Davis et al., 2014; Davis et al., *in press;* Gifford et al., 2011; MacPherson et al., 2010).

All studies provided inclusion and exclusion criteria which specified various baseline levels of smoking required for inclusion. Studies varied in their requirements for and assessment of participants' motivation to quit; some studies required participants to commit to a quit date within one month (Bricker et al., 2013; Brown et al., 2013), others required a self-reported expression of motivation to quit

at screening (Brewer et al., 2011; Davis et al., 2014; Davis et al., in press), while others made no such specification (Davis et al., 2013; Gifford et al., 2004, 2011; Hernandez-Lopez et al., 2009; MacPherson et al., 2010). This may have introduced some variability in receptivity to interventions (Szasz et al., 2012) although there is no reason to suppose receptivity would be different *between* treatment groups.

Studies also differed in their criteria regarding participants' use of nicotine replacement therapy (NRT). Four studies made no stipulation (Brewer et al., 2011; Bricker et al., 2013; Davis et al., 2013; Davis et al., in press), one study excluded participants using NRT to isolate the effect of psychological treatment (Hernandez-Lopez et al., 2009) and four studies utilised NRT within one or more of their comparison groups. Studies which did not require the use of NRT in combination with psychological interventions (Brewer et al., 2011; Bricker et al., 2013; Davis et al., 2013; Davis et al., in press) may have been seeking to isolate the effect of the interventions in the absence of pharmacological effects. However, this may limit the external validity of these findings given the widespread recommendation for dual treatment (behavioural and pharmacological) in smoking cessation. Participants with a psychiatric diagnosis or who were currently using psychotropic medication were commonly excluded, with only two studies not specifying this (Bricker et al., 2013; Davis et al., in press). This may also represent a threat to external validity, given the high prevalence of smoking in people with mental health diagnoses (Farrell et al., 2001).

3.3.6 Interventions

Table 2 provides details of treatments provided. Brewer et al. (2013) delivered twice weekly mindfulness groups for a period of 4 weeks. The intervention was manualised and well matched to the control condition on a range of factors

including session length, day of delivery and the presence of a quit date at week two. Detailed information is provided regarding the content of each session. Bricker et al. (2013) developed an ACT web based intervention, which is described in detail. Brown et al., (2013) delivered a distress tolerance intervention over nine two-hour groups and six individual sessions. Detailed therapist manuals were used which describe exercises drawn from exposure and acceptance based approaches.

Three studies describe a group-based mindfulness intervention which involved six (Davis et al., 2013) or seven (Davis et al., *in press*) two-hour classes followed by a mindfulness retreat to coincide with a scheduled quit date. Group sessions involved following instructions, exercises, group discussions and mindfulness practice although more detailed sessional information is not provided. The mindfulness retreat provided seven hours of guided mindfulness practice. Participants all attended two additional classes which provided a forum for group discussion and peer support. One further study by the same researchers describes a group-based six-session mindfulness intervention (Davis et al., 2014). During each class facilitators would play an instructional video, followed by exercises and individualised instruction. Hernandez-Lopez et al., (2009) delivered an ACT group over seven weekly 90 minute sessions. The group was delivered using a detailed treatment manual and was well matched to the comparison group. MacPherson et al., (2010) delivered eight one-hour behavioural activation sessions which were matched in time with the comparison group. Finally, two studies (Gifford et al., 2004; Gifford et al., 2011) compared an ACT informed smoking cessation intervention which involved both individual and group sessions. Both interventions were manualised and described in detail within the papers.

3.3.7 Comparison groups

Comparison groups took a variety of formats. They included psychosocial groups (Brewer et al., 2011; Brown et al., 2013; Davis et al., in press; Hernandez-Lopez et al., 2009; Macpherson et al., 2010), a web-based intervention involving quit planning, skills training and advice (Bricker et al., 2013), a telephone quit line (Davis et al., 2014), bupoprion treatment (Gifford et al., 2004; Gifford et al., 2011) or a combination of these. The general use of active controls (based on established national standards for smoking cessation interventions) is a strength shared by the majority of studies (with the exception of Davis et al., 2013), although between group differences are less likely to be detected.

In studies examining group-based interventions efforts were made to match the groups for variables such as group size, session structure, day of delivery and contact time (Brewer et al., 2011; Brown et al., 2013; Davis et al., in press; Macpherson et al., 2010).

Treatment was commonly provided by master's students (Davis et al., 2013; Gifford et al., 2011) or clinical psychology doctoral students (Brown et al., 2013; Gifford et al., 2004; Hernandez-Lopez et al., 2009; MacPherson et al., 2010). Three studies used accredited clinical psychologists (Brewer et al., 2011; Hernandez-Lopez et al., 2009; MacPherson et al., 2010) or other therapists with relevant and completed training (Davis et al., 2014).

Some studies assessed variables which might account for responses to treatment including treatment satisfaction (Bricker et al., 2013; Gifford et al., 2004; Gifford et al., 2011), session attendance (Davis et al., 2013; Davis et al., in press) and treatment acceptability (Davis et al., 2013; Hernandez-Lopez et al., 2009). However, factors such as credibility and outcome expectancy were not measured. A more

widely used measure of treatment integrity was therapist adherence, which was assessed using rating scales (Brown et al., 2013; Gifford et al., 2011; Hernandez-Lopez et al., 2009; Macpherson et al., 2010) or within supervision (Gifford et al., 2004). As such, only five studies measured therapist adherence out of the nine studies in which it was relevant.

3.3.8 Follow-up

All studies collected data on abstinence at multiple follow up periods (see Table 2) with the exception of Davis et al., (2013). Follow-up periods varied from four weeks (Davis et al., *in press*) to one year after treatment initiation or quit date (Gifford et al., 2004; Gifford et al., 2011; Hernandez-Lopez et al., 2009). Abstinence was verified using biochemical markers in all studies except Bricker et al., (2013) who relied only on self-report due to practicalities resulting from the use of an off-site web-based intervention.

Rates of attrition varied considerably at follow up. High attrition at follow-up often reflected expected rates for the samples in question (e.g. participants in a web-based intervention, Bricker et al., 2013; young binge drinkers, Davis et al., 2013). These studies may be especially susceptible to reduced statistical power and external validity. The impact of high rates of attrition upon outcomes was partially controlled for by the widespread use of conservative intent-to-treat analyses in all except two studies (Bricker et al., 2013; Gifford et al., 2004), although no statistical method will fully compensate for missing data.

3.4 Treatment outcome research measures and outcomes

Results were clearly reported across the studies and all included effect sizes and confidence intervals using odds ratios, with the exception of Brewer et al. (2011)

who reported correlation coefficients. Means and standard deviations were less consistently reported with only three studies providing this information (Davis et al., 2013; Davis et al., 2014; Davis et al., *in press*).

3.4.1 What are the effects of interventions that are predicted to increase psychological flexibility on behavioural, metacognitive and acceptance-related outcomes?

All treatment outcome studies measured psychological flexibility targeted outcomes (as defined in section 1.6). The primary outcome was biologically verified point prevalence abstinence. Other theoretically targeted outcomes included general experiential avoidance (Bricker et al., 2013; Brown et al., 2013; Gifford et al., 2011; Hernandez-Lopez et al., 2009), smoking specific experiential avoidance (Brown et al., 2013; Gifford et al., 2004; Gifford et al., 2011) and measures of mindful awareness (Davis et al., 2014; Davis et al., in press).

Post-treatment benefits for psychological flexibility interventions upon abstinence were found in four studies (Brewer et al., 2011; Brown et al., 2013; Gifford et al., 2011; Macpherson et al., 2010). Other studies also found beneficial post-treatment effects for psychological flexibility interventions upon smoking abstinence; however these between group differences did not reach statistical significance (Brown et al., 2011; Davis et al., 2013; Davis et al., *in press*). Reductions in experiential avoidance were also evidenced, either generally or specifically in relation to smoking (Bricker et al., 2013; Brown et al., 2013; Gifford et al., 2004; Gifford et al., 2011; Hernandez-Lopez et al., 2009).

At various follow-up points (see Table 2) post treatment benefits for psychological flexibility interventions upon abstinence were found for seven studies (Brewer et al., 2011; Bricker et al., 2013; Davis et al., 2014; Gifford et al., 2004;

Gifford et al., 2011; Hernandez-Lopez et al., 2009; Macpherson et al., 2010). Interestingly, the effect sizes for ACT without medication at one year follow-up (*OR*=4.2, *CI* 1.04-16.73; Gifford et al., 2004) were larger than in a later study which investigated ACT with medication (*d*=0.33, Gifford et al., 2011).

Table 4 provides the results of the analysis of abstinence effect sizes. There was a significant effect size for psychological flexibility interventions upon post treatment abstinence (*OR = 1.98;* 95% *CI* = 1.47 – 2.67; *p < .001).* Therefore the odds of abstinence post-treatment were 1.98 higher in the psychological flexibility groups than comparison groups. There was also a significant effect size for psychological flexibility interventions upon abstinence at six months follow-up (*OR = 2.06;* 95% *CI* = 1.38 – 3.07; *p < .001).* The odds of abstinence were 2.06 higher in the psychological flexibility groups than comparison groups. According to Rosenthal's (1996) criteria, both of these effect sizes would be considered small – medium.

Table 4. *Effect sizes for abstinence*

Abstinence measurement point	*k*	Treatment as usual control group	Psychological flexibility group	*OR*	95% CI	*z*	I^2
Post-treatment abstinence	9	524	481	1.98	[1.47 – 2.67]	4.48*	5%
Six months follow-up abstinence	8	433	398	2.06	[1.38 – 3.07]	3.52*	0

Note: k indicates the number of pooled effect sizes, CI = confidence interval

* $p < .001$

3.4.2 What are the effects of such interventions upon outcomes related to the frequency and/or intensity of internal experience?

Treatment outcome studies additionally measured other outcome measures not directly targeted by the psychological flexibility model. These included affect, withdrawal symptoms, stress and depressive symptoms. Benefits for psychological flexibility interventions were found for negative affect (Brown et al., 2013; MacPherson et al., 2010), withdrawal symptoms (Brown et al., 2013), cravings and stress (Davis et al., in press). Two studies found no benefits upon affect or withdrawal symptoms (Gifford et al., 2004; Gifford et al., 2011).

Discussion

This review draws together the empirical literature on the application of interventions informed by or consistent with the psychological flexibility model of psychopathology to smoking cessation and related outcomes. Since one of our aims was to consider how basic clinical science could inform clinical research, we reviewed both experimental, laboratory-based studies as well as treatment outcome research.

Overall, a review of both this research suggests that the development of psychological flexibility in smokers through the use of mindfulness, acceptance and integrated (ACT) strategies is an effective way of achieving important outcomes such as abstinence. However, the review also identifies key limitations in methodology which may limit the widespread adoption of these interventions until future research address these.

4.1 Experimental component studies

Experimental component studies examining components of the psychological flexibility model do not appear to provide support for the model in reducing smoking behaviour or other theoretically relevant outcomes compared to comparison conditions. However, it is worth reiterating at this point that the purpose of laboratory-based component studies is rarely to establish clinical impact or to model treatment outcomes, but rather to develop insight regarding the validity of theoretical concepts which can then be used to refine treatments. Despite this, it is striking that only two studies identified a benefit for a psychological flexibility model-consistent intervention on theoretically relevant outcomes (i.e. smoking behaviour, Bowen & Marlatt, 2009; meta-cognitive beliefs about cravings, Nosen & Woody, 2013). Unfortunately, the findings from Bowen & Marlatt (2009) are difficult to generalise since its participants were untypical (they had low levels of nicotine dependence) and no biological verification of smoking behaviour was used at follow-up.

More generally, the review identified that many of the studies assessed severity of *cravings*. However, the psychological flexibility model proposes that strong emotions (like craving, and attendant negative affect) are likely to change indirectly and as a consequence of changes in theoretically defined primary outcomes (e.g. reductions in experiential avoidance, improved mindful attention and acceptance). This has been demonstrated in a variety of psychological and physical disorders (Hayes et al., 2006). The focus on *changes in* cravings and other aspects of internal experience in some of the included studies is particularly problematic in studies in which the comparison condition consists of an intervention which *does* aim to change internal experience more directly and immediately (e.g. reappraisal; Szasz et al, 2012). The result may be bias in short-term effects against the psychological

flexibility model-consistent intervention. This appears to be an issue that laboratory based component studies examining 'micro-interventions' (often lasting mere minutes) are generally susceptible to. Specifically, craving and other internal experiences are easier to track and report in acute studies and are much more likely to respond to micro-interventions than behaviour over the course of hours or days is. Nevertheless, this does not necessarily constitute a methodological criticism of the included studies, since studies were often derived from an alternative therapy mode which may aim to reduce aspects of internal experience (for example, mindfulness-based stress reduction; Grossman et al., 2004).

Other methodological features of the experimental component studies may help to explain the apparent inconsistent impact of psychological flexibility model-consistent interventions on outcomes. Biological markers of smoking status and abstinence were inconsistently used, casting uncertainty on the level of smoking within samples. Inconsistent reporting of current use of nicotine replacement therapy (NRT) within the samples raises the possibility of between-group differences in physiological responses to the withdrawal symptoms induced by temporary abstinence. Measures of credibility or expectancy were only used in two of the nine studies. Such assessment is important, particularly given the difficulties of masking the intention of psychological interventions (Turk, Rudy, & Sorkin, 1993) and considering that ACT approaches which do not privilege symptom reduction may be experienced as counter-intuitive by participants (Eifert & Forsyth, 2005). The majority studies did not measure participants' intention to quit, raising the possibility of variation in receptivity to the experimental manipulations.

Manipulation checks seldom featured, leaving uncertainty regarding whether the brief manipulations reported in the component studies possessed face validity and

were adequately understood and implemented by participants. Indeed, Litvin et al., (2012) found that participants in the acceptance group had a poorer understanding of the manipulation than participants in the control condition. This issue is particularly salient for studies which recruited non-treatment seeking participants with unspecified levels of motivation to quit, who may be less motivated to engage in the strategy and generally less susceptible to brief experimental manipulations.

It is also important to note that some studies used only audio or written instructions to guide participants through an intervention rather than experiential exercises and metaphors, which would be more consistent with ACT theory. According to Relational Frame Theory (Hayes, Barnes-Holmes & Roche, 2001) the use of 'mere' language (i.e. instructions in the absence of understanding grounded in experience) to develop psychological flexibility would be questioned on theoretical grounds when language itself is hypothesised to be at the core of inflexibility. Indeed, a recent meta-analysis suggested that interventions which only provide a rationale for the use of psychological flexibility procedures (rather than providing metaphors and experiential practice) should be considered inert (Levin et al., 2012). Instructions explaining one aspect of the psychological flexibility model in isolation may also have failed to adequately represent the process. For example, instructions regarding acceptance which fail to reference values or committed action (Szasz et al., 2012) may lead to assumptions about the need to *tolerate* strong unpleasant feelings rather than developing *willingness* and openness to experience in the interests of value consistent action.

There are other difficulties with such instructions when specifically testing components of the psychological flexibility model. In particular, psychological flexibility-informed interventions should not create expectancies regarding symptom

change as a result of employing such a strategy. As such, describing acceptance as a '*coping strategy'* (Litvin et al., 2012) is inconsistent with the psychological flexibility model, which emphasises the benefits of *willingness* to experience thoughts and feelings rather than strategies for 'coping' with them.

4.2 Treatment outcome studies

The treatment outcome studies consistently measured outcomes that were theoretically relevant to the psychological flexibility model. These studies provided more consistent support for the application of the model to smoking behaviour. Post-treatment benefits for psychological flexibility interventions upon smoking abstinence were found in six studies, while follow-up post treatment benefits for psychological flexibility interventions upon smoking abstinence were found for nine of the ten studies. These improvements were often associated with a decrease in experiential avoidance, supporting psychological flexibility as a treatment mechanism. A further study reported large effect sizes that tended to support the benefits of psychological flexibility upon smoking cessation which did not achieve statistical significance, perhaps due to issues relating to power (Davis et al., 2013).

The small-medium weighted effect sizes found for interventions consistent with the psychological flexibility model suggest the interventions are likely to have high levels of clinical significance and cost effectiveness. Indeed, if six months of continuous abstinence is considered the key indicator of a successful outcome (West et al., 2005), even small effect sizes translate into very substantial reductions in premature death and financial savings (West, 2007). For example, an increase of just one percent in abstinence rates at six months leads to three additional years of life for every 100 40-year-old smokers treated (West, 2007). If this one percent increase in abstinence were to cost £100 to deliver, the cost per life-year gained would be

approximately £6600 (West, 2007). This is far less than estimated median cost per life-year gained for other life-saving treatments (£10,000; Bell et al., 2006). This places the clinical significance and cost effectiveness of psychological flexibility-informed interventions for smoking cessation beyond question, particularly since these effect sizes reflect comparisons with national standards in smoking cessation interventions rather than no treatment comparisons.

The QATSI indicated some common methodological strengths across the treatment outcome studies. These relate specifically to the use of active comparison groups which often utilised national standards in smoking cessation and randomisation to groups. This was with the exception of one study (Hernandez-Lopez et al., 2009) whose quasi-experimental design risked introducing bias by allocating participants recruited by one university to CBT and others to ACT.

Other strengths included the clear reporting of inclusion and exclusion criteria and detailed reporting of demographic information. However, this highlighted some possible under-representation of ethnic minorities and people with psychiatric diagnoses within the samples. The majority of participants identified their ethnicity as Caucasian (72.2%) with five studies recruiting more than 88% of their sample who identified as Caucasian. Depending on whether these figures reflect the demographics of the population from which the samples were drawn, this may represent a continuation of the historic underrepresentation of ethnic minorities in smoking cessation studies (Macpherson et al., 2010) and limit the generalisability of the findings.

