



University of HUDDERSFIELD

University of Huddersfield Repository

Saunders, Rebecca

Goal-directed tobacco seeking: a study examining the impact of stress and other factors on smoking behaviour

Original Citation

Saunders, Rebecca (2018) Goal-directed tobacco seeking: a study examining the impact of stress and other factors on smoking behaviour. Masters thesis, University of Huddersfield.

This version is available at <http://eprints.hud.ac.uk/id/eprint/34523/>

The University Repository is a digital collection of the research output of the University, available on Open Access. Copyright and Moral Rights for the items

on this site are retained by the individual author and/or other copyright owners.

Users may access full items free of charge; copies of full text items generally can be reproduced, displayed or performed and given to third parties in any format or medium for personal research or study, educational or not-for-profit purposes without prior permission or charge, provided:

- The authors, title and full bibliographic details is credited in any copy;
- A hyperlink and/or URL is included for the original metadata page; and
- The content is not changed in any way.

For more information, including our policy and submission procedure, please contact the Repository Team at: E.mailbox@hud.ac.uk.

<http://eprints.hud.ac.uk/>

**Goal-directed tobacco seeking: a study examining the
impact of stress and other factors on smoking behaviour**

Rebecca Saunders

Masters by Research (MSc) Psychology

The University of Huddersfield

First Submission: August 2017

Second Submission: January 2018

Copyright Statement

- i. The author of this thesis (including any appendices and/or schedules to this thesis) owns any copyright in it (the "Copyright") and s/he has given The University of Huddersfield the right to use such Copyright for any administrative, promotional, educational and/or teaching purposes.
- ii. Copies of this thesis, either in full or in extracts, may be made only in accordance with the regulations of the University Library. Details of these regulations may be obtained from the Librarian. This page must form part of any such copies made.
- iii. The ownership of any patents, designs, trade marks and any and all other intellectual property rights except for the Copyright (the "Intellectual Property Rights") and any reproductions of copyright works, for example graphs and tables ("Reproductions"), which may be described in this thesis, may not be owned by the author and may be owned by third parties. Such Intellectual Property Rights and Reproductions cannot and must not be made available for use without the prior written permission of the owner(s) of the relevant Intellectual Property Rights and/or Reproductions.

Acknowledgements

I would like to firstly thank Dr Chris Retzler, it has been a pleasure to work with him again on another project and I am very grateful for his hard work and determination throughout this research. I would also like to thank all the individuals who gave up their time to participate in this research and also to those who further recruited friends and family, I cannot thank you enough.

Abstract

The aim of this research was to assess the impact of the amount smoked, mental health status and perceived loneliness level in regards to the influence on smoking behaviour and the type of smoker an individual is (daily or recreational). Individuals were exposed to either a stressful or non-stressful cold pressor task (CPT) and measures assessing them on a variety of factors including the amount of cigarettes they smoke per day and their anxiety, depression and loneliness levels. Participants completed several questionnaires, a two-part concurrent choice task and a CPT, these were then analysed using correlational and ANCOVA analyses. The results suggest the amount of cigarettes smoked per day has a significant impact on how many times the individual will respond for cigarettes in the extinction part of concurrent choice task. Thus suggesting the heavier the smoker the higher the incentive value of cigarettes compared to the neutral stimulus. However, a significant impact of the level of depression, anxiety and loneliness on the response rate of cigarettes was not found. Possible reasoning for these outcomes are discussed, including methodological issues of the CPT. Whilst providing evidence towards the influence of the amount smoked and the incentive value of cigarettes, the findings are expected have to therapeutic potential by aiding what is targeted in abstinence programmes.

List of Abbreviations

ANCOVA - Analysis of Covariance

BDI - Beck Depression Inventory

BSQU – Brief Questionnaire of Smoking Urges

CDS-5 - Cigarette Dependence Scale-5

CO – Carbon Monoxide

CPT - Cold pressor task

DV – Dependent Variable

GSR - Galvanic skin response

IV – Independent Variable

MC-4 - Melanocortin-4

NHS - National Health Service

POMS-1 - Profile of Mood States 1

POMS-2 - Profile of Mood States 2

Qpack – Question Pack

SECPT - Socially Evaluated Cold Pressor Task

UCLA - University of California, Los Angeles

WISDM-68 - Wisconsin Inventory of Smoking Dependence Motives-68

Table of Contents

Acknowledgements	3
Abstract	4
List of Abbreviations	5
Goal-directed tobacco seeking: a study examining the impact of stress and other factors on smoking behaviour.	8
Goal-directed tobacco seeking	9
Stress and tobacco seeking	12
Anxiety, depression and tobacco seeking	14
Social factors and tobacco seeking	20
Method	23
Participants	23
Materials and apparatus	25
Design	32
Procedure	32
Results	35
Inferential testing	37
CPT group and cigarette responses in extinction	38
Cigarettes per day	39
BDI score	39
Anxiety difference score	39
Correlational analyses	40
Social isolation analysis	44
Multiple regression analyses	44
Discussion	45
CPT stress	45
Number of cigarettes per day	48
Depression	51
Anxiety	55
Social factors	57
Limitations	59
Conclusion	63

References	65
Appendices	82
Appendix A - Qpack for participants	82
Appendix B - List of dependent variables	101

Goal-directed tobacco seeking: a study examining the impact of stress and other factors on smoking behaviour.

According to the World Health Organization, tobacco use kills around six million people worldwide each year (World Health Organisation, 2017) and despite government attempts to encourage and help smokers to quit, between 75 and 80% of those who manage to quit will relapse (Carmody, 1992). Whilst tobacco sales have been reported to bring in around £12 billion in direct tax revenues (Full Fact, 2012), it is trickier to pin down the cost to the government and society from tobacco use. However, data suggests that in 2006 it was estimated that the cost of treating smokers was around £2.7 billion. The National Health Service (NHS) also offers many stop smoking services to individuals, such as the option to join a local stop-smoking support group who meet once a week, to receive one-to-one support or to receive telephone support. In 2013 the total expenditure for these NHS treatments in England were said to be at £87.7 million, which is £0.5 million less than in 2011/12, but around £63.2 million more than in 2002/03 (NHS Digital, 2013). Although this is a large cost to the government, it is also evident that the six million deaths per year could be prevented or substantially reduced, if an effective way to quit with as minimal risk of relapse as possible was developed.

At present the underlying mechanisms of nicotine addiction are not well understood. Previous literature, which is subsequently described, has highlighted stress, anxiety, depression and social isolation (in terms of loneliness) as some of the key contributors to the initiation and continuation of smoking behaviour. They have also been deemed detrimental in regards to smoking cessation and subsequent abstinence. Therefore, this paper will attempt to help further this understanding of the cognitions of smoking behaviour with regards to these variables. This will be conducted via the use of a selection of questionnaires, a cold pressor task (CPT) and a concurrent choice task, which is a two-part task representing tobacco seeking. The concurrent choice task has been found to display real-world application as cues that are linked to smoking behaviour have been found to increase cravings for cigarettes (Ferguson &

Shiffman, 2009). These are implemented in the task by the use of a pictorial representation of cigarettes.

To gain a further understanding of the mechanisms behind this decision-making process and the influence of stress, mental health factors and social isolation could prove useful in not only addressing smoking behaviour and aiding the prevention of relapse in treatment, but application could also be made to addiction management in additional drugs with regards to these variables.

Goal-directed tobacco seeking

Goal-directed tobacco seeking has been defined as the process whereby explicit knowledge is learned regarding the instrumental contingency between smoking behaviour and the following rewarding effects (Hogarth, Dickinson & Duka, 2010). The instrumental contingency is the probability whereby gaining a targeted reward is related to the performance of a specific action, compared to the probability of gaining the reward in the absence of the action (Liljeholm, Tricomi, O'Doherty & Balleine, 2011). Therefore, smoking behaviour is controlled by the awareness of the behaviour required to produce the drug and the motivational value of the effects of said drug (De Wit & Dickinson, 2009). This is in comparison to habitual responding, whereby following the learning of the associations between smoking and the rewarding effects the response is automatically performed with little or no planning (Ostlund & Balleine, 2008).

Previous literature has claimed that smoking behaviour is habit-based and formed by the continued need to smoke because of chemical cravings in the brain (Durazzo, Meyerhoff & Nixon, 2010). Cigarette smoking is frequently described as a 'bad habit' and therefore quitting smoking should just be down to the ability to 'break the habit' (Ostlund & Balleine, 2008). The habitual view does nicely capture the compulsive, 'out-of-control' nature of drug taking, however this view is considered an oversimplification of the complex problem of addiction and more recent literature now shows that it can be goal-directed in nature (Skinner & Aubin, 2010). This means rather than a cue triggering an

automatic response (habit-based), tobacco seeking can be directed towards a goal with contingent knowledge of the behavior and its outcome (Hogarth, 2012). Additional research has proposed that what has then begun by goal seeking formulates into a habit.

From human action theory Dickinson and Balleine (1994) argued that to be classified as goal-directed the performance of an action should depend on two factors: (1) the causal relationship between the action and outcome, and (2) the current motivational value of that outcome. Research, as described below, has found that drug-seeking performance can be impacted by the interpretation of the rewards. Thus, indicating that drug seeking is facilitated by a combination of information regarding the response-outcome contingency, whereby a response is learned to produce a certain outcome, and knowledge of the current incentive value of the outcome. Evidence of this comes from studies by Hutchenson, Everitt, Robbins and Dickinson (2001) and Olmstead, Lafond, Everitt and Dickenson (2001) who trained rats on a seeking-training chain to obtain a drug in order for the rats to learn the causal contingency between these actions and the outcome of taking the drug. Following this the outcome of the chain was revalued by experience of the high incentive value of the drug in withdrawal, or devalued by removing the taking lever. In other words, the motivational effects of the drug were experienced at a period where relief from the symptoms of withdrawal would be highly favoured, or they were inhibited by removing the ability to access the drug. Following this performance of the drug-seeking response was tested in extinction, which is where the stimuli used in the training phase to indicate which response led to which outcome is removed. This was in order to evaluate whether performance of the drug-seeking response would be impacted due to an awareness of the altered value of the outcome via the subsequent devaluation treatment. It was found that the rats would increase their drug seeking response when the rewards were revalued, but decrease the response when the rewards were devalued. As proposed by Hogarth & Chase (2011), individuals that perceive the effect of a drug to be more rewarding may therefore exhibit drug seeking more due to an awareness of the positively valued consequences. In application to the goal-directed theory of smoking behaviour

this suggests that smokers who interpret the effects of smoking as rewarding rather than negative will be more likely to carry out this behaviour.

Furthermore, Hogarth, Balleine, Corbit and Killcross (2013) explain how in goal-directed drug seeking the individual will acquire knowledge of the instrumental contingency between the drug seeking response and the drug's identity and value. Dickinson (1985) developed the outcome devaluation procedure, which is classified as the principal method for identifying goal-directed control. In short, rats learn that two different lever press responses produce different rewarding outcomes. The drug is then devalued by pairing it with a negative outcome, such as sickness, so that the positive value is reduced. The animal is then given the opportunity to press one of the two levers in an extinction task where the expected reward is no longer received following the response. This is in order to assess whether or not the rat will reduce responding for the drug outcome. As this method contains no stimuli that signal the two outcomes, any devaluation effect cannot be associated with a change in the amount of the cues to produce a response for their associated outcome. Additionally, as the outcomes are not presented in the extinction part of the task any devaluation effect cannot be related to reinforcement. Following this any reduction in drug choice must be down to the animals' knowledge of the reward-outcome contingencies and current low value of the drug outcome, together determining the inclination to select the response and demonstrating the goal-directed nature of drug seeking via its nature to be determined by the reward value of the drug.

The outcome devaluation procedure is also used in experiments using human participants (Hogarth, 2012; Hogarth & Chase, 2011). In the concurrent training stages of such research smokers learned that one key would result in tobacco points but another key would lead to chocolate points. Tobacco was then devalued by smoking to satiety, the presentation of smoking health warnings or the use of nicotine nasal spray. It was found following the devaluation that participants were more inclined to press the response that led to chocolate points due to the knowledge of the current value of the tobacco outcome.

Although the current study is not using a devaluation procedure, it is interesting to note the effects of devaluing the expected outcome of smoking behaviour on tobacco seeking. In the present research, participants are either presented with a stressful CPT or a non-stressful CPT, the implication towards tobacco seeking is then measured with regards to the percentage of cigarettes chosen in the extinction part of the concurrent choice task as previously described. However, it is not just as simple as smoking to receive a reward, other factors have been found to contribute towards smoking behaviour.

Stress and tobacco seeking

Sinha (2008) has proposed many reasons for the vulnerability to addiction, which include factors such as negative life events (i.e. physical violence and emotional abuse), as well as isolation and the type of family structure. However, Sinha (2008) suggested that stress is a key element of these factors and this is the key reason why they can be a contributor to addiction development. According to previous preclinical research, stress has been found to enhance drug self-administration and reinstate drug seeking in animals with prior experience of the drug (Sinha, 2001). Kouvonen, Kivimäki, Virtanen, Pentti and Vahtera (2005) sought to examine the relationship between work stress and smoking via a set of regression models. It was found that those with a high imbalance in their effort-reward or those who perceived to have lower rewards compared to effort put in were more likely to be smokers. Higher job strain and effort-reward imbalance (including components such as low job control and low rewards) were additionally related to an increased likelihood for higher smoking intensity. This was also found to be higher in women with active jobs, passive jobs and low effort expenditure. In terms of the likelihood of being a current smoker Kouvonen, *et al.* (2005) found this to be associated with high job strain, high effort-reward imbalance and high job demands, i.e. a high stress environment. In comparison, a common feature of an ex-smoking status was low effort and subsequently less stress.

With regards to how stress influences smoking behaviour research has discovered various motives behind this. It has been proposed that increasing stress levels decrease behavioural control and increase impulsivity. Thus, with the increase in distress there is a greater risk of maladaptive behaviours, such as smoking (Hayaki, Stein, Lessor, Herman & Anderson, 2005; Tice, Bratslavsky & Baumeister, 2001). Other studies have proposed that whilst smoking is initially thought of as a way to relieve stress, after a period of time it can result in an increase in stress levels. Ikard, Green and Horn (1969) found that 80% of smokers agreed with statements in questionnaires that indicated smoking was relaxing and pleasurable to them. Whilst smoking may be relaxing when the individual is engaging in smoking behaviour, the periods in between cigarettes and just before have been reported to be stressful for the smoker. Hughes, Higgins and Hatsukami (1990) found that during periods of nicotine abstinence smokers report negative moods, such as stress and irritability, with the only way to relieve these being to smoke. Parrott (1994) found that the most dependent smokers tend to report mood control as a central reason for their smoking addiction. Parrott (1999) also found that adolescent smokers reported increasing levels of stress as they developed regular patterns of smoking and that the cessation of smoking led to a reduction in stress. Therefore, Parrott (1999) concluded that the stress relieving effects of smoking are just the reversal of the irritability and strain brought on by the reduction of nicotine. Further to this, research has found that acute stress increases the selection of outcomes that were previously considered rewarding, but impairs the avoidance of negative outcomes (Mather & Lighthall, 2012).

In order to examine the impact of stress on smoking behaviour in a laboratory setting, the CPT has been used as a means to implement acute, short-term stress. With regards to the CPT as a successful way to induce stress, Cahill, Gorski and Le (2003) found that when presented with the CPT individuals' salivary cortisol levels were significantly heightened. Cortisol, which is released as part of the biological stress response, is a hormone that is the final product of the hypothalamic-pituitary-adrenal axis (King & Hegadoren, 2002). Therefore, the findings of an increase in cortisol can be interpreted as evidence for the CPT

as an effective method to stimulate stress. In application to the present study, this finding suggests that the acute stress brought upon by the CPT should increase the percentage amount an individual chooses cigarettes during the extinction task.

From the research cited it is apparent that stress can be an implementer to maladaptive smoking behaviours and therefore this study will seek to assess the impact that an acute stressor (the CPT) will have on an individual's urge to seek cigarettes. This will be measured via the amount of cigarette responses in an extinction task. Also taken into account will be whether the individual smokes daily or recreationally, as differences have been proposed in terms of the number of cigarettes per day as described further in this section.

Anxiety, depression and tobacco seeking

Anxiety is a term used to describe a feeling of unease, such as worry or fear, and it can be mild or severe and it can also appear in various forms, the most common being generalised anxiety disorder (NHS Choices, 2016a). Research, as described below, has found that there can be a link between anxiety status and tobacco seeking.

Evidence from a plethora of previous research has asserted that when anxiety symptoms are high, the need to smoke becomes higher and there is an increased risk in heavier smoking behaviour (Collins & Lepore, 2009; Morrell & Cohen, 2006). Additionally, the majority of research assessing the differences between smokers and non-smokers with anxiety has found that, compared to non-smokers, smokers with anxiety disorders tend to report greater anxiety sensitivity and greater anxiety symptoms (Morissette, Brown, Kamholz & Gulliver, 2006). Thus suggesting that smoking could contribute to the anxiety disorder an individual experiences in terms of heightening the symptoms and therefore worsening the anxiety.

Anxiety sensitivity, which is a concept defined as the sensitivity to aversive internal states of anxiety, in other words the fear of anxiety-related sensations, such as the rush of panic (McNally, 2002), has also been related to an increase in smoking behaviour. Zvolensky, Farris, Schmidt and Smits (2014) found there was an indirect relationship between anxiety sensitivity and barriers to cessation, a higher number of prior quit attempts and greater mood-management smoking expectancies. This was via the tendency of individuals to respond inflexibly or to avoid the occurrence of distressing smoking-related thoughts, feelings and internal sensations. Zvolensky *et al.* (2014) proposed that individuals with higher levels of anxiety sensitivity may tend to be more inflexible with their smoking behaviour during highly emotional contexts, which may contribute to more quit attempts and perceived challenges in quitting smoking. In other words, the higher an individual is in terms of anxiety sensitivity the less likely an individual is to avoid smoking due to the negative thoughts associated with quitting. In relation to the present study, this suggests that those with a higher anxiety score may be more inclined to respond with the key for cigarettes due to the positive feeling associated with smoking behaviour and declining anxiety levels.

Piper, Cook, Schlam, Jorenby and Baker (2011) found that smokers with anxiety disorders, such as panic attacks, social anxiety or generalized anxiety disorder, reported higher levels of nicotine dependence and pre-quit withdrawal symptoms, when compared to those that never met the criteria for panic attacks or social anxiety disorder who showed greater quit-day negative affect. Additionally, Piper *et al.* (2011) found that smokers who met the criteria for panic attacks or social anxiety disorder were less likely to be abstinent at eight weeks and six months post-quit and showed no benefit from 'single-agent' or 'combination-agent' pharmacotherapies. This further highlights the detrimental impact anxiety can have on smoking behaviour.

It has not only been suggested that anxiety can impact the desire to smoke or negatively affect the success of cessation, but also that the risk for mental illnesses, such as anxiety, can increase with addiction severity. A sample

of smokers admitted to a smoking cessation clinic was assessed using face-to-face semi-structured interviews and questionnaires to measure their mental health status and nicotine addiction severity. Emre, Topal, Bozkurt and Topaktas (2014) found that the risk for mental health disorders was significantly higher for smokers than for non-smokers, anxiety and depression scores were higher among smokers than non-smokers and the nicotine addiction severity was higher in smokers with higher anxiety and depression scores. Degenhardt and Hall (2001) found current tobacco use was associated with a range of other substance use and mental health problems and these problems are likely to reduce the success of quit attempts. Therefore, it is apparent these problems need to be considered with any smoking-cessation treatment. In relation to the current study these findings suggest that those who smoke a higher number of cigarettes per day will score higher in terms of their anxiety level, henceforth whether the individual smokes daily or recreationally is taken into account in this investigation.

