The Contribution of Cognitive Biases to the Development and Maintenance of Smoking-related Addiction in Adolescents and Adults

By

Louise Hopper

A dissertation submitted for the degree of Doctor of Philosophy of the University of Dublin, Trinity College, Dublin 2, Ireland.

2013

Declaration

I declare that this thesis has not been submitted as an exercise for a degree at this or any other university and it is entirely my own work.

I agree to deposit this thesis in the University's open access institutional repository or allow the Library to do so on my behalf, subject to Irish Copyright Legislation and Trinity College Library conditions of use and acknowledgement.

Signed:_________________________

Louise Hopper

Date: _________________________

Summary

Anomalies between self-reported smoking intentions and actual smoking behaviour are common, yet few studies investigate both the explicit and implicit measurement of smoking cognitions within the same sample. Nor do many studies consider implicit adolescent smoking cognitions, despite the knowledge that smoking onset typically occurs during this period. The aim of this thesis was to examine the role that cognitive biases play in the initiation and maintenance of tobacco smoking. Within the context of cognitive and socio-cognitive models of nicotine addiction, the three studies that comprise this research investigated age-related changes in cognitive beliefs and the implications that these have for smoking behaviour. Participants in each study were grouped by age into adolescent (15-18), young adult (19-25), and older adult (26+) groups, and then categorised by smoking status; a non-smoking group served as the control in each case.

Chapter 1 reviewed the prevalence and the developmental context of tobacco smoking. Affect-based, psychobiological, cognitive, and socio-cognitive theories of addiction were then evaluated. Smoking-related memory, attention, prevalence estimation, and optimistic risk biases were discussed, and the explicit and implicit measurement of these biases was then considered. Chapter 2 aimed to investigate whether explicit and implicit measurement of smoking expectancies would reveal differences in the types and sequence of outcomes endorsed by smokers and non-smokers of different ages (N = 231), and if these differences could successfully predict current smoking behaviour. Results demonstrated that although positive and negative smoking expectancies were available to all groups, smokers, and in particular adolescent smokers, exhibited a positive memory bias for smoking-related information. Chapter 3 then sought to identify how smokers and non-smokers in each age group (N = 182) managed positive and negative smoking-related information. Implicit reactions to positive and negative smoking words and images, relative to general positive, general negative, and to neutral stimuli were examined using

lexical decision, modified-Stroop, and visual dot-probe tasks. A suppression effect was found for smoking negative words, while attentional biases to smoking images and to negative images were found for all participants.

Chapter 4 aimed to develop and validate a revised explicit smoking expectancy measure for use in diverse age and smoking experience groups. It first explored the psychometric properties of the revised scale used in the first study. It subsequently validated this scale using data from a larger sample of adolescent and adult smokers and non-smokers (*N* = 1046). Chapter 5 aimed to replicate earlier smoking expectancy findings, and to extend false consensus (FCE) and optimistic risk research by examining potential age- and experience-related influences on peer prevalence and risk perceptions of smoking (*N* = 1011). Different patterns of bias were found across smoking status and age groups, which suggests that they may facilitate the maintenance and potential escalation of smoking behaviour. As a result, Chapter 6 sought to develop an extended theory of planned behaviour model of smoking intentions and current smoking behaviour, which incorporated measures of smoking-related cognitive biases. Smoking expectancy positivity bias, clear overestimation of peer smoking norms, moral norms, group identity, and relative risk perceptions were found to increase the explanatory power of the extended model in each age group.

Chapter 7 summarised the main findings from the empirical studies. Taken together, they emphasised the importance of considering the influence of smoking-related cognitive biases when attempting to explain smoking behaviour. Key models of addiction were reviewed in terms of their ability to explain smoking-related cognitive biases, and conclusions regarding the affective, cognitive, and social learning influences on smoking were drawn. Finally, the discussion addressed general methodological limitations and suggestions for future research.

Acknowledgements

There are a number of individuals whose influence and support I would like to acknowledge on the completion of this thesis.

I am very grateful to all of the participants, schools, and youth groups who took part in these studies, and to those who assisted in the recruitment process.

I would like to sincerely thank my supervisor, Dr. Michael Gormley, for his guidance, skills, knowledge, and generous support throughout this process. Thanks are also due to Dr. Mary Creaner and Dr. Paul Dockree, for their appraisal of this research.

Over the last four years I have received great support from the postgraduate community in the School of Psychology. I would especially like to acknowledge the help of Katriona O'Sullivan whose advice, support, insight, and friendship were invaluable throughout. I would also specifically like to thank Sonia and Margo, who were always willing to go and make another cup of tea! To Des, Emily, Lucy, Ashling, Maria, Fearghal, Kristen, Judy, and all of the other post-graduates who are too numerous to mention, thanks for the tea breaks, intercultural lunches, helpful thoughts and ideas, and general all-round good humour.

There are many other individuals within the School of Psychology who have been extremely helpful over the years. In particular I am grateful to Siobhan Walsh, Luisa Byrne, Pat Holohan, Lisa Gilroy, Ensar Hadziselimovic, June Switzer, June Carpenter, and Michelle Le Good. I would particularly like to thank Dr. Jean Quigley who supported my desire to learn more about psychology from the first time I spoke to her about the H.Dip programme.

A huge thank you to my family and friends who understood when I wasn't around. Most of all, I cannot adequately express my gratitude to my husband Dermot, who lived every step of this journey with me. Your love, support, and encouragement kept me going throughout. Thank you.

Publications and Presentations Arising from this Thesis

Refereed Publications:

Hopper, L. & Gormley, M. (2013). *The Smoking Consequences Questionnaire: Measurement of smoking expectancies in diverse age and smoking status groups*. Manuscript in preparation for submission.

Hopper, L. & Gormley, M. (2013). *Implicit and explicit smoking expectancy measures. Comparison by smoking status and age*. Manuscript in preparation for submission.

Conference Presentations, and Posters:

Hopper, L. & Gormley, M. (March, 2013). *Smoking risk perceptions in Irish adolescents with varied smoking experience*. Paper presented at the 19th Society for Research on Nicotine and Tobacco (SRNT) Annual Meeting, Boston, USA.

Hopper, L. & Gormley, M. (March, 2013). *The implications of cue valence in an adolescent and adult Nicotine Stroop study*. Poster presented at the 19th Society for Research on Nicotine and Tobacco (SRNT) Annual Meeting, Boston, USA.

Hopper, L. & Gormley, M. (September, 2012). *Extent of, and influences on, clear overestimation of peer prevalence by age and smoking status*. Poster presented at the 14th Annual European Meeting of the Society for Research on Nicotine and Tobacco (SRNT), Helsinki, Finland.

Hopper, L. & Gormley, M. (November, 2011). *Investigating the valence and saliency of commonly used smoking-related words in adolescent and adult smokers and non-smokers*. Paper presented at the 41st Psychological Society of Ireland (PSI) Annual Conference 2011, Galway, Ireland.

Hopper, L., O'Sullivan, K. & Gormley, M. (September, 2011). *Smoking expectancies: How age and smoking status impact on implicit and explicit evaluations of smoking*. Paper presented at the 13th Annual European Meeting of the Society for Research on Nicotine and Tobacco (SRNT), Antalya, Turkey.

Hopper, L., O'Sullivan, K. & Gormley, M. (September, 2011). *Comparing the utility of smoking dependency measures across different age groups*. Paper presented at the 13th Annual European Meeting of the Society for Research on Nicotine and Tobacco (SRNT), Antalya, Turkey.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

Addiction results in substantial health, social, and economic problems not only for drug users, but for their families, friends and wider communities. Gaining an understanding of addictive behaviours is essential in order to refine prevention and treatment models, and to inform public health policies (Albery & Munafò, 2008). This thesis will focus on the development and maintenance of nicotine addiction specifically in relation to cigarette smoking. Although a variety of alternate forms of tobacco consumption exist, such as chewing tobacco, smokeless tobacco, snuff, and snus, manufactured and self-rolled cigarettes still account for the majority of worldwide and European Union (EU) tobacco consumption (European Commission, 2012).

1.1 Tobacco Smoking

1.1.1 Prevalence and control

The World Health Organisation (WHO; 2012b) currently estimates that there are one billion smokers in the world. The adverse health effects of smoking are well established and six million people die from tobacco-related deaths each year (WHO, 2011); five million are attributable to direct tobacco use and just over 600,000 to exposure to second-hand smoke. This accounts for 12% of male and 6% of female annual deaths worldwide. These figures are projected to increase to 7.5 million by the year 2020, which will represent around 10% of all deaths in that year. Smoking is responsible for approximately 71% of lung cancer deaths, 42% of chronic respiratory disease, almost 10% of all cardiovascular disease, and is a significant risk factor for communicable diseases such as tuberculosis and lower respiratory infections. Research has also linked smoking with a range of mental health conditions including depression (Glassman et al., 1990; McKenzie, Olsson, Jorm, Romaniuk, & Patton, 2010) and schizophrenia (Dome, Lazary, Kalapos, & Rihmer, 2010), and an increased likelihood of broader substance use (Lewinsohn, Rohde, & Brown, 1999). It should be noted that research has yet to establish a clear causal link between smoking and the risk of mental health or additional substance use problems; it may be that individuals with these conditions are just more likely to smoke.

The highest overall prevalence of smoking across both sexes is found in Europe (29%), and the lowest in Africa (8%). Prevalence among women is also highest in Europe (20%); male prevalence rates (46%) are highest in the Western Pacific Region (WHO, 2011). The EU (European Commission, 2012) estimates that 695,000 die prematurely from smoking-related illness each year, and that smoking results in a €100 billion economic cost to the region. Almost no significant changes have been seen in smoking prevalence since 2009, and as of March 2012, 28% of EU citizens smoke (29% in the 15 to 24 age group). Highest smoking rates are seen in Greece (40%), and the lowest in Sweden (13%), with Ireland averaging one percentage above the overall EU mean (28%). The SLAN report (Brugha et al., 2009) found that 31% of Irish adult males smoke, and 27% of Irish adult females, which suggests that Ireland has the third highest female smoking prevalence rate in Europe after Germany and Greece. Higher rates of smoking were seen for younger Irish smokers: 18 to 29 years (35%), 30 to 44 years (34%), 45 to 64 years (25%), and over 65 years (14%). Unfortunately adolescent smoking was not captured by this report although previous estimates found that 16% of 12 to 15 year olds in Ireland smoked, a figure which rises to 28% for 16 to 17 year olds (Office of Tobacco Control, 2008). Ireland has the lowest average smoking initiation age in Europe (European Commission, 2012) at 15.6 years, and while 70% of EU smokers have started by age 18, this figure is 78% in Ireland and over 50% have started smoking by age 15 (Office of Tobacco Control, 2008). Peer influence is the most common reason given for smoking initiation in Europe (79%) and in Ireland (89%) with parental smoking and taste as the next most commonly cited reasons (EU: 21% and 19%; Ireland: 23% and 21% respectively).

Manufactured and hand-rolled cigarettes remain most common across the EU (93%) and most smokers (46%) smoke between 11 and 20 cigarettes per day (CPD); 29%

smoke 6 to 10 CPD, 16% smoke 1 to 5 CPD, 2% smoke less than 1 CPD, and 9% smoke more than 21 CPD. The overall EU average is 14.2 CPD; Irish averages are slightly higher at 15.7 CPD (European Commission, 2012). Irish adolescents smoke on average 5-10 CPD but often 20 or more at weekends especially when combined with alcohol intake (Pfizer, 2009). Twenty-one percent of current EU smokers have tried to quit in the last 12 months citing health concerns (60%), price (35%), and pressure from family and friends (33%) as the key motivators to quit (European Commission, 2012). No gender differences were seen in quit motivations, but price was a stronger motivator to quit among younger smokers. Interestingly, Ireland had the largest proportion of smokers who mentioned health concerns (76%). They also indicated that health warnings were more likely to encourage them to stop smoking (16%). Although Irish adolescents were generally well informed about the health risks of smoking, most felt such risks were 'years away' and that they would be able to stop smoking at some future point of their deciding (Pfizer, 2009).

Public health policies, such as reducing or prohibiting tobacco advertising, increasing taxes and duties, age-restrictions on the purchasing of cigarettes, image and/or text health-warnings on cigarette packages, and the introduction of smoking bans in work and public places, have been successful in reducing worldwide smoking prevalence (WHO, 2012b). Such policies aim not only to increase cessation rates among current smokers, but also to sustain cessation rates in ex-smokers, and to prevent new smoking initiation in never-smokers, particularly among the adolescent population. It has been demonstrated that the longer adolescent initiation can be postponed, the lower the risk of developing a nicotine dependence or addiction in later life (Breslau, Fenn, & Peterson, 1993; Robins & Przybeck, 1985), with a similar pattern being seen in alcohol (DeWit, Adlaf, Offord, & Ogborne, 2000) and illicit drugs (Anthony & Petronis, 1995). A recent review of the association between tobacco control policies and smoking behaviour in 29 EU countries found differential success rates in different age groups (Hublet et al., 2009);

point-of-sale advertising was particularly encouraging to young smokers, public smoking bans had most impact on older smokers, media-based informational campaigns had little impact on youth smoking except in one study of a state-sponsored anti-tobacco media campaign (Emery et al., 2005), and health warnings were not found to be particularly effective in stopping smoking initiation, although plain-packaging may prove more so as brand identity was a key factor among youth smokers (Grant, Hassan, Hastings, MacKintosh, & Eadie, 2008).

1.1.2 Developmental context of smoking

Most experimentation with smoking starts in early adolescence and prevalence rates rise to a peak during late adolescence and early adulthood, and then commence a gradual decline (Chassin, Presson, Rose, & Sherman, 1996). A similar pattern is seen for alcohol and marijuana use which suggests that there are general risk factors for substance use in adolescence, and potential developmental explanations for the associated changes in substance use behaviour (Griffin, 2010). Adolescence is a period of transition involving significant physiological, social, emotional, and cognitive changes. During this developmental phase adolescents form their own identities, become more autonomous from their parents, are increasingly influenced by peer-group relations, and are more susceptible to adult role models, media influences, and societal messages (Arnett, 1999), in particular those that portray mature, rebellious, and independent individuals. Adolescents also tend to experience more intense mood fluctuations than either children or adults, which can lead to periods of anxiety and depression (Spear, 2009). They also have a tendency to ignore risks and potential negative consequences when engaging in risky behaviours (Colder, Chassin, Lee, & Villalta, 2010) and some studies suggest that motivation for positive arousal increases during adolescence, at a time when development of executive behavioural control lags behind (Spear, 2000; Steinberg, 2008). As a result of these developmental changes, adolescents are left looking for ways to cope with negative affect and to enhance positive affect.

Adolescence is not just a period of experimentation, however, but also the time during which occasional substance use can progress to regular and potentially problematic use (Griffin, 2010). Smoking is generally regarded to be a behaviour that occurs in stages and begins when very young (Flay, Orleans, & Slade, 1993; Leventhal & Cleary, 1980). In the preparatory stage, children form knowledge, accrue beliefs, and develop expectations about smoking and about the functions that it can serve (Flay, et al., 1993). From here, they progress to initial trying, which refers to the first two or three smoking attempts only. The physiological (e.g., taste, coughing, buzz) and psychological (e.g., peer approval, anxiety relief, state enhancing) effects of these first few tries will determine whether or not the individual progresses to experimentation that is repeated but is still irregular smoking. At that point, smoking is often context specific, but over time it becomes more regular, perhaps first weekly and then daily, and evident across a variety of different situations. The final stage is a progression to problematic use, defined as nicotine dependence or addiction.

Relatively little is known about the exact developmental course of nicotine dependence in adolescence (Turner, Mermelstein, & Flay, 2004), or the time that it takes to move between stages. Research has demonstrated the possibility of dependence at a young age (Colby, Tiffany, Shiffman, & Niaura, 2000; DiFranza et al., 2002), however many adolescents stop after a period of experimentation (Chassin, 1984). Evidence suggests that different stages of smoking are likely to have different determinants (Chassin, Presson, & Sherman, 2005) such that initial reasons for experimenting (e.g., peer influence and social facilitation) could be different to reasons for continuing to smoke (e.g., taste, stress reduction, and avoidance of withdrawal effects). As well as distinguishing the characteristics of adolescents who start smoking from those who do not, it is equally important to determine the attributes of those who are more likely to progress to regular smoking and the risk and protective factors involved in these decision-making processes.

1.1.3 Defining nicotine dependence and addiction

Although the word ‘addiction’ is still frequently used to describe problematic substance dependence, the WHO recommends the use of the term ‘dependence syndrome’, and in its Tenth Revision of the International Classification of Diseases and Health Problems (ICD-10) it defines dependence syndrome as being “a cluster of physiological, behavioural, and cognitive phenomena in which the use of a substance or a class of substances takes on a much higher priority for a given individual than other behaviours that once had greater value.” (WHO, 2012a). Central to this definition is the overwhelming desire to use the addictive substance and the likelihood that re-use following a period of abstinence is likely to result more rapidly in renewed dependence than would be the case in nondependent individuals. The definition therefore encompasses both physical and psychological dependence. The DSM-IV-TR (APA; American Psychiatric Association, 2000) again suggests that a cluster of physiological and psychological symptoms are required in order to diagnose substance abuse and substance dependence, but differentiating between drug abuse and addiction in this way has resulted in some confusion. As a result, the APA (2012) has proposed that all addictions and related problems will fall under a single ‘substance use disorders’ category in the DSM-5. Disorders will be graded as mild, moderate, or severe, and whereas substance abuse required the presence of only one DSM-IV-TR diagnostic symptom, mild substance use disorder will now require the presence of at least two symptoms that lead to clinically significant impairment or distress.

These definitions of problematic substance use facilitate investigation of the psychological processes that contribute to the development and maintenance of addiction.

A significant body of work exists which attempts to explain the processes and motivations underlying substance abuse. These theories have proved to be both comprehensive and informative. It is beyond the scope of this thesis to present a detailed analysis of each model and extensive reviews of addiction theory have been provided by Drummond (2001), Robinson and Berridge (1993), Skinner and Aubin (2010), and Tiffany (1990). The models presented here have been selected for review on the basis of their potential to explain how a combination of explicit and implicit cognitive processes underpin a series of biased cognitive belief systems which help to initiate and maintain smoking behaviour, and to predict relapse. Two traditional models of addiction will be presented first, followed by a psychobiological theory that examines the neural sensitisation that can result from repeated drug administration (Robinson & Berridge, 1993, 2001). Subsequently, cognitive and socio-cognitive models addressing the involvement of automated cognitive and affective processes (Tiffany, 1990) and of social learning processes will be reviewed, along with the role that associative memory plays in the processing of substance-related cues themselves.

1.2 Traditional Theories of Nicotine Addiction

Traditional theories of addiction have tended to focus on either the desire to experience the pleasurable effects of a drug or to avoid the aversive effects of withdrawal from that drug. They are based on the classical conditioning processes of positive and negative reinforcement (Stewart, de Wit, & Eikelboom, 1984) and each conceptualises the urge to use a drug as a subjective, motivational and affective state necessary, but not sufficient, for addictive behaviour (Tiffany, 1990).

1.2.1 Negative reinforcement and withdrawal models

Negative reinforcement models of addiction suggest that drug-related behaviours are sustained by alleviating rather than producing physiological states (Wise & Bozarth, 1987). Although specific symptoms vary from drug to drug, these models suggest that drug-seeking behaviour is maintained to avoid intense and aversive withdrawal effects (Hughes et al., 1990). Initially, it was suggested that conditioned withdrawal responses were induced by situations and stimuli consistently associated with drug withdrawal (Mucha, Pauli, & Weyers, 2006), however subsequent research has proposed that conditioned stimuli not only come from the external drug-taking environment (Siegel, Baptista, Kim, McDonald, & Weise-Kelly, 2000), but also from the body's own interoceptors which can induce compensatory conditioned responses. In the latter case, drug-related behaviour is maintained by the anticipation of withdrawal relief, and drug urges arise from an attributional process whereby the individual interprets the physiological reactions associated with both conditioned withdrawal and conditioned compensatory responses, as a desire or need to use the drug (West & Schneider, 1987).

Contemporary theory has moved a step further suggesting that the conditioned responses need not be physiological, but may be affective instead (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004). Several lines of empirical evidence exist to support the contention that negative affect is a powerful motivator of drug-use. Alcohol has been shown to reduce negative affect in certain stressful situations (Sayette, 1993), smokers hold expectancies of negative affect reduction as a consequence of smoking (Brandon & Baker, 1991), and several longitudinal studies have found that adolescents who display symptoms of depression are more likely to start smoking (Breslau, Kilbey, & Andreski, 1993). Even in relatively novice groups of adolescent smokers, reductions in negative mood following smoking were attributable to alleviation of withdrawal symptoms (Kassel et al., 2007). Smokers have also been seen to display significant attentional biases to both smoking-related and negative-affect words, but not to positive-affect words (Drobes, Elibero, & Evans, 2006).

Inconsistent with this support, however, is the demonstration that both humans and animals continue to self-administer drugs in the absence of withdrawal symptoms, and animals have been shown to self-administer drugs that do not produce withdrawal effects (Stewart, et al., 1984). Periods of high drug-use have been shown to occur when withdrawal distress is low, and providing relief from withdrawal symptoms has had only minor success in combating addiction (Wise & Bozarth, 1987). It is also well-established that relapses can occur after lengthy periods of abstinence (Robinson & Berridge, 2003) when the individual is no longer troubled by aversive withdrawal symptoms. Furthermore, a number of studies on nicotine addiction have found only weak correlations between smoking and negative affect (Shiffman et al., 2002), and relapse has been shown to occur during periods of positive affect (Shiffman & Waters, 2004).

1.2.2 The conditioned drug-like model

Given the deficiencies of negative reinforcement models, Stewart and colleagues (1984) focused instead on positive reinforcement as the basis of addiction. Their conditioned drug-like model suggests that drug-related behaviour is maintained by appetitive motivational states that result from craving the pleasurable effects and the positive emotions associated with drug use. This model assumes that stimuli repeatedly paired with positive experiences of drug use come to elicit drug-like conditioned responses. Support for this theory is provided by many studies which have demonstrated the stimulating effects of drug use (Cowen & Lawrence, 1999; Mansvelder & McGehee, 2000), and neural evidence demonstrates a role for dopamine release in the mesolimbic dopamine 'reward' system of the brain as a direct result of subjective pleasurable experience (W. M. Cox, Fadardi, & Pothos, 2006; Powell, Gray, Bradley, & Kasvikis, 1990).

Yet despite its highly addictive nature, nicotine does not produce pronounced euphoric states, and Robinson and Berridge (1993) contest that its incentive-motivational properties can therefore be dissociated from its subjective pleasurable effects. Recent neuroimaging studies affirm the likelihood that a series of common neural pathways mediate a range of different appetitive processes (Garavan et al., 2000); one which relates to pleasure, and another more automatic pathway. Taken together, these findings weaken the positive reinforcement model as they illustrate that drug-use can be initiated and maintained in the absence of subjective pleasure. The model also makes no attempt to explain how situations and stimuli associated with drug-use give rise to craving and relapse (Stewart, et al., 1984). It is unlikely that drug-related stimuli become emotionally salient because of positive or negative reinforcement alone, and further evidence from attentional bias studies suggest that instead salience develops from the motivational relatedness of the stimuli to an individual's current concerns (W. M. Cox, et al., 2006).

1.3 Incentive-Sensitization Model of Nicotine Addiction

Evidence has been presented that addictive substances are often taken without any subjective pleasure accruing to the user (Lamb, Preston, Schindler, & Meisch, 1991; Robinson & Berridge, 2000). In fact as addiction progresses the divergence of incentive and hedonic value becomes more pronounced (Robinson & Berridge, 1993). Neurobiological research of animal addiction, and evidence for separable neural substrates for incentive and hedonic reward in humans (Wise & Bozarth, 1987), led Robinson and Berridge (1993, 2001, 2003) to propose an incentive-sensitisation theory of addiction. This theory assumes that repeated administration of addictive drugs can induce neural sensitization in humans. Expected individual variation in susceptibility to neural sensitization could then explain individual differences in vulnerability to addiction.

Three distinct psychological processes operate jointly to produce incentive-sensitization (Robinson & Berridge, 2001). Firstly, pleasure is derived from initial drug use, but this 'liking' alone is insufficient to motivate continued use. Addictive drugs induce persisting neuroadaptations in brain areas typically involved in motivation and reward learning, namely the mesolimbic dopamine system. Secondly, these become hypersensitive to the effects of the drugs and, through associative learning, to stimuli affiliated with their use. Finally, incentive-salience is attributed to these stimuli which become attractive in their own right, capable of eliciting pleasure, and of commanding attention. Over time the reward value reduces and drug-liking is completely replaced by drug-wanting. A critical aspect of this theory is that it is not the portion of the reward system associated with hedonic value (‘liking’ the drug) that becomes sensitized, rather an ‘incentive-salience’ subsection responsible for ‘wanting’ the drug (Robinson & Berridge, 1993). In this instance, wanting is synonymous with hunger; while you may like the food you eat, wanting food can and does occur independently of any hedonic evaluation of the food. The term incentive-salience is used to represent the cognitive and neural processes associated with the motivational value of conditioned stimuli and it provides an index of the attention-grabbing properties of drug-related cues. Increasing incentive-salience effectively represents increasing attention towards stimuli associated with drug use, making them more noticeable and therefore more wanted (Robinson & Berridge, 2003). Consequently, it is this sensitization of the ‘wanting’ area, coupled with behavioural sensitisation, that is hypothesised to lead to compulsive drug use, and it is the persistent nature of the neuroadapations beyond drug use cessation that leaves the individual vulnerable to relapse in the longer term, particularly as drug-wanting is deemed an automatic process whereby relapse may occur without conscious awareness.

In a recent review of the incentive-sensitisation model, Robinson and Berridge (2008) advance the claim that both ‘liking’ and ‘wanting’ can be expressed explicitly and implicitly. They suggest that ‘wanting’ is a motivational process, driven by incentive-salience, which is explicitly exhibited through conscious craving and purposeful drug-related behaviour. It can, nevertheless, be triggered implicitly following cue exposure, resulting in an unconscious craving. They view ‘liking’ as a subjective pleasurable emotional response, and present evidence that this can also occur implicitly following exposure to subliminal stimuli (Berridge & Winkielman, 2003). The incentive-sensitisation model would therefore predict that increasing levels of neuroadaptation should result in higher levels of attentional bias towards drug-related stimuli, and this has been well supported. (W. M. Cox, et al., 2006). Heavy smokers have been shown to demonstrate significantly stronger attentional bias than light smokers (Waters & Feyerabend, 2000), as have abstinent smokers when compared to non-smoking controls (Munafo, Mogg, Roberts, Bradley, & Murphy, 2003), and alcohol abusers even after treatment (W. M. Cox, Hogan, Kristian, & Race, 2002). The associative learning process can also account for situations in which current smokers display slower reaction times for targets presented in the presence of smoking stimuli (Sayette & Hufford, 1994).

1.4 Cognitive Models of Nicotine Addiction

Early theory highlighted the importance of conditioned learning and the role of affect in the explanation of addiction. Recent psychobiological theory reaffirms the role of associative learning and highlights the importance of examining the explicit and implicit cognitive processes underpinning addiction. This review will now concentrate on research in the cognitive and socio-cognitive domains which has been used to provide a framework for understanding addiction.

1.4.1 Dual-affect model

It has been argued that negative and positive reinforcement models each explain some, but not all, characteristics of addictive behaviour, and the dual-affect model (Baker, Morse, & Sherman, 1986) was created in an attempt to explain situations where drug-related behaviour could be triggered by either a withdrawal or an appetitive response to drug cues. For example, smokers often give each as reasons for smoking, depending on the particular situation, and their mood at the time (L. S. Cox, Tiffany, & Christen, 2001; Powell, Tait, & Lessiter, 2002). The dual-affect model suggests that drug craving represents the interaction of negative and positive affect systems. Aversive stimuli (e.g., withdrawal or negative emotional states) activate the negative affect system, which triggers drug use based on the negative reinforcement model. Appetitive stimuli activate the positive affect system and trigger drug-use based on the conditioned drug-like model. The two systems are purported to operate in an automatic and mutually inhibitory fashion; for example, the positive reinforcing effects of drug-use would inhibit the negative affect system. Despite some support for the dual-affect model (Zinser, Baker, Sherman, & Cannon, 1992), the suggestion that an individual cannot experience both negative and positive affective reactions to drug stimuli at the same time has been widely challenged; see Tiffany (1995) for a review of this evidence.

An updated model has been proposed by Baker and colleagues (2004) in an attempt to address the criticisms levelled at the original. This new model is more consistent with negative reinforcement theories of addiction, although it argues that drug use is driven primarily by a need to avoid negative affect rather than a desire to be free of aversive physiological withdrawal symptoms, and that affective symptoms are greater motivators of behaviour than somatic symptoms. Extensive empirical support exists for the centrality of negative affect in drug-seeking behaviour across a range of addictions (Koob, 2009; R. A. Wheeler et al., 2008), and specifically in relation to smoking (Kassel, et al., 2007; Kassel & Shiffman, 1997; Shiffman & Waters, 2004; Wetter et al., 1994). Consistent with these findings, smoking outcome expectancy studies report that negative affect reduction is one of the perceived benefits of smoking for smokers of all ages (Brandon & Baker, 1991; Copeland, Brandon, & Quinn, 1995; Lewis-Esquerre, Rodrigue, & Kahler, 2005). Despite this evidence, criticism of the dual-affect approach remains. Firstly, relapse can occur in response to positive affect, as opposed to solely as a means of negative affect reduction (Brandon, Wetter, & Baker, 1996; Shiffman, Paty, Gnys, Kassel, & Hickcox, 1996). Secondly, the model views negative affect to be synonymous with drug cravings and states that much of the motivational impact of drug cravings occurs outside conscious awareness, but conflicting results have been found regarding the association between craving and other implicit measures of addiction. For example, correlations between addiction-related attentional bias and self-reported urge to smoke have been reported as significant (Mogg & Bradley, 2002; Zack, Belsito, Scher, Eissenberg, & Corrigall, 2001), marginal (Waters et al., 2003), and non-existent (Wertz & Sayette, 2001). Finally, the model fails to provide a clear mechanism of how these automatic motivational triggers operate.

1.4.2 Cognitive processing model

Tiffany's (1990) cognitive processing model is also based on the idea of automatic drug-related behaviours. He acknowledged that novice drug users would require a conscious intention to initiate drug use, but he proposed that more compulsive drug use would predominately be directed by unconscious and automatic processes, analogous to those controlling any frequently performed behaviour. Based primarily of the work of Schneider and Shiffrin (1977) and Logan (1988), the automatic processes in his model are defined as being generally fast and inflexible, and once initiated, very difficult to disrupt. They require very little attention as they operate effortlessly, and in the presence of the appropriate triggering stimuli, they can be involuntarily and unconsciously activated.

Various models exist to describe how behaviours become automatic (Bargh, 1992; Newell, 1978), and it is generally accepted that this process will happen most rapidly when the same stimulus conditions are repeatedly linked to a given response. Newell (1978) suggests that a memory is created, in the form of an action schema, which contains the triggers that initiate the behaviour and the procedural steps needed to carry out the action. In a situation where the action schema is disrupted, voluntarily or involuntarily, in an individual who is not attempting to refrain from drug use, abstinence-avoidance urges are generated in a bid to successfully complete the drug-use behaviour (Tiffany, 1990). If the automatic processes within the action schema do not contain the information required to resolve this disruption, more effortful, non-automatic processes are required. In situations where individuals are attempting to remain abstinent, approach-avoidance urges are produced when confronted with drug-related stimuli. Non-automatic processes are again required in order to prevent the triggering of automatic action schemas, and the reinforcing of those actions if they were allowed to complete. If the non-automatic processes associated with abstinence-promotion do not succeed in completely halting the automatic drug-approach actions, urges arise which can precede and initiate relapse to drug use.

Several lines of research support this model. Highly practised social behaviours have been shown to move from intentional to non-intentional control (Bargh & Chartrand, 1999). Cue-reactivity studies have found increased self-reported craving coupled with faster initial orienting of attention to, and longer gaze dwell times on, addiction-related stimuli in drug-users in comparison to controls (Bradley, Mogg, Wright, & Field, 2003; Mogg, Bradley, Field, & De Houwer, 2003). Drug cues have also been shown to elicit physiological changes, such as an increase in heart rate, during urge responding (Franken, 2003), and Tiffany (1990) suggests that these changes are direct consequences of more effortful, slow, and determined non-automatic cognitive processes; smokers, for example, have been seen to respond more slowly to situations where automatic smoking action schemas have been interrupted when compared to instances where they were undisturbed (Baxter & Hinson, 2001). Non-automatic processes are also predicted to disrupt an individual's successful performance on any task that also necessitates non-automatic processing, and significant evidence exists which suggests that this model may explain the attentional bias that is associated with many addictive behaviours in problematic users (W. M. Cox, et al., 2006; M. Field, Mogg, Bradley, Wiers, & Stacy, 2006; McCusker, 2001; Tiffany, 1995), including that of smokers (Mogg & Bradley, 2002; Waters, Shiffman, Bradley, & Mogg, 2003).

The cognitive processing model therefore argues that addictive behaviour is maintained by a combination of automatic and non-automatic processes. Its premise that drug-related stimuli can automatically activate behavioural sequences, attempts to explain why craving may not be necessary for continued drug use and how individuals can relapse without experiencing any urge or desire to do so. It has, however, been criticised for not adequately explaining the compulsive nature of drug use, the motivational factors involved, and the degree of individual vulnerability to addiction (Robinson & Berridge, 2003).

1.4.3 Expectancy models

Cognitive social learning theory (CSLT) assumes that addictive behaviours are learned through their association with social and environmental stimuli and as such resemble any other learned habitual behaviour, albeit that certain addictive substances can intensify this learning process (Albery & Munafò, 2008). Whilst not disregarding the fact that learning may still have important biological correlates, CSLT places greater emphasis on the role of interpersonal and social factors, including peer influences and observational learning, and on intrapersonal factors such as self-efficacy, attributional style, and coping mechanisms. In a meta-analysis of 27 studies that investigated reasons for smoking initiation among children, Conrad, Flay, and Hill (1992) found strong support for the predictive value of social learning factors. CSLT therefore combines classical conditioning processes that facilitate the generation of automatic associations between substances and outcomes initially unconnected with their use, and operant conditioning processes whereby behaviours resulting in favourable outcomes for the individual are reinforced (positively or negatively) and tend to increase in frequency over time (Albery & Munafò, 2008).

Within this context, Marlatt (1985) developed an outcome-expectancy model of addiction, or more specifically of relapse prevention, that suggests that drug use is motivated by anticipated positive outcome expectancies associated with the behaviour, in combination with self-efficacy, that is an individual’s perceived notion of their ability to resist a behaviour (Bandura, 1977). The individual who expects greater positive than negative outcomes from drug use is more likely to continue using, and this is particularly the case in situations where they experience low levels of self-efficacy. Outcome-expectancy models assume that experimental substance use begins in adolescence and is driven by the attitudes and behaviours of role models from whom adolescents acquire their substance-specific beliefs. Although CSLT argues that the key to prevention is in changing role models not beliefs, it overlaps with cognitive-affective theories in that it also assumes that substance-specific cognitions proximally cause substance-related behaviour, and that outcome expectancies are essentially critical beliefs that can be shaped by direct and vicarious exposure to substance-use and to substance-related cognitions; for example, merely by hearing influential others favour use (Petraitis, Flay, & Miller, 1995).

Despite an initial focus on relapse prevention, recent research suggests that outcome-expectancy models can be helpful in explaining initiation and maintenance of drug-related behaviour. They demonstrate that differential alcohol-related outcome expectancies of heavy and light drinkers are associated with attentional bias towards sedating and arousing alcohol words (Kramer & Goldman, 2003), and attentional bias in smokers is positively associated with self-reported expected positive smoking outcomes (Waters et al., 2009). Given that expectancies are essentially cognitive beliefs, expectancy networks can then be conceptualised as associative memory systems operating according to the principles of spreading activation (Collins & Loftus, 1975). Experience with a substance generates positive and negative cognitive and affective responses which, in the absence of conscious control, will result in drug-related behaviour that becomes highly associated with those initial responses; behaviour that can subsequently be activated implicitly as well as explicitly (Rather & Goldman, 1994). This model of outcome expectancy networks is further supported by attentional bias research of alcohol (W. M. Cox, et al., 2002; Townshend & Duka, 2001), nicotine (Bradley, et al., 2003; Gross, Jarvik, & Rosenblatt, 1993; Waters, Shiffman, Bradley, et al., 2003), and opiates (Franken, Kroon, Wiers, & Jansen, 2000). Furthermore, the explanation of the links between drug-related cognitions and behaviour is presented in terms of learned associations which, in the presence of certain drug-related stimuli, can become automatic and implicitly activated, which clearly overlaps with Tiffany's (1990) cognitive processing model, and strongly suggests the involvement of both explicit and implicit cognitive processes in substance-related behaviour.

1.4.4 Associative memory models

CSLT offers some acknowledgement of implicit cognitive processing, but associative memory theories such as the spreading activation model (Collins & Loftus, 1975; Litz, Payne, & Colletti, 1987) better illustrate how memory associations can trigger cognitive processing, how memory may be automatically cued, how object perception may trigger substance-related cravings, and how habits may be maintained (Munafo & Albery, 2006). These models see long-term memory as a collection of 'nodes' which represent units of information, and 'links' which represent the semantic and episodic associations between these units (J. R. Anderson, 1983). When a stimulus and outcome pairing is first encountered, an association is formed between the stimulus and outcome nodes, which is then strengthened through repeated encounters. When one node in memory is triggered, activation spreads across the network triggering other associated nodes which represent all the 'available' related constructs in memory. The more practised the associations between nodes, the stronger the links become, the more likely they are to be triggered automatically (Shiffrin & Schneider, 1977), and the more 'accessible' one construct becomes in the presence of the other. Automatically accessible associations are more likely to influence a particular cognitive processing sequence (Palfai, 2002), and will therefore be more closely linked to behaviour (Bargh, 1992). This is supported by the finding that accessibility of substance-related memory associations has been found to predict future drug use (Stacy, 1997).

It has been observed that smokers rate the affective characteristics of smoking-related images more positively than never-and ex-smokers (van Hanswijck de Jonge & Gormley, 2005). They have also been found to demonstrate an implicit memory bias for positive in relation to negative smoking information (Leung & McCusker, 1999) which suggests that they are using inhibitory processes, either consciously or automatically, as a type of adaptive suppression limiting the accessibility to, but not the availability of, negative information in memory (Bjork, Roediger, & Craik, 1989). Barnier, Levin and Maher (2004) suggest that this retrieval inhibition can operate across at least three levels. In its weakest form, the expression of memory may be behaviourally inhibited at recall. Alternatively, memory accessibility can simply be lowered during retrieval or, in its strongest form, retrieval inhibition can lower the activation level of the representation of the memory itself. Retrieval practise will increase the accessibility of an item in the future (Baddeley, 1990), so concentrating on the retrieval of positive memories at the expense of negative ones would decrease the overall accessibility of these negative memories and could explain dissociations seen in the pattern of free association retrieval between substance users and controls (Barnier, et al., 2004). Taken together, this evidence further supports the view that two different aspects of cognition are involved when making substance-use decisions; an implicit memory activation triggered by motivational and situational circumstances, and a more explicit outcome expectancy component which is likely to influence the more deliberate and introspective aspects of the decision-making process (A. Weinstein & Cox, 2006).

1.4.5 Socio-cognitive models

The Theory of Planned Behaviour (TPB; Ajzen, 1988) model is one of the most widely used models in health-related behaviour research (Armitage & Conner, 2001). It suggests that an individual's intention to engage in behaviour, and the perceived behavioural control (PBC) they feel they exert over that behaviour, proximally determines their behavioural decision. PBC in this model is related to Bandura's (1977) concept of self-efficacy described above. Behavioural intentions are themselves mediated by attitudes and beliefs (i.e., whether the behaviour is wise, risky, pleasurable, distasteful, etc.), subjective norms (i.e., perceived attitudes of important others towards the behaviour), and also by PBC. The incorporation of both a direct and an indirect influence of PBC on decision making in the model enables it to predict both volitional behaviour and automatic behaviour outside of volitional control (Higgins & Conner, 2003). An individual will therefore engage in behaviour if they think it will lead to a valued outcome, if they perceive that significant others would encourage the behaviour, and if they believe that they have the opportunity and ability to successfully perform the behaviour.

Health-related TPB models have received much support and several studies have demonstrated that at least some aspect of smoking behaviour can be predicted by this model (Chassin, 1984; Godin, Valois, Lepage, & Desharnais, 1992; Hukkelberg & Dykstra, 2009; Petraitis, et al., 1995; Spijkerman, van den Eijnden, Vitale, & Engels, 2004). However, the robust relationship seen between intentions and much health-related behaviour appears weakened in addiction (McCusker, 2001) where substance-use often continues despite intentions to quit. Over 50% of smokers report strong intentions to stop smoking but few do, and of those that try, over 90% relapse within a year (Cohen et al., 1989). Armitage and Conner (2001) provide a comprehensive review of the strengths and weaknesses of the TPB model and its ability to predict smoking-related behaviour. The key issues will be considered briefly here and subsequently discussed in detail in the introduction to Chapter 6, which presents an empirical study based on an extended-TPB model.

Warshaw and Davis (1985) argue that the TPB model fails to differentiate between true behavioural intentions and behavioural expectations. Whereas the former are defined as a person's plans for their future behaviour, the latter refer to the perceived likelihood of the individual performing that behaviour without necessarily having formed a plan to do so. For example, a smoker may feel it likely that they will quit smoking in the next year without specifically forming an intentional cessation plan. A further issue is that past behaviour is often found to be a significant predictor of future behaviour regardless of behavioural intentions (Godin, et al., 1992; Higgins & Conner, 2003), yet the model makes no allowance for this. A final area of contention is the fact that the only normative influence included in the TPB model is that of subjective norms, and these seem to be the weakest predictor of intentions (Armitage & Conner, 2001). As such, the model disregards other potential normative influences on behaviour, such as moral and descriptive norms (McMillan & Conner, 2003; Vitória, Salgueiro, Silva, & de Vries, 2011; White, Smith, Terry, Greenslade, & McKimmie, 2009).

As a result, TPB models have been variously extended to include past behaviour, and moral, descriptive and personal norms in an attempt to address these issues (Conner & Armitage, 1998), yet their ability to successfully predict habitual behaviour remains compromised (McMillan, Higgins, & Conner, 2005). Typically, smoking-related studies show only small to moderate predictive effects for expanded TPB model variables (Engels, Knibbie, & Drop, 1999). Interestingly, studies have found that it is the overestimation of descriptive norms that is predictive of smoking behaviour (Botvin, Botvin, Baker, & Dusenbury, 1992; Sutton & Bolling, 2003) more so than the actual extent of smoking among the peer group. When applied to adolescent smoking, the extended-TPB models suggest that if adolescents hold favourable attitudes towards smoking, and towards peers or important others who smoke, they are more likely to try smoking themselves (Armitage & Conner, 2001), particularly if they determine that smoking is a prevalent, as well as a positive, peer-group behaviour. This again suggests that biased cognitive processes are involved in smoking-related decisions, in this case a false consensus effect (Ross, Greene, & House, 1977) for peer smoking prevalence, and it could be argued that incorporating a role for automatic cognitions in extended-TPB models may have the potential to explain anomalies seen in research results to date.

1.5 Cognitive Biases in Nicotine Addiction

Regardless of which theory is preferred, cognitive biases for drug-related information and environmental stimuli are evident across a range of addictions. A combination of explicit and implicit cognitive processes appear to result in automatic associations between smoking behaviour and a variety of cues and stimuli that come to be associated with that behaviour, and together they facilitate continued use (Wiers & Stacy, 2006). As tobacco smoking is the particular focus of this thesis, the next section will address four common cognitive biases associated with smoking; positive memory bias, attentional bias for smoking-related information, the false consensus effect for peer smoking prevalence, and optimistic risk bias. These cognitive ‘errors’ may make smoking seem attractive, desirable, statistically normative, socially acceptable, and not immediately detrimental to an individual’s health and well-being. A number of factors associated with nicotine addiction have been found to correlate with these biases and attempts continue to identify those that may be predictive of smoking initiation, maintenance, and relapse.

1.5.1 Positive memory bias

Smoking outcome expectancies are conceptualised as a form of memory association thought to exist at both an explicit and an implicit level. Positive memory biases, characterised by inflated positive outcome expectancies, have been identified in regular smokers. Addiction theory suggests that both social learning processes and subjective experience (Stacy, Ames, Wiers, & Krank, 2010) will bias automatic outcome expectancies because of repeated past pairings with the positive consequences of smoking. Childhood smoking expectancies are typically negative but they become more positive in adolescence with the onset of smoking behaviour (O'Connor, Fite, Nowlin, & Colder, 2007), and then increasingly more negative with age and the accumulation of negative smoking experience (Wetter, et al., 1994). Although adolescents have been shown to have an awareness of the negative consequences of smoking (Brady, Song, & Halpern-Felsher, 2008), and although some negative outcomes such as coughing and nausea are reported by novice and experimental smokers (Friedman, Lichtenstein, & Biglan, 1985; Pomerleau, Pomerleau, & Namenek, 1998), they also report a significant number of positive consequences (Brandon & Baker, 1991; Lewis-Esquerre, et al., 2005), including a pleasurable buzz, relaxation, and a variety of social facilitation outcomes.

The positive consequences of smoking are often more immediate than the negative ones. Future health and addiction risks can seem very distant to a teenager and, as a result, adolescents seem particularly capable of ignoring distal negative outcomes in favour of the more proximal positive consequences of smoking. Although smoking expectancies generally become more negative with age, positive smoking consequences are also seen to be influential among regular adult smokers (Copeland, et al., 1995). They too display a positive memory bias for smoking-related information and an ability to exercise some form of cognitive control to manage these discrepant cognitions (Leung & McCusker, 1999). To the best of the author's knowledge, no study has yet examined the relative size of this bias across different age groups and this question, along with an examination of explicit and implicit assessment methods, will be addressed in Chapter 2 of this thesis.

1.5.2 Attentional bias

Attentional biases to addiction-related stimuli in the environment seem especially problematic for drug-users and for individuals trying to abstain (Waters & Feyerabend, 2000). Attention, an adaptive mechanism that preferentially selects the environmental stimuli that an individual will notice (MacLeod & MacDonald, 2000), is automatically directed towards cues with motivational significance (Franken, 2003). As incentive-salience is indexed by the attention-grabbing properties of the stimuli, someone with an elevated attentional bias for certain addiction-related stimuli experiences a world full of cues related to that addiction. Stimuli that seem neutral to a non-smoker may command attention and promote drug-seeking behaviour in smokers (Hogarth, Dickinson, & Duka, 2003). Implicit perception of addiction-related stimuli may lead to conditioned withdrawal or conditioned compensatory responses (Niaura et al., 1988), they may disrupt mood (Baker, Piper, et al., 2004), and they may trigger automatic drug action schema (Tiffany, 1990). In essence, attentional bias is an inherently automatic process that occurs without the individual's awareness. As attentional capacity is limited, it may in turn interfere with cognitive resources needed for other aspects of everyday life, and result in a failure to process competing environmental cues (Franken, 2003).

A significant body of work supports the existence of a smoking-related attentional bias. The modified-Stroop task has been widely used to demonstrate an attentional bias for smoking-related information, in comparison to neutral, in adult (Mogg & Bradley, 2002; Munafo, et al., 2003; Waters & Feyerabend, 2000; Wertz & Sayette, 2001) and in adolescent smokers (Zack, et al., 2001), although not all studies successfully replicated this bias (Johnsen, Thayer, Laberg, & Asbjornsen, 1997). Smokers have also exhibited an attentional bias for smoking-related imagery in visual dot-probe tasks (M. Field, Mogg, & Bradley, 2004; Mogg, et al., 2003; Waters, Shiffman, Bradley, et al., 2003), a bias that is not seen in non-smokers (Bradley, et al., 2003; Hogarth, Mogg, Bradley, Duka, & Dickinson, 2003). In addition to a bias in initial orienting to a smoking-related stimulus, eye-movement studies find that smokers tend to gaze at smoking-related imagery for longer periods of time (M. Field, Mogg, Zetteler, & Bradley, 2004; Mogg, et al., 2003).

Conflicting results have been found regarding the factors that are associated with attentional bias for smoking-related cues, such as the inconsistent correlations found between attentional bias and smoking urge as discussed in section 1.4.1 (Mogg & Bradley, 2002; Waters, Shiffman, Sayette, et al., 2003; Waters et al., 2004). Similarly, while some studies have failed to find associations between attentional bias and use or dependence

(Waters, Shiffman, Bradley, et al., 2003), others report significant correlations (Mogg & Bradley, 2002), and conclude that attentional bias can predict the time lapse after waking before the first cigarette of the day is smoked. This suggests that attentional bias is more tightly linked to individual vulnerability to sensitization than to lifetime consumption (Waters & Feyerabend, 2000). A relationship between attentional bias and deprivation (Gross, et al., 1993; Zack, et al., 2001) suggests that abstinence causes an individual to become increasingly preoccupied with thoughts of smoking, and reduces their ability to ignore a stimulus or override an involuntary response. In contrast, other studies have failed to find any influence of abstinence (Mogg & Bradley, 2002; Munafo, et al., 2003), or suggest that it is only evident when an individual is also experiencing high craving levels (Sayette & Hufford, 1994). Attempts continue to be made to identify those correlates of attentional bias that may be predictive of clinical outcome (Waters, Shiffman, Sayette, et al., 2003), constitute an important factor in drug relapse (Shiffman, et al., 1996), and prove amenable to therapeutic intervention (Munafo, et al., 2003). Chapter 3 will investigate attentional bias for positive and negative smoking-related information in more detail, including an examination of any age-related differences that may be found.

1.5.3 The peer prevalence false consensus effect

The false consensus effect (FCE, Ross, et al., 1977) represents the tendency an individual has to see their own attitudes and behaviours as more common among some reference group than they actually are. Explanations of this effect have variously been based on selective exposure, motivational distortion, causal attributions, and behavioural conformity (Sherman, 1983; Sussman, Dent, Mestel-Rauch, & Johnson, 1988). Firstly, Ross and colleagues (1977) suggest that people base their prevalence estimates on the number of significant people in their immediate environment who smoke. Overestimation would be more likely from an individual whose close friends smoke or who inhabits environments where smokers and non-smokers mix freely. This selective exposure explanation also predicts that individuals will overestimate smoking prevalence to a greater extent for their peer group than they would for other groups. Alternatively, the false consensus effect could be driven by motivational factors and the simple need to justify one's own risky behaviour (Ross, et al., 1977). A third explanation involves the types of behavioural attributions that people commonly make. Jones and Nisbett (1971) have demonstrated that in general people make situational attributions for their own behaviour but dispositional attributions for the behaviour of others. In this regard, people who feel that smoking decisions are primarily driven by situational variables will have a tendency to over-estimate smoking prevalence. Finally, the more socially approved a behaviour is, the more prevalent it seems, and the more likely an individual will be to conform to the behaviour of the majority (Sherman, 1983).

Studies have consistently found sizeable differences between estimated peer prevalence rates for a range of substances (Pollard, Freeman, Ziegler, Hersman, & Goss, 2000; Prinstein & Wang, 2005; Wolfson, 2000), including smoking (Otten, Engels, & Prinstein, 2009; Sherman, 1983), and overestimation of peer prevalence was predictive of use in each case. It should be noted that the vast majority of research has been carried out with adolescents, although one study did find a similar effect in a middle-aged smokers (Cunningham & Selby, 2007). Relatively little is known about the comparative size of the overestimation in different age groups and it would be informative to uncover how this bias may alter with age. As well as overestimating descriptive norms, smokers have a tendency to overestimate injunctive norms such as the level of peer approval for smoking (Sussman, et al., 1988) and inferring higher levels of approval has been implicated in the maintenance of smoking behaviour. Making decisions and performing behaviours on the basis of these false consensus effects can lead to self-fulfilling prophecies; in other words, smoking because everyone else seems to be reinforces the perception that everyone else is doing it, which leads to higher perceived prevalence, and the cycle continues. Educating adolescents about the actual prevalence rates of smoking in their peer group has had some success as adolescents seem to be able to provide more accurate peer prevalence estimates if they understand that they have a tendency to overestimate this frequency (A. K. Brown et al., 2010).

1.5.4 Optimistic risk bias

A number of studies have demonstrated that not only can smokers identify the risks of smoking, but that they often overestimate the extent to which smoking causes particular health problems, such as lung cancer (Viscusi, 1991). There is little evidence, however, that knowledge and awareness of smoking risk deters adolescents, whereas it is judged to have a greater influence on adult smoking behaviour (Romer & Jamieson, 2001). It may be that adolescent smokers do not fully appreciate the risks associated with smoking, that they do not view these risks to be personally applicable until some point in the future (Slovic, 1998), or that they can store them in such a way that does not influence behaviour (Gerrard, Gibbons, Benthin, & Hessling, 1996). It may also be that risks are generally assessed on the basis of the average or 'typical' smoker and adolescents do not see themselves as identifying with this smoker prototype (Viscusi, 1991). Nor is there a distinction made between lifetime risk and the specific risk posed by the next cigarette, even though each is likely to impact a smoking decision in a different way (Viscusi, 1992). Given that risk-related information is essentially a subset of negative smoking expectancies, it may simply be that this information is less salient, or more likely to be suppressed in favour of positive smoking associations, and in both cases becomes less accessible when the smoking decision is being made.

Most people's assessment of their own risk of any deviant behaviour also tends to be prone to optimistic bias (N. D. Weinstein, 1998) such that they see themselves at less risk than their peers; however, inconsistent results have been found for smokers. Some studies have observed that smokers rate their personal health risk as higher than non- and ex-smokers do (Boney-McCoy, Gibbons, & Gerrard, 1999; Cohn, Macfarlane, Yanez, & Imai, 1995; Gerrard, et al., 1996), some find similar ratings regardless of smoking status (Greening & Dollinger, 1991), and others find that smokers give the lowest personal risk ratings (Arnett, 2000; Hansen & Malotte, 1986; Lee, 1989). Interestingly, Slovic (2000) noted that smokers were less likely than non-smokers to rate short-term smoking as harmful, which supports the idea of differential impacts of perceptions of short- and long-term risks. Finally, smokers tend to exhibit an optimistic quit bias which is an unrealistically confident belief that they can quit smoking whenever they feel they need to (N. D. Weinstein, Marcus, & Moser, 2005). This belief is likely to facilitate smoking behaviour even in those who appear to have a good understanding of smoking-related risk. Taking all of this evidence together, there remains a question of how smokers of different ages perceive smoking risk, whether they are in fact optimistic about this risk, and if risk bias should form part of a basic model that explains the explicit and implicit cognitive processes associated with smoking initiation, maintenance, and relapse. These questions will be considered, along with normative biases, and other TPB smoking-related variables, in Chapters 5 and 6 of this thesis.