Common weaknesses in methodology across the treatment outcome studies included the limited reporting of power analyses and variable sample sizes, which may have impacted on the power to detect effects. Also highlighted was the

inconsistent use of measures of important variables such as credibility and expectancy. It is notable that the interventions tended to be reasonably resource intensive, often offering participants weekly sessions. Given the prevalence of smoking and the high numbers of people seeking support it may be necessary to evaluate treatment outcomes using briefer interventions, for which laboratory based component studies may provide valuable insight.

Another significant limitation characterising the treatment outcome studies was the high rate of attrition at various follow-up points. High rates of attrition may have resulted in a self-selected sample consisting of those who were most receptive to the training, thus artificially increasing effect sizes. Conversely, attrition may have suppressed abstinence reports and reduced effect sizes within intent to treat analyses which usually considered non-attendance as a relapse.

4.3 Clinical implications and recommendations for future research

Future research should seek to address the limitations of the laboratory based component studies reviewed here by including biological markers of smoking status, measures of credibility and manipulation checks. Future experimental research should also aim to utilise a broader range of outcomes and specify the primary outcomes as either behavioural (reduced smoking), meta-cognitive (e.g. reduced personal significance attributed to smoking-related beliefs) or reduced experiential avoidance, for example.

The weighted effect sizes found for interventions consistent with the psychological flexibility model within the treatment outcome studies reviewed here suggest that smoking cessation interventions consistent with the psychological flexibility model hold considerable clinical utility and cost effectiveness. The

efficacy of these smoking cessation interventions is particularly striking considering that these effects were achieved in comparison with existing national standards in smoking cessation. Future research should seek to address the limitations of the treatment outcome studies reviewed here by including measures of important variables such as credibility. Given the high attrition in this population, future studies may also benefit from seeking to delineate smokers who respond well to a psychological flexibility intervention from those who do not.

The review has found support for the hypothesis that cultivating psychological flexibility may offer scope to target the associative learning process which maintains nicotine addiction, rather than teaching avoidance or otherwise circumventing cues. Given that pharmacotherapies are thought to target background rather than cue-induced craving (Ferguson & Shiffman, 2009) it is possible that a combination of pharmacotherapies and increased psychological flexibility may not only help to achieve initial cessation but also contribute to longer term cessation rates by targeting the 'addictive loops' (Brewer et al., 2013), therefore reducing likelihood of relapse once medication is ceased (Brewer et al., 2011). This may result from the targeting of both background and cue-induced craving and the potential of psychological flexibility to facilitate alternative, adaptive associations in smokers by increasing awareness of a conditioned stimulus.

On the other hand, the symptom reduction emphasis of pharmacotherapies such as NRT may somewhat undermine psychological flexibility processes (particularly acceptance). Indeed, the effect size for ACT without the addition of medication in Gifford et al., (2004) was larger than the effect size for a similar ACT intervention with medication (Gifford et al., 2011). Further research is needed to address this issue.

4.4 Limitations of current review

A formal rating scale was not used to assess the methodological quality of the laboratory based component studies. This decision was informed by the difficulty of establishing methodological standards for this type of laboratory-based experimental research, given the heterogeneity within these studies and the common lack of relevant details within method sections (Levin et al., 2012). Psychological flexibility researchers have begun to highlight methodological issues which should be considered when designing laboratory based component studies (Barnes-Holmes & Hayes, 2003) but these have not yet been published.

The current review did not include non-published studies and studies published in languages other than English. These decisions were motivated by practical restraints and the use of publication as a benchmark of methodological quality, but will have increased the risk of bias within the results.

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Part 2: Empirical paper

A comparison of defusion, reappraisal and suppression as emotion regulation strategies in smokers: Effects on smoking behaviour, craving and affect

Abstract

Aim: To compare the effects of emotion regulation strategies that target smoking-related thoughts on behavioural, affective and subjective correlates of smoking.

Method: Seventy-five participants were sequentially allocated to cognitive defusion (n=25), reappraisal (n=25) or suppression (n=25) conditions and applied these strategies to thoughts associated with smoking during a cue-induced craving procedure in a single experimental session. Dependent variables included smoking behaviour, behavioural approach/avoidance bias, and subjective measures of experiential avoidance, cue-induced craving, and affect.

Results: Defusion and reappraisal were associated with restraint in smoking behaviour in the immediate post-session period and a reduction in smoking at seven day follow-up compared to suppression. Benefits for smoking behaviour were associated with a reduction in craving in the reappraisal condition and a greater reduction in experiential avoidance in the defusion condition. Those in the suppression condition exhibited the strongest approach bias for smoking related cues but also rating the strategy as having lower credibility and treatment expectancy relative to the two other conditions.

Conclusion: Defusion and reappraisal resulted in similar benefits in terms of smoking-related behavioural outcomes. However, defusion and reappraisal were associated with distinctive experiential and affective outcomes. The results are considered in the context of lower credibility and expectancy ratings in the suppression condition and discussed with reference to the development of Cognitive Therapy and Acceptance and Commitment Therapy for addiction-related disorders.

Introduction

Projections indicate that by the end of the 21st century, tobacco use will have killed over one billion people (Shafey, Eriksen, Ross & Mackay, 2010). Smoking is the primary cause of preventable illness and premature death in the United Kingdom, accounting for approximately 100,000 deaths per year (Statistics on Smoking: England, 2012). Smoking incurs costs of £5.2 billion to the NHS annually while the total cost of smoking to England is estimated at £13.74 billion per year (Allender, 2009). While smoking rates are declining at approximately 0.5% annually (West & Brown, 2012), those who try to quit often resume, perhaps because of the distress and negative affect associated with craving (Brown, Lejuez, Kahler, Strong & Zvolensky, 2005).

1.1 Negative affect and craving

Craving is central to nicotine addiction with behavioural, physiological and cognitive correlates reflecting activation of motivational systems (Sayette, Martin, Hull, Wertz & Perrot, 2003). Craving for nicotine has been conceptualised within models that emphasise conditioned reinforcement (Li, 2000), incentive-sensitisation (Robinson & Berridge, 2000), dopamine system dysregulation (Grace, 2000), social learning (Marlatt & Gordon, 1985) and cognitive processing (Tiffany, 1990). This intense affective-motivational experience is also hypothesised to modulate approach behaviour, which involves the tendency of motor actions to be biased towards approaching smoking-related stimuli in preference to other stimuli (Mogg, Bradley, Field & De Houwer, 2003; Stacy & Wiers, 2010). Craving enhances these biases which, in turn, increase craving (Robinson & Berridge, 2000). Unsurprising this

process is implicated in the high rates of relapse associated with nicotine addiction (West & Grunberg, 1991).

Negative affect has been linked to tobacco use through conditioning, motivational and neurobiological models of addiction (Carmody, Vieten & Astin, 2007). The 'negative affect model' of nicotine dependence suggests that the initiation and maintenance of nicotine dependence is partly determined by both a tendency to experience and low tolerance for negative affect. This model suggests that nicotine dependence is maintained by 'emotion regulation' problems (emotion regulation refers to a range of responses designed to influence "which emotions we have, when we have them, and how we experience and express them" [Gross, 2002, p.282]) and an expectation that smoking will reduce negative affect (Brown, Lejuez, Kahler, Strong & Zvolensky, 2005). The degree of negative affect predicts relapse independently of withdrawal symptoms (Piasecki, Jorenby, Smith, Fiore & Baker, 2003). These findings suggest a role for strategies that enhance the ability to regulate negative affect in promoting abstinence.

1.2 Emotion regulation

Individuals differ in their habitual use of emotion regulation strategies to manage strong affect. These strategies may include avoidance, reappraisal, rumination, escape, suppression, distraction, problem-focused coping and use of drugs or alcohol to increase or blunt emotional experience (Gross, 1998). Most of these strategies subsume a range of responses which aim to alter the form, frequency or situational occurrence of an emotional experience. Some strategies such as rumination (Nolen-Hoeksema, Wisco & Lyubomirsky, 2008) and thought suppression (Gross & Thompson, 2007) can be unhelpful. For example, attempts to

suppress unwanted thoughts can exacerbate the experience (Wegner, 1994). Other strategies are more effective in minimising the negative impact of an aversive event (Gross, 1998, 2002). Cognitive Behavioural Therapy (CBT) is an effective treatment for a wide range of mental health conditions (Butler, Chapman, Forman & Beck, 2006) and focuses on how thoughts impact upon an individual's response to strong affect such as craving (Marlatt & Gordon, 1985). Therapeutic strategies based on this model involve reappraisal (or 'cognitive restructuring,' the term used in cognitive therapy literature) of beliefs and outcome expectancies relating to self-efficacy (for example, in managing craving) and drug effects (Marlatt & Gordon, 1985).

However, the specific contribution of cognitive restructuring to the efficacy of CBT has been disputed (Longmore & Worrell, 2007). Research suggests that attempts to change, reduce or suppress unwanted thoughts can inadvertently increase their frequency (Deacon, Fawzy, Lickel & Wolitzky-Taylor, 2011; Hooper, Saunders & McHugh, 2010; Wegner, Schneider, Carter & White, 1987). More recently developed new forms of CBT ('third wave' approaches) such as Acceptance and Commitment Therapy (ACT; Hayes, Strosahl & Wilson, 1999) have been proposed, which emphasise an individual's *relationship towards* his/her thoughts rather than targeting their form or frequency (Hayes, 2004; Segal, Teasdale & Williams, 2004). ACT incorporates strategies including mindfulness, acceptance and 'cognitive defusion' to decrease experiential avoidance, increase psychological flexibility and promote behaviour consistent with values (Hayes et al., 1999).

ACT is sometimes positioned in opposition to CBT (e.g., Hofmann & Asmundson, 2008) despite its proponents consistently locating it within the larger collection of behavioural and cognitive therapies (Forman & Herbert, 2009; Hayes, Wilson & Strosahl, 1999). The broad aims of both CBT and ACT are to help

individuals select behaviours and experiences that are not simply guided by momentary craving and other strong emotions. In this respect, the outcome of successful CBT/ACT is emotion regulation.

Scepticism in ACT regarding the need to identify and reappraise distorted cognitions or to modify dysfunctional beliefs (Beck, 2011) reflects a philosophy of science called functional contextualism and a contemporary operant theory of human language and cognition called relational frame theory (RFT; Hayes, Barnes-Holmes & Roche, 2001).

1.3 Functional Contextualism and RFT

ACT is grounded in a philosophy of science called functional contextualism, which takes a functional and pragmatic approach to the utility of emotion regulation. As such, success of an emotion regulation strategy depends upon whether the desired outcome is achieved (Forsyth, Eifert & Barrios, 2006). This depends upon context. It is proposed that behaviour can only have meaning with reference to context. The 'truth' criterion of success depends on effective working towards values and the unit of analysis is the behaviour (which refers to overt action *and* psychological events such as thinking, feeling, sensing and remembering) in context. Functional contextualists seek to *predict* and *influence* the interactions between a psychological event and a situational or historical context (Hayes, Strosahl & Wilson, 2012). Therefore, models which specify the relation of one psychological event to another (including thought-behaviour relations in the case of traditional CBT) are considered incomplete without identifying contextual variables which can be changed to exert influence on behaviour (Biglan & Hayes, 1996). Rather than emphasising change in the *form* of private experience, ACT advocates changing the *function* of private

experiences by altering the context in which thoughts and feelings are usually related to overt behaviour. This is achieved through treatment methods such as defusion, which are informed by RFT (Hayes et al., 2001).

RFT conceptualises language as a form of relational operant behaviour; we speak or think as we do because of what has been previously reinforced. Humans learn to use language to relate stimuli in ways that change how we respond to these stimuli. This ability allows humans to form relations between virtually any two stimuli, including words, objects, thoughts and feelings. As children develop, relations require less deliberate learning and instead can be derived. This 'derived stimulus responding' is considered a pervasive influence upon almost all aspects of human behaviour, responsible for great achievement, creativity and problem solving but also implicated in the development of pathology and distress. These derived stimulus relations structure our world to the extent that they begin to form automatically, without conscious control. In this respect, RFT conceptualises language and cognition as consisting of largely arbitrarily learnt relations, which people tend to treat as absolute truths.

For example, consider a smoker who values being healthy and wishes to quit smoking. Based on his learning history, he may relate 'feeling relaxed' with 'smoking'. He may easily derive relations including (1) 'smoking helps me to stop feeling anxious' or (2) 'without smoking I will be unable to relax'. Fusion with a cognition such as 'smoking helps me to stop feeling anxious' increases the likelihood that behaviour becomes controlled by this thought. The individual therefore confuses the *content* of thoughts with the *process* of thinking. As a result, behavioural repertoires narrow and continued smoking becomes more likely.

This state of 'cognitive fusion' can also facilitate avoidance of aspects of psychological experience (such as smoking to relieve anxiety), even when doing so leads to behaviour which is inconsistent with a value such as 'being healthy'. Indeed, people with higher tendencies towards experiential avoidance in response to stress tend to smoke more (Pirkle & Richter, 2006) and are more likely to relapse (Gifford, Kohlenberg, Hayes, Antonuccio, Piasecki, Rasmussenhall & Palm, 2004). Conversely, the process or strategy of noticing cognitions and *looking at* thoughts rather than *from* them involves defusion.

Defusion is a strategy used to undermine the behaviour controlling functions and literal believability of thoughts (Twohig, Masuda, Varra & Hayes, 2005). Defusion is not a term that is currently recognised in the emotion regulation literature. However, like reappraisal, individuals can be taught to reliably use this strategy (see below). Individuals are introduced to the experience of perceiving thoughts from a detached perspective. By taking this detached perspective, thoughts become less dominant determinants of behaviour.

1.4 Defusion and the current evidence for smoking cessation

Indirect support for the effectiveness of cognitive defusion in smoking cessation is derived from ACT treatment programmes that include these strategies (Bricker, Wyszynski, Comstock & Heffner, 2013; Brown et al., 2013; Gifford et al., 2004; Gifford, Kohlenberg, Hayes, Pierson, Piasecki, Antonuccio & Palm, 2011; Hernández- López, Bricker, Roales-Nieto & Montesinos, 2009). Developing an understanding of the effectiveness of defusion as a treatment component remains an important goal in optimising ACT treatments (Levin, Hildebrandt, Lillis & Hayes,

2012). Studies have begun to provide more direct evidence for the effectiveness of defusion as a critical ingredient of ACT.

Experimental studies of defusion have commonly applied defusion techniques to negative self-referential thoughts. One technique is based on Titchener's (1916) word-repetition exercise, in which continual and fast verbal repetition of a word leads to a temporary decrease or loss in the word's semantic meaning (Lambert & Jakobovits, 1960). For example, Masuda, Hayes, Sackett, and Twohig (2004) reduced self-relevant negative thoughts to a single word and found that fast, continual repetition of this word led to a reduction in discomfort and believability of the original negative self-referential thought. This reduction was achieved quickly (in less than 25 seconds; Masuda, Hayes, Twohig, Drossel, Lillis & Washio, 2009) and was more effective when a clinical rationale, brief training and experiential practice were provided (Masuda, Feinstein, Wendell, & Sheehan, 2010). An alternative defusion strategy involves creating a sense of psychological distance between a thought or feeling by prefixing expression of the experience with 'I notice that…..' (e.g. 'I notice that I'm having the thought that I'm a bad person'). This strategy also decreases the stimulus functions (i.e. emotional discomfort) of this thought and reduces experiential avoidance (Healy, Barnes-Holmes, Barnes-Holmes, Keogh, Luciano & Wilson, 2008).

These experimental studies commonly used non-clinical samples without an active comparison condition. Outcome measures tended to be self-report measures of attitude or subjective state rather than implicit or behavioural measures. Furthermore, the longer-term impact of defusion techniques was not tested beyond approximately five minutes post-intervention (Masuda et al., 2004, 2009, 2010). Substantial questions therefore remain regarding its effectiveness (Deacon, Fawzy, Lickel &

Wolitzky-Taylor, 2011). Moreover, there are currently no studies that have examined the specific utility of defusion in substance-use disorders.

Nonetheless, a limited amount of recent research addresses these methodological limitations in studies which have indirect relevance to substance use disorders. For example, a brief defusion procedure for chocolate cravings led to greater behavioural change (specifically a reduction in the amount of chocolate eaten) than suppression or control conditions (Hooper, Sandoz, Ashton, Clarke & McHugh, 2012). In a similar study, Jenkins and Tapper (2013) demonstrated that a brief defusion intervention led to less chocolate consumption post-intervention and over the following five days than both acceptance and relaxation conditions. Hooper and McHugh (2013) compared defusion and experiential avoidance as strategies for coping with unwanted thoughts during a learned helplessness preparation prior to a maze task. Those who engaged in defusion were quicker to complete the maze task, suggesting fusion with unwanted thoughts was overcome.

Only two other studies to date have compared defusion with established, active cognitive emotion regulation strategies. Moffitt, Brinkworth, Noakes and Mohr (2012) compared cognitive reappraisal and cognitive defusion for managing chocolate cravings. Following a 60 minute DVD which presented a variety of defusion instructions and exercises, those in the defusion condition consumed less chocolate. This difference only remained significant for participants high in baseline distress. Deacon et al., (2011) compared defusion with reappraisal in a clinical analogue sample of participants distressed by negative cognitions regarding body shape. The results support shorter-term benefits of defusion in line with Masuda et al., (2004, 2009, 2010) and suggest that defusion effects generalised beyond the

targeted thought. However, similar effects were found for both cognitive strategies and the effect was no longer present at one week follow-up.

To summarise, experimental studies suggest that cognitive defusion techniques may have clinical utility. However, methodological limitations of the existing research mean that important questions remain, not least about the applicability and effectiveness of this approach beyond negative self-referential thoughts in healthy participants.