Research between anxiety and smoking behaviour can also be related to smoking during pregnancy. In 2016/17 it was found that just fewer than 11% of mothers were considered smokers at the time of birth (NHS Digital, 2017) despite explicit knowledge of how detrimental it can be on the foetus. Smoking can cause an increase in the prevalence of childhood wheeze and asthma, increased risk of hospitalisation for respiratory infections (McEvoy & Spindel, 2017) as well as impaired function of the reproductive, cardiovascular and neurological systems (Holbrook, 2016). Using a variation of questionnaires and in-person assessments Massey, Lieberman, Reiss, Leve, Shaw and Neiderhiser (2011) found that depression, anxiety and novelty-seeking were lower in those women who discontinued their substance use, compared to those who continued to use. Correlational evidence found that in polysubstance users, defined as individuals who use more than one substance at a given time (Connor, Gullo, White & Kelly, 2014), the number of substances discontinued during the pregnancy was negatively correlated with depression, anxiety and self-worth. In other words the lower the rate of depression, anxiety and lack of self-worth the lower the substance use amount. Massey *et al.* (2011) also found results they

believed contrary to the notions of the addictive potential of various substances. Massey *et al.* (2011) hypothesised that due to statistics rating cocaine as the most highly addictive substance compared to alcohol and nicotine, the women in their study would be less likely to quit cocaine use and more likely to quit smoking. However, the opposite was found and this was believed to be due to psychological factors and social pressure, which influenced the cessation of one drug class compared to another. This could be due to the differences in the perceived harm of the different substances along with the stigmatisation of one substance against another. For example illicit drugs and those who use them are stigmatised in society, such as cocaine which is an illegal Class A substance and the use of it is considered deviant (Ahern, Stuber & Galea, 2007), but nicotine is sold legally with ease of access and is seen as a norm in today's society (McCool, Cameron & Petrie, 2001). Whilst the concept of pregnancy, anxiety and smoking was not tested in this research it is important to acknowledge the extent to which anxiety can impact the need to smoke. Although it is common knowledge that smoking can be seriously harmful to the foetus, findings from the aforementioned research have provided evidence of how detrimental anxiety can be to the abstinence of smoking behaviour and why it is therefore an important variable of consideration when examining factors that can influence smoking behaviour.

Another factor that can be related to anxiety and smoking behaviour is emotional intelligence. Emotional intelligence is defined as the ability to perceive, understand, manage and harness emotions in the self and others, and utilizing suitable emotions in adaptive ways (Mayer & Salovey, 1993). Abdollahi, Yaacob, Talib and Ismail (2015) found in a sample of high school students that high levels of emotional intelligence are negatively associated with positive attitudes towards cigarette smoking, but on the other hand social anxiety is associated with a positive attitude towards cigarette smoking. Those who are better able to manage their emotions even when they seem overpowering are therefore less likely to view smoking as a positive concept and less likely to use smoking as a way to relieve anxiety.

However, in comparison to the above findings a study assessing high school students who were high in trait social anxiety compared to low socially anxious students found that highly socially anxious students were equally or less likely to smoke, but more likely to report an increased *urge* to smoke during friend interactions (Henry, Jamner & Whalen, 2012). Henry, Jamner and Whalen (2012) concluded that these highly anxious students might believe that when in anxiety-provoking situations they *should* need a cigarette, which could develop into more frequent smoking behaviours. Therefore, the ability of these individuals to cope with their anxiety by smoking is fueled by not the physical need to smoke, but the cognition that they *should* smoke to alleviate the anxiety. Additionally, Evatt and Kassel (2010) found that smoking only reduced anxiety in those who were considered highly anxious smokers in the high stress condition of the experiment, but not in the low stress situation. However, the low anxiety smokers experienced anxiolysis (defined as the reduction of anxiety, Jarvik, Caskey, Rose, Herskovic & Sadeghpour, 1989) in both of the conditions. Evatt and Kassel (2010) proposed that this could be due to a mixture of individual differences and the situational context the individuals faced.

Anxiety has been found to co-occur with depression, which can make the diagnosis, research and treatment difficult (Gorman, 1996). Depression is also problematic to define as it can occur in many different forms: it can be mild where the individual feels persistently low, or it can be more severe where life feels like it is no longer worth living and feelings of suicide can be prevalent (NHS Choices, 2016b). Depression can also cause many different feelings typically inducing stress, unhappiness or anxiety, but also causing tiredness, a decline in sex-drive and various physical aches and pains. Research, however, has shown that as with anxiety and stress, an individual's level of depression can be associated with their smoking behaviour.

In terms of depression and smoking behaviour, similar to anxiety, the majority of findings in the field do report that an increase in depressive symptoms leads to an increase in smoking behaviour. In a review by Morrell and Cohen (2006) it was found that cigarette smoking is highly comorbid with

clinical depression, but this relationship does tend to be dependent on the age, type of disorder and level of nicotine dependence the individual presents. Two theories have been used to explain how negative mood can prime smoking behaviour (Hogarth *et al.*, 2015). The stimulus-response theory argues that smoking during a negative mood state is experienced as more reinforcing than during a positive mood state, which therefore establishes a direct and automatic link between the adverse mood state and tobacco seeking. In other words, when an individual smokes and this is found to relieve any negative or unwanted feelings, the individual consequently associates smoking behaviour with feeling good. Therefore, when the individual experiences a negative mood state following this association, they will want to smoke due to the previously established link between smoking and the relief from these negative feelings. The second theory is the incentive learning theory, whereby smoking is *expected* to be more reinforcing during a negative mood state, this is combined with the instrumental knowledge of the response required to produce the outcome. Therefore, if the individual expects the behaviour of smoking to be more rewarding during a certain period and is aware of the action to produce the pleasing outcome, they will be more likely to smoke during this time. Hogarth *et al.* (2015) found that participants given a choice between cigarettes and chocolate after they had smoked to satiety increased their tobacco choice in extinction when presented with negative mood induction, compared to those who had received positive mood induction. This adds support to the second theory as it indicates that negative mood increases drug seeking by heightening the expected value of the cigarettes via incentive learning, additionally even though the participants had smoked to satiety they still chose cigarettes highlighting the significance of mood state. This can be important in smoking cessation as if the reward of smoking is expected to relieve negative mood then it could make it harder for those experiencing severe depression to stop smoking.

A study which used a sample of 2032 14- and 15-year-old students found that depression and anxiety predicted initiation of experimental smoking, whilst also emphasising the risks associated with smoking due to peer involvement. It was concluded that promoting psychological wellbeing of adolescents is not only

important to ensure good mental health, but also to lower the risks of adolescents carrying out experimental smoking (Patton, Carlin, Coffey, Wolfe, Hibbert & Bowes, 1998). This can also be related to the above theories as those experiencing low mood may interpret smoking to be more rewarding during a negative mood state and therefore engage in experimental smoking.

From the aforementioned research and theories it is clear that anxiety disorders and the symptoms of depression can impact not only the need to smoke, but also the success of individuals' treatment and the likelihood that they will be abstinent/remain abstinent into the future. Therefore, the present study will also aim to establish whether or not there is a relationship between the levels of anxiety and depression and the amount of cigarette responses in an extinction task, whilst considering the number of cigarettes smoked per day. A relationship between depression and/or anxiety and the number of cigarette responses in extinction would suggest that the choice to press the cigarette key is not just due to learning about the association between the outcome-response contingency, neither would it suggest the choice is just due to habitual behaviour. It would imply that additional factors are influencing the perceived value of cigarettes compared to the neutral stimulus used in the task. Evidence of a relationship between these variables could also be used in aiding the cessation of smoking, as providing mental health support could enable a higher abstinence rate.

Social factors and tobacco seeking

Research has also assessed social factors that may impact an individual's decision to smoke/continue to smoke despite the negative health effects that are warned. Ennett and Bauman (1993) found that in four out of five schools, the odds of being a smoker were significantly higher for isolates than those with a strong friendship group. Ennett and Bauman (1993) have attributed this to four potential explanations, which are important to note. Firstly, social isolation may cause boredom or stress that could lead to the onset of smoking. Secondly,

cigarette smoking could *cause* social isolation, for example groups who are mainly non-smokers may prevent smokers from joining and remove those who become smokers. Fisher and Bauman (1988) found that smoking influences friendship formation, as non-smoking adolescents tend to befriend others who do not smoke. Thirdly, the relationship may be spurious; it is possible that both smoking and social isolation may be initiated by the same factors such as problem behaviours or psychological factors, which in turn could produce a non-causal association for smoking and social isolation. The fourth, and final, explanation is that those who are considered to be isolates in the school setting are members of groups outside of school who have turned to deviant behavior – such as smoking. In support of the aforementioned research, Shankar, McMunn, Banks and Steptoe (2011) found that social isolation and loneliness were associated with a greater possibility of health-risk behaviours, including smoking.

Research has also assessed the relationship between socioeconomic position and smoking cessation. Hiscock, Judge and Bauld (2011) analysed data from two separate studies commissioned by the NHS smoking cessation program. The two studies used an identical research design and were carried out by the same team. The smoking cessation programmes studied were an intensive group programme and one-to-one support in a pharmacy setting in Glasgow, Scotland, and primary care-based programmes offering one-to-one behavioural support and some group support in the North of England. Hiscock, Judge and Bauld (2011) found that socioeconomic disadvantage was a barrier to quitting even after taking part in a cessation programme. It was also established that adherence to treatment was an important determinant of quitting and inequalities in quitting, and that there was a tendency among disadvantaged smokers to attend fewer sessions and take the medication for fewer weeks than those who were considered advantaged. However, of most interest to the current research was that the gap between the most and least advantaged at the English sites did *not* appear to be impacted significantly by the amount of social support. Whereas, other research has pinned social support as a key influencer in quitting success. For example, Lacey, Manfredi, Balch, Warnecke, Allen and Edwards

(1993) found that barriers to smoking cessation included a lack of social support that was believed would be beneficial in aiding smoking abstinence. Additionally, Havassy, Hall and Wasserman (1991) discovered that greater structural and partner support predicted a lower rate of relapse in not only cigarette smokers, but also those dependent on alcohol and opiate use.

In the study mentioned previously by Emre *et al.* (2014) highlighting the increased risk for mental health disorders where the addiction severity is higher, it was also found that having a high personal income, being unmarried, high alcohol use and a high risk for depression were also related to the risk for smoking. A study by Kahneman and Deaton (2010) found that whilst high income can improve life satisfaction it could not determine the happiness level of the individuals, and other factors such as loneliness may be prevalent. In relation to this is an experiment conducted by Alexander, Coombs and Hadaway (1978) called Rat Park, which sought to establish the link between loneliness and substance abuse. Rats were taught to self-administer drugs by pressing a lever in their cage. These caged rats began to self-inject over and over, many of them choosing the injections over food and water and consequently dying. However, those placed in enriched cages, whereby they were not alone, had access to toys and enough space to run around freely did not become addicted to the solutions and none of them died as a consequence. These rats chose the connection and enrichment over the drugs.

It is apparent from the previously discussed research that social factors have been found to play an important part in the development and sustainability of addictive behaviours. Particularly found to be important throughout several pieces of research is the concept of social isolation, which has been found to not only impact the initial uptake of smoking behaviour, but is also evident to affect the success of cessation treatment. Therefore, the present study will seek to measure whether there is a correlation between the loneliness score and smoking behaviour, in order to assess whether this is a factor that should be considered important when assessing individuals in terms of contributors to their smoking behaviour. It is thought based on the formerly discussed literature

that a higher loneliness score will also present an increase in smoking behaviour, particularly in relation to the number of cigarettes smoked per day and the percentage amount of cigarettes chosen in the extinction part of the concurrent choice task used in this research.

Based on the above subsections and the aforementioned research the main area of interest in this study and the initial hypothesis was to assess whether participants in the cold CPT group would show an increase in the number of cigarette responses in the extinction task compared to those in the hot CPT group, and whether this relates to addiction level in terms of the number of cigarettes per day. This was also assessed with regards to the levels of depression, anxiety and loneliness, which have been highlighted as important factors for smoking behaviour. Correlational analyses were additionally performed on a variety of the variables calculated, in particular those related to whether the perceived loneliness score correlated with factors such as the number of cigarettes smoked per day and the percentage number of cigarette responses in extinction. Based on the aforementioned literature and theory it was hypothesised that those with a higher loneliness score would smoke more cigarettes and also press the key for cigarettes more frequently than those who scored lower.

Method

Participants

58 participants were recruited from various courses at the University of Huddersfield via the SONA online recruitment system, posters around the university campus and accommodation complexes, and also by word-of-mouth. The age range was from 19 to 51 and included 22 males and 36 females (see Table 1 for demographic data on the participants by group). Data from 25 participants of the overall amount were from recruitment over October 2015 – May 2016, whereas the other 33 participants were recruited during October 2016 – May 2017. This was in line with university term time.

Participants were daily and non-daily smokers who were both recruited in order to be able to assess whether smoker status had an impact on the findings of the research. 36 were daily smokers and 22 were reported as non-daily (recreational) smokers. Although there was random allocation of participants to the conditions, daily and non-daily smokers were not balanced across the groups due to time constraints, see the discussion section for further comment on this. Individuals who partook were required to meet certain criteria as follows: they must not have been taking antidepressant medication, had not taken illicit drugs for 5 days, had not taken sedatives 48 hours before their timeslot, had not consumed alcohol 12 hours before their participation timeslot, had not consumed caffeine or smoked one hour before their timeslot and did not suffer from any condition that could have been made worse by the cold pressor equipment, such as Reynaud’s disease. The participants were made aware of the eligibility requirements of the study prior to signing up, but this was also assessed when they arrived for participation.

Upon arrival individuals were assigned to one of the experimental conditions, depending on which timeslot they had signed up to, which was either the cold experimental group or hot control group and then either the ‘D’ key for cigarettes or the ‘H’ key for cigarettes. For example, ‘Participant One’ was in the cold experimental group and the ‘D’ key was used as the cigarette key.

Table 1. Demographic data of participants for each condition.

	Mean Age (SD)	Number of Males	Number of Females	Number of Daily Smokers	Number of Non-Daily Smokers
Cold Condition	25.57 (8.10)	14	23	21	15
Hot Condition	23.33 (6.65)	8	13	15	7

Materials and apparatus

Each participant was required to complete a Question Pack (Qpack) document (see Appendix A), this included a set of questionnaires and instruction pages on when to contact the researcher to complete the computer tasks and CPT. The Qpack was broken into two parts. In the first part were seven questionnaires, these were performed in order to analyse the individual's smoking behaviour, their addiction level, mental health status and loneliness level. These were conducted in the order that follows (see Appendix A for each questionnaire).

Smoking questionnaire

The smoking questionnaire comprised six questions in which individuals were asked the average number of cigarettes per day they smoke, the number of days per week on average they smoke, the time of their last cigarette, the years they have spent smoking, the age they began smoking and whether they were trying to quit or cut down. When entering the data from this questionnaire into SPSS each question was input as a separate variable and the number the participant had written was input as the data, apart from the time the participant had their last cigarette. As the participant was required to put a time as their answer (such as 21:30) when entering this into the SPSS datasheet the number of minutes since their last cigarette and the time of the experiment starting was calculated and this was used.

Wisconsin Inventory of Smoking Dependence Motives-68

The Wisconsin Inventory of Smoking Dependence Motives-68 (WISDM-68) developed by Piper *et al.* in 2004 was designed to assess individual's motivation to smoke. The questionnaire comprises 68 questions that contribute to one of 13 subscales. The subscales include factors that relate to tobacco dependency such as affiliative attachment, a loss of control and as a means to control weight. A brief version of the WISDM-68 that contains only 37 questions, which offset into 11 subscales, has been developed by Smith *et al.* (2010)

however the 68-item version was used in this experiment in order to obtain data for the 13 subscales. In terms of psychometric properties of the WISDM-68 the questionnaire has been used widely as a reliable and valid tool in measuring smoking motivation. Shenassa, Graham, Burdzovic and Buka (2009) conducted a test on the psychometric properties of the inventory; this was a replication and extension of the original validation for the instrument by Piper *et al.* (2004) and included participants older than the average and heavier smokers than those in the original cohort. Included in this analysis was the internal consistency of the subscales, extension of the confirmatory factor analysis, the interdependence of the subscales as well as additional tests of validation. It was found that the 13 subscales had a good internal consistency and regression models supported the validity of these subscales; therefore deeming the WISDM-68 an appropriate material to use for this experiment.

Cigarette Dependence Scale-5

The Cigarette Dependence Scale-5 (CDS-5; Etter, Jacques & Perneger, 2003) was used to evaluate participants' dependence on cigarettes by measuring them on five primary concepts of smoking behaviour, including how long after waking they smoke and how addicted on a scale of one to 100 they would report themselves to be. This five-item version is a shorter version of the 12-item version, which contains a more comprehensive content. When analysing the CDS-5 in regards to psychometric properties Etter, Jacques and Perneger (2003) found that the scale presented a high test-retest validity and internal consistency. At a retest it was additionally found that daily smokers who had cut down to smoking less frequently obtained a decrease in their scores, which is consistent with the premise of the scale. Stavem, Røgeberg, Olsen and Boe (2008) also analysed the CDS-12 alongside the CDS-5) and the Fagerström Test of Nicotine Dependence and its shortened version. It was found that both questionnaires were deemed similar to each other and their abbreviated versions, thus supporting the construct validity of the scales.

Brief Questionnaire of Smoking Urges

The Brief Questionnaire of Smoking Urges (BQSU; Cox, Tiffany & Christen, 2001) is a shortened version of the original 32-item form and was used in the present experiment to measure cigarette craving. This 10-item questionnaire asks participants to rate how much they agree with statements such as how good a cigarette would be at the present moment, if they intend to smoke as soon as they possibly can and whether a cigarette would make them less depressed. Individuals are required to rate their answer out of seven; one being 'strongly disagree' and seven being 'strongly agree'. The questionnaire implements a two-factor structure of smoking urges. The first reflecting a strong desire and objective to smoke and the second factor representing the anticipation of relief from negative affect with an urgent want to smoke (Cox, Tiffany & Christen, 2001). By performing a seven week clinical trial on smoking cessation Cappelleri, Bushmakin, Baker, Merikle, Olufade and Gilbert (2007) concluded that the validity and reliability of the instrument and the two factor structure of self-reported craving proposed were subsequently supported. Therefore regarding the BSQU as an appropriate means of measuring smoking urges in participants of this research.

Beck Depression Inventory

The Beck Depression Inventory (BDI; Beck, Steer & Brown, 1996) is a well-known and widely used method for calculating the level of depression of an individual. Participants are given four statements relating to a symptom of depression (in this case there are 20 symptoms). The higher the participant scores represents the higher the severity of depression and this is classified into either minimal, mild, moderate or severe depression. In the case of using the instrument in this research the categories of depression were not utilised, instead the raw score of each participant was entered into SPSS. As the BDI has been used in not only psychological experimentation but also clinical settings, the reliability and validity has been extensively scrutinised. Many claim the BDI

to have limitations in measuring depression due to its self-report method and also as symptoms of depression can vary in individuals, yet the questionnaire is only given at one-time usually when an individual is feeling very low (Wang & Gorenstein, 2013). However, Wang and Gorenstein (2013) did find the BDI to yield high reliability and validity with other measures of depression and anxiety. It was also found to have the ability to be adjusted in different clinical settings to detect major depression. Due to its popularity and extensive use in the medical field to assess depression, as well as validation from the aforementioned systematic review the use of the BDI in the present experiment was considered appropriate.