1.6 Measuring Cognitive Processes in Nicotine Addiction

Finally, some consideration must be given to the most appropriate assessment methods for measuring cognitive processes involved in smoking-related behaviour. Traditionally, cognitive assessment has relied on self-report measures, yet the anomalies that exist between explicitly stated beliefs and exhibited smoking behaviours must call into question whether these measures assess all of the cognitive processes that actually direct behaviour (McCusker & Gettings, 1997). Social desirability bias can be problematic for self-report measures, and the content of earlier items within the measure can prime responses to later items (McCusker, 2001), thus constituting a potential confound. Memory is also highly cue- and situation-dependent, and self-reported expectancies have been shown to change pre- and post-cue exposure (Cooney, Gillespie, Baker, & Kaplan, 1987).

The theory and research evidence presented in this chapter clearly support the likelihood that two types of cognitive processes are implicated in smoking-related behaviour. The first are explicit processes engaged in executive functioning, and in deliberate, planned and controlled behaviour. The second are implicit, automatically activated processes, which are fast, efficient, difficult to interrupt, and not subject to introspection. Furthermore, the two types of processes are likely to interact with each other when smoking decisions are made. Environmental cues evoking positive smoking-related memories may tend to influence implicit cognition, whereas stimuli activating an awareness of the negative effects of smoking may tend to influence explicit cognition, at least until such point as this information becomes habitually activated and stored as implicit cognitive associations (Sussman, 2010; Wiers, de Jong, Havermans, & Jelicic, 2004). A combination of explicit and implicit assessment techniques will therefore be required to properly understand smoking-related behaviour.

Implicit cognitive tests provide new and useful ways for studying addictive behaviours. Free association, lexical decision, and word-based priming tasks measure the strength of semantic associations in memory. The greater the associative strength between two concepts, the more accessible one is likely to be when presented with the other (Baddeley, 1990) and the more likely automatically triggered associations are to be revealed. Attentional bias tasks such as the modified-Stroop and the visual dot-probe tasks illustrate the involuntary performance degradation that occurs when an individual detects the presence of drug-related stimuli, in comparison to neutral. This reduction in performance can be said to reflect the incentive-salience of these stimuli and provide an objective index of the desire to use these drugs (Franken, Kroon, Wiers, et al., 2000). The validity of these tasks has been established as they illustrate that attentional bias is not dependent on an individual's level of executive control, can distinguish abusers from non-abusers, and can successfully predict an increased potential for relapse (W. M. Cox, et al., 2006). Given the involuntary nature of the cognitive processes underlying addiction, implicit measures may produce more reliable predictions of smoking behaviour as they provide the ability to directly access memory processes and aspects of cognition that are not open to introspection (Stacy, 1997).

1.7 Thesis Aims and Hypotheses

Few studies investigate both the explicit and implicit measurement of smoking cognitions within the same sample. For example, only one study to date has addressed adolescent and adult differences in substance-related memory associations and outcome expectancies (Sussman, Skara, & Ames, 2008), and that study merely reviewed the different investigative approaches undertaken with each group along with the implications for prevention and treatment. Concentrating on only one measurement approach, not only reduces our understanding of the cognitions underpinning addictive behaviour, but also limits the theoretical models used to explain them. As smoking onset typically occurs after age 12 and before age 24 (Sher, Wiers, & Stacy, 2006), it is also surprising that there continues to be little investigation of implicit adolescent smoking cognitions.

The aim of this thesis was to examine the role that cognitive biases play in the initiation and maintenance of tobacco smoking. Within the context of the cognitive models of nicotine addiction presented above, the research will directly investigate age-related changes in cognitive beliefs and the implications that these have for smoking behaviour. It will seek to identify how smokers manage the negative information pertaining to smoking that they encounter in everyday life. It will question if the apparent cognitive avoidance of the ramifications of negative smoking-related information is driven solely by a positive memory bias or if it can be considered to be a form of thought suppression, and it will strive to ascertain how best to measure this suppression. It will also aim to identify if there are any measures of implicit cognition that are capable of reliably differentiating between early smokers and non-smokers, and between smokers of different ages, in a way that can be used to improve prediction of the cognitive characteristics of those most likely to become addicted over time. Specifically, this thesis will attempt to answer the following research questions:

1. To what extent do smokers and non-smokers of different ages appreciate both the positive and negative consequences associated with smoking?
    a. This will be investigated by measuring smoking status and age-related differences in the relative strength of positive and negative smoking expectancies, using both explicit and implicit assessment methods.
    b. According to CSLT and associative memory models of addiction, smokers would be expected to demonstrate a positive memory bias for smoking-related information when assessed implicitly; a bias which would not be seen in non-smokers.
    c. It was also expected that explicit and implicit measures would each predict a unique portion of the smoking status variance between groups demonstrating the importance of assessing smoking expectancies using both types of measurement.
2. How do smokers and non-smokers of different ages manage negative smoking-related information and if cognitive avoidance is demonstrated by smokers, does this process involve a form of natural thought suppression?
    a. This will be investigated by examining implicit reactions to positive and negative smoking words and images, in comparison with general positive, general negative and neutral stimuli. These reactions will be correlated with two common suppression measures to determine if either could be used to accurately measure naturally occurring suppression.

b. Cognitive models would suggest that attentional bias to smoking-related information should be observed in smokers but not in non-smokers. Additionally, CSLT and associative memory theories would predict that smokers will respond more quickly to positive smoking-related stimuli, in comparison to other stimulus categories.

3. Do smokers overestimate peer prevalence rates of smoking and does this overestimation change with age or smoking experience?
   a. This will be investigated by examining estimates of peer smoking prevalence in comparison to actual prevalence rates in Ireland.
   b. Smokers are expected to demonstrate a false consensus effect but that the size of the overestimation would decline with age. The extent of the overestimation was also expected to predict current smoking status.

4. Do smokers understand the risks involved when they decide to smoke or do they exhibit optimistic relative risk biases for smoking-related health and addiction risks?
   a. This will be investigated by examining the extent to which smokers and non-smokers of different ages endorse negative health and addiction expectancies of smoking. Their attitudes to risk in general, and to smoking risks in particular, will be examined in relation to themselves, to their peers in general, and to the 'typical' peer smoker.
   b. Given the proliferation of negative information pertaining to smoking, particularly since the smoking ban was introduced in Ireland, all participants are expected to show an awareness of the risks of smoking, but smokers, and in particular younger smokers, are expected to demonstrate an optimistic relative risk bias.

5. How does implicit cognition, and in particular implicit memory, contribute to smoking behaviour and could measures of implicit cognitive bias be added to an extended-TPB model to more accurately predict smoking behaviour?
    a. A combination of implicit and explicit assessments of smoking-related attitudes, expectancies, norms, and risks will have been collected from smokers and non-smokers of different ages when investigating the questions above. These will be combined in an attempt to create a dual implicit and explicit cognitive model that predicts smoking behaviour.
    b. It is expected that the combination of explicit and implicit measures will better predict smoking behaviour than either would alone.

Throughout the studies presented in this thesis, participants will be grouped by age into adolescent (15-18), young adult (19-25) and adult (26+) groups. Within each group participants will be categorised by smoking status with a non-smoking group serving as the control in each case.

Combined adolescent and adult smoking research using implicit measures is practically non-existent and the results of this thesis should both add to our knowledge of cognitive control within the field, and also specifically extend the limited amount of information available on how it changes with age. Although initially focusing on tobacco smoking, these research findings could potentially generalise to other addictions and to other risky behaviours commonly initiated in adolescence. Given the automatic nature of at least some of the processes known to be involved in these behaviours, and the inherent difficulties trying to change these processes, a greater understanding of their causes and correlates may help to predict initiation, relapse and to identify more effective treatment strategies.

The structure of the thesis is as follows: Chapter 2 reports an investigation of the explicit and implicit measurement of smoking expectancies and it proposes an adjusted explicit smoking consequences measure appropriate for use in heterogeneous samples (Study 1). Chapter 3 presents an implicit assessment of associative memory strength for positive and negative smoking-related words using a lexical decision task, and an examination of attentional bias to positive and negative smoking-related imagery using modified-Stroop and visual dot-probe tasks (Study 2). Chapter 4 extends the results presented in Chapter 2 by re-examining positive and negative evaluations of smoking in a larger sample (Study 3) and validating the revised explicit expectancy measure previously obtained. Chapters 5 and 6 present the main findings of Study 3 which investigated the core components of an extended-TPB smoking model: attitudes; descriptive, subjective, and moral norms; risks; current and past smoking-behaviour. Within- and between-group differences are discussed and a revised model for predicting smoking behaviour from a combination of implicit and explicit assessment of smoking-related information is proposed. Finally, Chapter 7 is a general discussion of the main findings from the empirical studies, which reviews the comprehensiveness of the key models of addiction, and their ability to explain smoking-related cognitive biases. Conclusions regarding the affective, cognitive, and social learning influences on smoking are drawn.

Chapter 2: Smoking Expectancies: Explicit and Implicit Assessment in Adolescent and Adult Smokers and Non-smokers (Study 1)

2.1 Introduction

Drug expectancies represent an individual's beliefs and assumptions about the consequences of drug use (Goldman, 1999). They can be conceptualised as models of long-term positive and negative use-and-effect memory associations (Bolles, 1972; Goldman, 1999). They are dynamic, formed initially from perceptions and altered as experience is gained (Rather & Goldman, 1994). Typically, they refer to outcomes which are most often measured explicitly with pre-determined questionnaires. Such questionnaires present lists of positive expectancies (e.g., smoking helps if I feel bad about myself), and negative expectancies (e.g., by smoking I risk heart disease and lung cancer), and then require the participant to endorse each expectancy at an ordinal level of agreement. As discussed in Chapter 1, many addiction theories include a role for outcome expectancies (Baker, Brandon, & Chassin, 2004; Brandon, Herzog, Irvin, & Gwaltney, 2004; Marlatt, 1996) claiming that initial decisions to use a substance are influenced by the potential for positive consequences. Drug use is then maintained by the presumption that these outcomes can continue to be achieved through sustained use (Leigh & Stacy, 2004), and expectancies relating to negative affect reduction are particularly associated with problematic substance use (Farber, Khavari, & Douglass, 1980; Myers, MacPherson, McCarthy, & Brown, 2003).

Thush and colleagues (2007) propose that implicit drug-related cognitions, which embody early drug-use experiences, vicarious learning, and other behaviours that influence affective experience, have a more automatic and less effortful influence on drug-related behaviour. Social learning theories of addiction offer only a limited acknowledgement of implicit processing (Kelly, Masterman, & Marlatt, 2006). Memory theories, such as the spreading activation model (Litz, et al., 1987), better illustrate how memory associations can trigger cognitive processing, how memory may be automatically cued, how object perception may trigger substance-related cravings, and how habits can be maintained (Munafo & Albery, 2006). Automatically accessible associations are more likely to influence a particular information processing sequence (Palfai, 2002), and will be more closely linked to behaviour (Bargh, 1992). Using both explicit and implicit measures to examine which expectancies are held, and by whom, is crucial to our understanding of how addictions are initiated and maintained, especially as behaviour seems to be driven not only by the presence of these beliefs, but also their ease of activation in memory.

2.1.1 Explicit assessment of smoking expectancies

Explicitly assessed smoking expectancies have been shown to predict smoking behaviour among adolescents (Bauman, Fisher, Bryan, & Chenoweth, 1984; Wahl, Turner, Mermelstein, & Flay, 2005), young adults (Downey & Kilbey, 1995), and older adults (Copeland, et al., 1995). The Smoking Consequences Questionnaire (SCQ; Brandon & Baker, 1991) is a common explicit assessment of smoking expectancies which has been used to identify four expectancy factors in a student population: negative consequences (e.g., my throat burns after smoking), positive reinforcement (e.g., I enjoy parties more when I am smoking), negative reinforcement (e.g., if I am tense, a cigarette helps me to relax), and appetite/weight control (e.g., smoking helps me stay slim). It has also been used to identify a number of population specific differences, which has resulted in the creation of SCQ measures specifically for adolescents (Lewis-Esquerre, et al., 2005; Myers, et al., 2003; Wahl, et al., 2005), young adults (Downey & Kilbey, 1995; Schleicher, Harris, Catley, Harrar, & Golbeck, 2008), and older adults (Copeland, et al., 1995; Rash & Copeland, 2008), which demonstrate strong internal consistency (α = .72 to .97) and good convergent validity.

Individuals can simultaneously hold both positive and negative expectancies, but smokers typically give more positive endorsements of smoking than both non-and ex-smokers, even in situations where their overall evaluation of smoking is negative (Lewis-Esquerre, et al., 2005; Rash & Copeland, 2008). Positive expectancies, especially those related to experiencing pleasure, best predict changes in adolescent smoking, including initiation and increased use. High levels of negative reinforcement expectancies, such as stress relief, are associated with relapse, and low levels with decisions to quit, and they have been identified as the best predictors of cessation outcomes in adults (Copeland, et al., 1995; Wetter, et al., 1994). Smoking expectancies have also successfully differentiated between smokers of different experience levels, with daily smokers holding stronger levels of positive and negative reinforcement expectancies than occasional, ex- and never-smokers (Brandon & Baker, 1991), and net-positive views of smoking have been correlated with even minimal non-daily smoking (Carpenter, Baker, Gray, & Upadhyaya, 2010). Adolescent expectancies are also consistently associated with dependence, smoking duration, and increased use over time (Brady, et al., 2008; Piko, 2001), although the exact nature of the relationship is unclear. For example, use has been found to influence positive expectancies (Palfai, 2002; Schleicher, et al., 2008), but increased smoking has also been associated with a greater likelihood of experiencing negative consequences (Brady, et al., 2008).

In general, the strongest behavioural correlations are found with the positive, rather than the negative, reinforcing effects of smoking (C. B. Anderson, Pollak, & Wetter, 2002). Although this explicit approach to expectancy assessment successfully detects smoking-related associations available in long-term memory, the anomalies often seen between beliefs and behaviour (Tiffany, 1990) challenge the idea that action is purely driven by the expectancies captured using explicit self-report measures. Furthermore, McCusker (2001) argues that individuals may be endorsing socially held beliefs (e.g., smoking causes cancer) rather than personally relevant smoking-related expectancies, and that even if these social beliefs were to motivate behaviour, the extent to which they would do so would depend on how retrievable they are from memory, when faced with smoking-related decisions.

2.1.2 Implicit assessment of smoking expectancies

Memory paradigms, such as free association tasks, have been used to capture self-generated substance-related expectancies as they measure association strength and the elaboration of substance-related information in memory (Stacy, Leigh, & Weingardt, 1994). They also successfully reveal automatically accessible associations as well as those available from conscious introspection (Baddeley, 1990). Smokers have been found to freely generate more positive, but similar numbers of negative, smoking expectancies than non-smokers (Leung & McCusker, 1999). O'Connor and colleagues (2007) suggest that this is a result of weaker negative implicit associations which are therefore less accessible, but Leung and McCusker (1999) argue that smoking-related contexts and stimuli facilitate a positive memory bias for smoking associations in smokers. They further support their argument by examining the relative strength of positive to negative expectancies within smoking and non-smoking groups. While social learning theory would suggest that this balance would be consistent for both groups across time, Leung and McCusker (1999) found that smokers generated more of their positive associations earlier in a free association period than non-smokers. They argued that these associations were more automatic in nature and represented those most accessible in memory, whereas those generated later reflected the results of a more deliberate and effortful search of available memory.

The importance of distinguishing between positive and negative smoking-related associations is further justified by the finding that smokers rate the affective characteristics of smoking-related images more positively than never-and ex-smokers (van Hanswijck de Jonge & Gormley, 2005). Implicit measurement of smoking expectancies has demonstrated that accessibility of robust positive expectancies predict smoking initiation

(C. B. Anderson, et al., 2002), continued use (O'Connor, et al., 2007), and relapse (McCusker, 2001) in smokers, while access to a strong set of negative expectancies acts as a protective factor in non-smokers (Sherman, Rose, Koch, Presson, & Chassin, 2003), so those for whom positive associations become most highly accessible may beat greater risk of smoking dependence.

2.1.3 Age variation in expectancies

As smoking experience increases, smoking-related expectancies also change. Childhood smoking expectancies are typically negative but they become more positive in adolescence with the onset of smoking behaviour (O'Connor, et al., 2007), and then increasingly more negative with age and the accumulation of negative smoking experience (Wetter, et al., 1994). Adolescents seem to be aware of the negative consequences of smoking and may even experience some themselves (Brady, et al., 2008), yet they appear able to inhibit the potentially dissuading impact of negative outcomes in favour of more immediate positive consequences such as enhanced image and peer regard (Slovic, Finucane, Peters, & MacGregor, 2004). It may be that positive expectances best predict smoking behaviour in adolescents or in early smokers while negative expectancies become more accessible in older and more experienced smokers. That said, if positive expectancies are retrieved more frequently by someone experimenting with smoking, regardless of age, this in itself will make them more likely to be retrieved automatically when faced with future smoking-related decisions. It is important, therefore, in any study of expectancies and behaviour, to consider how their presence differs with age.

2.1.4 Measuring nicotine dependence

Nicotine dependence is associated with the quantity and frequency of smoking (DiFranza, et al., 2002; Nonnemaker & Homsi, 2007), previous quit attempts and low intention to quit in adults (John, Meyer, Hapke, Rumpf, & Schumann, 2004), lower readiness and ability to quit in adolescents (Horn, Fernandes, Dino, Massey, & Kalsekar, 2003; Prokhorov et al., 2001), and implicit attitudes to smoking (Waters et al., 2007). The Fagerström Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991) is short, practical, and the most common self-report measure of nicotine dependence across a substantial body of research with smokers of different ages and experience levels (Piper, McCarthy, & Baker, 2006). Although its use with adolescents has been supported (Nonnemaker & Homsi, 2007), some researchers argue that it was designed for adults and relies too heavily on cigarette use, thereby making it unsuitable for adolescent and novice users (Colby, et al., 2000; K. C. Wheeler, Fletcher, Wellman, & Difranza, 2004). Carpenter and colleagues (2010) have suggested using an adjusted version of the FTND that omits the item regarding cigarette use (question 4).

An alternate measure, the Hooked on Nicotine Checklist (HONC), was specifically developed for use with adolescents (DiFranza et al., 2000). This scale claims to measure loss of autonomy over the quantity of cigarettes smoked. Acknowledgement of any one of the symptoms included in the scale, such as craving or difficulty refraining from smoking, is interpreted as being a barrier to quitting. The HONC has successfully been used with adolescent smokers (MacPherson, Strong, & Myers, 2008; K. C. Wheeler, et al., 2004), and with adults (Wellman, DiFranza, Savageau, & Dussault, 2004), and it has been argued that it is uniquely suited to low consumption smokers (Wellman et al., 2006). Associations between the two measures are modest at best indicating that they may not, in fact, measure the same underlying construct (Kleinjan et al., 2007). Nevertheless, there is a need to identify accurate self-report dependency measures that are simple, brief, easily administered, and which can be used in heterogeneous populations.

2.1.5 Suppression of negative associations

One of the ways in which people manage the discrepant cognitions involved in continuing a behaviour they know to be bad for them is to avoid thinking about the dangers associated with the behaviour (Gerrard, et al., 1996). Few studies have examined the relationship between substance use and thought suppression despite the fact those who seek to control substance use cravings seem least able to do so (Polivy, 1998; Wenzlaff & Wegner, 2000). Salkovskis and Reynolds (1994) found high levels of intrusive smoking-related thoughts in smokers trying to abstain, yet elsewhere, no relationship was found with relapse (Haaga & Allison, 1994). Research on fear appeals has also demonstrated that recipients of fear-based messages can suppress concepts semantically related to a threat, and that they exhibit an attentional bias away from threat-relevant stimuli (Nielsen & Shapiro, 2009). Importantly, this form of suppression is described as a natural response to the fear appeal when threat avoidance is not viable (Witte, 1992).

Two self-report measures are commonly used in suppression studies and each is thought to index a different type of suppression (Wenzlaff & Wegner, 2000). The White Bear Suppression Inventory (WBSI; Wegner & Zanakos, 1994) assesses chronic thought suppression and it is primarily a measure of the conscious desire to suppress thoughts. Participants agree or disagree with statements such as “There are things I prefer not to think about” and “My thoughts frequently return to one idea”. The authors argue that chronic thought suppression decreases the likelihood that an individual will habituate to stimuli related to the suppression target. As a result, the desire to inhibit particular thoughts (e.g., smoking-related) may potentially lead to a hypersensitivity to stimuli relevant to those thoughts (e.g., smoking cues). The WBSI has been shown to have good reliability (α = .89), to be predictive of unwanted intrusive thoughts, and to demonstrate good convergent validity with measures of obsession-compulsion, anxiety, depression, and intrusive thinking (Muris, Merckelbach, & Horselenberg, 1996). It has been used to measure suppression associated with eating behaviour (Soetens, Braet, Dejonckheere, & Roets, 2006) and to demonstrate that participants instructed to suppress their urge to drink alcohol made faster endorsements of alcohol outcome expectancies following exposure to alcohol cues, than those in the non-suppression group (Palfai, Monti, Colby, & Rohsenow, 1997).

In contrast, the Thought Control Questionnaire (TCQ; Wells & Davies, 1994) measures different strategies used to suppress unpleasant, intrusive, and unwanted thoughts. The scale is made up of three suppression-related factors: distraction (e.g., I do something I enjoy), worrying (e.g., I replace the thought with a more trivial bad though), and punishment (e.g., I get angry at myself for having the thought); and two non-suppression factors: social coping (e.g., I talk to a friend about the thought) and reappraisal (e.g., I question the reason for having the thought). Although it has been shown to have acceptable reliability (factor level Cronbach's alphas range from .64 to .79), there is a lack of systematic investigation of its convergent and discriminant validity so it remains unclear how useful a measure this is (Fehm & Hoyer, 2004). The TCQ scale has been successfully used to measure suppression in rebound experiments, for example with OCD (Abramowitz, Whiteside, Kalsy, & Tolin, 2003), and significant associations have been found between punishment and worry scores and perceptions of impaired control over cognition (Wells & Davies, 1994).

2.1.6 Aims of the current study

Given that explicit and implicit expectancies predict smoking, two different aspects of cognition are conceivably involved; an explicit expectancy component which is likely to influence deliberate and introspective aspects of the smoking-decision process, and an implicit memory activation triggered by motivational and situational circumstances which accounts for the more automatic aspects of smoking-related decisions (A. Weinstein & Cox, 2006). Despite these findings, few studies investigate both the explicit and implicit measurement of smoking expectancies within the same sample. Concentrating on only one measurement approach, not only reduces our understanding of these expectancies, but also limits the theoretical models used to explain them, and potentially decreases the amount of variance that can be explained when differentiating between smokers and non-smokers. Fewer still analyse the relative strength of positive and negative outcomes endorsed, which is potentially important as the predominance of positive expectancies increases drug-taking while the dominance of negative expectancies motivates drug-use restriction (Oei & Morawska, 2004). As smoking onset typically occurs after age 12 and before age 24 (Sher, et al., 2006), it is also surprising that there continues to be little research of implicitly measured smoking expectancies with adolescents. On that basis, this study investigated if explicit and implicit measurement of smoking expectancies would reveal differences in the types and sequence of outcomes endorsed by adolescent (age 15-18), young adult (age 19-25) and older adult (age 26-40) smokers and non-smokers, and if these differences could successfully predict current smoking behaviour.

The research aimed to address five specific questions; the first three questions relate specifically to smoking expectancy measurement, the fourth to the appropriate measurement of nicotine dependence, and the fifth to the potential measurement of natural thought suppression. First, the study sought to investigate smoking status and age-related differences in the relative strength of positive and negative smoking expectancy endorsement, as measured explicitly by an SCQ scale. It was hypothesised that all participants would give a more negative than positive explicit evaluation of smoking, the latter of which would decline with age. Second, the study sought to determine the relative balance of positive and negative expectancies generated in a free association task (implicit measure). Again, all participants were expected to give more negative than positive evaluations of smoking, but smokers were expected to be more positive than non-smokers. Both these differences were expected to decline with age. Smokers were also expected to produce more of their positive smoking expectancies earlier in the free association period than non-smokers, whose distribution of positive and negative associations was predicted to be more temporally balanced. Third, the findings from the two expectancy measures would be compared to investigate which was most closely linked with self-reported smoking behaviour. It was hypothesised that implicit assessment would more successfully reveal accessible, as well as available, smoking associations, including those highly accessible positive associations thought to influence much smoking-related behaviour. It was also expected that each measure would predict a unique portion of the smoking status variance between the two groups, thus demonstrating the importance of assessing smoking expectancies using both types of measurement.

Fourth, the study sought to determine whether the FTND or the HONC provided a better measure of nicotine dependence among a diverse group of smokers, and if common scoring adjustments made to both measures are necessary in order for the measurement to be successful. Finally, this study is based on the assumption of a rational decision-making process whereby positive consequences have to outweigh negative consequences in order to initiate and maintain behaviour. As negative consequences are expected to be available to smokers, they must then be altering their cognitions in some way in order to maintain their smoking behaviour. In this case, suppression of available negative consequences may be required to negate their impact on behaviour. Two commonly used suppression measures, the WBSI and the TCQ, will be administered as part of this study to determine which might indicate whether suppression of negative consequences is a real phenomenon in smokers.

2.2 Method

2.2.1 Participants

Two hundred and thirty-one participants took part in this research. Following data collection they were grouped by smoking status (smoker and non-smoker) and age (adolescents: 15 to 18 years, young adults: 19 to 25, and older adults: 26 to 40). Eighteen year olds were included in the adolescent group as this is the typical school-leaving age in Ireland, and it represents a transition point to work or higher education. Young adult populations are generally age 25 and under in implicit cognitive addiction research (Rooke, Hine, & Thorsteinsson, 2008) so this categorisation was adopted here. Groups comprised of 89 smokers (33, 27, 29) and 142 non-smokers (83, 30, 29). A full breakdown of participant characteristics is presented with the results. Adult participants were recruited via posters and emails. Some were undergraduate students who participated in exchange for research credits, others for entry into a draw for €50. Adolescents were recruited from three post-primary schools, the principals of which had agreed that their school should participate in this research. The study was approved by the School of Psychology Research Ethics Committee in Trinity College Dublin (see Appendix 1). Parental consent was provided for participants under the age of 18. All others provided formal written consent prior to commencing the study (see Appendix 2).

2.2.2 Measures

2.2.2.1 Explicit smoking expectancies. Age specific versions of the SCQ contain items particularly relevant to an age group, but they can also omit important outcomes; for example, including popularity expectancies in the adolescent version while omitting serious health risks and craving-related items (Lewis-Esquerre, et al., 2005). None of the age specific SCQ questionnaires were therefore considered appropriate for a study investigating age-related smoking expectancy differences. Although a shortened version of the SCQ has previously been used within an adolescent population (Myers, et al., 2003) concerns have been raised about the age-related validity of some its items (Lewis-Esquerre, et al., 2005). In order to obtain a measure containing a broad range of smoking-related consequences oriented to all ages, the items in the original SCQ (Brandon & Baker, 1991) were compared to those in the adolescent (Lewis-Esquerre, et al., 2005) and adult (Copeland, et al., 1995) versions. Twenty-nine items were common across the scales. They adequately represented the original SCQ factors of negative consequences (10 items), negative reinforcement (8 items), positive reinforcement (7 items) and weight control (4 items), so they formed the basis of the SCQ measure used in this study (see Appendix 3). Participants responded to each item using a Likert scale running from 1 (Extremely unlikely) to 6 (Extremely likely). Mean responses were calculated for all positive (negative reinforcement, positive reinforcement and weight control) and all negative (negative consequences) SCQ items so that, although there were a different number of positive and negative expectancies, nevertheless their responses could be meaningfully compared. Only the 29 common SCQ items inform the analysis in this chapter. However, to facilitate the future definition of a more complete cross-age SCQ measure, participants were asked to respond to nine additional positive expectancy items. These were selected from the age-specific SCQs in outcome areas under-represented in the original, based on arguments made by the authors of the revised scales. Chapter 4 presents a full description of this selection process, an exploratory factor analysis of participant responses to the full 38 SCQ items, and a confirmatory factor analysis of the resulting revised SCQ measure using participant responses from a new sample (Study 3).

2.2.2.2 Free association task. A 3 minute pen-and-paper free association (FA) task, similar to that used by Leung and McCusker (1999), was used to capture implicit smoking expectancies. Participants were asked to write down whatever came to mind when they thought about smoking. They were instructed that this could include how smoking made them feel, and how they felt about it, but that they should leave out brand names and nouns such as cigarettes, cigars, and pipe. Numbered blank lines were provided and participants were asked to use one line for each word or thought. Following Leung and McCusker's (1999) procedure, after 90 seconds, participants were instructed to draw a line under the last word written and to continue until asked to stop. This step was required in order to differentiate between words generated in each half of the FA task. FA words were first validated to remove nouns (e.g., tobacco, lighter, my dad), then classified as either positive or negative by the experimenter and by an additional smoker and non-smoker. Word classifications with full inter-rater agreement (98.68%) were retained.

2.2.2.3 Nicotine dependence. Given the debate regarding appropriate nicotine dependence measures for adolescents (Colby, et al., 2000; K. C. Wheeler, et al., 2004), both the FTND (Heatherton, et al., 1991) and the HONC (DiFranza, et al., 2000) were completed by all smokers. Two nicotine dependence scores were calculated for FTND responses for each participant; the first using the regular scoring method (FTND) and the second using the adjusted method that omits question four (FTND-Adj). Two scoring options also exist for the HONC scale. The measure was originally developed using a dichotomous scoring mechanism with 'Yes' responses scoring 1 and 'No' responses scoring 0. Subsequently a 4-point Likert response scale was suggested (O'Loughlin et al., 2003): (1) Never, (2) Seldom, (3) Sometimes, and (4) Often, and studies are increasingly using this alternate approach (Kleinjan, et al., 2007). Participants in this study were asked to respond using the 4-point scale but two sets of response scores will be calculated; HONC scores based on the 4-point scale, and HONC-Y/N scores based on the dichotomous scoring method with the 'Never' and 'Seldom' response options are mapped to 'No' and the 'sometimes' and 'often' options to 'Yes'. In all cases, higher scores indicate greater dependence.

2.2.2.4 Thought suppression. All participants were asked to complete the WBSI (Wegner & Zanakos, 1994) and the TCQ (Wells & Davies, 1994). Although a factor structure does exist for the WBSI, it is highly controversial (Blumberg, 2000; Höping & de Jong-Meyer, 2003), so the total score will be used in this study. Participants respond using a 5-point scale from 1 (strongly disagree) to 5 (strongly agree) such that higher scores indicate higher suppression levels. The TCQ scale comprises of three suppression-related factors; distraction (TCQ-D), worrying (TCQ-W), and punishment (TCQ-P), and two non-suppression factors; social coping (TCQ-S) and reappraisal (TCQ-R). Participants respond using a 4-point scale from 1 (never) to 4 (always) and higher scores indicate higher use of the particular strategy measured by each factor.

2.2.2.5 Demographics and smoking history. All participants provided demographic (gender and age) and smoking-related (status, smoking intentions, cigarettes per day/week, age started smoking, quit attempts, time since last cigarette) information. Consistent with existing research (Reid, Manske, & Leatherdale, 2008), smoking status was assessed using a 5-point scale: (1) "I have never smoked a cigarette, not even a puff" (*never-smoker*); (2) "I've never really smoked, but I have tried a few puffs" (*trier*); (3) "I used to smoke but now I've stopped" (*exsmoker*); (4) "I don't smoke every day, but every week" (*weekly smoker*); (5) "I smoke every day" (*daily smoker*). For this study, categories 4 and 5 were combined to form the smoker group. Non-smokers were defined as those in categories 1 and 2. The latter participants were included as no individual in that group had ever smoked a full cigarette, even on an occasional basis, and it had been at least a year since anyone had even a puff of a cigarette. Paper copies of all questionnaires were used.

2.2.3 Procedure

Adolescents were tested on school premises. Parental consent was sought in advance of the test date and only those volunteers with this consent proceeded to testing. Adolescents completed all tasks individually but were tested in groups according to their school year. Most adults were tested individually, or in small groups of 5 or less, in Trinity College Dublin. Twelve adult participants (10%) were tested in a quiet room in their home or office[1] to facilitate participant time constraints. Smokers were instructed to smoke as normal on the day of testing. Upon arrival and having provided written consent, participants first completed the FA, then the SCQ measure, the suppression measures, the nicotine dependence measures, and finally the demographic and smoking history questions. The FA task was always completed first as it is likely that FA word generation

[1] Analyses confirmed that no significant differences were found for implicit expectancies generated, or explicit expectancies endorsed, between those tested in Trinity College Dublin and those tested elsewhere.

would have been impacted by completing the SCQ first. Non-smokers were instructed to skip the two dependence measures but to answer the questions on smoking intentions.

2.2.4 Data analysis

2.2.4.1 Smoking expectancy analysis. It has been argued that smokers typically give more positive endorsements of smoking than non-smokers, even in situations where their overall evaluation of smoking is negative. This suggests that the groups differ in the relative balance of positive and negative smoking expectancies held. In order to analyse the balance of positive and negative expectancies endorsed on the explicit measure, an SCQ difference score was calculated by subtracting the mean negative endorsement score from the mean positive endorsement score such that a positive value indicated a net positive evaluation of smoking. The valence of the items was based on the factor analysis carried out by Brandon and Baker (1991). The SCQ difference score was then analysed using a 2 (smoking status) x 3 (age) analysis of variance (ANOVA).

The same analytical model was used to analyse smoking expectancies generated during the implicit assessment task; an FA difference score was calculated by subtracting the frequency of negative expectancies generated from the frequency of positive expectancies generated. As the main purpose of the FA task was to differentiate those expectancies most quickly accessible in memory from those available with more deliberate searching, difference scores were calculated for each half of the FA task (T1 and T2). These difference scores were then analysed using a 2 (smoking status) x 3 (age) x 2 (time) mixed factorial ANOVA. To facilitate direct comparison between the smoking expectancies that were most assessable to participants and the relative strength of those explicitly endorsed, FA T1 and SCQ difference scores were standardised (*z*-scores), and analysed using a 2 (smoking status) x 3 (age) x 2 (measure: FA T1, SCQ) mixed factorial ANOVA. Given gender differences in smoking, additional analyses were carried out with gender as a between-groups factor, but no significant gender differences were found so these results are not included. Finally, multiple logistic regression analysis was used to examine three smoking expectancy models to determine which best predicted current smoking status; model one contained SCQ difference scores and participant age, model two contained FA T1 difference scores and participant age, while model three was a combined model that included both SCQ and FA T1 difference scores and participant age.

2.2.4.2 Nicotine dependency analysis. Between-group ANOVA analyses were used to investigate the appropriateness of each of the four dependence measures (FTND and HONC, each with two scoring methods) in each age group, and to determine the ability of each measure to distinguish between weekly and daily smokers within each age-group. Pearson correlations were run to investigate the associations between the measures themselves, the relationship between dependence and smoking expectancies, and associations with other smoking behaviour variables such as cigarette use and smoking intentions.

2.2.4.3 Thought suppression analysis. Smoking status and age-related differences in WBSI thought suppression were analysed using a between-group factorial ANOVA, while a between-group MANOVA analysis, followed by a series of separate between-group ANOVA analyses, was carried out on the TCQ subscale suppression scores. Pearson correlations were run to investigate the associations between the WBSI and TCQ measures, the relationship between thought suppression and smoking expectancies, and associations with other smoking behaviour variables such as cigarette use and smoking intentions.

All statistical analyses were conducted using SPSS 19 (SPSS Inc., Chicago, Illinois 60606, US) and *p*-vales presented in post-hoc analyses were Bonferroni corrected using the SPSS general linear model post-hoc Bonferroni correction function, unless otherwise stated. Correlations requiring multiple comparisons have also been Bonferroni corrected.

2.3 Results

2.3.1 Participant characteristics

The demographic profiles of the full sample, and of each age group, are presented in Table 2.1 along with the average use and dependence characteristics of each smoking group.

Table 2.1 *Demographic Profile, Means (Standard Deviations), of Smoker and Non-smoker Participants including a Breakdown of Demographic Characteristics by Age Group*

	All Participants		**Adolescents**		**Young Adults**		**Older Adults**	
	Smoker	Non-S	Smoker	Non-S	Smoker	Non-S	Smoker	Non-S
	n = 89	*n* = 142	*n* = 33	*n* = 83	*n* = 27	*n* = 30	*n* = 29	*n* = 29
Female	50	76	18	34	17	22	15	20
Male	39	66	15	49	10	8	14	9
Age	24.37	21.17	17.42	16.62	23.26	22.88	33.30	32.42
	(7.16)	(6.7)	(0.93)	(0.83)	(2.06)	(1.89)	(3.90)	(4.95)
Smoking History								
Age Start	14.84 (2.62)		14.05 (1.95)		15.63 (2.59)		15.00 (3.11)	
Age Daily	15.79 (4.25)		13.58* (5.31)		17.54 (2.40)		16.91 (2.81)	
Yrs Smoking	9.53 (7.16)		3.37 (1.57)		7.63 (3.66)		18.30 (4.24)	
Years Daily	7.75 (7.08)		1.83 (1.21)		5.82 (3.62)		16.37 (4.46)	
Cig per Day	9.02 (6.21)		7.10 (5.14)		8.39 (6.23)		11.74 (6.51)	
FTND	2.18 (2.29)		2.12 (2.04)		2.04 (2.62)		2.41 (2.29)	
HONC	27.70 (7.42)		27.91 (9.50)		25.85 (7.54)		29.17 (5.18)	

Note. *Not all smokers are daily smokers but those that are started younger.

As would be expected, the smoker groups differed significantly in terms of age, years smoking, and years as a daily smoker. No significant differences existed in terms of the age at which smokers started to smoke or current nicotine dependence (as measured by both FTND and HONC). Adolescent smokers consume significantly fewer cigarettes per day than older adult smokers ($t(59) = 3.10$, $p < .01$, two-tailed, $d = .80$), and they started smoking on a daily basis at a significantly younger age than smokers in the young adult ($t(55) = 3.41$, $p < .01$, two-tailed, $d = .71$) and older adult groups ($t(59) = 2.99$, $p < .01$, two-tailed, $d = .38$).

2.3.2 Explicit (SCQ) expectancy measurement

This SCQ analysis relates to scores calculated for the 29 items common to the original and the age-specific variations of the SCQ scale, as described above. Internal consistency measures for the SCQ were high; total SCQ (α = .86), positive subscale (α = .94), and negative subscale (α = .80). The subscale scores, difference scores (mean positive minus mean negative endorsement), and reliability estimates for each smoking status group, are provided in Table 2.2, for all participants, and for each age group. All smokers gave higher ratings for positive expectancies than negative, while the reverse was found for non-smokers.

Table 2.2 *Mean (Standard Deviation) Positive and Negative SCQ Scores, SCQ Difference Scores, and Cronbach's Alpha Reliability Estimates by Smoking Status and Age*

	Smokers				Non Smokers			
	n	Mean	(*SD*)	α	n	Mean	(*SD*)	α
All Participants								
Positive	89	3.93	(0.80)	.86	141	2.80	(1.19)	.95
Negative	89	4.09	(0.66)	.72	141	4.68	(0.73)	.77
Difference Score	89	-0.16	(0.93)		141	-1.88	(1.55)	
Adolescents								
Positive	33	3.94	(0.85)	.87	82	2.56	(1.06)	.94
Negative	33	3.84	(0.76)	.80	82	4.74	(0.75)	.76
Difference Score	33	0.10	(0.94)		82	-2.19	(1.38)	
Young Adults								
Positive	27	4.16	(0.71)	.85	30	3.20	(1.24)	.96
Negative	27	4.17	(0.56)	.66	30	4.57	(0.72)	.79
Difference Score	27	-0.01	(0.75)		30	-1.37	(1.69)	
Older Adults								
Positive	29	3.71	(0.78)	.87	29	3.08	(1.36)	.96
Negative	29	4.30	(0.56)	.58	29	4.63	(0.68)	.79
Difference Score	29	-0.59	(0.95)		29	-1.55	(1.69)	

To determine if groups differed in the strength of endorsement of positive versus negative expectancies, an SCQ difference score (mean positive endorsement minus mean negative endorsement) was calculated and analysed using a 2 (smoking status) x 3 (age) ANOVA. A significant smoking status by age interaction was found, $F(2,224) = 5.14$, p

<.01, $\eta_p^2 = .04$. As illustrated in *Figure 2.1*, non-smokers were significantly more negative than smokers in each age group (adolescents: $t(113) = 8.75$, $p < .001$, two-tailed, $d = 1.81$; young adults: $t(55) = 3.86$, $p < .001$, two-tailed, $d = 1.03$; older adults: $t(56) = 2.66$, $p < .05$, two-tailed, $d = .71$). A large difference was found for adolescents and young adults, but the size of this difference decreased for older adults, even though it remained significant. Alternatively, a simple main effect of age ($F(2,86) = 5.19$, $p < .01$, $\eta_p^2 = .11$) for smoker suggests that as age increased, the difference score decreased; older adults were significantly more negative than both adolescents ($t(60) = 2.87$, $p < .01$, two-tailed, $d = .74$) and young adults ($t(54) = 2.53$, $p < .05$, two-tailed, $d = .44$). Whereas, a simple main effect of age ($F(2,86) = 5.19$, $p < .01$, $\eta_p^2 = .11$) within the non-smoking group demonstrated that adolescents were more negative than younger adults ($t(110) = 2.61$, $p < .05$, two-tailed, $d = .56$). No other significant interactions were found.

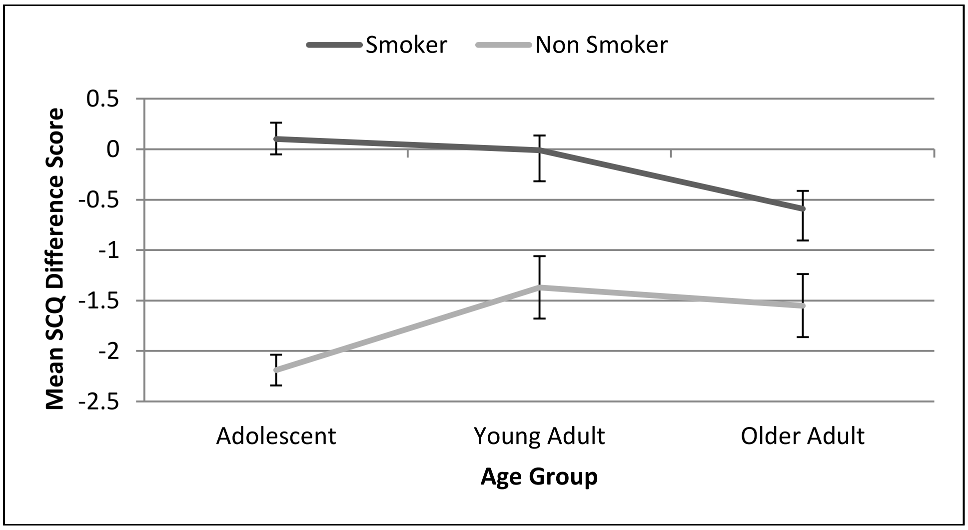


Figure 2.1 Mean smoker and non-smoker SCQ difference scores by age. Error bars represent standard errors.

2.3.3 Implicit (FA) expectancy measurement

FA words generated by each group across the total FA time period, and broken down into first and second half periods, are provided in Table 2.3. It is evident that differences exist in the absolute numbers of words generated in each half of the task. To

Table 2.3 *Mean (Standard Deviation) Group Positive and Negative Words Generated, and FA Difference Scores, for the Total, First and Second Halves of the FA Task*

	All Participants		**Adolescents**		**Young Adults**		**Older Adults**	
	Smoker n = 89	Non Smoker n = 142	Smoker n = 33	Non Smoker n = 83	Smoker n = 27	Non Smoker n = 30	Smoker n = 29	Non Smoker n = 29
Total								
Positive	5.91 (3.28)	2.02 (2.36)	6.09 (3.48)	1.51 (1.72)	6.59 (2.29)	3.27 (2.74)	5.07 (3.73)	2.21 (3.01)
Negative	6.88 (4.81)	9.49 (3.72)	5.39 (4.13)	8.96 (3.45)	7.33 (4.00)	10.33 (4.37)	8.14 (5.82)	10.14 (3.60)
Diff Scores	-0.97 (6.20)	-7.47 (4.30)	0.70 (5.88)	-7.46 (4.09)	-0.74 (4.74)	-7.07 (4.23)	-3.07 (7.27)	-7.93 (5.00)
First Half								
Positive	4.19 (2.35)	1.19 (1.42)	4.36 (2.51)	1.06 (1.25)	4.52 (2.08)	1.63 (1.52)	3.69 (2.39)	1.10 (1.72)
Negative	3.91 (2.98)	6.65 (2.80)	3.18 (2.87)	6.40 (2.56)	3.85 (2.67)	7.17 (3.70)	4.79 (3.22)	6.83 (2.39)
Diff Scores	1.28 (4.26)	-5.46 (3.27)	1.18 (4.48)	-5.34 (3.09)	0.67 (3.76)	-5.53 (3.94)	-1.10 (4.23)	-5.72 (3.10)
Second Half								
Positive	1.72 (1.73)	0.83 (1.47)	1.73 (1.81)	0.45 (0.86)	2.07 (1.51)	1.63 (1.99)	1.38 (1.8)	1.10 (1.86)
Negative	3.97 (2.67)	2.86 (1.91)	2.21 (2.12)	2.57 (1.91)	3.48 (2.36)	3.17 (1.68)	3.34 (3.33)	3.38 (2.04)
Diff Scores	-1.35 (3.57)	-2.20 (2.51)	-0.59 (3.07)	-2.41 (2.14)	-1.46 (3.25)	-1.53 (2.78)	-1.97 (4.21)	-2.36 (3.03)

ensure that frequency differences do not confound results, and to facilitate a more direct comparison with explicit SCQ expectancy measurement, difference scores (mean positive expectancies generated minus mean negative expectancies generated) were calculated for each half of the task, such that a positive score indicated a net positive evaluation of smoking. These difference scores were then analysed using a 2 (smoking status) x 3 (age) x 2 (time) mixed factorial ANOVA. A significant smoking status by time interaction was located, $F(1,207) = 65.12$, $p < .001$, $\eta_p^2 = .24$. As illustrated in *Figure 2.2*, smokers had a significantly higher difference score than non-smokers in both halves (T1: $t(305) = 13.52$, $p < .001$, two-tailed, $d = 1.69$; T2: $t(264) = 2.30$, $p < .01$, two-tailed, $d = .30$), and although significant differences between T1 and T2 scores were found for smokers ($t(82) = 2.71$, $p < .01$, two-tailed, $d = .30$) and non-smokers ($t(182) = 12.78$, $p < .001$, two-tailed, $d = .95$), the smokers' score became more negative with time while non-smokers' score became more positive, although it remained net negative overall. No other significant interactions were found.

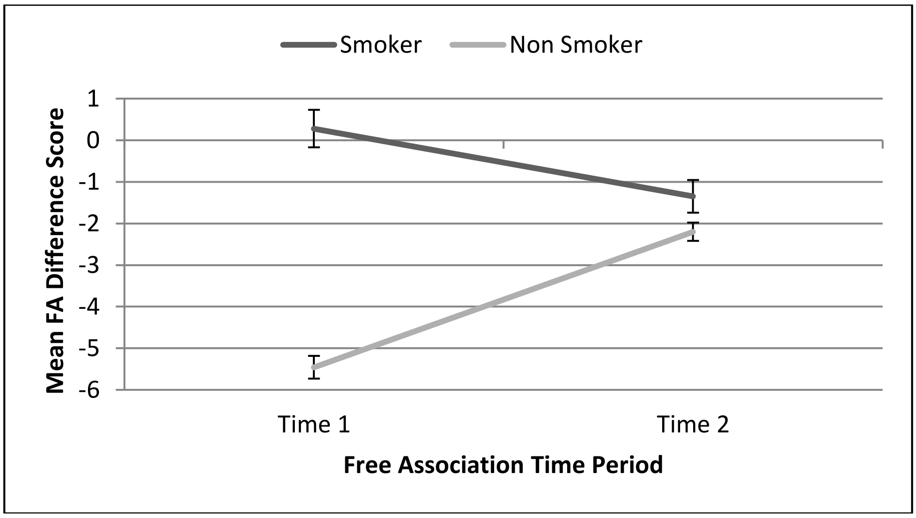


Figure 2.2. Smoker and non-smoker mean FA difference scores for each time period. Error bars represent standard errors.

The time variable, which represents each half of the FA task, contributed to the above interaction and conclusions should therefore be drawn on the basis of this analysis.

However, the difference score for the full FA task was also analysed in order to facilitate a more direct comparison to the earlier explicit SCQ analysis. A 2 (smoking status) x 3 (age) factorial ANOVA found a main effect of smoking status, $F(1,225) = 80.49$, $p < .001$, $\eta_p^2 = .26$, and a main effect of age, $F(1,225) = 3.22$, $p < .05$, $\eta_p^2 = .03$. Smokers had a significantly higher FA total difference score than non-smokers ($t(305) = 11.03$, $p < .001$, two-tailed, $d = 1.38$), while adolescents had significantly higher difference scores than older adults ($p < .05$).

2.3.4 Comparison of explicit and implicit measures

Also of interest was a comparison between the balance of positive and negative expectancies measured explicitly using the SCQ, and those most immediately accessible to each group (as measured by T1 of the FA task). Adolescents were the only group with positive SCQ difference scores (see *Figure 2.1*), yet both adolescent and young adult smokers had net positive FA T1 difference scores (see Table 2.3). This disparity was investigated by directly comparing standardised (*z*-score) SCQ and FA T1 difference scores using a 2 (smoking status) x 3 (age) x 2 (measure) mixed factorial ANOVA. No 3-way interaction was found, instead a significant smoking status by age interaction, $F(2,224) = 4.86$, $p < .01$, $\eta_p^2 = .04$, and a significant smoking status by measure interaction, $F(1,224) = 5.28$, $p < .05$, $\eta_p^2 = .02$ were found. In relation to the first interaction, a main effect of smoking status was found in each age group: adolescents, $F(1,113) = 136.33$, $p < .001$, $\eta_p^2 = .55$; young adults, $F(1,55) = 42.60$, $p < .001$, $\eta_p^2 = .44$; and older adults, $F(1,56) = 24.02$, $p < .001$, $\eta_p^2 = .30$. Adolescent smokers were also significantly more positive about smoking than older adult smokers ($p < .05$). No other differences were significant (see *Figure 2.3*).

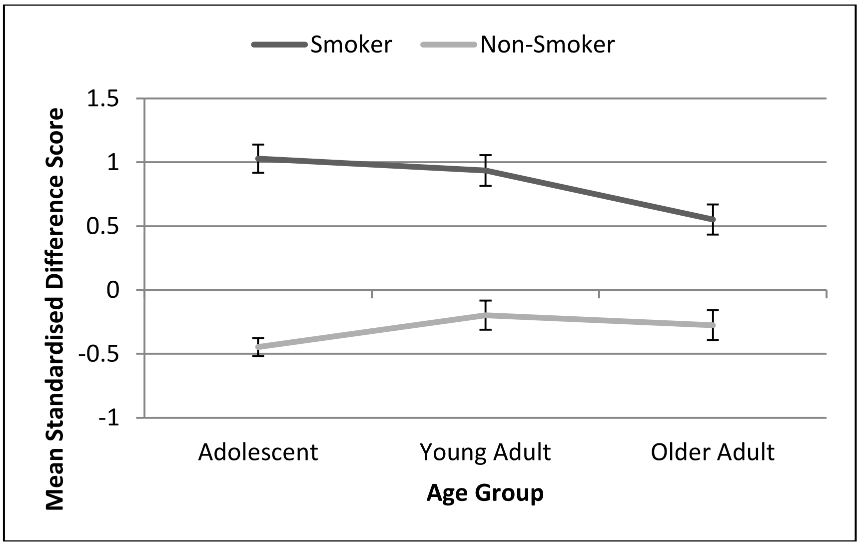


Figure 2.3 Smoking status by age interaction found in the comparison of explicit and implicit measurement of smoking expectancies. Error bars represent standard errors.

In relation to the second interaction, smokers gave significantly more positive evaluations of smoking in FA T1 than they did on the SCQ task ($t(88) = 2.26$, $p < .05$, two-tailed, $d = .24$). Differences for non-smokers were not significant (see *Figure 2.4*).

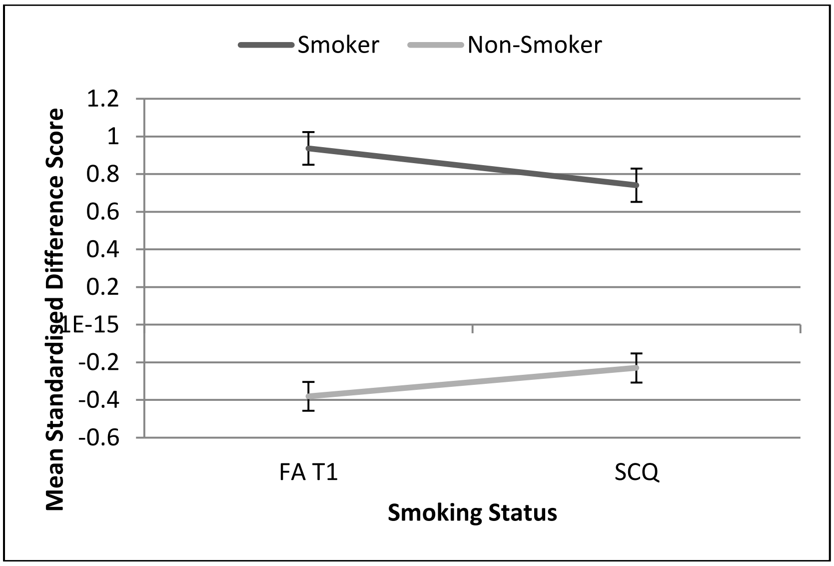


Figure 2.4 Smoking status differences found in the comparison of explicit and implicit measurement of smoking expectancies. Error bars represent standard errors.

2.3.4.1 Prediction of current smoking behaviour. Results from a series of multiple logistic regression analyses, including model-fit statistics, regression coefficients, and odds ratios with 95% confidence intervals, for each of the predictors, are presented in Table 2.4. The SCQ model was the least successful in predicting current smoking status; 67.4% of smokers and 78.7% of non-smokers were correctly predicted, giving an overall prediction success rate of 74.3%. The FA (T1) model was more successful, correctly predicting 71.9% of smokers and 90.1% of non-smokers for an overall success rate of 83.1%, but the combined FA (T1) and SCQ model best predicted current smoking status. This model had an overall success rate of 86.5%, correctly predicting 80.9% of smokers and 90.1% of non-smokers.