Recent comparisons have been made between cognitive reappraisal, cognitive suppression and acceptance. Acceptance is another feature of ACT that involves active acceptance of psychological events without attempts to change them, in the interests of moving towards values. Studies comparing these strategies for managing anxiety (Hofmann, Heering, Sawyer & Asnaani, 2009), other aversive emotions (Wolgast, Lundh & Viborg, 2012), anger (Szasz, Szentagotai & Hofmann, 2011) and cravings in smokers (Szasz, Szentagotai & Hofmann, 2012) found consistent support for cognitive reappraisal over acceptance and suppression. However, some of this research has been conducted by researchers with an allegiance to 'traditional CBT', which may espouse the value of reappraisal over acceptance. Furthermore, the acceptance instructions used in these studies were brief and not consistently matched across the groups. These instructions also do not tend to refer to 'values,' which may have led to participants misinterpreting acceptance instructions as advocating *tolerance* rather than *openness* to experience in the interests of value consistent behaviour. The credibility of the strategies was not assessed and their impact was commonly evaluated in terms of effectiveness in reducing aspects of internal experience, which is not the primary focus of acceptance (Hayes et al., 2012).

Hoffman et al. (2009) call for further research to explore the impact of other strategies derived from ACT and for research which looks beyond the immediate impact of these experimental manipulations. The current study seeks to contribute to the literature in this way and has been designed to address methodological limitations of previous research. It was also of interest to determine whether the strategy was effective at seven days follow-up.

The strategies of reappraisal and defusion tend to have beneficial shorter and longer-term effects on emotion regulation. Cognitive suppression on the other hand, which involves the effortful and deliberate attempt to prevent distressing thoughts and feelings from coming into awareness, tends to be ineffective or have paradoxical effects on emotion regulation (Gross & Thompson, 2007).

1.5 Study aims and research questions

The current study aimed to examine the comparative effects of brief instruction in defusion, reappraisal and suppression upon smoking-relevant and theory-consistent outcomes. In particular the study examined the acute effects of these instructions on smoking behaviour, behavioural approach/avoidance bias, and subjective measures of experiential avoidance, cue-induced craving, and affect. Based on existing literature (Gross & Thompson, 2007), we hypothesised that suppression would be associated with higher levels of smoking behaviour and experiential avoidance, greater approach/avoidance bias to smoking cues and higher levels of craving and negative affect.

The CBT model of psychopathology predicts that reappraisal of smoking related cognitions will be associated with the greatest impact on smoking behaviour, weaker approach bias to smoking cues and the least craving and negative affect. The

ACT model does not primarily focus on changing or reducing internal experiences, therefore craving, affect and approach bias are not predicted to change in response to defusion instructions. Rather, since defusion strategies aim to alter the context and therefore the function of thoughts it was predicted that defusion would be associated with the greatest impact on smoking behaviour.

Barnes-Holmes and Hayes (2003) highlight methodological issues which should be considered when designing laboratory based component studies and experimental analogues of ACT processes. For example, participants should articulate intervention strategies and the verbal material should be checked to ensure the manipulation successfully altered the intended behavioural process. Interventions should include active and experiential elements, due to the weakness of rationale-alone interventions evidenced by meta-analyses (for example, Levin et al., 2012). These recommendations were used in the current study.

Method

2.1 Participants: Characteristics, recruitment and retention

Participants were 75 adult smokers recruited through online announcements, posters, leaflets and word of mouth. The advertisement sought volunteers who ‘speak fluent English, are aged between 18-50 years old and smoke five or more cigarettes per day but want to quit in the future’. People who have some level of desire to quit were targeted, based on the assumption that they will be more engaged with and responsive to experimental inductions of strategies of emotion regulation (Szasz et al., 2012). The experiment was not advertised as a smoking cessation treatment.

Other inclusion criteria included being willing to abstain for at least two hours prior to participation and expressing motivation to quit by selecting item four

or lower on the Motivation to Stop Scale (MTSS; Kotz, Brown & West, 2013). Item four states 'I really want to stop smoking but I don't know when I will' (as such those who endorsed items five, six or seven indicated lower degrees of motivation and were therefore excluded). Further inclusion criteria were: moderate nicotine dependence (measured by a score of ≥4 on The Fagerström Test of Nicotine Dependence; Heatherton, Kozlowski, Frecker, & Fagerström, 1991) and willingness to provide a carbon monoxide breath sample to verify recent abstinence. Exclusion criteria included being currently enrolled in a structured programme designed to help people quit smoking, suffering from a current psychiatric illness or currently taking medication for a psychiatric disorder, current use of or dependence upon illicit drugs, current alcohol dependence and current use of nicotine replacement therapy. These exclusion criteria were explicit in information provided to participants and participants self-declared the absence of these conditions. Figure 1 provides an overview of the sample attrition.

The power calculation for this study was informed by prior work by Szasz et al., (2012), who used the Questionnaire of Smoking Urges-Brief (QSU-Brief; Cox, Tiffany, & Christen, 2001) to measure changes in craving in a sample of adult smokers following instruction in reappraisal, acceptance or suppression. Their observed effect size was large (Field, 2005). Specifying an alpha level of 5% and desired power of 80% the required sample to detect an interaction in a repeated measures ANOVA with an effect size of $\eta^2 = 0.13$ (Szasz et al, 2012) was estimated at 69 using G*Power 3 (Faul, Erdfelder, Lang and Buchner, 2007).

2.2 Design

A mixed-group design was used with participants pseudo-randomly allocated to groups according to cognitive strategy. Matched random assignment to condition was utilised, which allowed experimental groups to be matched for gender. 'Condition' (i.e. defusion, reappraisal or suppression) was the between-group independent variable and 'time' (pre, post, 24 hours follow up, seven days follow up) the within-group independent variable.

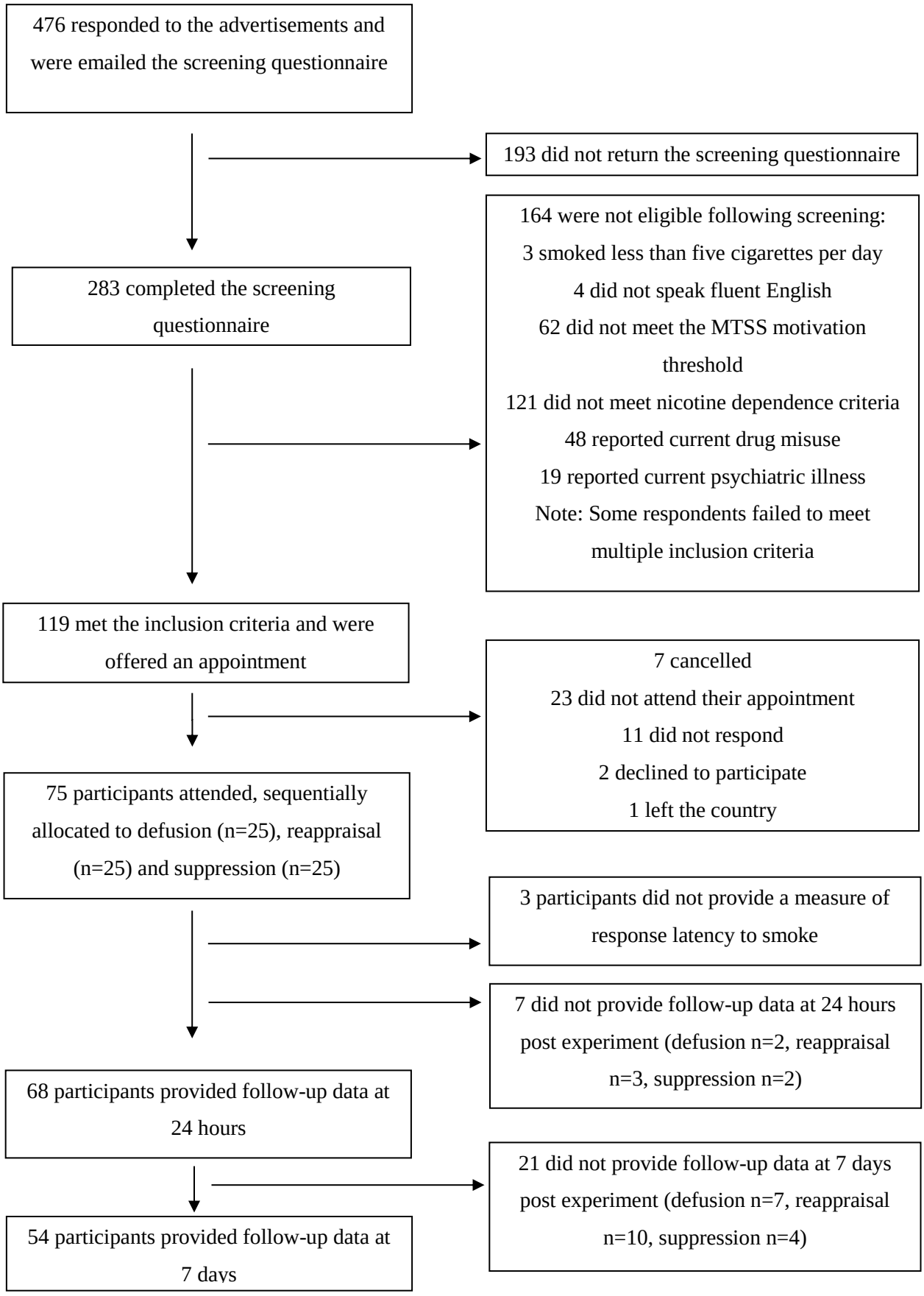

Figure 1. *Flow diagram of sample attrition*

2.3 Measures

Demographic information was gathered including age, gender, ethnicity, education level, number of cigarettes smoked per day, whether cigarettes or roll ups were smoked and how long ago the last cigarette was smoked.

Expired carbon monoxide (CO) content was measured using a Bedfont Micro Smokerlyzer CO monitor (Bedford Technical Instruments Ltd, Sittingbourne, Kent, United Kingdom) to confirm smoking status. Carbon monoxide is the most commonly used biological measure and provides an easy, non-invasive and immediate support of self-reports (Middleton & Morice, 2006).

2.3.1 Nicotine dependence

The Fagerström Test of Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991) was used to assess nicotine dependence. Participants rate their smoking on six questions. For example, 'do you smoke even if you are so ill that you are in bed most of the day?' The FTND has shown good internal consistency, positive associations with key smoking variables (Payne, Smith, McCracken, McSherry, & Antony, 1994), and high degrees of test-retest reliability (Pomerleau, Carton, Lutzke, Flessland, & Pomerleau, 1994).

2.3.2 Emotion regulation style

The Affective Style Questionnaire (ASQ; Hofmann & Kashden, 2010) is a 20-item Likert-style questionnaire that measures a limited set of emotion regulation strategies. The questionnaire consists of three subscales (concealing, adjusting and tolerating). Respondents indicate the degree to which statements such as 'I have my emotions well under control' are true. Szasz et al., (2012) found good internal

consistency values of 0.94, 0.82 and 0.68 for the concealing, adjusting and tolerating subscales respectively. Although the subscales do not map precisely onto the strategies we tested in the current study, the ASQ was used to determine whether groups showed similar use of emotion regulation strategies prior to intervention.

An additional emotion regulation style, unrelated to the three styles noted above is 'experiential avoidance' (Hayes et al., 2004) and this was assessed using the Acceptance and Action Questionnaire II (AAQ-II; Bond et al., 2011). Participants are asked to rate the truth of each statement on a scale of 1-7. For example, 'I am afraid of my feelings'. The AAQ-II has satisfactory reliability, validity and structure with a mean alpha coefficient of 0.84 (0.78-0.88) and 3 month test-retest reliability (r = 0.81) (Bond et al., 2011).

The Avoidance and Inflexibility Scale (AIS; Gifford et al., 2004) provides a smoking specific measure of experiential avoidance (Gifford et al., 2004). Given its greater sensitivity, the AIS was used to measure pre-post differences in experiential avoidance while the AAQ-II provided a more general trait measure of experiential avoidance. The AIS consists of 13 Likert-style items, scored on a scale of 1-5 which measure an individual's responses to their cognitions, affect and physiological sensations. For example, 'how likely is it that these thoughts will lead you to smoke?' The AIS has demonstrated excellent internal consistency (0.93; Gifford et al., 2011)

2.3.3 Smoking behaviour

Participants' smoking behaviour over seven days prior to screening, as well as during the seven days follow-up period, was assessed using the Timeline Follow-back (TLFB; Brown, Burgess, Sales, Whiteley, Evans & Miller, 1998). Participants

estimate the number of cigarettes smoked per day over a specified period using a series of instructions which encourage participants to anchor recall against events of personal salience. Participants are then asked to report the number of cigarettes smoked daily over the specified time period, starting with the current day. The TLFB possesses good test-retest reliability and strong correlations with a daily smoking diary (Brown et al., 1998) and other self-report measures of smoking (Gariti, Alterman, Ehrman, & Pettinati, 1998; Harris, Golbeck, Cronk, Catley, Conway & Williams, 2009).

A further behavioural measure was included, specifically response latency to smoke. This was measured by the amount of time participants reported passed from when they left the experimental session until they smoked their first cigarette.

2.3.4 Positive and negative affect

Positive and negative affect was measured using The International Positive and Negative Affect Schedule Short Form (IPANAS-SF; Thompson, 2007). The IPANAS-SF is a well-validated, brief, cross-culturally reliable ten item measure of positive and negative affect developed by Thompson (2007) based on the PANAS (Watson, Clark, & Tellegen, 1988), which is a well validated and longer measure of affect (Crawford & Henry, 2004). Participants indicate on a 5-point Likert scale the degree to which 10 adjectives describe how they feel. For example, ‘upset’ or ‘inspired’. The IPANAS-SF has demonstrated excellent internal consistency reliabilities of 0.73-0.78 and 0.72-0.76 for the positive and negative affect subscales respectively (Thompson, 2007).

2.3.5 Cravings

The Questionnaire of Smoking Urges-Brief (QSU-Brief; Cox, Tiffany & Christen, 2001) was used to assess cravings to smoke. Respondents indicate on a seven point scale their agreement with ten statements, such as 'I have a desire for a cigarette right now'. This scale is reliable (Cox, Tiffany & Christen, 2001) and Szasz et al., (2012) found internal consistency values above 0.90. Measures of craving provide a proxy for abstinence in the preliminary testing of interventions (West & Ussher, 2009).

Single item six point ratings of 'strength of urge to smoke' and 'time spent with urges to smoke' were also included. These items were taken from the mood and physical symptoms scale (MPSS; West & Hajek, 2004). These measures were included to allow correlations between the MPSS and the QSU-brief to be further (West & Ussher, 2009) explored as part of a separate study.

2.3.6 Credibility and expectancy

The six item credibility/expectancy questionnaire (CEQ; Devilly & Borkovec, 2000) was adapted for the current study. The scale contains a credibility factor reflecting cognitive processes based on three items (e.g. 'how logical do these instructions seem?'), each rated on a nine point scale. The credibility factor has shown high internal consistency (0.78) and good test-retest reliability (r = 0.75; Devilly & Borkovec, 2000). The expectancy factor reflects an affective process and is based on three items, for example 'how much do you feel these instructions will reduce your cravings?' Two questions from the expectancy factor which ask participants to imagine how they might feel at the end of a course of therapy were

therefore deemed less relevant to a brief experimental induction and were omitted. The wording of other items was changed from ‘this therapy’ to ‘these instructions’.

2.3.7 Other measures

A manipulation check required participants to write a qualitative description of the cognitive strategy they were using. At follow-up two single item Likert-style scales asked participants how helpful the strategy was and whether they intended to use the strategy in the future.

2.3.8 Stimulus response compatibility task

The current study used a computerised version of a task originally based on work by De Houwer, Crombez, Baeyens & Hermans (2001) and more recently adapted by Mogg et al., (2003) in which participants are required to move a computerised manikin towards or away from pictorial stimuli. These toward or away moves represent behavioural tendencies to approach or avoid stimuli and the task is therefore referred to as a ‘stimulus response compatibility’ (SRC) task. Participants judge whether a presented picture is related to smoking or not and respond by moving the manikin either away from or towards the picture. Given that evidence shows that such tasks are sensitive to the affective or motivational valence of the presented picture, people who evaluate smoking related pictures positively should be quicker to make approach than avoidance movements towards the stimuli. Conversely, people tend to categorise stimuli with negative valence slower if the categorisation response represents an approach movement (Neumann & Strack, 2000).

The pictorial stimuli consisted of 20 colour photographs containing smoking related cues (for example, a woman holding a lit cigarette to her mouth). Each of

these photographs was paired with a photograph which was similar in content but without any smoking related cues (for example, a woman holding a lip balm to her mouth). The task consisted of two blocks, each containing 20 practice trials and 80 test trials. During the test trials, each of the 20 smoking-related images and 20 neutral images were presented twice. The pictures were presented on a 16 inch colour screen and participants provided responses using a standard keyboard. In each trial, the picture was presented in the centre of the screen and the manikin appeared either above or below the pictures an equal number of times. Participants were invited to take a short break after 40 trials.

Each of the blocks required participants to respond to pictorial stimuli differently. In block one participants were required to move the manikin towards the smoking related image and away from the neutral image. In block two, these instructions were reversed. The order in which the blocks were presented was counterbalanced across participants. Figure 2 provides a screenshot from the task.