University of California Los Angeles Loneliness Scale

The University of California, Los Angeles (UCLA) Loneliness Scale (Russell, Peplau & Cutrona, 1980) was used in this research to calculate a loneliness score for each participant. The UCLA Loneliness Scale required individuals to rate each statement on a scale from one to four, following this the scores participants had given were given their own scores calculated with the score sheet. These scores were then totalled resulting in an overall loneliness score, the higher the score meaning the higher the level of loneliness. With regards to evaluating the psychometric properties of the scale, Russell (1996) found from data collected by students, nurses and teachers etc. that the instrument had a high internal consistency and test-retest reliability of one year. Convergent validity was established with significant correlations to other measures of loneliness and construct validity was found with regards to measures of the capability of individuals' interpersonal relationships. Knight, Chisholm, Marsh and Godfrey (1988) additionally reported that the instrument has a high alpha coefficient, thus presenting homogeneity with regards to the scale items. Based on the previously mentioned research the findings exhibit the questionnaire as a suitable method of measuring individual loneliness.

Profile of Mood States-1 and -2

The Profile of Mood States 1 (POMS-1; McNair, Lorr & Droppleman, 1981) is a psychological test with 65 statements describing feelings and participants are required to indicate how they feel on a five-point scale from 0-5. With regards to the present experiment the POMS was used to assess current mood in relation to feelings such as anxiety, anger, positive and negative mood. The POMS was presented to participants twice, as the POMS-1 and POMS-2. Both questionnaires were the same, but completion was required twice in order to be able to calculate an anxiety difference score between pre- and post-CPT. When evaluating the psychometric properties of the test Spielberger (1972) found that concurrent validity of the POMS can be found with regards to correlations with other personality measures and symptom checklists. Additionally, the scale was found to present good test-retest validity and a well-established homogeneity of the scales. Gibson (1997) further noted strong support for the concurrent validity of the measure, also the ability to discriminate between healthy adults and those known to have a mood disturbance. Once again good internal consistency and test-retest reliability were concluded. The aforementioned research therefore deems the POMS as a reliable and valid measure of mood states and subsequently confirms its use in the present experiment in order to compare pre- and post-CPT anxiety levels.

After the first set of questionnaires the next part of the experiment involved the concurrent choice task and the CPT. In the middle of the Qpack document were pages to inform participants of what task they would be completing next and subsequent questions relating to the task. These questions asked participants to rate on a 7-point scale how much pain they felt from the CPT and those in the cold condition were presented with a question asking participants to rate on another 7-point scale how they felt about having to compete the CPT again. This was further used to heighten stress levels, as participants would not actually have to complete the CPT again. Following this – and the final part of the experiment – was the last of the eight questionnaires:

the Profile of Mood States 2 (POMS-2; McNair, Lorr & Droppleman, 1981) as described above. Whilst initially attached, the consent form was removed to protect the participants' identity in line with their data and kept separately for record. Participants were only identifiable by their 'Participant Number', which they were made aware of in case they wished to contact the researcher regarding their data after the experiment was over.

The Smokerlyzer machine was used to measure carbon monoxide in the breath of the participants. This enabled the researcher to identify whether or not the individual had smoked before their timeslot. Whilst it was stated that participants should not smoke up to one hour before their timeslot, the information from the Smokerlyzer would enable this to be taken into account as a potentially confounding variable if the individual had smoked close to their slot. If an individual presented a high score then the time they last smoked was considered as a reason behind this. However, in some cases the smokerlyzer did identify a high score where participants had not smoked for the requested hour before their slot. When queried it was found that some individuals who had smoked for a long period of time were presenting a high Carbon monoxide (CO) level. For example one participant who had smoked for 30 years had a CO level of 17, but had reported not smoking for 75 minutes before their timeslot. Therefore, high scores should not just be reflected as a result of smoking beforehand.

The experiment was programmed in Eprime (Psychology Software Tools Inc., 2017) and it was used twice during the experiment: first for behavioural training on a concurrent choice task, and secondly as a behavioural concurrent choice task in extinction (testing). The training was completed before the CPT and the testing was completed after the CPT. The training part of the concurrent choice task was used to enable participants to learn which key 'won' each rewards, so if the 'D' key was used to represent cigarettes then the participants would be primed to learn that this key won cigarettes over the duration of the training trials. The keys were counterbalanced, so for some individuals the 'D' key would represent cigarettes and for others the 'H' key would represent

cigarettes. Participants were informed prior to the experiment in the instructions that they do not actually win the cigarettes or chocolate, instead a picture of the item associated with their key will pop up to reveal what they have 'won'. In the testing stage the participants were instructed to press either the 'D' or 'H' key in response to the cross on the screen, however they would not be able to see which rewards they had won until the end. Each phase (training and testing) had 48 trials each.

A 250g bar of Cadbury's Dairy Milk chocolate was used to prime participants, as well as cigarettes. The participants were asked before they began the training part of the computer task, which would be their preferred brand of the packs presented. The brands presented were: Marlboro Gold, Lambert and Butler, Mayfair Blue, Sterling and Golden Virginia. The cigarettes pack chosen was placed above the key that was representing the cigarette key in the Eprime task and the chocolate was placed above the other key that was therefore representing the chocolate key.

The cold pressor machine was used as the Socially Evaluated Cold Pressor Task (SECPT), whereby individuals were recorded whilst immersing their hand in a cold-water bath. This has been shown by prior research to successfully induce stress (Menkes *et al.*, 1989; Minkley, Schröder, Wolf & Kirchner, 2014; Schwabe, Haddad & Schachinger, 2008) and was set at 5 degrees Celsius in line with other research (Wolf & Hardy, 1941). A maximum immersion time was set at three minutes for health and safety reasons (von Baeyer, Piira, Chambers, Trapanotto & Zeltzer, 2005). If the individual removed their hand before the three minutes limit then they were given the opportunity to keep trying or to stop. After the time was up or they had stopped the task, they were told they would have to repeat the SECPT again. For the non-stressful group the cold pressor was set at 37 degrees Celsius and they were asked to keep their hand immersed until told to remove it. The length of time the participants in the hot group had to keep their hand in water was matched to other members of the cold group.

A video camera was also used to evoke stress for those in the cold group, as this has been shown in prior research to be a useful tool in enabling short-term acute stress and activates the body in a similar way to real-life stress events (Schwabe, Haddad & Schachinger, 2008). The participants were told they would be recorded for facial analysis, however the recording was deleted immediately after the experiment had finished. The video camera was not used for those in the non-stressful group.

Design

This study used an independent groups design. The independent variable was the group the participants were in, which contained two levels: the hot or the cold CPT condition. Allocation to the IV group was random and additionally this was also counterbalanced by sex. This was to ensure that the groups included around an equal amount of participants and an equal amount of males and females. There were 25 dependent variables measured, the majority of these were questionnaire measures, but some were also computed via the computer task and the CPT. From these measures additional scores were calculated (see Appendix B for the list of dependent variables (DVs) and those calculated from these materials).

Procedure

Ethical approval was submitted to the University of Huddersfield's ethics committee where it received consent. Standardised instructions were followed for each participant and each condition (see Appendix A, first page of the Qpack document) to ensure each individual was given the same instructions and to prevent differing instructions from potentially impacting the results of the study.

Participants were presented with their 'Qpack' but before they began to complete it they were asked the preliminary questions that included their age and sex, females were also asked whether or not they were on contraceptive medication. They were then told to read through the first page of the 'Qpack', which was the information sheet of the experiment containing details regarding

what would follow and their role, it also stated that cigarettes and chocolate would physically not be won. Following this if they did not have any questions or comments they were told that they could turn the page to read and sign the consent form. Once the consent form was checked and signed by the researcher, the experiment would begin and experimental conditions were set.

The first task was to use the Smokerlyzer to measure the CO levels in the participants' lungs. The participants were instructed to take a deep breath in, hold it and then follow the instructions on screen as to when they should breathe out. The experimenter then noted the value the Smokerlyzer produced on the front of the 'Qpack'. The participants then completed the first section of questionnaires (the smoking questionnaire, the WISDM-68, the CDS-5, the Brief Questionnaire of Smoking Urges, the BDI, the UCLA Loneliness Scale, the POMS-1), answering as honestly and accurately as they could until they found the page instructing them to let the experimenter know they were ready to begin the computer training.

Participants were then presented with five packets of cigarettes and asked to state which would be their preferred brand, even if the one they would normally choose was not presented. When they had chosen their preferred brand the packet was put above either the 'D' or 'H' key, depending on the group the participant was randomly allocated to before the study began. Once sat at the computer and ready to begin the training part of the experiment the on-screen instructions were read out: "this is a game in which you can win the cigarettes and chocolate in front of you. In each trial, press the 'D' or 'H' key to see if you have won a point for these rewards. You will only win on some trials. Press the space bar to begin". There were two parts of the training, the acquisition phase and the knowledge test. During the acquisition phase the participant has an infinite time to respond to the cross on the screen with either the 'D' or 'H' key, the outcome is then presented: either a cigarette or chocolate picture representing a cigarette point or a chocolate point. The knowledge test then asked the participants "which key earned cigarette points?" and "which key

earned chocolate points?” whereby the Eprime software recorded their response.

After they had finished either the ‘D’ or ‘H’ key training the participant was told to sit next to the cold pressor so that their left arm was able to be placed comfortably into the water. If the participant was in the stressful condition then they were firstly informed that a video camera would be used to record facial expressions for analysis. Participants were told that they must try to look at the video camera during the task. The individuals were then read instructions on how the CPT would work and informed that the cold water may be painful but it is not harmful and they can remove their hand at any time. The participants were then counted down and the timer began, it was stopped if they removed their arm and they were then told that they could put their arm back in if they wanted to whenever they were ready. If they attempted the task again then the timer would be resumed from where it was stopped. If they did not choose to go again, then the time was noted down under the total time. If the participants lasted for the whole three minutes they were told to remove their hand. Participants were then told to answer the likert scale to rate how painful from one to seven the cold pressor was. Following this they were informed that they would have to complete the cold pressor task again after a short computer task, but next time they should try to keep their arm in the water for longer. If they were in the non-stressful hot group, the participants were told to keep their arm in the water and when the timer reached their counter-partner they were told to remove their arm. For those in the control group there was no video camera, nor were they told that they would have to complete the task again.

Both groups then completed the ‘D’ or ‘H’ key testing computer task, which was the extinction task, and were also presented with contingency test questions in order to assess whether they had remembered which key was for which reward. The instructions for the extinction phase of the testing task read as: “You can now earn cigarettes and chocolate by pressing the ‘D’ or ‘H’ keys as before. You will only be told how many of each reward you have earned at the end of the experiment. Press the space bar to begin.” During the extinction phase

the individuals were presented with a fixation screen (a cross in the middle of the screen) where they responded with either the 'D' or 'H' keys (infinite duration), this was followed by a random interstimulus interval of either 750 or 1250 milliseconds. Following this phase was the transfer phase where participants responded in the presence of either smoking, blank or chocolate cues as pictures on the screen (infinite duration). The computer task then ended with another knowledge test where participants were once again asked "which key earned cigarette points?" and "which key earned chocolate points?" Finally, participants completed the final two questionnaires: the Preoccupation Question and the POMS-2.

Participants were finally debriefed and any questions they had about the experiment were answered, as well as being provided with contact details for the researcher, contact details were also provided for the NHS quit smoking service and counselling services.

Results

An Analysis of Covariance (ANCOVA) was used to analyse the data, this was deemed appropriate due to its ability to not only control for covariates, but to also scrutinise specifically the impact of the covariates on the dependent variable.

The means and standard deviations of the 58 participants were firstly examined to assess whether the cold CPT group appeared to press the cigarette key more than those in the hot CPT group. It was found that the means and standard deviations coincided with the direction predicted by the initial hypothesis that those in the cold condition would press the key for cigarettes more than those in the hot condition, when in the extinction part of the task. When interpreting the means and standard deviations that were calculated during each ANCOVA these were also found to be in the same direction. That is, the mean number of responses for cigarettes in the extinction task was higher

for those in the cold condition than those in the hot condition. Upon the initial calculation of the descriptive statistics for the variables in Table 2, the significance values were also analysed. The presentation of the lack of significant differences in the variables provides statistical support that the groups (cold and hot) were balanced. However, one *P* value has presented as significant, the Anxiety Difference Score, which can be explained due to the removal of one participant's POMS score. During the data analysis it was apparent that one participant had answered the POMS questionnaires incorrectly, subsequently their POMS analysis could not be included in the overall data analysis.

Henceforth this explains the significant *P* value presented here. Additionally, due to the exclusion of the participant from the POMS-1 and POMS-2 analyses there is also a difference in the value in the cold condition *N* column. With regards to the CDS-5 scores to address the level of smoking dependency, the groups both presented a moderate addiction and no significant difference was found between the groups. This shows that, as of the other variables, the cold and hot groups were balanced on their level of nicotine dependency. Table 2 provides a list of these means and standard deviations.

Table 2. The means and standard deviations in relation to the cold or hot CPT conditions.

Variable	Cold Condition			Hot Condition			Sig.
	Mean	SD	N	Mean	SD	N	
Age	25.57	8.10	37	23.33	6.65	21	.287
Years spent smoking	7.86	7.47	37	6.71	6.81	21	.565
Days per week spent smoking	5.57	1.98	37	6.00	1.76	21	.409
Percentage of cigarettes in extinction	21.54	11.05	37	19.24	8.52	21	.413
Cigarettes per day	9.35	8.24	37	8.48	5.19	21	.663
BDI score	9.51	8.67	37	9.14	5.35	21	.860
Anxiety difference score	0.09	0.58	36*	-0.51	0.63	21	.001
CDS-5	12.16	4.78	37	13.10	4.72	21	.476

* Different N value due to incomplete POMS by one participant

Inferential testing

When taking into account the aims of the research and the data set it was deemed appropriate to use a one-way ANCOVA as the inferential test for the data. The standard use of the ANCOVA is to look for differences in adjusted means with control and/or exclusion of a variable that is not part of the experimental manipulation that is believed could affect the data by correlating

with the dependent variable (Coolican, 2009). However, for these analyses the covariate function was also used to assess the specific effect of the following factors that were set as covariates: cigarettes per day, the BDI score and anxiety difference score. The ANCOVA was chosen in this case due to an interest in specifically the effect of said variables on the percentage of cigarettes chosen in extinction, rather than treating them as confounding variables. The independent variable was always the CPT (hot or cold) and the dependent variable was always set as the percentage amount the cigarette key was pressed in the extinction task. The analyses were conducted using IBM SPSS Statistics Version 22.

Before carrying out the ANCOVA, several assumptions were required to be met. The majority of these are the same as any other linear model, but there are some additional ones to assess. From visual examination the data presented a normal distribution as the histograms were in the form of a bell-shaped curve, additionally the Sharpiro-Wilk test was insignificant. Levene's test of homogeneity was also non-significant ensuring the samples are of equal variance. Following these assumptions of the ANCOVA being met, this statistical test was carried out to assess the impact of the CPT on the percentage of cigarettes chosen in extinction, additionally the number of cigarettes per day, the BDI score and the POMS anxiety difference score were taken into account as covariates.

CPT group and cigarette responses in extinction

An independent groups t-test was conducted as a simple analysis to establish whether or not the cigarette key was pressed more by the cold CPT group, than the hot CPT group. The independent variable was the group (cold or hot) and the dependent variable was the amount of cigarette responses in the extinction part of the concurrent choice task. It was found that although the means were in the predicted direction (as shown earlier and presented in Table 2) there was no significant difference between the cold or hot CPT groups with regards to the cigarette responses, $t(56) = .825, p = .413$.

Cigarettes per day

A one-way ANCOVA was conducted in order to assess the potential impact of the covariate number of cigarettes per day. The independent variable was the CPT group (hot or cold) and the dependent variable was the percentage of cigarettes chosen in the extinction part of the concurrent choice task. Levene's test was firstly conducted to assess homogeneity of variance and the assumptions were met, therefore ensuring homogeneity ($F(1, 56) = .386, p = .537$). The ANCOVA was conducted to assess the impact of the group on the percentage number of cigarettes in the extinction task, but also to measure the impact of just the number of cigarettes per day on this dependent variable. The group was not found to significantly impact the number of cigarettes chosen in extinction ($F(1, 55) = .521, p = .474$), however a significant effect was found for the number of cigarettes per day on the DV: $F(1, 55) = 4.979, p = .030$, partial Eta squared = .083. Figure 1 below shows a plot of these variables following a subsequent correlational analysis.

BDI score

A one-way ANCOVA was carried out in order to evaluate whether the covariate of level of depression, measured by the BDI, impacted the percentage choice of cigarettes in the extinction task. Again, the IV was the CPT group (hot or cold) and the DV was the percentage number of cigarettes chosen in the extinction part of the computer task. Levene's test was conducted and the assumptions were once again met to ensure homogeneity of variance ($F(1, 56) = .230, p = .634$). The ANCOVA revealed the BDI score did not have a significant impact on the amount of times the cigarette key was pressed in the extinction part of the task ($F(1,54) = 2.125, p = .151$, partial Eta squared = .038).

Anxiety difference score

A further one-way ANCOVA was additionally performed to assess whether the covariate POMS anxiety difference score impacted the percentage of cigarettes chosen in extinction. The IV was once again the CPT group (hot or cold) and the DV was the percentage of cigarette responses in extinction. The

covariate in this case was the POMS anxiety difference score, which was calculated using SPSS by deducting the POMS-1 anxiety score from the POMS-2 anxiety score. This score provides the level of anxiety for each individual following both the CPT and the concurrent choice task, this was calculated in order to provide a current anxiety score for each individual. Levene's test was conducted and was non-significant confirming homogeneity of variance once again ($F(1, 55) = .049, p = .826$). The following ANCOVA test also found no significant impact of the POMS anxiety difference score on the percentage of cigarettes chosen in extinction, $F(1, 53) = .499, p = .483$, partial Eta squared = .012.

Correlational analyses

Several Pearson's r correlational analyses have been further conducted to assess whether a relationship is present between the following variables. Particularly between the UCLA Loneliness scale and the number of cigarettes per day and the percentage of cigarettes chosen in the extinction part of the concurrent choice task to answer the hypothesis. The hypothesis stated that those who presented a higher loneliness score would smoke more cigarettes per day and choose cigarettes over chocolate in the concurrent choice task. However, additional correlational analyses were carried out in order to determine the direction of the relationship found (see the first correlation below) and whether although causality cannot be drawn, if any correlations were present between variables and if previous theory and literature could be explained by or account for reasoning behind them. Following this Multiple Regression analyses were carried out on two of the DVs: the number of cigarettes per day and the BDI score. These analyses were performed in order to assess whether one (or more) of the significant relationships could predict the DVs.

A Pearson's r correlational analysis was carried out between the covariate number of cigarettes per day and the dependent variable percentage of cigarettes chosen in the extinction task to test whether a correlational relationship was present, and if so, what the direction was. The relationship

between these was found to be a weak, yet significant, positive correlation ($r = .292$, $n = 58$, $p = .026$). Thus revealing that as the number of cigarettes per day an individual smokes increases, so does the percentage amount the individual will press the cigarette key in the extinction part of the concurrent choice task. Interpretation of this result is further discussed in the following discussion section. The scatterplot below summarises this correlation (see Figure 1).