Table 2.4 *Model-Fit Statistics Including Beta Values, Standard Errors, and Odds-ratios with 95% Confidence Intervals for the Factors Associated with Prediction of Current Smoking Status in Each Model*

				95% CI for Odds Ratio		
	β (*SE*)	χ^2 (*df*)	R^2	Lower	Odds Ratio	Upper
Model 1: FA (T1)		119.4*** (2)	.55			
FA (T1) Difference	-.46 (.06)***			.56	.63	.71
Age	-.10 (.03)***			.86	.91	.95
Constant	1.48 (.61)*				4.38	
Model 2: SCQ		82.85*** (2)	.41			
SCQ Difference	-.97 (.14)***			.29	.38	.50
Age	-.06 (.02)*			.90	.94	.99
Constant	.87 (.57)				2.39	
Model 3: FA (T1) and SCQ		147.74*** (3)	.64			
FA (T1) Difference	-.42 (.07)***			.58	.66	.75
SCQ Difference	-.77 (.17)***			.33	.46	.65
Age	-.09 (.03)**			.87	.92	.97
Constant	.56 (.70)				1.75	

Note. Nagelkerke R^2 values are reported.

*$p < .05$, ** $p < .01$, *** $p < .001$.

2.3.4.2 Relationship between expectancy measures. As presented in Table 2.5, a number of significant medium-sized positive correlations were observed between the SCQ and the Total FA and FA Time 1 scores for smokers. For clarity, non-significant correlations have not been presented. No significant correlations were observed between the measures for non-smokers.

Table 2.5 *Pearson Correlations between FA and SCQ Expectancy Scores for Smokers*

	Total FA Period			FA Time 1		
	Positive	Negative	Difference	Positive	Negative	Difference
SCQ Positive	.43***		.32**	.46***		.42***
SCQ Negative		.37***	-.24*		.39***	-.24*
SCQ Difference	.32**	-.37***	.46***	.35**	-.48***	.53***

Note. *** $p < .001$, ** $p < .01$, * $p < .05$.

Within the smoking group, the correlations between the FA and SCQ positive subscale are driven by adolescents (see Table 2.6). The correlations between the FA and SCQ negative subscale are driven by associations within the young and older adult groups, while the correlations between FA and SCQ difference scores are predominately driven by the adolescent smokers, with some contribution from older adult smokers with regard to the SCQ and FA T1 relationship. For clarity, non-significant correlations have not been presented.

Table 2.6 *Pearson Correlations between FA and SCQ Expectancy Scores for Smokers of Different Ages*

	Total FA Period			FA Time 1		
	Positive	Negative	Difference	Positive	Negative	Difference
Adolescent						
SCQ Positive	.60***	-.37*	.62***	.66***	-.43*	.65***
SCQ Negative						
SCQ Difference	.41*	-.48**	.58***	.49**	-.55**	.63***
Young Adult						
SCQ Positive						
SCQ Negative		.47*			.47*	
SCQ Difference						
Older Adult						
SCQ Positive						
SCQ Negative					.49**	
SCQ Difference					-.42*	

Note. *$p < .05$, ** $p < .01$, *** $p < .001$.

2.3.4.3 Relationship with smoking behaviour. With regard to smoking behaviour, a significant medium-sized negative correlation was found between FA T1 negative words and the age daily smoking commenced in adolescents ($r = -.41$, $p < .05$). No other significant correlations were found between use and FA expectancies. A significant positive association was found between the SCQ positive subscale and age daily smoking commenced in adolescents (*r* = .41, *p* < .05), while the association was negative in young adults (*r* = -.50, *p* < .05) and not significant in older adults. Instead, the SCQ positive subscale was significantly associated with cigarettes per week (*r* = .44, *p* < .05) in the older adult group. No other significant correlations were found. Associations between smoking expectancies and smoking (and non-smoking) intentions were also investigated. No associations were found between intent and FA expectancies for smokers, whereas significant negative correlations were found for older adult smokers between non-smoking intentions and total FA positive words (*r* = -.49, *p* < .01) and FA T1 positive words (*r* = -.60, *p* < .01). Smaller significant positive correlations were found for adolescent and older adult non-smokers between non-smoking intentions and total FA negative words (*r* = .28, *p* < .05; *r* = .41, *p* < .05 respectively). In contrast, the SCQ positive scores are significantly correlated with smoking intent in young adult smokers (*r* = .53, *p* < .01). No other significant correlations were found.

2.3.5 Nicotine dependence measurement

2.3.5.1 Smoking Status Differentiation. Mean FTND, FTND-adjusted, HONC, and HONC-Y/N scores were similar for each of the groups; see Table *2.7*.

Table 2.7 *Mean (Standard Deviation) Dependence Scores and Cronbach's Alpha Reliability Estimates for each Measure in each Age Group*

	Adolescent (*n* = 33)			Young Adult (*n* = 27)			Older Adult (*n* = 29)		
	Mean	(*SD*)	α	Mean	(*SD*)	α	Mean	(*SD*)	α
FTND	2.16	(2.07)	.63	2.00	(2.62)	.83	2.41	(2.29)	.72
FTND-Adj	1.91	(1.82)	.55	1.59	(2.14)	.77	1.69	(1.83)	.66
HONC	28.22	(9.48)	.94	25.85	(7.54)	.92	29.17	(5.18)	.80
HONC-Y/N	6.53	(3.18)	.94	5.33	(3.04)	.92	6.86	(6.86)	.80

In order to investigate the appropriateness of the four measures in each age group, a one-way ANOVA was run for each dependence score with age as the between groups variable. No significant effect of age was found for any of the measures, yet as depicted in

Figure 2.5, the difference between the FTND and FTND-adjusted scores would appear to be increasing with age. Given that young adults smoke more cigarettes than adolescents, but score lower on all measures, it would seem to indicate that it is unsafe to arbitrarily remove question four as suggested in the FTND-Adj scoring approach, and that further investigation of the impact of levels of cigarette use is warranted.

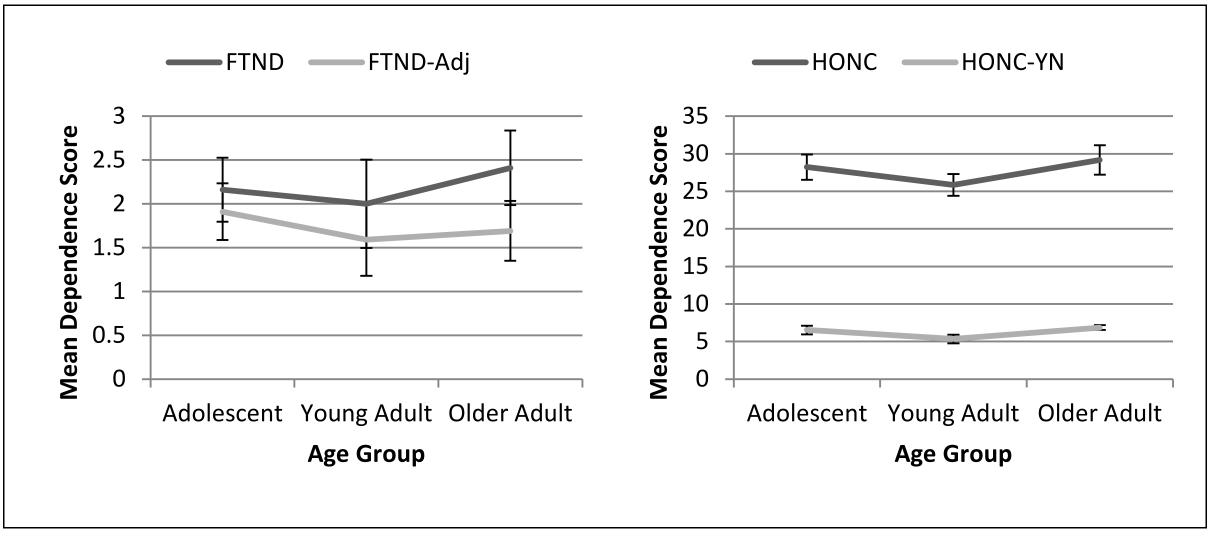


Figure 2.5. Mean age group scores for both scoring methods on the FTND and on the HONC nicotine dependence scales. Error bars represent standard errors.

Smoking participants had indicated whether they were weekly or daily smokers and although the numbers of weekly smokers were quite low, each measure was analysed to determine how successful it was at differentiating between smokers of different levels of experience. Table 2.8 presents the means and standard deviations for each dependence measure as a function of smoking status and age. A 2 (smoking status) x 3 (age) ANOVA was run for each measure. A main effect of smoking status was found for the FTND ($F(1,82) = 20.98$, $p < .001$, $\eta_p^2 = .20$) and the FTND-Adj scores ($F(1,82) = 19.35$, $p < .001$, $\eta_p^2 = .19$).

Table 2.8 *Mean (Standard Deviation) Dependence Scores for Each Measure/Scoring Method Combination, by Smoking Status and Age.*

	Weekly			Daily		
	Adolescent (n = 7)	YA (n = 10)	OA (n = 5)	Adolescent (n = 25)	YA (n = 17)	OA (n = 24)
FTND	0.71 (1.11)	0.10 (.32)	0.40 (.89)	2.56 (2.1)	3.12 (2.74)	2.83 (2.28)
FTND-Adj	0.71 (1.11)	0 (0)	0.20 (.45)	2.24 (1.86)	2.53 (2.21)	2.00 (1.87)
HONC	19.14 (10.92)	23.20 (8.47)	23.60 (7.23)	30.76 (7.45)	27.41 (6.72)	30.33 (3.93)
HONC-Y/N	4.14 (3.58)	4.40 (3.63)	5.20 (2.8)	7.20 (2.78)	5.88 (2.6)	7.21 (1.44)

Daily smokers scored higher on both although the FTND has a marginally larger effect size (see *Figure 2.6*). No other significant results were found.

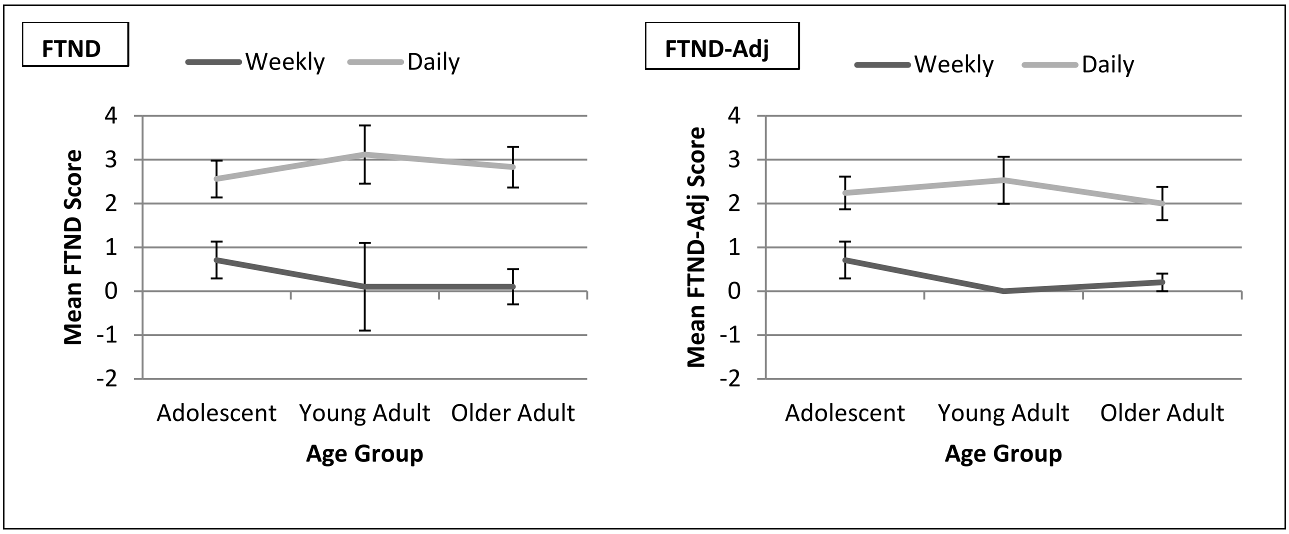


Figure 2.6. Mean FTND and FTND-Adj scores for weekly and daily smokers in each age group. Error bars represent standard errors.

Similarly, A main effect of smoking status was found for the HONC ($F(1,82) = 17.98$, $p < .001$, $\eta_p^2 = .18$) and the HONC-Y/N scores ($F(1,91) = 10.81$, $p < .01$, $\eta_p^2 = .12$). Daily smokers scored higher on both with a larger effect size found on the HONC (see *Figure 2.7*). No other significant results were found.

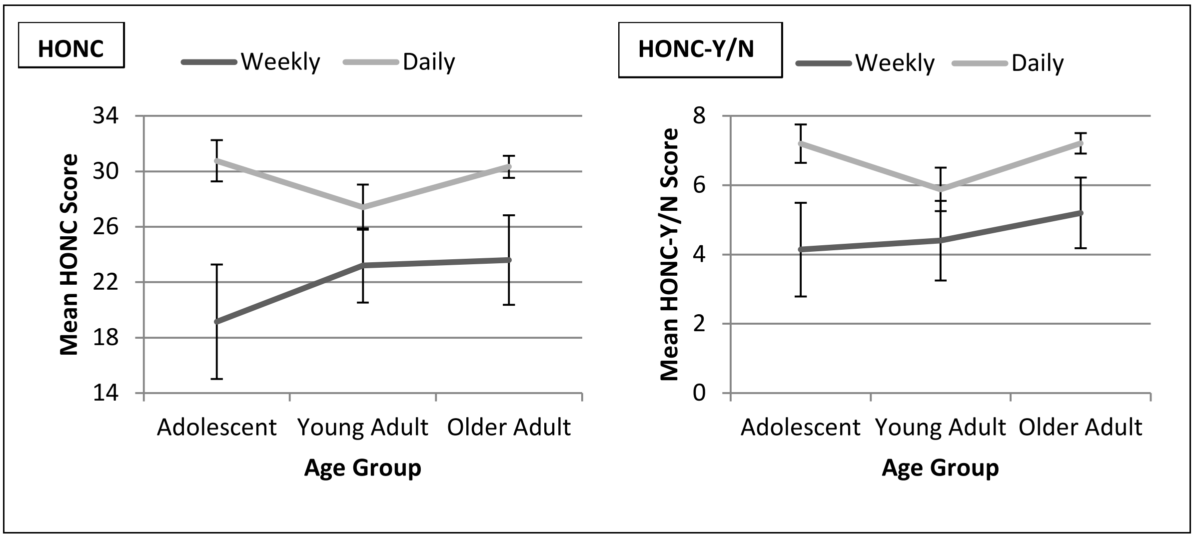


Figure 2.7. Mean HONC and HONC-Y/N scores for weekly and daily smokers in each age group. Error bars represent standard errors.

Although no main effect of age was found in either ANOVA analysis, an interesting pattern of responding is evident for young adults. Post-hoc t-test analyses were carried out on the FTND and HONC scores to investigate this further. Significant differences were evident between daily and weekly smokers on the FTND for all age groups (adolescents: $t(30) = 2.22$, $p < .05$, two-tailed, $d = .97$; young adults: $t(25) = 3.45$, $p < .01$, two-tailed, $d = 1.4$; older adults: $t(27) = 2.32$, $p < .05$, two-tailed, $d = 1.16$) but, the only significant smoking status differences on the HONC were found in the adolescent ($t(30) = 3.29$, $p < .01$, two-tailed, $d = 1.43$) and older adult ($t(27) = 3$, $p < .01$, two-tailed, $d = 1.5$) groups.

2.3.5.2 Relationship between measures. The FTND and HONC scores were found to be significantly positively correlated for all groups, but associations for young adults ($r = .44$, $p < .05$) were lower than for adolescents ($r = .64$, $p < .001$) and older adults ($r = .55$, $p < .005$). Strong positive associations were found between the FTND scores and cigarette use in all age groups ($r = .75$ to $.81$, $p < .001$), while HONC scores were most associated with reported 'difficulty not smoking'. Strong positive associations were observed in the adolescent ($r = .71$, $p < .001$) and young adult ($r = .73$, $p < .001$) groups, with weaker associations evident for older adults ($r = .46$, $p < .05$).

2.3.5.3 Relationship with smoking expectancies. No significant correlations were found between nicotine dependence and FA expectancies, but FTND scores were significantly associated with the SCQ positive subscale in older adult smokers (r = .52, p < .01), and with SCQ difference scores (r = .65, p < .001) in the same group. Significant correlations were also found between HONC scores and the SCQ positive subscale in adolescent (r = .54, p < .01) and older adult (r = .71, p < .001) smokers, with the SCQ negative subscale in adolescent smokers (r = -.43, p < .05), and with SCQ difference scores in older adult smokers (r = .60, p < .01). No significant correlations were found for non-smokers.

2.3.6 Thought suppression measurement

2.3.6.1 Smoking status and age analysis. Mean WBSI and TCQ subscale scores are presented in Table *2.9.*

Table 2.9 *Mean (Standard Deviation) WBSI and TCQ Factor Scores, and Cronbach's Alpha Reliability Estimates for Smokers and Non-smokers, and for Each Age Group.*

	WBSI		TCQ									
			D		W		P		S		R	
	M (SD)	α	M (SD)	α	M (SD)	α	M (SD)	α	M (SD)	α	M (SD)	α
Smoker Status												
Smoker	49.85 (12.08)	.91	14.55 (2.96)	.64	10.33 (3.37)	.80	10.13 (2.93)	.66	14.35 (4.52)	.86	15.35 (3.41)	.67
Non-smoker	49.20 (11.31)	.89	15.37 (3.27)	.68	10.26 (3.28)	.80	9.11 (2.68)	.68	14.38 (4.04)	.82	15.01 (3.92)	.75
Age Group												
Adolescent	50.05 (11.79)	.89	15.2 (3.39)	.66	10.93 (3.60)	.78	9.83 (3.26)	.71	13.85 (4.21)	.80	14.19 (3.78)	.68
Young Adult	51.88 (9.43)	.85	15.19 (2.81)	.66	9.84 (2.71)	.75	9.51 (2.05)	.53	14.58 (4.41)	.89	16.02 (3.65)	.78
Older Adult	45.88 (12.43)	.93	14.62 (3.08)	.72	9.43 (2.99)	.83	8.86 (2.40)	.67	15.19 (3.96)	.85	16.17 (3.23)	.71

Note. D: Distraction, W: Worrying, P: Punishment, S: Social Coping, R: Reappraisal

The WBSI scale was found to be consistently reliable. The TCQ-W and TCQ-S subscales had strong reliability across groups, while reliability of the TCQ-D, TCQ-R, and TCQ-P scales was generally acceptable. The one exception was the TCQ-P scale for young adults which was mediocre (α = .53). A 2 (smoking status) x 3 (age) ANOVA was used to investigate between group differences in WBSI scores. A main effect of age was found, $F(2,225) = 4.56$, $p < .05$, $\eta_p^2 = .04$, but there was no main effect of smoking status, and no significant interaction. Post hoc analysis with Bonferroni corrections revealed significantly higher suppression scores for young adults, in comparison to older adults, $t(113) = 2.91$, $p < .05$, two-tailed, $d = .55$. No other significant differences were found.

TCQ subscale scores were analysed using a 2 (smoking status) x 3 (age) MANOVA. Using Pillai's trace, there was a significant main effect of age, $V = 3.24$, $p < .001$, $\eta_p^2 = .07$. No other significant results were found. Separate univariate ANOVAs on the TCQ subscales confirmed a significant main effect of age for the TCQ-W ($F(2,224) = 5.68$, $p < .01$, $\eta_p^2 = .05$), TCQ-P ($F(2,224) = 5.61$, $p < .01$, $\eta_p^2 = .05$), and TCQ-R ($F(2,224) = 6.79$, $p < .01$, $\eta_p^2 = .06$), however, the result for TCQ-P is qualified by a main effect of smoking status ($F(1,224) = 6.33$, $p < .05$, $\eta_p^2 = .03$) and a significant smoking status by age interaction, $F(2,224) = 4.18$, $p < .05$, $\eta_p^2 = .04$ (see *Figure 2.8*).

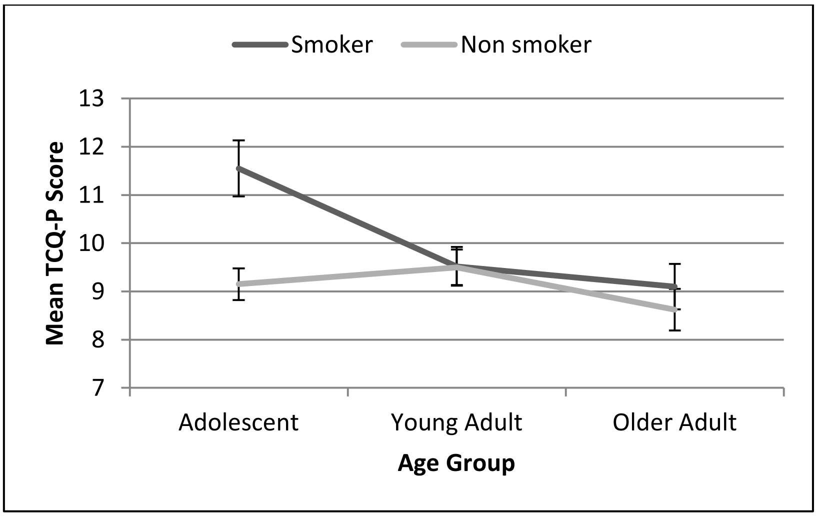


Figure 2.8. Mean TCQ-P scores for smokers and non-smokers in each age group. Error bars represent standard errors.

Post hoc analysis with Bonferroni corrections were carried out to reveal the source of the interaction. There were no significant differences between smokers and non-smokers in either adult group, but TCQ-P scores for adolescent smokers were significantly higher than for adolescent non-smokers, $t(113) = 3.77$, $p < .001$, two-tailed, $d = .78$.

2.3.6.2 Relationship between measures. As illustrated in Table 2.10, the WBSI was most strongly correlated with the TCQ-P scale in both smokers and non-smokers. Strong correlations were also seen between WBSI and TCQ-W for smokers, with weaker correlations for non-smokers. The WBSI was negatively correlated with the TCQ-S scale, but only weakly so. Little association was found between the WBSI and either the TCQ-D or the TCQ-R scales. For clarity, non-significant correlations are not presented.

Table 2.10 *Pearson Correlations between WBSI and TCQ Suppression Scales by Smoking Status and Age within Smoking Status*

WBSI	TCQ Total	TCQ-D	TCQ-W	TCQ-P	TCQ-S	TCQ-R
Smoker	.28**		.48***	.52***	-.26*	
Adolescent	.35*		.61***	.51**	-.38*	
Young Adult						
Older Adult			.53**	.68***		
Non-smoker			.34***	.51***	-.26**	
Adolescent			.32**	.52***		
Young Adult			.42*		-.47**	
Older Adult		.44*	.40*	.62***	-.39*	

Note. D: Distraction, W: Worrying, P: Punishment, S: Social Coping, R: Reappraisal
$*p < .05$, $** p < .01$, $*** p < .001$.

2.3.6.3 Relationship with smoking expectancies. WBSI scores were significantly correlated with FA T1 positive words generated in adolescent smokers ($r = .33$, $p < .01$). It was also significantly correlated to both SCQ positive scores ($r = .41$, $p < .001$) and SCQ negative scores ($r = .26$, $p < .05$) in the full smoking group. The association with the SCQ positive subscale is driven by the older adult group ($r = .45$, $p < .05$), whereas the association for the SCQ negative subscale is driven by the adolescent ($r = .55$, $p < .01$) and older adult ($r = .38$, $p < .05$) smokers. No clear pattern of associations was found between smoking expectancies and TCQ measures of suppression. TCQ-D scores were significantly correlated with total FA difference scores in young adult smokers ($r = .53$, $p < .01$). TCQ-W scores were associated with FA T1 positive words generated by young adult non-smokers (r = .51, p < .01). TCQ-W scores were also both positively associated with adolescent smoker SCQ negative scores (r = .43, p < .05). The only significant correlations found for TCQ-P scores were in the older adult smoking group with total FA negative words generated (r = .50, p < .01), FA T1 negative words generated (r = .46, p < .05), and with SCQ negative scores (r = .46, p < .05). Finally, TCQ-S scores were negatively correlated with both SCQ positive scores (r = -.62, p < .001) and SCQ difference scores (r = -.61, p < .001) in the older adult smoking group. No other significant correlations were found.

2.4 Discussion

2.4.1 Smoking expectancies

The main aim of this study was to assess the accessibility and availability of smoking expectancies using a combination of implicit and explicit measures with smokers and non-smokers of diverse ages. This element of the study was designed to address three questions. First, if the relative strength of positive and negative expectancies explicitly endorsed on an SCQ scale would differ by smoking status and age. As expected, smokers of all ages gave more positive explicit evaluations of smoking than non-smokers. Adolescent smokers were most positive about smoking giving a net-positive evaluation overall, albeit only marginally so. Results only partially supported the hypothesis that explicit evaluations of smoking become more negative with age. Older adults were most negative on the explicit SCQ measure, and although young adults gave a marginal net-negative evaluation, it did not differ significantly from that given by adolescents. The second question examined smoking-status and age-related differences in the relative strength of positive and negative expectancies generated in a FA task. As hypothesised, smokers of all ages were more positive about smoking than non-smokers, although only adolescent smokers were net positive overall. Smokers were also most positive about smoking in the first half of the FA task, with both adolescents and younger adults giving net positive evaluations in this time period. These results support the hypothesis that a positive evaluation of smoking, when measured implicitly, declines with age.

Thirdly, the study compared the size of the difference in the relative balance of positive and negative evaluations of smoking across the two measures, and investigated which would be most associated with current smoking behaviour. As expected, the size of the difference was more pronounced when expectancies were measured using an implicit task, in this case the first part of the FA task. In addition, the first half FA difference was more successful in predicting the self-reported current smoking status of an individual than the SCQ difference score alone, although the combination of the two measures was shown to provide the most successful model. This suggests that each measurement approach is capable of explaining a unique portion of the smoking status variance. The results of this study therefore address a number of interesting questions about the smoking expectancies held by different age groups, the value of both implicit and explicit measurement, and the importance of analysing within-group differences in the relative balance of positive and negative expectancies.

Previous research has looked at measuring smoking-related expectancies using explicit (Lewis-Esquerre, et al., 2005; Rash & Copeland, 2008) or implicit (C. B. Anderson, et al., 2002; Leung & McCusker, 1999) approaches and in both cases has consistently found a positive memory bias for smoking-related information in smokers. While explicit measurement successfully identified the positive memory bias for smoking-related information in smokers in this study, the implicit FA task incorporated an element of time which allowed it to distinguish between associations most highly accessible and those merely available. In both time periods, non-smokers produced more negative than positive expectancies, yet smokers produced similar numbers of positive and negative outcomes, and proportionally more of their positive associations, in the first half of the FA task. Accepting that the FA task measures the strength of memory associations (Baddeley, 1990), it would seem that, in absolute terms, positive and negative smoking-related associations are equally available to smokers which challenges the view that negative implicit associations are weaker and therefore less accessible (O'Connor, et al., 2007).

More notable is that although smokers were significantly more positive than non-smokers in both FA periods, the size of the disparity between smoker and non-smoker FA difference scores was much larger in the first half, than in the second half of the task. This suggests not only that smokers have a positive memory bias for smoking-related associations, but most importantly that this is a relative measure and that it is the size of the difference between positive and negative evaluations of smoking that is most important. The more the relative strength tends towards a positive overall evaluation of smoking, and the more automatically these positive associations are triggered, the more they are likely to influence smoking-related decisions and subsequent behaviour (Palfai, 2002), and the more resistant they will become to change (Tiffany, 1990). For example, decisions such as quitting smoking may be driven by the non-automatic, deliberate, and in the case of older adults, larger and more cohesive negative smoking-related schema. Conversely, momentary smoking-related decisions, such as trying cigarettes or relapsing, will be driven by the automatically accessible positive smoking associations.

Despite this positivity bias, Leung and McCusker (1999) found that adult smokers (mean age = 22) gave an overall negative evaluation of smoking. This claim is only partially supported by our results. In terms of the difference between positive and negative evaluations, older adults were more negative than both younger age groups, but a novel finding here was that adolescents and younger adults were net positive about smoking in the first half of the FA task. This suggests that the positive consequences of smoking are most strongly linked in the memory of young smokers, and hence more automatically accessible to them. It seems unlikely that novice smokers only experience the positive consequences of smoking. Previous research confirms that negative outcomes are encountered by early smokers (Brady, et al., 2008) but it is likely that these are less salient to them than the positive outcomes, so they are less readily encoded in, and retrieved from, memory. This supports a similar argument made by Leigh and Stacy (2004) who propose that many of the negative outcomes associated with a behaviour become more salient with age. These negative outcomes start to be retrieved more frequently, become more tightly linked in memory and as a result, more highly accessible. It remains unclear whether it is age or experience alone, or some combination of the two, which drives this change. For example, the relationship between expectancies and use in adolescents highlights the fact that negative expectancies are less accessible for those who commence smoking at an early age, but in adults, the strongest relationship is between expectancies and cigarettes smoked per day, whereby negative expectancies are less accessible to those who smoke more. It would be important in future research to compare the relative strength of positive and negative smoking expectancies in smokers with differing levels of use and dependency, regardless of age. If it were possible to identify the key factors underlying the shift in expectancies with age and experience, these elements could be incorporated into age-appropriate anti-smoking prevention and treatment programmes.

It is also interesting that no significant effect of age was found in the analyses of FA smoking outcomes but that it was evident when expectancies were measured explicitly. Research that relies on explicit measures alone could conclude that adolescent smoking expectancies are qualitatively different to those of adults, whereas in fact, implicit findings suggest that smokers of all ages have similar numbers of accessible positive smoking expectancies. The implication is that the age-related differences seen in the explicit results could be an artefact of the way smoking consequences have been measured. A number of the SCQ items contain social facts, such as “Smoking causes cancer” (McCusker, 2001) which many participants readily endorse without it having a personal relevance, but which are less likely to be as salient for younger, in comparison to older, individuals. Adults may also be more susceptible to socially desirable responding than adolescents (Welte & Russell, 1993) which leads them to endorse more socially accepted negative smoking consequences, rather than expressing personally held beliefs.

These results have implications for the measurement and the clinical relevance of smoking expectancies. Implicit and explicit measurement may assess different aspects of smoking outcomes and it would be important to establish if each predicts similar or unique aspects of smoking behaviour. Using implicit measures to explore the differences in the relative strength of positive and negative expectancies in different age groups with diverse smoking histories might explain why many but not all adolescents experiment with smoking, why use escalates to problematic levels in some but not in others, and who is most at risk for relapse. Clinical diagnosis based solely on explicit measures may not account for the more automatic smoking associations held by individuals. Prevention and treatment programmes also need to acknowledge that positive smoking outcomes do occur. To date adolescent prevention programmes have only been moderately successful (Hine, Summers, Tilleczek, & Lewko, 1997) and they may need to be changed to focus both on enhancing the accessibility of negative smoking outcomes, while at the same time, consider alternate ways for the individual to meet the positive expectations they have of smoking.

Some methodological limitations should be taken into account in the interpretation of these results. Smokers' dependence scores were quite low which may limit the generalisability of these results to more heavily dependent groups. Despite these low levels, both measures were capable of differentiating between smokers and non-smokers, and produced results comparable to studies with more dependent populations (Copeland, et al., 1995). It may be that dependence influences the rate at which expectancies become more negative with age which needs further investigation. The effect sizes associated with some of the significant interactions were quite small which may be attributed to group size.

While no gender differences were found in this study, it is possible that they exist in different age groups and are being masked by the fact that an analysis involving smoking stage, age and gender would have been underpowered. A larger gender-balanced sample would facilitate such an analysis.

In order to assess the relative strength of positive and negative outcomes generated within each of their experimental groups, Leung and McCusker (1999) analysed proportions of positive/negative words generated in each half of the FA task. For this method to be successful, it is necessary that each participant generates at least one word of each valence. No negative smoking-related expectancies were generated by some smokers in this study, and several non-smokers failed to list any positive smoking associations. Data analysis was therefore based on the relative difference between positive and negative words generated in each half. It could be argued that it is not possible to carry out a direct comparison between both sets of results, yet both measures index the relative accessibility of positive, in comparison to negative, smoking-related associations and should therefore be capable of explaining the same underlying processes.

Finally, in order to investigate age-related expectancy differences, an explicit measure was required that contained valid smoking outcomes for different age groups. This necessitated the use of a cut-down version of the original SCQ (Brandon & Baker, 1991) as no other measure had been validated across a range of smokers and non-smokers of different ages. Reliability values were high, yet it would have been preferable to use a broader measure that addressed the concerns raised by previous researchers (Lewis-Esquerre, et al., 2005; Wahl, et al., 2005). Many scales are being developed for increasingly narrower populations, but it is important to ensure that measures exist that can be used with more heterogeneous populations. The creation of a revised version of the SCQ scale, for use with participants of diverse age and smoking status, will be addressed in Chapter 4.

2.4.2 Nicotine dependence

An attendant objective in this study was to determine whether the FTND or the HONC provided a better measure of nicotine dependence among a diverse group of smokers, and if common scoring adjustments made to both measures are necessary in order for the measurement to be successful. Results indicate that both the FTND and the HONC, without the need for adjusted scoring, can be used to measure nicotine dependence among diverse smoking groups as each was capable of differentiating daily and weekly smokers of all ages. Yet, only medium strength correlations were found between the two measures, and the FTND was found to be most closely associated with cigarette use while the HONC was most closely associated with difficulty not smoking, supporting the concern that each scale may be measuring a different underlying aspects of dependence (Kleinjan, et al., 2007).

Results might have been expected to show a decline in correlation strength with age if the HONC is best suited to adolescents (DiFranza, et al., 2000). Although the strongest correlations are found for adolescents, medium strength correlations were seen for older adults, and the weakest correlations for young adults. The unexpected responding of the young adult group is interesting, given the number of studies that rely on participants from this age group. The HONC was not as successful as the FTND in differentiating by smoker status in this group, although caution is required in interpreting this result given the low number of weekly smokers in this age group. As this research was part of a larger study, participants were not specifically recruited for their daily versus weekly smoking status. Consequently, it would be prudent to replicate these results in a larger sample and to include a biochemical validation of self-reported smoking status. Given that there were very few heavy adult smokers in the sample, it is also not possible to comment on the suitability of the HONC for this population; high nicotine dependence would equate to FTND scores of six or higher (Heatherton, et al., 1991).

In light of the significant volume of research findings based the use of the FTND, and the confirmation that it is a successful measure of nicotine dependence in adolescents, and in lighter, or novice, smokers, it is therefore suggested that the FTND is the appropriate measure to use in cross-age studies among diverse smoking populations. If nicotine dependence is a core research construct, it may be appropriate for more than one measure to be used.

2.4.3 Thought suppression

Finally, this study sought to determine if either the WBSI or the TCQ scales would provide a useful index of naturally occurring thought suppression. Results suggest that neither was entirely successful in this case. The strongest inter-measure relationships were found between the WBSI and the TCQ-P scale across all participants and between the WBSI and the TCQ-W scale in smokers. Few clear associations were found between smoking expectancies and either suppression measure, although older adult smokers who scored highly on the social coping TCQ scale gave lower scores for positive smoking expectancies on the SCQ scale, while those who scored higher on the punishment TCQ scale gave higher scores for the negative expectancies on both measures. Positive evaluations of smoking on the FA task were associated with higher scores on the distraction TCQ scale in young adult smokers, but with higher scores on the worry TCQ scale in non-smokers of the same age.

It is likely that each measure is indexing a more ‘ironic’ suppression process (Wegner, 1994) and that alternate approaches to measuring naturally occurring thought suppression will be required. Such a measure would also need to be able to differentiate between different forms of unwanted thoughts and distinguish more effectively between worries and unwanted negative behaviour-related intrusions. There is also a need to evaluate the extent to which people actively use a ‘strategy’ to suppress unwanted negative behavioural-related thoughts, and to consider the possibility that people do not use any strategy at all, or at least not one that they can introspectively report. It could be expected that these strategies would be thoughtful, goal-directed, and requiring cognitive effort, so they should be capable of being frustrated under conditions with increased cognitive load (Wegner & Erber, 1992). Chapter 3 will examine the relationship between these two suppression measures and a lexical decision task, a modified-Stroop task, and a visual dot-probe task.

2.5 Conclusion

The current findings indicate that although smokers endorse a range of negative smoking expectancies using an explicit measure, they self-generate less negative associations across the full FA time period, and more positive associations earlier in the task. This emphasises the importance of assessing the relative strength of positive and negative smoking outcomes alongside the typical between-group analysis carried out in most studies. A difference was also seen in the impact of age when smoking expectancies were measured explicitly and implicitly, and the combination of the two measures, in conjunction with participant age, was most successful at predicting self-reported current smoking status. Taken together, these findings demonstrate that implicit assessment of smoking-related expectancies reveals not only available information in memory, but also that which is most accessible and most likely to directly influence behaviour, providing a more direct and ecologically sound measure than traditional questionnaires. Furthermore, it is evident that smoking-related associations in memory change with both age and experience, yet it is not known exactly how this shift in expectancies occurs.

Chapter 3: Memory and Attentional Biases for Positive and Negative Smoking-related Stimuli (Study 2)

3.1 Introduction

As discussed in Chapter 1, cognitive (Collins & Loftus, 1975; Shiffrin & Schneider, 1977; Tiffany, 1990), socio-cognitive (Rather & Goldman, 1994), and incentive-sensitisation (Robinson & Berridge, 1993, 2001, 2003) models argue that addictive behaviour is maintained by a combination of automatic and non-automatic processes. Highly practised social behaviours have been shown to move from intentional to non-intentional control (Bargh & Chartrand, 1999), leading to situations where drug-related behavioural sequences are automatically triggered by drug-related stimuli. The findings from Study 1 have demonstrated that implicit assessment of smoking-related expectancies reveals not only available smoking-related information in memory, but also content which is more accessible and therefore most likely to automatically influence behaviour. Specifically, a memory bias for positive smoking-related information was seen in smokers, and it was found to be greatest in younger smokers. However, smoking expectancy studies have not as yet revealed whether this positivity bias reflects the hyper-accessibility of positive smoking-related information in memory, or the automatic suppression of negative smoking-related associations. This chapter presents the findings from Study 2: an implicit assessment of associative memory strength for positive and negative smoking-related words using a lexical decision task, and an examination of attentional bias to positive and negative smoking-related imagery using modified-Stroop and visual dot-probe tasks.

3.1.1 Memory accessibility of smoking-related words

Word association tasks are widely used measures of associative memory strength in implicit cognitive research (Stacy, Ames, Grenard, & Wiers, 2006). These paradigms aim to reveal cognitive processes that occur automatically and therefore without the need for conscious deliberation, and spreading activation memory models (Collins & Loftus, 1975; Litz, et al., 1987) are typically used to explain their findings. For example, brief exposure to information related to the positive expected outcomes of drinking resulted in alcohol-related words being faster identified as real words, relative to neutral letter strings (Weingardt, Stacy, & Leigh, 1996). The increase in speed of response as a result of the semantically related prime was considered to be a measure of the spreading activation of alcohol-related concepts in memory. Evidence from fear appeal studies demonstrated that cognitions directly related to a threat – for example, negative outcomes associated with the behaviour – are suppressed in memory when an individual processes a low-efficacy fear appeal (Nielsen & Shapiro, 2009). Witte (1992) suggests that this suppression occurs as the individual attempts to reduce anxiety felt in the face of a behaviour that they feel is unavoidable; that is, they feel low levels of perceived behavioural control regarding the risky behaviour.

3.1.1.1 Lexical Decision Task (LDT). Within the family of word association tasks, the lexical decision task (LDT) is a commonly used measure of semantic memory structure and memory association strength. Participants are presented with a mixture of word and non-word letter strings. They are then asked to quickly, but accurately, decide whether each string represents a real word or a non-word, and to respond by pressing a button. LDT scores reflect the difference in time taken to make the word/non-word decision in an experimental category relative to a neutral or control category. Slower response times to experimental words would be assessed as suppression and faster response times as hyper-accessibility (Meyer & Schvaneveldt, 1971). In many LDT, the word or non-word letter string is preceded by a prime. The time taken to make the lexical decision is usually shorter when the word is preceded by a semantically related prime (e.g., smoke – smell) than when it is preceded by an unrelated prime (e.g., house – smell) (Neely, 1991).

Most addiction research using the LDT has been carried out in alcohol studies. Hill and Paynter (1992) found that alcohol-dependent individuals were faster at responding to alcohol words following an alcohol prime, relative to a neutral prime, in comparison to non-dependent drinkers; no differences were found in this study between non-dependent heavy and light drinkers. The LDT has successfully distinguished between problem drinkers with varying levels of psychiatric distress (Zack, Toneatto, & MacLeod, 1999), and between craving and withdrawal in early abstinence from alcohol, relative to longer periods of abstinence (Feldtkeller, Weinstein, Cox, & Nutt, 2001). The task has also been used to investigate the speed of lexical decisions in respect of aggressive words, following alcohol relative to neutral primes; significantly faster lexical decisions were made by individuals who strongly associated alcohol with aggression (Bartholow & Heinz, 2006). Although little specific smoking research has been carried out, Jarvik, Gross, Rosenblatt, and Stein (1995) demonstrated that abstinent smokers showed enhanced lexical access for smoking-related words, in comparison to neutral words, relative to non-abstinent smokers.

Recent research has begun to investigate the influence of emotional motivations on addictive behaviour. Austin and Smith (2008) determined that drinking following social conflict was associated with increased anxiety-alcohol priming, which suggests that alcohol-related concepts such as negative reinforcement expectancies can be automatically triggered by context. Furthermore, memory associations between negative emotional words and alcohol words were also found to predict alcohol use in women (Campos-Melady & Smith, 2012). The importance of word affect is debated in the literature. While some researchers argue that negative words result in slower lexical decisions than positive words (Wentura, Rothermund, & Bak, 2000), this effect was only found for a small subset of negative words in a large-scale analysis of stimuli typically used in emotional-Stroop studies (Larsen, Mercer, & Balota, 2006). Estes and Adelman (2008) also illustrated that as words increased in negativity, along a scale from highly positive to highly negative, there was a decrease in the size of the slowdown for the middle portion of that scale. Essentially, a U-shaped quadratic relationship was found. This could be likened to the inverted-U shaped relationship seen between levels of fear and attitude change (Zajonc, Crandall, Kail Jr, & Swap, 1974). In this case, individuals are not motivated to attend to messages that contain very low levels of fear, and at very levels of fear they become anxious and distracted from the message content. The top of the arc represents moderate levels of fear which lead to increased arousal, interest, and attention. If differences do exist in lexical responses to positive and negative words, it would be interesting to discover whether these differences are the result of valence alone, which may confound results in LDT tasks that use mixed positive and negative word categories, or whether the influence of valence itself differs between general words and those related to a specific behaviour; for example, those representing either positive or negative aspects of smoking.

3.1.2 Attentional bias to smoking-related cues

As described in Chapter 1 (see section 1.5.2), attentional biases to addiction-related stimuli seem especially problematic for drug users and for individuals trying to abstain (Waters & Feyerabend, 2000), and a significant body of work supports the existence of a smoking-related attentional bias (Waters & Sayette, 2006). Attentional bias can arise as a result of the initial orienting of attention towards a smoking-related cue, or it can represent the difficulty an individual may have disengaging with the cue once it has been attended to. The modified-Stroop task and the visual dot-probe task are commonly used to measure attentional bias to smoking-related cues. Whereas the former measures the level of attentional interference caused by the smoking-related cues, the latter measures the allocation and maintenance of visual attention to these cues.

3.1.2.1 Modified-Stroop Task. Modified-Stroop tasks have become the most widely used mechanism for assessing selective attention (MacLeod, 1991; J. M. G. Williams, Mathews, & MacLeod, 1996). They require an individual to identify the colour of a word, or of a border surrounding an image, while ignoring the semantic content of the stimulus itself. Each task uses words and/or images belonging to a neutral category and to one or more experimental categories. Attentional bias is measured as the degree of interference found in the colour-naming of an experimental stimulus when compared to that of a neutral stimulus. The resulting time difference is referred to as the modified-Stroop effect. Similar response patterns have been detected for threat-, hobby- and self-related words (J. M. G. Williams, et al., 1996), suggesting that the modified-Stroop effect indexes the level of activation of an individual's current concerns. MacLeod (1991) argued that environmental input related to current concerns would be more practised than less pertinent information. Therefore, even though an individual might have tried not to attend to a particular stimulus, information nevertheless flowed along an automatic pathway triggering automatic response patterns, which in turn interfered with the less practised colour-naming of the word or image border.

This sensitivity to, and fixation with, salient stimuli is present in addiction (W. M. Cox, Fadardi, & Pothos, 2006), and modified-Stroop effects have been seen across many addiction types, including alcohol (W. M. Cox, et al., 2002), nicotine (Gross, et al., 1993), and opiates (Franken, Kroon, Wiers, et al., 2000). They have been said to provide an objective index of an individual's desire to use drugs (Franken, Kroon, Wiers, et al., 2000) and they are accompanied by expected physiological reactions such as increased heart rate and skin conductance (W. M. Cox, Fadardi, & Pothos, 2006). They have also successfully distinguished abusers from non-abusers (Waters & Feyerabend, 2000) and predicted an increased potential for relapse (Waters, Shiffman, Sayette, et al., 2003). Previous smoking-related research has found modified-Stroop effects for smoking-related information, in comparison to neutral, in adult (Mogg & Bradley, 2002; Munafo, et al., 2003; Waters & Feyerabend, 2000; Wertz & Sayette, 2001) and in adolescent smokers (Zack, et al., 2001), although not all studies have successfully replicated this bias (Johnsen, et al., 1997).

Inconsistent results have also been found regarding the ability of modified-Stroop tasks to differentiate between smokers and non-smokers. Many Stroop smoking studies fail to include a non-smoking control group (Drobes, et al., 2006; Gross, et al., 1993; Mogg & Bradley, 2002; Waters, et al., 2009; Waters & Feyerabend, 2000; Waters, Shiffman, Bradley, et al., 2003; Wertz & Sayette, 2001; Zack, et al., 2001), so they are unable to demonstrate that attentional bias effects are specifically attributable to smoking status. Some studies that have included smokers and non-smoking controls have found evidence of a modified-Stroop effect in both groups (Domier et al., 2007; Johnsen, et al., 1997), while others have found no evidence of a smoking-related attentional bias in either (Fehr, Wiedenmann, & Herrmann, 2006; Waters & Li, 2008). Only the study by Munafo and colleagues (2003) successfully differentiated between smokers and non-smokers, illustrating that smokers alone were slower to colour-name smoking words in comparison to control words.

3.1.2.2 Visual dot-probe tasks. An alternate measure of attentional bias is provided by the visual dot-probe task (Posner, 1980), and this focuses on the allocation and maintenance of visual attention to experimental cues. Participants are simultaneously shown two images on screen, one experimental and the other a control. After a brief interval these images disappear and a probe is displayed either where the experimental or where the control image previously appeared. Participants respond to the location of the probe and attentional bias is measured as a faster response time to a probe that replaces an experimental image, relative to one that replaces a control image. Addiction research has demonstrated that drug users were faster to detect a probe replacing a drug-specific image relative to one replacing a neutral image (M. Field, Mogg, & Bradley, 2004; M. Field, et al., 2006; M. Field, Mogg, Zetteler, et al., 2004; Mogg, et al., 2003; Waters, Shiffman, Bradley, et al., 2003). In smoking studies, this bias has successfully differentiated between smokers and non-smokers (Bradley, et al., 2003; Hogarth, Mogg, et al., 2003).

Visual dot-probe tasks also facilitate the investigation of the effect of drug-related cues on two different aspects of attention: initial orientating and maintenance (Bradley, Field, Mogg, & Houwer, 2004). This is achieved by varying the duration of the image display prior to presenting the probe. If attentional bias is driven by initial orientation of attention, it should be evident following brief image presentations (100-200ms), whereas attentional bias to cues presented for a longer duration (2000ms) is more likely to be the result of a slow disengagement of attention. A bias in initial orientation of attention to drug cues was found for users of cocaine (Franken, Kroon, & Hendriks, 2000) and alcohol (Stormark, Field, Hugdahl, & Horowitz, 1997), although this bias was not capable of differentiating between heavy and light drinkers (M. Field, Mogg, Zetteler, et al., 2004). In contrast, a smoking study found an attentional bias to smoking-related cues in smokers, but not in non-smokers, and this bias was found for both brief (200ms) and longer (2000ms) stimulus presentation durations (Bradley, et al., 2004). Extension of the visual dot-probe task to include eye-movement tracking has also demonstrated that in addition to a bias in initial orienting to a smoking-related image, smokers also tended to gaze at smoking-related imagery for longer periods of time (M. Field, Mogg, Zetteler, et al., 2004; Mogg, et al., 2003). However, the most consistent attentional bias effects have been found at the longer stimulus presentation durations in smokers (Bradley, et al., 2003; M. Field, Mogg, & Bradley, 2004; Mogg, et al., 2003) and in alcohol users (M. Field, Mogg, Zetteler, et al., 2004).

3.1.2.3 Valence of smoking-related images. It has been suggested that inconsistent attentional bias findings in smokers and non-smokers could be the result of differential responding to the affective characteristics of the smoking images, rather than solely to their smoking properties (Carter et al., 2006; W. M. Cox, Fadardi, & Pothos, 2006). It has been observed that smokers rate the affective characteristics of smoking-related images more positively than never- and ex-smokers (van Hanswijck de Jonge &

Gormley, 2005). A positive memory bias for smoking expectancies in smokers (Leung & McCusker, 1999) might also suggest that their attention is biased towards the positive aspects of smoking-related stimuli, or it may indicate the existence of an automatic process that suppresses negative smoking-related information. In contrast, non-smokers were found to hold very negative attitudes towards smoking. These are likely to be reinforced by public health policies, smoking bans, and ongoing exposure to negative smoking-related information in the media. It is possible that these negative aspects of smoking represent a current concern for non-smokers, which may lead to an associated attentional bias for negative smoking-related information in this group (W. M. Cox, Fadardi, Klinger, Wiers, & Stacy, 2006). Conversely, their attention may be captured by seemingly incongruent positive depictions of smoking.

The influence of the affective properties of drug-related cues was initially investigated in alcohol studies, and results were mixed. One study found similar levels of attentional bias in both an alcohol-dependent and a control group, and each demonstrated greater levels of bias for alcohol-related, in comparison to positive and negative general words (Bauer & Cox, 1998). However, a similar study found no evidence of an attentional bias for alcohol-related relative to negative emotional words in an alcohol-dependent group (Stormark, Laberg, Nordby, & Hugdahl, 2000). A subsequent Stroop smoking study found no differences in Stroop effects in recent smokers and non-smokers for positive and negative emotional words, relative to neutral words, but they did find that abstinent smokers showed less interference for emotional words than those who had just smoked (Powell, et al., 2002). Bradley, Field, Healy, and Mogg (2008) also investigated the differences in attentional bias to positive and negative portrayals of smoking using both short (200ms) and long (2000ms) stimulus presentation durations in a visual dot-probe study. Greater attentional bias was found in smokers relative to non-smokers, but only for smoking cues presented for 2000ms, and they found that this attentional bias was not impacted by the affective properties of the smoking-related images.

3.1.3 Aims of the current study

This study will examine implicit reactions to positive and negative smoking words and images, in comparison with general-positive, general-negative, and neutral stimuli. It will attempt to determine whether positive smoking-related information is hyper-accessible and particularly attention-grabbing for smokers, and whether they appear to employ some form of automatic suppression process for negative smoking-related information. It will also examine the utility of three implicit cognitive paradigms – the LDT, the modified-Stroop task, and the visual dot-probe task - as measures of affective salience. A clearer understanding of the differences between smoker and non-smoker affective evaluations of smoking-related cues will provide further insight into the cognitive biases associated with smoking. Given the age-related smoking expectancy differences found in the previous study, the influence of age will also be examined in this study. Taken together, the results of these analyses will also help to explain some of the inconsistent attentional bias results seen across previous research findings.

This study had three main aims. First, it aimed to measure the accessibility of valenced (positive or negative depiction) smoking-related words in comparison to neutral words, and to valenced general words, in smokers and non-smokers of different ages. As the aim was to investigate naturally occurring memory biases, an unprimed version of the LDT was used. This is one of the simplest forms of the LDT and it has been used to investigate the natural cognitive processing of salient information (Geer & Bellard, 1996). By removing the added complexity of priming stimuli, lexical decisions based on more natural thought processes can be examined and potential confounds deriving from experimental procedures or experimental demand can be avoided. It was hypothesised that smokers, in comparison to non-smokers, would make faster lexical decisions to smoking-related words than to general or to neutral words, and in line with the smoking expectancy results in Study 1, smokers were predicted to most quickly identify smoking-positive words. Additionally, smokers' response latencies to smoking-negative words were also expected to be longer than to all other word categories if automatic smoking-related suppression processes were operating. The magnitude of smoking status biases were also predicted to vary with age.

Second, the study aimed to use a pictorial modified-Stroop task as an interference-based measure of attentional bias for valenced smoking-related images, relative to valenced general images, and to neutral images, in smokers and non-smokers of different ages. It was predicted that smokers and non-smokers of all ages would demonstrate an attentional bias for smoking-related cues in comparison to general and to neutral cues. It was further predicted that smokers would display a stronger attentional bias towards smoking-positive images, relative to both general-positive and to smoking-negative images. In contrast, non-smokers were expected to exhibit a stronger attentional bias to smoking-negative images, in comparison to both general-negative and to smoking-positive images. It was also expected that these differences would change with age.

Finally, the study aimed to examine differences in maintenance of attention to valenced smoking-related images, relative to valenced general images, and to neutral images, in smokers and non-smokers of different ages, using a visual dot-probe task. It was hypothesised that smokers and non-smokers of all ages would demonstrate an attentional bias for smoking-related cues in comparison to general and to neutral cues. Again, smokers were expected to demonstrate greater attentional bias for smoking-positive images, but the stronger bias in non-smokers was predicted to be for the smoking-negative images. Again, these patterns of bias were expected to differ with age. Given that memory accessibility and attentional biases are thought to index drug-use motivation, it was also predicted that scores for the LDT, the modified-Stroop, and the dot-probe tasks would cohere.

3.2 Method

3.2.1 Participants

The 231 participants from Study 1 were invited to take part in this study. One hundred and eighty-two participants volunteered, and they were again grouped by smoking status (smoker and non-smoker) and age (adolescents: 15 to 18 years, young adults: 19 to 25, and older adults: 26 to 40). Groups comprised of 86 smokers (30, 27, 29) and 96 non-smokers (37, 30, 29). A full breakdown of participant characteristics is presented with the results. The study was approved by the School of Psychology Research Ethics Committee in Trinity College Dublin. Parental consent was provided for participants under the age of 18. This was sought at the same time as the consent for Study 1. All participants provided formal written consent prior to commencing the study (see Appendix 2). All participants also had normal or corrected-to-normal eyesight.