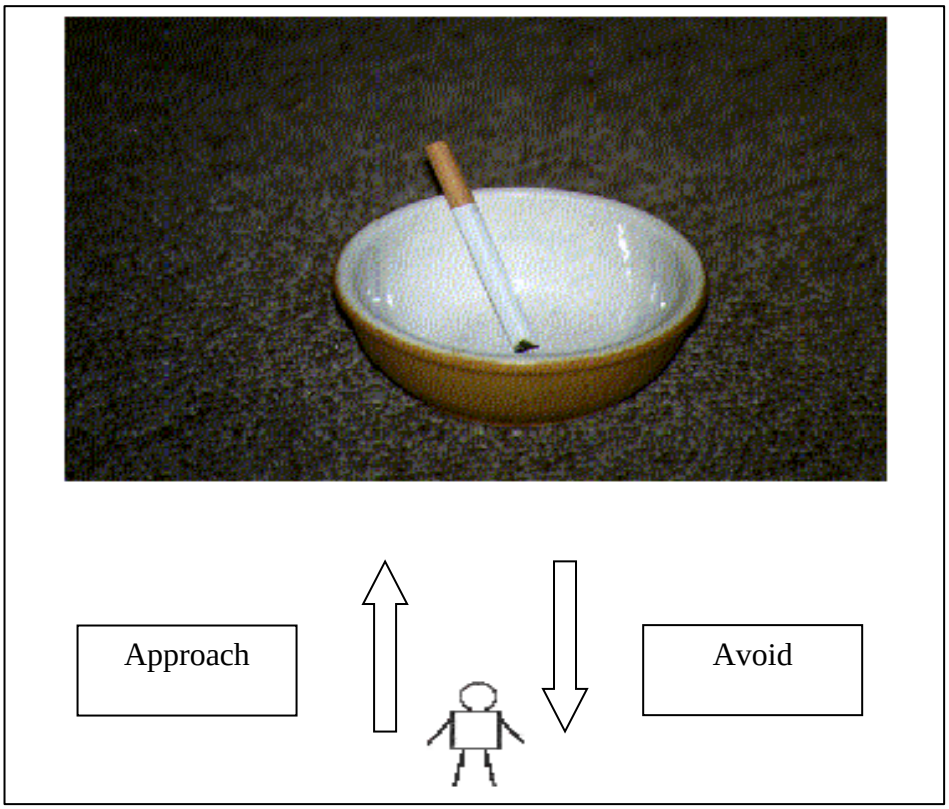

Figure 2. *A screenshot from the SRC task with a smoking-related stimulus and showing directions of the approach and avoid responses.*

Participants responded by using the keyboard to move the manikin up or down. The image and manikin disappeared when the manikin reached either the edge of the screen or the picture. There was a 500-ms interval between trials. The latency was recorded between each picture onset and the response. Within each block the order of images and position of manikin in relation to the images varied.

2.4 Procedure

Individuals who responded to the advertisements were contacted via email and asked to complete the screening questionnaire. Those who did not respond were emailed a reminder. If no response was received it was assumed they no longer wished to participate.

Those who responded but did not meet inclusion criteria following screening were sent an email of thanks. Those who met criteria were sent an email specifying an appointment time. They were reminded that a condition of participation would be consent to a two hour period of abstinence prior to arrival, verified by administration of a carbon monoxide measurement. A longer period of abstinence was not required for the current study, due to practical constraints and also to guard against the possibility that cue reactivity effects on craving would no longer be noticeable due to ceiling effects (Sayette, Martin, Wertz, Shiffman & Perrott, 2001). Participants were sent a copy of the information sheet and asked to bring cigarettes, lighters and any smoking equipment to the appointment. Participants were told the appointment would take approximately one hour and would involve following instructions, answering questionnaires and completing a computer task.

Upon arrival at the experiment, informed consent was obtained. Participants were asked to record the time since they last smoked and to provide a measure of expired carbon monoxide. Baseline questionnaires were completed including the AAQ-II, ASQ, QSU-Brief, IPANAS-SF, the AIS and single item ratings of strength of urge to smoke and time spent with urges to smoke. Participants were then presented with one of three booklets containing printed instructions. Task order for the experimental session is shown in Table 1.

Table 1. *Order of task administration during the experimental session*

Time (mins)	Tasks and measures
0	Information sheet, consent form and CO breathalyser
5	Baseline questionnaires
20	Strategy instructions: Introduction, theoretical rationale and experiential exercise involving an example of a personally salient smoking related thought
25	Credibility and expectancy of outcome ratings
30	First viewing of the smoking related videos: Participants asked to notice any smoking related thoughts
37	Second viewing of the smoking related videos. Participants asked to apply defusion, reappraisal or suppression to smoking related thoughts
42	Post craving-induction questionnaires and SRC task
58	Manipulation check - qualitative description of the strategy

2.4.1 Strategy instructions

The booklets containing printed instructions in font size 12 which explained the cognitive strategy to which participants had been randomised. The format of the written instructions was informed by previous ACT component research (for example, Masuda et al., 2004, 2009, 2010). The instruction sets included a clinical and theoretical rationale for the cognitive strategy, a metaphor to provide an alternative, looser and non-literal form of explanation (Hayes et al., 2012) and an experiential exercise (as recommended by Hayes & Barnes-Holmes, 2003; Levin et

al., 2012). Instructions were presented in a standardised, written format to minimise experimenter effects, non-specific effects and within group variability (Masuda et al., 2009). The three sets of instructions were as equal as possible in complexity, duration, sequence of components, number of prompts given and number of words which might constitute a smoking related cue, thus addressing limitations of previous research (Szasz et al., 2012). In addition to close matching of these components of the instructions by the researchers (MB, SK, PS) the instructions were also reviewed by three internationally-recognised expert researchers in CBT/ACT (three in the UK and one in the US) to ensure that (i) they captured the emotion regulation strategy accurately and (ii) they were well matched to the other two strategies.

The instruction sets are briefly described below, but are presented in full in the appendices.

Reappraisal instructions

The core message was that if we can challenge, dispute and change unhelpful thoughts about smoking to create different, more helpful thoughts then it is possible to cope with cravings more effectively (Appendix A). The experiential exercise asked participants to imagine gathering evidence, as if for a court case, to establish whether their thoughts about smoking were either true or helpful. The wording and the format of the experiential exercise was taken from a text written by a leading CBT clinician (Beck, 2011).

Defusion instructions

The core message was that if we can separate ourselves from our thoughts about smoking and practice noticing these thoughts as *just thoughts* rather than commands which must be followed, we can then act on thoughts about craving less

automatically and instead choose how we wish to behave (Appendix B). The experiential exercise asked participants to create a sense of psychological distance between themselves and their thoughts about smoking by prefixing expression of the thought with *'I notice I'm having the thought that…..'* The wording and format of the experiential exercise was taken from a text written by leading ACT clinicians (Harris, 2009; adapted from Hayes et al., 1999).

Suppression instructions

The core message was that if we can stop thinking negative thoughts about smoking and push these thoughts away rather than dwelling on them, we can avoid cravings and other emotional distress associated with negative thoughts (Appendix C). The experiential exercise asked participants to concentrate on pushing thoughts about smoking out of their minds and to stop thinking these thoughts. The wording and format of the experiential exercise was informed by Wegner's studies of thought suppression (for example, Wegner et al., 1987).

The experiential exercises required participants to recall a recent smoking related cognition, bring it to mind and experience responding to the cognition by using the strategy. In preparation, participants were asked to verbally articulate their smoking related cognition to the experimenter; this helped to ensure that participants had identified a thought rather than an emotion, physiological state or other aspect of experience. If participants struggled to identify a thought, a standardised procedure was used. This initially involved verbally emphasising the instructions, but if necessary participants were then asked to select a self-relevant example from a list of smoking related cognitions. These were taken from measures of craving within the

literature. For example, ‘the only thing I can think about is smoking a cigarette’ (the Cigarette Withdrawal Scale; Etter, 2005).

Following the experiential exercise participants returned to the written instructions. The instructions prompted participants to assess the credibility of the cognitive strategy using the Credibility/Expectancy Questionnaire and then to experience the cue-induced craving procedure.

2.4.2 The cue-induced craving procedure

A set of four 30 second videos were used to induce cravings. The videos each show male and female actors of a variety of ages and ethnicities smoking cigarettes. These were selected from a set of 12 videos which have previously been shown to effectively induce cue-elicited craving (Tong, Bovbjerg, & Erblich, 2007). A subset of the 12 videos was used with the author’s permission for practical reasons. Participants were also asked to place their smoking equipment out on the table in front of them, to provide a secondary cue.

Participants were initially instructed to watch the videos without using their allocated cognitive strategy, but instead to simply write down any smoking related cognitions they noticed during the video. The purpose of this was to support participants in applying the strategies to cognitions, rather than to other aspects of mental experience. Examples of cognitions identified by participants included ‘I need to roll and smoke a cigarette’ and ‘a cigarette would make me feel better’. If participants struggled to identify a smoking related cognition, the standardised procedure previously described was implemented.

Participants were then instructed to watch the videos again and to apply the cognitive strategy they had learnt to any smoking related thoughts. Following this,

post-induction questionnaires were completed including the QSU-Brief, the IPANAS-SF, the AIS and the single item ratings of strength of urge to smoke and time spent with urges to smoke.

Following this, participants completed the SRC task and then provided the qualitative description of the strategy they had been using during the videos.

At the end of the session participants were presented with a cue card (see Appendix D) which provided a brief summary of their cognitive strategy. Participants were encouraged to store this cue card with their smoking equipment for use during periods of high craving during the following week. Participants were then compensated for participating in the experimental session and paid in advance for providing follow-up measures. This included consenting to send a text to report response latency to smoke following the end of the experimental session. Follow-up contact also involved participants responding to an email or telephone call to complete follow-up measures at 24 hours and seven days following the experimental session. These measures included the QSU-Brief, the single item ratings of strength of urge to smoke and time spent with urges to smoke, the TLFB and two single item measures of helpfulness and intention. Participants were sent an email or text reminder halfway through the week reminding them to use the strategy.

2.4.3 Manipulation check

Participants' qualitative descriptions of emotion regulation strategy were transcribed and read by an independent researcher blind to group allocation. Any descriptions which did not approximate the intended emotion regulation strategy were excluded from the analysis.

2.5 Piloting

The experimental protocol was piloted on two people who smoke who met the study's inclusion criteria. Piloting elicited positive feedback regarding the effectiveness of the cue induction procedure, supported by an average pre-post increase on the QSU-Brief score of 19 points. Piloting led to minor editing of the instructions to enhance clarity.

2.6 Ethics

Ethical approval was obtained from the UCL Research Ethics Committee (Project ID 0760/002; see Appendix E). Written, informed consent was obtained from each participant (see Appendix F and G for copies of the information sheet and consent form respectively). Participants were informed of their right to withdraw at any time without consequence. Participant's contact details were kept on a separate password protected database which linked identifying information with corresponding ID numbers.

Participants were required to refrain from smoking for at least 2 hours prior to testing. This perhaps represented a challenge for some and may have temporarily caused mild stress. However, the level of craving should not have risen above that experienced upon waking. The distracting nature of much of the protocol, and the fact that the 'active' experimental conditions were designed to reduce craving, meant that any discomfort participants experienced would have been periodic and temporary.

Participants were paid to compensate for their time and/or expenses in taking part in the experiment. The level of payment (£15) was consistent with agreed institution guidelines regarding appropriate compensation for research participants.

Given that participants were often recruited through word-of-mouth ('snowballing'), it was essential that potential participants were not unintentionally made aware by others of the study's hypotheses before participating. Therefore, participants were not debriefed following participation. This avoided the possibility of socially-desirable responding. The information sheet emphasised that participants were not being offered a treatment.

2.7 Statistical analysis

Demographic characteristics, baseline smoking information and baseline measures on dependent variables were assessed for balance between conditions using between group ANOVAs. Analysis of dependent variables used a variety of between group and mixed ANOVAs. Given the multiple comparisons, all post-hoc tests were Bonferroni corrected using the appropriately adjusted values calculated within SPSS.

2.7.1 Missing data

Less than 1% of the total data was missing from completed measures. Missing data points were not inputted to avoid potential biases in effect size estimates (Barnes, Larsen, Schroeder, Hanson & Decker, 2010). One participant whose SRC data was incomplete due to a technical fault could not be included in the analysis. Such exclusions are reflected in varying degrees of freedom in statistical analyses.

2.7.2 Assumptions of normality

Continuous data was subjected to tests of normality to assess adherence to the assumptions required for parametric testing. Inspection of histograms and use of the skewness, kurtosis and Kolmogorov-Smirnov values indicated violated assumptions

of normality for the response latency to smoke measure, the IPANAS-SF *negative affect* subscale and response latency measures of the SRC task. Square root and logarithmic transformations were attempted accordingly. Data from the response latency to smoke item and response latency measures of the SRC task were normal after transformation. Skew of the IPANAS-SF *negative affect* subscale scores could not be corrected through transformation, although given the current sample size this was not a major concern (Tabachnick & Fidell, 2001)

2.7.3 Outliers

Data was screened for outliers through inspection of box-plots and calculation of Z-scores. Z-scores larger than 2.5 were deemed to be exerting undue influence upon the mean (Stevens, 2009). One influential outlier was identified on the response latency to smoke measure within the defusion condition. Two further outliers were identified on the IPANAS-SF negative affect subscale at baseline and following the cue-induced craving procedure (one outlier from both the defusion and reappraisal conditions). One outlier was also identified on each of the SRC task subscales (within the defusion condition). All four outliers reported above were replaced with the group mean of the subscale plus 2.5 standard deviations (Field, 2005).

2.7.4 Mediation analysis

Mediation analysis was conducted to clarify the potential intermediate role of credibility and expectancy of outcome on the effect of strategy on dependent variables. To test for mediation, a PROCESS mediation analysis (Hayes, 2013) was conducted. Bootstrapping procedures were used to test the significance of indirect effects.

Results

3.1 Inter-item reliability

Internal consistency checks were conducted for the AAQ, QSU-Brief, credibility scale and all subscales of the ASQ, IPANAS-SF and the AIS. Cronbach's alpha coefficients were found to be acceptable across all scales with scores ranging from 0.60 – 0.94 (see Appendix F).

3.2 Demographic and baseline information

Table 2 provides a summary of key demographic and smoking characteristics across the three groups.

Table 2. *Descriptive statistics separated by study condition*

Variable		Defusion	Reappraisal	Suppression
		N (%)	*N* (%)	*N* (%)
Sex				
	Female	13 (48)	13 (52)	12 (48)
	Male	12 (52)	12 (48)	13 (52)
Ethnicity*				
	White	13 (52)	13 (52)	15 (60)
	Mixed/multiple ethnic groups	1 (4)	2 (8)	1 (4)
	Asian/Asian British	5 (20)	4 (16)	2 (8)
	Black/African/Caribbean/Black British	4 (16)	1 (4)	1 (4)
	Other ethnic group	2 (8)	4 (16)	4 (16)
	Missing	0 (0)	1 (4)	2 (8)
Education				
	Years = 11	2 (8)	1 (4)	0 (0)
	Years = 13	10 (40)	6 (24)	12 (48)
	Years = 16	8 (32)	13 (52)	7 (28)
	Years = 17	5 (20)	5 (20)	6 (24)

**Ethnic group categories taken from the Office for National Statistics (2012)*

Seventy-six percent of the sample was university students. The remaining were in paid employment (16%) or unemployed (8%). 45% of the sample smoking pre-rolled cigarettes and 55% preferred hand-rolled cigarettes. There were no between group differences in employment status or smoking preferences. Table 3 provides a summary of group means and standard deviations for age and key smoking characteristics.

Table 3. *Age and key smoking characteristics separated by study condition*

Variable	Defusion (*N*=25)	Reappraisal (*N*=25)	Suppression (*N*=25)
	M (SD)	*M (SD)*	*M (SD)*
Age	25.40 (7.49)	24.40 (6.56)	25.20 (7.93)
Motivation to quit smoking	3.08 (0.91)	2.96 (1.14)	2.80 (0.76)
Estimated number of cigarettes per day	11.53 (3.96)	14.64 (4.88)	12.81 (4.81)
FTND Score	4.58 (1.05)	5.56 (1.39)	5.28 (1.28)
TLFB score	11.04 (4.15)	14.77 (5.26)	12.35 (5.54)
Hours since last cigarette	6.48 (4.53)	5.02 (3.68)	5.32 (3.85)

3.2.1 Baseline group characteristics

At baseline the experimental groups were comparable in cigarettes smoked per day (TLFB score; F [2, 72] = 2.92, p = 0.06, η^2 = 0.08), hours since the last

cigarette F [2, 72] = 0.92, p=0.41, η^2 = 0.02) and motivation to quit (MTSS) F [2, 72] = 0.55, p = 0.58, η^2 = 0.01). There were no baseline differences between groups in general experiential avoidance (F [2, 72] = 1.15, p = 0.32, η^2 = 0.03), smoking specific experiential avoidance (F [2, 72] = 0.36, p = 0.70, η^2 = 0.01) or emotion regulation style (concealing subscale F [2, 72] = 2.42, p = 0.10, η^2 = 0.06; adjusting subscale F [2, 72] = 0.83, p = 0.44, η^2 = 0.02; tolerating subscale (F [2, 72] = 0.62, p = 0.54, η^2 = 0.02). The groups did not differ at baseline on positive affect (F [2, 72] = 0.18, p = 0.84, η^2 <0.01) or negative affect scores from the IPANAS-SF (F [2, 72] = 1.06, p = 0.35, η^2 = 0.03), cravings (F [2, 72] = 0.58, p = 0.56, η^2 = 0.02), strength of urges (F [2, 72] = 0.38, p = 0.68, η^2 = 0.01) or time spent with urges (F [2, 72] = 0.93, p = 0.40, η^2 = 0.03).

There were baseline differences between the groups in level of nicotine dependence on the FTND scale (F [2, 72] = 4.15, p = 0.02, η^2 = 0.10) and number of cigarettes smoked in the past seven days (TLFB score; F [2, 72] = 3.55, p = 0.03, η^2 = 0.09). Post-hoc comparisons indicated that nicotine dependence was lower in the defusion group than the reappraisal group (t [48] = 2.81, p = 0.02, d = 0.80). TLFB scores were also lower in the defusion group than the reappraisal group (t [48] = 2.76, p = 0.02, d = 0.79). The effect sizes for these analyses were approaching Cohen's (1988) convention for a large effect (d=0.80). The potential impact of these differences on outcomes of interest is discussed at the end of this section.

3.3 Effects of emotion regulation strategy on dependent variables

3.3.1 Manipulation check

Two participants from the suppression condition were excluded on the basis of their description of strategy use.

3.3.2 Use of strategy at follow-up

Figure 1 shows that 66 participants provided data at 24 hours follow-up and 52 after seven days. A minority of these participants reported failing to use their allocated emotion regulation strategy during the follow-up period (*N*=6 at 24 hours, *N* =7 at seven days). These participants remained included in the analysis of follow-up data to reduce bias.