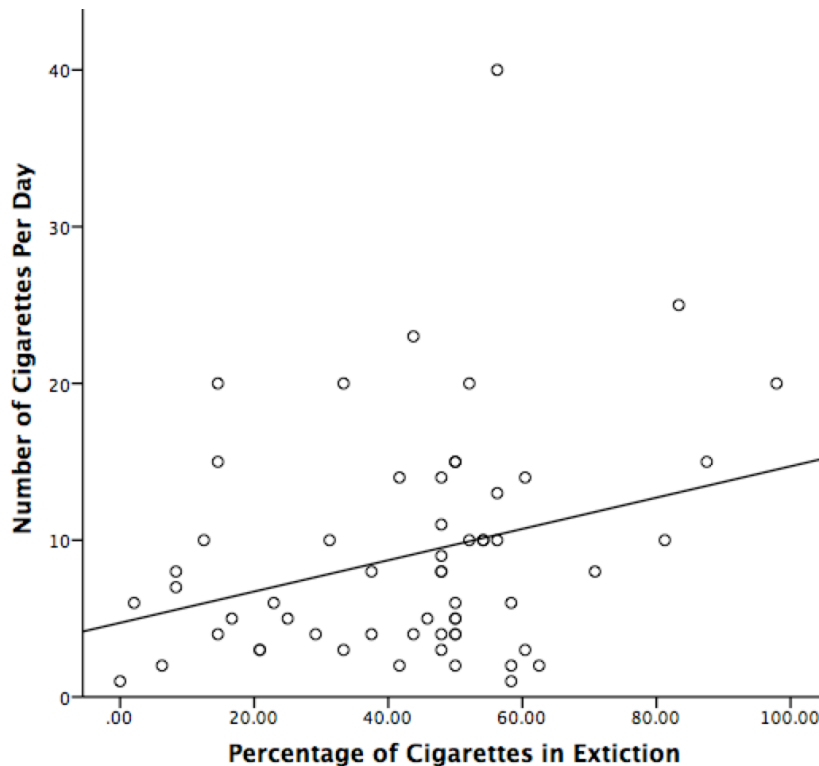


Figure 1. A scatterplot showing the relationship between the number of cigarettes per day and the percentage of cigarettes chosen in extinction, representing the measure of cigarettes per day as an indicator of dependence.

Another correlation that was significant and should be considered important is the number of cigarettes per day and the CDS-5 score ($r = .655$, $n = 58$, $p < .001$), which is further evaluated in the discussion section (see Figure 2 for the summary of this correlation).

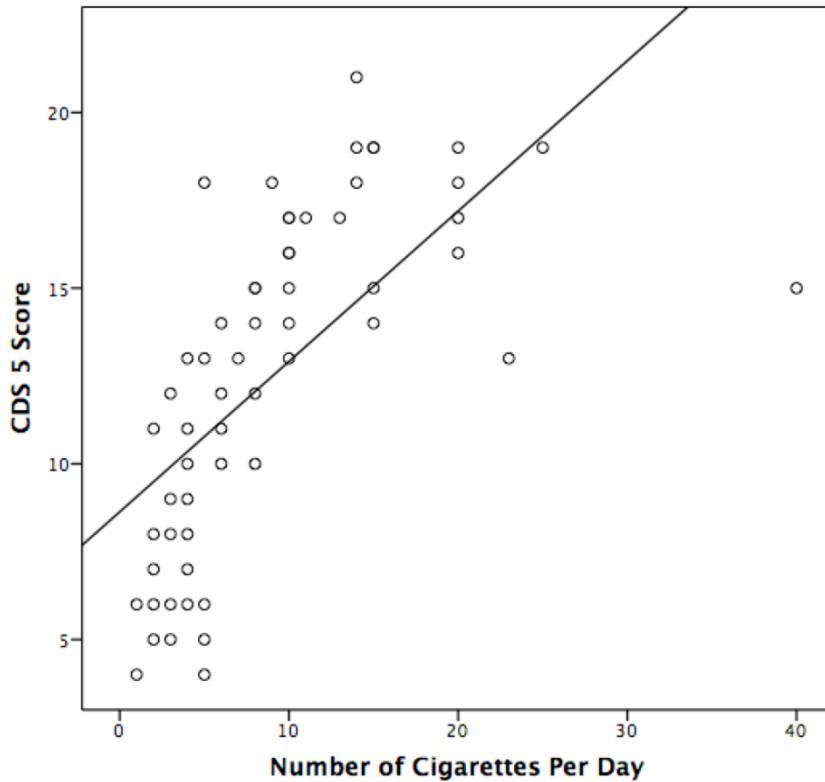


Figure 2. A scatterplot displaying the correlation between the score on the CDS-5 and the number of cigarettes per day.

Pearson's *r* correlational analyses were further carried out for the BDI score regarding days per week smoked and the WISDM-68 weight control. A weak, but nevertheless significant, positive correlation was found between the BDI score and the number of days per week smoked ($r = .291, n = 58, p = .027$).

The second Pearson's *r* correlation regarding BDI score and weight control via smoking calculated by the WISDM-68 was found to be significant ($r = .315, n = 58, p = .016$) this was a moderate positive correlation (see Figure 3).

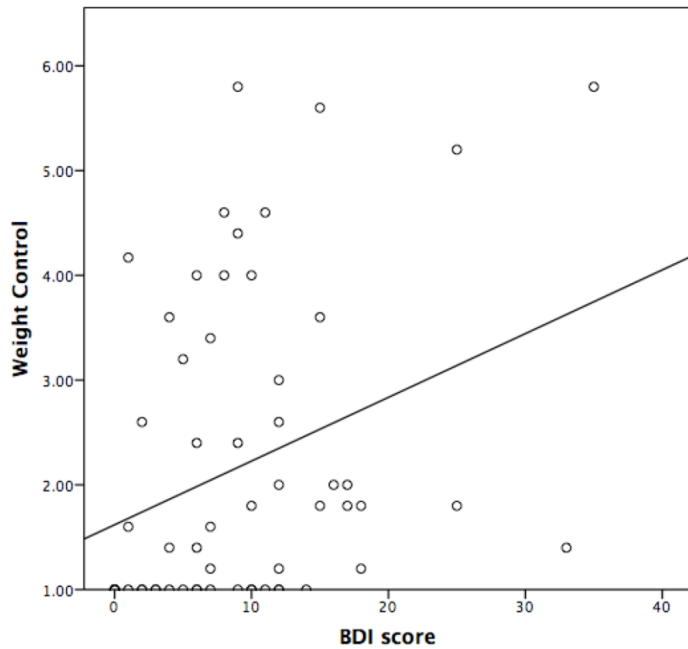


Figure 3. A scatterplot depicting the correlation between BDI score and the use of smoking to control weight calculated by the WISDM-68.

In terms of the POMS anxiety difference score, a significant correlation was found between the UCLA Loneliness score ($r = -.381, n = 33, p < .029$). Analysis as to why this correlation was found to be significant is reviewed in the discussion section (see Figure 4 for the scatterplot depicting the correlation).

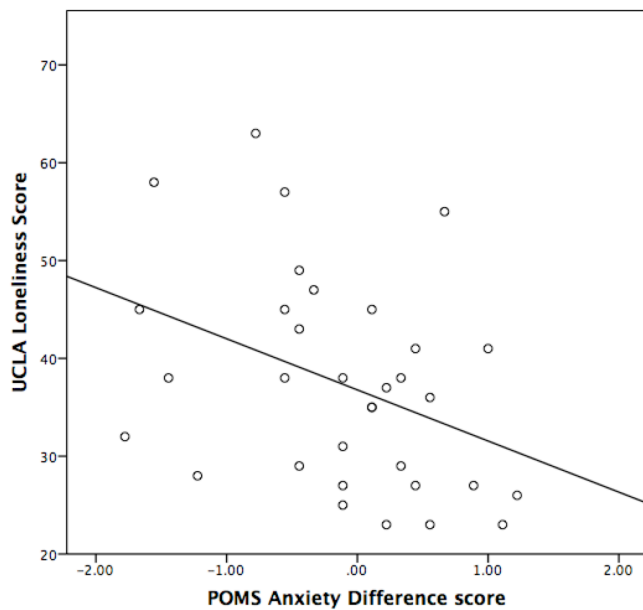


Figure 4. A scatterplot displaying the negative correlation between the POMS Anxiety difference score and the UCLA Loneliness score.

Social isolation analysis

Table 2. Correlations associated with the UCLA Loneliness Scale. An * represents a significant result at the alpha level of 0.05.

	Pearson's <i>r</i>	N	<i>P</i>
UCLA Loneliness Score			
Number of cigarettes per day	.190	33	.290
Percentage of cigarette responses in extinction	-.210	33	.240
Number of Cigarettes per Day			
UCLA Loneliness Score	.190	33	.290
Percentage of cigarette responses in extinction	.292	58*	.026*

* The participant number is different here due to the UCLA Loneliness Scale being added to the research for the 2016-2017 year of recruitment.

In addition to the correlation between the POMS anxiety difference score, Pearson's correlations were also carried out between the UCLA Loneliness Scale score and the number of cigarettes per day and the percentage of cigarettes chosen in the extinction task. Neither of the correlations related to the UCLA Loneliness Scale score were found to be significant (see Table 2), therefore a correlational relationship between the number of cigarettes per day and the loneliness score could not be drawn.

Multiple regression analyses

Following the correlational analyses, two multiple regression analyses were carried out. Firstly on the number of cigarettes per day as the DV and the percentage of cigarettes in extinction and CDS-5 score as the IVs. The second multiple regression analysis was conducted as the BDI as the DV and the WISDM-

68 weight control score and the number of days per week smoked as the IVs. Again, these were conducted in order to assess whether one (or more) of the IVs can account as predictors for the DVs of the previously statistically significant correlational relationships.

A multiple regression was carried out in order to predict the number cigarettes per day from the percentage of cigarettes in extinction and the CDS-5 score. The ANOVA found that both the variables statistically predicted the number of cigarettes per day, $F(2,55) = 21.894, p < .001, R^2 = .443$. However, only the CDS-5 added to the prediction with statistical significance, ($t = 5.945, p < .001$), the percentage of cigarettes in extinction was not found to be significant ($t = 1.211, p = .231$). This is further commented on in the subsequent discussion section.

The second multiple regression analysis was conducted to examine whether the WISDM-68 weight control score and/or the number of days per week smoked predicted the DV BDI score. Neither the WISDM-68 weight control score ($t = 1.845, p = .070$) nor the number of days per week smoked ($t = 1.572, p = .122$) were found to be statistically significant predictors of the BDI score.

Discussion

CPT stress

Following the analysis reported above in regards to the predicted impact of the CPT group (either hot or cold) on the percentage amount of cigarettes chosen in extinction, the independent groups t-test analysis did not yield a significant result. Although the means were found to be in the direction predicted (the mean response was higher for the cold group than the hot group) this increase found in the percentage of cigarette responses cannot statistically be attributed to the CPT.

From previous research described beforehand the CPT has been found to successfully initiate a stress response by raising the salivary cortisol levels (Cahill, Gorski & Le, 2003). Additionally, the literature on stress and smoking behaviour mainly argues that heightened stress will lead to an increase in the urge to smoke (for example as cited beforehand Sinha, 2008 and Kouvonen, *et al.*, 2005). In the current study, the cold group was the stressful condition and the hot group was the control non-stress group. Furthermore, the cold group was led to believe their reaction to the task was being video recorded and they were also told they would have to repeat the CPT once again after the second computer task (the testing part). However, no measure was taken in order to validate if the participants in the cold group felt more stressed than those in the hot group. Perhaps here it would have been beneficial to have an additional measure for stress, such as heart rate or galvanic skin response, in order to provide biopsychological evidence in terms of the impact of the CPT. Galvanic skin response (GSR) is a widely used method of recording stress, which is used alongside pulse rate. In short, GSR provides an indication of changes in the human nervous system by measuring the conductivity of the skin (Shi, Ruiz, Taib, Choi & Chen, 2007) and studies have established that when stress levels increase the GSR level also increases (Ahuja, Agarwal, Mahajan, Mehta & Kapadia, 2003). Additionally, heightening with stress levels is the pulse (heart) rate, due to the increase in demand of oxygen via blood flow to skeletal muscles in order to induce the fight-or-flight response (Kirsch, 2014). Measuring the GSR and pulse therefore would have enabled analysis to be conducted with regards to a group difference in stress levels. Limitations of using the CPT to induce stress are further highlighted in this report.

The concept that cigarettes actually exacerbate stress can also be of application to this non-significant finding. It has been found from daily mood reports by smokers that normal mood is experienced during smoking and worse mood is experienced between cigarettes. Consequently, those who smoke dependently need to carry on smoking to relieve the stress brought upon by the nicotine depletion from previous smoking (Parrott, 1999). In relation to the present research, both daily and recreational smokers were in the stressful and

non-stressful groups, they were also all told not to smoke for an hour before. Henceforth it would be expected for cravings in the heavier smokers to be building up and, as described above, stress to be increasing regardless of the stress initiated by the CPT. It is suggested that further research regarding this would be beneficial as the concept of stress and smoking behaviour is not as simple as initially thought. Whilst research previously highlighted has proposed that inducing stress in individuals will lead to an increase in the desire to smoke and the act of smoking, it is apparent that this relationship is not as linear as expected. It is also important to take into account not only the other factors assessed in this study (depression, anxiety and social isolation) but also the stress brought upon by smoking. This also has further implications in terms of assessing and helping those who wish to quit smoking and as proposed by Parrott (1999) research depicting smoking as an additional stressor could be used to aid prevention of young people experimenting with smoking. However, as previously stated the non-significant result in this research does therefore imply the stress induced by the CPT did not have an effect on the percentage amount of cigarettes chosen in the extinction part of the concurrent choice task and this should also be accounted for in subsequent research.

Number of cigarettes per day

The insignificant findings from the t-test concluded that the CPT did not increase the number of responses in the extinction task for the cold group, therefore the initial hypothesis regarding whether the CPT increased the cigarette choice and if this could be related to the number of cigarettes per day was rejected. However, the data analysis from the one-way ANCOVA indicated that there is a relationship between the number of cigarettes smoked per day and the percentage of cigarette chosen in the extinction part of the concurrent choice task. Furthermore, the Pearson's *r* correlation was conducted to assess the direction of this relationship. The correlational analysis found that there is a significant *correlational* relationship from the whole sample of participants, not just the cold stressor condition, in terms of the number of cigarettes smoked per day and the percentage amount of times the cigarette key is pressed in the extinction task. Subsequently the analysis indicated a positive relationship: as one variable (the number of cigarettes per day) increased so did the other (the percentage number of cigarette responses in extinction) and vice-versa. Again, this cannot draw causality due to the nature of correlational analyses but the finding does add further empirical evidence to the relationship between the concept of an increase in the number of cigarettes smoked per day and how an individual will respond to an extinction task, i.e. the addiction level.

In this experiment the individuals were firstly exposed and “trained” to learn which key (D or H) represents cigarettes and which key signifies chocolate, this can be related to real-life exposure. For instance, research has reported that cues associated with smoking behaviour are found to increase cravings for cigarettes, and subsequently can trigger relapse from abstinence (Ferguson & Shiffman, 2009). Linked to this is the phenomenon of the inflexibility of the habit. Ostlund and Balleine (2008) report that under normal conditions the learning of habits can be highly adaptive, allowing the control of routine behavioural responses to be used in a system that requires fewer cognitive resources, prioritising this system to other tasks that require greater cognitive control. In other words, these habits are then expressed more readily than other cognitive

functions. In this case it also appears that the number of cigarettes smoked per day can be deemed an indicator of the addiction level, due to its correlation to the score on the CDS-5, which is a measure of dependence level. The strong positive correlation found between these variables therefore adds empirical evidence to the use of the CDS-5 as a measure of cigarette dependence, which is important for the reliability and validity of this measure. Furthermore, from the multiple regression analysis, the CDS-5 was found to be a significant predictor of the number of cigarettes smoked per day. In other words, an individual's score on their cigarette dependence using the CDS-5 can predict the number of cigarettes they smoke per day; i.e. the higher they score on the CDS-5, the more cigarettes per day they will report to smoke. This not only supports the use of the measure of cigarettes per day, but it can also be interpreted that the relationship between the number of cigarettes per day and the percentage amount of times the cigarette key is pressed, is associated to the habitual cognitive "loss of control" described by Ostlund and Balleine (2008). In other words, when exposed to a certain predecessor related to cigarettes the decision-making process is geared towards the outcome of receiving the cigarettes. This is shown by the increase in the amount of times the cigarette key is pressed in extinction compared to the chocolate key. Therefore, even when it seems there is no "direct" cue, the training has already successfully associated each key to an outcome and it appears that the "loss of control" described by Ostlund and Balleine (2008) associated with dependence is present for these individuals in terms of the correlation found. For example, with regards to the finding of a positive correlation it can be inferred that as the dependence level (number of cigarettes per day) increases, so does the loss of control of what is now considered habitual behaviour, consequently the system uses less cognitive control due to the automaticity of the behaviour. This thinking can be attributed to the Cognitive Processing Theory of drug use (Tiffany, 1990), which suggests that as individuals repeatedly engage in drug taking behaviour in an array of conditions, further automatic actions plans related to the new conditions are formed. Thus, in the presence of stimuli associated to the drug, such as the corresponding key for cigarettes, the automatic processing leads to a difficulty to control the urge and the associated behaviour can occur without conscious

awareness or intent, i.e. pressing the key for cigarettes over the key for chocolate (Brandon, Herzog, Irvin & Gwaltney, 2004).

The motivational value of the reward from smoking can also be attributed to the way an individual will respond when presented with the concurrent choice paradigm. As described in the introduction, with knowledge of the response-outcome contingency and the reward incentive of drug-seeking, performance in tasks like this could be facilitated for those who are more dependent (Dickson & Balleine, 1994). It could be inferred that due to the correlation between cigarettes per day and dependence level that the reward incentive level is higher for those who smoke more cigarettes each day. In other words, those who smoke more per day could do so due to factors such as perceived stress relief or the impact that smoking has been found to have on chemicals in the brain (see Bacher *et al.* (2011) in the subsequent paragraph). Therefore, during the extinction part of the concurrent choice task the value of cigarettes is interpreted as more worthwhile than the chocolate and henceforth the individual responds more with the key they believe will reward them with cigarette points rather than chocolate points. Whilst this should be interpreted with caution this could potentially add further support to the previous findings in terms of smoking behaviour and its subsequent incentive value, with regards to the outcome knowledge (Hogarth and Chase (2011)).

The rewarding effects of smoking behaviour can further be attributed to the MAO-A levels in certain areas of the brain. Bacher *et al.* (2011) found that the amount of MAO-A in brain regions related to mood control rose by 25% eight hours after withdrawal from heavy smoking, levels that were much higher than those who do not smoke and those who would not be considered heavy smokers. MAO-A is an enzyme that catalyses chemicals such as serotonin, henceforth the higher the amount of MAO-A the lower the amount of serotonin in these regions (De Colibus, Li, Binda, Lustig, Edmondson & Mattevi, 2005). Smoking therefore relieves the influx of MAO-A and prevents the destruction of serotonin, which is the neurotransmitter whereby a deficiency is associated with mental health disorders, such as depression and anxiety (Young, 2007). Whilst this was not

tested in the current research, this connection based on previous literature could additionally provide further support for the incentive value of smoking and the significant correlation between the number of cigarettes and the percentage number of cigarettes chosen in extinction. Once again, it should be emphasised that whilst the finding of the positive correlation can give some insight the relationship between the number of cigarettes per day and the percentage amount of cigarette responses in the extinction part of the task, causality cannot be drawn and further research is needed to assess this relationship. Additionally, both the significant ANCOVA result and correlation cannot be attributed to the impact from the cold or hot conditions that participants were subjected to because of the previously stated insignificant t-test finding regarding this.