3.2.2 Measures

Demographic information had been provided in the course of Study 1. Participants were asked to confirm their smoking status and no changes were reported. Computerised versions of each task were used. They were designed using Super Lab 4 (Cedrus Corporation, San Pedro, CA, USA) stimulus-presentation software and were run on a laptop computer with a 12-inch screen. Participants were seated approximately 500 mm from the screen and responses were made using a standard QWERTY keyboard.

3.2.2.1 Lexical decision task (LDT). This study used an unprimed LDT task which consisted of 116 trials: 12 practise trials containing six neutral words and six matched non-word letter strings; 4 repeat practise trials at the start of the experimental block, the responses to which were later discarded; and 100 randomised experimental trials containing 50 words (10 smoking-positive, 10 smoking-negative, 10 general-positive, 10 general-negative, and 10 neutral) and 50 matched non-word letter strings. Each target stimulus was presented once. On each trial, a fixation cross was presented in the centre of the screen for 150 ms, immediately followed by the target stimulus. This was presented as a white lowercase letter string, 2 cm in height, against a black background. Participants were asked to respond as quickly and accurately as possible and to categorize target stimuli as words or non-words by pressing the “*b*” key for word responses and the “*m*” key for non-word responses. “*Yes*” and “*No*” stickers ensured that these two keys were clearly identified. The stimulus remained on-screen until a response had been entered.

The positive and negative smoking-related words were taken from those used in three previous studies (Mogg & Bradley, 2002; Waters & Feyerabend, 2000; Zack, et al., 2001). The general positive and negative words were taken from the affective word lists used by Zack and colleagues (1999). Sixteen neutral words were selected from neutral categories also used in previous studies (Hester, Dixon, & Garavan, 2006; Mogg & Bradley, 2002; Waters & Feyerabend, 2000; Waters, Shiffman, Bradley, et al., 2003); 10 formed the neutral category, and six were used for practise trials. The words in each of the categories are listed in Table 3.1. The procedure used by Zack and colleagues (1999) was followed when creating matching non-word letter strings for each category. The aim was to generate pronounceable representations of real words, so smoking and general words were each matched by frequency and length to another word in print using Leech, Rayson, and Wilson’s (2001) word frequency counts. One vowel and one consonant were then randomly replaced in each of these words to create the non-word letter string.

Table 3.1 *The Smoking, General, and Neutral Words used in the Lexical Decision Task*

Smoking		General		Neutral	Practise
Negative	Positive	Negative	Positive		
Ash	Fags	Weak	Glad	Sand	Bus
Lung	Pack	Pain	Safe	Pond	Sign
Urge	Drag	Sick	Warm	Barn	Silver
Smell	Slim	Ugly	Enjoy	Ocean	Curtain
Bored	Smoke	Dirty	Caring	Adapt	Welcomed
Habit	Inhale	Lonely	Embrace	Handle	Evidence
Cancer	Exhale	Stupid	Worship	Bathroom	
Stressed	Matches	Failure	Glorious	Keyboard	
Anxious	Cigarette	Unhappy	Cheerful	Telephone	
Desperate	Tobacco	depressed	Affection	Invitation	

3.2.2.2 Modified-Stroop task. A pictorial modified-Stroop task was used in which each stimulus comprised of a colour image (300 x 300 pixels) within a border of a single colour (10 pixels). Five categories of experimental stimuli were created: smoking-negative, smoking-positive, general-negative, general-positive, and neutral. Each category contained seven images and each image was displayed in combination with each of four border colours: blue, green, red, and yellow. The set of smoking-related images was created using 13 previously validated images (van Hanswijck de Jonge & Gormley, 2005) and one widely used pictorial health warning (Physicians for a Smoke-Free Canada, 2010). The health warning image was included to ensure that a strongly negative smoking-related image was represented. The general images were taken from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005) and each was selected to match the valence, emotional intensity, and complexity of a particular smoking-related image (M. A. Miller & Fillmore, 2010). Seven IAPS pictures with neutral valence ratings were selected for the neutral category. An additional four images (two smoking and two general) were created specifically for use as practise trials. All images used are available in Appendix 4.

Image categories were presented in blocked format to control for inter-trial carry over effects (Waters, Sayette, & Wertz, 2003). A 32-trial practise block was presented first to minimise learning effects, followed by the experimental blocks of 28-trials which were counterbalanced across participants. Trials were presented randomly within a block. Each trial was initiated by the central presentation of a fixation cross for 150 ms followed by the image which remained on-screen until a response was given. Participants were instructed to identify the border colour and to respond as quickly and accurately as possible. Responses were input using the keyboard with coloured stickers used to minimise errors: blue on ‘p’, green on ‘]’, yellow on ‘#’, and red on ‘;’. Participants were given a 30-second break between experimental blocks.

3.2.2.3 Visual dot-probe task. The visual dot-probe task was based on that used by Mogg and colleagues (2003) and it consisted of 115 trials: 16 practise trials and three buffer trials each containing paired neutral images, and 96 randomised experimental trials consisting of four presentations of each of four smoking-negative/general-negative (SN-GN) image pairs, four smoking-negative/neutral (SN-NU) pairs, four general-negative/neutral (GN-NU) pairs, four smoking-positive/general-positive (SP-GP) pairs, four smoking-positive/neutral (SP-NU) pairs, and four general-positive/neutral (GP-NU) pairs. Each trial was initiated by the central presentation of a black fixation cross against a white screen for 150 ms, then two images (850 x 850 mm) were displayed; one vertically centred 1700 mm from the left hand side of the screen and the other vertically centred 1700 mm from the right hand side of the screen. The images remained on the screen for 2000 ms. A black asterisk symbol (5x 5) was then displayed where one of the two pictures had previously been shown. Participants were asked to identify which side of the screen the symbol appeared on, and to respond as quickly and as accurately as possible. Responses were input using the keyboard with "Left" and "Right" stickers used to minimise errors: Left on 'a' and Right on 's'. The inter-trial interval was 500ms. Each pair of images appeared four times: for example, an SN-GN pair would appear (1) SN left GN right, symbol replaces SN on the left; (2) SN left GN right, symbol right; (3) GN left SN right, symbol left; and (4) GN left SN right, symbol right.

Images for the dot-probe task were selected using the same procedures as those used for the modified-Stroop task. Eight smoking-positive and five smoking-negative images were drawn from previous research (van Hanswijck de Jonge & Gormley, 2005). An additional three pictorial health warnings (Physicians for a Smoke-Free Canada, 2010) were also used in the smoking-negative category. Eight general-positive, eight general-negative, 16 neutral, and four practise images were selected from the IAPS (Lang, et al., 2005) system. All images are available in Appendix 5.

3.2.2.4 Stimulus ratings. Participants were required to provide an affect-based rating, on a scale from 1 (very negative) to 8 (very positive), for all smoking-related words and images used in the above tasks.

3.2.3 Procedure

Adolescents were individually tested on school premises. Parental consent was sought in advance of the test date and only those volunteers with this consent proceeded to testing. Adults were also tested individually, in Trinity College Dublin or, as in Study 1, in a quiet room in their home or office[2]. Smokers were instructed to smoke as normal on the day of testing. Upon arrival and consent, participants were asked to confirm their smoking status. They were also asked if their smoking behaviour had changed since they were tested in Study 1. Participants then completed the LDT, the modified-Stroop task, and the dot-probe task in a random sequence, and finally the image rating task. On average, 8.30 days (*SD* = 19.44) elapsed between Study 1 and Study 2 testing.

3.2.4 Data analysis

All data analyses were carried out using SPSS 19 (SPSS Inc., Chicago, Illinois 60606, US). Raw reaction time (RT) data for the LDT, the modified-Stroop task, and the visual dot-probe task were examined for errors and outliers. No participant outliers were found. Error trials and trial-level outliers three times the inter-quartile range beyond the 25^{th} and 75^{th} percentiles were removed prior to further analysis. Participant valence ratings for the smoking-related stimuli in each task were then examined to confirm that a significant rating difference existed between smoking-positive and smoking-negative stimuli in each case, and that this difference was found in the expected direction. Following the analysis of each task, LDT, modified-Stroop, and visual dot-probe scores were correlated to examine the relationships between the tasks themselves.

---

[2] Analyses confirmed that no significant differences were found for LDT, modified-Stroop, or dot-probe results, between those tested in Trinity College Dublin and those tested elsewhere.

3.2.4.1 LDT analysis. . In order to examine differences in lexical decision speed for the different word categories, mean LDT RTs were first analysed using a 2 (smoking status) x 3 (age) x 3 (word: smoking, general, neutral) mixed factorial ANOVA. The influence of word valence in the smoking and general categories was then examined using a 2 (smoking status) x 3 (age) x 2 (word) x 2 (valence) mixed factorial ANOVA. The first analysis was conducted to specifically determine the effect of the neutral category, as the inclusion of valence in the second analysis necessarily required the neutral category to be excluded. Given that primed LDT tasks are more usual in addiction research, an *a posteriori* analysis was also carried out to examine the differential influence of valence in those participants who completed the LDT first (unprimed) and those who completed the LDT last (primed by having completed the modified-Stroop and dot-probe tasks). Pearson correlations were run to investigate the relationships between the LDT RTs and smoking expectancy and suppression scores (Study 1) for this set of participants. Associations between smokers' LDT RTs and smoking-behaviour variables such as cigarette use and smoking intentions were also examined.

3.2.4.2 Modified-Stroop analysis. Modified-Stroop attentional bias scores were also first analysed using a 2 (smoking status) x 3 (age) x 3 (image: smoking, general, neutral) mixed factorial ANOVA. The influence of image valence in the smoking and general categories was then examined using a 2 (smoking status) x 3 (age) x 2 (image) x 2 (valence) mixed factorial ANOVA. Pearson correlations were again used to investigate the relationships between modified-Stroop scores, smoking expectancies, suppression, and smoking behaviour in smoker groups.

3.2.4.3 Visual dot-probe analysis. Six pairs of images were used in this task and they have been named such that the 'target' image (i.e., the image which is predicted to be more likely to grab attention) is listed first, followed by the control image; for example, SN is the target image and GN the control image in the SN-GN group. Following the procedures used in previous visual dot-probe studies (Mogg, et al., 2003), mean RT congruent scores were calculated by combining all trials where the probe replaced the target image; this included the trials where the target and probe appeared on the left and those where they appeared on the right. Mean RT incongruent scores were calculated by combining all trials where the probe replaced the control image. Finally, mean dot-probe attentional bias scores are calculated as Mean RT incongruent minus Mean RT congruent, such that positive values indicated vigilance for target images. Mean dot-probe attentional bias scores were first analysed using a 2 (smoking status) x 3 (age) x 6 (image pairing) mixed factorial ANOVA. The four experimental-neutral image pairs were then analysed used a 2 (smoking status) x 3 (age) x 2 (image) x 2 (valence) mixed factorial ANOVA to investigate whether valence influenced attentional bias to smoking images differently to general images. To test the hypothesis that smoking-related attentional biases may be influenced by the control images (general and neutral) used, separate 2 (smoking status) x 3 (age) x 2 (image pairing) mixed factorial ANOVAs of the SN-GN and SN-NU pairings and of the SP-GP and SP-NU pairings were run. Pearson correlations were used to analyse the relationships between dot-probe attentional bias, smoking expectancies, suppression, and smoking behaviour in smoker groups.

3.3 Results and Discussion

The demographic profiles of the full sample, and of each age group, are presented in Table 3.2 along with the average use and dependence characteristics of each smoking group.

Table 3.2 *Demographic profile, Means (Standard Deviations), of Smoker and Non-smoker Participants including a Breakdown for each Age Group*

	All Participants		Adolescents		Young Adults		Older Adults	
	Smoker *n* = 86	Non-S *n* = 96	Smoker *n* = 30	Non-S *n* = 37	Smoker *n* = 27	Non-S *n* = 30	Smoker *n* =29	Non-S *n* = 29
Female	49	63	17	21	17	22	15	20
Male	37	33	13	16	10	8	14	9
Age	24.62 (7.15)	23.37 (7.16)	17.44 (.92)	16.66 (.90)	23.26 (2.06)	22.88 (1.89)	33.30 (3.9)	32.42 (4.95)
Smoking History								
Age Start	14.83 (2.66)		13.93 (0.18)		15.63 (2.59)		15.00 (3.11)	
Age Daily	15.79 (4.33)		13.33* (5.51)		17.54 (2.4)		16.91 (2.81)	
Yrs Smoking	9.79 (7.14)		3.51 (1.58)		7.63 (3.66)		18.30 (4.24)	
Years Daily	7.99 (7.09)		1.90 (1.24)		5.82 (3.62)		16.37 (4.46)	
Cig per Day	9.05 (6.27)		6.98 (5.22)		8.39 (6.23)		11.74 (6.51)	
FTND	2.16 (2.32)		2.03 (2.08)		2.04 (2.62)		2.41 (2.29)	
HONC	27.06 (8.21)		26.10 (10.68)		25.85 (7.54)		29.17 (5.18)	

Note. *Not all smokers are daily smokers but those that are started younger.

3.3.1 LDT task

3.3.1.1 LDT results. Mean LDT RTs generated by each group for smoking, general, and neutral word categories, and for positive and negative smoking and general words, are presented in Table 3.3.

Table 3.3 *Mean (Standard Deviation) LDT RTs (ms) for Smoking (positive and negative), General (positive and negative), and Neutral Words by Age and Smoking Status*

	Adolescents		Young Adults		Older Adults	
	Smoker *n* = 30	Non Smoker *n* = 37	Smoker *n* = 27	Non Smoker *n* = 30	Smoker *n* = 29	Non Smoker *n* = 29
Smoking	1008.82 (221.23)	978.51 (141.24)	940.66 (154.89)	965.24 (148.94)	953.93 (144.80)	938.17 (120.54)
Negative	1005.29 (181.13)	970.98 (169.91)	947.93 (170.06)	956.02 (156.13)	943.87 (148.03)	925.51 (125.22)
Positive	1006.83 (260.90)	983.30 (165.78)	932.25 (148.64)	974.68 (153.16)	963.35 (157.86)	947.88 (134.64)
General	1004.39 (204.31)	934.78 (114.96)	910.62 (123.23)	962.41 (168.41)	947.93 (160.21)	927.60 (127.19)
Negative	953.26 (189.59)	917.48 (107.00)	912.87 (150.53)	935.14 (137.27)	936.92 (146.18)	918.10 (138.39)
Positive	1053.89 (238.53)	950.09 (136.49)	905.21 (124.26)	989.07 (208.57)	957.06 (199.90)	934.71 (124.99)
Neutral	1083.91 (290.16)	1010.78 (171.50)	961.70 (146.35)	990.31 (177.95)	956.94 (144.41)	923.19 (102.14)

Prior to carrying out the LDT analysis, participant valence ratings for smoking-related words were validated using paired-sample *t*-tests with Bonferroni corrections for multiple comparisons. An analysis of the mean participant feeling scores for the positive and negative LDT smoking-related words revealed that all participants rated the smoking-positive words significantly more positively than the smoking-negative words (see Table 3.4). Furthermore, the same rating pattern was observed in the different smoking status and age groups.

Table 3.4 *Mean (Standard Deviation) Participant Rating Scores for the LDT Smoking-Positive and Smoking-Negative words*

Group	Smoking-Positive	Smoking-Negative	t(df)	p	Cohen's *d*
All Participants	4.72 (1.39)	2.09 (0.98)	*t*(181) = 28.00	<.001	2.08
Smoker	5.58 (1.17)	2.25 (0.75)	*t*(85) = 28.31	<.001	3.05
Non-Smoker	3.94 (1.09)	1.96 (1.13)	*t*(95) = 18.54	<.001	1.89
Adolescent	4.80 (1.64)	2.26 (1.29)	*t*(66) = 14.10	<.001	1.72
Young Adult	4.91 (1.06)	2.04 (0.71)	*t*(56) = 19.75	<.001	2.61
Older Adult	4.43 (1.34)	1.95 (0.75)	*t*(57) = 16.67	<.001	2.19

Mean RTs were first analysed using a 2 x 3 x 3 mixed factorial ANOVA with smoker status (smoker and non-smoker) and age (adolescent, young adult, and older adult) as the between-group variables, and word type (smoking, general, and neutral) as the within-group variable. A main effect of word type, $F(2, 352) = 14.54$, $p < .001$, $\eta_p^2 = .08$, and a significant age by word type interaction, $F(4, 352) = 4.93$, $p < .001$, $\eta_p^2 = .05$ were found. As illustrated in *Figure 3.1*, a simple main effect of word was observed in the adolescent ($F(2,65) = 13.74$, $p < .001$, $\eta_p^2 = .30$) and in the young adult ($F(2,55) = 5.24$, $p < .01$, $\eta_p^2 = .16$) groups. Paired t-tests, with Bonferroni corrections, demonstrated that neutral words took significantly longer to '*pop-out*' than general words, for both adolescents ($t(66) = 4.93$, $p < .001$, two-tailed, $d = .60$) and young adults ($t(56) = 3.23$, $p < .01$, two-tailed, $d = .43$). Adolescents also recognised neutral words significantly more slowly than smoking words ($t(5) = 3.08$, $p < .01$, two-tailed, $d = .38$).

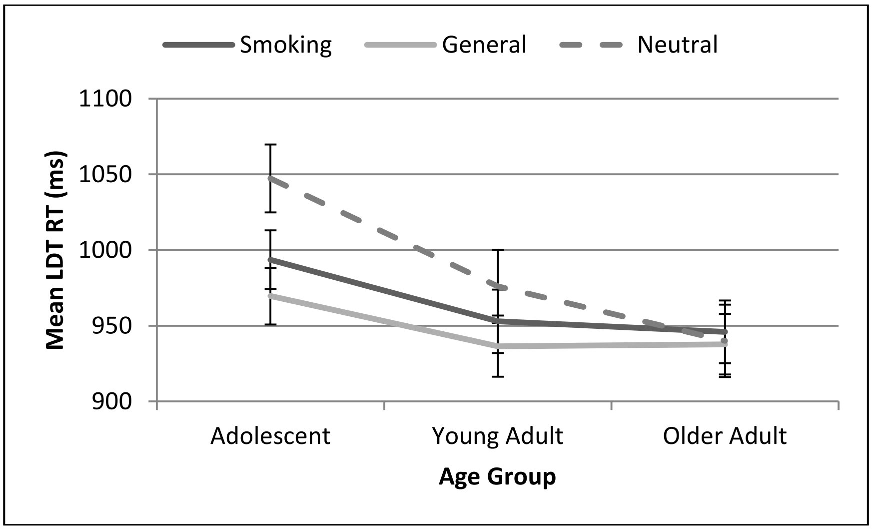


Figure 3.1. Mean smoking, general, and neutral LDT RTs (ms) by age group. Error bars represent standard errors.

In order to further investigate the influence of valence within the smoking and general word categories, Mean RTs were analysed using a 2 x 3 x 2 x 2 mixed factorial ANOVA with smoker status and age as the between-group variables, and word type (smoking and general) and valence (negative and positive) as the within-group variables. A main effect of word type, $F(1, 176) = 7.80$, $p < .01$, $\eta_p^2 = .04$, a main effect of valence, $F(1, 176) = 2.98$, $p < .01$, $\eta_p^2 = .07$, and a significant word type by valence interaction, $F(1, 176) = 4.30$, $p < .05$, $\eta_p^2 = .02$ were found. As illustrated in *Figure 3.2*, general-negative words were identified significantly faster than smoking-negative words ($t(181) = 3.90$, $p < .001$, two-tailed, $d = .29$) and general-positive words ($t(181) = 4.14$, $p < .001$, two-tailed, $d = .31$). No significant 4-way interaction was observed, although both the word type by smoker by age interaction ($F(2, 176) = 3.01$, $p = .052$, $\eta_p^2 = .03$) and the valence by smoker by age interaction ($F(2, 176) = 2.98$, $p = .054$, $\eta_p^2 = .03$) approached significance.

Finally, no significant correlations were found between LDT scores and either smoking expectancy or suppression scores as measured in Study 1. Nor were any significant correlations found between LDT scores and smoking-behaviour variables in smokers of any age.

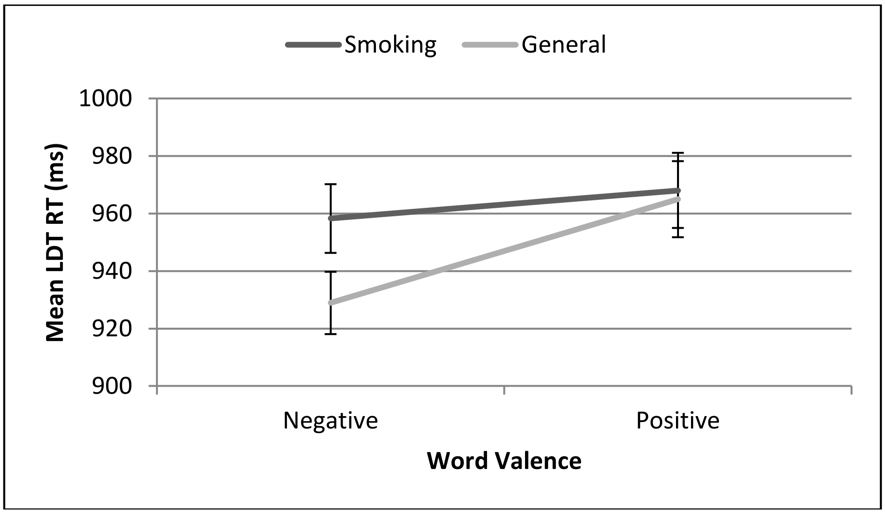


Figure 3.2. Mean smoking and general LDT RTs (ms) by word valence. Error bars represent standard errors.

'A posteriori' analysis of a potential priming effect. As primed versions of the LDT are more widely used than those with no priming mechanism, an analysis was carried out to determine if the observed results for the subset of participants who completed the LDT first (n = 61), would differ from those who completed it last (n = 62). It is possible that completing the modified-Stroop and dot-probe tasks could have had some priming impact for the latter group. Mean RTs were analysed separately for each group using a 2 (smoking status) x 3 (age) x 2 (word type) x 2 (valence) mixed factorial ANOVA. In the LDT-first group, a significant main effect of valence, $F(1, 55) = 5.36$, $p < .05$, $\eta_p^2 = .09$ was found, and the word type by valence interaction ($F(1, 55) = 3.98$, $p = .051$, $\eta_p^2 = .07$) approached significance. These results were qualified by a significant smoking status by age by valence interaction, $F(2, 55) = 4.48$, $p < .05$, $\eta_p^2 = .14$. In order to identify the source of the 3-way interaction, separate 2 (smoking status) x 2 (valence) ANOVAs were carried out for each age group. A significant main effect of valence, $F(1, 18) = 6.55$, $p < .05$, $\eta_p^2 = .27$ was found for older adults; they were slower to recognise positive words (M = 969.34, SD = 106.02) than negative words (M = 934.69, SD = 130.25). No other effects remained significant when adjustments were made for multiple comparisons.

In the LDT-last group, a main effect of valence, $F(1, 56) = 6.43$, $p < .05$, $\eta_p^2 = .10$, and a significant 4-way interaction, $F(2, 56) = 3.67$, $p < .05$, $\eta_p^2 = .12$ were found. In order to identify the source of the 4-way interaction, separate 2 (smoking status) x 2 (word) x2 (valence) ANOVAs were carried out for each age group. A significant main effect of valence, $F(1, 21) = 4.46$, $p < .05$, $\eta_p^2 = .18$, and a significant word by valence by smoking status interaction, $F(1, 21) = 5.02$, $p < .05$, $\eta_p^2 = .19$, was found for adolescents. Post-hoc analysis revealed a word by valence interaction for adolescent smokers, $F(1, 10) = 13.18$, $p < .01$, $\eta_p^2 = .57$ (see *Figure 3.3*). Paired sample *t*-tests found that adolescent smokers were significantly faster at recognising smoking-negative words relative to smoking-positive words, $t(10) = 2.55$, $p = .029$, two-tailed, $d = .77$, smoking-positive words relative to general-positive words $t(10) = 2.43$, $p = .036$, two-tailed, $d = .73$, and general-negative words relative to general-positive words, $t(10) = 4.11$, $p = .002$, two-tailed, $d = 1.24$. Only last difference remained significant when results were adjusted for multiple comparisons. No significant differences were found for adolescent non-smokers.

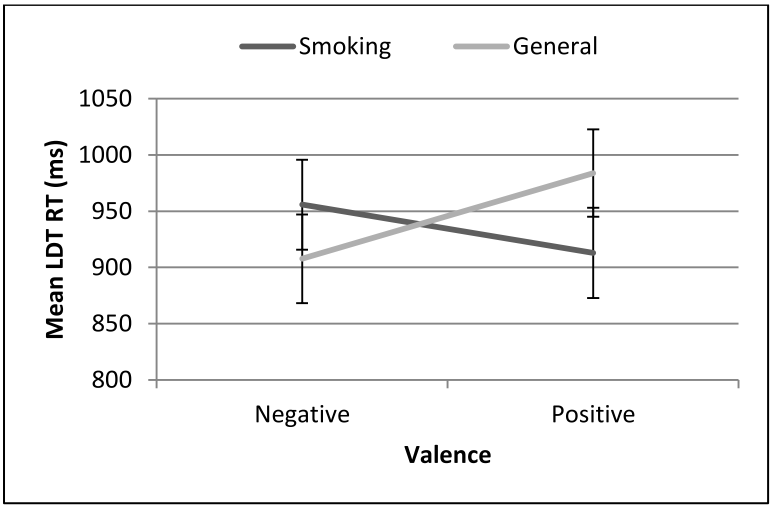


Figure 3.3. Adolescent smoker mean LDT RTs for negative and positive, smoking and general words. Error bars represent standard errors.

No significant results were found for young adults, while a significant valence by smoking status interaction was found for older adults, $F(1, 18) = 4.58$, $p < .05$, $\eta_p^2 = .20$. However, these differences did not remain significant when Bonferroni corrections were made (see *Figure 3.4*).

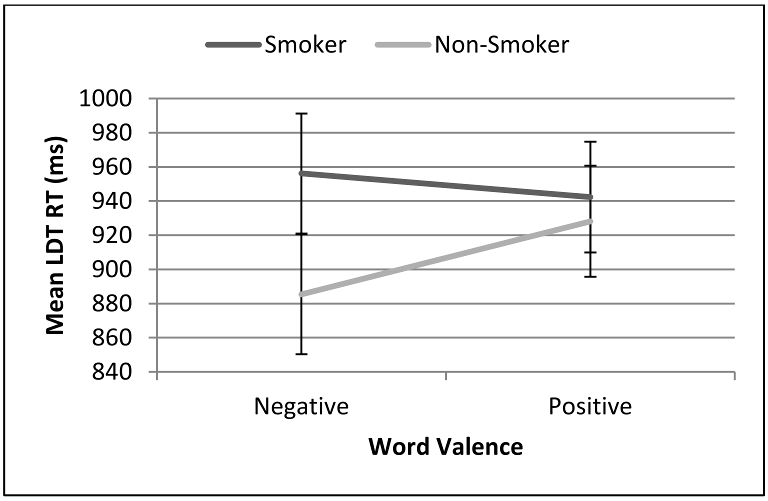


Figure 3.4. Older adult mean valence LDT RTs (ms) by smoking status. Error bars represent standard errors.

Finally, correlations were rerun for the LDT-last group to investigate whether priming would influence association between LDT scores, smoking expectancies, suppression measures, and smoking-behaviour variables. The only significant correlations found were in the non-smoker group; significant medium-sized negative correlations were found between the strength of explicit SCQ endorsement of negative smoking expectancies and LDT RTs for smoking-negative ($r = -.37$, $p < .05$), and for general-positive ($r = -.44$, $p < .05$).

3.3.1.2 LDT discussion. Using an unprimed LDT, this study first measured the accessibility of smoking words, relative to general and to neutral words. Contrary to expectations, no significant difference was found between the speed of lexical decisions to smoking and to general words in any group, but all participants were faster at recognising both smoking and general words, relative to neutral words. This suggests that any form of affective content will speed up word recognition, which is unsurprising given that affective stimuli have been shown to capture attention and to produce interference to a greater extent than neutral stimuli (J. M. G. Williams, et al., 1996). As a result, when addiction-related words are examined relative to neutral words, some element of the difference found between participant responses to each will be accounted for by the mere fact that the addiction-related words are likely to incorporate affective properties.

To investigate the influence of affect more specifically, this study measured the accessibility of positive and negative smoking-related words, in comparison to positive and negative general words, across the smoking-status and age groups. Contrary to expectations, smokers did not make faster lexical decisions to smoking-positive words relative to non-smokers, nor were they faster at identifying smoking-positive words relative to the other word categories. Smokers were also expected to demonstrate longer response times to smoking-negative words if automatic smoking-related suppression processes were operating, but this prediction was not supported. Instead, all participants were found to make faster lexical decisions for general-negative words relative to general-positive and to smoking-negative words. This difference was not found between smoking-negative and smoking-positive words. Taken together, these observations challenge previous research which found slower lexical decisions for negative words (Estes & Adelman, 2008; Wentura, et al., 2000), and that which found no difference between lexical responses to positive and to negative words (Larsen, et al., 2006). The fact that general-negative words are identified faster on an unprimed LDT for all participants, regardless of age or smoking status, suggests the existence of a natural automatic vigilance for these words which improves lexical decision speed (Houwer & Hermans, 1994). It should be noted that no age-related differences were found in LDT responding.

The lack of expected findings may also have been due to the unprimed nature of the LDT. Although an unprimed task has successfully been used to investigate naturally occurring memory biases (Geer & Bellard, 1996), and it has demonstrated a natural vigilance for general-negative words in this study, the task may be limited in terms of its ability to differentiate between smoker and non-smoker responses to the affective characteristics of smoking and general words. Primed LDT tasks are more common in addiction research and they have successfully demonstrated faster lexical decisions for addiction-related words (Hill & Paynter, 1992; Jarvik, et al., 1995; Weingardt, et al., 1996). To investigate further, participants who completed the LDT first (unprimed) were compared to those who completed it last (primed by the modified-Stroop and visual dot-probe tasks). Word valence remained the only means of differentiating between LDT responses in the unprimed group, but different patterns of responding emerged across the smoking-status and age groups when primed.

Non-smokers continued to display faster lexical decisions for negative words, relative to positive words. In contrast, age-related differences were found in the smoking group. General-negative words were more easily identified than both general-positive and smoking-negative words by adolescents. No differences were found among adult smokers. These results could be interpreted as younger smokers managing to suppress or inhibit negative information that specifically relates to smoking (Slovic, et al., 2004), even though they show vigilance for general-negative information. Of additional importance was the finding that smoking-positive words were more accessible than general-positive words for adolescent smokers in this primed group, whereas older adults were faster at recognising the general-positive words. This finding supports the Study 1 observation of a positivity bias for smoking-related information in smokers, but one that declines with age.

Although the unprimed LDT did not prove to be successful in detecting differences in the memory accessibility of positive and negative smoking-related information across the groups, results from the primed LDT demonstrated the merit of continuing to examine the affective characteristics of smoking-related cues. Furthermore, the nature of this particular priming effect is likely to have been more subtle than measuring lexical decision speed immediately following a prime, and it can therefore be argued that it provides a measure of a more natural bias towards positive smoking-related information, and the suppression of negative smoking-related information, in adolescent smokers.

Some methodological limitations should also be taken into account in the interpretation of the LDT findings. The examination of the LDT-last group demonstrated some smoking status and age-related differences in responding, but not all of these remained significant when results were adjusted for multiple comparisons. As this analysis could only be carried out with one third of the total participants, individual group sizes were very small and it is likely that the analyses were under-powered as a result. It would be important to replicate these findings with a more suitable sample size.

Also, the LDT used smoking-related words from published smoking-Stroop studies, so the valance classifications made for these words were based on the categories to which the words belonged in the original study. Participant ratings for smoking-negative words were significantly lower than for smoking-positive words, although the words themselves varied in affective strength which may have influenced lexical decision speed when compared to strongly positive and negative general words. It is also possible that participants would have had difficulty in identifying some of the words as being related to smoking; for example, bored, anxious, slim, and pack. It would be interesting for future research to investigate lexical decision speed to different word categories using a blocked design, so that it would be more evident which category each of the words belonged to. It is also possible that the priming effect seen in the LDT-last group is due to the fact that participants were more aware of the different stimulus categories and thus words related to smoking were more readily interpreted as such when the LDT task came last. It would have been preferable to be able to select these words from a single validated set of valenced smoking-related words, but no systematic review has been carried out to examine the saliency and emotional ratings of the smoking-related words used in so many addiction studies. Given that images used in similar addiction studies are subject to rigorous salience, feeling, and arousal rating examination, research is required to establish a similarly validated list of smoking-related words.

3.3.2 Modified-Stroop task

3.3.2.1 Modified-Stroop results. Mean modified-Stroop RTs generated by each group for smoking, general, and neutral images, and for positive and negative smoking and general images, are provided in Table 3.5.

Table 3.5 *Mean (Standard Deviation) Stroop RTs for Smoking (positive and negative), General (positive and negative), and Neutral Images by Age and Smoking Status*

	Adolescents		Young Adults		Older Adults	
	Smoker	Non Smoker	Smoker	Non Smoker	Smoker	Non Smoker
	n = 30	n = 37	n = 27	n = 30	n = 29	n = 29
Smoking	903.33 (223.26)	819.35 (111.07)	800.02 (113.39)	803.49 (109.33)	813.90 (103.21)	825.73 (110.97)
Negative	914.57 (229.71)	840.98 (136.29)	812.19 (121.28)	824.70 (120.49)	828.06 (126.65)	833.25 (114.97
Positive	885.99 (233.77)	795.10 (99.21)	786.65 (116.89)	781.54 (106.27)	799.74 (96.73)	819.52 (117.17)
General	842.59 (103.75)	806.54 (110.01)	791.26 (109.84)	777.44 (99.92)	801.27 (101.97)	814.57 (114.80)
Negative	852.53 (119.08)	809.15 (107.08)	810.29 (133.60)	789.34 (114.10)	811.66 (122.62)	836.05 (117.57)
Positive	839.33 (116.37)	809.71 (150.23)	766.45 (98.16)	768.10 (100.64)	790.69 (103.05)	793.97 (124.50)
Neutral	816.55 (105.99)	804.49 (102.40)	779.13 (100.57)	776.39 (108.82)	777.51 (100.48)	787.86 (101.56)

Mean Stroop RTs were first analysed using a 2 x 3 x 3 mixed factorial ANOVA with smoker status and age as the between-group variables, and image (smoking, general, and neutral) as the within-group variable. A main effect of image, $F(2, 352) = 18.93$, $p < .001$, $\eta_p^2 = .10$, and a significant image by age by smoking status interaction, $F(4, 352) = 2.52$, $p < .05$, $\eta_p^2 = .03$ were found. In order to identify the source of the 3-way interaction, separate 2 (smoking status) x 3 (image) ANOVAs were carried out for each age group. A significant smoking status by image interaction was found for adolescents, $F(2,130) = 3.77$, $p < .05$, $\eta_p^2 = .06$. As illustrated in *Figure 3.5*, post-hoc analysis revealed a significant main effect of image in the adolescent smoking group, $F(2,58) = 6.69$, $p < .01$, $\eta_p^2 = .19$. A Stroop effect was found for the smoking-related images, in comparison to neutral ($p < .05$). No other significant results were found.

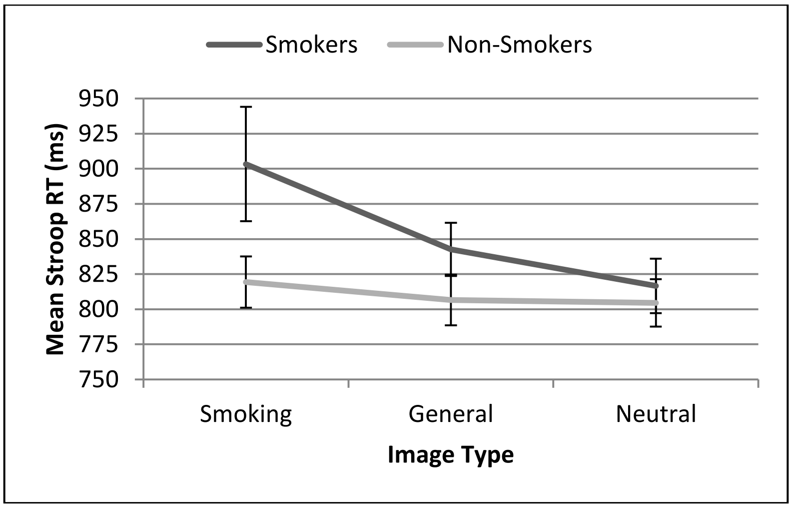


Figure 3.5. Mean Stroop RTs for each main image category in the adolescent smoking and non-smoking groups. Error bars represent standard errors.

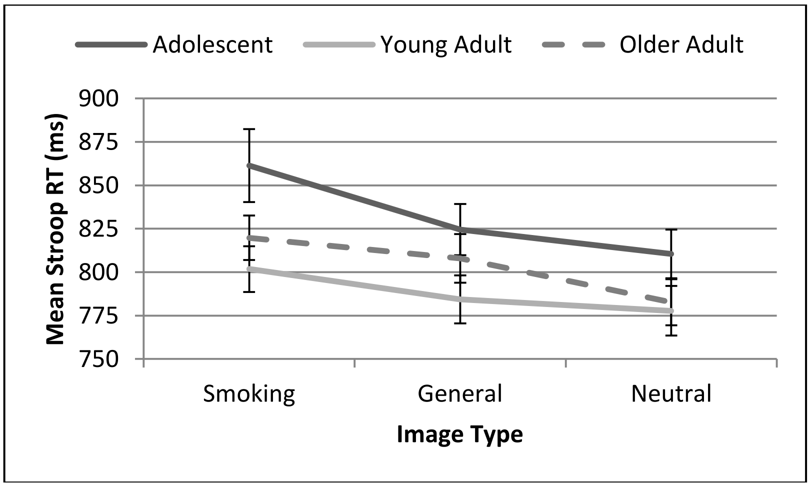


Figure 3.6. Mean Stroop RTs for each image category in each age group. Error bars represent standard errors.

Significant main effects of image were also found for young adults, $F(2,110) = 3.87$, $p < .05$, $\eta_p^2 = .07$, and for older adults, $F(2,112) = 14.09$, $p < .001$, $\eta_p^2 = .20$. As depicted in *Figure 3.6*, young adults demonstrated a Stroop effect for smoking-related images, in comparison to neutral, although this effect did not remain significant when adjusted for multiple comparisons. Older adults also demonstrated a Stroop effect for smoking-related in comparison to neutral, images ($p < .001$).

Given the observation of a Stroop effect for smoking-related images in smoker and non-smokers, an analysis of image valence was carried out in order to determine if each group was reacting to different affective properties of the smoking image. Prior to carrying out this analysis, participant valence ratings for smoking-related images were validated using paired-sample *t*-tests with Bonferroni corrections for multiple comparisons. An analysis of the mean participant feeling scores for the positive and negative Stroop smoking-related images revealed that all participants rated the smoking-positive images significantly more positively than the smoking-negative images (see Table 3.6). Furthermore, the same rating pattern was observed in the different smoking status and age groups. The largest effect size was found in the smoking group, which is consistent with the literature.

Table 3.6 *Mean (Standard Deviation) Participant Rating Scores for the Smoking-Positive and Smoking-Negative modified-Stroop Images*

Group	Smoking-Positive	Smoking-Negative	t(df)	p	Cohen's *d*
All Participants	4.71 (0.11)	2.15 (0.99)	$t(181) = 26.77$	<.001	1.98
Smoker	5.60 (1.22)	2.24 (0.77)	$t(85) = 28.84$	<.001	3.11
Non-Smoker	3.90 (1.10)	2.06 (1.15)	$t(95) = 18.88$	<.001	1.82
Adolescent	4.75 (1.68)	2.33 (1.29)	$t(66) = 13.71$	<.001	1.67
Young Adult	4.92 (1.12)	2.09 (0.68)	$t(56) = 18.66$	<.001	2.47
Older Adult	4.44 (1.38)	2.00 (0.82)	$t(57) = 15.45$	<.001	2.03

In order to determine if image valence differentially contributes to the Stroop effect across the groups, mean Stroop RTs were analysed using a 2 x 3 x 2 x 2 mixed factorial

ANOVA with smoker status and age as the between-group variables, and image (smoking and general) and valence (negative and positive) as the within-group variables. A main effect of image, $F(1, 176) = 11.92$, $p < .01$, $\eta_p^2 = .06$, and a main effect of valence, $F(1, 176) = 34.71$, $p < .001$, $\eta_p^2 = .17$ were found. No other significant results were found. All participants responded more slowly to smoking images (M = 826.86, SD = 135.31) than to general (M = 806.44, SD = 111.44), $t(181) = 3.66$, $p < .001$, two-tailed, $d = .27$. They also responded more slowly to negative images (M = 830.38, SD = 125.34) than to positive (M = 803.50, SD = 118.00), $t(181) = 5.92$, $p < .001$, two-tailed, $d = .44$.

Finally, no significant correlations were found between modified-Stroop scores and any of the smoking expectancy scores, or any of the suppression scores, gathered in Study 1 in the full smoker and non-smoker groups. Higher SCQ negative smoking expectancy scores in young adult smokers were significantly correlated with general-negative Stroop bias ($r = -.50$, $p < .01$), while in older adult non-smokers, TCQ-D scores were correlated with general-positive ($r = .42$, $p < .01$) bias. No significant correlations were found between any of the smoking-behaviour variables and modified-Stroop scores in smokers of any age.

3.3.2.2 Modified-Stroop discussion. The second aim of the study was to examine modified-Stroop attentional bias for valenced smoking-related information in smokers and non-smokers of different ages. It was first predicted that smokers and non-smokers would demonstrate an attentional bias for smoking-related cues in comparison to general and to neutral cues. This hypothesis was partially supported as a Stroop effect was found for smoking-related images, in comparison to neutral, in both the younger adult and older adult groups. Interestingly, this smoking Stroop effect was found in adolescent smokers, but not in non-smokers, which supports the prediction that age-related changes in attentional bias would be observed. In all cases, the smoking Stroop effect was only found relative to the neutral controls. Valence was subsequently investigated for both smoking-related and general images to ensure that any differences in smoking Stroop effects could not be attributable to image valence. All participants responded more slowly to smoking images in comparison to general images, and they responded more slowly to negative images than to positive images, but contrary to expectations, no combined valence and image-type effects were found. These results were consistent across all age groups.

Finding a smoking Stroop effect in both adult smokers and non-smokers supports similar findings in previous adult research (Domier, et al., 2007; Johnsen, et al., 1997), and challenges those which found no smoking-related attentional bias in either group (Fehr, et al., 2006; Waters & Li, 2008), and that which successfully utilised the modified-Stroop task to differentiate between smoking-related attentional bias in adult smokers and non-smokers (Munafo, et al., 2003). It has been suggested that non-smokers may demonstrate a smoking-related attentional bias because of the negative properties of the smoking stimulus (W. M. Cox, Fadardi, Klinger, et al., 2006). The results of the valence analysis, however, do not support this view or the findings of some previous alcohol-related studies (Bauer & Cox, 1998). Instead, they support research which did not find any valence-related differences (Powell, et al., 2002; Stormark, et al., 1997) in attentional bias. On the basis of these results, it cannot be argued that smokers and non-smokers are responding to different affective characteristics of the smoking images (W. M. Cox, Fadardi, & Pothos, 2006).

The novel finding from this study was the age-related difference in the modified-Stroop effects found; specifically the observation of a smoking Stroop effect in adolescent smokers but not in adolescent non-smokers. This suggests that smoking information is processed differently by disparate age groups. The lack of a modified-Stroop effect in adolescent non-smokers may simply reflect the fact that their attention is less drawn by smoking-related imagery, or it may reflect a situation where the bias to positive and negative smoking images are in different directions, and thus essentially balance each other out. As no significant differences were found between responses to positive and negative imagery in this study, more research is required to determine the specific characteristics of the images that adolescent smokers and non-smokers are drawn to. It will then be important to clarify how and when attention becomes biased towards the smoking images as non-smokers age.

One of the strengths of the image-based tasks in this study was the fact that they used images which had been previously validated for affective content, and in the case of smoking-images, for saliency. Although the emotional intensity and complexity of positive and negative images were matched, the picture content was not precisely the same in each in each version; for example, a positive depiction of three people smoking did not have a corresponding negative depiction of the same three people smoking. Negative categories also included one more people-oriented image than object-oriented image, whereas the opposite was the case for positive categories. Similarly, the precise picture content differed between smoking and general images (i.e., three people in a smoking context was not matched with the same three people in a non-smoking context). These findings should therefore be interpreted in light of these limitations, and future research should consider the systematic production of positive and negative smoking and general images based on the same underlying picture content, and taking image complexity and people versus object content into consideration.

3.3.3 Visual dot-probe task

3.3.3.1 Visual dot-probe results. Mean dot-probe attentional bias scores for each set of paired images are provided in Table 3.7 below, for smokers and non-smokers in each age group. Prior to carrying out the dot-probe analysis, participant valence ratings for smoking-related images were validated using paired-sample *t*-tests with Bonferroni corrections for multiple comparisons. An analysis of the mean participant feeling scores for the positive and negative dot-probe smoking-related images revealed that all participants rated the smoking-positive images significantly more positively than the smoking-negative images (see Table 3.8). Furthermore, the same rating pattern was observed in the different smoking status and age groups. Again, the largest effect size was found in the smoking group, which remains consistent with the literature.

Table 3.7 *Mean (standard deviation) Visual Dot-probe Attentional Bias Scores for Paired Image Sets by Age and Smoking Status*

	Adolescents		**Young Adults**		**Older Adults**	
	Smoker	Non Smoker	Smoker	Non Smoker	Smoker	Non Smoker
	n = 30	*n* = 37	*n* = 27	*n* = 30	*n* = 29	*n* = 29
SN-GN	-17.50	-1.34	-3.83	5.22	0.59	16.22
	(97.00)	(71.46)	(26.12)	(41.77)	(32.71)	(33.72)
SN–NU	-18.22	3.20	-2.12	2.46	-0.14	-6.15
	(84.75)	(84.26)	(36.80)	(51.13)	(46.41)	(45.99)
GN-NU	-12.58	19.97	4.50	1.82	-0.15	-4.70
	(50.32)	(71.37)	(36.14)	(45.37)	(43.33)	(42.25)
SP-GP	2.25	12.50	-7.03	-20.88	-12.20	-4.71
	(156.27)	(78.66)	(39.06)	(37.37)	(43.05)	(37.66)
SP-NU	-29.66	25.64	12.36	-5.48	-0.59	-6.29
	(130.77)	(85.67)	(35.86)	(47.95)	(45.22)	(60.90)
GP-NU	60.07	6.96	6.67	8.74	12.45	-5.02
	(285.60)	(43.97)	(38.15)	(41.69)	(64.52)	(41.89)

Note. SN, smoking-negative; GN, general-negative; NU, neutral; SP, smoking-positive; GP, general-positive

Table 3.8 *Mean (Standard Deviation) Participant Rating Scores for the Smoking-Positive and Smoking-Negative Visual Dot-probe Images*

Group	Smoking-Positive	Smoking-Negative	t(df)	p	Cohen's *d*
All Participants	4.73 (1.39)	2.05 (1.01)	$t(181) = 27.62$	<.001	2.05
Smoker	5.57 (1.18)	2.25 (0.79)	$t(85) = 25.79$	<.001	2.78
Non-Smoker	3.97 (1.11)	1.86 (1.15)	$t(95) = 18.15$	<.001	1.85
Adolescent	4.84 (1.65)	2.19 (1.34)	$t(66) = 13.75$	<.001	1.68
Young Adult	4.89 (1.03)	2.01 (0.76)	$t(56) = 19.79$	<.001	2.62
Older Adult	4.43 (1.34)	1.19 (0.75)	$t(57) = 16.79$	<.001	2.21

Mean dot-probe scores for each of the image pairings were first analysed using a 2 x 3 x 6 mixed factorial ANOVA with smoker status (smoker and non-smoker) and age (adolescent, young adult, and older adult) as the between-group variables, and image-pair

(SN-GN, SN-NU, GN-NU, SP-GP, SP-NU, and GP-NU) as the within-group variable. No significant results were found. Secondly, an analysis of the experimental-neutral image pairings was carried out to investigate if valence differentially influenced attentional bias to smoking images in comparison to general images. A 2 (smoking status) x 3 (age) x 2 (image: smoking and general) x 2 (valence) mixed factorial ANOVA did not find any significant results. Thirdly, the mean score for the two image pairs containing smoking-negative images was compared to the mean score for the two image pairs containing smoking-positive images as it had been predicted that smokers would be more drawn to the smoking-positive images. A 2 (smoking status) x 3 (age) x 2 (valence) ANOVA did not find any significant results.

To test the hypothesis that smoking-related attentional biases may be influenced by the control images (general and neutral) used, separate 2 (smoking status) x 3 (age) x 2 (image-pair) mixed factorial ANOVAs of the SN-GN and SN-NU pairings and of the SP-GP and SP-NU pairings were run. No significant results were found for the SN-GN and SN-NU pairs, but the analysis of the SP-GP and SP-NU pairs found a significant smoking status by age interaction, $F(2, 176) = 3.78$, $p < .05$, $\eta_p^2 = .04$. As illustrated in *Figure 3.7*, post-hoc analysis revealed a significant main effect of age in the non-smoking group, $F(2,93) = 3.39$, $p < .05$, $\eta_p^2 = .07$. A significantly larger dot-probe attentional bias was found for adolescent non-smokers when compared with young adult non-smokers ($p < .05$). Given that positive dot-probe scores indicate vigilance for target images, this demonstrates that adolescent non-smokers were significantly faster at locating probes that replaced smoking-positive images than those replacing control images, regardless of whether the control images were general-positive or neutral.[3] No other significant results were found.

[3] No significant smoking status or age differences were found for the GP-NU image category indicating that this effect was specific to smoking-positive images.

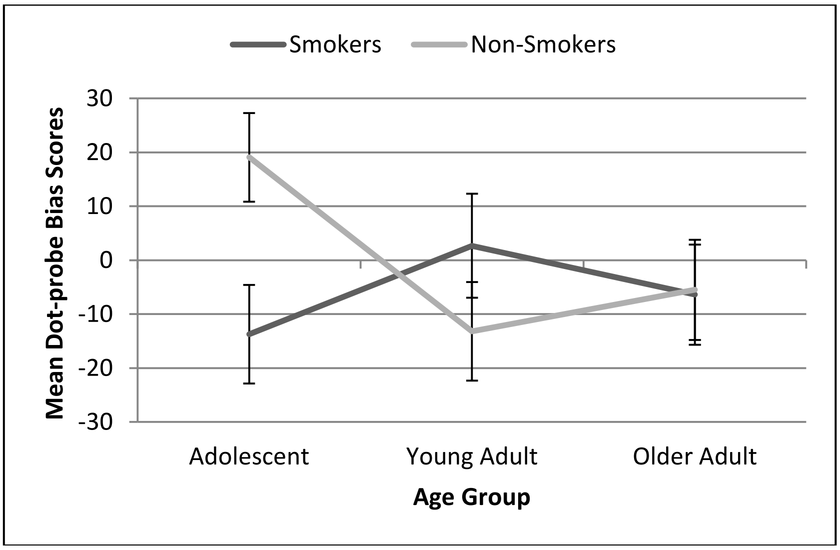


Figure 3.7. Mean dot-probe attentional bias scores for smokers and non-smokers in each age group. Error bars represent standard errors.

Few significant correlations of any size were found when the full smoker and non-smoker groups were analysed, but some relationships between dot-probe bias scores and Study 1 variables emerged in the older adult groups. Higher endorsement of SCQ negative smoking expectancies was significantly negatively correlated with GP-NU bias (r = -.50, $p < .01$) in older adult smokers, while higher ratings for the smoking-positive images were significantly correlated with GN-NU bias (r = .42, $p < .05$), and more positive ratings for the smoking-negative images were correlated with SN-NU images (r = -.48, $p < .01$). In older adult non-smokers, more positive FA T1 difference scores were significantly negatively correlated with GP-NU bias (r = -.50, $p < .01$). No other significant correlations were found.

3.3.3.2 Visual dot-probe discussion. Finally, the study aimed to use a visual dot-probe task to examine differences in the maintenance of attention to smoking-related information in the same sample. Specifically, attentional bias was examined across six different image pairs; three investigated negative affect: SN-GN, SN-NU, and GN-NU, and three investigated positive affect: SP-GP, SP-NU, and GP-NU. Contrary to expectations, no attentional bias was evident for any of the image pairs. A subsequent analysis of the SN-GN and SN-NU pairs determined that, unlike modified-Stroop findings, no attentional bias was evident for smoking-negative information regardless of the type of control image used. In contrast, an analysis of the SP-GP and SP-NU pairs illustrated that adolescent non-smokers' attention was drawn to smoking-positive images to a greater extent that in any other group. It is interesting that this effect was not found for adolescent smokers, so it is unlikely to reflect a general attractiveness of smoking-positive images in this age group. It is possible that the images are incongruent to non-smokers' expectations of smoking and it is this contradiction that maintains their attention (W. M. Cox, Fadardi, Klinger, et al., 2006). No attentional bias was found to smoking-positive images in adolescent non-smokers on the Stroop task, however, so this reinforces the need for further research to determine the characteristics of attentional bias to smoking-related information in this age group.

Despite previous findings that smokers were faster to locate a probe replacing a smoking-related image than one replacing a neutral image (Bradley, et al., 2004; Bradley, et al., 2003; Hogarth, Mogg, et al., 2003), these results have not been replicated here. The previous studies did not consider the valence of the smoking images, and all smoking comparisons were made relative to a neutral image category; nevertheless the SN-NU and SP-NU image pairs would have replicated those conditions. If smokers' attention was likely to be captured by smoking-related cues of any kind, an attentional bias would have been expected in these pairs. The calculation of the visual dot-probe attentional bias score was the same in this as it was in previous studies, and errors and outliers were also removed before all analyses were carried out. It is unlikely, therefore, that differences in analytical procedures can account for the resulting difference in the findings. It is possible, however, that methodological differences in the design of the dot-probe task may have influenced results.

Some methodological limitations should also be taken into account in the interpretation of the visual dot-probe findings. Each of the dot-probe studies described in the introduction, which found an attentional bias for smoking-related information in smokers, came from a single research group and so used similar visual dot-probe tasks and the same set of smoking-related images. Although the task used in this study was based on their design (Mogg, et al., 2003), some differences were required given the apparatus available for use here. The dimensions of the images used varied in previous studies; image sizes ranged between 800 x 600 mm, 1100 x 700 mm, and 950 x 1300 mm. The images used in this dot-probe task were 850 x 850 mm, so they fell within this range. Vertical image screen placement was also the same as in previous studies, but horizontal screen placement differed. The distance between the inner edges of the images in the previous studies was 300 mm, whereas the distance between the inner edges of the two images in this task was 800 mm. In addition, participants in the previous studies used a separate response box so they were seated further away from the screen (between 1100 mm and 1200 mm) than they were in this study (500 mm), where they used the keyboard to enter their responses.