3.3.3 Credibility and expectancy

There were between group differences on perceived credibility of strategy (F [2, 70] = 9.19, $p < 0.001$, $\eta^2 = 0.21$) and expectancy (of treatment effects) following use of the strategy (F [2, 70] = 3.61, $p = 0.03$, $\eta^2 = 0.09$). Post-hoc comparisons indicated that credibility was lower amongst participants in the suppression group (M = 14.16, SD = 4.84) than the defusion (M = 18.52, SD = 4.00; t [46] = 3.66, p = 0.001, d = 0.98) and reappraisal (M = 18.72, SD = 4.11; t [46] = 3.82, p = 0.001, d = 1.02) groups. Expectancy was lower amongst participants in the suppression group (M = 4.36, SD = 1.66) than the reappraisal (M = 5.70, SD = 1.62; t [46] = 2.66, p = 0.03, d = 0.82) group only.

A chi-square test of independence found no relation between condition (defusion, reappraisal or suppression) and use of strategy at 24 hours (X^2 [2, N = 73] = 0.90, p = 0.64) or seven days (X^2 [2, N = 73] = 3.49, p = 0.18) follow-up.

3.3.4 Effects of emotion regulation strategy on smoking behaviour

To examine the impact of strategy on smoking behaviour, a 2 (time) x 3 (strategy) mixed ANOVA was conducted with change in TLFB smoking (the difference between baseline TLFB smoking and seven day follow-up TLFB

smoking) as the dependent variable, Time (screening and seven days follow-up) as the within-subjects factor, and Strategy (defusion, reappraisal or suppression) as the between-subjects factor (see Table 4). There was a significant main effect of Time on change in TLFB smoking (F [1, 51] = 25.79, $p < 0.001$, $\eta^2 = 0.31$), such that participants reported a reduction in the number of cigarettes smoked during the seven day follow-up period compared to cigarettes smoked over the seven days prior to screening. There was no overall effect of Strategy (F [2, 49] = 1.42, $p = 0.25$, $\eta^2 = 0.05$).

Table 4. *Means and standard deviations for Timeline Follow-back scores*

TLFB score	Defusion (N = 18)	Reappraisal (N =15)	Suppression (N =19)
	M (SD)	*M (SD)*	*M (SD)*
Seven days before screening	10.78 (4.55)	13.82 (5.62)	11.91 (4.74)
Seven days follow-up	7.55 (4.75)	8.89 (5.83)	11.05 (5.08)

However, there was a Time x Strategy interaction effect (F [2, 49] = 3.98, $p = 0.03$, $\eta^2 = 0.10$). Pairwise comparisons indicated that participants in the defusion (t [17] = 3.23, $p = 0.002$, $d = 1.21$) and reappraisal conditions (t [14] = 4.50, $p < 0.001$, $d = 0.77$) reported a reduction in TLFB smoking while those in the suppression condition did not (t [18] = 0.88, $p = 0.39$, $d = 0.26$).

A one-way ANOVA revealed a significant and large effect of emotion regulation strategy on latency to first cigarette following completion of the

experimental session (F [2, 67] = 6.28, p = 0.003, η^2 = 0.16). Pairwise comparisons indicated that those in the suppression group (M = 1.03, SD = 0.44) reported smoking within a shorter period after leaving the experimental session than those in the defusion (M = 1.61, SD = 0.79; t [46] = 3.20, p = 0.006, d = 0.91) and reappraisal (M = 1.57, SD = 0.59; t [46] = 2.93, p = 0.01, d = 1.04) groups. There were no differences between the defusion and reappraisal groups.

3.4.3 Effects of emotion regulation strategy on cue-induced craving

A 4 (time) x 3 (strategy) mixed ANOVA was conducted to explore the impact of strategy on craving, with QSU-Brief score as the dependent variable, Time (pre cue-induced craving procedure, post cue-induced craving procedure, 24 hours follow-up and seven days follow-up) as a within-subjects factor, and Strategy as a between-subjects factor. There was a significant main effect of Time on cravings (F [3, 49] = 21.01, p < 0.001, η^2 = 0.39). Inspection of the group means (Figure 3) indicated that craving was highest across groups prior to strategy implementation. There was no overall effect of Strategy (F [2, 49] = 1.95, p = 0.15, η^2 = 0.07) but a Time x Strategy interaction effect (F [6, 147] = 2.91, p = 0.01, η^2 = 0.06). Pairwise comparisons indicated that at post craving-induction participants in the reappraisal condition reported lower cravings than those in the suppression condition (t [46] = 3.08, p = 0.01, d = 1.04).

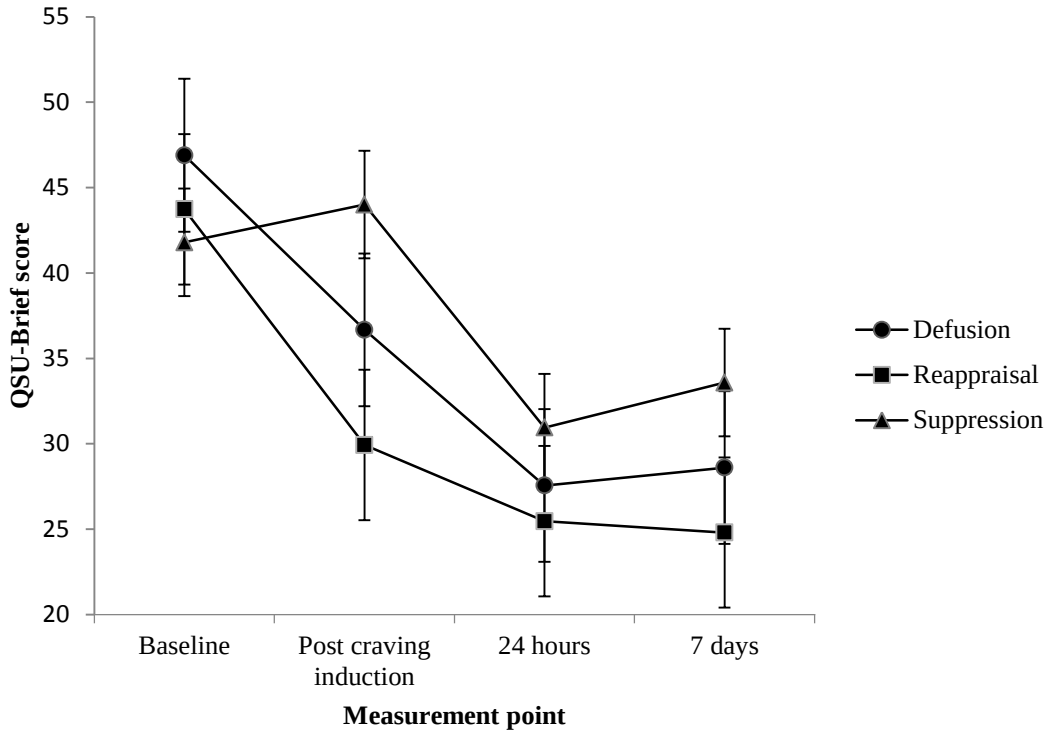

Figure 3. *Mean and standard error of measurement for QSU-Brief scores of the three experimental groups at baseline, post craving-induction, at 24 hours follow-up and 7 days*

There was no association between smoking preference (cigarettes or roll-ups) and level of craving at post cue-induced craving ($r = 0.07$, $N = 73$, $p = 0.54$).

3.4.5 Effects of emotion regulation strategy on positive and negative affect

Changes in affect were assessed using participants' scores on the positive and negative affect subscales of the IPANAS-SF at pre-cue induced craving and post-cue induced craving. Table 5 provides means and standard deviations. Analyses revealed no significant main effect of Time (F [1, 72] = 2.40, $p = 0.13$, $\eta^2 = 0.03$) or Strategy (F [2, 70] = 2.18, $p = 0.12$, $\eta^2 = 0.06$) upon positive affect. There was, however, a Time x Strategy interaction (F [2, 70] = 6.42, $p = 0.003$, $\eta^2 = 0.15$). Positive affect increased post cue-induction in the reappraisal condition (t [24] = 3.52, $p = 0.001$, d

= 0.64) but not in the defusion (t [24] = 0.85, p = 0.40, d = 0.17) or suppression (t [22] = 1.58, p = 0.12, d = 0.36) conditions.

Analyses revealed no main effect of Time (F [1, 72] = 0.58, p = 0.45, η^2= 0.008) or Strategy (F [2, 70] = 2.20, p = 0.12, η^2 = 0.03) upon negative affect, nor was there a Time x Strategy interaction effect (F [2, 70] = 1.14, p = 0.33, η^2 = 0.06).

Table 5. *Means and standard deviations for positive and negative affect scores*

	Defusion (N = 25)	Reappraisal (N = 25)	Suppression (N = 23)
	M (SD)	*M (SD)*	*M (SD)*
Baseline positive affect	15.44 (3.49)	15.00 (2.80)	14.87 (3.77)
Post craving induction positive affect	16.00 (4.13)	17.32 (3.73)	13.78 (3.32)
Baseline negative affect	7.04 (2.30)	6.84 (3.17)	7.30 (1.82)
Post craving induction negative affect	6.88 (2.59)	6.36 (2.87)	7.87 (3.06)

3.4.6 Effects of emotion regulation strategy on smoking specific experiential avoidance

Changes in smoking specific experiential avoidance were assessed using participants' overall scores on the Avoidance and Inflexibility Scale (AIS) at pre-cue induced craving and post-cue induced craving. Analyses revealed no main effect of

Time (F [1, 72] = 2.14, p = 0.15, η^2 = 0.03) or Strategy (F [2, 70] = 2.22, p = 0.12, η^2 = 0.06) upon experiential avoidance. There was, however, a Time x Strategy interaction (F [2, 70] = 3.56, p = 0.03, η^2 = 0.09). Participants in the defusion condition reported a reduction in smoking specific experiential avoidance (t [24] = 2.24, p = 0.03, d = 0.51) whereas those in the reappraisal (t [24] = 1.69, p = 0.10, d = 0.25) and suppression (t [22] = 0.88, p = 0.39, d = 0.41) conditions did not. Figure 4 depicts the mean AIS scores of the three experimental groups at pre-cue induced craving and at post cue-induced craving.

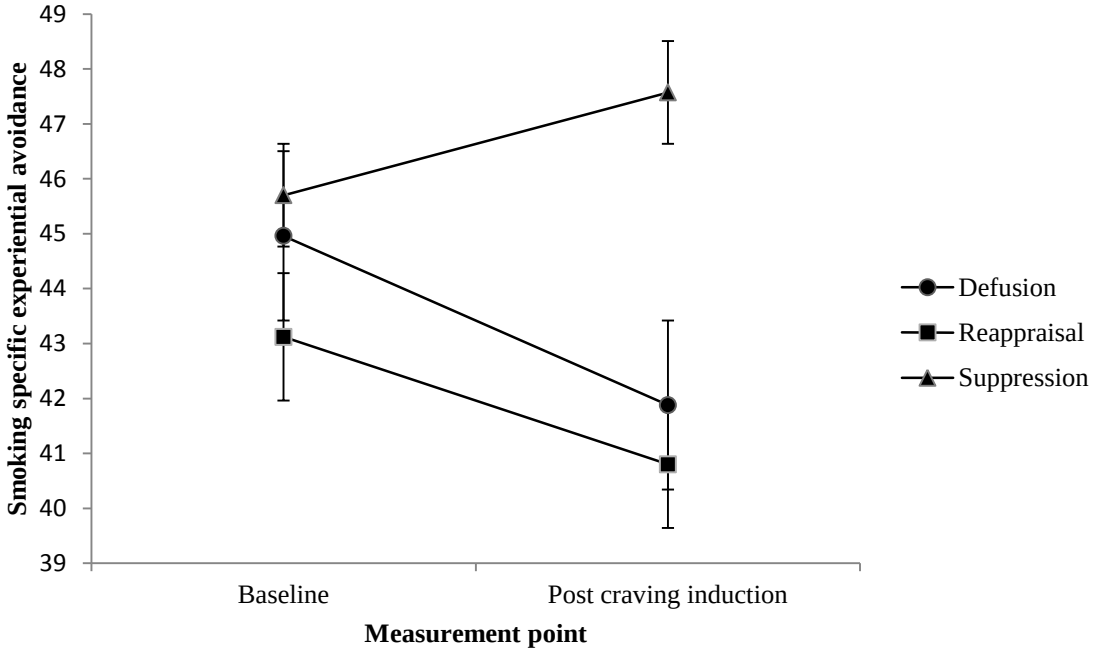

Figure 4. *Mean and standard error of measurement for smoking specific experiential avoidance in the three experimental groups at pre and post cue-induced craving*

The 'thoughts' subscale of the AIS was also examined, since instructions across conditions aimed at targeting cognitions rather than smoking related feelings or physiological sensations. There was a main effect of Time (F [1, 72] = 7.22, p = 0.009, η^2 = 0.08) but not of Strategy (F [2, 70] = 1.27, p = 0.29, η^2 = 0.03). There was a Time x Strategy interaction upon experiential avoidance of smoking related thoughts (F [2, 70] = 4.13, p = 0.02, η^2 = 0.10). Pairwise comparisons indicated that participants in the defusion (t [24] = 3.07, p = 0.003, d = 0.69) and reappraisal (t [24] = 2.47, p = 0.02, d = 0.40) conditions reported a reduced level of experiential avoidance of smoking related thoughts in the post cue-induced craving interval, while those in the suppression condition (t [22] = 0.88, p = 0.39, d = 0.19) did not. Table 6 provides means and standard deviations.

Table 6. *Means and standard deviations for the 'thoughts' subscale of the AIS*

Dependent variable	Defusion (N = 25)	Reappraisal (N = 25)	Suppression (N = 23)
	M (SD)	*M (SD)*	*M (SD)*
Baseline AIS thoughts scale	14.68 (2.72)	13.96 (3.14)	14.35 (2.85)
Post craving induction AIS thoughts scale	13.04 (2.94)	12.64 (3.49)	14.78 (3.15)

3.4.7 Effects of emotion regulation strategy on approach/avoidance behaviour

To examine the impact of strategy on approach/avoidance behaviour, a 2 (Behaviour) x 2 (Stimulus) x 3 (Strategy) mixed ANOVA was conducted with

response time on the SRC task as the dependent variable, Behaviour (approaching or avoiding stimuli) and Stimulus (smoking related or neutral images) as within-subject factors and Strategy (defusion, reappraisal and suppression) as a between-subjects factor.

There was a significant main effect of Behaviour (approaching/avoiding the neutral/smoking stimulus) on response time (F [1, 71] = 23.06, $p < 0.001$, $\eta^2 = 0.25$) such that participants were faster on approach trials than avoidance trials across strategies and stimuli. There was also a main effect of Stimulus on response time (F [1, 71] = 67.81, $p < 0.001$, $\eta^2 = 0.48$), such that participants were quicker to respond to smoking related images than neutral images across strategies and behaviour. There was no effect of Strategy on response time (F [2, 69] = 1.52, $p = 0.23$, $\eta^2 = 0.04$).

There was no Behaviour x Strategy (F [2, 69] = 0.45, $p = 0.64$, $\eta^2 = 0.01$) or Stimulus x Strategy interaction (F [2, 69] = 1.67, $p = 0.20$, $\eta^2 = 0.02$). However, there was a Behaviour x Stimulus interaction with a large effect size (F [2, 69] = 37.58, $p < 0.001$, $\eta^2 = 0.40$), such that participants were quicker to approach smoking related images than neutral images across all conditions. There was also a Behaviour x Stimulus x Strategy interaction (F [2, 69] = 3.57, $p = 0.03$, $\eta^2 = 0.08$). Across all conditions participants were quicker to approach smoking related images than neutral images (defusion t [23] = 3.75, $p < 0.001$, $d = 0.62$; reappraisal t [24] = 4.72, $p < 0.001$, $d = 0.92$; suppression t [22] = 7.20, $p<0.001$, $d = 1.24$). Those in the suppression condition were also quicker to avoid than approach neutral images (t [22] = 2.41, $p < 0.001$, $d = 0.44$), reflecting a simultaneous tendency of participants in the suppression condition to avoid non-appetitive cues while also showing a generalised approach-tendency. Figure 6 depicts the differences in approach/avoidance bias between the experimental groups.