Depression

The findings from the statistical analysis did not provide support in terms of a relationship between the BDI score and percentage of cigarette responses. Therefore, the question of whether an impact occurs on the number of cigarettes chosen over chocolate due to the level of depression cannot be conclusively answered. Given the research discussed previously, such as the review by Morrell and Cohen (2006), which presented depression as one of the main contributors to smoking, it is interesting to discuss possible reasoning for why, in this case, this outcome was not found.

In terms of the previous literature, much of which was cited beforehand, there appears to be a strong link between smoking and depression. For instance, Patton *et al.* (1998) found that depression was one of the predictors for teenage experimental smoking initiation, Hogarth *et al.* (2015) also used two theories to demonstrate the priming effect of negative mood on smoking behaviour and Diener and Chan (2011) reported those who express contentment with life are at less risk of carrying out addictive behaviours, such as smoking. It can be noted however that whilst Morrell and Cohen (2006) found cigarette smoking to be highly correlated with clinical depression, this was dependent on certain factors such as age, disorder type and the level of nicotine dependence. Additionally, research assessing depression and smoking tends to use individuals who are

clinically depressed. The participants in this research were not specifically required to have a diagnosis of clinical depression and instead the level of depression was used, which was calculated using the BDI. If perhaps the majority were not depressed then it would be difficult to conclude whether a relationship exists between depression and the performance in the extinction task, therefore whilst inferences can be made this should be interpreted with caution.

Whilst in this case a statistically significant relationship was not found the aforementioned correlational analyses did reveal two interesting associations. Firstly, the positive correlation between the BDI score and the number of days per week spent smoking. This can be related to the findings specified above and also to the stimulus response theory (Hogarth *et al.*, 2015), which argues smoking during a negative mood state as more reinforcing than during a positive mood state. This positive reinforcement therefore provides evidence for an automatic link between the low mood experience and the urge to relieve this via smoking. Research has also found an influence of negative affect on how an individual will respond to smoking cues. It was reported that smokers tended to focus their attention more on the smoking-related cues and showed a greater urge to smoke when in a negative mood compared to a neutral mood (Bradley, Garner, Hudson & Mogg, 2007). This can also be related to the MOA-A enzyme discussed above, as for heavy smokers smoking would hinder the depletion of serotonin and reduce the low mood associated with a lack of this neurotransmitter. Consequently, if an individual scores higher on the BDI then it should be expected that the individual would spend more days feeling lower and they would therefore smoke for more days than another individual who scores lower on the scale. Nevertheless, this conclusion needs to be carefully interpreted. Firstly, the BDI was carried out once, at one time, on one day, therefore the way the participant was feeling at that particular time could have influenced their responses (Ahava & Iannone, 1998). If the BDI was carried out a second time on another day then the result could have been different. Additionally, this is a correlational relationship, whilst useful in showing that there is a relationship evident, hence why it was conducted in the analysis of the data, causality cannot be drawn and thus further research is required.

The second interesting conclusion was the link found between BDI score and smoking for weight control (WISDM-68). Existing literature has established a relationship between smoking and weight control, for example a study conducted in the United States found that among adults younger than 30 years old those who were trying to lose weight were more likely to smoke than those older than 30 years (Wee, Rigotti, Davis & Phillips, 2001). Within research to assess motivation behind contemplation of smoking and actual smoking experimentation, links were also found concerning weight control behaviours and cognitions (Tomeo, Field, Berkey, Colditz & Frazier, 1999). It was found regarding the contemplation of tobacco use, that the perception of being overweight, dissatisfaction with appearance and altering eating habits around peers were found to be prevalent. Whereas smoking experimentation was linked to weight control via daily exercise among boys, and purging (monthly) and daily dieting among girls.

Depression is also found to be a common illness among those with an eating disorder (Carlat, Camargo Jr & Herzog, 1997). Killen, Taylor, Telch, Robinson, Maron and Saylor (1987) reported that young teenage bulimics and purgers were more likely to engaged in substance abuse than those without an eating disorder, this substance abuse also entailed the use of cigarettes. Findings from research into eating disorders have further discovered that one reason for this extreme control of weight is the feeling of being in control (Reid, Burr, Williams & Hammersley, 2008). Many individuals with an eating disorder will report that they feel a lack of control in their lives, therefore by taking control of their hunger and ignoring the urge to eat it acts as a reward where there is a sense of control that is physically visible. In a survey of 16,000 young students aged 9-19 it was reported that the heaviest regular smokers were the most likely to report smoking as a way to control weight, compared to those who had never smoked who were the least likely to agree (Charlton, 1984). It was further suggested from these findings that the high incidence rate of smoking among teenage girls might be due to the aspect of weight control. Research has also found that those aged between 14 and 25 are most at risk for developing an

eating disorder (Anorexia & Bulimia Care, 2015), it is therefore apparent that the perception of smoking as an aid for weight control along with depressive mood disorder needs to be accounted for in research regarding eating disorders. Although the findings from this study were correlational and cannot provide a causal link, there is still evidence here for an association between the two variables of mood and weight control via smoking. Further research should therefore seek to establish how this could be included in order to treat patients displaying this association.

Research regarding brain chemistry and weight control has discovered the melanocortin system to be a key regulator of body weight via the reduction of food intake and aiding weight loss. Furthermore, a reduction in specifically the melanocortin-4 (MC-4) receptor has been linked to increased food consumption and subsequent weight gain (Seeley & Sandoval, 2011). The MC-4 receptors are activated by a precursor synthesized by the POMC neurons, and research has additionally revealed that nicotine directly activates the POMC neurons. This activation further stimulates the alpha-3 beta-4 receptors that are known to mediate nicotine's potent appetite-suppressant effects by subsequently enhancing the firing of the POMC neurons. Evidence from this was also found in mice without the POMC neurons that were unable to suppress their appetite with the use of nicotine (Mineur *et al.*, 2011). Research has also reported that the MC-4 receptors are linked to depressive symptoms. Chaki and Okubo (2007) found that when given a MC-4 antagonist, particularly under high stress, antidepressant effects were exerted. It could be presumed here that when the depressive symptoms are treated using an MC-4 antagonist that there would therefore be increased food consumption and weight gain, thus suppressing the weight control ability that smoking has been found to exhibit.

Whilst the brain chemistry was not assessed in the current research the connection between this previous literature could be used to support the theory of weight control, depression and smoking, and therefore should be taken into consideration with regards to further research in this area. The findings reported highlight how the associations between depression and smoking with regards to

the increase in serotonin levels and the suppression of weight gain could be formed via enhancing positive mood and via activation of certain receptors. Thus providing a basis for a potential link between these variables, and therefore suggesting the need for further research to be conducted in order to yield data that takes into account the brain regions discussed, depression and weight control. The theories and application to certain brain regions may also be useful in terms of smoking cessation, but also of value in adolescent eating disorder research. It is also apparent that there is a positive correlation between the BDI score and the amount of days that an individual reported smoking. Whilst from this data the correlation cannot be interpreted as causal, it is suggested that further research, which takes into account not just one depression inventory on one day, would be beneficial in order to establish whether or not this is a causal relationship.

Anxiety

Similar to the research that is present for the relationship between depression and smoking, it was predicted that the increase in the level of anxiety experienced as part of the CPT task would result in an increase in the percentage of cigarettes chosen in extinction. However, the statistical analysis did not find a significant result and neither was there found to be a correlation between these variables. Again, from the large abundance of literature claiming anxiety level has a significant effect on the amount smoked, much cited in the introduction, reasoning as to why this was not found in the present experiment opens interesting discussion.

When discussing this in terms of related findings in the literature it is apparent in research with experimental designs that manipulate anxiety levels and measure factors such as cravings and the urge to smoke, that the result tends to be in favour of anxiety increasing smoking behaviour. An example of this comes from research whereby individuals were exposed to stage-fright anxiety, monotonous concentration and a relaxed control for a ten-minute duration, with a cigarette being lit at the 5-minute point during each of these tasks (Rose, Ananda & Jarvik, 1983). The two tasks conditions were related to an increase in

the amount smoked, supporting the theory that situations provoking anxiety stimulate smoking behaviour compared to low-anxiety relaxed conditions. Additionally, research that was conducted over an extended period of time has reported a link between anxiety and smoking initiation. Patton *et al.* (1998) found in a sample of 2032 14- and 15-year-old students over three years that experimental smoking was an important predictor of daily smoking later on. However, the present experiment did not find a correlational relationship between the POMS anxiety difference score and the amount of days smoked (daily or recreational smoking).

One consideration could be that the anxiety measure used was not very reliable. The score was calculated from part of the POMS questionnaire that analysed various mood states not just anxiety; these included anger, depression, fatigue, friendliness and confusion etc. It may have been better to use measures that specifically assess the required variable for a more precise measurement, such as the State Trait Anxiety Inventory. The STAI can be used to diagnose anxiety, but to also distinguish it from depression (APA, 2017), which is known to have a high level of comorbidity with anxiety and could therefore be a problem in the POMS questionnaire (Shankar, McMunn, Banks & Steptoe, 2011).

Although in this particular instance a relationship between anxiety and heightened levels of smoking behaviour was not found, this does not mean that research reporting this should be questioned. In this case it is probable that methodologically the experiment needs further consideration. As discussed beforehand a measure that is primarily created to assess anxiety would perhaps have yielded different data than calculating a difference score from the POMS-1 and POMS-2, which measure various mood states. The only correlation that was found in this particular instance was between the Anxiety Difference score and the UCLA Loneliness score.

Social factors

The results revealed that there was no correlation between the UCLA loneliness score and the number of cigarettes per day, neither was there a correlation between the percentage of responses in extinction. Likewise, to the variables discussed above these findings do not correspond to the outcomes from previous literature, whereby loneliness increases smoking behaviour significantly. It is noteworthy however, that a significant correlation was found between the UCLA loneliness score and the POMS anxiety difference Score. However, this was a negative correlation: as the UCLA loneliness score increased the POMS anxiety score decreased. As discussed previously in the introduction this also was not expected, as prior literature seemed to point towards a positive link between loneliness and anxiety. In other words the higher the level of anxiety the more socially anxious and potentially lonely an individual will be (or vice-versa). A good example being the Rat Park study (Alexander, Coombs & Hadaway, 1978), whereby the rats that were in cages alone with little enrichment were found more likely to drink the water containing cocaine, than those in cages with other rats and more enrichment. This study has had high influential value in terms of taking into account the effects of social isolation and loneliness when thinking about addiction.

When attempting to assess the reasoning for the findings from this study it can be considered that the perception of what is loneliness may be blurred due to the heavy reliance on the use of social media and technology in today's society. Research into the rise of the Internet and social media tends to yield data that interprets this as a large causational factor for anxiety, depression and loneliness/isolation from society (Kraut, Patterson, Lundmark, Kiesler, Mukophadhyay & Scherlis, 1998). However, it was found in a particular instance that this is not the case and the Internet use seemed to reduce the feelings of loneliness and depression whilst increasing perceived social support and self-esteem (Shaw & Gant, 2002). This does not explain entirely the negative

correlation found in this research, but it does give good insight into what may be problematic when assessing loneliness.

Another concept that may be applicable to why a correlation was not found between the UCLA loneliness score and the number of cigarettes per day is that of self-esteem. Michell and Amos (1997) proposed that young girls who smoke might not lack self-esteem or be lonely; instead they appeared to have higher levels of self-confidence and social skills than non-smoking acquaintances. It was found that peer group structure was an important variable with regards to smoking behaviour and girls who were at the top of what was described as a hierarchal system were more likely to smoke. In comparison to this, fewer girls met the stereotype of having low self-esteem and poor social skills. These findings therefore suggest that although it was initially believed a correlation would exist in terms of the greater the loneliness score and the greater the amount smoked, the relationship is not as simple and loneliness may not be so clear-cut with regards to the amount smoked.

Another consideration could be the cohort that this was tested on. A study using Australian university students found that those who displayed high openness levels used Facebook to discuss their interests, yet those who scored high in terms of loneliness used the application to make up for their lack of offline connections. However, both groups tended to report having more Facebook friends than the average (Skues, Williams & Wise, 2012). It was also reported that students found Facebook to be like '*social glue*' in terms of assisting the move to university life and socialising with new people (Madge, Meek, Wellens & Hooley, 2009). The current study also used university students and following the research it is apparent that the feeling of loneliness is not as straightforward as initially thought of. However, it is still an important factor to take into consideration here as research has also found that relationship difficulties at university can independently predict anxiety onset, even in those individuals who were previously symptoms free (Andrews & Wilding, 2004). Even though the correlation found is not as simple to interpret in relation to the previous research as perhaps a positive correlation would be, it still suggests

importance to the prevalence of anxiety in students and the interpretation of loneliness and use of social media. It is possible that the heavy reliance on social media could be increasing the feelings of anxiety, or it could instead be helping as a support network. Together these interpretations of social media could be used in addiction treatment. For example, if found that social media is accommodating to addiction management it could be useful as a means to assist in smoking cessation.

From the aforementioned research it is apparent that the construct of loneliness is still a contributor towards smoking behaviour. Even though the findings from this piece of research did not point towards this conclusion, the large volume of literature needs to be taken into account. It is therefore suggested that caution needs to be taken when studying this concept, and further research would be beneficial in terms of assessing the impact of lifestyle on smoking behaviour trends, for example in students and those who are in full-time work. The effect of social media should also be accounted for as for many people, not just those in university, it has been found to play a large role in daily life and seems to affect how a person feels regarding their connections with others.

Limitations

When designing the present study and the method, each measure and task used was accounted for and used with justification. However, like any piece of research not all potential flaws are apparent at this initial stage and do not become evident until after the data collection and subsequent analysis. For example, what can be described as one of the main methodological criticisms for this study is the use of the CPT. In this case the CPT was used to either initiate stress in the experimental condition via cold water or it was used as the non-stressful control condition by using hot water. To initiate stress the water temperature was set at 5 degrees Celsius (as well as a “video recording” being taken) and participants were told to keep their hand in for as long as they possibly could. This was used as part of the experimental design due to other

previous pieces of research doing so (Duncko, Johnson, Merikangas & Grillon, 2009; Lighthall *et al.*, 2011) and validating it as a successful way to induce stress. However, as well as prior research using the CPT as a way to induce stress, alternative studies have used the CPT to induce pain (Dufton, Konik, Colletti, Stanger, Boyer, Morrow & Compas, 2008; Roelofs, Peters, van der Zijden & Vlaeyen, 2004), thus making it questionable how the participants included in this study would have interpreted the task. Ditre and Brandon (2008) found that pain could be a motivator of smoking, which was partially mediated by pain-induced negative affect. It could therefore be questioned as to whether the individuals who increased the amount they pressed the key for cigarettes during the extinction task, were doing so because of stress or because of pain.

The CPT is now considered a popular choice in terms of pain and stress research, although the equipment is not low-cost it is easy to use, has very few exclusion criteria and, due to its non-invasive nature, would be more likely to gain ethical approval than other techniques (Birnie, Caes, Wilson, Williams & Chambers, 2014). With the popularity of use increasing, the problem of whether the CPT induces pain or stress could present as highly detrimental to the findings of future research that incorporate it into the experimental method. Research has previously found that even slight changes in the temperature of the water can significantly impact the pain intensity and tolerance time of individuals (Mitchell, MacDonald & Brodie, 2004). It is therefore suggested that research needs to be conducted in order to assess the use of the CPT with regards to the stress and pain response to establish if any link exists between the two, and if so what can be done to compensate for this.

Additional problems have been encountered during the use of the CPT and participant interpretation, for example regarding individual coping styles and apprehension. In terms of the latter this was found during the present experiment, for instance it was noted that when some individuals were about to place their hand into the water they reported feeling nervous – this was regardless of the group they were in. Regarding individual coping styles it has been found in previous literature that individuals who are considered ‘pain

tolerant' will catastrophise less than those who are 'pain sensitive' (Geisser, Robinson & Pickren, 1993). This therefore suggests that the level of pain an individual believes they can cope with may affect how they perceive they will do on a task and could subsequently impact their stress levels. Litt (1988) found that self-efficacy perception could be a causal determinant of behaviour in adverse situations. The changes in self-efficacy expectations were related to changes in the tolerance of the CPT: if the individual displayed a higher expectation in their ability to cope then they were able to tolerate the CPT better. A higher level of perceived control over aversive stimuli has also been related to a reduction in stress (Geer, Davison & Gatchel, 1970) demonstrating real-life application of the task. In relation to the present research, if an individual began to catastrophise about the CPT part of the experiment, this could have caused their stress levels to heighten regardless of the experimental group they were in. Consequently, this could have affected the percentage number of cigarettes chosen in extinction.

Following these limitations of the CPT it is apparent that this method needs to be assessed in terms of its use as a measure for pain and stress. Additionally, it would be beneficial to analyse whether there is any association between these two phenomena and whether there are any significant implications to the results of the studies exercising this method.

The use of both self-report and behavioural questionnaire measures can be seen as a strength in this research due to the ability therefore to not only account for the individuals' perceived thoughts and feelings regarding the assessed concepts, but to also test them empirically. For example, the choice of cigarettes or chocolate in extinction and the number of cigarettes per day. However, as previously identified the lack of a biological measure can be criticised. The implementation of for example GSR and pulse, could aid in determining whether the participants appeared to be stressed or not due to the CPT and provide evidence for any group differences. Therefore, this is recommended for consideration in further research that uses apparatus, such as the CPT, to induce stress. Additionally, this experiment only measured loneliness

via one self-report questionnaire, the UCLA Loneliness Scale. Although as previously stated the questionnaire has been shown to have good reliability and validity from prior research when measuring the concept of loneliness, research stemming from this should seek to perhaps either use additional self-report measures relating to social isolation constructs or include an experimental method. This would allow for research to focus more on a causal relationship between loneliness and smoking behaviour rather than the correlational associations done so here.

In regards to the imbalance of daily and non-daily smokers across the groups, this is a potential limitation that could possibly be of benefit to rectify in future research of the same or a similar method. In this research the groups were imbalanced due to time constraints and the difficulty in obtaining smokers to participate in the research. The participant cohort was limited to students and staff at the University of Huddersfield and with further criteria the participants had to meet to take part, this further restricted those who could contribute. With reference to further research in the area it is recommended that the groups be balanced in terms of equal numbers in the hot and cold conditions and the type of smoker to avoid any potential impact on the significance of findings.

Finally, it is worth repeating that the use of correlational analyses can be criticised and this has been addressed throughout. Whilst these analyses have been useful in this case to determine relationships between variables with application to the previous literature and theory, the findings do need to be interpreted with caution due to the inability to draw causal conclusions. However, with regards to the present experiment the correlational analyses in this case allowed exploration into a range of variables that could be statistically related and thereafter, for two multiple regression analyses to be performed in order to evaluate potential predictors for the relevant DVs.

Conclusion

The results of this research, whilst not all significant, still emphasise the importance of certain variables on smoking behaviour. For instance the lack of a linear relationship found between stress and the cigarette responses in extinction, opens up thinking with regards to how stress may not simply lead to smoking. Instead smoking may *cause* stress, thus resulting in a snowball effect where smoking is used to relieve the stressful feelings. As previously stated this information could be beneficial in practical terms when helping those who wish to abstain from smoking in order to alter the way the individual views their smoking behaviour. Furthermore, the finding that the number of cigarettes per day has a significant impact on the percentage amount of times the cigarette key is pressed during extinction, could lead to further research in terms of level of addiction. This should be taken into account when considering ways to implement smoking cessation. For example, a better quitting method for heavy smokers could be to cut down slowly before attempting to abstain in an attempt to lower the risk of relapse when presented with smoking related cues. Additionally, from this research depression and smoking to control weight was found to have a correlational relationship and henceforth highlights that this is a factor of considered importance particularly in this student-based cohort. This information could also be of use in regards to potential triggers over what may encourage an individual to smoke when attempting to abstain.