The implication of these differences is that the visual angle was larger in this task; the edge of the image is likely to have appeared in foveal vision in previous studies, whereas it is likely to have appeared in parafoveal vision in this study (Calvo & Lang, 2005). It is possible that this task variation accounted for the lack of bias found in this study since the images may not have been inspected in enough detail to detect key differences, although Calvo and Lang (2005) demonstrated that the processing of emotional images can begin in advance of foveal fixation. Furthermore, as the probe can only appear in one of two potential spatial locations, it is likely that participants constantly shift the spatial focus of their attention between these positions while the images remain on screen. This study requires replication using a similar set of apparatus to that used in previous research. If attentional bias is not found with similar presentation settings, the next step would be to consider the detailed content of the image sets used in each study.

3.3.4 Relationship between the tasks

3.3.4.1 Inter-task correlation results. Few significant correlations were found between the three implicit tasks, although some group-specific patterns did emerge. In adolescent smokers, attentional bias to smoking-negative images in the visual dot-probe SN-NU image pair, was significantly negatively correlated with each of the Stroop image categories: smoking-negative (r = -.80, p < .001), smoking-positive (r = -.67, p < .001), general-negative (r = -.56, p < .01), general-positive (r = -.49, p < .01), neutral (r = -.50, p < .01). This pattern of responding was not seen in any other group. No significant correlations were found in the adolescent non-smoking group.

No significant visual dot-probe correlations were found in the young adult smoking group. In contrast, significant positive correlations were found between LDT GN word recognition and four of the modified-Stroop image categories: smoking-negative (r = .62, p < .001), smoking-positive (r = .53, p < .01), general-negative (r = .53, p < .01), and general-positive (r = .60, p < .01). For young adult non-smokers, significant negative correlations were found between SN-NU scores and LDT SN word recognition (r = -.51, p < .01), and between GP-NU scores and LDT SP word recognition (r = -.48, p < .01), but no significant correlations were found between Stroop and LDT scores in this group.

In the older adult smoking group, LDT RTs for general-negative words were significantly positively correlated with GN-NU dot-probe scores (r = .55, p < .01). No other significant correlations were found. In older adult non-smokers, attentional bias to smoking-positive images in the SP-NU image pair, was negatively correlated with LDT RTs for smoking-positive words (r = -.52, p < .01), so as smoking-positive images attracted attention in the dot-probe task, they were recognised more quickly in the LDT task. LDT general-positive word recognition was significantly positively correlated with modified-Stroop bias for general-negative images ($r = .50$, $p < .01$). Finally, LDT neutral word recognition was significantly positively correlated with modified-Stroop bias for smoking-positive images ($r = .64$, $p < .001$), smoking-negative images ($r = .50$, $p < .01$), and general-positive-images ($r = .66$, $p < .001$).

3.3.4.2 Inter-task correlation discussion. Few consistent relationships were found between the three tasks in this study. As the modified-Stroop and visual dot-probe tasks both measure attentional bias, and image versions of both tasks were used, a relationship would have been expected between their results. No such relationship was found in either adult group or among adolescent non-smokers. Furthermore, the more vigilant adolescent smokers were to smoking-negative images on the dot-probe task, the less attention was grabbed by any category on the modified-Stroop task; this negative relationship was particularly strong for the smoking-negative images themselves. Many previous studies have also failed to find a relationship between these two tasks (Mogg & Bradley, 2002; Sherman, et al., 2003). As a result, it has been argued that the cognitive processes involved in the early, pre-conscious, selective-attention measured by the modified-Stroop task (W. M. Cox, Fadardi, & Pothos, 2006), differ from those involved in visuo-spatial orienting and maintenance of attention as measured by the visual dot-probe task (Mogg & Bradley, 2002). The findings from this study provide further support that these two tasks are likely to be engaging different cognitive processes.

Two interesting relationships were seen between the visual dot-probe and the LDT tasks. Firstly, the more vigilant young adult non-smokers were to smoking-negative images, the faster they were to recognise smoking-negative words. This suggests that this group did not suppress smoking-negative information in any way. The tasks were not capable, however, of identifying any inhibitory processes in smokers. Secondly, although no relationships were found for smoking-content between the two tasks in the older adult smoking group, the faster they recognised general-negative words on the LDT, the less vigilant they were to general-negative imagery on the dot-probe task. This could potentially be interpreted as demonstrating vigilance for threat-related information in the first task, but showing an inhibitory effect for the same threatening information on the second. In addition, this pattern of responding did not extend to smoking-negative stimuli. A relationship was also found between the modified-Stroop and LDT tasks for older adult non-smokers; greater attentional bias was found towards smoking-positive images on the former as smoking-positive words were recognised more quickly on the latter. However, the stimulus types differed between the LDT and the attentional bias tasks. Although consistent attentional bias has been demonstrated across word and image versions of the modified-Stroop task (Hester, et al., 2006), it is possible that these findings reflect a difference in responding to different stimulus types when used in two different tasks.

3.4 Conclusion

This study explored implicit reactions to positive and negative smoking-related stimuli, in relation to general valenced and to neutral stimuli, in three implicit cognitive tasks. Cognitive models would suggest that attentional bias to smoking-related information should be observed in smokers but not in non-smokers. Additionally, CSLT and associative memory theories predict that smokers would respond more quickly to positive smoking-related stimuli, in comparison to other stimulus categories. In this study, both smokers and non-smokers, with the exception of adolescent non-smokers, displayed a modified-Stroop attentional bias to smoking-related images, relative to neutral images. This general bias was not found for either the LDT or the visual dot-probe task. Adolescent smokers were shown to suppress smoking-negative words on a LDT task, and adolescent non-smokers were found to have an attentional bias to smoking-positive images on the dot-probe task. Only two consistent relationships were found between the tasks themselves. The vigilance for general-negative words on the LDT was associated with attentional bias scores to general-negative images on the dot-probe task in the adolescent and older adult groups, and it was associated with modified-Stroop attentional bias scores to all valenced images in younger adults.

While a clearer understanding of the differences between smoker and non-smoker affective evaluations of smoking-related, general, and neutral cues would provide further insight into the cognitive biases associated with smoking, the lack of consistency between the findings for the three tasks in this study, and between the study results and those of previous research, prevents any clear conclusions from being drawn. It is possible that a primed LDT may prove useful in measuring naturally occurring suppression of smoking-negative information, and modified-Stroop studies seem the most effective at uncovering attentional bias to smoking-related information, although further research is required in both cases to gain a better understanding of the influence of affect.

Chapter 4: Development of an Explicit Smoking Expectancy Measure for use with Heterogeneous Smoking Status and Age Groups

4.1 Introduction

Studies are increasingly investigating smoking measures in narrowly defined populations, yet there is a need to identify measures that can successfully be used with heterogeneous populations. In this chapter, data from two studies are used to develop and validate a revised explicit smoking expectancy measure, based on the original Smoking Consequences Questionnaire (SCQ; Brandon & Baker, 1991), that would be suitable for use in research with participants of diverse age and smoking behaviour. The SCQ data previously presented in Chapter 2 (Study 1) formed the development sample and an exploratory factor analysis (EFA) of these data was used to create the revised SCQ. Data from a new participant sample (Study 3) was then subjected to a confirmatory factor analysis (CFA) to validate the results of the factor structure derived in the development phase.

4.1.1 Development of commonly used SCQ scales

As illustrated in Chapter 2, explicit smoking expectancies have been shown to predict smoking behaviour among adolescents (Bauman, et al., 1984; Wahl, et al., 2005), young adults (Downey & Kilbey, 1995), and older adults (Copeland, et al., 1995). The SCQ (Brandon & Baker, 1991) was one of the first scales developed to explicitly measure smoking expectancies and it contains 50 statements of positive and negative proximal and distal consequences typically associated with smoking. Participants are asked to provide two different ordinal ratings for each item on the list: first an indication of the desirability of the outcome described in the statement using a scale from extremely undesirable (-5) to extremely desirable (+5); and second the likelihood of each consequence using a scale from 0 to 9. For example, participants would consider a smoking expectancy such as “Cigarettes help me deal with anxiety or worry” and they would rate how desirable they would find this consequence of smoking. They would then rate how likely they thought this outcome would be. The two rates for each item are multiplied to obtain a subjective expectancy utility (SEU) score. Brandon and Baker (1991) suggested that this SEU index provided a better predictor of behaviour than desirability or likelihood ratings alone, although they acknowledged that negative expectancies were related to smoking status on the likelihood scale only, and subsequent research supports the view that likelihood ratings alone are more successful at differentiating between smoking status groups (Myers, et al., 2003; Rash & Copeland, 2008).

Brandon and Baker (1991) developed their SCQ scale using a college sample of 382 daily, occasional, and ex-smokers (mean age was 18.7 years). Daily smokers smoked an average of 11.2 CPD and had a mean FTND dependence score of 2.8. A principal components analysis (PCA) suggested the 50 items loaded onto four reliable factors: negative consequences (NC, 18 items, $\alpha = .95$) which included items related to health risk, addiction risk, negative physical consequences such as throat irritation and coughing, and negative social risks such as looking ridiculous and being less attractive; positive reinforcement (PR, 15 items, $\alpha = .91$) which included items related to taste, boredom reduction, social facilitation, and urge reduction; negative reinforcement (NR, 12 items, $\alpha = .94$) which included items related to decreasing anxiety, anger, and depression, and improving concentration; and appetite and weight control (WC, 5 items, $\alpha = .96$) which appeared to form a distinct factor separate to other positive expectancies. The three factors containing positive expectancies of smoking (PR, NR, and WC) were significantly inter-correlated (r ranged from .41 to .64) but they were uncorrelated with NC. The full scale demonstrated strong internal consistency ($\alpha = .94$) and good validity; SCQ smoking expectancies successfully differentiated between smokers of different experience levels, demonstrating that daily smokers held stronger levels of positive reinforcement and negative reinforcement expectancies than occasional and ex-smokers. Women were also found to give higher expectancy ratings on the WC and NR subscales, regardless of smoking status. The only interaction between gender and smoking status was observed in ex-smokers where females rated NR expectancies as highly as female smokers, but males produced extremely low rating scores for that subscale.

Wetter and colleagues (1994) subsequently established that the 4-factor model suggested by Brandon and Baker (1991) fits SCQ data more accurately than smaller models, although some researchers have since argued that there is potential for larger and better fitting models within specific populations (Copeland, et al., 1995; Schleicher, et al., 2008). Others have queried the applicability of some scale items in specific populations, such as with adolescents (Lewis-Esquerre, et al., 2005; Wahl, et al., 2005), and it has been suggested that the use of college samples limited the generalisability of early SCQ results (Copeland, et al., 1995).

Copeland and colleagues (1995) examined responses to the original pool of 80 SCQ development items (Brandon & Baker, 1991), in 227 heavy current smokers (mean age = 35.5, CPD = 26.6), 126 heavy smokers commencing cessation treatment (mean age = 46.7, CPD = 28), and 54 ex-smokers (mean age = 44.5). They determined that a 55-item 10-factor model best described the data. The ten factors suggested by this solution, which they refer to as the SCQ-Adult, are negative affect reduction (NAR, 9 items, $\alpha = .96$), health risk (HR, 4 items, $\alpha = .92$), social facilitation (SF, 5 items, $\alpha = .86$), appetite and weight control (WC, 5 items, $\alpha = .96$), addiction risk (ADD, 6 items, $\alpha = .83$), negative physical feelings (NPF, 3 items, $\alpha = .83$), negative social impressions (NSI, 3 items, $\alpha = .83$), stimulation/state enhancement (SE, 7 items, $\alpha = .89$), taste/sensorimotor manipulation (TSM, 9 items, $\alpha = .88$), and boredom reduction (BR, 4 items, $\alpha = .87$). The SCQ-Adult had good internal consistency ($\alpha = .87$), and good validity. Although desirability, likelihood, and therefore SEU responses were obtained in this study, the results demonstrated that the likelihood ratings best discriminated between smoking status groups for both positive and negative expectancies. The NAR and BR subscales were also found to predict smoking rates at different points in time. Some gender differences were observed, although again there was no interaction with smoking status; women were found to give higher ratings on the HR, WC, and NSI subscales, while men produced higher ratings on the TSM subscale. Nicotine dependence was measured by an adjusted version of the Fagerström Tolerance Questionnaire (FTQ; Fagerström, 1978) and although it was positively correlated with six subscales (NAR, SE, SF, WC, ADD and BR), these relationships were small (*r* ranged from .12 to .20).

Rash and Copeland (2008) subsequently created a brief version of the SCQ-Adult which they called the BSCQ-Adult, and they found that this 25-item version was also best described by a 10-factor model within a population of adult heavy smokers (mean age = 36.49, CPD = 24.88, FTND = 5.96). Again, the measure demonstrated good internal consistency ($\alpha = .79$) and good convergent validity. The noteworthy finding from these adult smoker studies is that they recommend SCQ models with larger numbers of factors than the original which supports the claim that expectancies become more refined with age and experience (S. A. Brown, 1993). A separate short version of the SCQ was created specifically for use with an adolescent substance abuse population (Myers, et al., 2003). This sample had a mean age of 19.1, consumed an average of 14.7 CPD, and were moderately dependent on nicotine (mean FTND = 4.4). The original Brandon and Baker (1991) 4-factor model fitted these data well which supports the idea that smoking expectancies in younger age groups are more global in nature. This study made no attempt to fit larger models, however, and evidence for a 9-factor smoking expectancy model was found by Schleicher and colleagues (2008) in an undergraduate sample with similar age (M = 19.06) and CPD (M = 11.8), but lower FTND scores (M = 2.6).

In addition to uncertainty regarding the best SCQ factor model for use with adolescents, Lewis-Esquerre and colleagues (2005) have argued that a more fundamental problem exists regarding the age- and experience-related validity of some of the SCQ items for this age group. Several smoking expectancies considered important for adolescents, such as peer relationships and image (Hine, Tilleczek, Lewko, McKenzie-Richer, & Perreault, 2005; Lewis-Esquerre, et al., 2005), were under-represented in the original scale. The Adolescent-SCQ was developed by Lewis-Esquerre and colleagues (2005) as a 38-item smoking expectancy measure that could be used in an adolescent sample heterogeneous in smoking experience. Again, the items were drawn from the original 80 SCQ items (Brandon & Baker, 1991). Even among these relatively inexperienced smokers, a 7-factor structure was found to best fit the data. Five factors represented positive smoking expectancies: NAR (8 items, $\alpha = .88$); TSM (2 items, $\alpha = .78$); SF (8 items, $\alpha = .77$); WC (5 items, $\alpha = .79$); and BR (2 items, $\alpha = .63$). Two factors represented negative expectancies: NPF (3 items, $\alpha = .66$) and NSI (3 items, $\alpha = .56$). No expectancies associated with health risk, addiction risk, or with stimulation/state enhancement remained in the final scale. Non-smokers endorsed significantly less positive expectancies than smokers on all scales other than WC. Both groups held similar expectancies regarding NAR but non-smokers rated NSI significantly higher than smokers. Gender differences were not examined as part of this study.

4.1.2 Limitations of the current scales

Research supports the validity of the SCQ scale as an explicit smoking expectancy measure. Findings in a number of age groups suggest that smoking expectancies can differ with age and experience, so population-specific measures, with larger factor structures than the original 4-factor model, may offer more comprehensive detail regarding smoking expectancies in specific age-groups. This can be helpful when revising prevention and treatment programmes appropriate to these age groups (Schleicher, et al., 2008). The difficulty with this approach is that if the SCQ continues to develop within increasingly narrower populations, the resulting measures will become so specialised that their results are no longer generalisable to a wider population. Also problematic is the fact that although age-specific versions of the SCQ contain items particularly relevant to an age group, they also omit important consequences that merit further investigation; for example, including popularity expectancies in the adolescent version while omitting serious health risks and addiction-related items (Lewis-Esquerre, et al., 2005). Recent evidence suggests that adolescents are aware of these negative consequences (Brady, et al., 2008) and this view is supported by the findings of Study 1 of this thesis, as presented in Chapter 2.

Research investigating the developmental aspects of smoking behaviour requires measures that are valid within more heterogeneous populations. The main purpose of the two studies presented in this chapter was to develop and validate a revised SCQ scale for use in diverse age and smoking experience groups. Study 1 participants, previously described in Chapter 2, constituted the developmental sample which was used to determine the most appropriate items and factor structure for measuring smoking expectancies in a diverse group. The recommended measure was then validated using a new larger sample of both adolescent and adult smokers, non-smokers, and ex-smokers (Study 3). The psychometric properties of the new scale were examined in both studies and it was expected that a factor structure, larger than the original 4-factor Brandon and Baker (1991) model, would best fit the data. Between-group differences were examined to establish scale validity and it was hypothesised that the new scale would be capable of distinguishing between participants of varied smoking status. Although previous studies did not examine developmental differences in smoking expectancies, given the findings in Chapter 2, it was expected positive smoking expectancies would be associated with current smoking and younger age, but also with increased levels of use and dependence, whereas negative expectancies were expected to be associated with non-smoking status, older age, and also increased levels of use and dependence. Finally, it was hypothesised that women would more readily endorse negative smoking expectancies, and those specifically related to weight control, than men, although it was felt unlikely that gender would interact with either smoking status or age.

4.2 Development of a revised SCQ scale

Data collected as part of Study 1 was used to develop a version of the SCQ scale that could be used in a sample of different ages and varied smoking status.

4.2.1 Method

4.2.1.1 Participants. The 231 participants described in Chapter 2 took part in this study. Again they were grouped by smoking status (smoker and non-smoker) and age (adolescents: 15 to 18 years, young adults: 19 to 25, and older adults: 26 to 40). Groups comprised of 89 smokers (32, 27, 29) and 142 non-smokers (83, 30, 29).

4.2.1.2 Measures.

Revised Smoking Consequences Questionnaire. A 38-item revised-SCQ was created which included 29 of the original SCQ items (Brandon & Baker, 1991) that were common to the Adolescent-SCQ (Lewis-Esquerre, et al., 2005) and the SCQ-Adult (Copeland, et al., 1995), and an additional nine expectancies selected from the age-specific SCQ versions. Given the importance of SF expectancies to adolescents (Lewis-Esquerre, et al., 2005), five additional items were selected from the Adolescent-SCQ SF scale; two items related to image, two to popularity, and one to being generally more friendly and outgoing. Two other items were chosen from the Adolescent-SCQ scale. The first related to the look and feel of a cigarette in the mouth and it was chosen as it was one of only two taste-related items in the Adolescent-SCQ and it had a very high factor loading (.93). The second related to the expectancy that smoking would help people stay slim. It was chosen due to the clarity of its wording, in comparison to similar items already in the scale, as the association between weight management and smoking seems particularly strong in adolescents and in young adults (Camp, Klesges, & Relyea, 1993; Harakeh, Engels, Monshouwer, & Hanssen, 2010). The final two items included in the scale were taken from the SCQ-Adult (Copeland, et al., 1995); the first related specifically to the handling of a cigarette and the second to group belonging, two expectancies not specifically covered by any other scale item.

Some minor wording adjustments were needed to ensure consistency in the revised-SCQ scale. For the most part, the original SCQ wording was maintained. Items taken directly from the Adolescent-SCQ were reworded to use the 1st person singular, and in three cases the simplified adolescent wording was retained. The 38 items, their sources, and any wording changes made, are presented in Table 4.1. Participants responded to each item using a Likert scale running from 1 (Extremely unlikely) to 6 (Extremely likely). Desirability ratings were not assessed given the poorer validity associated with this measure.

Demographics and smoking history. Participants completed demographic, smoking history, and nicotine dependence measures as described in Chapter 2.

4.2.1.3 Procedure. The procedure for this study has been outlined in Chapter 2. Participants completed the full set of SCQ items immediately after the free association task, and before any other tasks.

4.2.1.4 Data Analysis. All data analyses were carried out using SPSS 19 (SPSS Inc., Chicago, Illinois 60606, US). An EFA was conducted to determine the most appropriate item and factor structure for the revised-SCQ. Based on previous research that demonstrates a relationship between SCQ factors themselves, an oblique (direct oblimin) rotation method was applied to permit multi-factorial solutions with correlated factors. The Kaiser-Meyer-Olin measure was used to assess sampling adequacy, and Bartlett's test of sphericity evaluated data adequacy. Cattell's (1966) scree test was used to determine the number of factors to extract. A factor loading of 0.4 on the pattern matrix was used as the criterion for

Table 4.1 *List of Revised-SCQ Items with their Original Sources, Factor Assignments, and an Indication of Wording Changes Made Where Applicable.*

Item		**Valence**	**Brandon and Baker (1991)**		**Copeland et al. (1995)**		**Lewis-Equerre et al. (2005)**	
1	When I'm angry, a cigarette can calm me down.	Pos	✓	NR	✓	NAR	✓[a]	NAR
2	By smoking I risk heart disease and lung cancer.	Neg	✓	NC	✓	HR		
3	Cigarettes taste good.	Pos	✓	PR	✓	TSM	✓	TSM
4	If I'm tense, a cigarette helps me to relax.	Pos	✓	NR	✓	NAR		
5	Cigarettes help me deal with anxiety or worry.	Pos	✓	NR	✓	NAR	✓[b]	NAR
6	Smoking makes me look ridiculous or silly.	Neg	✓[c]	NC	✓[c]	NSI	✓[a]	NSI
7	The more I smoke, the more I risk my health.	Neg	✓	NC	✓	HR		
8	I enjoy parties more when I am smoking.	Pos	✓	PR	✓	SF	✓[a]	SF
9	Just handling a cigarette is pleasurable.	Pos			✓	TSM		
10	If I have nothing to do, a smoke can help kill time.	Pos	✓	PR	✓	BR	✓[ab]	BR
11	I feel more at ease with other people if I have a cigarette.	Pos	✓	PR	✓	SF	✓[ab]	SF
12	Smoking makes me look tough or cool.	Pos					✓[a]	SF
13	Smoking makes me feel older or more mature.	Pos					✓[a]	SF
14	Cigarettes help me concentrate.	Pos	✓	NR			✓[a]	NAR
15	Cigarettes keep me from overeating.	Pos	✓	WC	✓	WC	✓[a]	WC
16	Smoking makes me seem less attractive.	Neg	✓	NC	✓	NSI	✓[a]	NSI
17	I will become more dependent on nicotine if I continue smoking.	Neg	✓	NC	✓	Add		
18	When I am worrying about something, a cigarette is helpful.	Pos			✓	NAR	✓[ab]	NAR
19	Cigarettes make my lungs hurt.	Neg	✓	NC	✓	NPF	✓[a]	NPF
20	The look and feel of a cigarette in my mouth is good.	Pos					✓[a]	TSM
21	My throat burns after smoking.	Neg	✓	NC	✓	NPF	✓[a]	NPF
22	People look up to those who smoke.	Pos					✓	SF
23	Cigarettes are good for dealing with boredom.	Pos	✓	PR	✓	BR		
24	People think less of me if they see me smoking.	Neg	✓	NC	✓	NSI		
25	I feel like part of a group when I'm around other smokers.	Pos			✓	SF		
26	Smoking helps if I feel bad about myself.	Pos	✓[c]	NR			✓[a]	NAR
27	Smoking calms me down when I'm feeling nervous.	Pos	✓	NR	✓	NAR		
28	Smoking helps me stay slim.	Pos					✓[a]	WC
29	Smoking gives me something to do with my hands.	Pos	✓[b]	PR			✓[a]	BR
30	Smoking will make me cough.	Neg	✓	NC			✓[a]	NPF
31	People gain weight when they stop smoking.	Pos	✓[c]	WC	✓[c]	WC	✓	WC
32	I think most popular people smoke cigarettes.	Pos					✓[a]	SF
33	Smoking irritates my mouth and throat.	Neg	✓	NC	✓	NPF	✓[ab]	NPF
34	Smoking helps me control my weight.	Pos	✓	WC	✓	WC	✓[ab]	WC
35	When I'm upset with someone, a cigarette helps me cope.	Pos	✓	NR	✓	NAR	✓[ab]	NAR
36	I become more addicted the more I smoke.	Neg	✓	NC	✓	Add		
37	Smoking controls my appetite.	Pos	✓	WC	✓	WC	✓[ab]	WC
38	Smoking makes me feel more friendly or outgoing.	Pos					✓	SF

Note. Pos, Positive; Neg, Negative

[a] The source item was written in the 3rd person; 1st person wording from the original SCQ item was retained.

[b] This item covers a similar expectancy to that covered in the original albeit with slightly different wording; original SCQ item retained.

[c] This item covers a similar expectancy to that covered in the original; the Adolescent-SCQ wording retained as more suited to younger participants.

establishing if the item loaded significantly onto any given factor (Tabachnick & Fidell, 2007) and the internal consistency of the scale was measured using Cronbach's alpha. Subscale scores were calculated as the average score for items loading onto that factor.

Concurrent validity was examined using a 2 (smoking status) x 3 (age) x 2 (gender) multivariate analysis of variance (MANOVA) to assess the association of each of the subscale scores with smoking status, age, and gender groups. All *p*-values presented in between-group post-hoc analyses are Bonferroni corrected using the SPSS general linear model post-hoc Bonferroni correction function. Subscale scores were then correlated with nicotine dependence (FTND), use (CPD), and age smoking and daily smoking commenced.

4.2.2 Results

Missing data were found for 17 participants who were removed from the analysis, leaving a total of 214. Groups comprised of 85 smokers (30, 26, 29), and 129 non-smokers (71, 30, 28). Characteristics of these participants are displayed in Table 4.2, along with average use and dependence characteristics for each smoking group.

Table 4.2 *Mean Demographic Profile (Standard Deviations) of Smoker and Non-smoker Participants in each Age Group.*

	Adolescents		**Young Adults**		**Older Adults**	
	Smoker n = 30	Non-S n = 71	Smoker n = 26	Non-S n = 30	Smoker n = 29	Non-S n = 28
Female	16	30	17	22	15	20
Male	14	41	9	8	14	8
Age	17.42 (0.92)	16.66 (0.83)	23.20 (2.08)	22.88 (1.89)	33.30 (3.90)	32.34 (0.95)
Smoking History						
Age Start	14.02 (1.94)		15.58 (2.63)		15.00 (3.11)	
Age Daily	15.38 (1.55)		17.48 (2.43)		16.91 (2.81)	
CPD	7.57 (5.14)		8.25 (6.31)		11.74 (6.51)	
FTND	2.33 (2.02)		1.96 (2.66)		2.41 (2.29)	

Note. Non-S, non-smoker; CPD, number of cigarettes smoked per day.

A principal component analysis (PCA) was carried out on the 38 scale items. The Kaiser-Meyer-Olin measure found excellent sampling adequacy for the analysis, KMO = .91 (Hutcheson & Sofroniou, 1999), and all KMO values for individual items were greater than the recommended value of 0.5 (A. Field, 2009). Bartlett's test of sphericity, χ^2 (703) = 5546.5, $p < .001$, also indicated that between-item correlations were sufficiently large for PCA. Potential 7-factor and 8-factor models were suggested by the scree plot. Both models were subjected to direct oblimin rotations ($\Delta = 0$) and examined for suitability and ease of interpretation. The 7-factor model explained 66% of the total variance in smoking expectancy items, while the 8-factor model explained 68.63% of total variance. Difficulties with factor loadings emerged on closer inspection of both models. Six items were found to have similar loadings onto more than one factor, and for five of these items, all loadings were less than 0.5. The six items were numbers 3, 11, 20, 25, 32 and 38 (see Table *4.1*). Of the initial 38 items, 32 were retained and all had pattern matrix loadings greater than .47.

A PCA with direct oblimin rotations ($\Delta = 0$) was carried out on the remaining 32 items. Both the Kaiser-Meyer-Olin measure (KMO = .9) and Bartlett's test of sphericity (χ^2 (496) = 4570.24, $p < .001$) indicated that the data remained suitable for analysis. The scree plot again suggested possible 7-factor and 8-factor solutions. The 7-factor model explained 68.78% of the total variance, however the 8-factor model was deemed to be more suitable as it accounted for 71.73% of total variance and good simple structure had been achieved with all factor loadings within the model exceeding 0.4.

Items with factor loadings greater than 0.7 were used to define the factors which were labelled in accordance with expectancy factor labels commonly used across SCQ scale versions (Brandon & Baker, 1991; Copeland, et al., 1995; Lewis-Esquerre, et al., 2005). Four factors described negative smoking expectancies: negative physical feelings (NPF, 4 items), addiction risk (ADD, 2 items), health risks (HR, 2 items), and negative social impressions created by smoking (NSI, 3 items). The remaining four factors described positive smoking expectancies: negative affect reduction (NAR, 9 items), social facilitation (SF, 3 items), the weight control (WC, 5 items), and positive reinforcement expectancies (PR, 4 items). The item loadings and internal consistency measures associated with each of the eight factors are presented in Table 4.3. Values below 0.4 have been suppressed for clarity. The 32 retained items combined to form the new heterogeneous smoking consequences questionnaire which will subsequently be referred to as the H-SCQ.

4.2.2.1 Reliability and factor inter-correlations Coefficient (Cronbach's) alpha reliabilities were calculated for the H-SCQ as a whole (0.88) and for each of the factors. High reliability values were found for the NAR (α = .95), WC (α = .87), PR (α = .82), SF (α = .81), and NPF (α = .80) subscales which are comparable to previously reported adult (Copeland, et al., 1995), young adult (Brandon & Baker, 1991), and adolescent (Lewis-Esquerre, et al., 2005) values. While reliability for the NSI subscale (α = .67) is lower than found in previous adult samples, is it higher than that found for adolescents (Lewis-Esquerre, et al., 2005). Reliability was also lower for the HR (α = .56) and ADD (α = .59) subscales, although comparison could only be made with previous adult samples as these factors were not included in the adolescent SCQ. Examination of the correlations between subscales demonstrated that the NAR scale was negatively correlated with PR (-.28), and also with WC (-.34) and NSI (-.28), but positively correlated with SF (.28); the WC and PR subscales were themselves negatively correlated (.33). In each case the correlations were small-to-medium. The NPF subscale was positively correlated with NSI (.25) and HR (-.21), which were themselves positively correlated (.17), but again the correlations were small.

Table 4.3 *Direct Oblimin (Δ = 0) Rotated Factor Loadings for the 32 Retained H-SCQ Items.*

		Rotated Factor Loadings							
	Item	NAR	NPF	SF	WC	Add	HR	PR	NSI
4	If I'm tense, a cigarette helps me to relax.	.89							
1	When I'm angry, a cigarette can calm me down.	.88							
5	Cigarettes help me deal with anxiety or worry.	.87							
18	When I am worrying about something, a cigarette is helpful.	.86							
27	Smoking calms me down when I'm feeling nervous.	.80							
35	When I'm upset with someone, a cigarette helps me cope.	.74							
14	Cigarettes help me concentrate.	.67							
8	I enjoy parties more when I am smoking.	.60						.47	
26	Smoking helps if I feel bad about myself.	.57							
33	Smoking irritates my mouth and throat.		.73						
21	My throat burns after smoking.		.70						
30	Smoking will make me cough.		.70						
19	Cigarettes make my lungs hurt.		.65						
12	Smoking makes me look tough or cool.			.89					
13	Smoking makes me feel older or more mature.			.84					
22	People look up to those who smoke.			.67					
34	Smoking helps me control my weight.				-.91				
37	Smoking controls my appetite.				-.87				
28	Smoking helps me stay slim.				-.81				
31	People gain weight when they stop smoking.				-.60				
15	Cigarettes keep me from overeating.				-.60				
17	I will become more dependent on nicotine if I continue smoking.					-.90			
36	I become more addicted the more I smoke.		.46			-.57			
2	By smoking I risk heart disease and lung cancer.						.89		
7	The more I smoke, the more I risk my health.						.69		
10	If I have nothing to do, a smoke can help kill time.	.48						.49	
29	Smoking gives me something to do with my hands.				-.41			.48	
23	Cigarettes are good for dealing with boredom.	.45						.46	
9	Just handling a cigarette is pleasurable.							.40	
16	Smoking makes me seem less attractive.								.78
6	Smoking makes me look ridiculous or silly.								.68
24	People think less of me if they see me smoking.								.50
	Eigenvalues (following rotation)	9.23	3.43	3.72	5.13	1.58	1.87	3.05	3.26

Note. Pattern matrix loadings are reported ; items in bold represent retained factor items; values below 0.4 have been suppressed; NAR, negative affect reduction; NPF, negative physical feeling; SF, social facilitation; WC, weight control; Add, addiction risk; HR, health risk; PR, positive reinforcement; NSI, negative social impression.

4.2.2.2 Between-group differences. Concurrent validity was examined by looking at smoking status, age, and gender differences in H-SCQ scores. A 2 (smoking status) X 3 (age group) X 2 (gender) MANOVA of subscale scores found a significant smoking status by age interaction using Pillai's trace; $V = 0.17$, $F(16,392) = 2.27$, $p < .01$, $\eta_p^2 = .09$, and a significant smoking status by gender interaction using Pillai's trace; $V = 0.11$, $F(8,195) = 3.07$, $p < .01$, $\eta_p^2 = .11$. For clarity, the post-hoc analysis for each interaction will be presented separately.

Smoking status and age group differences. Mean subscale scores for smokers and non-smokers in each age group were calculated for each of the factors in the H-SCQ scale and these are presented in Table 4.4.

Table 4.4 *Mean H-SCQ Subscale Scores (Standard Deviation), by Smoking Status and Age.*

	Adolescents		Young Adults		Older Adults	
	Smoker n = 33	Non-S n =71	Smoker n =26	Non-S n = 30	Smoker n =29	Non-S n =28
NAR	4.67 (0.79)	2.52 (1.35)	4.37 (0.81)	3.36 (1.49)	3.94 (0.99)	2.96 (1.75)
NPF	3.12 (1.11)	4.63 (1.06)	3.69 (0.89)	4.32 (1.17)	3.82 (0.96)	4.47 (1.02)
SF	2.24 (1.67)	2.24 (1.30)	2.21 (1.20)	2.57 (1.14)	1.67 (0.73)	2.24 (1.14)
WC	2.99 (1.54)	2.99 (1.16)	3.57 (1.30)	3.35 (1.20)	3.28 (1.23)	3.49 (1.23)
Add	5.12 (1.10)	5.00 (1.19)	4.88 (1.22)	5.22 (1.32)	4.60 (1.11)	5.14 (0.94)
HR	5.37 (1.05)	5.68 (0.55)	5.42 (0.63)	5.63 (0.60)	5.50 (0.55)	5.61 (0.66)
PR	3.68 (1.16)	2.52 (1.19)	4.44 (1.05)	2.94 (1.45)	3.91 (1.09)	3.29 (1.39)
NSI	2.99 (1.16)	4.16 (1.11)	3.45 (1.02)	3.77 (0.98)	3.94 (0.95)	3.83 (1.01)

Note. Non-S, non-smoker; NAR, negative affect reduction; NPF, negative physical feeling; SF, social facilitation; WC, weight control; Add, addiction risk; HR, health risk; PR, positive reinforcement; NSI, negative social impression.

In order to identify the source of the smoking status by age interaction, separate 2 (smoking status) X 3 (age) ANOVAs were run on each of the subscales. Significant smoking status by age interactions were found on the three of the revised SCQ subscales: NAR, $F(2,208) = 5.0$, $p < .01$, $\eta_p^2 = .05$.; NPF, $F(2,208) = 4.16$, $p < .05$, $\eta_p^2 = .04$.; and NSI $F(2,208) = 6.77$, $p < .01$, $\eta_p^2 = .06$ (see *Figure 4.1*).

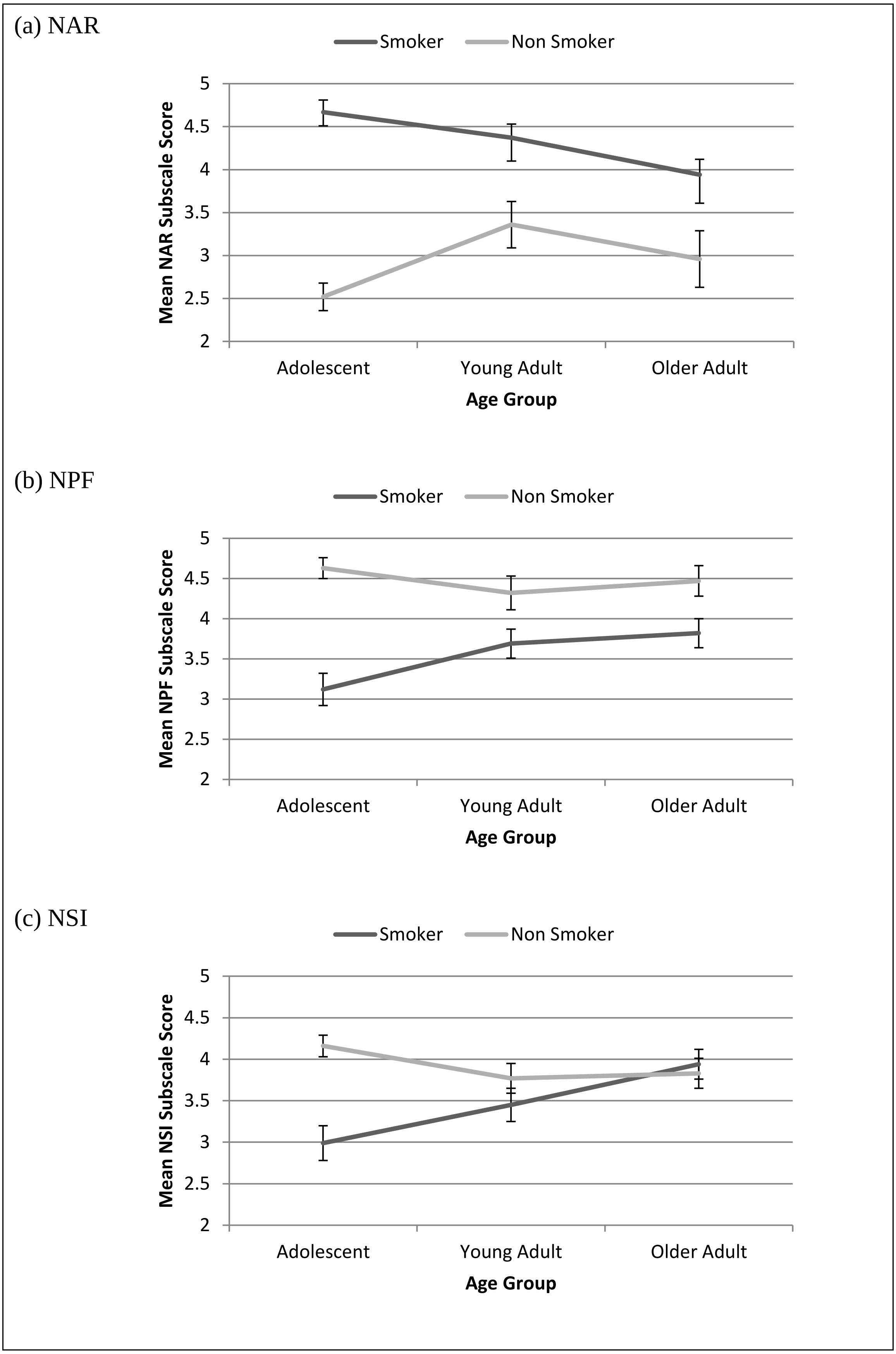


Figure 4.1 Mean smoking status by age H-SCQ subscale scores for NAR, NPF, and NSI expectancies. Error bars represent standard errors.

Post-hoc analysis of the NAR subscale demonstrated that smokers rated NAR expectancies significantly higher than non-smokers in each age group: adolescents, $t(99) = 8.15$, $p < .001$, $d = 1.78$; young adults, $t(54) = 3.06$, $p < .01$, $d = 83$; and older adults, $t(55) = 2.62$, $p < .05$, $d = .70$. Within the smoking group, adolescents rated NAR expectancies significantly higher than older adults ($p < .01$) whereas in the non-smoking group, adolescents rated these expectancies significantly lower than young adults ($p < .05$). No other significant differences were found. Post-hoc analysis of the NPF subscale demonstrated that smokers rated NPF expectancies significantly lower than non-smokers in each age group: adolescents, $t(99) = 6.43$, $p < .001$, $d = 1.41$; young adults, $t(54) = 2.22$, $p < .05$, $d = .61$; and older adults, $t(55) = 2.49$, $p < .05$, $d = .66$. Within the smoking group, adolescents rated NPF expectancies significantly lower than older adults ($p < .05$); no other significant differences were found. Post-hoc analysis of the NSI subscale demonstrated that adolescent smokers rated NSI expectancies significantly lower than adolescent non-smokers, $t(99) = 4.80$, $p < .001$, $d = 1.05$. Within the smoking group, adolescents rated NSI expectancies significantly lower than older adults ($p < .01$); no other significant differences were found

The 2 (smoking status) X 3 (age) ANOVA analysis of the PR scale revealed both a main effect of smoking status, $F(1,208) = 37.92$, $p < .001$, $\eta_p^2 = .15$, and a main effect of age, $F(1,208) = 4.81$, $p < .01$, $\eta_p^2 = .04$, but no significant interaction. Post-hoc *t*-tests revealed that smokers rated PR expectancies significantly higher than non-smokers, $t(212) = 6.89$, $p < .001$, $d = .97$. Post-hoc analysis also revealed that adolescents rated PR expectancies as significantly less likely than both young adults ($p < .01$) and older adults ($p < .01$). Only a significant main effect of smoking status was found in the analysis of the HR scale, $F(1,208) = 4.71$, $p < .05$, $\eta_p^2 = .02$, and post-hoc *t*-tests revealed that smokers rated HR expectancies significantly lower than non-smokers, $t(212) = 2.43$, $p < .05$, $d = .34$. No significant differences were found on the SF, WC or ADD scales.

Gender differences. In order to further examine the smoking status by gender interaction, separate analyses of each subscale revealed a smoking status by gender interaction for the NSI scale only, $F(1,210) = 13.31$, $p < .01$, $\eta_p^2 = .05$. Female smokers gave significantly higher NSI ratings ($M = 3.72$, $SD = 1.22$) than male smokers ($M = 3.11$, $SD = 0.84$), $t(83) = 2.61$, $p < .05$, $d = .58$. The opposite pattern was seen among non-smokers with males ($M = 4.23$, $SD = 1.2$) giving higher NSI ratings than females ($M = 3.81$, $SD = 0.92$), although this difference was not significant when adjusted for multiple comparisons. A main effect of gender was also found for the WC subscale, $F(1,210) = 22.26$, $p < .001$, $\eta_p^2 = .10$, where females ($M = 3.54$, $SD = 1.25$) gave significantly higher ratings than males ($M = 2.8$, $SD = 1.16$). No other significant effects of gender were found.

4.2.2.3 Correlations with tobacco use. Within the smoking group, Pearson correlations were examined between H-SCQ-subscale scores and four measures of tobacco use; nicotine dependence (FTND), cigarette use (CPD), age smoking started, and age daily smoking commenced. As presented in Table *4.5*, a number of significant but small to moderate correlations were found with FTND, CPD, and the age when smoking started. The strongest correlations were found between the age at which daily smoking commenced and the NAR and PR subscales.

Table 4.5 *H-SCQ Factor Correlations with Nicotine Dependence, Cigarette Use, and Age Smoking and Daily Smoking Commenced.*

H-SCQ Scale	NAR	SF	WC	PR	NPF	HR	NSI	ADD
FTND	.39**	-.18**		.33**	-.28**	-.25**	-.19**	
CPD	.28**	-.24*		.23*				
Age Start	.36**	-.35**		.32**	-.42**			
Age Daily	.51**	-.33**	.21*	.50**	-.30**			

Note. NAR, negative affect reduction; SF, social facilitation; WC, weight control; PR, positive reinforcement; NPF, negative physical feeling; HR, health risk; NSI, negative social impression; ADD, addiction risk; ** p < .01; * p < .05

4.3 Validation of the H-SCQ scale

Data from a larger and more diverse sample, gathered as part of Study 3, were used to validate the H-SCQ. An 8-factor baseline model was created from the results of the EFA analysis and Confirmatory Factor Analysis (CFA) was used to assess model fit. The factor structure, reliability and concurrent validity of the new scale were compared to that found in the developmental sample.

4.3.1 Method

4.3.1.1 Participants. A total of 1074 participants, grouped by smoking status (smoker, ex-smoker, and non-smoker) and age (adolescents: 15 to 18 years, young adults: 19 to 25, and older adults: 26 to 45), took part in this research as part of a larger study. Twenty-eight participants had large amounts of missing SCQ data and were therefore excluded from the analysis, leaving a total of 1046. Groups comprised of 328 smokers (170, 106, 52), 122 ex-smokers (34, 20, 68), and 596 non-smokers (375, 146, 75). A full breakdown of participant characteristics is presented with the results. Adult participants were recruited via posters and emails. Some were undergraduate students who participated in exchange for research credits, others for entry into a draw for €50. Adolescents were recruited from four post-primary schools, where the principal had given prior consent for the school to participate in the research. A combination of adolescent and young adult participants were also recruited from eight youth reach groups, again with prior group leader consent. The study was approved by the School of Psychology Research Ethics Committee in Trinity College Dublin (see Appendix 6). All participants provided formal written consent prior to commencing the study and parental consent was also provided for those under the age of 18 (see Appendix 7).

4.3.1.2 Measures. The measures analysed in this study formed part of a larger survey. The other elements of this survey will be presented in the next chapter.

Revised Smoking Consequences Questionnaire. As in Study 1, participants completed the revised 38-item SCQ. This was completed as the second element of the survey, following a free association task (as in Study 1). Participants also completed the same demographic, smoking history, and FTND measures as before. These formed that last section of the survey (as in Study 1).

4.3.1.3 Procedure. This study followed the same procedure used in Study 1 when testing adolescents in the four post-primary schools and in seven of the eight youth reach groups. In all cases, these participants completed one of six paper versions of the questionnaire; multiple versions were used to alternate the sequence of later elements in the survey which are not applicable for analysis here. Participants in one youth reach group, and all other adult participants, completed the survey online via SurveyGizmo (Widgix, LLC, Boulder, CO, USA).

4.3.1.4 Data Analysis. A missing values analysis was first carried out using SPSS 19 (SPSS Inc., Chicago, Illinois 60606, US). Confirmatory Factor Analysis (CFA), using the maximum-likelihood method (ML) was then conducted in AMOS 19 (SPSS Inc., Chicago, Illinois 60606, US) to determine the suitability of the 8-factor H-SCQ structure suggested in Study 1. Consistency across multiple indices is suggested to be most indicative of model fit (Mulaik et al., 1989) so a variety of goodness-of-fit indices are reviewed for each analysis; the chi-square goodness-of-fit statistic (χ^2), the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), the Normed Fit Index (NFI), and the root-mean-square error of approximation (RMSEA). A non-significant chi-square test indicates good model fit, but the chi-square test is sensitive to sample size which can result in the rejection of reasonable models when the sample size is large (Bryant & Yarnold, 1995). CFI, TLI, and NFI indices have values ranging from 0 to 1 and good model fit is indicated by a value greater than .90 (Bentler & Bonett, 1980), with values near or greater than .95 indicating excellent model fit (Hu & Bentler, 1999). RMSEA values of .10 or below are required; well-fitting models will range from .05 to .08 (Vandenberg & Lance, 2000) and models with moderate fit from .08 to .10 (MacCallum, Browne, & Sugawara, 1996). Modification indices were reviewed for factor cross-loadings and error covariances. Where substantive rationale existed for re-specifying the model, an adjusted version was created. These adjusted models were reviewed in a nested fashion which facilitated the use of chi-squared difference tests to examine improved model fit; a significant difference indicates that the model associated with the smaller chi-square value demonstrates a better fit to the data (Kline, 2010).

The resulting model was then examined for multi-group invariance which essentially compares the factor structure of the H-SCQ across participant groups. Given the size of the sample, it was not possible to evaluate model invariance across nine combined smoking status and age groups. Instead, multi-group invariance tests were carried out first by smoking status, and then by age, using the AMOS multi-group functionality (Byrne, 2008). Factorial invariance is tested by comparing a model that constrains the factor loadings (measurement model) with a model that has no constraints (configural model). The classical approach to arguing for evidence of invariance is to demonstrate a non-significant change in the chi-square value (Byrne, 2008), although recent researchers suggest that this is a very stringent test and that it may be more reasonable to base invariance decisions on a difference in CFI values (Cheung & Rensvold, 2002), where evidence of non-invariance is based on a CFI difference exhibiting a probability of < 0.01. Structural equivalence is assessed in the same way by comparing a model that additionally constrains the factor covariances (structural model) with the configural model. Equivalence across groups would mean that the H-SCQ scale was capable of assessing the same smoking expectancy constructs for people with varied smoking status, and across people of different ages. Analysis of scale reliability, inter-scale correlations, between-group differences, and correlations between smoking expectancies and smoking behaviour were conducted as in Study 1 (see section 4.2.1.4).

4.3.2 Results

4.3.2.1 Participant characteristics. Nine participants had more than 5% missing data and were excluded from further analysis. Only 19 of the remaining 1,065 participants had incomplete data and these were also removed from the analysis[4]. Data from the remaining 1,046 participants were analysed. Their demographic profile and the average use and dependence characteristics of each smoking group are presented Table 4.6.

Table 4.6 *Demographic Profile, Means (Standard Deviations), of Smoker, Ex- and Non-smoker Participants Including a Breakdown of Demographic Characteristics by Age.*

	Adolescents			**Young Adults**			**Older Adults**		
	Smoker	Ex-S	Non-S	Smoker	Ex-S	Non-S	Smoker	Ex-S	Non-S
	n = 170	n = 34	n = 375	n = 106	n = 20	n = 146	n = 52	n = 68	n = 75
Female	79	19	229	60	18	118	31	47	60
Male	91	15	146	46	2	28	21	21	15
Age	16.84	16.94	16.46	20.65	21.50	21.06	33.27	37.96	35.15
	(0.94)	(0.98)	(0.96)	(1.78)	(2.07)	(1.94)	(6.06)	(9.08)	(6.99)
Smoking History									
Age Start	13.38	13.81		14.69	14.85		15.12	15.57	
	(2.24)	(1.44)		(2.73)	(2.19)		(2.48)	(3.72)	
Age Daily	13.97	14.19		12.56*	12.79*		14.49*	17.61	
	(3.19)	(3.14)		(6.94)	(6.37)		(7.00)	(5.19)	
CP D	9.61			9.41			18.39		
	(6.71)			(8.00)			(35.53)		
FTND	2.52			2.03			2.08		
	(2.43)			(2.33)			(2.16)		

Note. Ex-S, ex-smoker; Non-S, non-smoker; CPD, number of cigarettes smoked per day.
*Not all smokers are daily smokers but those that are started younger.

Some age differences were observed in comparison to participants in the development sample. Adolescent smokers in this validation sample were significantly younger, $t(198) = 3.11$, $p < .01$, $d = .61$. Young adult smokers and non-smokers were also

[4] When these 19 participants were retained, and missing values imputed using SPSS Expectation maximization functionality, the overall model fit and item level assessment remained the same. It was therefore viewed to be more correct to remove these participants from the data analysis.

significantly younger, $t(130) = 6.33$, $p < .001$, $d = 1.39$ and $t(174) = 4.70$, $p < .001$, $d = .94$ respectively. No other significant age differences were found. Young adult smokers also commenced daily smoking at a younger age than those in the developmental sample, $t(114) = 3.34$, $p < .01$, $d = .78$, but no differences were found for use or dependence measures in this age group, nor were any significant differences found for smoking-related variables in the other age groups. Gender distribution within the groups was also examined and only one significant difference was found. This was observed in the adolescent non-smoking groups, $U = 10808$, $p < .01$, $r = -0.14$, but the effect size was very small.

4.3.2.2 CFA of the H-SCQ scale. An assessment of multivariate normality indicated that the H-SCQ data were suitable for CFA analysis. Although no clear consensus exists in terms of the size of problematic kurtosis values (Kline, 2010), a standardised kurtosis index (β_2) greater than or equal to 7 is typically used a guide to indicate early departure from normality (Finch, West, & MacKinnon, 1997). Only two H-SCQ items were identified as being potentially problematic, item two ($\beta_2 = 7.84$) and item seven ($\beta_2 = 7.99$). Both dealt with expectancies of smoking-related health risk and both loaded on the same factor, which in turn had no other item loadings. Kurtosis values for the remaining items ranged from -1.47 to +2.61. Overall, the data were deemed to be sufficiently normal to proceed with the CFA analysis.

Model fit was assessed for the 8-factor H-SCQ model suggested by the EFA analysis in Study 1. In the baseline CFA model (A), items were only allowed to load onto one factor. The factors themselves were allowed to freely correlate. The analysis of model A indicated that it achieved good fit as measured by the RMSEA index, but only moderate fit based on the CFI, TLI, and NFI indices (see Table 4.7). The chi-square test resulted in a significant p value, $\chi 2 = 2108.42$, $df = 436$, $p < .001$, which does not automatically indicate a poor model fit given the sensitivity of the CFA to sample size (Bryant & Yarnold, 1995). No significant factor cross-loadings were found on examination of the modification indices, however, significant error covariances were found for four item pairs. These will be examined in descending order of the modification index (MI) strength.

Items 1 and 4 (MI = 135.59) both referred to NAR expectancies, were phrased in a similar way “When I’m angry ...” and “If I’m tense ...”, and the partial correlation for their error variances was 0.34. Items 4 and 5 (MI = 95.15) also referred to NAR expectancies, dealt with tension reduction outcomes of smoking, and error variances were partially correlated with a value of 0.25. In both cases, the presence of a common secondary influence is suggested. Items 8 and 9 (MI = 92.61) demonstrated the largest partial error variance correlation of 0.56. Although item 8 referred to increased enjoyment of social situations when smoking and item 9 referred to the pleasurable sensation felt when handling a cigarette, both items deal with positive expectancies of smoking and a prevailing feeling of enjoyment. Finally, a partial correlation of 0.31 was found for the error variances of items 14 and 15 (MI = 50.20). Item 14 dealt with the ability of cigarettes to improve concentration and item 15 with the ability of smoking to restrain over-eating. Both could be said to relate to outcomes of improved focus.

Taken together, these MIs suggest that a better model fit could be achieved by allowing some error variances to freely correlate. As a result amended models were created, in a nested fashion, such that error covariances for item pairs with the largest MI were tested first. Model fit and modification indices were examined for each new model in order to determine (a) if model fit improved from previous versions and (b) if any additional modifications required consideration. A total of four amended models (B through E) were analysed. Chi-Square difference tests indicated that each new model achieved a better fit than the previous version such that the best-fitting model was model E. This model included each of the problematic error covariances identified in the initial analysis and no further modifications were required. Table 4.7 presents a summary of the adjustments made and the model-fit statistics for each model. The RMSEA index for model E indicates excellent fit, while the CFI, TLI, and NFI indices demonstrate good fit.