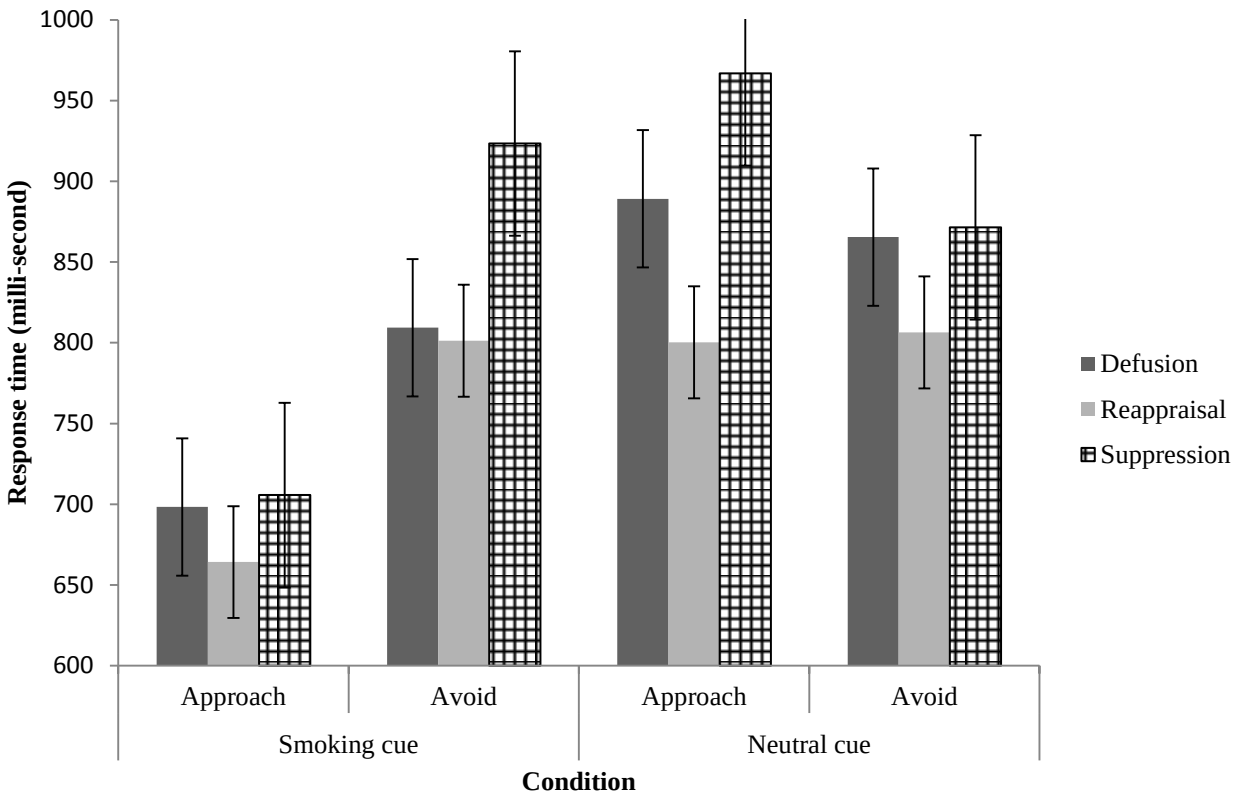

Figure 5. *The differences in approach/avoidance bias between the three experimental groups*

3.4.8 Perceived 'helpfulness' and intention to use emotion regulation strategy

Single item measures of strategy 'helpfulness' and 'intention to use the strategy' were administered at 24 hours and seven days follow-up. The mean average ratings of ‘helpfulness’ and ‘intention’ were calculated across the two time points. A one-way ANOVA revealed a significant effect of strategy on helpfulness (F [2, 63] = 9.23, p < 0.001, η^2 = 0.23) and intention (F [2, 63] = 6.42, p = 0.003, η^2 = 0.17)

Pairwise comparisons indicated that suppression (M = 2.74, SD = 1.26) was less helpful than both defusion (M = 4.22, SD = 1.28; t [42] = 3.49, p = 0.003, d = 1.17) and reappraisal (M = 4.43, SD = 1.64; t [41] = 3.95, p = 0.001, d = 1.16). Participants in the suppression condition (M=4.93, SD=1.76) also indicated less intention to use the strategy in the future than participants in the defusion (M=3.43,

SD=1.36; *t* [32] = 3.04, *p* = 0.01, *d* = 0.95) and reappraisal conditions (*M* = 3.34, *SD* = 1.76; *t* [32] = 3.20, *p* = 0.007, *d* = 0.90).

3.5 Association between outcomes and baseline scores

Given the presence of statistically significant baseline differences in key smoking variables (TLFB smoking levels; FTND) these were correlated with those outcomes that showed group differences to determine the potential dependence of these differences on baseline group differences. Pearson correlation analyses were conducted between baseline TLFB and FTND scores and change scores from pre to post cue-induced craving or at follow-up on the following variables: smoking behaviour, cravings, positive affect, smoking specific experiential avoidance and SRC task outcomes. There was a small-medium correlation between change in TLFB smoking and baseline TLFB (*r* = 0.41, *N* = 52, *p* = 0.003) and FTND (*r* = 0.37, *N* = 52, *p* = 0.007) scores.

When group-wise correlations were considered, the reappraisal condition showed a significant correlation between pre cue-induced craving FTND and change in smoking at seven days (*r* = 0.54, *N* = 15 *p* = 0.04) whereas the suppression (*r* = 0.2, *N* = 19, *p* = 0.41) and defusion (*r* = 0.42, *N* = 18, *p* = 0.08) conditions did not. These correlations were transformed into *z*-scores using Fisher's *r*-to-*z* transformation. A *z*-score based on the difference between these two values and the variance of the difference between the two scores was obtained. Using a 1-tailed test of significance, this indicated that the reappraisal correlation coefficient was not statistically significantly different from the suppression (*z* = 1.05, *p* = 0.15) or defusion (*z* = 0.40, *p* = 0.34) correlation coefficients (Preacher, 2002).

The reappraisal condition also showed an association between pre cue-induced craving TLFB and change in smoking at seven days (r = 0.53, N = 15, p = 0.04) whereas the suppression (r = 0.23, N = 19, p = 0.23) and defusion (r = 0.43, N = 18, p = 0.08) conditions did not. Using Fisher's r-to-z transformation and a 1-tailed test of significance, this indicated that the reappraisal correlation coefficient was not statistically significantly different from the suppression (z = 0.93, p = 0.18) or defusion (z = 0.34, p = 0.37) correlation coefficients (Preacher, 2002).

Overall, this suggests that the group differences in TLFB at seven days follow-up were not driven by baseline differences in nicotine dependence or smoking level.

3.6 Association between outcomes and credibility

Pearson correlations were used to explore the association between credibility, expectancy and changes in scores from baseline to post cue-induced craving or at follow-up on the following variables: smoking behaviour, cravings, smoking specific experiential avoidance and SRC task outcomes.

Credibility was correlated with change in TLFB smoking (r = 0.34, N = 52, p = 0.01), with higher credibility scores associated with greater reductions in smoking. Expectancy was also related to change in smoking behaviour at seven days follow up (r = 0.34, N = 52, p = 0.01), with higher expectancy scores also associated with greater reductions in smoking. There were no other associations between credibility, expectancy and other outcomes.

Mediation analysis was conducted to clarify the potential intermediate role of credibility on the effect of strategy on change in TLFB smoking with strategy and

credibility as predictor variables and change in TLFB smoking as the outcome variable. The overall model was significant (R = 0.38, F (2, 49) = 4.11, p = 0.02).

As Figure 6 illustrates, the standardized regression coefficient between strategy and credibility was statistically significant, but the coefficient linking credibility and change in TLFB smoking was not. The bootstrapped standardized indirect effect (the product of the two indirect coefficients) was -0.46 (95% CI = -1.53 – -0.05). The failure of the confidence intervals to include zero indicates statistical significance, suggesting that the effect of strategy on behaviour was mediated by credibility (Hayes, 2013).

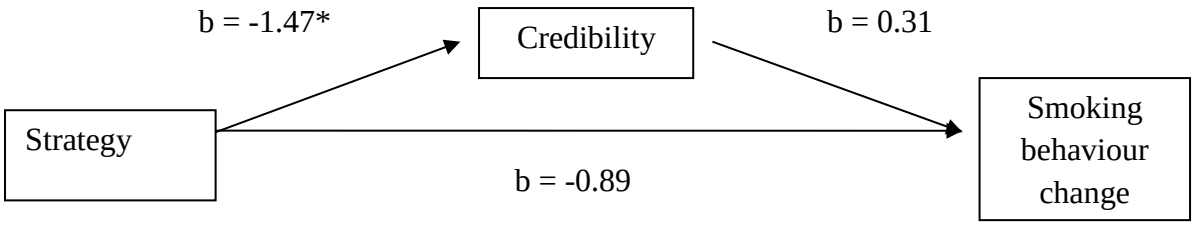

Figure 6. *Standardised regression coefficients for the relationship between strategy and change in smoking behaviour at seven days follow-up as mediated by credibility*. *p < 0.05

Mediation analysis (Hayes, 2013) was also conducted with strategy and expectancy as predictor variables and TLFB change scores as the outcome variable. While the overall model was significant (R = 0.41, F (2, 49) = 5.08, p = 0.01) the standardized regression coefficient between strategy and expectancy was not statistically significant. The bootstrapped standardized indirect effect was not statistically significant (-0.06, 95% CI = -0.82 – 0.41), suggesting that the effect of strategy on behaviour was not mediated by expectancy.

Discussion

The objective of the current study was to compare the specific and isolated effects of defusion, reappraisal and suppression upon smoking behaviour and other smoking-relevant, theory-consistent outcomes. The main findings of the study can be summarised as follows:

(1) Defusion and cognitive reappraisal were associated with improved behavioural outcomes including a longer latency to smoke following the experimental session. The larger reduction in smoking after seven days in the reappraisal and defusion groups compared to suppression group was mediated by between group differences in credibility; in particular, those in the suppression group rated this strategy as having lower credibility.

(2) A reduction in craving and an increase in positive affect at post-cue induced craving only occurred in the reappraisal group.

(3) A reduction in smoking specific experiential avoidance occurred in the defusion group, and to a lesser extent, the reappraisal group.

(4) Those in the suppression condition showed the largest differential responding between neutral and smoking related stimuli in the SRC task.

Baseline differences were found in nicotine dependence and smoking behaviour, with participants in the defusion condition reporting lower levels of nicotine dependence and lower levels of smoking behaviour than those in the reappraisal condition. Higher nicotine dependence and rates of smoking were also associated with greater reductions in smoking after seven days. Although these baseline differences were statistically significant they were only associated with one

of the outcome variables. Moreover, when the *r-z* transformed values were compared across groups, there was no difference in the strength of the association between groups. This suggested that the baseline differences in nicotine dependence and smoking were not driving the group differences in this outcome.

Changes in TLFB smoking at seven days follow-up were mediated by participants' perceptions of credibility of the emotion regulation strategies. Mediation by credibility can be theoretically conceptualised within the theory of planned behaviour (Ajzen, 1991), which proposes that attitudes toward behaviour, subjective norms and perceived behavioural control shape an individual's health intentions and health behaviours. Perceived behavioural control is influenced by self-efficacy and outcome expectancies (Bandura, 1986). Attitudes toward a particular behaviour, or in this case toward an emotion regulation strategy, depend on 'behavioural beliefs' (Ajzen, 1991) which refer to beliefs regarding the consequences of a proposed strategy.

The defusion and reappraisal conditions were associated with increased latency to smoke compared to the suppression condition. This is consistent with previous research supporting the immediate and short-term benefits of brief instruction in defusion (Masuda et al., 2004, 2009, 2010) and reappraisal (Hofmann et al., 2009; Szasz et al., 2011; Szasz et al., 2012; Wolgast et al., 2012). Latency to smoke was not associated with credibility.

Although defusion and reappraisal were associated with similar latencies to smoke, these strategies were associated with differential effects on craving and experiential avoidance. Participants in the reappraisal condition experienced a decrease in the strength of cravings following the craving induction procedure.

Defusion on the other hand had no impact on cravings or affect. The ACT model would not predict such changes since the model does not target these aspects of internal experience, but instead emphasises willingness to experience thoughts and feelings in the interests of behaving in a manner consistent with one's values (Hayes et al., 2012).

Further support for reappraisal was found in results demonstrating that those in the reappraisal condition reported lower cravings and higher positive affect than those in the suppression condition. No hypotheses were made in the current study regarding positive affect. However, the findings relating to cravings are consistent with the cognitive therapy model, which would predict that cognitive reappraisal of smoking related cognitions would be associated with the least craving (Beck, 2011).

The beneficial effects of defusion on latency to smoke following the craving induction procedure, which occurred in the absence of changes in craving or affect, may indicate changes in an individual's response to these experiences. Consistent with the ACT model, defusion was the only condition in which participants reported a reduction in smoking specific experiential avoidance (as measured by the AIS) following application of the emotion regulation strategy. In terms of experiential avoidance of smoking related cognitions, participants in the defusion condition also reported the greatest reduction. This is consistent with the ACT model, which identifies experiential avoidance as an important therapeutic target (Hayes et al., 2012).

Unexpectedly, reappraisal was also associated with a reduction in experiential avoidance of smoking related cognitions, albeit with a smaller effect size than defusion. It is possible that the effortful process of reappraising cognitions requires

an awareness and reflection upon the way in which cognitions can affect behaviour (Juarascio, Forman & Herbert, 2010). This implies a degree of distancing from cognitions, which may account for the decrease in experiential avoidance of smoking related cognitions. This finding highlights how the meta-cognitive process of noticing and reflecting upon the presence and function of cognitions is a shared feature of both defusion and reappraisal, and in this respect these different strategies share an important similarity.

Within the SRC task, a smoking-approach bias occurred across groups. These findings are relevant to models of nicotine dependency such as the incentive salience model of dependency (Robinson & Berridge, 2000), which proposes that smoking-related cues acquire incentive salience and lead to an increase in the degree to which cues are experienced as attractive, noticeable and difficult to ignore. Smoking related cues therefore capture attention and elicit faster approach tendencies. These processes operate outside awareness and higher levels of incentive salience results in stronger subjective experiences of craving.

The smoking-approach bias was stronger in the suppression condition than the reappraisal condition, with a relatively large effect size. This finding was consistent with the cognitive therapy model, which would predict that reappraisal of smoking related cognitions would be associated with a weaker approach/avoidance bias towards smoking related cues. Effect sizes for approach bias were also larger in the suppression condition than the defusion condition. The stronger approach bias associated with suppression suggests that participants applying this emotion regulation strategy experienced an appetitive motivational state for smoking-related cues to a greater degree than those in the defusion and reappraisal conditions. Given the implicit nature of this measure, this finding perhaps argues against a purely

credibility/expectancy based interpretation of the differential impact of emotion regulation strategy upon smoking behaviour.

Indeed, theory would argue that a separate, impulsive information processing system is involved in this task, rather than a more reflective system which is engaged during self-report assessments (Strack & Deutsch, 2004). It is important to acknowledge the possibility that conscious expectations or perceptions of credibility of the emotion regulation strategies could also have impacted on implicit task performance. However, the dual processing model proposed by Strack and Deutsch (2004) proposes a fundamental distinction between implicit associations and explicit expectations (such as credibility), suggesting that implicit, appetitive processes which maintain addiction receive little control from reflective processes (Stacy & Wiers, 2010). This perspective is supported by the absence of correlation between SRC task performance and changes in craving, expectancy and credibility.

4.2 Methodological issues

This study compliments and extends previous research on ACT and smoking in a number of important respects. Firstly, the sample had a moderate level of nicotine dependence, higher than recorded in previous studies which have evaluated the impact of emotion regulation strategies on smoking-related urges and behaviour (Bowen & Marlatt, 2009). Secondly, smoking status was verified using a biological measure of expired breath CO. Thirdly, instructions were well matched and experimenter effects were minimised through the use of typed instructions. The instructions incorporated practice, experiential exercises and metaphors as recommended by previous research (Levin et al., 2012). Fourthly, the study responded to the limitations of previous work by including both behavioural and

implicit measures in addition to self-report and collecting follow-up data at 24 hours and seven days following the experiment. Finally, the inclusion of credibility, expectancy and manipulation measures allowed these important variables to be assessed in relation to the three different strategies.

The direct comparison of emotion regulation strategies to managing smoking related cognitions allowed the effect of these strategies to be measured in isolation without the additive effects of other change mechanisms associated with treatment packages. However, since it is likely that emotion regulation strategies are less effective when delivered in isolation without interaction with other treatment components (Hayes et al., 2012) measuring these effects in isolation may limit the scope of their potential to effect change. This represents a limitation of the current study and ACT component research more generally.

Losses at follow up may have meant that the study was slightly underpowered for some of the repeated measures analyses. Also the groups differed at baseline for number of daily cigarettes and level of nicotine dependence. A larger sample and/or matching groups at the randomisations stage for level of smoking and dependence may have obviated these difficulties.

Smoking cue-exposure research such as the current study commonly focuses on the difference between cravings present during smoking cue-exposure and cravings present during an abstinence-based baseline. However, the clinical relevance of teasing apart cue-based and abstinence-based cravings in this way has been questioned (Perkins, 2009). The assessment of 'peak-provoked cravings' has been proposed as an alternative (Sayette & Tiffany, 2012), which involves the measurement of cravings during cue-induction in nicotine deprived smokers without subtracting baseline cravings. Future research may benefit from adopting this

approach, which potentially possesses more clinical relevance (Sayette & Tiffany, 2012).

Other methodological limitations include the predominant use of self-report measures to assess craving, negative affect and experiential avoidance. From an ACT perspective, these aspects of internal experience are functional processes which should be studied within the context of ongoing stimulus-behaviour relations. Self-report measures generally fail to capture these processes and therefore the development of behavioural methodology that elucidates the functions of thoughts, feelings and behaviour would be beneficial.

Anecdotally, some participants reported that the cue induction procedure induced a disgust rather than appetitive response. This was particularly the case for smokers of hand rolled cigarettes, who stated they considered pre-rolled cigarettes 'dirty', 'disgusting' or 'unappealing'. Importantly, participants were also asked to display personal smoking cues, such as their lighters or packets, to provide an alternative smoking cue. However, future research may consider utilising an alternative induction procedure or alternatively updating the videos to include people smoking roll-ups.

Other limitations perhaps relate to the brief nature of the instructions, which may limit the degree to which confidence can be placed in the findings, particularly after seven days. On the other hand, the effects of brief instruction suggest that longer-term interventions could reasonably be expected to be powerful. Furthermore, the medium or longer-term effects of these cognitive emotion regulation strategies may be less important than demonstrating their effectiveness in particular contexts. Defusion in particular aims to facilitate psychological flexibility within a given context, rather than achieving a long-term or permanent sense of distance from a

particular cognition. Therefore, the effects of a particular defusion technique do not necessarily need to be evaluated in terms of long term change, but rather aim to provide individuals with new learning and experience.

4.3 Clinical application

In terms of clinical application, this study should not be construed as a comparison of ACT and CBT. Instead, the current study sought to compare the process and outcome of two specific techniques from these multicomponent packages that are intended to help people respond to unhelpful cognitions. The results suggest that both cognitive defusion and cognitive reappraisal are psychologically active even when brief instructions are utilised and seem to achieve their effects in theoretically consistent ways. In this respect, both defusion and reappraisal constitute useful emotion regulation strategies to respond to cue-induced craving. However, these findings should be considered in the context of higher credibility and expectancy ratings than were provided in the suppression condition. The study offers tentative support to the hypothesis presented elsewhere that techniques associated with ACT and CBT may achieve similar behavioural outcomes via different mediating processes (Forman et al., 2007). Future research should aim to delineate between the individual characteristics of those who find defusion or reappraisal most helpful.