The experiment also offered a novel approach to studying smoking behaviour by including not only a concurrent choice task, previously used in smoking research, but a stressor task utilising the cold pressor machine and several questionnaires to study all different aspects of smoking behaviour and influencers, including that of social isolation. Whilst the present study did not experimentally test the impact of smoking on the chemical receptors in the brain, the connection through previous research described in regards to the findings from this study has highlighted this as an area of importance. From this research it can therefore be suggested that rather than thinking of smoking treatment in terms of either accounting mainly for the psychological or biological triggers,

both should be considered important. However, further research is needed to clarify this based on empirical evidence.

It is also suggested from evaluation of the experimental method used that future research also needs to consider the methods used. As discussed the use of the CPT needs to be assessed in terms of whether it is inducing pain or stress, and the implications this could have on the findings of research that utilises this equipment.

Overall this experiment has provided a novel stance on the study of smoking behaviour and the results from this study have provided further empirical evidence towards how stress, depression, anxiety and loneliness can influence smoking behaviour with the use of a concurrent choice task. The findings have further been related to not only psychological theory, but also biological research and the implications regarding additional investigation in the area and on the treatment of smoking addiction have been discussed. As mentioned beforehand not only do these findings have application when studying the theory behind smoking behaviour, but they also offer practical functionality when addressing abstinence programmes and the current UK government-led quit services. Whilst preferable and more cost-effective to be able to generalise treatments and the way smoking behaviour is assessed, this research has further highlighted that in terms of providing successful intervention it may be better to consider more than just cutting down the amount the individual smokes. This could include important life events that potentially could cause smoking to relieve stress, such as tension at work, the mental health status of the patient and factors related to social status, such as time spent with others and their smoking status. Again, further research into this following these findings would be beneficial in assessing this practical approach.

References

- Abdollahi, A., Yaacob, S. N., Talib, M. A., & Ismail, Z. (2015). Social anxiety and cigarette smoking in adolescents: The mediating role of emotional intelligence. *School Mental Health, 7*(3), 184-192. doi:10.1007/s12310-015-9141-4
- Ahava, G. W., & Iannone, C. (1998). Is the beck depression inventory reliable over time? an evaluation of multiple test-retest reliability in a nonclinical college student sample. *Journal of Personality Assessment, 70*(2), 222-231. doi:10.1207/s15327752jpa7002_3
- Ahern, J., Stuber, J., & Galea, S. (2007). Stigma, discrimination and the health of illicit drug users. *Drug and alcohol dependence, 88*(2), 188-196. doi:10.1016/j.drugalcdep.2006.10.014
- Ahuja, N. D., Agarwal, A. K., Mahajan, N. M., Mehta, N. H., & Kapadia, H. N. (2003). GSR and HRV: Its application in clinical diagnosis. *Computer Based Medical Systems, 279-283*. doi:10.1109/CBMS.2003.1212802
- Alexander, B. K., Coombs, R. B., & Hadaway, P. F. (1978). The effect of housing and gender on morphine self-administration in rats. *Psychopharmacology, 58*(2), 175-179. doi:10.1007/BF00426903
- Andrews, B., & Wilding, J. M. (2004). The relation of depression and anxiety to life-stress and achievement in students. *British Journal of Psychology (London, England : 1953), 95*(Pt 4), 509-521. doi:10.1348/0007126042369802
- Anorexia & Bulimia Care. (2015). *About Eating Disorders*. Retrieved from <http://www.anorexiabulimiacare.org.uk/about/about-eating-disorders>
- APA. (2017). *The State Trait Anxiety Inventory*. Retrieved from <http://www.apa.org/pi/about/publications/caregivers/practice-settings/assessment/tools/trait-state.aspx>

- Bacher, I., Houle, S., Xu, X., Zawertailo, L., Soliman, A., Wilson, A. A., ... & Kish, S. J. (2011). Monoamine oxidase A binding in the prefrontal and anterior cingulate cortices during acute withdrawal from heavy cigarette smoking. *Archives of general psychiatry*, *68*(8), 817-826. doi:10.1001/archgenpsychiatry.2011.82
- Beck, A.T., Steer, R.A., & Brown, G.K. (1996). Manual for the Beck Depression Inventory-II. San Antonio, TX: Psychological Corporation.
- Birnie, K. A., Caes, L., Wilson, A. C., Williams, S. E., & Chambers, C. T. (2014). A practical guide and perspectives on the use of experimental pain modalities with children and adolescents. *Pain*, *4*(2), 97-111. doi:10.2217/pmt.13.72
- Bradley, B. P., Garner, M., Hudson, L., & Mogg, K. (2007). Influence of negative affect on selective attention to smoking-related cues and urge to smoke in cigarette smokers. *Behavioural pharmacology*, *18*(4), 255-263. doi:10.1097/FBP.0b013e328173969b
- Brandon, T. H., Herzog, T. A., Irvin, J. E., & Gwaltney, C. J. (2004). Cognitive and social learning models of drug dependence: Implications for the assessment of tobacco dependence in adolescents. *Addiction*, *99*(s1), 51-77. doi:10.1111/j.1360-0443.2004.00737.x
- Bunn, W. B., Stave, G. M., Downs, K. E., Alvir, J. M. J., & Dirani, R. (2006). Effect of smoking status on productivity loss. *Journal of Occupational and Environmental Medicine*, *48*(10), 1099-1108. doi:10.1097/01.jom.0000243406.08419.74
- Cahill, L., Gorski, L., & Le, K. (2003). Enhanced human memory consolidation with post-learning stress: Interaction with the degree of arousal at encoding. *Learning & Memory (Cold Spring Harbor, N.Y.)*, *10*(4), 270-274. doi:10.1101/lm.62403

- Cappelleri, J. C., Bushmakin, A. G., Baker, C. L., Merikle, E., Olufade, A. O., & Gilbert, D. G. (2007). Multivariate framework of the brief questionnaire of smoking urges. *Drug and Alcohol Dependence, 90*(2), 234-242.
doi:10.1016/j.drugalcdep.2007.04.002
- Carlat, D. J., Camargo Jr, C. A., & Herzog, D. B. (1997). Eating disorders in males: a report on 135 patients. *The American Journal of Psychiatry, 154*(8), 1127.
doi:10.1176/ajp.154.8.1127
- Carmody, T. P. (1992). Affect regulation, nicotine addiction, and smoking cessation. *Journal of Psychoactive Drugs, 24*(2), 111-122.
doi:10.1080/02791072.1992.10471632
- Chaki, S., & Okubo, T. (2007). Melanocortin-4 receptor antagonists for the treatment of depression and anxiety disorders. *Current topics in medicinal chemistry, 7*(11), 1145-1151. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/17584135>
- Charlton, A. (1984). Smoking and weight control in teenagers. *Public Health, 98*(5), 277-281. doi:10.1016/S0033-3506(84)80003-7
- Collins, B. N., & Lepore, S. J. (2009). Association between anxiety and smoking in a sample of urban black men. *Journal of Immigrant and Minority Health, 11*(1), 29-34. doi:10.1007/s10903-008-9164-0
- Connor, J. P., Gullo, M. J., White, A., & Kelly, A. B. (2014). Polysubstance use: diagnostic challenges, patterns of use and health. *Current opinion in psychiatry, 27*(4), 269-275. doi:10.1097/YCO.0000000000000069
- Coolican, H. (2009). *Research methods and statistics in psychology* (5th ed.). London: Hodder Education.

- Cox, L. S., Tiffany, S. T., & Christen, A. G. (2001). Evaluation of the brief questionnaire of smoking urges (QSU-brief) in laboratory and clinical settings. *Nicotine & Tobacco Research, 3*(1), 7-16. doi:10.1080/14622200020032051
- De Colibus, L., Li, M., Binda, C., Lustig, A., Edmondson, D. E., & Mattevi, A. (2005). Three-dimensional structure of human monoamine oxidase A (MAO A): relation to the structures of rat MAO A and human MAO B. *Proceedings of the national academy of sciences of the United States of America, 102*(36), 12684-12689. doi:10.1073/pnas.0505975102
- De Wit, S., & Dickinson, A. (2009). Associative theories of goal-directed behaviour: A case for animal-human translational models. *Psychological Research, 73*(4), 463-476. doi:10.1007/s00426-009-0230-6
- Degenhardt, L., & Hall, W. (2001). The relationship between tobacco use, substance-use disorders and mental health: results from the National Survey of Mental Health and Well-being. *Nicotine & Tobacco Research, 3*(3), 225-234. doi:10.1080/14622200110050457
- Dickinson, A. (1985). Actions and habits: the development of behavioural autonomy. *Philosophical Transactions of the Royal Society of London B: Biological Sciences, 308*(1135), 67-78. doi:10.1098/rstb.1985.0010
- Dickinson, A., & Balleine, B. (1994). Motivational control of goal-directed action. *Animal Learning & Behavior, 22*(1), 1-18. Retrieved from <https://link.springer.com/content/pdf/10.3758%2FBF03199951.pdf>

- Diener, E., & Chan, M. Y. (2011). Happy people live longer: Subjective well-being contributes to health and longevity. *Applied Psychology: Health and Well-Being*, 3(1), 1-43. doi:10.1111/j.1758-0854.2010.01045.x
- Ditre, J. W., & Brandon, T. H. (2008). Pain as a motivator of smoking: Effects of pain induction on smoking urge and behavior. *Journal of Abnormal Psychology*, 117(2), 467-472. doi:10.1037/0021-843X.117.2.467
- Dufton, L. M., Konik, B., Colletti, R., Stanger, C., Boyer, M., Morrow, S., & Compas, B. E. (2008). Effects of stress on pain threshold and tolerance in children with recurrent abdominal pain. *Pain*, 136(1), 38-43. doi:10.1016/j.pain.2007.06.012
- Duncko, R., Johnson, L., Merikangas, K., & Grillon, C. (2009). Working memory performance after acute exposure to the cold pressor stress in healthy volunteers. *Neurobiology of Learning and Memory*, 91(4), 377-381. doi:10.1016/j.nlm.2009.01.006
- Durazzo, T. C., Meyerhoff, D. J., & Nixon, S. J. (2010). Chronic cigarette smoking: implications for neurocognition and brain neurobiology. *International journal of environmental research and public health*, 7(10), 3760-3791. doi:10.3390/ijerph7103760
- Emre, N., Topal, K., Bozkurt, N., & Topaktas, E. (2014). Mental health screening and increased risk for anxiety and depression among treatment-seeking smokers. *Tobacco Induced Diseases*, 12(1), 20-20. doi:10.1186/1617-9625-12-20

- Ennett, S. T., & Bauman, K. E. (1993). Peer group structure and adolescent cigarette smoking: A social network analysis. *Journal of Health and Social Behavior, 34*(3), 226-236. Retrieved from <http://www.jstor.org/stable/2137204>
- Etter, J. F., Jacques, L. H., & Perneger, T. V. (2003). A self-administered questionnaire to measure dependence on cigarettes: The cigarette dependence scale. *Neuropsychopharmacology, 28*(2), 359-370. doi:10.1038/sj.npp.1300030
- Evatt, D. P., & Kassel, J. D. (2010). Smoking, arousal, and affect: The role of anxiety sensitivity. *Journal of Anxiety Disorders, 24*(1), 114-123. doi:10.1016/j.janxdis.2009.09.006
- Ferguson, S. G., & Shiffman, S. (2009). The relevance and treatment of cue-induced cravings in tobacco dependence. *Journal of Substance Abuse Treatment, 36*(3), 235-243. doi:10.1016/j.jsat.2008.06.005
- Field, A. P. (2009). *Discovering statistics using SPSS: And sex and drugs and rock 'n' roll* (3rd ed.). London: SAGE.
- Fisher, L. A., & Bauman, K. E. (1988). Influence and selection in the friend-adolescent relationship: Findings from studies of adolescent smoking and drinking. *Journal of Applied Social Psychology, 18*(4), 289. doi:10.1111/j.1559-1816.1988.tb00018.x
- Full Fact. (2012). *Does Smoking Cost as Much as it Makes for the Treasury?* Retrieved from <https://fullfact.org/economy/does-smoking-cost-much-it-makes-treasury/>
- Geer, J. H., Davison, G. C., & Gatchel, R. I. (1970). Reduction of stress in humans through nonveridical perceived control of aversive stimulation. *Journal of Personality and Social Psychology, 16*(4), 731. doi:10.1037/h0030014

- Geisser, M. E., Robinson, M. E., & Pickren, W. E. (1993). Differences in cognitive coping strategies among pain-sensitive and pain-tolerant individuals on the cold-pressor test. *Behavior Therapy, 23*(1), 31-41. doi:10.1016/S0005-7894(05)80306-5
- Gibson, S. J. (1997). The measurement of mood states in older adults. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences, 52*(4), P167-P174. doi:10.1093/geronb/52B.4.P167
- Gorman, J. M. (1996). Comorbid depression and anxiety spectrum disorders. *Depression and Anxiety, 4*(4), 160-168. doi:10.1002/(SICI)1520-6394(1996)4:4<160::AID-DA2>3.0.CO;2-J
- Havassy, B. E., Hall, S. M., & Wasserman, D. A. (1991). Social support and relapse: Commonalities among alcoholics, opiate users, and cigarette smokers. *Addictive Behaviors, 16*(5), 235-246. doi:10.1016/0306-4603(91)90016-B
- Hayaki, J., Stein, M. D., Lessor, J. A., Herman, D. S., & Anderson, B. J. (2005). Adversity among drug users: relationship to impulsivity. *Drug and alcohol dependence, 78*(1), 65-71. doi:10.1016/j.drugalcdep.2004.09.002
- Henry, S. L., Jamner, L. D., & Whalen, C. K. (2012). I (should) need a cigarette: Adolescent social anxiety and cigarette smoking. *Annals of Behavioral Medicine, 43*(3), 383-393. doi:10.1007/s12160-011-9340-7
- Hogarth, L. (2012). Goal-directed and transfer-cue-elicited drug-seeking are dissociated by pharmacotherapy: Evidence for independent additive controllers. *J. Exp. Psychol. Anim. Behav. Processes, 38*: 266-278. doi:10.1037/a0028914
- Hogarth, L., Balleine, B. W., Corbit, L. H., & Killcross, S. (2013). Associative learning mechanisms underpinning the transition from recreational drug use to addiction. *Annals of the New York Academy of Sciences, 1282*(1), 12-24. doi:10.1111/j.1749-6632.2012.06768.x

- Hogarth, L. & Chase, H. W. (2011). Parallel goal-directed and habitual control of human drug seeking: implications for dependence vulnerability. *J. Exp. Psychol. Anim. Behav. Process.* 37: 261–276. doi:10.1037/a0022913
- Hogarth, L., Dickinson, A., & Duka, T. (2010). The associative basis of cue-elicited drug taking in humans. *Psychopharmacology*, 208(3), 337-351. doi:10.1007/s00213-009-1735-9
- Hogarth, L., He, Z., Chase, H. W., Wills, A. J., Troisi II, J., Leventhal, A. M., . . . Hitsman, B. (2015). Negative mood reverses devaluation of goal-directed drug-seeking favouring an incentive learning account of drug dependence. *Psychopharmacology*, 232(17), 3235-3247. doi:10.1007/s00213-015-3977-z
- Holbrook, B. D. (2016). The effects of nicotine on human fetal development. *Birth Defects Research Part C: Embryo Today: Reviews*, 108(2), 181-192. doi:10.1002/bdrc.21128
- Hughes, J. R., Higgins, S. T., & Hatsukami, D. (1990). Effects of abstinence from tobacco. In *Research advances in alcohol and drug problems* (pp. 317-398). Springer: US.
- Ikard, F. F., Green, D. E., & Horn, D. (1969). A scale to differentiate between types of smoking as related to the management of affect. *International Journal of the Addictions*, 4(4), 649-659. doi:10.3109/10826086909062040
- Jarvik, M. E., Caskey, N. H., Rose, J. E., Herskovic, J. E., & Sadeghpour, M. (1989). Anxiolytic effects of smoking associated with four stressors. *Addictive Behaviors*, 14(4), 379-386. doi:10.1016/0306-4603(89)90025-7
- Kahneman, D., & Deaton, A. (2010). High income improves evaluation of life but not emotional well-being. *Proceedings of the national academy of sciences*, 107(38), 16489-16493. doi:10.1073/pnas.1011492107

- Killen, J. D., Taylor, C. B., Telch, M. J., Robinson, T. N., Maron, D. J., & Saylor, K. E. (1987). Depressive symptoms and substance use among adolescent binge eaters and purgers: A defined population study. *American Journal of Public Health, 77*(12), 1539-1541. doi:10.2105/AJPH.77.12.1539
- King, S. L., & Hegadoren, K. M. (2002). Stress hormones: How do they measure up? *Biological Research for Nursing, 4*(2), 92-103. doi:10.1177/1099800402238334
- Kirsch, D. L. (2014). *Stress in Health and Disease, An Issue of Psychiatric Clinics of North America* (Vol. 37, No. 4). USA: Elsevier Health Sciences.
- Knight, R. G., Chisholm, B. J., Marsh, N. V., & Godfrey, H. P. (1988). Some normative, reliability, and factor analytic data for the revised UCLA loneliness scale. *Journal of Clinical Psychology, 44*(2), 203-206. doi:10.1002/1097-4679(198803)44:2<203::AID-JCLP2270440218>3.0.CO;2-5
- Kouvonen, A., Kivimäki, M., Virtanen, M., Pentti, J., & Vahtera, J. (2005). Work stress, smoking status, and smoking intensity: an observational study of 46 190 employees. *Journal of Epidemiology and Community Health, 59*(1), 63-69. doi:10.1136/jech.2004.019752
- Kraut, R., Patterson, M., Lundmark, V., Kiesler, S., Mukophadhyay, T., & Scherlis, W. (1998). Internet paradox: A social technology that reduces social involvement and psychological well-being? *American Psychologist, 53*(9), 1017-1031. doi:10.1037/0003-066X.53.9.1017
- Lacey, L. P., Manfredi, C., Balch, G., Warnecke, R. B., Allen, K., & Edwards, C. (1993). Social support in smoking cessation among black women in Chicago public housing. *Public Health Reports (1974-), 108*(3), 387-394. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1403392/pdf/pubhealthrep00067-0125.pdf>

- Lighthall, N. R., Sakaki, M., Vasunilashorn, S., Nga, L., Somayajula, S., Chen, E. Y., ... & Mather, M. (2011). Gender differences in reward-related decision processing under stress. *Social Cognitive and Affective Neuroscience*, 7(4), 476-484. doi:10.1093/scan/nsr026
- Liljeholm, M., Tricomi, E., O'Doherty, J. P., & Balleine, B. W. (2011). Neural correlates of instrumental contingency learning: Differential effects of action-reward conjunction and disjunction. *Journal of Neuroscience*, 31(7), 2474-2480. doi:10.1523/JNEUROSCI.3354-10.2011
- Litt, M. D. (1988). Self-efficacy and perceived control: cognitive mediators of pain tolerance. *Journal of personality and social psychology*, 54(1), 149. doi:10.1037/0022-3514.54.1.149
- Madge, C., Meek, J., Wellens, J., & Hooley, T. (2009). Facebook, social integration and informal learning at university: 'it is more for socialising and talking to friends about work than for actually doing work'. *Learning, Media and Technology*, 34(2), 141-155. doi:10.1080/17439880902923606
- Massey, S. H., Lieberman, D. Z., Reiss, D., Leve, L. D., Shaw, D. S., & Neiderhiser, J. M. (2011). Association of clinical characteristics and cessation of tobacco, alcohol, and illicit drug use during pregnancy. *The American Journal on Addictions*, 20(2), 143-150. doi:10.1111/j.1521-0391.2010.00110.x
- Mather, M., & Lighthall, N. R. (2012). Risk and reward are processed differently in decisions made under stress. *Current Directions in Psychological Science*, 21(1), 36-41. doi:10.1177/0963721411429452
- Mayer, J. D., & Salovey, P. (1993). The intelligence of emotional intelligence. *Intelligence*, 17(4), 433-442. doi:10.1016/0160-2896(93)90010-3