Table 4.7 *Summary CFA Model-fit Statistics.*

Model	χ^2	*df* (*p*)	RMSEA	CFI	TLI	NFI	$\Delta\chi^2$
A. 8-factor H-SCQ	2108.42	436*	.061	.909	.897	.889	
B. e1 – e4 correlation (*r* = .39)	1960.55	435*	.058	.917	.906	.897	147.87*
C. e4 – e5 correlation (*r* = .25)	1852.05	434*	.056	.923	.912	.902	108.5*
D. e8 – e9 correlation (*r* = .57)	1750.61	433*	.054	.929	.918	.908	101.44*
E. e14 – e15 correlation (*r* = .31)	1694.83	432*	.053	.932	.922	.911	55.78*

Note. N = 1046; χ^2, chi-square goodness-of fit index; RMSEA, root-mean-square error of approximation; CFI, comparative fit index; TLI, Tucker-Lewis index; NFI, normed fit index; $\Delta\chi^2$, chi-square difference test; * p < .001.

Inspection of the factor loadings confirmed that model E was most suited to the data and it was retained as the final model (see

Table *4.8*). All but two of the items in the model had factor loadings greater than 0.57 and no cross loadings greater than 0.29. The two remaining items had factor loadings of .45 and .32 respectively, but despite these low values, they had no cross loadings greater than 0.2. Stronger factor loadings had also been found for these items in the development sample so they were retained in the final model.

4.3.2.3 Suitability of factor structure for different groups. An additional concern in this study was whether the H-SCQ scale functioned in the same way for people with different levels of smoking experience, and those of different ages. Participants were first split into three smoking status groups: non-smokers (*n* = 596), smokers (*n* = 328), and ex-smokers (*n* = 122). AMOS multi-group (Byrne, 2008) was used to test whether the 8-factor structure validated above (model E) applied equally well to each smoking status group.

Table 4.8 *H-SCQ Item-factor Loadings Following CFA Analysis*

Scale		Loading
Negative Affect Reduction (NAR)		
27	Smoking calms me down when I'm feeling nervous.	.90
18	When I am worrying about something, a cigarette is helpful.	.89
35	When I'm upset with someone, a cigarette helps me cope.	.88
4	If I'm tense, a cigarette helps me to relax.	.86
5	Cigarettes help me deal with anxiety or worry.	.86
1	When I'm angry, a cigarette can calm me down.	.82
26	Smoking helps if I feel bad about myself.	.70
14	Cigarettes help me concentrate.	.63
8	I enjoy parties more when I am smoking.	.61
Negative Physical Feelings (NPF)		
33	Smoking irritates my mouth and throat.	.81
21	My throat burns after smoking.	.72
19	Cigarettes make my lungs hurt.	.68
30	Smoking will make me cough.	.62
Social Facilitation (SF)		
13	Smoking makes me feel older or more mature.	.86
12	Smoking makes me look tough or cool.	.82
22	People look up to those who smoke.	.32
Weight Control (WC)		
34	Smoking helps me control my weight.	.86
28	Smoking helps me stay slim.	.83
37	Smoking controls my appetite.	.80
15	Cigarettes keep me from overeating.	.72
31	People gain weight when they stop smoking.	.45
Addiction Risk (ADD)		
36	I become more addicted the more I smoke.	.75
17	I will become more dependent on nicotine if I continue smoking.	.60
Health Risk (HR)		
7	The more I smoke, the more I risk my health.	.76
2	By smoking I risk heart disease and lung cancer.	.58
Positive Reinforcement (PR)		
10	If I have nothing to do, a smoke can help kill time.	.86
23	Cigarettes are good for dealing with boredom.	.77
29	Smoking gives me something to do with my hands.	.65
9	Just handling a cigarette is pleasurable.	.59
Negative Social Impression (NSI)		
16	Smoking makes me seem less attractive.	.70
6	Smoking makes me look ridiculous or silly.	.65
24	People think less of me if they see me smoking.	.59

This involved a three step testing process, the results of which are summarised in Table 4.9. Step one involved the creation of a configural model, which imposed no equality constraints, to determine if the same number of factors and factor-loading pattern existed for each group. The goodness-of-fit characteristics for this model confirmed a good fit to the data across groups. The configural model was then used as the baseline against which subsequent multi-group invariance models were tested.

A measurement model was created in step two in which all factor loadings were constrained to be equal. The goodness-of-fit characteristics for this model continued to illustrate a good fit to the data across groups. Of more interest was the finding of non-significant results for both the $\chi 2$ and the CFI difference tests, demonstrating that the measurement components of the model are equivalent across groups. Finally, a structural model was created in which all of the covariances were constrained to be equal. Again good model fit to the data was demonstrated across groups. The $\chi 2$ difference test remained non-significant, but the ΔCFI slightly exceeded the cut-off value of .01 suggested by Cheung and Rensvold (2002). Given the stringent nature of the former, it was deemed that the structural components of the model were found to be equivalent across groups. The overall results suggest that the factor structure derived for the full sample represented the data reasonably well in each smoking status group.

A similar three step process was used to examine invariance of the H-SCQ model across the three age groups: adolescents (n = 579), young adults (n = 272), and older adults (n = 195). The goodness-of-fit characteristics for the configural model confirmed a good fit to the data across groups, as did the goodness-of-fit characteristics for the measurement model (see Table 4.9). Non-significant results were found for both the $\chi 2$ and the CFI difference tests, demonstrating that the measurement components of the model are equivalent across age groups. Good model fit to the data across groups was also found for the structural model and both the $\chi 2$ and the CFI difference tests were non-significant, demonstrating equivalence of the structural components of the model across groups. The overall results suggest that the factor structure derived for the full sample also represented the data reasonably well in each age group.

Table 4.9 *Summary Goodness-of-fit Statistics for Tests of Multi-group Invariance for Smoking Status and for Age Groups.*

Model Description	χ^2	*df*	$\Delta\chi^2$	Δdf *(p)*	RMSEA	TLI	CFI	ΔCFI
Smoking Status Groups								
1. Configural Model	2648.60	1296			.032	.91	.922	
2. Measurement Model	2757.87	1352	109.27	56 (ns)	.032	.91	.918	.004
3. Structural Model	2971.51	1408	322.91	112 (ns)	.033	.90	.909	.013
Age Groups								
1. Configural Model	2852.21	1296			.034	.91	.918	
2. Measurement Model	2930.13	1352	77.92	56 (ns)	.033	.91	.915	.003
3. Structural Model	3031.65	1408	179.44	112 (ns)	.033	.91	.913	.005

Note. χ^2, chi-square goodness-of fit index; $\Delta\chi^2$, chi-square difference between models; Δdf, degrees of freedom difference between models; RMSEA, root-mean-square error of approximation; TLI, Tucker-Lewis index; CFI, comparative fit index; ΔCFI, CFI difference between models; ns, not significant; Configural model, no equality constraints imposed; Measurement model, all factor loadings constrained equal; Structural model, all covariances constrained equal.

4.3.2.4 Reliability and factor inter-correlations. Coefficient (Cronbach's) alpha reliabilities were calculated for the H-SCQ as a whole (0.89) and for each of its subscales. These are presented in bold on the diagonal of Table 4.10. High reliability values were found for the NAR, WC, PR, and NPF subscales and moderate reliability was demonstrated for the NSI subscale, each of which is comparable to reliability values found in the development sample, and in the literature. Reliability for the SF scale was lower in this sample than in the development sample (α = .81) but comparable to that found by (Rash & Copeland, 2008). In relation to the development sample, reliability improved for the ADD (compared with .59), and the HR (compared with .56) subscales, although it remains lower than that found in previous adult samples; these factors were not included in the adolescent-SCQ so no comparisons can be made with this age group.

Examination of the correlations between subscales demonstrated significant moderate positive correlations between all of the negative expectancy factors (NPF, HR, NSI, and ADD), and significant moderate to strong positive correlations between all of the positive expectancy factors (NAR, SF, WC, and PR). Some significant negative correlations were observed between negative and positive expectancy factors but these were small in comparison (see Table 4.10).

Table 4.10 *H-SCQ Factor Inter-correlations and Cronbach's Alpha Reliability Estimates (presented in bold on the diagonal).*

H-SCQ Scale	NPF	HR	NSI	ADD	NAR	SF	WC	PR
NPF	**.80**							
HR	.42 ***	**.61**						
NSI	.61 ***	.41 ***	**.68**					
ADD	.50 ***	.51 ***	.39 ***	**.62**				
NAR	-.23 ***	.05	-.34 ***	.27 ***	**.94**			
SF	.07	.05	-.17 ***	.20 ***	.42 ***	**.69**		
WC	.10	.09 *	-. 05	.35 ***	.60 ***	.45 ***	**.85**	
PR	- .17 ***	.03	-.33 ***	.27 ***	.83 ***	.48 ***	.60 ***	**.81**

Note. NAR, negative affect reduction; NPF, negative physical feeling; SF, social facilitation; WC, weight control; Add, addiction risk; HR, health risk; PR, positive reinforcement; NSI, negative social impression.
*** $p < .001$; * $p < .05$

4.3.2.5 Between-group differences

Concurrent validity was examined by looking at smoking status, age, and gender differences in H-SCQ scores. A 3 (smoking status) X 3 (age group) X 2 (gender) MANOVA of subscale scores found a significant smoking status by age interaction using Pillai's trace; $V = 0.09$, $F(32, 4096) = 2.83$, $p < .001$, $\eta_p^2 = .02$. No significant gender interactions were observed, although a main effect of gender was found using Pillai's trace; $V = 0.02$, $F(8,1021) = 3.04$, $p < .01$, $\eta_p^2 = .02$. The post-hoc analysis for the smoking status by age interaction will be presented first, followed by the analysis of the main effect of gender.

Smoking status and age group differences. Mean subscale scores for smokers, ex-smokers, and non-smokers in each age group were calculated for each of the factors in the H-SCQ scale and are presented in Table 4.11.

Table 4.11 *Mean H-SCQ Subscale Scores (Standard Deviations) by Smoking Status and Age*

	Adolescents			**Young Adults**			**Older Adults**		
	Smoker n = 170	Ex-S n = 34	Non-S n = 375	Smoker n =106	Ex-S n = 20	Non-S n = 146	Smoker n =52	Ex-S n = 68	Non-S n = 75
NAR	4.09 (1.04)	2.72 (1.15)	243 (1.27)	3.91 (1.05)	3.46 (1.04)	2.83 (1.50)	4.32 (0.93)	3.31 (1.32)	3.23 (1.62)
NPF	3.19 (1.18)	3.28 (1.25)	4.59 (1.05)	3.44 (1.13)	3.85 (1.25)	4.62 (1.18)	4.02 (1.12)	4.60 (0.90)	4.56 (.98)
SF	1.92 (0.91)	1.72 (0.87)	2.06 (1.09)	2.08 (1.08)	1.98 (1.05)	2.21 (1.20)	1.66 (0.66)	2.09 (1.14)	2.34 (1.32)
WC	3.16 (1.27)	2.45 (0.92)	2.74 (1.15)	2.85 (1.08)	3.40 (1.03)	3.15 (1.31)	3.51 (1.29)	3.64 (1.32)	3.73 (1.40)
Add	4.72 (1.27)	4.00 (1.61)	4.92 (1.33)	4.43 (1.41)	4.60 (1.64)	4.82 (1.46)	4.90 (1.28)	5.24 (1.09)	5.23 (0.99)
HR	5.29 (0.86)	5.12 (1.13)	5.53 (0.99)	5.20 (1.01)	5.38 (0.90)	5.62 (0.85)	5.54 (0.72)	5.82 (0.40)	5.81 (0.47)
PR	3.52 (1.13)	2.18 (1.17)	2.26 (1.13)	3.54 (1.22)	3.36 (1.33)	2.93 (1.42)	3.88 (1.11)	3.31 (1.35)	3.18 (1.55)
NSI	3.23 (1.06)	3.89 (1.41)	4.41 (1.17)	2.97 (1.04)	3.78 (1.23)	4.04 (1.20)	3.69 (1.17)	4.08 (1.06)	4.00 (1.16)

Note. Ex-S, ex-smoker; Non-S, non-smoker;

Separate 3 (smoking status) X 3 (age) ANOVAs were then run on each of the subscales. Significant smoking status by age interactions were found on six of the revised SCQ subscales: three negative expectancy factors, NPF, $F(4,1037) = 7.82$, $p < .001$, $\eta_p^2 = .03$; NSI, $F(4,1037) = 3.72$, $p < .01$, $\eta_p^2 = .01$; ADD, $F(4,1037) = 2.87$, $p < .05$, $\eta_p^2 = .01$; and three positive expectancy factors, NAR, $F(4,1037) = 3.38$, $p < .01$, $\eta_p^2 = .01$; WC, $F(4,1037) = 5.57$, $p < .001$, $\eta_p^2 = .02$; and PR, $F(4,1037) = 4.43$, $p < .01$, $\eta_p^2 = .02$.

As illustrated in *Figure 4.2*, post-hoc analysis of the NPF subscale demonstrated that smokers rated NPF expectancies significantly lower than non-smokers in each age group: adolescents ($p < .001$); young adults ($p < .001$); and older adults ($p = .01$). Smokers also rated NPF expectancies as significantly lower than ex-smokers in the older adult group ($p < .01$), whereas ex-smokers in the other two age groups were more similar to smokers, giving significantly lower NPF ratings than non-smokers in both cases;

adolescents ($p < .001$), young adults ($p < .05$). No significant age differences were found for non-smokers, but older adults rated NPF expectancies significantly higher than adolescents and younger adults in the smoking ($p < .001$ and $p < .01$) and ex-smoking ($p < .001$ and $p < .05$) groups.

Post-hoc analysis of the NSI subscale demonstrated that smokers rated NSI expectancies significantly lower than non-smokers and ex-smokers in the adolescent ($p < .001$ and $p < .01$) and young adults ($p < .001$ and $p < .05$) groups. Adolescent ex-smokers also rated NSI expectancies significantly lower than adolescent non-smokers ($p < .05$). Within the smoking group, older adults gave significantly higher NSI ratings than adolescents ($p < .001$) and young adults ($p < .01$), but among non-smokers adolescents gave significantly higher NSI ratings than young ($p < .01$) and older adults ($p < .05$). No significant age-related differences were found for ex-smokers.

Few significant differences were found in the post-hoc analysis of the ADD subscale. The only smoking status differences were found in the adolescent group where ex-smokers gave significantly lower ADD expectancy ratings than both smokers ($p < .05$) and non-smokers ($p < .001$). A clear linear increase in ADD ratings with increasing age was also revealed in the ex-smoking group where older adults gave significantly higher ratings than adolescents ($p < .001$). No other significant differences were found.

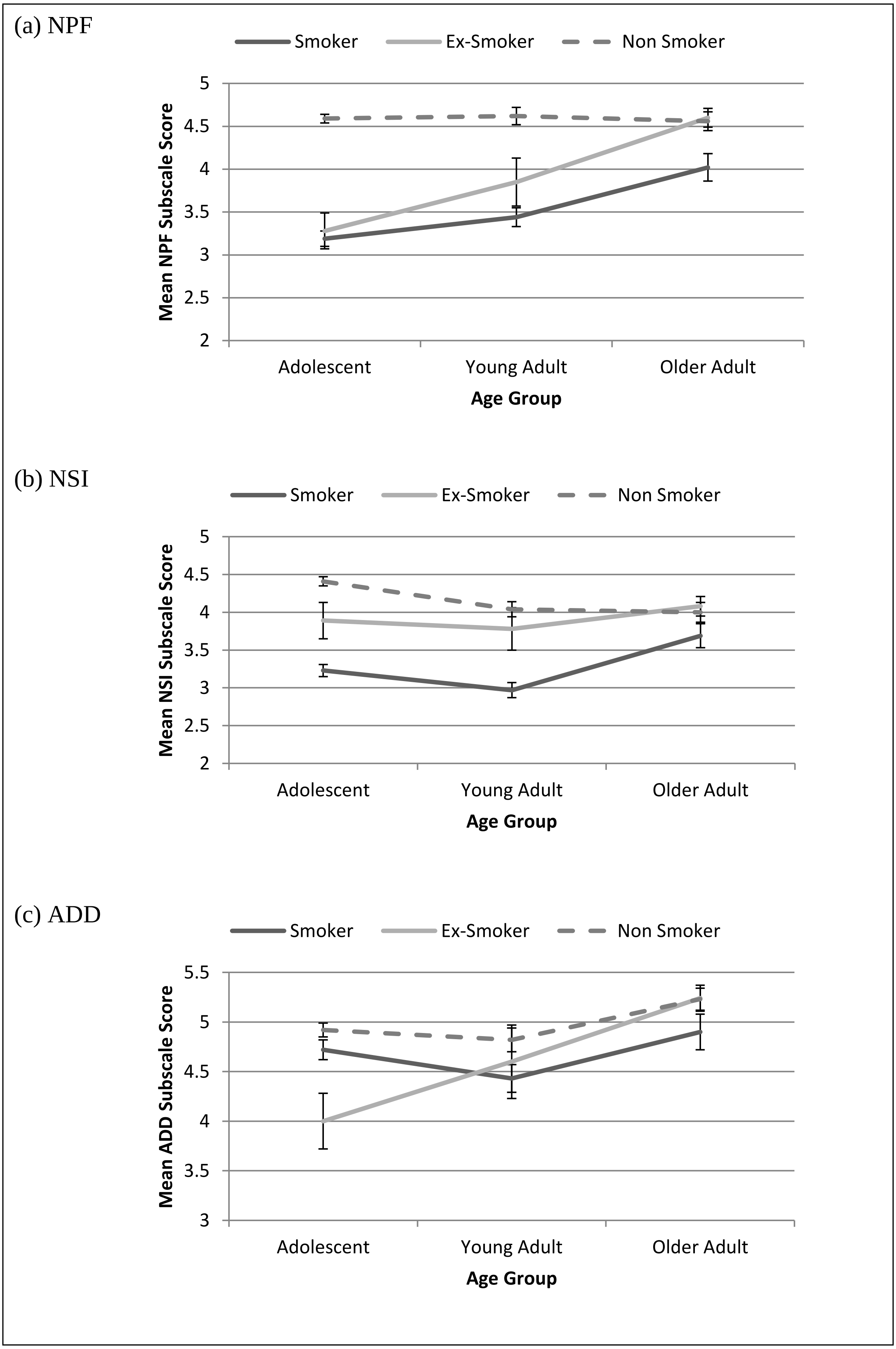


Figure 4.2 Mean smoking status by age H-SCQ subscale scores for the negative NPF, NSI, and ADD factors. Error bars represent standard errors.

As illustrated in *Figure 4.3*, post-hoc analysis of the NAR subscale demonstrated that smokers rated NAR expectancies significantly higher than non-smokers in each age group - adolescents ($p < .001$), young adults ($p < .001$), and older adults ($p < .001$) - and significantly higher than ex-smokers in the adolescent group ($p < .001$). No significant age differences were observed among smokers or ex-smokers, but within the non-smoking group, older adults rated NAR expectancies significantly higher than adolescents ($p < .01$) and younger adults ($p < .001$).

Post-hoc analysis of the WC subscale demonstrated that adolescent smokers rated WC expectancies significantly higher than adolescent non-smokers ($p < .001$) but significantly lower than adolescent ex-smokers ($p < .01$), whereas no significant smoking status differences were seen in other age groups. An age-related increase in WC ratings is seen in non-smokers where older adult ratings are significantly higher than young adults ($p < .01$) and adolescents ($p < .001$), and younger adult ratings significantly exceed those of adolescents ($p < .01$). A similar pattern is seen for ex-smokers where adolescent WC ratings are also significantly lower than both young ($p < .05$) and older adults ($p < .001$), although in this case the adult groups do not differ significantly. Among smokers, the only significant difference was found between the adult groups where older adults rate WC expectancies as significantly higher than younger adults ($p < .01$).

Post-hoc analysis of the PR subscale demonstrated that smokers rated PR expectancies significantly higher than non-smokers in each age group: adolescents ($p < .001$), young adults ($p < .01$), and older adults ($p < .05$). Adolescent smokers also gave significantly higher ratings than ex-smokers ($p < .001$). No age-related differences were found among smokers, but adolescents rated PR expectancies significantly lower than young and older adults in the non-smoking ($p < .001$ and $p < .001$) and ex-smoking ($p < .01$ and $p < .001$) groups.

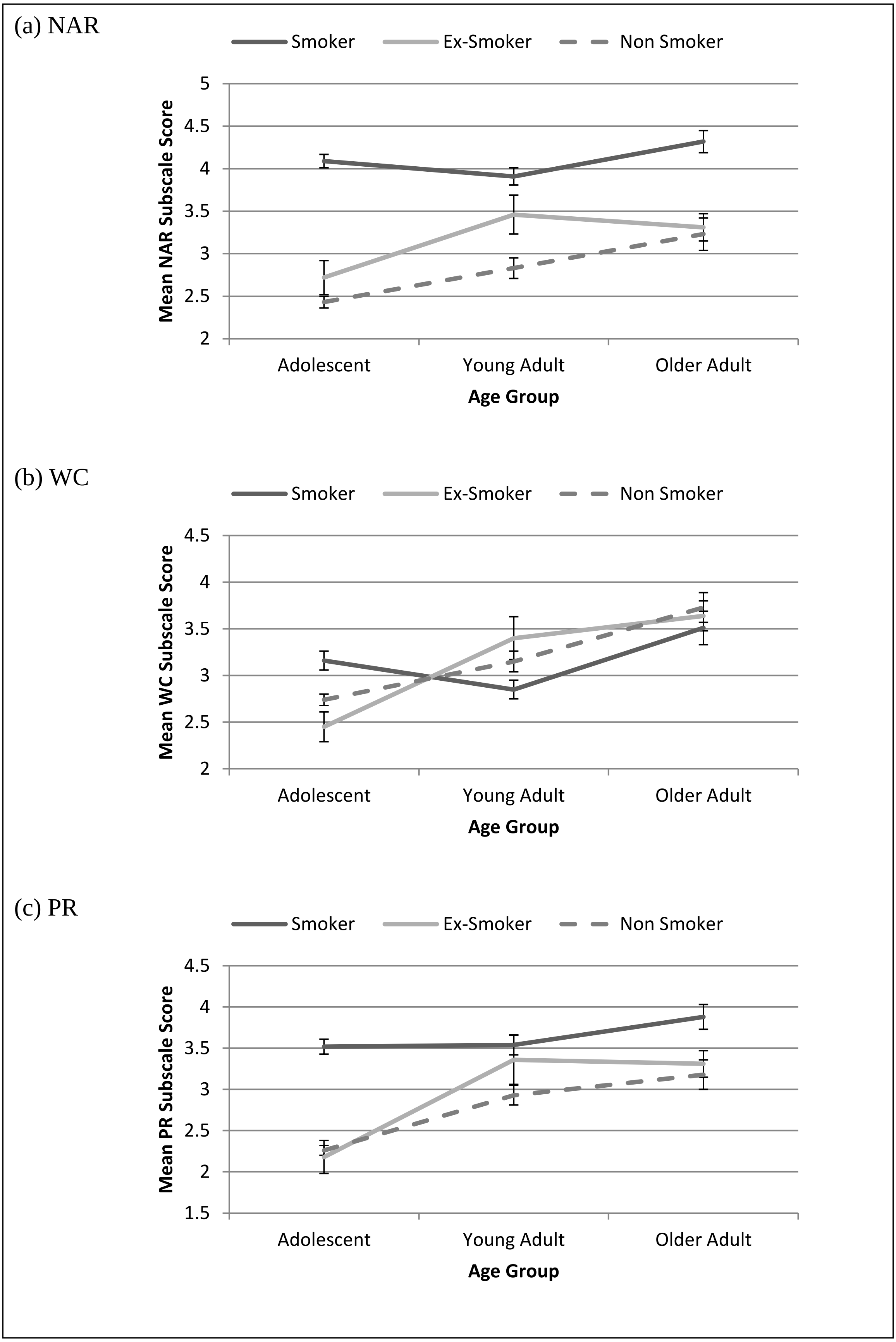


Figure 4.3 Mean smoking status by age H-SCQ subscale scores for the positive NAR, WC, and PR factors. Error bars represent standard errors.

Although no significant interactions were found on the HR and SF scales, some smoking status and age-related differences were observed. The 3 (smoking status) X 3 (age) ANOVA analysis of the HR scale revealed both a main effect of smoking status, $F(2,1037) = 10.11$, $p < .001$, $\eta_p^2 = .02$, and a main effect of age, $F(2,1037) = 11.93$, $p < .001$, $\eta_p^2 = .02$. Post-hoc analysis revealed that smokers (*M* = 5.3, *SD* = 0.9) rated HR expectancies significantly lower than both non-smokers ($p < .001$, *M* = 5.59, *SD* = 0.91) and ex-smokers ($p < .05$, *M* = 5.55, *SD* = 0.82). In addition, older adults (*M* = 5.74, *SD* = 0.54) gave significantly higher HR ratings than both adolescents ($p < .001$, *M* = 5.44, *SD* = 0.97) and young adults ($p < .01$, *M* = 5.44, *SD* = 0.94). Only a significant main effect of smoking status was found in the 3 (smoking status) X 3 (age) ANOVA analysis of the SF scale, $F(2,1037) = 7.76$, $p < .001$, $\eta_p^2 = .02$, and post-hoc analysis revealed that non-smokers (*M* = 2.13, *SD* = 1.15) rated SF expectancies significantly higher than smokers ($p < .05$, *M* = 1.93, *SD* = 0.94). No significant differences were found in relation to ex-smokers (*M* = 1.97, *SD* = 1.06).

Gender differences. Separate analyses of each subscale found this main effect for NPF and WC expectancies only. Females gave significantly higher NPF ratings (*M* = 4.27, *SD* = 1.22) than males (*M* = 3.98, *SD* = 1.27), $t(1044) = 3.6$, $p < .001$, $d = .27$. They also gave significantly higher WC ratings (*M* = 3.19, *SD* = 1.29) than males (*M* = 2.81, *SD* = 1.17), $t(1044) = 4.71$, $p < .001$, $d = .30$. As no interactions were found with either smoking status or age, no further analysis of gender will be carried out.

4.3.2.6 Correlations with tobacco use Within the smoking group, correlations were examined between H-SCQ subscale scores and four measures of tobacco use. Significant but small positive correlations were found between nicotine dependence (FTND) and NAR ($r = .31$, $p < .001$), PR ($r = .23$, $p < .001$), ADD ($r = .18$, $p < .001$), and WC ($r = .15$, $p < .001$). CPD was positively correlated with NAR ($r = .14$, $p < .001$). No significant correlations were found between the H-SCQ and the age someone started smoking, but a number of small correlations were found with the age at which daily smoking commenced: NAR ($r = .24$, $p < .001$), WC ($r = .18$, $p < .001$), PR ($r = .17$, $p < .001$), ADD ($r = .14$, $p < .001$), and SF ($r = .12$, $p < .05$).

4.4 Discussion

The studies presented in this chapter aimed to develop and validate an explicit measure of smoking expectancies that would be suitable for use with participants of different ages and varied smoking experience. Study 1 sourced items for a revised SCQ measure from the original SCQ (Brandon & Baker, 1991), the SCQ-Adult (Copeland, et al., 1995), and the Adolescent-SCQ (Lewis-Esquerre, et al., 2005) scales. An 8-factor model was found to best fit the data for the resulting 32-item H-SCQ scale. As hypothesised, this model was larger than the original 4-factor SCQ model (Brandon & Baker, 1991) and it was shown to be reliable and valid across the different groups. The eight factors were also consistent with the types of expectancy clusters found in the SCQ literature and they were labelled accordingly (Copeland, et al., 1995; Lewis-Esquerre, et al., 2005; Rash & Copeland, 2008; Schleicher, et al., 2008). Four factors represented negative smoking expectancies: NPF (4 items), ADD (2 items), HR (2 items), and NSI (3 items), and four described positive smoking expectancies: NAR (9 items), SF (3 items), WC (5 items), and PR (4 items). The model was subsequently validated in a larger and more diverse sample and factorial invariance analyses revealed that the 8-factor structure was suited to participants of varied smoking status, and to those of different ages.

Items in each factor had reasonably high loadings, and generally did not cross-load onto other factors. Internal consistency estimates for the overall scale were high in both samples, and factor reliabilities were consistent with those found in the literature, in particular for the NAR, WC, PR, NPF and SF subscales. Reliability estimates for the HR and ADD subscales were somewhat lower that those found in adult studies but were moderately high, particularly in the larger validation sample. As these risk expectancies have been removed from adolescent versions of the SCQ, there are no comparative values for these subscales. Additional research in adolescent populations is needed in order to establish consistent reliability estimates for these two subscales. It would also be interesting to determine if a difference exists between those individuals with low HR and ADD ratings and those who initiate or maintain smoking despite an awareness of the likelihood of these risky outcomes. Hence, it is important to retain these subscales and attempt to improve their consistency in younger age-groups, rather than removing them completely from the measurement scale.

The relationships between the H-SCQ factors themselves were inconsistent across the two samples. Stronger correlations were found in the larger validation sample. As expected, the negative expectancy factors (NPF, NSI, HR, and ADD) had strong positive associations with each other, as did the positive expectancy factors (NAR, PR, WC, and SF), and the negative and positive factors are generally negatively correlated with each other, albeit that these relationships were a lot weaker than those seen among expectancy factors of the same valence. This pattern of associations supports findings from previous adolescent (Lewis-Esquerre, et al., 2005) and adult (Copeland, et al., 1995) research.

Finding that an 8-factor model fits these diverse data well contrasts with previous research that uses evidence of larger adult SCQ models, in comparison to those for younger participants, to support the view that outcome expectancies become more refined with age and experience (S. A. Brown, 1993); for example, Copeland and colleagues (2007) argue that the evidence for 3-factor models in children but models with nine or ten factors in heavy adult smokers clearly indicates that a combination of age and increased smoking clarifies expectancies. Yet expectancy theory also suggests that an individual does not require direct experience of a particular behaviour to associate it with certain outcomes (Bandura, 1977; Petraitis, et al., 1995) and larger models of smoking expectancies have been found for both smokers and non-smokers in studies of adolescents (seven factors; Lewis-Esquerre, et al., 2005) and young adults (nine factors; Schleicher, et al., 2008). These studies suggest that the organisation of smoking expectancies may be similar across different age groups, and across those with different levels of direct smoking experience, which in turn supports the claim that smoking-related associations can be developed vicariously as well as with direct smoking experience. Adolescents increasingly encounter smoking-related information, whether this is through smoking prevention programmes in schools or the smoking-related opinions and behaviours of influential others. They are also likely to find themselves in social situations where smoking-related decisions are required, perhaps to a greater extent than would be the case for younger children whose expectancies do seem to be consistently more global in nature (Copeland, et al., 2007).

Furthermore, evidence from alcohol research suggests that even though expectancies become better defined with increased alcohol experience, the factor content of outcome expectancy scales remains relatively stable across experience and age (Christiansen, Goldman, & Inn, 1982; Wiers, Van Woerden, Smulders, & De Jong, 2002), but that the patterns of expectancy endorsement can differ between groups. A very clear pattern of results emerged from the studies conducted here that demonstrates the ability of the H-SCQ to differentiate between groups in this way, supporting the view that it is the type of endorsements made within each expectancy category that is more likely to change with age and smoking experience.

As expected, smokers endorsed more positive outcome expectancies and less negative outcome expectancies than non-smokers, which is consistent with previous findings in the literature (Copeland, et al., 1995; Lewis-Esquerre, et al., 2005; Rash & Copeland, 2008). Specifically, smokers of all ages rated NPF, NSI, and HR expectancies significantly lower than non-smokers, but they rated NAR, PR, and in the case of adolescents, WC expectancies, significantly higher than non-smokers. Both smokers and non-smokers gave similar ratings for ADD expectancies, so there seems to be a general acceptance that smoking carries a risk of addiction. Interestingly it was non-smokers of all ages who gave the highest ratings for SF expectancies. This suggests that they perceive that individuals can start smoking for social reasons whereas in fact this is an expectancy that smokers don't rate as particularly relevant to their smoking decisions.

Positive smoking consequences were also expected to be associated with younger age, and negative consequences with older age groups. Results only partially supported this hypothesis as the age effects tended to be influenced by smoking status to a greater degree than the reverse. No impact of age was found for SF expectancies, and despite significant associations between smoking-related weight control beliefs and adolescent smoking (Hine, McKenzie-Richer, Lewko, Tilleczek, & Perreault, 2002), especially among young girls (Boles & Johnson, 2001), a roughly linear increase in WC ratings was found in this study. Age influenced PR ratings in a similar way, but it only impacted NAR ratings in the non-smoking group where older adults gave the highest ratings. This again could be interpreted as a perception held by older adults as to why people choose to smoke; in other words they see smoking primarily as a coping mechanism (Shiffman, et al., 1996).

As expected, older adults rated HR expectancies as more likely than adolescents or young adults, and those older adults who were smokers or ex-smokers rated NPF expectancies higher than their younger counterparts. This would support the view that as a person ages, they become more aware of the health and physical consequences of smoking. A different pattern is seen for negative social consequences. Older adults gave the highest NSI rating among smokers which suggests that they feel most ostracised, but it was adolescents who gave the highest NSI ratings among non-smokers. This result clearly has implications for the type of negative expectancies that may prevent an adolescent from starting to smoke, especially as it is this same group that perceived SF expectancies to be more important to a smoking decision than adolescent smokers did themselves. Finally, the only difference in ADD expectancy ratings was found in the ex-smoking group where adult ex-smokers rated addiction risk much higher than adolescent ex-smokers. It is possible that this effect reflects a longer history of trying to quit among the adult population, whereas it may just reflect the fact that adolescent smokers, given their age, have successfully quit in the relatively recent past.

As the new scale should be capable of being used with participants of varied smoking status, the inclusion of the ex-smoker group in the validation sample is important, and a novel finding was the differences in the patterns of expectancy endorsement seen in ex-smokers across the different age groups. In some instances they appeared to be behaving in a similar way to smokers; for example they rated HR and NPF expectancies significantly lower than non-smokers, although older adult ex-smokers did have higher NPF ratings than older adult smokers. This supports the view that NPF expectancies can be predictive of cessation success in adult smokers (Copeland, et al., 1995; Wetter, et al., 1994). In other cases ex-smokers gave similar expectancy ratings to non-smokers; for example, on NAR, NSI, and WC subscales. Again there was one exception; adolescent ex-smokers gave the highest WC ratings. Given their age they are likely to have quit smoking recently, and it has been demonstrated that WC ratings rise with age over the whole sample, so this particular finding may illustrate an association that people have between smoking cessation and weight gain, which could undermine cessation attempts. It is very likely that a combination of the ease with which the individual quit smoking, and the length of time since cessation, influences the smoking expectancies held by ex-smokers. This would be a productive area for future research.

Several studies have also demonstrated that positive smoking but not negative smoking expectancies are significantly associated with nicotine dependence and cigarette use (Copeland, et al., 1995; Lewis-Esquerre, et al., 2005; Rash & Copeland, 2008;

Schleicher, et al., 2008). The data from these two studies provides further support for these findings. Positive expectancy subscales, other than SF, were significantly correlated with FTND scores, and NAR and PR expectancies with CPD. Although these correlations were relatively small, they are of the same order of magnitude as those found in previous research (Schleicher, et al., 2008), but the lack of strong behavioural correlations could further support the contention that direct smoking experience is not the only mechanism through which smoking expectancies develop and become more refined. Contrary to previous studies, one consistent relationship was found between smoking behaviour and negative smoking expectancies. Small but significant positive correlations were found between addiction risk and both FTND and the age at which daily smoking commenced. It is likely that those who are more dependent and those who are older when they begin regular smoking are more aware of and concerned about becoming addicted. Given the lack of a relationship between smoking behaviour and the other H-SCQ negative factors, smokers may not perceive the negative consequences and risks of smoking as personally meaningful. This suggestion of an optimistic risk bias in relation to smoking will be explored further in the next chapter.

Contrary to previous research, very little impact of gender was found. Lewis-Esquerre and colleagues (2005) suggested that gender differences may not emerge until older adolescence or young adulthood, or until the individual becomes a long-term daily smoker, but no evidence was found to support this claim in these data.

4.4.1 Limitations.

Some methodological limitations should be taken into account in the interpretation of these results. The overall sample size for Study 3 was moderately large but the relative sample size of each of the groups varied considerably. There were substantially more adolescent non-smokers than smokers, and ex-smoker numbers were particularly low in this and in the young adult group. Older adult groups were more balanced. These unequal sample sizes may have influenced results found here, yet the overall pattern of findings for the three smoking status groups and for the three age groups suggests that the H-SCQ performs well in each sample. While few gender differences were found it must be acknowledged that gender was not balanced across groups and the 3-way ANOVA analysis in Study 1 in particular, was likely to be underpowered. Additional research is needed to confirm the psychometric properties of the H-SCQ in more balanced samples. Smokers' dependence scores were also quite low which may limit the generalisability of these results to more heavily dependent groups. It would also be valuable for future research to demonstrate the utility of the H-SCQ across groups with varied levels of nicotine dependence, from purely experimental smokers to more heavily dependent groups.

Different response methods (i.e., completing paper versus online questionnaires) were required for adolescent and adult participants in Study 3 in order to facilitate access to a wider range of ages and smoking behaviours, but it is not expected that these methodological variations influenced the results. Previous research found no significant differences between paper-based and web-based assessments of a similar nature (E. T. Miller et al., 2002). Finally, the construction of the H-SCQ was based on 29 items that were common across SCQ versions, with the addition of nine under-represented expectancies from age-specific scales, rather than the full set of 80 items used to develop the original SCQ. Although this decision was taken primarily for practical reasons, in particular to facilitate adolescent testing within a single class time-period, it is consistent with the goal of identifying a relatively short heterogeneous scale from a baseline of well validated versions of the same scale. As findings are analysed across studies at a factor level, differences in structure and format between the various SCQ versions precludes a pure comparison of results. Despite these limitations, these studies provide preliminary evidence of the reliability and validity of the H-SCQ scale and of its utility in samples heterogeneous in age and smoking experience.

4.5 Conclusion

To the best of the author's knowledge these studies represent the first examination of the SCQ in a sample heterogeneous in smoking status and age, and their findings indicate that the H-SCQ is appropriate for use in such a sample. Some smoking expectancies were shown to be common across all participants, but results also illustrated the unique and combined influence of both smoking status and age. Some of the perceived outcomes endorsed by non-smokers seemed unrelated to the expectancies that smokers had of their own behaviour, and ex-smokers were not found to be uniformly similar to either smoking or non-smoking groups. Although endorsement patterns differed across groups, the underlying smoking expectancies seemed to operate in similar ways in each group, so it is possible to evaluate a wider range of expectancy factors in heterogeneous populations than some previous research suggests. The HR and ADD scales should be used with caution given their lower coefficient reliabilities, and future studies are needed to establish better psychometric properties for these two scales.

Overall, the results suggest that positive expectancies of smoking more greatly influence the initiation and maintenance of smoking behaviour than negative expectancies. The ability to measure a wider range of expectancies facilitates their integration into larger and more complex predictive models; an idea suggested when the original SCQ was created (Brandon & Baker, 1991) but one which has received little attention to date, particularly in a developmental context. Chapter 6 will examine the ability of the H-SCQ to predict smoking status alone, and in conjunction with implicitly measured expectancies, and it will investigate the merit of incorporating smoking expectancies into predictive models.

Chapter 5: Positivity, False Consensus, and Optimistic Risk Biases (Study 3)

5.1 Introduction

The results from Study 1, in conjunction with findings from previous research, indicate that although smokers endorse a range of negative smoking expectancies when these are measured explicitly, they self-generate less negative and more positive smoking outcomes when an implicit measure is used. Furthermore, it was evident that smoking-related associations in memory changed with both age and experience. Identifying a positivity bias in smoking-related memory associations is meaningful in that it demonstrates the importance of assessing the relative strength of positive and negative smoking outcomes. The age-related differences in this bias are also important as they suggest that the pattern of other smoking-related biases, such as consensus or optimistic risk bias, may also differ as a function of both smoking status and age.

The purpose of the current study – Study 3 - was threefold: it first aimed to replicate the smoking expectancy findings of Study 1 in a larger participant group which was more diverse in age and smoking behaviour; it then sought to determine if normative or risk-related biases were detectable in relation to smoking behaviour and how they differed with age and smoking experience; and finally it sought to gather additional socio-cognitive smoking-related information to facilitate the development of a smoking behaviour model which would incorporate measures of smoking-related cognitive biases. This chapter will present the findings of the first two objectives of this study, while the creation and evaluation of the model will be presented in Chapter 6.

5.1.1 The false consensus effect for peer smoking prevalence

As discussed in Chapter 1, the Theory of Planned Behaviour (TPB; Ajzen, 1988) suggests that behaviour is determined by behavioural intent which in turn is influenced by attitudes, subjective norms, and perceived control over the behaviour in question. Individuals are therefore motivated to conform to the perceived frequency of the behaviour in their peer group and the relationship between peer prevalence and smoking behaviour has been well established, especially in adolescents (Botvin, et al., 1992). Several lines of research have illustrated that individuals tend to overestimate the proportion of people who hold attitudes that are similar to their own thus demonstrating a consensus bias or a false consensus effect (FCE) for this information (Ross, et al., 1977).

Overestimating peer prevalence has been more closely associated with smoking status than actual peer smoking prevalence (Reid, et al., 2008; Sussman, et al., 1988). Despite the fact that everyone seems to overestimate population prevalence to some extent, regardless of their own level of smoking (Sherman, 1983), smokers have been found to give higher perceived prevalence estimates than non-smokers (Hoffman, Sussman, Unger, & Valente, 2006; Otten, et al., 2009; Sutton & Bolling, 2003), and several studies have found the FCE to be predictive of adolescent smoking onset (Botvin, et al., 1992; Conrad, et al., 1992; Sherman, 1983). Changes in prevalence estimates have also been positively associated with changes in behaviour (Gibbons & Gerrard, 1995). More consistent FCE results have been found for adolescents than for adults (Sherman, 1983), although the effect has been successfully reproduced in college students (Pollard, et al., 2000) and middle-aged daily smokers (Cunningham & Selby, 2007). Developmental differences may be related to the fact that adolescents, in comparison to adults, are more sensitive to the conformity pressures associated with real and perceived social norms (Hoffman, et al., 2006). Nevertheless, it would seem that by overestimating peer prevalence, people are indirectly overestimating the social benefits associated with smoking thereby increasing their risk of initiating or maintaining this behaviour (Botvin, et al., 1992; Conrad, et al., 1992). In other words, people are motivated to conform to peer norms that are themselves overestimated (Sussman, et al., 1988).

Several explanations have been made in terms of the cognitive and motivational processes that drive this overestimation. Ross and colleagues (1977) first proposed that individuals who engaged in, or were frequently exposed to, a specific behaviour were likely to overestimate the prevalence of that same behaviour among others. This selective exposure hypothesis suggests that smokers would tend to associate with other smokers as they share their attitudes and perform similar behaviours (Marks & Miller, 1987; Sherman, 1983). If this is the case, prevalence estimates should be related to the number of significant smokers in an individual's immediate environment and to their relationship with their peer group. Otten and colleagues (2009) found that adolescent overestimation was predicted by being a member of predominately smoking peer groups, best friend smoking, and having at least one parent who smoked. Reid and colleagues (2008) demonstrated that in addition to gender, grade, and own smoking status, close friend's smoking, family members' smoking, and seeing smoking at school and in the home, were clearly associated with overestimation of peer smoking prevalence in adolescents. They found only a tentative relationship with the school smoking rate and with an individual's susceptibility to smoking. This both supports (Unger & Rohrbach, 2002) and challenges (Sussman, et al., 1988) previous research findings. Those most likely to overestimate were found to be younger (grade 9 to 11), female, experimental smokers themselves, to have more friends who smoked, to see smoking at school, to go to a school with a low smoking rate, to have family members who smoked, and to be exposed to select levels of smoking within the home.

Evidence for the predictive value of the participants' own smoking behaviour is inconsistent across studies. Unger and Rohrbach (2002) found no relationship between smoking status and FCE. Reid and colleagues (2008) found that regular smokers were less likely to overestimate than experimental smokers, but Sussman and colleagues (1988) found that smokers overestimate but non-smokers underestimate peer prevalence and they used these findings to proffer a motivational self-reference explanation of FCE. This hypothesis suggests that individuals engage in social comparison with similar others. They then assume that all others are alike in cognitions and behaviour, and as a result they use their own behaviour as a yardstick for judging the behaviour of others.

An alternate explanation, particularly in relation to deviant behaviours, is that people exhibit an egocentric attributional bias and distort the consensus to make their own behaviour seem more common and more favourable (Marks & Miller, 1987). As well as accounting for overestimation in smoking groups, the self-enhancement motives suggested by this explanation can also account for overestimation by non-smokers (Gibbons & Gerrard, 1995). Suls, Wan, and Saunders (1988) suggest that this is a type of *false-uniqueness effect*; people who do not engage in a behaviour that is considered to be deviant can "feel distinctive in a positive way" (p. 76) by overestimating the prevalence of the behaviour. Sherman (1983) argues that for self-enhancement hypotheses to be valid there should be a pronounced developmental trend in overestimation such that the extent of the FCE declines with age. Although he does caution that any such trend could also be explained by the selective exposure hypothesis. An important assumption underlies the idea of a developmental difference in self-enhancement, namely that smoking is considered a more deviant behaviour for adolescents than for adults. This leads to the expectation that adolescents would distort prevalence estimates to the greatest extent. Given the proliferation of anti-smoking information and the introduction of smoking bans over recent years, this assumption may no longer be valid and adults might now be expected to demonstrate a similar self-enhancement bias.

Finally, salience and cognitive availability explanations of FCE are based on the idea that the more salient the behaviour is for the individual, the more likely they are to perceive greater consensus for that behaviour (Marks & Miller, 1987). This explanation can again account for higher prevalence estimates among smokers than non-smokers, and it overlaps with the selective exposure hypothesis as people would be more inclined to attend to others performing salient behaviours which itself leads to overestimation

(Sherman, Presson, & Chassin, 1984). Many of the current hypotheses regarding the FCE overlap with each other to some extent and the mechanisms they describe seem to be triggered in different circumstances, yet they are likely to work together in some way to produce the overestimation (Marks & Miller, 1987), which makes isolating FCE processes difficult but does explain the inconsistency in research findings. This lack of clarity is problematic and it has led some to question the value of peer prevalence estimates in terms of their ability to explain smoking decisions (Juvonen, Martino, Ellickson, & Longshore, 2007). Research studies are often restricted to one age group, mainly adolescents, whereas it would be important to determine how the rate of overestimation changes with age and smoking experience, and the factors which best predict the extent of the overestimation in these diverse groups.

5.1.2 Optimistic perceptions of smoking risk

Rather than disregarding the relationship between behaviour and its associated risks, it has been demonstrated that individuals engage in cognitive strategies that help maintain their current behaviour. In relation to smoking, these strategies include deciding that the positive consequences of smoking outweigh the negative (positive expectancy bias) and determining that many similar others are also taking these risks (FCE). It has also been suggested that smokers reduce the estimation of the risk personally applicable to themselves (Gerrard, et al., 1996) as it has been generally observed that the less conditional vulnerability felt by an individual, the more willing they are to engage in risky behaviour (Gerrard, Gibbons, Houlihan, Stock, & Pomery, 2008). Furthermore, people who see less risk of addiction are also more likely to use (Goldberg & Fischhoff, 2000).

Historically, it was suggested that smokers rationally weighed up the risks against the benefits of smoking (Viscusi, 1992), but more recently Slovic (2001) suggested that smokers, and in particular young smokers, were driven by the affective context of smoking decisions and that they give little or no conscious thought to the risks involved. Evidence has been found that supports the view that adolescents display greater risk-taking for affective decisions in comparison to more deliberative ones (Figner, Mackinlay, Wilkening, & Weber, 2009), but Gerrard and colleagues (1996) argue that cognitive avoidance of behavioural risk moves from motivated to unmotivated and habitual with increased exposure and experience, and that it likely to be triggered automatically when faced with smoking decisions. As such, there is value in understanding if smokers are therefore unaware of, under assess, or suppress smoking-related risk, and if they exhibit an optimistic bias when assessing personal levels of risk.

Relative risk perceptions can be measured in a number of different ways. Many adult studies look for a numerical risk estimate which is then compared to epidemiological or actuarial risk tables (Schoenbaum, 1997; Sutton, 1999), but this approach has been criticised as it assumes that people have the ability to assign a numerical value to the risk (Borland, 1997). An alternate method involves asking people to compare their own risk with that of the average person, thus avoiding the issues that are associated with numerical measures (Sutton & Bolling, 2003). This comparative approach also facilitates measuring the extent to which perceived personal risk may be biased. For example, if an individual views their personal risk as lower than the average person of the same sex and age, it could be argued that they are demonstrating an optimistic, or unrealistic, risk bias in that particular situation and that they therefore fail to perceive personal vulnerability (N. D. Weinstein, 1987). Extensive research has found that smokers consistently demonstrate an optimistic risk bias in terms of their chances of dying from a smoking-related condition, or of becoming addicted to cigarettes (Cohn, et al., 1995; Hansen & Malotte, 1986; Klein & Weinstein, 1997; Quadrel, Fischhoff, & Davis, 1993).

Given that adolescents have a tendency to engage in risky behaviour, and in doing so seem to ignore associated risks and negative consequences (Colder, et al., 2010), it would be expected that they would demonstrate the highest levels of optimistic bias. Yet, the evidence for age differences in risk perception is inconsistent. Gardner and Steinberg (2005) found that risk taking and risky decision making declined between adolescence and adulthood. They also established that in some situations riskier decisions were made when individuals were with their peers than when they are alone; an effect that again varied as a function of age. Explanations for potential age-related changes include differences in impulse control and sensation seeking (Cauffman & Steinberg, 2001), but also an increase in need for positive arousal in adolescence that is coupled with as yet underdeveloped executive behavioural control mechanisms (Spear, 2000; Steinberg, 2008). Recent studies of brain development have illustrated that adolescents are relatively more approach oriented in response to positive feedback, and less avoidant in response to negative feedback, when compared with adults (Cauffman et al., 2010). It can therefore be argued that developmental changes leave the adolescent looking for ways to enhance positive affect and/or cope with negative affect.

In contrast, Slovic (1998) argues that adolescents seem to be aware of, and freely endorse the long-term risky consequences of smoking, but that they tend to underestimate or downplay the short-term risks, and in particular, they underestimate the risk of becoming addicted to smoking (N. D. Weinstein, 2001). This evidence is stronger for smokers than ex- or non-smokers, and for heavy smokers in comparison to light. Previous research evidence (Brady, et al., 2008; Friedman, et al., 1985) and the findings presented in this thesis thus far, support the claim that regardless of smoking status, adolescents do endorse negative smoking outcomes, especially when measured explicitly using statements such as “By smoking I risk heart disease and lung cancer” and “I become more addicted the more I smoke”. Moreover, Romer and Jamieson (2001) found evidence that perceptions of short-term immediate harm from smoking, influences adolescent smoking behaviour to a greater extent than longer term smoking risk. This suggests that if perceived levels of immediate harm are low, it is more likely that an individual will experimental with, or engage in, a risky behaviour that they are favourable towards.

Yet, with the exception of Sutton and Bolling (2003), little research has been carried out that examines adolescents' views of the personal risks of smoking. Furthermore, very few studies investigate age-related changes in personal risk perceptions from adolescence to older adulthood. Those that do, find evidence that suggest that adolescents and adults display similar bias (Cohn, et al., 1995; Quadrel, et al., 1993; T. Williams & Clarke, 1997). There is also a suggestion that if smokers see themselves as different to the average or typical smoker, they can more easily discount smoking risk. Finally, regardless of age, it is important to understand differences between perceptions of general in comparison to more immediate smoking risks.

5.1.3 Aims of the current study

The evidence suggests that there is a relationship between risky behaviours such as smoking and biased processing of the cognitions associated with those behaviours. The purpose of this study was to gather expectancy, normative, and risk information related to smoking, such that positivity, false consensus, and optimistic risk could be evaluated across participants heterogeneous in age and smoking status. Accordingly, the study extends previous FCE and optimistic risk research by examining potential age- and experience-related influence on peer prevalence and risk perceptions of smoking.

The study first aimed to replicate the positive smoking expectancy bias previously found in Study 1. It was hypothesised that this larger and more diverse group would exhibit the same patterns of positivity bias found in the smaller sample; that is, a decrease in positivity would be seen with smoking experience and with age. Secondly, the study sought to examine how overestimation of peer smoking prevalence varied as a result of age and smoking status, and to determine which factors best predicted the FCE in these groups. On the basis of previous research, it was expected that the extent of overestimation would decline with age, but that it would increase with smoking experience. It was also expected that clear overestimation would be best predicted by the number of friends who smoke, seeing and being around smoking, and participants' own smoking behaviour, thus supporting a selective exposure explanation of the FCE. Thirdly, the study aimed to detect how optimistic smoking risk bias is influenced by age and experience. To achieve this, it examined differences in participant risk perceptions relative to both an average person and to a typical smoker their own age. It also investigated differences in perceptions of general smoking harm in comparison to immediate harm. Some degree of optimistic risk bias was predicted in smokers of all ages, in comparison to non-smokers, but the size of this bias was expected to be largest in the adolescent smoking group.

As mentioned at the start of the introduction, the final aim of this study was the development of a smoking behaviour model incorporating measures of smoking-related cognitive biases. This aspect of Study 3 will be presented in the next chapter.

5.2 Method

5.2.1 Participants

A total of 1074 participants, grouped by smoking status (daily, weekly, ex-, experimental, and never smoker) and age (adolescents: 15 to 18 years, young adults: 19 to 25, and older adults: 26 to 60), took part in this research. This same group of participants formed the validation sample in the last chapter, so their recruitment has been described in section 4.3.2.1 above. Sixty-three of these participants had more than 15% missing data and were therefore excluded from the analysis, leaving a total of 1011. Groups comprised of 240 daily (140, 66, 34), 78 weekly (34, 33 11), 117 ex- (34, 21, 62), 232 experimental (127, 76, 29), and 344 never smokers (253, 55, 36). Participants were classified as experimental smokers if they had smoked a cigarette, or a few cigarettes, just to try it out, but they had not smoked in the past two months (Cohn, et al., 1995). A full breakdown of participant characteristics is presented with the results.

5.2.2 Measures

In this study, two smoking expectancy measures, questions related to smoking norms, risks, other common TPB constructs, nicotine dependence, smoking history, and demographic information were combined into a single survey. An online version was created using SurveyGizmo (Widgix, LLC, Boulder, CO, USA). Paper-based versions of the survey were also used. Smoking expectancies were always evaluated first, immediately followed by the demographic questions and an assessment of smoking status. The norms, risks, and other TPB questions formed the main body of the survey. These questions were presented randomly in the online survey. Six different question sequences were also randomly generated at the design stage allowing six versions of the paper-based survey to be created; an example has been included in Appendix 8. The nicotine dependence and smoking history questions were always presented last. Never-smokers completing a paper-based survey were instructed to skip this final section. It was automatically skipped for never-smokers completing the online version.