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Part 3

Critical appraisal

1.1 Introduction

This appraisal provides a critical reflection on the current study. The appraisal will initially describe how the research proposal was refined as my understanding of the theoretical and philosophical differences between Acceptance and Commitment Therapy (ACT), Cognitive Behavioural Therapy (CBT) and their corresponding emotion regulation strategies developed. The appraisal will also provide reflections on the study's design and methodology. Suggestions will be made regarding how the study might now be approached differently, based on my experience of the research process. I will also discuss the challenges associated with funding recruitment for an experimental study as part of a DClinPsy thesis.

1.2 Theoretical and philosophical issues

The current study aimed to compare the comparative effects of emotion regulation strategies on behavioural, affective and subjective correlates of smoking. The research proposal initially detailed hypotheses relating to differential changes in *self-reported internal experiences* (such as cravings and negative affect) following implementation of defusion, reappraisal or suppression. The proposal therefore reflected assumptions regarding the need for the study to evaluate the three emotion regulation strategies in terms of their effectiveness in changing self-reported levels of thoughts and feelings. With hindsight, the proposal was informed by first year teaching and clinical experience which was predominantly characterised by CBT models of pathology. These models tend to be informed by assumptions which suggest that thoughts and/or feelings must change for overt behaviour to change and

that the primary aim of psychotherapy is symptom reduction. In these respects, the theoretical and philosophical assumptions underlying ACT and CBT differ somewhat (Flaxman, Blackledge & Bond, 2011). As my understanding of these differences developed, it became necessary to adjust aspects of the research proposal. For example, the study's hypotheses were reconsidered, such that no hypotheses were subsequently made in relation to defusion and changes in craving or affect.

Other changes to the proposal arising from my developing understanding of theory related to the use of self-report measures. While CBT would hypothesise that reappraisal would be associated with a self-reported reduction in affective and subjective correlates of smoking, from an ACT perspective undesirable internal experiences are part of a functional process (Masuda, Feinstein, Wendell & Sheehan, 2010). These internal experiences should be measured within the context of ongoing stimulus-response relations. Therefore, the use of subjective self-report measures which do not tend to measure contextual processes is not necessarily recommended. Instead, behavioural and implicit measures should be encouraged. This led to the inclusion of both behavioural and implicit outcome measures in addition to self-report.

As the research process continued, I also began to differentiate between defusion and reappraisal in terms of preferred temporal focus. While CBT (and its associated regulatory strategies) primarily focuses on the review or planning of experiences which have occurred in the past or future (with the exception of in vivo exposure exercises), ACT tends to exhibit a present moment focus on experience (Flaxman et al., 2011). Therefore, the aim of defusion exercises is not necessarily to effect changes in future cravings or negative affect. Rather, defusion aims to provide individuals with an opportunity to learn and experience that the psychological impact

of these internal events is contextually controlled. Thus, while follow-up measures of smoking behaviour and craving were administered, the primary focus of the study was on the acute, immediate effects of brief instruction in these various strategies.

Since completing the study, I continue to reflect on how my developing theoretical understanding of defusion and reappraisal might now lead me to approach the study differently. Future research may benefit from considering whether to continue to compare the differential effects of emotion regulation strategies, or whether a more useful approach might be to investigate the effects of promoting the flexible application of a broader range of emotion regulatory strategies in smokers.

For example, implicit in the current study's comparison of emotion regulation strategies is an assumption that certain strategies may prove more or less helpful to smokers. Indeed, the use of suppression as the control condition reflected the hypothesis that attempts to suppress thoughts about smoking will exacerbate such thoughts (Purdon, 1999; Wegner, 1994) and increase smoking (Erskine, Georgiou & Kvavilashvili, 2010). While theory supports cognitive suppression as a maladaptive response to a variety of stressors (Aldao, Nolen-Hoeksema & Schweizer, 2010), evidence also suggests that the flexible application of suppression may be associated with some short-term benefits (Abramowitz, Tolin & Street (2001). Indeed, Gross' model (1998) argues that suppression of emotional expression may reduce the subjective experience of emotion in the short term (Gross, 1998; Gross & Thompson, 2007).

From a functional contextualist perspective (which forms the philosophical basis of ACT), the utility of different emotion regulation strategies depends upon the degree to which they facilitate value consistent behaviour and whether they can be flexibly applied depending on context (Forsythe, Eifert & Barrios, 2006). Indeed,

discrimination of contexts in which a regulatory strategy may be more or less helpful is essential to the functional utility of strategies (Bonanno, Papa, Lalande, Westphal, & Coifman, 2004). Failing to discriminate in this way has also been conceptualised as a feature of problematic emotion regulation (John & Gross, 2004). Any behaviour (adaptive or otherwise) which is applied in a rigid and inflexible manner may become problematic. **Therefore, Bonanno et al., (2004) propose that optimal emotion regulation includes both the expression and suppression of thoughts and feelings, depending on context. One important aspect of context is the way in which an individual's experience has shaped the development of different regulation strategies. Future research may therefore benefit from considering how individual differences in personality characteristics or existing coping styles may impact upon the efficacy of alternative strategies. Research may also explore the effects of the flexible application of a broader range of regulation repertoires in smokers, rather than comparing the differential effects of individual strategies.**

1.3 Methodological and practical issues

1.3.1 Recruitment and funding

Participants were screened over email and therefore self-declared the absence of exclusion criteria such as current substance misuse or current psychiatric disorder. Since this was the case, direct contact with the researcher was not necessary and screening could more efficiently have been achieved using an automated computer system. A total of 476 potentially eligible participants responded to the advertisements and were emailed the screening questionnaire. This constituted a time

consuming process which would certainly have been more efficiently achieved using an automated process.

To achieve power the current study required a sample size of 69. Following feedback from an expert in the field who reviewed the proposal, we increased the sample size to 75. Based on current UCL guidelines for the recruitment of participants to experimental research, the current study required a total of £1125 to fund recruitment. Total costs were subsequently estimated at £1200. Applications to the Research Department of Clinical, Educational and Health Psychology and the UCL Graduate School achieved £500 funding. Funding requests were submitted to a variety of organisations with a vested interest in smoking cessation research including the British Heart Foundation, Allen Carr's Easyway and Niquitin, amongst others. The £700 shortfall was eventually met by generous gifts of £500 from Professor Robert West (Professor of Health Psychology and Director of Tobacco Studies, UCL) and £200 from GlaxoSmithKline. Without this additional funding, the project would have proven unfeasible or alternatively would have relied upon personal funding from the author, which raises ethical concerns. The feasibility of future experimental studies for DClinPsy theses is therefore questioned if sufficient funding to conduct a well-powered study is not routinely available without relying on the generosity of external organisations. While it is unsurprising that in the current financial climate courses do not have sufficient funding available for such projects, questions remain regarding the continued feasibility of experimental research for DClinPsy theses.

1.3.2 Instructions

The design of the instructions was a challenging process. It was particularly difficult to introduce and explain defusion while keeping the instruction sets

balanced for variables such as word count and number of smoking related words. This was perhaps because of the counter intuitive nature of defusion (Eifert & Forsyth, 2005). While it was necessary that instructions included metaphors, a theoretical rationale and experiential practice of the strategy (Levin, Hildebrandt, Lillis & Hayes, 2012), this also posed difficulties given the practical necessity for a brief intervention. Following a number of drafts and edits, all reviewers agreed that the brief interventions accurately represented the targeted process. Since beginning this research, other researchers have contacted me to ask to review the instructions used in the current study. For the benefit of future research, it may be helpful to consider pooling the resources available for future experimental studies of cognitive defusion. This topic is currently being discussed on the Association for Contextual Behavioural Science (ACBS) website.

1.3.3 Measures

The current study used the Acceptance and Action Questionnaire II (AAQ-II; Bond et al., 2011) to provide a trait measure of experiential avoidance. The AAQ-II is the most widely used measure of psychological flexibility and/or experiential avoidance and is recommended for clinical and research use on the ACBS website. While reviewing the items throughout the research process I reflected on the AAQ-II's content validity and wondered how many of the items of the AAQ-II were sufficiently refined to measure experiential avoidance. For example, item two asks respondents to indicate the extent to which 'I'm afraid of my feelings'. While responses to this item may indicate how participants feel about their emotions, responses will not necessarily indicate how people behave in response to their feelings. Being afraid does not necessarily lead to avoidance; indeed, this is somewhat contradictory to the notion of acceptance. Item six asks respondents

whether ‘it seems like most people are handling their lives better than I am’. Agreement may not necessarily indicate a tendency towards experiential avoidance, but rather could indicate deficits in another skill relevant to life management. Item one asks respondents whether ‘my painful experiences and memories make it difficult for me to live a life that I would value’. It is possible that respondents with more painful experiences and memories may be more inclined to agree. This would not necessarily indicate a tendency towards experiential avoidance, but rather could simply reflect particularly difficult life experiences.

In this respect, it is possible that the AAQ-II fails to distinguish between levels of difficult psychological experience and levels of experiential avoidance. This is potentially problematic, given that research has concluded that changes in scores on the AAQ-II are positively correlated with changes in quality of life (Hayes, Luoma, Bond, Masuda & Lillis, 2006; Ruiz, 2010), independent of level of difficult psychological experience. It is therefore possible that the association between AAQ-II scores and scores on quality of life measures could be mediated by frequency and intensity of unwanted internal experience. Future research should explore this possibility.

While I have questioned the specificity of some items of the AAQ-II it should be noted that Bond et al., (2011) provide evidence supporting the psychometric properties of this scale. Nonetheless future experimental studies might consider supplementing the AAQ-II with other measures. One possible alternative could be the Cognitive Fusion Questionnaire (Gillanders et al., 2014) which was published during the data collection period of the current study. The Cognitive Fusion Questionnaire is a brief, self-report measure of cognitive fusion. Alternatively, given the theoretical shortcomings associated with self-report measures from an ACT

perspective, additional measures of implicit cognitive processes could have been utilised.

Implicit processes can be measured using a variety of tools including measures of memory associations or attentional biases. Implicit measures of experiential avoidance have been recently developed (Implicit Relational Assessment Procedure: IRAP; Nooper, Villatte, Neofotistou & McHugh, 2010). Incorporating these implicit measures alongside a self-report measure of experiential avoidance into the current study would have allowed the results of these implicit and explicit measures to have been compared. This may have helped to differentiate between subjective effects of the emotion regulation strategies (which were vulnerable to the effects of credibility and expectancy ratings) and implicit effects which may be driven by a separate process within Strack and Deutsch's (2004) dual processing model. In turn, this might provide a fuller picture in relation to how implicit and explicit processes maintain smoking.

1.3.4 The craving induction procedure

A set of four videos were used to induce cravings (Tong, Bovbjerg, & Erblich, 2007). The videos each show male and female actors of a variety of ages and ethnicities smoking cigarettes. During testing, some participants reported experiencing the videos which showed actors smoking pre-rolled cigarettes as 'disgusting' and 'dirty', particularly when participants reported a preference for hand-rolled cigarettes. Although smoking cues may not necessarily be consciously experienced as appetitive (Stacy & Wiers, 2010), a distinction between pre-rolled and hand-rolled cigarettes is not made within the cue-induced craving paradigms reported by papers in the current review. It appears smoking preferences may exert important influence upon an individual's response to the cue-induced craving

paradigm. Importantly, the current study asked participants to place their smoking equipment on the table in front of them to provide a secondary cue. Further research should explore moderating variables which may influence whether a smoker experiences cue-induced craving paradigms as appetitive or otherwise.

1.3.5 Follow-up

In terms of attrition at follow-up, 68/74 (90.7%) participants provided data at 24 hours follow-up while 54/75 (72%) provided data at seven days follow-up. While this retention rate was similar to other experimental studies included in the review (Bowen & Marlatt, 2009; Nosen & Woody, 2013; Rogojanski, Vettese & Antony, 2011), the high rate merits comment. Offering participants payment in advance appears to effectively encourage participation in follow-up measures. Advance payment effectively involves entering into a social contract, which may have helped with reducing drop out.

1.4 Conclusion

The present study has demonstrated the beneficial effects of brief instruction in cognitive defusion and cognitive reappraisal on the behavioural, affective and subjective correlates of smoking. This appraisal has detailed the theoretical, philosophical and methodological challenges associated with drawing comparisons between emotion regulation strategies, which often aim to achieve different outcomes in different ways. Future research might consider investigating how these different emotion regulation strategies can be used flexibly in response to contextual demands, to optimise the management of difficult thoughts, feelings and other aspects of internal experience associated with quitting smoking.

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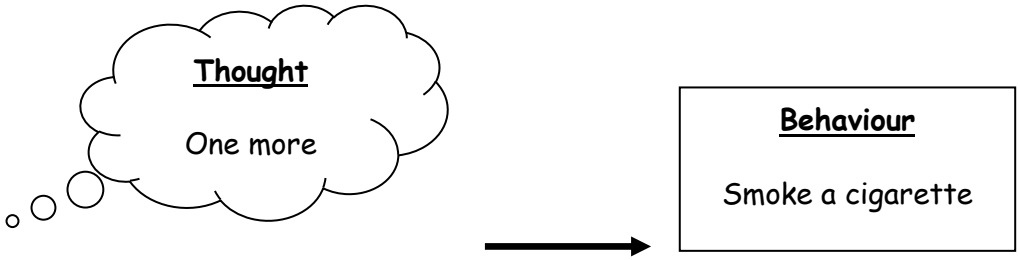
Appendix A

Reappraisal instructions

General introduction

It is often said that the core of our emotional and psychological suffering is caused by our negative thoughts, such as negative thoughts about the past, the self, and the future. According to these ideas, negative thoughts cause difficult feelings and unhelpful actions. For example, a person who is keen to stop smoking might think, "I know I should be trying to cut down, but one more cigarette won't hurt" and then smoke a cigarette.

Do you see this pattern? First, there is the negative thought and then the problematic behaviour, because we simply 'do what we're told' by our thoughts.



One way to prevent this pattern is to use cognitive reappraisal.

Explanation

Cognitive reappraisal refers to a strategy for deliberately changing these negative and unhelpful thoughts into helpful ones that allow us to cope more effectively. By using cognitive reappraisal, we can work on changing the way we think about ourselves and the world instead of suffering the negative consequences of unhelpful thoughts. This is hard to do because we tend to act on the automatic thoughts that pop into our minds.

For example, having the thought 'a cigarette would taste good right now' or 'if I were smoking now I could think more clearly' or 'smoking would make me feel better' would usually make it more likely we smoke a cigarette. This is because we tend to act on the thoughts that automatically pop into our minds.

How it works

By using cognitive reappraisal, we can modify our thoughts when they are distorted or unhelpful. We can begin to think about the situation differently.

If we want to stop smoking but we experience a craving, the best thing to do is to become aware of and modify any self-defeating thoughts into a different, more helpful thought. We can use reason and evidence to replace distorted thoughts with more accurate, believable, and helpful ones. That way, we can change the meaning of our thoughts or cravings.

Experiential exercise

The best way to demonstrate these ideas is to do a little exercise.

We would like you to think about the last time you really wanted a cigarette but couldn't have one. What do you imagine you might have thought?

Examples of thoughts might include 'if I were smoking now I could think more clearly' or 'a cigarette would taste good right now' or 'smoking would make me feel better'.

If you find it difficult to imagine what you might have been thinking, ask the experimenter to give you a card with some more examples of thoughts now.

Please tell your experimenter when you have a thought in mind.

(Participant indicates they have an appropriate thought or experimenter helps elicit a thought using a standardized procedure. At this point, instructions delivered verbally)

E: We would like you to really concentrate on this thought, get caught up in it, give it your full attention and focus on believing it.

E: Now, I would like you to imagine you're collecting evidence – as if for a court case - to determine whether this thought is true or helpful. What sorts of questions would you need to ask yourself? For example, will your thought that 'smoking would make me feel better' stand up in court against the evidence that in the past smoking might have made you feel worse, either immediately or in the longer term?

Some other questions you could ask yourself which might help to prove or disprove your thoughts about cigarettes include:

- What is the effect of you thinking about cigarettes like this?
- What would your best friend or parent say if they knew you wanted to quit and heard you thinking this thought?
- Are you jumping to conclusions, blowing the craving out of proportion or automatically assuming a thought about smoking must be true because of the way you're feeling?

Once you've asked yourself these questions, we would like you to think about whether there is a different, more helpful thought you can use to change how you're thinking about smoking

Do you have any questions? Great, please begin (30 seconds)

E: O.K., now stop. You can now continue to follow the written instructions

(Continue booklet instructions)

So, cognitive reappraisal allows you to change the meaning of our thoughts or cravings into something more helpful. By changing the way you think about cravings, we will act on them less automatically.

We would like to know what you think about these instructions. To do so, please answer the questions in the Credibility/Expectancy questionnaire.

Introducing the video

Viewing 1

Shortly you will view some videos of people smoking. Although the people and situations in the videos may be unfamiliar, please try and view the videos as if you were actually in the situation. While watching, please see whether any thoughts about cigarettes come to mind, particularly any specific words or sentences.

Thoughts that might arise could include the examples given earlier in these instructions. However, your own thoughts might be different to the ones you were shown by the experimenter - that is fine. Please remember the thought because I'll ask you to write it down in a minute.

Don't try to use the strategy we taught you yet.

PLAY VIDEO

Did you notice any thoughts?

Write them down?

_____

_____

Viewing 2

You will now watch the same videos.

This time I'd like you to apply the cognitive reappraisal strategy that you practised before you saw the video to any thoughts that arise during this viewing.