- McCool, J. P., Cameron, L. D., & Petrie, K. J. (2001). Adolescent perceptions of smoking imagery in film. *Social science & medicine*, *52*(10), 1577-1587. doi:10.1016/S0277-9536(00)00270-7
- McEvoy, C. T., & Spindel, E. R. (2017). Pulmonary effects of maternal smoking on the fetus and child: Effects on lung development, respiratory morbidities, and life long lung health. *Paediatric Respiratory Reviews*, *21*, 27-33. doi:10.1016/j.prrv.2016.08.005
- McNair, P.M., Lorr, M., & Droppleman, L.F. (1981). *POMS Manual*. (2nd ed.). San Diego: Educational and Industrial Testing Services.
- McNally, R. J. (2002). Anxiety sensitivity and panic disorder. *Biological psychiatry*, *52*(10), 938-946. doi:10.1016/S0006-3223(02)01475-0
- Menkes, M. S., Matthews, K. A., Krantz, D. S., Lundberg, U., Mead, L. A., Qaqish, B., ... & Pearson, T. A. (1989). Cardiovascular reactivity to the cold pressor test as a predictor of hypertension. *Hypertension*, *14*(5), 524-530. doi:10.1161/01.HYP.14.5.524
- Michell, L., & Amos, A. (1997). Girls, pecking order and smoking. *Social Science & Medicine*, *44*(12), 1861-1869. doi:10.1016/S0277-9536(96)00295-X
- Mineur, Y. S., Abizaid, A., Rao, Y., Salas, R., DiLeone, R. J., Gündisch, D., ... & Picciotto, M. R. (2011). Nicotine decreases food intake through activation of POMC neurons. *Science*, *332*(6035), 1330-1332. doi:10.1126/science.1201889
- Minkley, N., Schröder, T. P., Wolf, O. T., & Kirchner, W. H. (2014). The socially evaluated cold-pressor test (SECPT) for groups: Effects of repeated administration of a combined physiological and psychological stressor. *Psychoneuroendocrinology*, *45*, 119-127. doi:10.1016/j.psyneuen.2014.03.022

- Mitchell, L. A., MacDonald, R. A. R., & Brodie, E. E. (2004). Temperature and the cold pressor test. *Journal of Pain*, 5(4), 233-237. doi:10.1016/j.jpain.2004.03.004
- Morissette, S. B., Brown, T. A., Kamholz, B. W., & Gulliver, S. B. (2006). Differences between smokers and nonsmokers with anxiety disorders. *Journal of Anxiety Disorders*, 20(5), 597-613. doi:10.1016/j.janxdis.2005.08.003
- Morrell, H. E. R., & Cohen, L. M. (2006). Cigarette smoking, anxiety, and depression. *Journal of Psychopathology and Behavioral Assessment*, 28(4), 281-295. doi:10.1007/s10862-005-9011-8
- NHS Choices. (2016a). *Generalised Anxiety Disorder in Adults*. Retrieved from <http://www.nhs.uk/conditions/Anxiety/Pages/Introduction.aspx>
- NHS Choices. (2016b). *Clinical Depression*. Retrieved from <http://www.nhs.uk/conditions/depression/Pages/Introduction.aspx>
- NHS Digital. (2017). *Statistics on Smoking: England 2017*. Retrieved from https://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0ahUKEwjolJ_L2snVAhUlcAKHX3qDU0QFgguMAE&url=https%3A%2F%2Fdigital.nhs.uk%2Fmedia%2F31138%2FStatistics-on-Smoking-England-2017-Report%2Fdefault%2Fsmok-eng-2017-rep&usg=AFQjCNFyT1MQgngqmX-Xpxl56JRW31KigA
- NHS Direct. (2013). *Statistics on NHS Stop Smoking Services, England – April 2012 to March 2013*. Retrieved from <http://content.digital.nhs.uk/catalogue/PUB12228>
- Ostlund, S. B., & Balleine, B. W. (2008). On habits and addiction: An associative analysis of compulsive drug seeking. *Drug Discovery Today: Disease Models*, 5(4), 235-245. doi:10.1016/j.ddmod.2009.07.004
- Parrott, A. C. (1994). Individual differences in stress and arousal during cigarette smoking. *Psychopharmacology*, 115(3), 389-396. doi:10.1007/BF02245082

- Parrott, A. C. (1999). Does cigarette smoking cause stress? *American Psychologist*, 54(10), 817-820. doi:10.1037/0003-066X.54.10.817
- Patton, G. C., Carlin, J. B., Coffey, C., Wolfe, R., Hibbert, M., & Bowes, G. (1998). Depression, anxiety, and smoking initiation: A prospective study over 3 years. *American Journal of Public Health*, 88(10), 1518-1522. doi:10.2105/AJPH.88.10.1518
- Piper, M. E., Cook, J. W., Schlam, T. R., Jorenby, D. E., & Baker, T. B. (2011). Anxiety diagnoses in smokers seeking cessation treatment: Relations with tobacco dependence, withdrawal, outcome and response to treatment. *Addiction*, 106(2), 418-427. doi:10.1111/j.1360-0443.2010.03173.x
- Piper, M. E., Piasecki, T. M., Federman, E. B., Bolt, D. M., Smith, S. S., Fiore, M. C., & Baker, T. B. (2004). A multiple motives approach to tobacco dependence: The wisconsin inventory of smoking dependence motives (WISDM-68). *Journal of Consulting and Clinical Psychology*, 72(2), 139-154. doi:10.1037/0022-006X.72.2.139
- Reid, M., Burr, J., Williams, S., & Hammersley, R. (2008). Eating disorders patients' views on their disorders and on an outpatient service: A qualitative study. *Journal of Health Psychology*, 13(7), 956-960. doi:10.1177/1359105308095070
- Roelofs, J., Peters, M. L., van der Zijden, M., & Vlaeyen, J. W. S. (2004). Does fear of pain moderate the effects of sensory focusing and distraction on cold pressor pain in pain-free individuals? *Journal of Pain*, 5(5), 250-256. doi:10.1016/j.jpain.2004.04.001
- Rose, J. E., Ananda, S., & Jarvik, M. E. (1983). Cigarette smoking during anxiety-provoking and monotonous tasks. *Addictive Behaviors*, 8(4), 353-359. doi:10.1016/0306-4603(83)90035-7

- Russell, D. W. (1996). UCLA Loneliness Scale (Version 3): Reliability, validity, and factor structure. *Journal of personality assessment*, 66(1), 20-40. doi: 10.1207/s15327752jpa6601_2
- Russell, D., Peplau, L.A., & Cutrona, C.E. (1980). The revised UCLA Loneliness Scale: Concurrent and discriminant validity evidence. *Journal of Personality and Social Psychology*, 39, 472-480. doi:10.1037/0022-3514.39.3.472;10.1037//0022-3514.39.3.472
- Schwabe, L., Haddad, L., & Schachinger, H. (2008). HPA axis activation by a socially evaluated cold-pressor test. *Psychoneuroendocrinology*, 33(6), 890-895. doi:10.1016/j.psyneuen.2008.03.001
- Seeley, R. J., & Sandoval, D. A. (2011). Neuroscience: Weight loss through smoking. *Nature*, 475(7355), 176. doi:10.1038/475176a
- Shankar, A., McMunn, A., Banks, J., & Steptoe, A. (2011). Loneliness, social isolation, and behavioral and biological health indicators in older adults. *Health Psychology: Official Journal of the Division of Health Psychology, American Psychological Association*, 30(4), 377-385. doi:10.1037/a0022826
- Shaw, L. H., & Gant, L. M. (2002). In defense of the internet: The relationship between internet communication and depression, loneliness, self-esteem, and perceived social support. *CyberPsychology & Behavior*, 5(2), 157-171. doi:10.1089/109493102753770552
- Shenassa, E. D., Graham, A. L., Burdzovic, J. A., & Buka, S. L. (2009). Psychometric properties of the Wisconsin Inventory of Smoking Dependence Motives (WISDM-68): a replication and extension. *Nicotine & Tobacco Research*, 11(8), 1002-1010. doi:10.1093/ntr/ntp109

Shi, Y., Ruiz, N., Taib, R., Choi, E., & Chen, F. (2007). Galvanic skin response (GSR) as an index of cognitive load. Paper presented at the 2651-2656.
doi:10.1145/1240866.1241057

Sinha, R. (2001). How does stress increase risk of drug abuse and relapse?
Psychopharmacology, 158(4), 343-359. doi:10.1007/s002130100917

Sinha, R. (2008). Chronic stress, drug use, and vulnerability to addiction. *Annals of the New York Academy of Sciences*, 1141(1), 105-130.
doi:10.1196/annals.1441.030

Skinner, M. D., & Aubin, H. (2010). Craving's place in addiction theory: Contributions of the major models. *Neuroscience and Biobehavioral Reviews*, 34(4), 606-623. doi:10.1016/j.neubiorev.2009.11.024

Skues, J. L., Williams, B., & Wise, L. (2012). The effects of personality traits, self-esteem, loneliness, and narcissism on facebook use among university students. *Computers in Human Behavior*, 28(6), 2414. doi:10.1016/j.chb.2012.07.012

Smith, S. S., Piper, M. E., Bolt, D. M., Fiore, M. C., Wetter, D. W., Cinciripini, P. M., & Baker, T. B. (2010). Development of the brief Wisconsin inventory of smoking dependence motives. *Nicotine & Tobacco Research*, 12(5), 489-499.
doi:10.1093/ntr/ntq032

Spielberger, C. D. (1972). Review of profile of mood states. *Professional Psychology*, 3(4), 387-388. doi:10.1037/h0020742

- Spinhoven, P., van Balkom, A. J., & Nolen, W. A. (2011). Comorbidity patterns of anxiety and depressive disorders in a large cohort study: the Netherlands Study of Depression and Anxiety (NESDA). *J Clin Psychiatry*, *72*(3), 341-348. Retrieved from https://www.nesda.nl/nesda/wp-content/uploads/2015/08/Lamers_JClinPsych_2011.pdf
- Stavem, K., Røgeberg, O. J., Olsen, J. A., & Boe, J. (2008). Properties of the Cigarette Dependence Scale and the Fagerström Test of Nicotine Dependence in a representative sample of smokers in Norway. *Addiction*, *103*(9), 1441-1449. doi:10.1111/j.1360-0443.2008.02278.x
- Tice, D. M., Bratslavsky, E., & Baumeister, R. F. (2001). Emotional distress regulation takes precedence over impulse control: If you feel bad, do it!. *Journal of personality and social psychology*, *80*(1), 53. doi:10.1037/0022-3514.80.1.53
- Tiffany, S. T. (1990). A cognitive model of drug urges and drug-use behavior: Role of automatic and nonautomatic processes. *Psychological Review*, *97*(2), 147-168. doi:10.1037//0033-295X.97.2.147
- Tomeo, C. A., Field, A. E., Berkey, C. S., Colditz, G. A., & Frazier, A. L. (1999). Weight concerns, weight control behaviors, and smoking initiation. *Pediatrics*, *104*(4), 918-924. Retrieved from <http://pediatrics.aappublications.org/content/104/4/918.short>
- von Baeyer, C. L., Piira, T., Chambers, C. T., Trapanotto, M., & Zeltzer, L. K. (2005). Guidelines for the cold pressor task as an experimental pain stimulus for use with children. *Journal of Pain*, *6*(4), 218-227. doi:10.1016/j.jpain.2005.01.349

- Wang, Y. P., & Gorenstein, C. (2013). Assessment of depression in medical patients: a systematic review of the utility of the Beck Depression Inventory-II. *Clinics*, 68(9), 1274-1287. doi:10.6061/clinics/2013(09)15
- Wee, C. C., Rigotti, N. A., Davis, R. B., & Phillips, R. S. (2001). Relationship between smoking and weight control efforts among adults in the United States. *Archives of internal medicine*, 161(4), 546-550. doi:10.1001/archinte.161.4.546
- Wolf, S., & Hardy, J. D. (1941). Studies on pain. Observations on pain due to local cooling and on factors involved in the "cold pressor" effect. *Journal of Clinical Investigation*, 20(5), 521. doi:10.1172/JCI101245
- World Health Organisation. (2017). *Tobacco*. Retrieved from <http://www.who.int/mediacentre/factsheets/fs339/en/>
- Young, S. N. (2007). How to increase serotonin in the human brain without drugs. *Journal of psychiatry & neuroscience: JPN*, 32(6), 394. doi:PMC2077351
- Zvolensky, M. J., Farris, S. G., Schmidt, N. B., & Smits, J. A. J. (2014). The role of smoking inflexibility/avoidance in the relation between anxiety sensitivity and tobacco use and beliefs among treatment-seeking smokers. *Experimental and Clinical Psychopharmacology*, 22(3), 229-237. doi:10.1037/a0035306

Appendices

Appendix A – Qpack for participants

Experimenter's Name.....

Subject No.	Group	Key

Start time Date

Switch off phone Age

Gender CO

1. Consent and QPACK to POMS1
2. Arrange subject at computer with rewards
3. Training till break
4. Cold pressor + pain measures
5. Test phase
6. Preoccupation question
7. POMS2
8. Debrief

Information sheet: The effects of stress on smoking behaviour

You are being invited to take part in a research study. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

What is the purpose of study?

This study aims to find out more about people who smoke, specifically in terms of learning processes and factors which could lead to relapse.

What does the study involve?

The study involves a set of questionnaires which ask moderately personal questions (all data is anonymous and confidential), and a short computer task in which you can earn cigarettes and chocolate. Although you will win items during the task, you will not actually take these away with you. In the task you will simply choose between two buttons on the keyboard.

You will then be asked to immerse your hand in either cold or warm water (which condition you are in has been determined by a random number generator). The cold water will be uncomfortable but not harmful. You can remove your hand from the water at any point. You will then be asked to complete another computer task, similar to the first before answering another two questionnaires.

Confidentiality: Who has access to the data?

Personal information given to any researchers will be entirely confidential. You will not be identified by name in any report concerning the study; for all analysis, you will have a number allocated to your data, and only the research team will have access to this number. We will video record part of the study, only the research team will have access to this.

It is also important to note that this study will remain completely voluntary at all times. If you do not wish to participate or wish to stop participating at any stage you will be able to do so without having to explain why.

Exclusion Criteria

To participate in the study you must:

- Ability to understand the aims of the study and what it involves, in English, as set out in the information sheet and explained by the researcher.

- Have not drunk alcohol for at least 12 hours before the test session.
- Have not taken illicit drugs for at least 5 days before the test session (this information will be kept confidential)
- Have not taken sleeping pills for at least 48 hours before the test session.
- Not be currently taking anti-depressant medication (this information will be kept confidential)
- Not have a condition that will be adversely affected by the CPT (such as Raynaud's)

If you would like to discuss anything further, please contact the researcher:

Dr Chris Retzler

Department of Behavioural and Social Sciences (R2/19)
University of Huddersfield,
HD1 3DH

Tel: 01484 473409

Email: c.retzler@hud.ac.uk

If you have any questions please ask, otherwise if you are happy to participate please sign over the page. You have the right to withdraw at any time and your data will be treated as confidential.

CONSENT FORM

Material gathered during this research will be treated as confidential and securely stored. Please answer each statement concerning the collection and use of the research data.

- | | | |
|---|------------------------------|-----------------------------|
| I have read and understood the information sheet. | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| I have been given the opportunity to ask questions about the study. | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| I have had my questions answered satisfactorily. | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| I understand that I can withdraw from the study at any time without having to give an explanation. | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| I agree to interviews being digitally (video) recorded and the contents being used for the current experiment before being deleted. | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| I agree to field notes being recorded and the contents used for research purposes | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| I understand that my identity will be protected and that all data will be anonymous. | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| I agree to the data (in line with conditions outlined above) being archived and used by other bona fide researchers. | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| I would like to see a copy of the data in which I feature | Yes <input type="checkbox"/> | No <input type="checkbox"/> |

Name (printed)

Signature

_____ **Date** _____

Witnessed by (name printed)

Signature

_____ **Date** _____

Smoking Questionnaire

- On the days you smoke, how many cigarettes do you typically smoke?
.....
- How many days per week do you typically smoke?
.....
- When did you smoke your last cigarette (state hour and minute)?
.....
- How many years have you smoked?
.....
- What age did you start smoking?
.....
- Are you currently trying to quit or cut down smoking?
.....