5.2.2.1 Smoking expectancies. As in Study 1, participants first completed a 3 minute free association task followed by the revised 38-item SCQ.

5.2.2.2 Smoking norms. *Descriptive Norms* were measured using three items similar to those used by Reid and colleagues (Reid, et al., 2008): (1) “What percentage of your friends smoke?”; (2) “How many people your age do you think smoke?”; (3) “Think about the people in your school, college or work place. How many do you think smoke?” In each case, participants could choose from 10 categories ranging from 0-10% to 91-100%.

Subjective Norms were measured using two set of five items which measured the social influence of a best friend, friends in general, family, important others, and the wider society. These were based on similar sets of items used in previous research (Gibbons, Gerrard, Blanton, & Russell, 1998; Higgins & Conner, 2003; McMillan, et al., 2005).

Items in the first set were: “My friends think I should ___”, “My best friend thinks I should ___”, “My family think I should ___”, “People who are important to me think I should ___”, and “Society as a whole thinks I should ___”. The response scale ranged from -2 (should not smoke) to +2 (should smoke) such that zero indicated a neutral position. In the second set, participants were directed to “Think about each of the following people or groups of people. How much does their attitude to smoking influence your own smoking behaviour? My friends; My best friend; My family; People who are important to me; and Society. The response scale ranged from -2 (no effect at all) to +2 (effects it a lot). An index for each category of social influence was calculated as the sum of the corresponding items in each set such that lower scores indicated a non-smoking preference; for example, the response given for “My friends think I should ___” was added to the response to the level of influence friends’ attitudes to smoking had on the participants own smoking behaviour.

Own-view, represents a participant’s view of others’ smoking behaviour and as such it provides a measure of the perceived favourability, or otherwise, of smoking. It was measured using three items: “I think my best friend should ___”, “I think my family should ___”, and “I think people who are important to me should ___”. The response scale ranged from -2 (should not smoke) to +2 (should smoke) such that zero indicated a neutral position, and the three items were averaged to produce one own-view score.

Moral Norms (MN) were measured by one item, “I personally think that smoking is ___” (McMillan, et al., 2005) which was measured using a scale ranging from 1 (wrong) to 5 (right).

5.2.2.3 Smoking risk. *Relative risk* was measured in two ways: first “Compared with other people your age, ___” which will be referred to as relative general risk (RG), and second “Compared with a typical smoker your age” which will be referred to as relative smoker risk (RS). Two health risk items (Gerrard, et al., 1996) and one addiction risk item (Sutton & Bolling, 2003) were included in both measurements. In each case, participants responded to the question "Compared with … how likely do you think you are to: get lung cancer in the future; have a heart attack in the future; and be hooked on cigarettes in five years time?" using a 5-point response scale: 1 (much less likely) … 3 (about the same) … 5 (much more likely). RG and RS indices were created by adding the three risk item responses for each category such that a higher value indicated greater perceived risk.

Perceived harm from smoking was measured using three items (Jamieson & Romer, 2001). The first two items, "How risky do you think smoking is for your health?" and "How risky do you think smoking every day would be for your health?" were measured using a response scale ranging from 1 (very risky) to 4 (not at all risky). Responses to the third item: "The harmful effects of cigarettes have been exaggerated. Do you ___?" ranged from 1 (strongly disagree) to 4 (strongly agree). Individual item scores were reversed and then averaged to obtain a perceived-harm index on which higher values indicated greater perceived harm.

Immediate harm from smoking was measured using two items (Slovic, 1998, 2000). Participants were asked to "Imagine someone who starts to smoke a packet of cigarettes a day at age 16. How much do you agree with the following statements about this person? There is usually no risk to the person at all for the first few years" and "Although smoking may eventually harm this person's health, there is really no harm to him or her from smoking the very next cigarette." Responses ranged from 1 (strongly agree) to 4 (strongly disagree). An immediate-harm index was created by averaging the responses such that a higher value indicated greater perceived harm.

Avoidance of thoughts about health risks was assessed with one item similar to that used by Gerrard and colleagues (1996), "How likely is concern for your health to influence your decision to smoke or not to smoke?" This was measured using a scale ranging from 7 (very unlikely) to 1 (very likely).

General attitudes towards risk were measured using three subscales from the DOSPERT measure (Blais & Weber, 2006): health and safety risk, social risk, and recreational risk. For each subscale, participants were asked to indicate: (1) how likely it was that they would do what was being described (risk taking) using a scale from 1 (extremely unlikely) to 7 (extremely likely); (2) how risky they thought each of the activities were (perceived risk) using a scale from 1 (not at all risky) to 7 (extremely risky); and (3) if they thought they would get any benefits from doing each of the activities (expected benefit) using a scale from 1 (no benefits at all) to 7 (great benefits).

5.2.2.4 Extended TPB constructs. A series of questions were included to measure other common TPB model constructs not specifically covered by the previous sets of questions.

Attitudes towards smoking were measured by one item, "Do you like smoking?" which was measured using a scale ranging from +2 (very much) to -2 (definitely not), which was created in order to capture apathetic feelings towards the behaviour that might not be apparent from the differences scores calculated for the FA and H-SCQ tasks.

Self-Identity was measured using three items (Moan & Rise, 2006): "I look at myself as a person who smokes", "I'm a good example of a person who smokes", and "I would feel that I missed out on something if I didn't smoke". The response scale ranged from 1 (full disagree) to 7 (fully agree). An overall self-identity score was calculated as the sum of the three items such that higher scores indicate stronger identification with smoking.

Group Identity was also measured using three items. The first two items were taken from previous research (Moan & Rise, 2006): "To what extent are your friends important to you?", and "To what extent do you feel that you belong to your group of friends?" The third item was added to encourage participants to think specifically about how they identified with the group with which they spent most of their week days; "Think about your wider school, college, or work group. To what extent do you feel that you belong to this group?" The response scale ranged from 1 (low degree) to 7 (high degree). An overall group identity score was calculated as the sum of the three items such that higher scores indicate stronger peer group identification.

Anticipated Regret was measured using two items (McMillan, et al., 2005): "If I had smoked in the past two months, I would wish I had not" and "I would feel depressed if I had smoked in the past two months". The response scale ranged from 1 (unlikely) to 5 (likely). An index of was calculated as the average score for these two items.

Perceived Behavioural Control (PBC) was measured using nine items (McMillan, et al., 2005): "I am confident I could resist smoking over the next three months" with responses ranging from 1 (strongly disagree) to 5 (strongly agree); "For me to NOT smoke would be ___" with responses ranging from 1 (difficult) to 2 (easy); "How much control do you feel you have over not smoking?" with responses ranging from 1 (no control) to 5 (complete control); "I can say no to smoking, even at work / college / school"; "I can say no to smoking, even if offered a cigarette"; "I can say no to smoking, even if my friends want me to smoke"; "I can say no to smoking, even if I am the only one in the group not smoking"; "I can say no to smoking, even if I feel left out of the group"; and "I can say no to smoking, even if I feel like smoking"; responses for each of the last six items ranged from 1 (certain I cannot) to 5 (certain I can). A PBC score was calculated as the average of the nine items such that higher scores indicate more control.

Smoking Intentions were measured using two items similar to those used in previous research (Gibbons, et al., 1998; ter Doest, Dijkstra, Gebhardt, & Vitale, 2009): "How strong is your intention to smoke in the next six months?" with responses ranging from 7 (definitely) to 1 (definitely not); and "How strong is your intention not to smoke in the next six months?” with responses ranging from 1 (definitely won’t smoke) to 7 (definitely will smoke). A smoking intention score was calculated as the product of the two item responses such that a higher score indicated stronger smoking intentions.

Behavioural Willingness was separated from smoking intentions in this study, although it was measured using items previously combined with smoking intention questions (ter Doest, et al., 2009): “How likely is it that you will smoke in the next six months?” with responses ranging from 7 (very likely) to 1 (very unlikely); and “How likely is it that you will not to smoke in the next six months?” with responses ranging from 1 (very likely) to 7 (very unlikely). A smoking willingness score was calculated as the product of the two item responses such that a higher score indicated stronger behavioural willingness to smoke.

Environmental influences were measured using two items: “I often see others smoking in or outside school / college / work every day, or almost every day” (Reid, et al., 2008) which was measured using a four point scale running from 1 (strongly disagree) to 4 (strongly agree); and “How often are you around people your age who smoke?” (Juvonen, et al., 2007) which was measured using the scale: 0 (never), 1 (hardly ever), 2 (sometimes), and 3 (often).

5.2.2.5 Demographics and smoking history. Participants completed demographic, smoking history, and FTND measures as described in Chapter 2.

5.2.3 Procedure

Adolescents were tested on school or Youth Reach group premises. Parental consent was sought in advance of the test date and only those volunteers with this consent proceeded to testing. All adolescents, and those young adults attending all but one of the Youth Reach groups, individually completed one of the six paper versions of the survey. These were distributed randomly in each test session and participants were tested in class groups. Participants in one youth reach group (all young adults) and all other adult participants completed the survey online.

5.2.4 Data analysis

Statistical analyses were conducted in SPSS 19 (SPSS Inc., Chicago, Illinois 60606, US) and *p*-vales presented in post-hoc analyses are Bonferroni corrected using the SPSS general linear model post-hoc Bonferroni correction function, unless otherwise stated.

5.2.4.1 Missing data. While it can be acceptable to manage missing data using listwise or pairwise deletion in between-group difference analyses, this is not a sensible approach to take when analysing models containing a variety of different variables as it can result in the removal of many participants, and the loss of valuable data. An alternate approach is to estimate, or impute, the missing data values, and use these along with the rest of the data in further analyses. Various methods of data imputation have been developed and these range from simple single imputation (SI) models to more complex multiple imputation (MI) approaches (Tabachnick & Fidell, 2007). Mean substitution is the simplest form of SI and, as the name suggests, it involves replacing the missing data with the mean score for that variable. As this is a very crude approach which necessarily reduces the variance of the data item, it is seldom used (Tabachnick & Fidell, 2007). The most sophisticated form of SI, Estimation Maximisation (EM), creates a correlation matrix for the missing data, given a requested distribution (e.g., normal), and subsequently makes inferences about the missing values based on their likelihood under that distribution. It is an iterative process with two steps per iteration: determining an “expectation” or best guess for the missing data given the current information, and then performing maximum likelihood estimation as if the missing value had been filled in. Once convergence is reached, the observed and the filled in data are saved in the data set (Dempster, Laird, & Rubin, 1977; Tabachnick & Fidell, 2007). As error is not added to the imputed data, EM results in a bias that can be problematic for inferential statistics based on these data (Graham, 2009), although it would be expected that data remain appropriate for inferential analysis when the number of missing values is low; Tabachnick and Fidell (2007) suggest less than 5%.

MI involves a Monte Carlo approach which replaces missing data with plausible values in several simulated versions of the dataset (Rubin & Little, 2002; Schafer & Graham, 2002). Further statistical analyses are then performed on multiple random samples each containing an estimate for the missing data from the distribution of plausible estimates. Average parameter statistics from these statistical analyses are reported (Tabachnick & Fidell, 2007). MI estimates are less biased than those produced by SI, yet from a theoretical and practical perspective, MI is not automatically the recommended way to deal with missing data. Instead, Schafer and Graham (2002) propose that decisions on how to deal with missing data should be based on the characteristics of the missing data, and on the costs and benefits associated with each technique in the particular research circumstances. For example, they suggest that SI methods are acceptable for situations where the data are missing at random, but only when less than 10% of the data are missing. MI is suitable for use with up to 25% missing data.

As the intention was to use the same sample to examine between group differences in cognitive biases in this chapter, and to develop an extended TPB model in the next chapter, the extent and pattern of missing data were analysed across all variables in the dataset in order to determine the appropriate strategy for dealing with these missing values. High levels of missing data were found for the DOSPERT scales, particularly among adolescents. These scales were lengthy and repetitive, and a number of participants appeared to skip these and work through the rest of the survey. The pattern of responding is also suspect for a number of other participants (all 1s, all 7s, or cyclical 1 to 7 responding). Excluding these participants would result in the unnecessary loss of valid expectancy, normative, and perceived risk data. As a result, the decision was made to exclude the DOSPERT items from further analysis.

An additional 63 participants were found to have large amounts of missing data across all survey items (over 15%), these individuals were removed and a separate SPSS Missing Values Analysis was carried out for each variable in the study across the remaining 1011 participants. Missing data volumes ranged from less than 1% to 2.3% per item and in each case the data were missing completely at random. It is likely that some questions were accidently missed; it is also possible that some individuals were unwilling to answer a particular question which they then simply skipped. Given the overall size of the dataset, and the very low volumes of missing data, SI using EM was deemed the most effective and cost efficient method of estimating missing values. Separate EM analyses were carried out for each data item.

5.2.4.2 Smoking expectancy analysis. The same classifications used to code FA items in Study 1 were applied here. Word categorisation for 20% of the sample, and for new words not encountered in Study 1, were reviewed by an additional smoker and non-smoker. Classifications with full inter-rater agreement (94.23%) were retained. This figure was a little lower than in Study 1 as proportionally more of the words reviewed were difficult to interpret or to code as either positive or negative. The key elements of the Study 1 smoking expectancy analysis were replicated here and extended to incorporate the 5-level smoking status variable. First, the relative strength of positive and negative expectancies endorsed on the H-SCQ scale (H-SCQ difference score) was examined using a 5 (smoking status) x 3 (age) ANOVA. Second, the FA difference scores for each time period were analysed using a 5 (smoking status) x 3 (age) x 2 (time) mixed factorial ANOVA. The H-SCQ and the FA T1 difference scores were then standardised (*z*-scores) and directly compared using a 5 (smoking status) x 3 (age) x 2 (measure: FA T1, SCQ) mixed factorial ANOVA. Given gender differences in smoking, additional analyses were carried out with gender as a between-groups factor. A very small effect of gender was found in each analysis ($\eta_p^2 = .018$, $\eta_p^2 = .012$, and $\eta_p^2 = .005$ respectively). As these effect sizes are extremely small, these results will not be reported in detail in order to preserve clarity; females provided more negative evaluations in each case.

5.2.4.3 Peer smoking prevalence. Smoking prevalence estimates for "people your own age" were compared with actual Irish smoking prevalence rates (Office of Tobacco Control, 2010). An estimation difference score was calculated by subtracting the band within which the actual prevalence rate fell from the estimated prevalence band. Clear overestimation was defined as an estimate that exceeded the actual prevalence rate for that age group by more than one band (Reid, et al., 2008); an approach which minimises the effect of marginal overestimations. For example, if a peer prevalence estimate was in the 51-60% band and actual prevalence for that participant's age group was 23%, the estimation difference score was calculated as 51-60% minus 21-30% resulting in a value of 3. This in turn was categorised as a clear overestimation. Between group differences in estimation difference scores were analysed using a 5 (smoking status) x 3 (age) ANOVA and multiple logistic regression analysis was used to identify predictors of clear overestimation. No significant between-group gender differences were found so this analysis will not be reported Gender will be included as a potential predictor of overestimation in the regression analysis. Finally, Spearman's rho correlations were used to examine relationships between peer prevalence estimates and other normative indices.

5.2.4.4 Smoking risk. One index of relative risk was calculated for the three RG items and another for the three RS items. RG and RS smoking risk were then analysed using a 5 (smoking status) x 3 (age) x 2 (measure) mixed factorial ANOVA. This facilitated the comparison between perceptions of personal risk relative to a general other, with that relative to a typical smoker. Perceived general and immediate harm from smoking were also analysed using a 5 (smoking status) x 3 (age) x 2 (measure) mixed factorial ANOVA, facilitating a comparison between perceived long-term and short-term smoking harm. Between-group differences in avoidance of health-related thoughts were investigated using a 5 (smoking status) x 3 (age) ANOVA. Spearman's rho correlations were then used to examine relationships risk estimates, self and group identity, and attitudes towards smoking. Given gender differences in smoking, analyses were carried out with gender as an additional between-groups factor. No significant gender differences were found for RG and RS risks, and although a main effect of gender was found for the analysis of harm and avoidance (females reported higher rates of both), the effect sizes were extremely small ($\eta_p^2 = .028$ and $\eta_p^2 = .009$ respectively), so these results will not be reported in detail to preserve clarity.

5.2.4.5 Associations between cognitive biases. Finally, Spearman's rho correlations were used to determine the strength of the relationships between positivity, consensus, and optimistic risk biases.

5.3 Results

5.3.1 Participant characteristics

The demographic profile, and the average use and dependence characteristics of each smoking group, is presented below in Table 5.1 for the 1011 participants who remained following missing data analysis.

Table 5.1 *Demographic Profile, Means (Standard Deviations), of Participants by Age Group and Smoking Status (N = 1011)*

	Adolescents (n = 588)					Young Adults (n = 251)					Older Adults (n = 172)				
	Daily	Weekly	Ex-S	Exper.	Never	Smoker	Weekly	Ex-S	Exper.	Never	Smoker	Weekly	Ex-S	Exper.	Never
	n = 140	n = 34	n = 34	n = 127	n = 253	n = 66	n = 33	n = 21	n = 76	n = 55	n = 34	n = 11	n = 62	n = 29	n = 36
Female	64	19	19	77	156	34	20	19	63	40	24	6	44	21	29
Male	76	15	15	50	97	32	13	2	13	10	10	5	18	8	7
Age	16.40	16.56	16.94	16.76	16.48	21.07	21.14	21.52	20.79	20.58	35.72	34.03	38.34	31.73	33.74
	(0.91)	(1.01)	(0.98)	(1.02)	(0.92)	(1.82)	(2.06)	(2.02)	(1.82)	(1.77)	(6.45)	(7.15)	(9.02)	(4.92)	(6.50)
Smoking History															
Age Start	13.13	14.80				18.83	16.42				14.84	15.91			
	(2.29)	(1.58)				(2.65)	(2.05)				(2.58)	(2.07)			
Age Daily	14.35					15.71					16.63				
	(2.16)					(2.47)					(4.26)				
CPD	10.63	1.98				9.41	2.16				23.92	1.13			
	(3.01)	(1.68)				(8.00)	(5.11)				(39.36)	(2.80)			
FTND	3.01	0.26				2.03	0.39				2.91	0.82			
	(2.40)	(0.57)				(2.33)	(0.93)				(2.11)	(1.40)			

Note. Ex-S, ex-smoker; Exper., experimental smoker; Never, never smoker; CPD, number of cigarettes smoked per day.

5.3.2 Smoking expectancies

5.3.2.1 Explicit H-SCQ assessment Mean H-SCQ scores were calculated for all of the items that loaded onto the positive factors and those that loaded onto the negative factors. A H-SCQ difference score (mean positive endorsement minus mean negative endorsement) was then calculated (see Table 5.2). All groups endorsed more negative than positive smoking outcomes, but the smallest difference scores were found among smokers, and in particular daily smokers, in each age group.

Table 5.2 *Mean (Standard Deviation) Positive, Negative, and H-SCQ Differences Scores by Smoking Status and Age*

	Adolescents			Young Adults			Older Adults		
H-SCQ	Pos	Neg	Diff	Pos	Neg	Diff	Pos	Neg	Diff
Daily Smokers	3.52 (0.77)	3.88 (0.82)	-0.37 (1.02)	3.43 (0.78)	3.75 (0.84)	-0.32 (0.88)	3.93 (0.51)	4.40 (0.77)	-0.48 (0.81)
Weekly Smokers	3.01 (0.76)	3.69 (0.61)	-0.68 (0.98)	3.10 (0.83)	3.98 (0.69)	-0.88 (0.93)	3.08 (0.87)	4.51 (0.65)	-1.43 (0.93)
Ex-Smokers	2.41 (0.83)	3.91 (0.98)	-1.50 (1.20)	3.16 (0.76)	4.31 (0.94)	-1.14 (1.13)	3.16 (1.09)	4.78 (0.59)	-1.62 (1.31)
Experimental Smokers	2.51 (0.90)	4.62 (0.80)	-2.12 (1.12)	2.66 (1.16)	4.62 (0.80)	-1.97 (1.40)	2.84 (1.31)	4.63 (0.72)	-1.79 (1.60)
Never Smokers	2.36 (1.05)	4.85 (0.75)	-2.48 (1.28)	3.16 (1.33)	4.79 (0.91)	-1.63 (1.62)	3.47 (1.48)	4.79 (0.72)	-1.32 (1.95)

To determine if groups differed in the strength of endorsement of positive versus negative expectancies, the H-SCQ difference score was analysed using a 5 (smoking status) x 3 (age) ANOVA. A significant smoking status by age interaction was found, $F(8,996) = 4.48$, $p < .001$, $\eta_p^2 = .04$. As illustrated in *Figure 5.1*, simple main effects of smoking status were found in each age group: adolescents, $F(4,583) = 84.37$, $p < .001$, $\eta_p^2 = .37$; young adults, $F(4,246) = 17.18$, $p < .001$, $\eta_p^2 = .22$; and older adults, $F(4,167) = 4.45$, $p < .01$, $\eta_p^2 = .10$. These results demonstrate that as age increased, the effect size decreased. Within the adolescent group, daily smokers were significantly less negative than ex- ($p < .001$), experimental ($p < .001$), and never smokers ($p < .001$); weekly smokers were significantly less negative than ex- ($p < .05$), experimental ($p < .001$), and never smokers ($p < .001$); ex-smokers were significantly less negative than never smokers ($p < .05$), as were experimental smokers ($p < .05$). Within the young adult group, daily smokers were significantly less negative than experimental ($p < .001$) and never smokers ($p < .001$); weekly smokers were also significantly less negative than experimental ($p < .001$). Within the older adult group, daily smokers were significantly less negative than experimental ($p < .01$) and never smokers ($p < .01$). A simple main effect of age ($F(2,341) = 16.18$, $p <.001$, $\eta_p^2 = .09$) in the never-smoking group also suggests that as age increased, the difference score decreased; adolescents in this group were significantly more negative than both young adults ($p < .001$) and older adults ($p < .001$). No other significant differences were found.

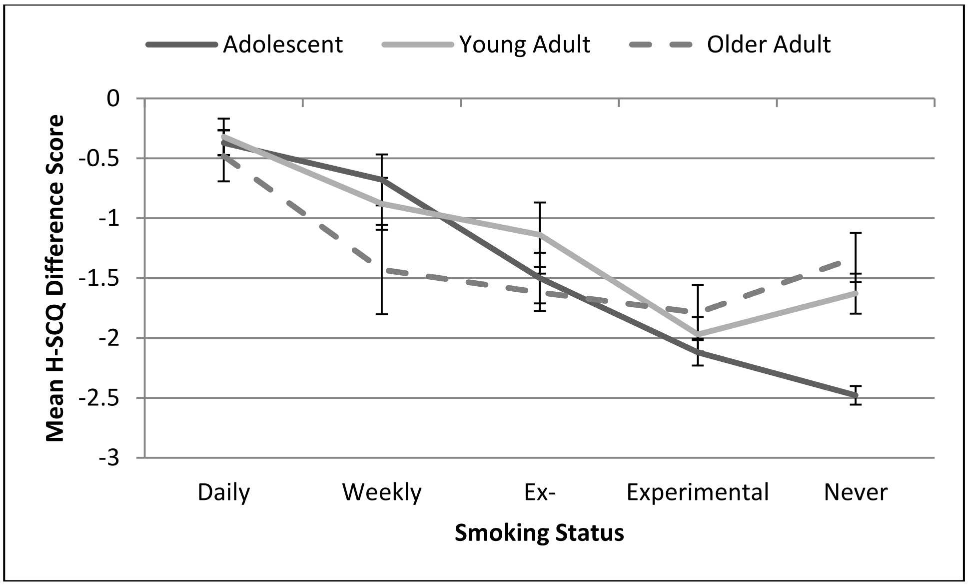


Figure 5.1 Mean H-SCQ difference scores for each smoking status and age group. Error bars represent standard errors.

5.3.2.2 Implicit FA assessment. FA difference scores (positive minus negative words generated) were calculated for each half of the task, such that a positive score indicated a net positive evaluation of smoking. As presented in Table 5.3, difference scores remained net negative for each group in each time period, but again the smallest difference scores were found in the smoking groups.

Table 5.3 *Mean (Standard Deviation) Difference Scores by Smoking Status and Age for each Half of the Free Association Task*

	Adolescents		**Young Adults**		**Older Adults**	
	FA T1	FA T2	FA T1	FA T2	FA T1	FA T2
Daily	-2.29 (3.77)	-1.12 (2.69)	-1.83 (4.37)	-0.56 (3.47)	-2.00 (4.86)	-2.35 (3.49)
Weekly	-2.59 (3.69)	-1.41 (2.34)	-1.09 (2.98)	-1.27 (4.03)	-3.18 (5.91)	-1.64 (2.87)
Ex-Smokers	-4.91 (2.86)	-2.03 (2.37)	-4.62 (4.80)	-2.52 (3.43)	-5.15 (4.60)	-2.97 (3.53)
Experimental	-5.63 (3.12)	-2.91 (2.60)	-6.96 (4.19)	-3.22 (3.24)	-5.97 (4.72)	-2.48 (3.49)
Never	-6.34 (3.16)	-3.04 (2.56)	-7.60 (3.78)	-3.51 (3.34)	-6.97 (3.83)	-3.06 (2.55)

Note. FA, Free association; T1, first half of the FA task; T2, second half of the FA task

These difference scores were analysed using a 5 (smoking status) x 3 (age) x 2 (time) mixed factorial ANOVA. A main effect of smoking status ($F(4,996) = 49.53$, $p < .001$, $\eta_p^2 = .17$) and a main effect of time ($F(1,996) = 149.71$, $p < .001$, $\eta_p^2 = .13$) were found. These were qualified by a significant smoking status by time interaction, $F(4,996) = 15.43$, $p < .001$, $\eta_p^2 = .06$. As illustrated in *Figure 5.2*, daily and weekly smokers had significantly higher difference scores in T1 than ex-, experimental, and never-smokers ($p < .001$ in each case). Daily and weekly smokers also had significantly higher difference scores in T2 than ex- ($p < .001$ and $p < .05$ respectively), experimental ($p < .001$), and never-smokers ($p < .001$). Significant differences between T1 and T2 scores were found for daily ($t(239) = 3.26$, $p < .01$, two-tailed, $d = .21$), ex- ($t(116) = 5.48$, $p < .001$, two-tailed, $d = .51$), experimental ($t(231) = 11.54$, $p < .001$, two-tailed, $d = .76$), and never-smokers ($t(343) = 16.92$, $p < .001$, two-tailed, $d = .91$), although the size of the difference was much smaller for both smoking groups and was non-significant for weekly smokers. No other significant interactions were found.

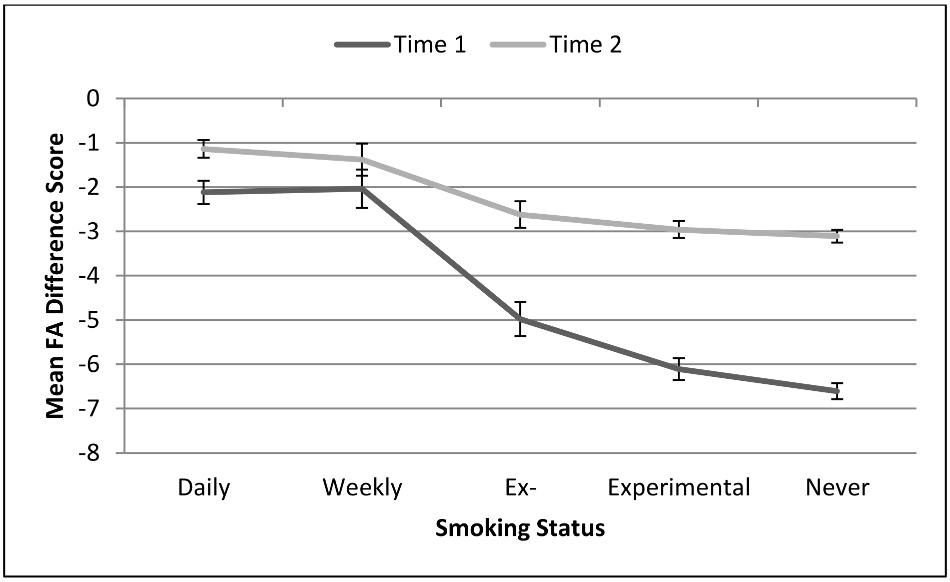


Figure 5.2 Mean FA T1 and T2 difference scores for each smoking status group. Error bars represent standard errors.

5.3.2.3 Comparison of explicit and implicit measures. Also of interest was a comparison between the relative strength of positive and negative expectancies measured explicitly using the H-SCQ, and those most immediately accessible to each group (as measured by T1 of the FA task). This was investigated by directly comparing standardised (*z*-score) H-SCQ and FA T1 difference scores using a 5 (smoking status) x 3 (age) x 2 (measure) mixed factorial ANOVA. A significant smoking status by measure interaction, $F(4.996) = 3.30$, $p < .05$, $\eta_p^2 = .01$, and a significant smoking status by age by measure interaction, $F(8.996) = 4.96$, $p < .001$, $\eta_p^2 = .04$. In order to identify the source of the 3-way interaction, separate 3 (age) x 2 (measure) ANOVAs were carried out for each smoking status. A significant age by measure interaction was found for never smokers, $F(2,341) = 19.81$, $p < .001$, $\eta_p^2 = .10$, and for experimental smokers, $F(2,229) = 3.48$, $p < .05$, $\eta_p^2 = .03$. As depicted in *Figure 5.3*, adolescent never smokers gave significantly less negative scores on the FA than on the H-SCQ measure, $t(252) = 4.31$, $p < .001$, two-tailed, $d = .27$), while significantly more positive H-SCQ scores were given by young adults, $t(54) = 3.16$, $p < .01$, two-tailed, $d = .43$. Neither the scores for older adult never smokers, nor the differences between experimental smoker groups, remained significant when Bonferroni corrections were made

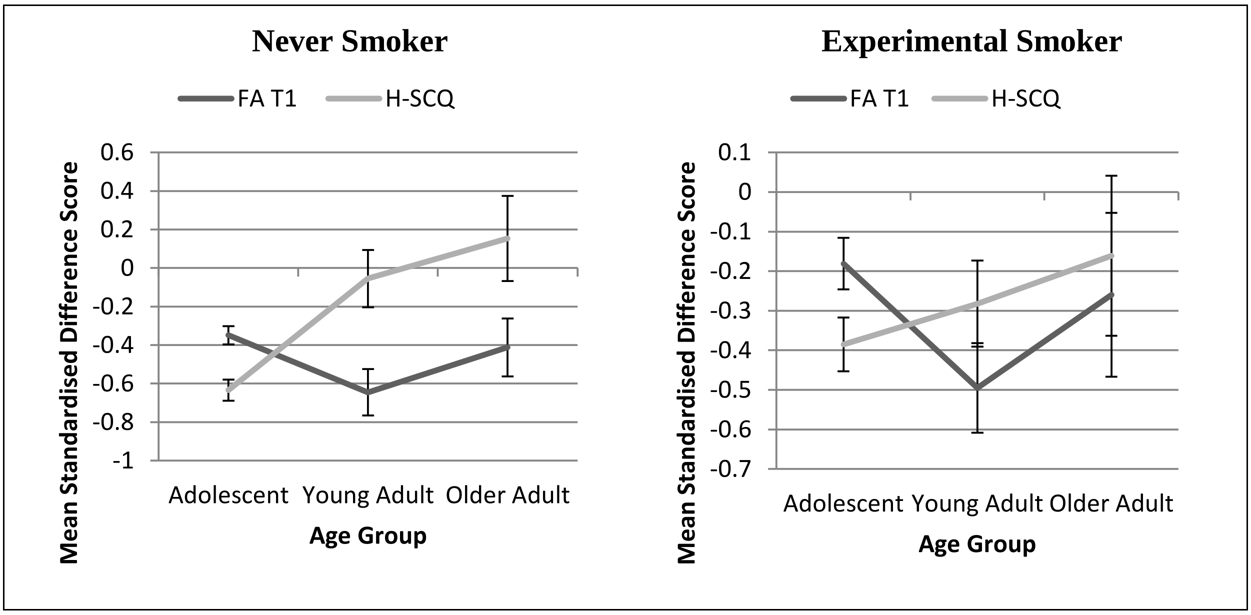


Figure 5.3 Never smoker and experimental smoker mean standardised FA T1 and H-SCQ difference scores. Error bars represent standard errors.

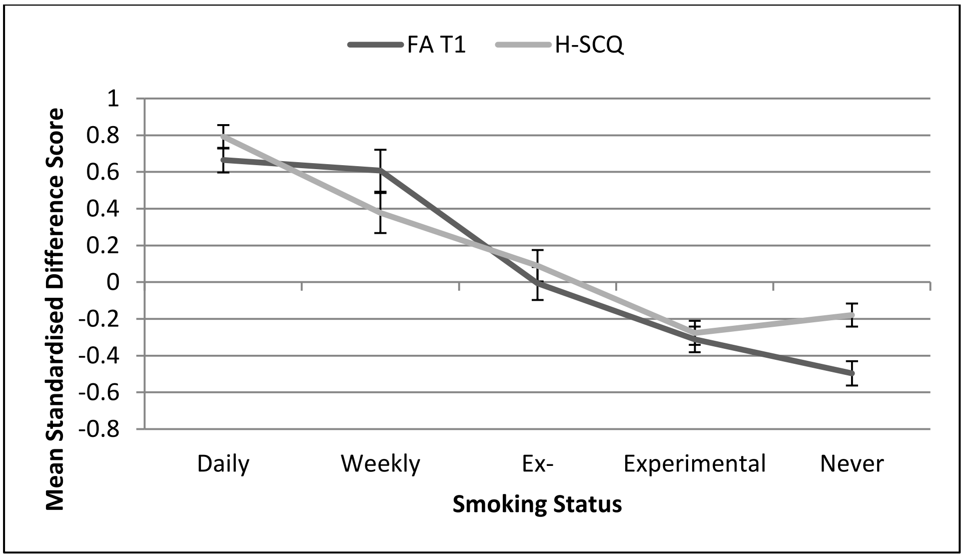


Figure 5.4 Mean standardised FA T1 and H-SCQ difference scores by smoking status. Error bars represent standard errors.

No 3-way interaction was found in the same analysis in Study 1 (see section 2.3.4), but a significant smoking status by measure interaction was observed, so post-hoc analysis of the smoking status by measure interaction found in these results was carried for comparative purposes. Significant differences ($p < .001$ in each case) were found between all smoking status groups other than never and experimental smokers, and weekly and daily smokers (see Figure *5.4)*. The only significant difference between explicit and implicit measurement scores was found in the daily smoking group, $t(239) = 2.69$, $p < .05$, two-tailed, $d = .17$.

Finally, different patterns of associations were found between expectancies and smoking behaviour in each age group. While no significant correlations were found for weekly adolescent smokers, the age daily smoking commenced and FA T1 positive words generated were positively correlated ($r = .28$, $p < .01$) in daily smokers, as were FTND and H-SCQ positive subscale scores ($r = .25$, $p < .01$). No significant correlations were found for young adults, but a very strong negative correlation was found between the age smoking started and FA T1 negative words generated in older adult weekly smokers ($r = -.70$, $p < .05$) and FTND scores were significantly positively correlated with H-SCQ negative subscale scores in the same group ($r = .69$, $p < .05$). FA T1 negative words generated and H-SCQ negative subscale scores were themselves strongly correlated ($r = .54$, $p < .001$). No significant correlations were found for older adult daily smokers.

5.3.3 Peer prevalence estimation

The majority of adolescents clearly overestimated peer prevalence rates regardless of smoking status (see Table 5.4). Most young adult daily, weekly, and ex-smokers also overestimated peer prevalence, although less overestimation was seen for experimental and never-smokers. Older adults are consistently better at estimating peer prevalence yet some still clearly overestimate, and interestingly the highest rate of overestimation was found in the never smoking group. No gender differences were found in any group. As illustrated in *Figure 5.5*, a clear linear decline in overestimation was seen with age, regardless of smoking status.

Table 5.4 *Median Peer Smoking Prevalence Estimates, and Percentage of Clear Overestimation within Group, by Age and Smoking Status.*

	Adolescent		Young Adult		Older Adult	
	Median	% Over	Median	% Over	Median	% Over
Daily	71-80%	97.1	61-70%	81.8	45-54%	25.0
Weekly	61-70%	97.1	51-60%	75.8	21-30%	13.8
Ex-smoker	61-70%	91.2	61-70%	76.2	21-30%	24.2
Experimental	51-60%	86.6	31-40%	48.7	21-30%	27.3
Never smoker	41-50%	82.2	31-40%	49.1	21-30%	50.0

Note. Actual smoking prevalence rates were: 14.2%, 15-17 years; 27.3%, 18-24 years; 30.3%, 25-34 years; 25.7%, 35-44 years; 23%, age 45 and over (Office of Tobacco Control, 2010).

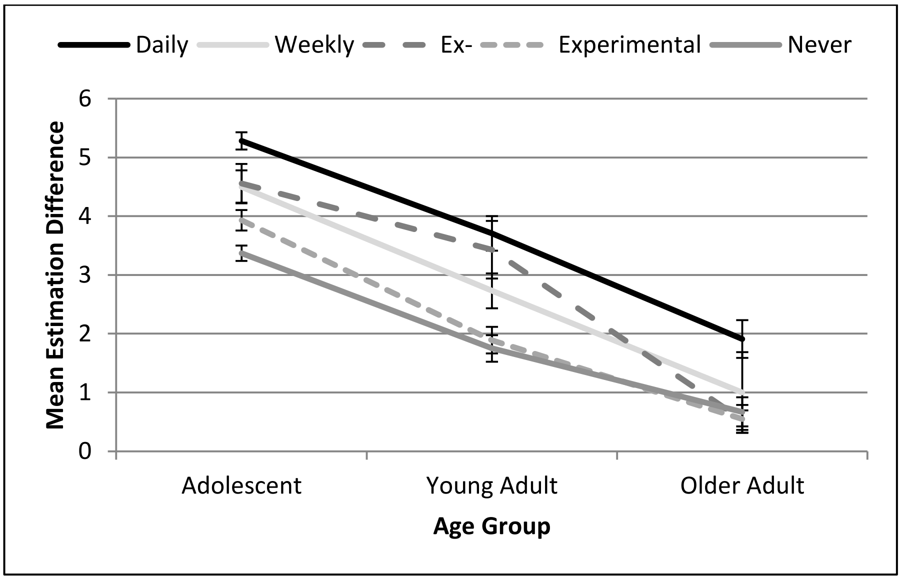


Figure 5.5 Mean estimation difference scores (perceived minus actual prevalence) by age and smoking status. Error bars represent standard errors.

In order to isolate the impact of smoking status and age, estimation difference scores (actual peer prevalence minus estimated) were analysed using a 5 (smoking status) x 3 (age) ANOVA. A main effect of smoking status, $F(4,996) = 21.64$, $p < .001$, $\eta_p^2 = .08$, and a main effect of age, $F(2,996) = 153.64$, $p < .001$, $\eta_p^2 = .24$, were found. Post-hoc analysis revealed that daily smokers were significantly more likely to overestimate than weekly ($p < .05$), ex- ($p < .01$), experimental ($p < .001$), and never ($p < .001$) smokers.

Weekly smokers were only more likely to overestimate than never smokers ($p < .05$), but ex-smokers significantly overestimated in comparison to both experimental ($p < .05$) and never ($p < .01$) smoking groups. In addition, adolescents were significantly more likely to overestimate than both younger ($p < .001$) and older ($p < .001$) adults.

5.3.3.1 Predicting peer overestimation. A variety of different factors have been associated with overestimation of peer smoking in the literature. The following variables were entered into a multiple logistic regression analysis (model 1) to determine those which best predict overestimation of peer smoking in this sample: percentage friends smoking, perceived prevalence of smoking "in your school, college or work place", being around smoking, seeing smoking on a regular basis, age, gender, and smoking status.

Table 5.5 *Beta Values, Standard Errors, and Odds-ratios with 95% Confidence Intervals for the Factors Associated with Overestimation of Peer Smoking Prevalence in each Model*

				95% *CI* for Odds Ratio (OR)		
	β (SE)	χ^2 (df)	R^2	Lower	OR	Upper
Model 1:		599.73*** (10)	.64			
% Friends smoking	.42 (.07)***			1.33	1.53	1.76
% Group smoking	.84 (.08)***			2.00	2.33	2.70
Age	-.10 (.02)***			.88	.90	.94
Others smoking	-.24 (.16)			.58	.79	1.08
Around smoking	-.03 (.14)			.73	.97	1.28
Gender (male)	.39 (.23)			.95	1.47	2.29
Smoking Status		11.88* (4)				
Experimental	1.07 (.42)*			1.28	2.92	6.65
Ex-smoker	.34 (.40)			.64	1.41	3.07
Weekly smoker	1.01 (.46)*			1.12	2.76	6.80
Daily smoker	.20 (.49)			.46	1.22	3.20
Constant	-2.06 (.88)*				.13	
Model 2:		594.18*** (7)	.64			
% Friends smoking	.39 (.07)***			1.30	1.48	1.68
% Group smoking	.82 (.07)***			1.97	2.27	2.62
Age	-.10 (.02)***			.88	.91	.94
Smoking Status		12.66* (4)				
Experimental	1.10 (.41)**			1.34	2.99	6.70
Ex-smoker	.37 (.39)			.67	1.44	3.12
Weekly smoker	1.06 (.46)*			1.18	2.90	7.12
Daily smoker	.21 (.49)			.48	1.24	3.21
Constant	-2.60 (.69)***				.07	

Note. Nagelkerke R^2 values are reported.

*$p < .05$, ** $p < .01$, *** $p < .001$.

Clear overestimation of peer smoking was found to be best predicted by the percentage of close friends who smoke, perceived prevalence in their own school, college or work place, age, and smoking status. This model had an overall prediction success rate of 86.7%, correctly predicting 93% of clear overestimation and 71% of non-overestimation. Seeing others smoke, being around smoking and gender were not found to be significant predictors, so the regression analysis was rerun without these variables (model 2). Prediction success was only marginally reduced (86.4%) for this more parsimonious model which correctly predicted 92.4% of clear overestimation and 71.3% of non-overestimation. Model-fit statistics are presented in Table 5.5.

5.3.3.2 Relationship with other constructs. Associations between overestimation of peer prevalence (estimation difference and clear overestimation scores), seeing and being around smoking, self-identity, group identity, moral and subjective norms were assessed using Spearman's rho correlations. Being around smoking was significantly correlated with estimation difference ($r_s = .37$, $p < .001$) and with clear overestimation ($r_s = .37$, $p < .001$), as was self-identity ($r_s = .22$ and $r_s = .15$, $p < .001$) and own-view of smoking ($r_s = .21$ and $r_s = .15$, $p < .001$), although in both cases these correlations were very small and neither variable significantly improved the logistic regression model.

5.3.4 Smoking risk assessment

Mean risk ratings for each of the risk items measured are presented in Table 5.6. In each case, a higher score means higher levels of perceived risk, avoidance, and harm.

5.3.4.1 Relative risk. As illustrated in *Figure 5.6*, a roughly linear increase in perception of relative smoking risk levels was seen with increased smoking. A score of 9 indicates a level of risk comparable to others of the same age. Risk relative to other smokers was rated slightly slower than general relative risk in each age group, but all groups other than daily smokers appeared optimistic in both RG and RS risk perceptions.

Table 5.6 *Mean (Standard Deviation) Participant Risk Profile by Age and Smoking Status*

	RG (α = .90)	RS (α = .94)	Avoid HR	Perceived Harm (α = .66)	Immediate Harm (α = .76)
Adolescent					
Daily	10.51 (3.04)	10.34 (3.07)	3.67 (1.82)	3.13 (0.60)	2.87 (0.95)
Weekly	7.35 (3.18)	7.79 (3.34)	2.88 (1.30)	3.17 (0.56)	3.03 (0.98)
Ex-smoker	6.74 (3.59)	6.68 (3.56)	2.65 (1.82)	3.35 (0.62)	3.08 (0.79)
Experimental	5.90 (3.59)	6.74 (4.64)	1.96 (1.47)	3.57 (0.49)	3.35 (0.75)
Never smoker	5.16 (3.01)	5.43 (3.68)	1.91 (1.70)	3.57 (0.47)	3.38 (0.72)
Young Adult					
Daily	10.70 (3.32)	10.12 (3.48)	3.59 (1.95)	3.12 (0.54)	2.81 (0.99)
Weekly	8.73 (3.61)	7.61 (3.58)	3.03 (1.45)	3.52 (0.47)	3.39 (0.58)
Ex-smoker	7.43 (3.92)	6.43 (3.50)	2.57 (1.83)	3.43 (0.72)	3.21 (0.90)
Experimental	5.78 (2.77)	4.83 (2.67)	2.05 (1.57)	3.70 (0.40)	3.56 (0.61)
Never smoker	5.16 (2.05)	4.00 (1.32)	1.51 (1.29)	3.80 (0.37)	3.58 (0.64)
Older Adult					
Daily	11.94 (2.90)	10.68 (2.87)	2.76 (1.56)	3.59 (0.53)	3.56 (0.66)
Weekly	9.18 (2.56)	8.18 (2.09)	2.45 (1.70)	3.88 (0.22)	3.23 (0.93)
Ex-smoker	7.35 (2.98)	5.68 (3.24)	1.55 (1.11)	3.87 (0.25)	3.41 (0.78)
Experimental	5.41 (2.03)	4.31 (2.11)	1.86 (1.48)	3.83 (0.39)	3.33 (0.70)
Never smoker	4.94 (1.87)	3.97 (1.52)	1.69 (1.74)	3.88 (0.28)	3.57 (0.67)

Note. RG, relative general risk; RS, relative smoker risk; HR, health-risk

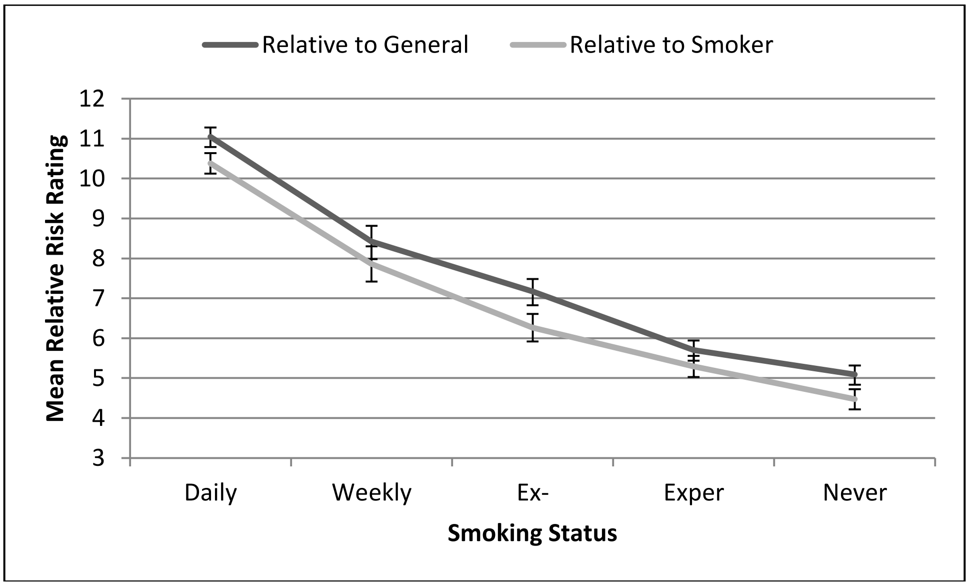


Figure 5.6 Mean RG and RS risk ratings for each smoking status group. Error bars represent standard errors.

Between-group differences in RG and RS risk were analysed using a 5 (smoking status) x 3 (age) x 2 (measure: RG, RS) mixed factorial ANOVA. No 3-way interaction was found, nor was there a significant smoking status by measure interaction, but a significant age by measure interaction was located, $F(2,996) = 71.64$, $p < .001$, $\eta_p^2 = .03$ (see *Figure 5.7)*. Post-hoc analysis revealed that young adults rated RG risk significantly higher than RS risk, $t(250) = 5.33$, $p < .001$, two-tailed, $d = .34$. A similar pattern was found for older adults, $t(171) = 6.25$, $p < .001$, two-tailed, $d = .48$, but ratings did not differ significantly for adolescents. In all age groups mean risk ratings were higher relative to comparable others.

A significant main effect of smoking status is also evident, $F(4,996) = 119.46$, $p < .001$, $\eta_p^2 = .32$ (see *Figure 5.6)*. Daily smokers perceived significantly more risk than all other groups ($p < .001$ for each). Weekly smokers also perceived significantly more risk than ex- ($p < .05$), experimental and never-smokers ($p < .001$ for both). Ex-smokers gave significantly higher risk estimates than never-smokers ($p < .001$), as did experimental smokers ($p < .05$).

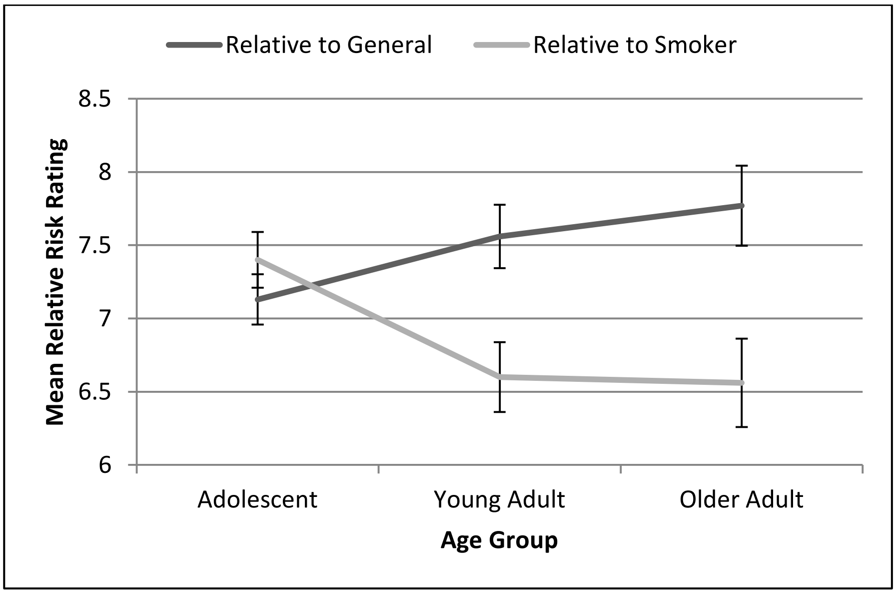


Figure 5.7 Mean RG and RS risk ratings for each age group. Error bars represent standard errors.

5.3.4.2 Perceived harm from smoking. Perceived general and immediate harm from smoking were also analysed using a 5 (smoking status) x 3 (age) 2 (measure) mixed factorial ANOVA. A main effect of measure was found, $F(1,996) = 63.41$, $p < .001$, $\eta_p^2 = .06$, and a post-hoc *t*-test illustrated that perceived general harm scores ($M = 3.52$, $SD = 0.54$) were significantly higher than those for immediate harm ($M = 3.28$, $SD = 0.82$), $t(1010) = 9.46$, $p < .001$, two-tailed, $d = .30$. No other significant effects of measure were found, however, a significant smoking status by age interaction was noted, $F(8,996) = 3.25$, $p < .001$, $\eta_p^2 = .03$. Post-hoc analysis revealed a main effect of smoking status for adolescents, $F(4,583) = 21.58$, $p < .001$, $\eta_p^2 = .13$, and for young adults, $F(4,246) = 21.18$, $p < .001$, $\eta_p^2 = .26$, but not for older adults (see *Figure 5.8*). Adolescent daily and weekly smokers gave significantly lower harm estimates than experimental ($p < .01$) and never smokers ($p < .001$). Young adult daily smokers gave lower harm estimates than weekly ($p < .001$), ex- ($p < .05$), experimental ($p < .001$), and never ($p < .001$) smokers.

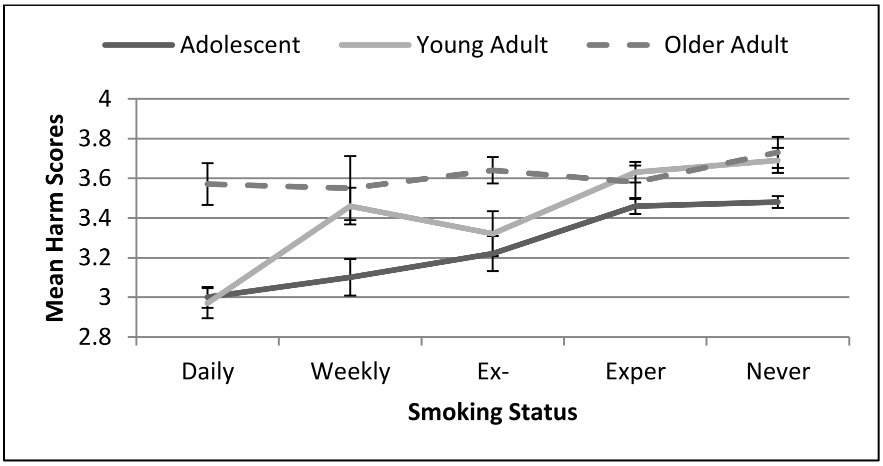


Figure 5.8 Mean perceived harm scores for each age and smoking status group. Error bars represent standard errors.

A main effect of age was also found in each smoking status group: daily, $F(2,237) = 13.36$, $p < .001$, $\eta_p^2 = .10$, adolescents and young adults gave lower ratings than older adults ($p < .001$ for each); weekly, $F(2,75) = 4.97$, $p < .01$, $\eta_p^2 = .12$, adolescents gave lower ratings than younger adults ($p < .05$); ex-smoker, $F(2,114) = 8.23$, $p < .001$, $\eta_p^2 = .13$, adolescents ($p < .001$) and young adults ($p < .05$) gave lower ratings that older adults; experimental, $F(2,229) = 3.43$, $p < .05$, $\eta_p^2 = .03$, adolescents gave lower ratings than young adults ($p < .05$); and never smokers, $F(2,341) = 7.87$, $p < .001$, $\eta_p^2 = .04$, adolescents gave lower ratings than younger and older adults ($p < .01$ for each).

5.3.4.3 Avoiding health-related thoughts. A 5 (smoking status) x 3 (age) ANOVA of avoidance of health-related thoughts found a main effect of smoking status, $F(4,996) = 71.0$, $p < .001$, $\eta_p^2 = .10$, and a main effect of age group, $F(2,996) = 5.36$, $p < .01$, $\eta_p^2 = .01$. Post-hoc analysis revealed a linear increase in avoidance with increased smoking (see *Figure 5.9*). Avoidance in daily smokers was significantly higher than weekly ($p < .05$) and ex-, experimental, and never smokers ($p < .001$ for each). It was also significantly higher in weekly smokers than in ex- ($p < .01$), experimental and never smokers ($p < .001$ for each). No significant differences were found among non-smoking groups. Avoidance was also significantly higher in adolescent and young adults than in older adults ($p < .01$ for each).