To summarise the strategy

- By using cognitive reappraisal, we can modify our thoughts when they are distorted or unhelpful. We can begin to think about the situation differently. If we want to stop smoking but we experience a craving, the best thing to do is to become aware of and modify any self-defeating thoughts into a different, more helpful thought and therefore change the meaning of our thoughts or cravings.

- You might think of your thoughts about smoking and your cravings as like a playground bully; you need to stand up to the bully and challenge what they're saying and how they're treating you if anything is going to change.

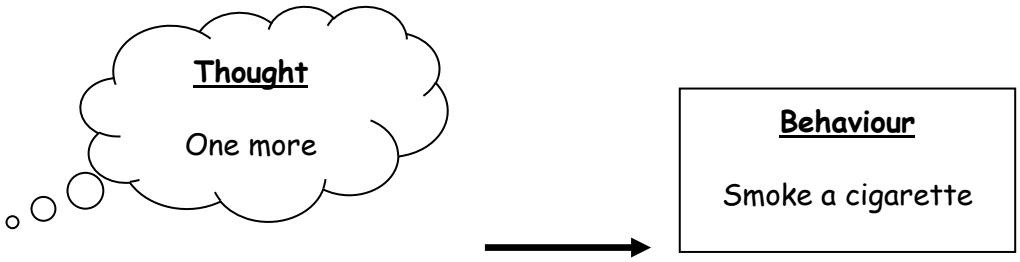
Appendix B

Defusion instructions

General introduction

It is often said that the core of our emotional and psychological suffering is caused by our negative thoughts, such as negative thoughts about the past, the self, and the future. According to these ideas, negative thoughts cause difficult feelings and unhelpful actions. For example, a person who is keen to stop smoking might think, "I know I should be trying to cut down, but one more cigarette won't hurt" and then smoke a cigarette.

Do you see this pattern? First, there is the negative thought and then the problematic behaviour, because we simply 'do what we're told' by our thoughts.



One way to prevent this pattern is to use cognitive defusion.

Explanation

Cognitive defusion refers to a strategy for 'separating' from our thoughts rather than becoming tangled up in them. By using defusion, we begin to notice a thought as *just a thought*, instead of getting caught up in it and doing what it tells us. This is hard to do because we grow used to listening to our thoughts and doing what they tell us, especially when they are self-defeating or unhelpful.

For example, having the thought 'a cigarette would taste good right now' or 'if I were smoking now I could think more clearly' or 'smoking would make me feel better' would usually make it more likely we smoke a cigarette. This is because we tend to act on the thoughts that automatically pop into our minds.

How it works

By using defusion we can 'separate' ourselves from our thoughts and notice that a thought is nothing more than a collection of words produced by our minds.

If we want to stop smoking but we experience a craving, the best thing to do is to notice our thoughts *as just thoughts*. That way, rather than accepting a thought as a fact or a command that we have to follow, we can see thoughts for what they really are - *just thoughts*. That way, we can deliberately decide what we want to do next rather than acting automatically.

Experiential exercise

The best way to demonstrate these ideas is to do a little exercise.

We would like you to think about the last time you really wanted a cigarette but couldn't have one. What do you imagine you might have thought?

Examples of thoughts might include 'if I were smoking now I could think more clearly' or 'a cigarette would taste good right now' or 'smoking would make me feel better'.

If you find it difficult to imagine what you might have been thinking, ask the experimenter to give you a card with some more examples of thoughts now.

Please tell your experimenter when you have a thought in mind.

(Participant indicates they have an appropriate thought or experimenter helps elicit a thought using a standardized procedure. At this point, instructions also delivered verbally).

E: We would like you to really concentrate on this thought, get caught up in it, give it your full attention and focus on believing it.

Now, to create some separation or distance from the thought we'd like you to silently replay the thought in your head with this phrase in front of it:

'I notice I'm having the thought that…..'

For example, 'I'm having the thought that smoking would make me feel better'.

Practice a few times, each time putting the phrase 'I notice I'm having the thought that…' in front of the thought you have in mind (pause for 20 seconds)

Do you have any questions?

Participant responds

Great, please begin (30 seconds)

E: O.K. now stop. You can now continue to follow the written instructions

(Continue booklet instructions)

E: So, cognitive defusion allows you to take a step back and see a thought as just words produced by our minds, rather than as a truth or a command. Thoughts are just thoughts, and there is nothing solid to them. By seeing a craving as just a thought, we will act on them less automatically.

We would like to know what you think about these instructions. To do so, please answer the questions in the Credibility/Expectancy questionnaire.

Introducing the video

Viewing 1

Shortly you will view some videos of people smoking. Although the people and situations in the videos may be unfamiliar, please try and view the videos as if you were actually in the situation. While watching, please see whether any thoughts about cigarettes come to mind, particularly any specific words or sentences.

Thoughts that might arise could include the examples given earlier in these instructions. However, your own thoughts might be different to the ones you were shown by the experimenter - that is fine. Please remember the thought because I'll ask you to write it down in a minute.

Don't try to use the strategy we taught you yet.

PLAY VIDEO

Did you notice any thoughts?

Write them down?

Viewing 2

You will now watch the same videos.

This time I'd like you to apply the cognitive *defusion* strategy that you practised before you saw the video to any thoughts that arise during this viewing.

To summarise the strategy

- By using defusion we can 'separate' ourselves from our thoughts and notice that thoughts are nothing more than words produced by our minds. If we want to stop smoking but we experience a craving, the best thing to do is to watch our thoughts as they come and go. That way, we can see them for what they truly are: just a thought.

- You might think of your thoughts about smoking and your cravings as like a playground bully; you need to notice how the bully is making you feel but then walk away and get yourself far away from the influence of the bully, so the bully loses interest in you.

Do you have any questions?

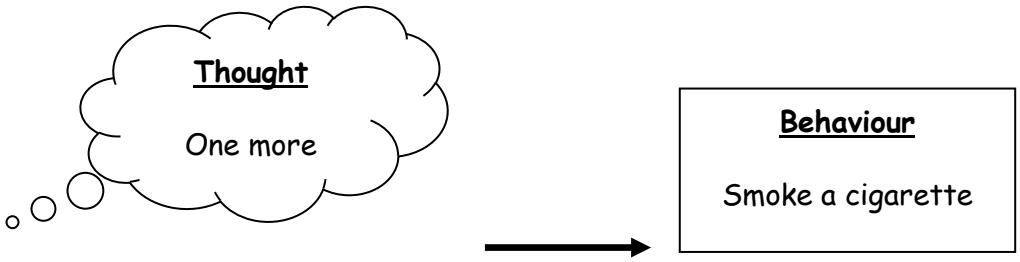
Appendix C

Suppression instructions

General introduction

It is often said that the core of our emotional and psychological suffering is caused by our negative thoughts, such as negative thoughts about the past, the self, and the future. According to these ideas, negative thoughts cause difficult feelings and unhelpful actions. For example, a person who is keen to stop smoking might think, "I know I should be trying to cut down, but one more cigarette won't hurt" and then smoke a cigarette.

Do you see this pattern? First, there is the negative thought and then the problematic behaviour, because we simply 'do what we're told' by our thoughts.



One way to prevent this pattern is to use cognitive suppression.

Explanation

Cognitive suppression refers to a strategy for consciously suppressing unwanted thoughts by "willing them away." By using cognitive suppression, we can avoid the negative consequences of these thoughts by focusing mental effort on stopping these thoughts or on pushing them out of our minds. This is hard to do because we grow used to listening to our thoughts and doing what they tell us, especially when they are self-defeating or unhelpful.

For example, having the thought 'a cigarette would taste good right now' or 'if I were smoking now I could think more clearly' or 'smoking would make me feel better' would usually make it more likely we smoke a cigarette. This is because we tend to act on the thoughts that automatically pop into our minds.

How it works

By using cognitive suppression, we can begin to stop thinking negative thoughts and therefore avoid the emotional distress that accompanies them.

If we want to stop smoking but experience a craving, the best thing to do is to stop thinking about it or to push the thoughts away. That way, we can stay in control of our thoughts so we don't let them get to us. Rather than dwelling on unhelpful thoughts and cravings, we should learn to stop them. The more we stop thinking them and push them away, the less automatically we will act on them.

Experiential exercise

The best way to demonstrate these ideas is to do a little exercise.

We would like you to think about the last time you really wanted a cigarette but couldn't have one. What do you imagine you might have thought?

Examples of thoughts might include 'if I were smoking now I could think more clearly' or 'a cigarette would taste good right now' or 'smoking would make me feel better'.

If you find it difficult to imagine what you might have been thinking, ask the experimenter to give you a card with some more examples of thoughts now.

Please tell your experimenter when you have a thought in mind.

(Participant indicates they have an appropriate thought or experimenter helps elicit a thought using a standardized procedure. At this point, instructions also delivered verbally)

E: We would like you to really concentrate on this thought, get caught up in it, give it your full attention and focus on believing it.

E: Now, I would like you to concentrate on pushing this thought out of your mind until I say stop. Stop thinking the thought and really try to push it away.

Do you have any questions?

Participant responds

E: Good! Don't think about your thought. Push it out of your mind. Are you ready? Begin (30 seconds passed).

E: O.K. now stop. You can now continue to follow the written instructions

(Continue booklet instructions)

So, cognitive suppression allows you to push cravings away and to stop thinking about them. By pushing cravings away, we will act on them less automatically.

We would like to know what you think about these instructions. To do so, please answer the questions in the Credibility/Expectancy questionnaire.

Introducing the video

Viewing 1

Shortly you will view some videos of people smoking. Although the people and situations in the videos may be unfamiliar, please try and view the videos as if you were actually in the situation. While watching, please see whether any thoughts about cigarettes come to mind, particularly any specific words or sentences.

Thoughts that might arise could include the examples given earlier in these instructions. However, your own thoughts might be different to the ones you were shown by the experimenter - that is fine. Please remember the thought because I'll ask you to write it down in a minute.

Don't try to use the strategy we taught you yet.

PLAY VIDEO

Did you notice any thoughts?

Write them down?

Viewing 2

You will now watch the same videos.

This time I'd like you to apply the cognitive suppression strategy that you practised before you saw the video to any thoughts that arise during this viewing.

To summarise the strategy

- By using cognitive suppression, we can stop thinking negative thoughts and avoid the emotional distress that accompanies them. If we want to stop smoking but experience a craving, the best thing to do is to stop the thoughts or push them away so we can stay in control of our thoughts rather than dwelling on them. The more we stop them and push them away, the less automatically we will act on these thoughts.
- You might think of your thoughts about smoking and your cravings as like a playground bully; you need to stop thinking about the bully and not show any sign that the bullying is affecting you. The bully may then lose interest.

Do you have any questions?

Appendix D

Cue cards for participants

Cue cards for participants

How to manage your cravings

Stop the thoughts or push them away!

If we can stop our thoughts and push them away rather than dwelling on them, we will act on them less automatically.

How to manage your cravings

Practice noticing your thoughts as they come and go.

If we can notice our thoughts as just words produced by our minds rather than commands, we will act on them less automatically.

How to manage your cravings

Change any unhelpful thoughts into a different, more helpful thought.

If we consider whether there is a different, more helpful way of thinking about cravings, we will act on them less automatically.

Appendix E

Ethical approval

UCL RESEARCH ETHICS COMMITTEE
GRADUATE SCHOOL OFFICE

Dr Sunjeev Kamboj
Research Department of Clinical, Educational and
Health Psychology
UCL

19 March 2013

Dear Dr Kamboj

Notification of Ethical Approval
Project ID: 0760/002: Craving changes? How do verbal and visuo-spatial strategies modify craving experiences in heavy smokers and drinkers

I am pleased to confirm that in my capacity as Chair of the UCL Research Ethics Committee I have approved your study for the duration of the project i.e. until March 2014 on condition that the Information Sheet is amended to include reference to the fact that a breathalyser test will be administered following the consumption of the alcoholic drink.

Approval is also subject to the following conditions:

1. You must seek Chair's approval for proposed amendments to the research for which this approval has been given. Ethical approval is specific to this project and must not be treated as applicable to research of a similar nature. Each research project is reviewed separately and if there are significant changes to the research protocol you should seek confirmation of continued ethical approval by completing the 'Amendment Approval Request Form'.

The form identified above can be accessed by logging on to the ethics website homepage: http://www.grad.ucl.ac.uk/ethics/ and clicking on the button marked 'Key Responsibilities of the Researcher Following Approval'.

2. It is your responsibility to report to the Committee any unanticipated problems or adverse events involving risks to participants or others. Both non-serious and serious adverse events must be reported.

   Reporting Non-Serious Adverse Events
   For non-serious adverse events you will need to inform Helen Dougal, Ethics Committee Administrator (ethics@ucl.ac.uk), within ten days of an adverse incident occurring and provide a full written report that should include any amendments to the participant information sheet and study protocol. The Chair or Vice-Chair of the Ethics Committee will confirm that the incident is non-serious and report to the Committee at the next meeting. The final view of the Committee will be communicated to you.

   Reporting Serious Adverse Events
   The Ethics Committee should be notified of all serious adverse events via the Ethics Committee Administrator immediately the incident occurs. Where the adverse incident is unexpected and serious, the Chair or Vice-Chair will decide whether the study should be terminated pending the opinion of an independent expert. The adverse event will be considered at the next Committee meeting and a decision will be made on the need to change the information leaflet and/or study protocol.

Appendix F

Information sheet and consent form

Information Sheet for Smokers Involved in Verbal and Visuospatial Stimulus-Processing Research Studies

You will be given a copy of this information sheet.

Title of Project: **Craving changes. How do verbal and visuospatial strategies modify craving experiences in heavy smokers and drinkers?**

This study has been approved by the UCL Research Ethics Committee (Project ID Number): 0760/002

Name: Matthew Beadman

Contact details: [redacted] Telephone: [redacted]

Details of Study: This study examines the effects of psychological task performance on craving experiences in smokers. We are interested in whether experiences of craving change when people engage in either visuospatial tasks (those involving images, shapes and object locations) or verbal tasks (those involving memory or instructions to use attention in a particular way). It is not currently known if performing these psychological tasks increases or decreases craving; whether they simply act as a distraction or can have a genuine and direct effect on craving itself. By learning more about the mental activities that increase or decrease craving we may be able to develop strategies for managing craving or identify activities that people should avoid to prevent cravings from increasing, especially if they are trying to avoid smoking. More generally, 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 smoke five or more cigarettes per day and are between 18-50 years old, fluent in English, have normal or corrected to normal vision, have no current serious psychological illness, no history of alcohol or drug dependence (apart from tobacco-related products) and have not taken part in a similar study, you may be eligible to take part?

What will happen to me if I take part? We will arrange for you to attend an appointment at UCL at a time convenient for you. **You will need to refrain from smoking for at least 2 hours prior to this appointment. Your researcher will give you more specific instructions.** You should not eat or drink any caffeinated drinks for three hours and any alcohol in the 12 hours prior to the appointment. Also you should not have used any recreational drugs in the last 24 hours. When you arrive we will take a measurement of the carbon monoxide in your breath.

You will then be given some questionnaires to measure your cravings, mood, attitudes about smoking, smoking history and use of other drugs. Next you will take part in computerized and pen and paper tasks before filling out the questionnaire measuring levels of craving again. The tasks will involve asking you to look at videos related to smoking. While you do this, we will measure your reaction times. We may also measure your bodily reactions, such as heart rate, blood pressure and skin conductance. Depending on the task you are randomly assigned to, you will also receive instructions to think about your mental and physical experiences in a different way, to think about future consequences to your health if you continue to smoke, or to perform a memory task. All of this will take up to one and a half hours. After this you will be paid for your time. We will ask you to email/text us to let us know how much time passed before you smoked your next cigarette. We would also like to contact you again: once after 24 hours, and again a week later to ask you some very brief (up to 5 minutes) additional questions about your experience since the appointment. During this time, you may also be asked to give us another measurement of your breath carbon monoxide. You may contact the researcher at any time after the study if you experience any difficulties.

Are there any risks in taking part?

There are no known risks in completing the questionnaires or tasks but looking at videos related to smoking and thinking about negative consequences of smoking can be temporarily, mildly distressing. The request that you do not smoke for at least 2 hours prior to the session may mean that you experience some stress or agitation but this will be short-lived.

Are there any benefits to taking part?

You will not benefit directly from taking part in this research but your participation will help us gain a better understanding of the experience of craving which may lead to better strategies for managing these challenging experiences. In addition, some of 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 G

Informed consent form for smokers involved in verbal and visuospatial stimulus-processing research studies

Informed consent form for smokers involved in verbal and visuospatial stimulus-processing research studies

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

Title of Project: **Craving changes? How do verbal and visuospatial strategies modify craving experiences in heavy smokers and drinkers**

This study has been approved by the UCL Research Ethics Committee (Project ID Number): 0760/002

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 H

Table of Cronbach Alpha Coefficients for all scales

Table of Cronbach Alpha Coefficients for all scales

Measure	Subscale	N	Mean	SD	Cronbach α
AAQ		75	18.60	7.18	.88
QSU-Brief (pre)		75	44.21	13.46	.92
QSU-Brief (post)		73	37.41	13.94	.94
QSU-Brief (24 hour follow-up)		66	27.76	11.91	.93
QSU-Brief (7 day follow-up)		52	29.33	12.22	.92
Credibility scale		73	16.85	4.75	.89
ASQ	Concealing	75	26.52	7.09	.88
	Adjusting	75	22.72	5.38	.82
	Tolerating	75	17.16	3.54	.66
IPANAS-SF (pre)	Positive affect	75	15.12	3.38	.60
	Negative affect	75	7.03	2.45	.67
IPANAS-SF (post)	Positive affect	73	15.75	3.98	.74
	Negative affect	73	7.01	8.24	.79
AIS (pre)	Thoughts	75	14.28	2.86	.78
	Feelings	75	17.87	3.34	.76
	Sensations	75	12.16	4.53	.94
AIS (post)	Thoughts	73	13.45	3.29	.82
	Feelings	73	17.81	3.40	.81
	Sensations	73	12.08	4.04	.91