WISDM-68

Below are a series of statements about cigarette smoking. Please rate your level of agreement for each using the following scale:

	1	2	3	4	5	6	7
Not True of Me At All							Extremely True of Me
1. I enjoy the taste of cigarettes most of the time.	1	2	3	4	5	6	7
2. Smoking keeps me from gaining weight.	1	2	3	4	5	6	7
3. Smoking makes a good mood better.	1	2	3	4	5	6	7
4. If I always smoke in a certain place it is hard to be there and not smoke.	1	2	3	4	5	6	7
5. I often smoke without thinking about it.	1	2	3	4	5	6	7
6. Cigarettes control me.	1	2	3	4	5	6	7
7. Smoking a cigarette improves my mood.	1	2	3	4	5	6	7
8. Smoking makes me feel content.	1	2	3	4	5	6	7
9. I usually want to smoke right after I wake up.	1	2	3	4	5	6	7
10. Very few things give me pleasure each day like cigarettes.	1	2	3	4	5	6	7
11. It's hard to ignore an urge to smoke.	1	2	3	4	5	6	7
12. The flavor of a cigarette is pleasing.	1	2	3	4	5	6	7
13. I smoke when I really need to concentrate.	1	2	3	4	5	6	7
14. I can only go a couple hours between cigarettes.	1	2	3	4	5	6	7
15. I frequently smoke to keep my mind focussed.	1	2	3	4	5	6	7
16. I rely upon smoking to control my hunger and eating.	1	2	3	4	5	6	7
17. My life is full of reminders to smoke.	1	2	3	4	5	6	7
18. Smoking helps me feel better in seconds.	1	2	3	4	5	6	7
19. I smoke without deciding to.	1	2	3	4	5	6	7
20. Cigarettes keep me company, like a close friend.	1	2	3	4	5	6	7
21. Few things would be able to replace smoking in my life.	1	2	3	4	5	6	7
22. I'm around smokers much of the time.	1	2	3	4	5	6	7
23. There are particular sights and smells that trigger strong urges to smoke.	1	2	3	4	5	6	7
24. Smoking helps me stay focussed.	1	2	3	4	5	6	7
25. Smoking helps me deal with stress.	1	2	3	4	5	6	7
26. I frequently light cigarettes without thinking about it.	1	2	3	4	5	6	7
27. Most of my daily cigarettes taste good.	1	2	3	4	5	6	7
28. Sometimes I feel like cigarettes rule my life.	1	2	3	4	5	6	7
29. I frequently crave cigarettes.	1	2	3	4	5	6	7
30. Most of the people I spend time with are smokers.	1	2	3	4	5	6	7
31. Weight control is a major reason that I smoke.	1	2	3	4	5	6	7
32. I usually feel much better after a cigarette.	1	2	3	4	5	6	7
33. Some of the cigarettes I smoke taste great.	1	2	3	4	5	6	7
34. I'm really hooked on cigarettes.	1	2	3	4	5	6	7
35. Smoking is the fastest way to reward myself.	1	2	3	4	5	6	7
36. Sometimes I feel like cigarettes are my best friends.	1	2	3	4	5	6	7

37. My urges to smoke keep getting stronger if I don't smoke.	1	2	3	4	5	6	7
38. I would continue smoking, even if it meant I could spend less time on my hobbies and other interests.	1	2	3	4	5	6	7
39. My concentration is improved after smoking a cigarette.	1	2	3	4	5	6	7
40. Seeing someone smoke makes me really want a cigarette.	1	2	3	4	5	6	7
41. I find myself reaching for cigarettes without thinking about it.	1	2	3	4	5	6	7
42. I crave cigarettes at certain times of day.	1	2	3	4	5	6	7
43. I would feel alone without my cigarettes.	1	2	3	4	5	6	7
44. A lot of my friends or family smoke.	1	2	3	4	5	6	7
45. Smoking brings me a lot of pleasure.	1	2	3	4	5	6	7
46. Cigarettes are about the only things that can give me a lift when I need it.	1	2	3	4	5	6	7
47. Other smokers would consider me a heavy smoker.	1	2	3	4	5	6	7
48. I feel a strong bond with my cigarettes.	1	2	3	4	5	6	7
49. It would take a pretty serious medical problem to make me quit smoking.	1	2	3	4	5	6	7
50. When I haven't been able to smoke for a few hours, the craving gets intolerable.	1	2	3	4	5	6	7
51. When I do certain things I know I'm going to smoke.	1	2	3	4	5	6	7
52. Most of my friends and acquaintances smoke.	1	2	3	4	5	6	7
53. I love the feel of inhaling the smoke into my mouth.	1	2	3	4	5	6	7
54. I smoke within the first 30 minutes of awakening in the morning.	1	2	3	4	5	6	7
55. Sometimes I'm not aware that I'm smoking.	1	2	3	4	5	6	7
56. I'm worried that if I quit smoking I'll gain weight.	1	2	3	4	5	6	7
57. Smoking helps me think better.	1	2	3	4	5	6	7
58. Smoking really helps me feel better if I've been feeling down.	1	2	3	4	5	6	7
59. Some things are very hard to do without smoking.	1	2	3	4	5	6	7
60. Smoking makes me feel good.	1	2	3	4	5	6	7
61. Smoking keeps me from overeating.	1	2	3	4	5	6	7
62. My smoking is out of control.	1	2	3	4	5	6	7
63. I consider myself a heavy smoker.	1	2	3	4	5	6	7
64. Even when I feel good, smoking helps me feel better.	1	2	3	4	5	6	7
65. I reach for cigarettes when I feel irritable.	1	2	3	4	5	6	7
66. I enjoy the sensations of a long, slow exhalation of smoke.	1	2	3	4	5	6	7
67. Giving up cigarettes would be like losing a good friend.	1	2	3	4	5	6	7
68. Smoking is the easiest way to give myself a lift.	1	2	3	4	5	6	7

CDS-5

1. Please rate your addiction to cigarettes on a scale of 0 to 100: I am NOT addicted to cigarettes at all = 0. I am extremely addicted to cigarettes = 100
____ Addiction
2. On average, how many cigarettes do you smoke per day?
____ Cigarettes / day
3. Usually, how soon after waking up do you smoke your first cigarette?
____ Minutes
4. For you, quitting smoking for good would be:
Impossible = 5
Very difficult = 4
Fairly difficult = 3
Fairly easy = 2
Very easy = 1

Please indicate whether you agree with the following statement:

5. After a few hours without smoking, I feel an irresistible urge to smoke
Totally disagree = 1
Somewhat disagree = 2
Neither agree nor disagree = 3
Somewhat agree = 4
Fully agree = 5

QSU-BRIEF

Indicate how much you agree or disagree with each of the following statements by placing a single checkmark (like this:) along each line between STRONGLY DISAGREE and STRONGLY AGREE. The closer you place your checkmark to one end or the other indicates the strength of your disagreement or agreement. Please complete every item. We are interested in how you are thinking or feeling **right now** as you are filling out the questionnaire.

1. I have a desire for a cigarette right now.

STRONGLY DISAGREE _____ : _____ : _____ : _____ : _____ : _____ : _____ : STRONGLY AGREE

2. Nothing would be better than smoking a cigarette right now.

STRONGLY DISAGREE _____ : _____ : _____ : _____ : _____ : _____ : _____ : STRONGLY AGREE

3. If it were possible, I probably would smoke now.

STRONGLY DISAGREE _____ : _____ : _____ : _____ : _____ : _____ : _____ : STRONGLY AGREE

4. I could control things better right now if I could smoke.

STRONGLY DISAGREE _____ : _____ : _____ : _____ : _____ : _____ : _____ : STRONGLY AGREE

5. All I want right now is a cigarette.

STRONGLY DISAGREE _____ : _____ : _____ : _____ : _____ : _____ : _____ : STRONGLY AGREE

6. I have an urge for a cigarette.

STRONGLY DISAGREE _____ : _____ : _____ : _____ : _____ : _____ : _____ : STRONGLY AGREE

7. A cigarette would taste good now.

STRONGLY DISAGREE _____ : _____ : _____ : _____ : _____ : _____ : _____ : STRONGLY AGREE

8. I would do almost anything for a cigarette now.

STRONGLY DISAGREE _____ : _____ : _____ : _____ : _____ : _____ : _____ : STRONGLY AGREE

9. Smoking would make me less depressed.

STRONGLY DISAGREE _____ : _____ : _____ : _____ : _____ : _____ : _____ : STRONGLY AGREE

10. I am going to smoke as soon as possible.

STRONGLY DISAGREE _____ : _____ : _____ : _____ : _____ : _____ : _____ : STRONGLY AGREE

BDI

Please tick one sentence from each item, which best indicates your current feelings.

1	<ul style="list-style-type: none"><input type="radio"/> I do not feel sad<input type="radio"/> I feel sad<input type="radio"/> I am sad all the time and I can't snap out of it<input type="radio"/> I am so sad and unhappy that I can't stand it
2	<ul style="list-style-type: none"><input type="radio"/> I am not particularly discouraged about the future<input type="radio"/> I feel discouraged about the future<input type="radio"/> I feel I have nothing to look forward to<input type="radio"/> I feel the future is hopeless and that things cannot improve
3	<ul style="list-style-type: none"><input type="radio"/> I do not feel like a failure<input type="radio"/> I feel I have failed more than the average person<input type="radio"/> As I look back on my life, all I can see is a lot of failures<input type="radio"/> I feel I am a complete failure as a person
4	<ul style="list-style-type: none"><input type="radio"/> I get as much satisfaction out of things as I used to<input type="radio"/> I don't enjoy things the way I used to<input type="radio"/> I don't get real satisfaction out of anything anymore<input type="radio"/> I am dissatisfied or bored with everything
5	<ul style="list-style-type: none"><input type="radio"/> I don't feel particularly guilty<input type="radio"/> I feel guilty a good part of the time<input type="radio"/> I feel quite guilty most of the time<input type="radio"/> I feel guilty all of the time
6	<ul style="list-style-type: none"><input type="radio"/> I don't feel I am being punished<input type="radio"/> I feel I may be punished<input type="radio"/> I expect to be punished<input type="radio"/> I feel I am being punished
7	<ul style="list-style-type: none"><input type="radio"/> I don't feel disappointed in myself<input type="radio"/> I am disappointed in myself<input type="radio"/> I am disgusted with myself<input type="radio"/> I hate myself
8	<ul style="list-style-type: none"><input type="radio"/> I don't feel I am any worse than anybody else<input type="radio"/> I am critical of myself for my weaknesses or mistakes<input type="radio"/> I blame myself all the time for my faults<input type="radio"/> I blame myself for everything bad that happens
9	<ul style="list-style-type: none"><input type="radio"/> I don't cry any more than usual<input type="radio"/> I cry more now than I used to<input type="radio"/> I cry all the time now<input type="radio"/> I used to be able to cry, but now I can't cry even though I want to
10	<ul style="list-style-type: none"><input type="radio"/> I am no more irritated by things than I ever was<input type="radio"/> I am slightly more irritated now than usual<input type="radio"/> I am quite annoyed or irritated a good deal of the time<input type="radio"/> I feel irritated all the time
11	<ul style="list-style-type: none"><input type="radio"/> I have not lost interest in other people

	<ul style="list-style-type: none"> ○ I am less interested in other people than I used to be ○ I have lost most of my interest in other people ○ I have lost all of my interest in other people
12	<ul style="list-style-type: none"> ○ I make decisions about as well as I ever could ○ I put off making decisions more than I used to ○ I have greater difficulty in making decisions more than I used to ○ I can't make decisions at all anymore
13	<ul style="list-style-type: none"> ○ I don't feel that I look any worse than I used to. ○ I am worried that I am looking old or unattractive. ○ I feel there are permanent changes in my appearance that make me look unattractive ○ I believe that I look ugly
14	<ul style="list-style-type: none"> ○ I can work about as well as before ○ It takes an extra effort to get started at doing something ○ I have to push myself very hard to do anything ○ I can't do any work at all
15	<ul style="list-style-type: none"> ○ I can sleep as well as usual ○ I don't sleep as well as I used to ○ I wake up 1-2 hours earlier than usual and find it hard to get back to sleep ○ I wake up several hours earlier than I used to and cannot get back to sleep
16	<ul style="list-style-type: none"> ○ I don't get more tired than usual ○ I get tired more easily than I used to ○ I get tired from doing almost anything ○ I am too tired to do anything
17	<ul style="list-style-type: none"> ○ My appetite is no worse than usual ○ My appetite is not as good as it used to be ○ My appetite is much worse now ○ I have no appetite at all anymore
18	<ul style="list-style-type: none"> ○ I haven't lost much weight, if any, lately ○ I have lost more than five pounds ○ I have lost more than ten pounds ○ I have lost more than fifteen pounds
19	<ul style="list-style-type: none"> ○ I am no more worried about my health than usual ○ I am worried about physical problems like aches, pains, upset stomach, or constipation ○ I am very worried about physical problems and it's hard to think of much else ○ I am so worried about my physical problems that I cannot think of anything else
20	<ul style="list-style-type: none"> ○ I have not noticed any recent change in my interest in sex ○ I am less interested in sex than I used to be ○ I have almost no interest in sex ○ I have lost interest in sex completely

Revised UCLA Loneliness Scale

Indicate how often you feel the way described in each statement using the following scale:

- 4 = "I feel this way **often**."
 3 = "I feel this way **sometimes**."
 2 = "I feel this way **rarely**."
 1 = "I have **never** felt this way."

1. I feel in tune with the people around me	
2. I lack companionship	
3. There is no-one I can turn to.	
4. I do not feel alone.	
5. I feel part of a group of friends.	
6. I have a lot in common with the people around me.	
7. I am no longer close to anyone.	
8. My interests and ideas are not shared by those around me.	
9. I am an outgoing person.	
10. There are people I feel close to.	
11. I feel left out.	
12. My social relationships are superficial.	
13. No-one really knows me well.	
14. I feel isolated from others.	
15. I can find companionship when I want it.	
16. There are people who really understand me.	
17. I am unhappy being so withdrawn.	
18. People are around me but not with me.	
19. There are people I can talk to.	

20. There are people I can turn to.	
-------------------------------------	--

POMS1

Please rate from 0= not at all to 4=extremely, how the different adjectives represent your current mood state

Not at all	A little	Moderately	Quite a bit	Extremely		Not at all	A little	Moderately	Quite a bit	Extremely	
0	1	2	3	4	Friendly	0	1	2	3	4	Lonely
0	1	2	3	4	Tense	0	1	2	3	4	Miserable
0	1	2	3	4	Happy	0	1	2	3	4	Efficient
0	1	2	3	4	Angry	0	1	2	3	4	Bitter
0	1	2	3	4	Worn out	0	1	2	3	4	Pleased
0	1	2	3	4	Unhappy	0	1	2	3	4	Alert
0	1	2	3	4	Confused	0	1	2	3	4	Ready to fight
0	1	2	3	4	Lively	0	1	2	3	4	Restless
0	1	2	3	4	Unable to concentrate	0	1	2	3	4	Good-natured
0	1	2	3	4	Sorry for things done	0	1	2	3	4	Gloomy
0	1	2	3	4	Shaky	0	1	2	3	4	Desperate
0	1	2	3	4	Listless	0	1	2	3	4	Rebellious
0	1	2	3	4	Overjoyed	0	1	2	3	4	Nervous
0	1	2	3	4	Peeved	0	1	2	3	4	Helpless
0	1	2	3	4	Agreeable	0	1	2	3	4	Weary
0	1	2	3	4	Sad	0	1	2	3	4	Elated
0	1	2	3	4	Active	0	1	2	3	4	Forgetful
0	1	2	3	4	On edge	0	1	2	3	4	Deceived
0	1	2	3	4	Grouchy	0	1	2	3	4	Full of pep
0	1	2	3	4	Fatigued	0	1	2	3	4	Warm-hearted
0	1	2	3	4	Muddled	0	1	2	3	4	Carefree
0	1	2	3	4	Blue	0	1	2	3	4	Furious
0	1	2	3	4	Energetic	0	1	2	3	4	Uncertain about things
0	1	2	3	4	Spiteful	0	1	2	3	4	Worthless
0	1	2	3	4	Hopeless	0	1	2	3	4	Anxious
0	1	2	3	4	Satisfied	0	1	2	3	4	Vigorous
0	1	2	3	4	Panicky	0	1	2	3	4	Terrified
0	1	2	3	4	Helpful	0	1	2	3	4	Good-tempered
0	1	2	3	4	Unworthy	0	1	2	3	4	Guilty
0	1	2	3	4	Annoyed	0	1	2	3	4	Bushed
0	1	2	3	4	Cheerful	0	1	2	3	4	Bad-tempered
0	1	2	3	4	Exhausted	0	1	2	3	4	Refreshed
0	1	2	3	4	Resentful						
0	1	2	3	4	Forgiving						
0	1	2	3	4	Discouraged						
0	1	2	3	4	Relaxed						
0	1	2	3	4	Bewildered						
0	1	2	3	4	Sluggish						
0	1	2	3	4	Uneasy						
0	1	2	3	4	Kindly						

**PLEASE LET THE EXPERIMENTER KNOW THAT YOU ARE READY TO
BEGIN THE TRAINING**

Cold pressor measures

Immersion length (minutes:seconds)

Immersion 1

Immersion 2

Immersion 3

Total immersion time

Immersion 4

Immersion 5

Immersion 6

After removal:

On a 1 to seven scale, how painful was that experience?

1=Not painful ____:____:____:____:____:____:____:7=Very painful

YOU WILL BE ASKED TO COMPLETE THE COLD PRESSOR TASK AGAIN LATER.

PLEASE COMPLETE THE CORRECT E-PRIME BEHAVIOURAL TEST

To be completed after the behavioural test (not just training)

Preoccupation question

To what extent are you preoccupied or worried about the prospect of having to complete the cold water task again.

Not worried ____:____:____:____:____:____:____: Very worried

POMS2

Please rate from 0= not at all to 4=extremely, how the different adjectives represent your current mood state

Not at all	A little	Moderately	Quite a bit	Extremely		Not at all	A little	Moderately	Quite a bit	Extremely	
0	1	2	3	4	Friendly	0	1	2	3	4	Lonely
0	1	2	3	4	Tense	0	1	2	3	4	Miserable
0	1	2	3	4	Happy	0	1	2	3	4	Efficient
0	1	2	3	4	Angry	0	1	2	3	4	Bitter
0	1	2	3	4	Worn out	0	1	2	3	4	Pleased
0	1	2	3	4	Unhappy	0	1	2	3	4	Alert
0	1	2	3	4	Confused	0	1	2	3	4	Ready to fight
0	1	2	3	4	Lively	0	1	2	3	4	Restless
0	1	2	3	4	Unable to concentrate	0	1	2	3	4	Good-natured
0	1	2	3	4	Sorry for things done	0	1	2	3	4	Gloomy
0	1	2	3	4	Shaky	0	1	2	3	4	Desperate
0	1	2	3	4	Listless	0	1	2	3	4	Rebellious
0	1	2	3	4	Overjoyed	0	1	2	3	4	Nervous
0	1	2	3	4	Peeved	0	1	2	3	4	Helpless
0	1	2	3	4	Agreeable	0	1	2	3	4	Weary
0	1	2	3	4	Sad	0	1	2	3	4	Elated
0	1	2	3	4	Active	0	1	2	3	4	Forgetful
0	1	2	3	4	On edge	0	1	2	3	4	Deceived
0	1	2	3	4	Grouchy	0	1	2	3	4	Full of pep
0	1	2	3	4	Fatigued	0	1	2	3	4	Warm-hearted
0	1	2	3	4	Muddled	0	1	2	3	4	Carefree
0	1	2	3	4	Blue	0	1	2	3	4	Furious
0	1	2	3	4	Energetic	0	1	2	3	4	Uncertain about things
0	1	2	3	4	Spiteful	0	1	2	3	4	Worthless
0	1	2	3	4	Hopeless	0	1	2	3	4	Anxious
0	1	2	3	4	Satisfied	0	1	2	3	4	Vigorous
0	1	2	3	4	Panicky	0	1	2	3	4	Terrified
0	1	2	3	4	Helpful	0	1	2	3	4	Good-tempered
0	1	2	3	4	Unworthy	0	1	2	3	4	Guilty
0	1	2	3	4	Annoyed	0	1	2	3	4	Bushed
0	1	2	3	4	Cheerful	0	1	2	3	4	Bad-tempered
0	1	2	3	4	Exhausted	0	1	2	3	4	Refreshed
0	1	2	3	4	Resentful						
0	1	2	3	4	Forgiving						
0	1	2	3	4	Discouraged						
0	1	2	3	4	Relaxed						
0	1	2	3	4	Bewildered						
0	1	2	3	4	Sluggish						
0	1	2	3	4	Uneasy						
0	1	2	3	4	Kindly						

Appendix B – List of dependent variables

- The CPT group: either hot or cold.
- Participant variables, including: sex, age, CO level and whether the individual was using oral contraceptives (females only).
- The smoking questionnaire which assessed: the amount of cigarettes per day, days smoked per week, time of the last cigarette smoked (in minutes), years spent smoking, age began and whether the individual was quitting or not. From this it was calculated whether the individual was a daily or non-daily (recreational) smoker and the amount of cigarettes they smoke per week.
- The WISDM-68 that was used to then calculate 13 variables: affiliative attachment, automaticity, loss of control, behavioural choice melioration, cognitive enhancement, craving, cue exposure associative processes, negative reinforcement, positive reinforcement, social/environmental goals, taste/sensory processes, tolerance and weight control.
- The CDS-5
- The QSU Brief
- The BDI
- The UCLA Loneliness Scale
- The POMS-1 and POMS-2 which both calculated: anxiety, depression, anger, vigour, fatigue, confusion, friendliness, elation, arousal, positive mood and negative mood.
- The amount of time the individual held their hand in the cold pressor machine.
- The pain rating of the CPT.
- The apprehension of repeating the CPT, only given to those who were in the cold CPT group.
- Calculated by the Eprime computer task was: the cigarettes chosen in extinction, Pavlovian Instrumental Transfer CIGARETTES-CIGARETTES, Pavlovian Instrumental Transfer CIGS-CHOCOLATE, Pavlovian Instrumental Transfer CIGARETTES-BLANK.

- Calculated from these measures were the POMS-1 total mean difference, the POMS-2 total mean difference, the POMS total mean difference, the POMS anxiety difference score and the percentage of cigarettes chosen in extinction.