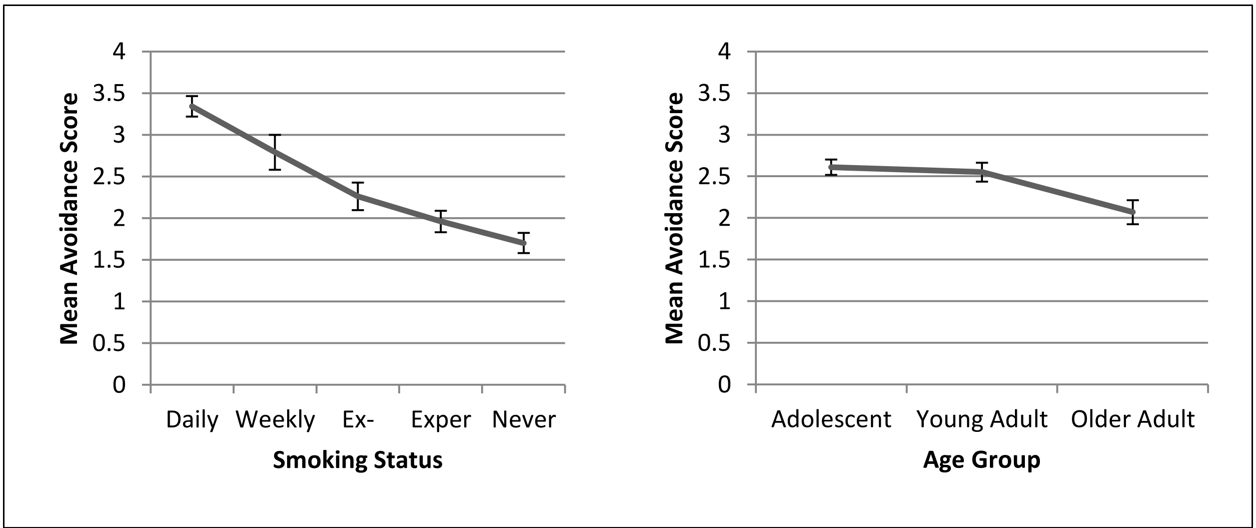


Figure 5.9 Mean health risk avoidance scores for smoking status and for age groups. Error bars represent standard errors.

5.3.4.4 Relationship with other constructs. Associations between risk estimates, self-identity, group identity, seeing and being around smoking, attitudes to smoking , subjective and moral norms were assessed using Spearman's rho correlations. Only those factors with at least some significant correlations above .25 are presented in Table 5.7.

Table 5.7 *Spearman's Rho Correlations between Risks and Self-identity, Environmental Smoking, Attitudes to Smoking, Subjective and Moral Norms*

	RG	RS	General Harm	Immediate Harm	Avoid HR
Self-identity	.54 ***	.53 ***	-.34 ***	-.22 ***	.49***
Around Smoking	.25 ***	.28 ***	-.22 ***	-.14 ***	.27 ***
Like Smoking	.47 ***	.41 ***	-.31 ***	-.21 ***	.45 ***
Own View	.27 ***	.27 ***	-.42 ***	-.27 ***	.39 ***
Friend SN	.22 ***	.17 ***	-.06 *	-.09 **	.15 ***
Best Friend SN	.21 ***	.14 ***	-.06 *	-.09 **	.13 ***
Moral Norms	.25 ***	.20 ***	-.39 ***	-.30 ***	.38 ***

Note. SN, Subjective norm; RG, Relative to general risk; RS, Relative to smoker risk; Avoid HR, Avoidance of health risk thoughts; *** $p < .001$; ** $p < .01$; * $p < .05$

5.3.5 Associations between cognitive biases. Spearman's rho correlations between positive expectancy bias, overestimation of peer prevalence, and risk scores were examined to determine the strength of the relationships between these cognitive biases. Small but consistent significant relationships ($p < .001$) were found between smoking expectancies and risk. H-SCQ difference scores were negatively related to general harm (r_s = - .33), and positively related to RG risk (r_s = .35), RS risk (r_s = .32), and avoidance (r_s = .39). FA T1 difference scores were also negatively related to general harm (r_s = - .31), and positively related to RG risk (r_s = .32), RS risk (r_s = .30), and avoidance (r_s = .36).

5.4 Discussion

5.4.1 Smoking expectancies

This study first examined the accessibility and availability of smoking expectancies in individuals of diverse age and smoking status. As expected, daily and weekly smokers of all ages gave more positive explicit evaluations of smoking than non-smokers, and as age increased, the size of the smoking status effect decreased. The most positive group was young adult daily smokers, closely followed by adolescent daily smokers. Although smoker and ex-smoker evaluations of smoking became more negative with age, this pattern was reversed in the experimental and never-smoker groups. This suggests that younger experimental and never smokers are very aware of the negative consequences of smoking, even if tempted to try smoking themselves. When smoking expectancies were measured implicitly, daily and weekly smokers of all ages were again most positive about smoking, although all groups were net negative overall. Similar smoking status differences were observed in Study 1, although adolescent smokers were net positive overall in that sample. In this study, young adult daily smokers gave the least negative evaluation, followed by older adults. Young adults were also least negative in the weekly smoking group, but in this case older adults were most negative. Age-related differences were also found in the comparison of explicit and implicit smoking expectancy measures in the experimental and never-smoking groups. In both cases, adolescents were more positive about smoking on the implicit measure.

The results of this study are therefore broadly in line with those presented in Chapter 2, and with previous research which has found a positive memory bias for smoking-related information in smokers using explicit (Lewis-Esquerre, et al., 2005; Rash & Copeland, 2008) and implicit (C. B. Anderson, et al., 2002; Leung & McCusker, 1999) measures. Explicit measurement was again successful at identifying a positive memory bias for smoking-related information in smokers, and a similar age effect was evident to that found in Study 1. Older adult daily, weekly, and ex-smokers gave the most negative explicit evaluations of smoking, while similar evaluations were given by adolescents and young adults. Implicit FA assessment was also successful at identifying a positivity bias. Again, smokers were significantly more positive than non-smokers in both FA periods, and the disparity between smoker and non-smoker FA difference scores was much larger in the first half than in the second half of the task. Additionally, no effect of age was seen in the FA analysis, which is comparable to previous findings.

In contrast to Study 1 results, all groups gave an overall negative FA evaluation of smoking which supports the findings of Leung and McCusker (1999). It should be noted that the adolescents and young adults in this study were significantly younger, on average, than those in Study 1 (see section 4.3.2.1 for the participant comparison), and it is recognised that children and younger adolescents give higher negative evaluations of smoking than older adolescents (O'Connor, et al., 2007). Furthermore, although there were no between-sample differences in either cigarette use or nicotine dependence, the positive association between age daily smoking commenced and the number of positive FA T1 smoking expectancies, in both adolescent and young adult daily smokers, suggests that greater numbers of positive expectancies were accessible by those who commenced daily smoking most recently. Nevertheless, a clear distinction is evident between the FA T1 differences scores of smokers and non-smokers, and the fact that greater numbers of positive expectancies are highly accessible to smokers is likely to exert an automatic maintaining influence on their behaviour (Palfai, 2002). It is also interesting to note the presence of a very strong relationship between highly accessible FA negative smoking expectancies in older adult weekly smokers who commenced smoking at a young age, and the fact that this group give higher explicit endorsements of negative smoking expectancies. Neither of these relationships were found in any other smoking group which suggests that although these older adults do smoke occasionally, the accessible negative smoking expectancies act as a protective factor which may prevent escalation to daily smoking (Sherman, et al., 2003).

Different results were found when explicit and implicit expectancy scores were compared in each study. Whereas Study 1 smokers gave significantly more positive evaluations of smoking in FA T1 than on the H-SCQ task, no differences were found between the two measures for weekly smokers in this study, and daily smokers gave significantly more positive evaluations on the H-SCQ measure. Further replications of these results are required in order to determine which pattern of results is more valid. A novel finding in this study is the fact that adolescent never and experimental smokers give more positive implicit evaluations of smoking in comparison to those found with the explicit measure. It is possible that these FA results are highlighting an early indication of increasing numbers of positive smoking associations in this group, which could potentially be predictive of smoking initiation or escalation. Taken together, these results further support the value of examining the relative difference between positive and negative evaluations of smoking, and the importance of distinguishing between memory associations that are highly accessible and those only available with conscious searching.

5.4.2 Peer prevalence estimation

The second aim of the study was to examine estimation of perceived peer smoking prevalence in adolescent and adult smoking and non-smoking groups. As expected, clear patterns of overestimation were found, and the extent of this overestimation, which is analogous to the size of the FCE, decreased with age. FCE was also predicted to increase with smoking experience, and the results mainly support this hypothesis. In all age groups, the largest FCE was found in daily smokers and the smallest in never-smokers. Adolescent overestimation clearly increased with experience, although ex-smokers demonstrated a FCE comparable to that of weekly smokers. A similar pattern was found for young adults, but in this case ex-smokers overestimated to a greater extent than weekly smokers, and were only marginally better at estimation than daily smokers. In older adults, never, experimental and ex-smokers overestimated the least, and to roughly the same extent as each other, but FCE increases were seen for weekly and for daily smokers. Across the groups, clear overestimation of peer smoking prevalence was best predicted by having large numbers of friends who smoked, perceiving high levels of smoking in the work, college, or school group, participant age, and current smoking behaviour. Contrary to expectations, seeing smoking and being around smoking did not significantly contribute to the FCE.

Both the clear linear decline in overestimation with age and the increase in overestimation with smoking experience in the adolescent and young adult age groups support previous research results (Hoffman, et al., 2006; Otten, et al., 2009; Sutton & Bolling, 2003). The third key finding from this study, that the percentage of friends and the percentage of group who smoke account for the largest proportion of FCE, also supports previous findings (Reid, et al., 2008; Unger & Rohrbach, 2002). The results of this study also demonstrate the predictive value of current smoking behaviour in the experimental and weekly smoking groups. This supports the findings of Reid and colleagues (Reid, et al., 2008) and challenges those that find no impact of current smoking behaviour on peer prevalence estimation (Unger & Rohrbach, 2002), and those that simply suggest that smokers will overestimate to a greater extent than non-smokers (Sussman, et al., 1988). Taken together, these findings can be attributed to both a selective exposure and to a motivational self-enhancement explanation of FCE (Sherman, 1983; Sutton & Bolling, 2003).

From a selective exposure perspective, the sampling frame available to an adolescent or young adult is likely to be smaller than that available to an older adult. For example, although actual smoking prevalence may be quite low among adolescents, a larger proportion of their sample may be made up of smokers. In this case, the relative balance of smokers and non-smokers in their peer group could be extrapolated to the wider population. It was expected that seeing smoking and being around smoking would have significantly predicted FCE, but this was not the case in this sample. It is likely, however, that any effect of these variables had already been accounted for by including the percentage of peer group who smoke in the model, and this was found to be a significant predictor. The selective exposure hypothesis can also explain the finding that younger experimental and never-smokers, particularly those in the adolescent group, also clearly overestimate peer smoking prevalence. It would be expected that these individuals associate with larger numbers of smoking peers thus skewing their sampling frame (Marks & Miller, 1987). A different impact of smoking status which warrants closer attention is seen in the older adult group. It would be insufficient to conclude that older adults are better able to estimate peer smoking prevalence due to larger and more heterogeneous sampling frames alone as this cannot account for the fact that the highest level of overestimation occurred in the never-smoking group. A motivational explanation of FCE (Gibbons & Gerrard, 1995) is more likely in this case.

The high levels of overestimation seen in older adult never-smokers could be indicative of a false-uniqueness effect (Suls, et al., 1988), whereby these adults are responding to the deviant nature of smoking and self-enhance by overestimating their distinctiveness relative to others of the same age. Accepting that smoking is a deviant behaviour for people of all ages allows a similar argument to be made for the overestimation that is seen in younger never-smoking groups. Motivational explanations of FCE can also account for the finding that adolescent and young adult smokers overestimate peer prevalence to a greater extent than non-smokers of the same age. In this case, the smokers are likely to be distorting the consensus to support their own deviant behaviour (Marks & Miller, 1987). Given that no significant relationships were found between overestimation and the implicit measurement of smoking expectancies, it is difficult to provide support for the salience and cognitive availability hypothesis with these results.

In summary, the findings from this study demonstrate the existence of a FCE for peer smoking prevalence. They illustrate that although the extent of overestimation differs with both age and smoking status, it is best predicted by having a predominately smoking peer group and larger numbers of friends who smoke. Both self-enhancement and selective exposure explanations of FCE can be supported by these results and it is possible that they operate simultaneously to produce the overestimation (Marks & Miller, 1987). These findings raise an issue for intervention programmes in terms of how best to build realistic perceptions of peer prevalence despite the influence of proximal social and environmental factors.

5.4.3 Optimistic risk bias

The study finally aimed to assess whether optimistic risk biases were present in any of the participant groups, and how these biases might be influenced by age and smoking status. It was expected that smokers of all ages would exhibit some degree of optimistic risk bias in comparison to non-smokers. This hypothesis was only partially supported by the results here. In terms of relative risk, daily smokers did not exhibit an optimistic risk bias. All other groups were optimistic relative to both an average person and to an average smoker, but an increase in risk awareness was demonstrated with increased smoking experience. An optimistic bias was more evident in the case of perceived harm from smoking. All groups gave significantly lower immediate harm ratings in comparison to general harm, but as predicted, the extent of the difference between the two was significantly larger for younger smoking groups. An increasing tendency to avoid health-related thoughts was also demonstrated with increased smoking experience, and by adolescents and young adults in comparison to older adults.

Daily smokers were in fact the only group to rate their own risk as higher than that of an average person and of a typical smoker their own age. All other smoking status groups demonstrated RG and RS optimistic biases. These findings echo those of Quadrel and colleagues (1993), and in both studies this unrealistic risk rating was similar for all ages. Although a small effect of age was found, this related to the difference between the RG and RS ratings. Adolescents gave similar ratings on both measures, while each adult group felt they were more at risk relative to an average person, than to a typical smoker their own age. Quite a strong relationship was found between self-identity and both relative risk ratings, so these results cannot be explained by the suggestion that smokers did not consider themselves to be similar to a "typical smoker". The results therefore suggest that people are not good at estimating their own risk even when a *relative* risk measure is used. An increasing awareness of risk is demonstrated in line with increasing smoking experience. This suggests that although all weekly, ex-, and experimental smokers underestimated their RG and RS risks in absolute terms, these groups are aware that they are at more risk than never-smokers, and they therefore do not display an optimistic relative risk bias by comparison. These results challenge previous research that has found a consistent optimistic risk bias in smokers relative to non-smokers (Cohn, et al., 1995; Hansen & Malotte, 1986; Klein & Weinstein, 1997; Quadrel, et al., 1993). Instead, they support the view that smokers, regardless of age, are aware of the risky consequences of smoking (Slovic, 1998). Furthermore, the same pattern of responding was identified for health and addiction risk, so smokers seem to be as aware that they are at more risk of addiction with increasing levels of smoking experience, which again challenges previous research findings (N. D. Weinstein, 2001).

In relation to the perceived harm of smoking, general harm scores were consistently higher than immediate harm scores across the groups. All participants, regardless of their age or smoking status, held a more optimistic view of the short-term risks of smoking in comparison to longer-term risks. These results highlight the importance of considering the context of the risk assessment, and they support Viscusi's (1992) assertion that when smoking risk is being estimated, it is essential to understand whether the participant is in fact judging the short- or the long-term risk of smoking. By extension, it becomes necessary to investigate if it is the short-term, long-term, or both perceived risk assessments that most influence smoking intentions and behaviour. In other words, it is important to understand which type of perceived risk most influences the smoking decision.

Smoking status and age were also found to influence perceptions of smoking harm. Both adolescent and young adult daily smokers saw significantly less immediate harm from smoking than non-smokers of the same age, and they saw significantly less immediate harm than older adult daily smokers. The same optimistic bias is evident in adolescent weekly smokers. These results are consistent with the claim that adolescents hold a particularly optimistic view of the short-term harm from smoking (Romer & Jamieson, 2001). A linear increase in avoidance of health-related thoughts was also found with increased smoking experience, and avoidance was more likely in younger age groups. It was also positively associated with identifying oneself as a smoker, liking smoking, and holding a favourable view towards smoking in important others. The combination of an optimistic view of the immediate harm from smoking, and avoidance of the health-related consequences, reduces the vulnerability the individual is likely to feel and, in concert with favourable attitudes, this increases their willingness to engage in smoking behaviour (Gerrard, et al., 2008).

In summary, while similar patterns of optimistic bias were found between adolescents and adults from 19 to 25 years of age, the same bias was not seen in older adult groups. As few studies have examined personal risk perceptions across varied age groups, no consistent pattern of age-related differences is available for comparison; however, the findings of this study broadly support those of Cohn and colleagues (1995) who illustrated that although adolescents displayed less general optimistic risk bias than their parents, those who were involved in risky health behaviours such as smoking did recognise their increased vulnerability to harm to some extent. Moreover, they recognised that increased involvement with the risky behaviour would further increase their own risk of harm. Taken together, these results demonstrate the importance of investigating developmental patterns of risk perception, in conjunction with smoking experience differences.

5.4.4 Limitations

Some methodological limitations should be taken into account in the interpretation of these results. The overall sample size for Study 3 was moderately large but the relative sample size of each of the groups varied considerably. There were substantially more adolescent never-smokers than smokers, and weekly smoker numbers were particularly low in each age group. Gender was also unbalanced across the groups, so although few gender differences were found, it would be prudent to repeat this research in more gender-balanced groups. Smokers' dependence scores remained quite low which is consistent with Study 1 and facilitates comparison of findings between the samples, but it potentially limits the generalisability of the results to more heavily dependent groups.

From an analytical perspective, two difficulties arise when a factorial design has cells of unequal size (Tabachnick & Fidell, 2007). Firstly, there is the problem of determining if the marginal mean should be the mean of the cell means, or if it should be the mean of the individual scores. Secondly, the sources of variability within the dataset contain overlapping variance which can be attributed to more than one source, resulting in a non-orthogonal factorial design. Equalising cell sizes by random deletion of cases is unsuitable in this and in many experimental designs. Tabachnick and Fidell (2007) recommend that ANOVA analyses are carried out with the assumption that each cell mean is given equal weight regardless of sample size, and that interactions are considered after their component main effects. This is the default option in SPSS GLM, which is what was used in all of the ANOVA analyses reported in this thesis. Significant main effects were also considered concurrently with attendant interactions so as to reduce the likelihood of making a type I error. Finally, although different response methods were used in this study (i.e., online and paper versions of the survey), this is not expected to have influenced the results (E. T. Miller, et al., 2002).

5.5 Conclusion

The current findings indicate that patterns of cognitive biases are detectable, to greater and lesser extents, in daily, weekly, and experimental smokers of all ages. These positivity, FCE, and optimistic immediate harm biases may facilitate the continued maintenance, and potential escalation, of smoking behaviour. In addition, the FCE for peer smoking prevalence is so pronounced in adolescent never-smokers that it may influence smoking initiation as these adolescents feel motivated to conform to social norms, despite the fact that these themselves are overestimated. Having detected that these biases are at work, it is now important to try to quantify the extent to which each influences smoking intentions and smoking behaviour. The final objective of this study was to incorporate these measures of positivity, overestimation, and risk bias into a socio-cognitive model of smoking behaviour, and these findings will now be presented in Chapter 6.

Chapter 6: Contribution of Cognitive Biases to the Prediction of Smoking Intent and Current Smoking Behaviour (Study 3)

6.1 Introduction

It has been established in this thesis thus far that a range of cognitive biases are associated with smoking behaviour, and the analysis of Study 3 data presented in the previous chapter found differential patterns of smoking expectancy positivity bias, FCE for peer smoking prevalence, and optimistic risk bias, in a group of participants heterogeneous in age and smoking experience. Given the ability of these variables to distinguish between participants in this way, it is likely that a model of smoking behaviour would benefit from their inclusion. There is growing empirical evidence that supports the extension of the basic TPB model to include additional social influence, social identity, affect, and behavioural variables, in an attempt to improve its ability to predict addictive behaviours. This chapter will review the evidence in relation to those factors considered particularly relevant to smoking. It will then consider the possibility that extending the model to include smoking-related cognitive biases will further improve its utility in explaining smoking behaviour. To the best of the author's knowledge, this constitutes the first attempt to extend TPB models in this way.

6.1.1 TPB models of smoking behaviour

Much previous research on the socio-cognitive factors associated with health-related behaviours, including smoking, has been based on the TPB model (Ajzen, 1988, 1991). As described in Chapter 1, and as illustrated in *Figure 6.1* below, this model suggests that attitudes, subjective norms (SN), and self-efficiacy beliefs (PBC) predict people's behavioural intentions, while a combination of PBC and intentions proximally determine the behaviour itself. According to Ajzen (1991), behavioural intentions are assumed to encompass the motivational factors that influence behaviour, while PBC measures the individual's perception of how easy or difficult it is to execute that behaviour. In situations where an individual has complete volitional control, intentions would exert the only direct influence on behaviour, but when behaviour is not under complete volitional control PBC moderates the relationship between attitudes and behaviour such that higher PBC levels would predict stronger attitude-behaviour links (Moan & Rise, 2006). Furthermore, the TPB model is regarded as a complete model of behaviour as all other influences impact behaviour via existing components of the model - that is attitudes, SN, and PBC (Conner & Armitage, 1998). The model therefore suggests that the key stages in a smoking-initiation decision, for example, would be: forming impressions of the costs and benefits of smoking; developing positive attitudes towards smoking; believing that important others endorse smoking; doubting one's ability to refuse pressures to smoke; and forming future smoking intentions (Petraitis, et al., 1995).

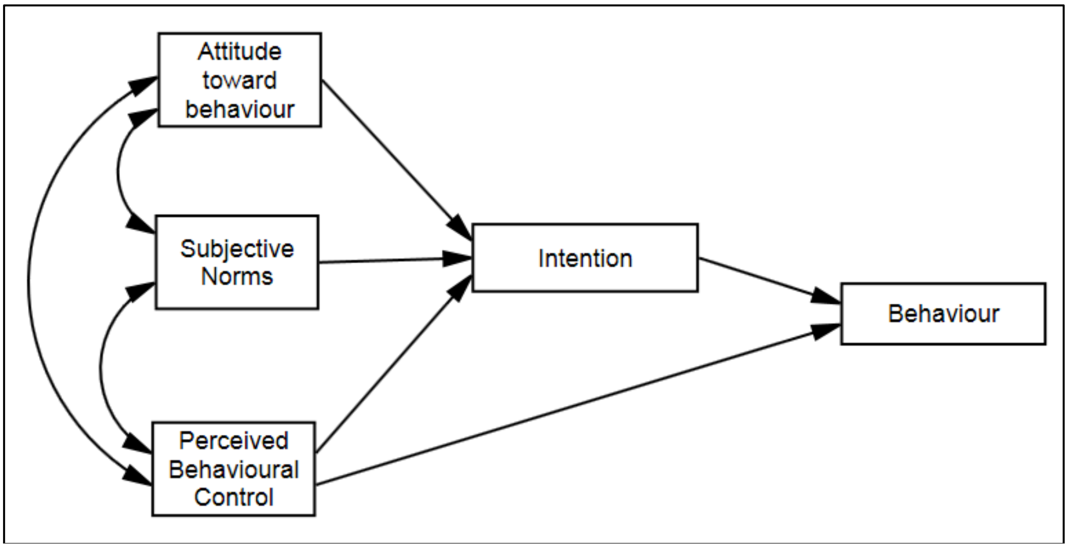


Figure 6.1. The theory of planned behaviour (TPB) model (Adapted from Ajzen, 1991).

In a meta-analysis of the efficacy of TPB models, Armitage and Conner (2001) found a significant interaction between PBC and intentions in 47% (9 of 19) of studies reviewed. At least some aspects of smoking have been successfully predicted by this model: for example, regular smoking in primary and secondary school children (de Vries & Kok, 1986); smoking initiation in adolescents (Chassin, 1984); and general smoking behaviour in adolescents (Higgins & Conner, 2003; Maher & Rickwood, 1997; Petraitis, et al., 1995; Vries, Backbier, Kok, & Dijkstra, 1995) and in adults (Godin, et al., 1992). Chassin (1984) also found that intentions were most predictive for experimental smokers, but poorly predictive of regular smoking; no differences were found in the pattern of predictions for sex, or age. TPB models have also successfully predicted intentions to quit (Rise, Kovac, Kraft, & Moan, 2008) and smoking reduction in adolescents (Moan & Rise, 2006).

Despite these successes, the robust relationship seen between intentions and many health-related behaviours is weakened in addiction (McCusker, 2001), where substance-use often continues despite intentions to quit. In a review of TPB smoking models, McMillan and Conner (2003) determined that the TPB components accounted for an average of 48% of variance in smoking intentions, which is similar to general TPB model efficacy findings (Armitage & Conner, 2001), but they accounted for less than 10% of the variance in smoking behaviour. Additionally, Sutton (1989) found that the attitudinal component of these models was a more important predictor of intention than subjective norms, albeit that the two constructs were themselves significantly positively correlated. These findings suggests that basic TPB smoking models are reasonably successful in accounting for habitual behavioural intentions but less so for the behaviour itself (Sheeran, Trafimow, Finlay, & Norman, 2002). McMillan and colleagues (2005) suggest that this may be the result of the automatic nature of many habitual behaviours, which come to be triggered without conscious awareness by the situational and contextual aspects of the environment in which the behavioural decision is being made.

TPB models are often criticised for failing to adequately define and operationalize their constructs: for example, intentions have been operationalised as plans (Conner, Sandberg, McMillan, & Higgins, 2006; McMillan, et al., 2005), certainty (Higgins & Conner, 2003), likelihood (Norman, Conner, & Bell, 1999), and expectations (Moan &

Rise, 2005). Sutton (1989) also argued that models should differentiate between behavioural intentions (i.e., an individual's future plans for their own behaviour) and behavioural expectations, which pertain to the perceived likelihood of the individual performing the behaviour, thus supporting earlier suggestions that a measure of behavioural willingness should be incorporated into the model (Warshaw & Davis, 1985). Another critique of the TPB model is that it suggests a very simple structure in which a large number of distal factors can influence behavioural decisions, but only through their effects on a smaller number of proximal determinants of the decision (Sutton, 1989). Some researchers have suggested that additional linkages, including potential reciprocal effects, should be considered (McMillan, et al., 2005): for example, attitudes may influence behaviour both indirectly via intentions, but also directly (Bentler & Speckart, 1981). Based on the idea of the MODE (Motivation and Opportunity as Determinants) model (Fazio, 1990), Conner and Armitage (1998) suggest that current TPB models are more successful at predicting behaviour that is highly motivated and can be evaluated in a reasoned and logical manner. The models are less likely to be successful when this motivation is missing, or when behaviour is triggered automatically with no time for deliberation. As such, attitudes may spontaneously and directly influence behaviour. Direct relationships have also been found between SN and behaviour (Harrison, Thompson, & Rodgers, 1985).

6.1.2 Potential TPB model extensions

TPB models have been variously extended in an attempt to address the issues raised above (Conner & Armitage, 1998), and there is growing empirical evidence to support the inclusion of a range of additional normative, affect, and behavioural components. Social influence in basic TPB models is represented solely by SN. These are typically measured as the product of the subjective likelihood that important others think the individual should or should not perform the behaviour, and the individual's motivation to comply with that referent (Conner & Armitage, 1998). The assumption is that salient SN exert a powerful and systematic influence on behaviour (Cialdini, Kallgren, & Reno, 1991), yet research demonstrates that their influence is often limited (White, et al., 2009), and that they are the weakest predictor of intention in TPB models (McMillan, et al., 2005). Armitage and Conner (2001) found that the average relationship between SN and intentions was half that of the average relationship between attitudes and intentions. The SN-intention relationship is also likely to change across behaviours and populations (Fishbein & Ajzen, 1974) which may account for some of the variations in its predictive strength. These issues limit the potential predictive ability of SN and suggested resolutions range from proposing that personal factors, such as attitudes and PBC, are the primary determinants of intention, to removing SN completely from the model (White, et al., 2009).

An alternate approach is to accept that norms are still important in a TPB model, but that a variety of different types of normative influence need to be accounted for (Kallgren, Reno, & Cialdini, 2000; Reno, Cialdini, & Kallgren, 1993; Vitória, et al., 2011; White, et al., 2009). In contrast to SN, *descriptive norms* (DN) reflect an individual's perception of the prevalence of behaviour in others. As such they motivate action towards what is perceived to be typical, normal, appropriate, and adaptive behaviour (Cialdini, et al., 1991), and they have been found to contribute to the prediction of intentions independently of SN (Conner & McMillan, 1999; Grube, McGree, & Morgan, 1986; McMillan & Conner, 2003), explaining an additional 5% of the variation in intentions (Rivis & Sheeran, 2003). They also explain an additional 7% of the variance in behaviour over and above attitudes, SN, and PBC combined (Vries, et al., 1995). Adolescents in particular are likely to be influenced by normative peer perceptions (Armitage & Conner, 2001) and Flay and colleagues (1994) found that different norms were predictive of different stages of smoking; only friends' descriptive smoking was predictive of smoking initiation, but both DN and SN were predictive after having smoked the first cigarette, and of general smoking escalation. Interestingly, studies have found that overestimation of DN is more predictive of smoking behaviour than actual levels of peer smoking prevalence (Botvin, et al., 1992; Sutton & Bolling, 2003). This suggests that prediction could be further improved by the addition of a measure of the extent of this overestimation (i.e., the size of the FCE for peer smoking prevalence).

Not all researchers accept the direct influence of DN on behaviour. Terry and Hogg (1996) argue that norms are tied to specific groups, and that a norm will only influence behaviour when the group itself is behaviourally relevant. This social identity perspective proposes that behavioural intentions are therefore only influenced by perceived group norms for individuals who identify strongly with the particular group (Ãstrom & Rise, 2001), not just because they lead to social approval, but also because the norms identify the attitudes and behaviours most appropriate for group members in a particular decision context. In contrast, attitudes and PBC would be expected to be the primary determinants of intentions and behaviour for those who do not strongly identify with a behaviourally relevant group. Adolescents, for example, have been shown to be heavily influenced by norms relating to peer group identification (Sussman, Pokhrel, Ashmore, & Brown, 2007), and Rise and Ommundsen (2011) demonstrated that strong commitment to a smoking group was associated with lower levels of quit intentions. Considering SN and DN in isolation of some measure of *group identity* therefore fails to assess the degree of individual difference that is likely to exist among participants in terms of the strength of their social identification with salient groups.

Social identity perspectives would also suggest that identifying oneself as a smoker constitutes a source of social influence distinct from normative influence (Moan & Rise, 2006), and research demonstrates that the more an individual identifies with being a smoker, the more likely their smoking escalation (Hertel & Mermelstein, 2012). As behaviour is repeated, *self-identity* becomes more salient, compared to relatively transient attitudes or the perceived social pressure from others, and its ability to predict behaviour increases (Charng, Piliavin, & Callero, 1988). It has also been demonstrated that the stronger a person's self-identity, the stronger related attitudes became over time, which is most likely the result of attitude consistency processes such as cognitive dissonance (Charng, et al., 1988; McCusker, 2001). On average, self-identity was found to account for an additional 1% of the variance in intention over and above traditional TPB components, suggesting that it too may prove a useful addition to TPB models.

Researchers also argue for the inclusion of *moral norms* (MN) which reflect internalised moral rules, or personal feelings of moral obligation, as to whether or not to smoke (Parker, Manstead, & Stradling, 2011). Research suggests that they are independent of the expectations and influences of others, contributing an additional 4% to the prediction of intentions over and above SN (Conner & Armitage, 1998; Conner & McMillan, 1999; Manstead, 2000). MN have been found to influence initiation (Taylor et al., 1999), and they may also act as a protective factor against smoking initiation, smoking escalation, and as an impetus to quitting, when they represent the undesirability of smoking (Moan & Rise, 2005). No clear position has been established in the literature in terms of where MN fit into extended TPB models other than an acceptance that their influence on behaviour is mediated by intentions (Maher & Rickwood, 1997). They may reflect an additional form of normative pressure, but they may also be associated with attitudes, or even PBC (Conner & Armitage, 1998). Manstead (2000) argues that, in some situations, MN will be independent of other TPB components, especially if they conflict with individual and social constructs. However, if the attitude component of TPB models is expected to reflect an individual's favourability or otherwise towards a particular behaviour, it would be reasonable to expect that this would include the moral conviction that performing the behaviour is inherently right or wrong. Raats, Shepherd, and Sparks

(1995) found that MN influenced intentions but also independently predicted attitudes. As the correlations between MN and both attitudes and SN are generally high (Conner & Armitage, 1998), they are likely to prove a useful extension to TPB models although their precise role may depend on the behaviour being assessed.

TPB models have also been extended to include *past behaviour* (Borland, Owen, Hill, & Schofield, 1991; Godin, et al., 1992; Higgins & Conner, 2003). Conner and Armitage (1998) argue that much behaviour is determined to a greater extent by people's own past behaviour than by their current cognitions. They argue that although past behaviour does not cause subsequent behaviour, if performed frequently enough it may bring the subsequent behaviour under the control of habitual or automatic processes. Past behaviour could be expected to predict both intent and behaviour (McMillan, et al., 2005), and although Ajzen (1991) argues that its effects would be mediated by PBC, the meta-analytic data reviewed by Conner and Armitage (1998) would not support this. They also argue that TPB models may undervalue the affective processes in decision making and they propose the addition of *anticipated regret* (AR) to the model to reflect the affect associated with potential negative consequences of the behaviour. This potential extension is supported by the finding that AR significantly added to predictions of intentions to initiate smoking in adolescents, over and above traditional TPB components (Conner, et al., 2006). It should be noted, however, that it was not predictive of smoking behaviour.

Despite these additions, the ability of extended TPB models to successfully predict habitual behaviour remains compromised (McMillan, et al., 2005), and smoking-related studies typically show only small-to-moderate predictive effects for the supplemental variables (Engels, et al., 1999). Given the possibility that overestimation of DN could prove more predictive of smoking behaviour than the prevalence estimates themselves, it is possible that other measures of cognitive bias should be considered as TPB model extensions. For example, Conner and Armitage (1998) proposed that attitudes may have a more direct influence on habitual behaviour when automatically triggered in the presence of the attitude object, but attitudes in TPB models are typically measured using single or multi-dimensional explicit measures. It is likely that implicit attitudes also have a role to play in the automatic elements of decision-making behaviour and, as such, the accessibility of these attitudes is an important component to be considered in any model of habitual behaviour. An attitudinal positivity bias could lead the individual to attend to the positive aspects of smoking, thus facilitating more approach behaviours (Conner & Armitage, 1998). This possibility becomes even more likely when the behaviour is also influenced by strong normative processes, which also promote a positive perception of the activity, as is the case for smoking (Conner & Armitage, 1998). Explicit and implicit measures of relative positive and negative attitudinal strength may therefore be fruitful additions to the TPB model.

Finally, although TPB models do not generally include measures of risk perception, it has been demonstrated in Chapter 5 that smokers, and in particular younger smokers, display optimistic smoking risk biases. Research also suggests that smokers reduce the risk personally applicable to themselves (Gerrard, et al., 1996) and that the less conditional vulnerability felt by an individual, the more willing they are to engage in risky behaviour (Gerrard, et al., 2008). There may therefore be merit in also including risk perceptions as possible extensions to the TPB model. It may be that they influence behaviour via attitudes to smoking, or through intentions, so each of these paths would require further investigation. *Figure 6.2* presents each of the potential TPB model extensions in terms of their potential associations with existing TPB constructs. As the exact location of MN within the model is unclear, they have been shown as potential attitudes and norms, and as an independent predictor of PBC. It is possible that their position will differ depending on the behaviour being modelled.

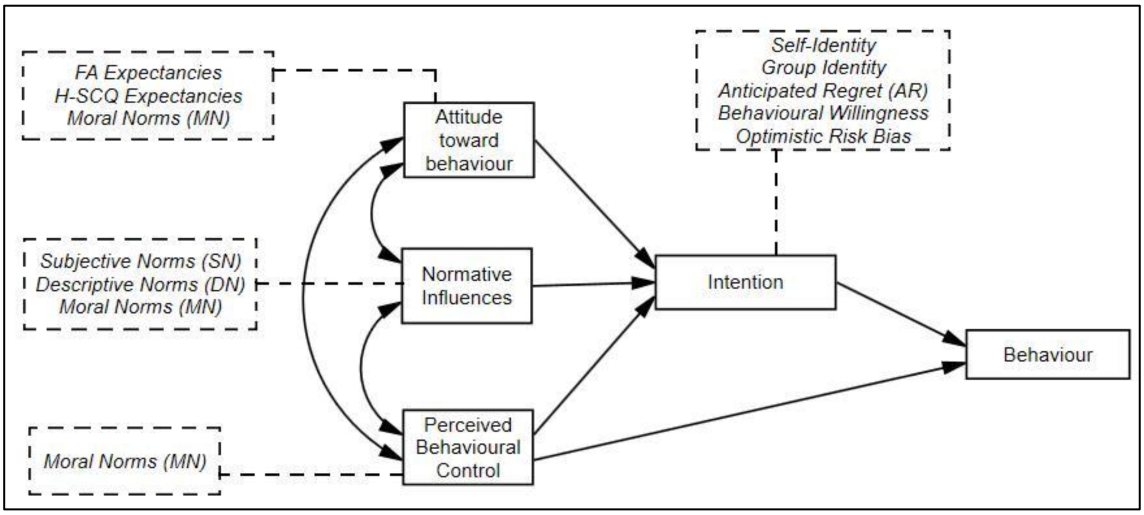


Figure 6.2. Potential extensions to the TPB model.

6.1.3 Aims of the current study

The purpose of Study 3, as described in Chapter 5, was to gather expectancy, normative, and risk information related to smoking, such that positivity, false consensus, and optimistic risk biases could be evaluated across participants heterogeneous in age and smoking experience. Given the relationship that appears to exist between smoking and biased processing of smoking-related cognitions, it is likely that including measures of cognitive biases in smoking models will facilitate a better understanding of smoking intentions and behaviours. No study to date has compared the impact of these additional variables simultaneously when applying the TPB to smoking behaviour. The final aim of the study was therefore to develop an extended-TPB smoking behaviour model that incorporated measures of smoking-related cognitive biases. As it was beyond the scope of this thesis to examine longitudinal smoking data, it was necessary to investigate the relationship between smoking intentions and current smoking status in this extended model. This analysis would both assist in understanding the immediate link between the two, and serve as a platform for further research into the suitability of the model for explaining prospective smoking behaviour. Clarifying the links between each of the model components and current smoking status is also important in terms of understanding how effective interventions can be designed to address existing smoking behaviour. Furthermore, analysis of the factors related to smoking status across different age groups will benefit not only in terms of understanding which factors best explain behaviour in each age group, but will also inform prevention and treatment efficacy.

It is unlikely that all of the suggested TPB extensions will be required for all smoking decisions - for example some researchers suggest that AR is more suited to smoking cessation decisions (Moan & Rise, 2005) - nevertheless, each potential addition will be considered in terms of its ability to predict intentions and current smoking status better than the basic TPB constructs. Overall, it is hypothesised that smoking expectancy positivity bias scores, DN represented as clear overestimation of peer norms, MN, group identity, self-identity, anticipated regret, behavioural willingness, and risk perceptions, would significantly add to the predictability of intentions and behaviour compared to basic TPB variables. In this extended model, smoking expectancy positivity bias scores and MN were expected to load onto attitudes which would directly influence intentions, SN and DN were both expected to directly influence intentions, as were self-identity, group identity, and risk perceptions. PBC was expected to influence both intentions and smoking status, in line with the basic TPB model. It is unclear if a single extended TPB model will be as successful in predicting smoking intentions and smoking status in both adolescents and adults, but it is expected that the predictive utility of each of the cognitive biases, and individual variables such as liking smoking, MN, group identity and AR, would vary by age.

6.2 Method

This research is based on the full set of data gathered in Study 3 and as such involves the same participant sample, measures, and procedure as described in the previous chapter.

6.2.1 Data analysis

Descriptive statistics were computed for each of the potential model components, first with a breakdown by smoking status, and then with a breakdown by age and smoking status. Correlations among the model variables were then computed to determine if the various factors were associated univariately. An initial TPB model, based on the original un-extended model created by Ajzen (1991), was constructed and tested using structural equation modelling (SEM). All SEM was carried out using the maximum-likelihood method (ML) in AMOS 19 (SPSS Inc., Chicago, Illinois 60606, US). Following an analysis of multivariate normality, and the removal of one problematic item related to the social influence of important others, an adjusted TPB model (Model A) was analysed. Consistent with the approach taken in Chapter 4, model fit was assessed using the chi-square goodness-of-fit statistic (χ^2), and the CFI, TLI, NFI, and RMSEA goodness-of-fit indices. Modification indices were reviewed for factor cross-loadings and error covariances, and adjusted models were compared to the original using chi-squared and CFI difference tests. The results of this analysis became the baseline against which extended models were measured. In addition, squared multiple correlations (SMC) were recorded for the smoking intent and smoking status endogenous variables. The SMC value represents the proportion of variance that is explained by the predictors of the variable in question (Byrne, 2009). As it is inappropriate for SEM analysis to provide a single statistic that accounts for total variance explained by the structural model (i.e., analogous to R^2 in regression analyses), these SMC values were also used as a baseline for future model comparisons.

A series of new models was then created which incorporated the three cognitive biases detailed in the previous chapter, namely the positive smoking expectancy bias, the FCE for peer prevalence estimation, and optimistic risk bias. The new models also included additional factors previously recommended as potential TPB extensions. The sequence of additions to the basic model was as follows: (a) inclusion of the explicit and implicit smoking expectancy measures as inputs to the latent attitude factor. These items were included first as they extended the attitude construct from a single- to a multi-dimensional measure, without the need to change existing model paths; (b) addition of descriptive and moral norms, which included clear overestimation of peer prevalence. These items were considered next as they were expected to extend the normative component of the model, and to identify the best location (i.e., attitude or norm) for MN within the model; (c) addition of the remaining TPB extension variables suggested by previous research; and finally (d) inclusion of risk variables. The latter were added last to the model as they have not previously been included as a separate latent factor in TPB extension models. At each stage, newly-added variables were only retained in the model if they significantly improved model fit.

Once all potential variables had been included and tested, the resulting model (Model E) was reviewed to determine if a more parsimonious model could be derived. Non-significant paths were removed from the model and the model-fit statistics were assessed (Model F). Both Model E and the more parsimonious Model F were examined for multi-group invariance, which essentially compared the measurement and structural aspects of the model across participant age groups. This analysis was approached in the same way as previously outlined in Chapter 4 (see section 4.3.1.4).

6.3 Results

The full breakdown of participant characteristics (*N* = 1011) for this sample has been presented in section 5.3.1 in the previous chapter.

6.3.1 Descriptive analysis of model variables

Means and standard deviations for each of the potential model components, first with a breakdown by smoking status, and then with a breakdown by smoking status and age, are presented in Table 6.1 and Table 6.2 respectively.

Where individual items were combined to form an index of a particular measurement, Cronbachs' alpha reliabilities are also displayed.

Table 6.1 *Mean (Standard Deviation) Scores for Potential Model Variables by Smoking Status*

		Daily		Weekly		Ex-smoker		Experimental		Never	
	α	M	(SD)	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Like Smoking		0.59	(1.33)	0.68	(1.04)	-0.59	(1.29)	-1.30	(0.96)	-1.90	(0.45)
FA Difference		-2.12	(4.09)	-2.04	(3.84)	-4.98	(4.18)	-6.11	(3.75)	-6.61	(3.36)
H-SCQ Difference		-0.37	(0.96)	-0.87	(0.97)	-1.50	(1.25)	-2.03	(1.28)	-2.23	(1.48)
Friend SN		-0.77	(1.75)	-0.17	(1.42)	-1.18	(1.62)	-1.41	(1.86)	-2.06	(1.72)
Best Friend SN		-0.77	(1.71)	-0.38	(1.70)	-1.26	(1.67)	-1.58	(1.69)	-2.05	(1.72)
Family SN		-1.21	(1.68)	-1.78	(1.60)	-1.61	(1.71)	-1.67	(1.73)	-1.76	(1.81)
Imp. Others SN		-0.83	(1.51)	-0.83	(1.56)	-1.67	(2.74)	-1.46	(1.72)	-1.83	(1.77)
Society SN		-1.60	(1.76)	-1.74	(1.50)	-1.72	(1.53)	-1.98	(1.62)	-2.04	(1.61)
Moral (MN)		2.30	(1.03)	2.37	(0.81)	1.69	(0.84)	1.81	(0.80)	1.45	(0.72)
Descriptive (DN)		7.00	(1.95)	5.66	(1.80)	4.36	(2.23)	4.73	(2.00)	4.24	(1.78)
Own view	0.88	-1.10	(0.97)	-1.52	(0.68)	-1.83	(0.42)	-1.84	(0.44)	-1.89	(0.35)
Self-identity	0.78	12.97	(4.25)	8.69	(3.59)	5.43	(3.55)	4.29	(2.89)	3.61	(2.10)
Group Identity	0.62	17.45	(2.96)	17.92	(2.49)	17.09	(3.28)	18.09	(2.66)	17.86	(2.76)
AR	0.70	2.56	(1.20)	2.34	(0.96)	3.53	(1.19)	3.09	(1.26)	3.97	(1.17)
Beh. Willingness		29.20	(16.94)	33.88	(13.77)	8.12	(10.62)	6.73	(9.14)	2.77	(5.61)
RG Risk	0.90	10.77	(3.12)	8.19	(3.34)	7.19	(3.33)	5.80	(3.17)	5.14	(2.77)
RS Risk	0.94	10.33	(3.16)	7.77	(3.27)	6.10	(3.39)	5.81	(3.96)	5.05	(3.30)
Avoid HR thoughts		3.52	(1.84)	2.88	(1.41)	2.05	(1.57)	1.98	(1.50)	1.82	(1.65)
Immediate Harm	0.76	2.95	(0.96)	3.21	(0.84)	3.28	(0.81)	3.41	(0.70)	3.43	(0.70)
General Harm	0.66	3.19	(0.60)	3.41	(0.55)	3.64	(0.54)	3.65	(0.45)	3.64	(0.45)
PBC	0.94	2.70	(0.90)	3.72	(0.86)	4.33	(0.83)	4.70	(0.46)	4.79	(0.55)
Intentions		26.05	(16.31)	27.99	(12.78)	6.35	(10.15)	5.30	(8.25)	1.49	(2.40)

Note. FA, free association; SN, subjective norms; MN, moral norms; DN, descriptive norms; Own view, whether friends should smoke or not; AR, anticipated regret; RG, risk relative to general other; RS, risk relative to other smokers; HR, health risk; PBC, perceived behavioural control..

Clear overestimation of peer smoking was found in 86.3% of daily smokers, 78.2% of weekly smokers, 53% of ex-smokers, 65.1% of experimental smokers, and 70.9% of never smokers. In relation to age, clear overestimation was seen in 88.1% of adolescents, 63.3% of young adults, and 27.9% of older adults

Table 6.2 *Mean (Standard Deviation) Scores for Potential Model Variables by Age*

	Adolescent		Young Adult		Older Adult	
	M	(SD)	M	(SD)	M	(SD)
Like Smoking	-0.97	(1.39)	-0.54	(1.51)	-0.70	(1.48)
FA Difference	-4.92	(3.73)	-4.78	(4.86)	-4.92	(4.88)
H-SCQ Difference	-1.74	(1.46)	-1.25	(1.42)	-1.35	(1.48)
Friend SN	-1.41	(1.88)	-1.02	(1.70)	-1.66	(1.79)
Best Friend SN	-1.50	(1.81)	-1.11	(1.73)	-1.58	(1.80)
Family SN	-1.66	(1.77)	-1.45	(1.66)	-1.59	(1.75)
Imp. Others SN	-1.50	(2.00)	-1.14	(1.63)	-1.51	(1.72)
Society SN	-1.87	(1.72)	-1.73	(1.53)	-2.04	(1.51)
Moral (MN)	1.83	(0.92)	2.02	(0.92)	1.59	(0.79)
Descriptive (DN)	5.64	(2.11)	5.14	(2.21)	3.37	(1.66)
Own view	-1.64	(0.67)	-1.60	(0.80)	-1.79	(0.53)
Self-identity	6.45	(4.88)	6.84	(4.92)	6.69	(5.26)
Group Identity	17.73	2.86	17.95	(2.81)	17.42	(2.86)
AR	3.25	(1.33)	3.03	(1.28)	3.59	(1.34)
Beh. Willingness	12.37	(16.18)	15.85	(17.43)	10.84	(15.01)
RG Risk	6.81	(3.84)	7.46	(3.74)	7.55	(3.57)
RS Risk	7.09	(4.21)	6.54	(3.76)	6.24	(3.58)
Avoid HR thoughts	2.44	(1.82)	2.51	(1.80)	1.93	(1.51)
Immediate Harm	3.22	(0.83)	3.32	(0.82)	3.45	(0.73)
General Harm	3.43	(0.56)	3.52	(0.54)	3.81	(0.37)
PBC	4.14	(1.10)	4.04	(1.15)	4.29	(0.98)
Intentions	10.24	(14.57)	13.35	(15.70)	8.99	(14.32)

Note. FA, free association; SN, subjective norms; MN, moral norms; DN, descriptive norms; Own view, whether friends should smoke or not; AR, anticipated regret; RG, risk relative to general other; RS, risk relative to other smokers; HR, health risk; PBC, perceived behavioural control.

6.3.2 Correlational analysis of model variables

The study variables are a mix of interval (most variables), categorical (smoking status) and continuous binary (clear overestimation), so a combination of Pearson’s, Spearman’s, and biserial correlations was used to examine the relationships between potential model variables (see

Table *6.3*).

Table 6.3 *Correlations between the Potential Extended Model Variables*

		1	2	3	4	5	6	7	8	9	10	11	12
1	Like Smoking												
2	FA Difference	.49***											
3	H-SCQ Difference	.49***	.37***										
4	Friend SN	.32***	.19***	.18***									
5	Best Friend SN	.32***	.22***	.17***	.77***								
6	Family SN	.05	.04	.03	.40***	.50**							
7	Imp. Others SN	.19***	.12***	.09**	.51***	.60***	.69***						
8	Society SN	.05	.00	.05	.39***	.34***	.36***	.39***					
9	Moral (MN)	.46***	.31***	.37***	.16***	.19***	.00	.09**	.04				
10	Descriptive (DN)	.28***	.26***	.27***	.15***	.11***	-.05	.03	.06*	.20***			
11	Clear Overestimation	.08	.14***	.08*	.07	.03	-.07	-.05	.03	.07	.88***		
12	Own view	.41***	.35***	.37***	.16***	.17***	.00	.12***	.08*	.46***	.32***	.16***	
13	Self-identity	.66***	.41***	.44***	.26***	.28***	.11***	.20***	.09**	.35***	.41***	.15***	.42***
14	Group Identity	-.04	-.09**	-.11***	.01	.02	.02	-.02	-.04	-.10**	-.05	-.03	-.12***
15	AR	-.44***	-.33***	-.29***	-.18***	-.19***	.02	-.10**	-.01	-.36***	-.28***	-.17***	-.35***
16	Beh. Willingness	.67***	.40***	.43***	.27***	.28***	.05	.19***	.06	.38***	.37***	.20***	.38***
17	RG Risk	.45***	.30***	.33***	.22***	.21***	.11***	.17***	.15***	.21***	.22***	.07	.25***
18	RS Risk	.37***	.26***	.26***	.16***	.14***	.06	.12***	.10**	.15***	.32***	.22***	.23***
19	Avoid HR thoughts	.38***	.30***	.32***	.08*	.09**	-.06	.02	-.04	.31***	.29***	.19***	.32***
20	Immediate Harm	-.21***	-.16***	-.24***	-.09**	-.09**	.01	-.06	.02	-.30***	-.14***	-.10*	-.25***
21	General Harm	-.32***	-.30***	-.35***	-.07*	-.06	.04	-.03	.01	-.39***	-.34***	-.28***	-.39***
22	PBC	-.60***	-.40***	-.48***	-.25***	-.26***	-.09**	-.17***	-.11***	-.34***	-.39***	-.22***	-.42***
23	Intentions	.70***	.42***	.45***	.27***	.29***	.04	.17***	.02	.43***	.41***	.20***	.45***
24	Smoking Status	.73***	.43***	.50***	.30***	.28***	.08*	.21***	.10***	.36***	.43***	.18***	.42***

Table 6.3 *Correlations between the Potential Extended Model Variables (continued)*

		13	14	15	16	17	18	19	20	21	22	23	24
13	Self-identity												
14	Group Identity	-.04											
15	AR	-.32***	.06*										
16	Beh. Willingness	.62***	.00	-.41***									
17	RG Risk	.54***	-.11**	-.25***	.44***								
18	RS Risk	.50***	-.05	-.18***	.42***	.65***							
19	Avoid HR thoughts	.39***	-.12***	-.36***	.39***	.29***	.23***						
20	Immediate Harm	-.21***	.18***	.21***	-.20***	-.16***	-.06	-.29***					
21	General Harm	-.31***	.16***	.30***	-.28***	-.18***	-.19***	-.36***	.36***				
22	PBC	-.68***	.09**	.35***	-.62***	-.49***	-.46***	-.45***	.28***	.37***			
23	Intentions	.62***	-.02	-.49***	.82***	.44***	.39***	.40***	-.22***	-.31***	-.64***		
24	Smoking Status	.73***	-.06	-.43***	.70***	.56***	.51***	.43***	-.20***	-.29***	-.72***	.74***	

Note. FA, free association; SN, subjective norms; MN, moral norms; DN, descriptive norms; Own view, whether friends should smoke or not; AR, anticipated regret; Beh., behavioural; RG, risk relative to general other; RS, risk relative to other smokers; HR, health risk; PBC, perceived behavioural control

6.3.3 Modelling intentions and current smoking status

6.3.3.1 Baseline TPB model. A basic TPB model was created which represented Ajzen's (1991) original TPB model as illustrated in Figure 6.1 above. Attitudes were represented by the *like-smoking* variable, the five indices of social influence formed the SN factor, PBC was represented by the index of the nine individual PBC items, and smoking behaviour was represented by current smoking status. An assessment of multivariate normality found that the social influence item relating to 'important others' was multivariate kurtotic which is particularly problematic for SEM analyses (Byrne, 2008). The standardised kurtosis index (β_2) for this variable was 23.60, which exceeds the recommended guide of greater than or equal to 7 typically used to indicate early departure from normality (Finch, et al., 1997). Kurtosis values for the remaining variables ranged from -1.37 to +0.82. None of the variables were found to be skewed to a problematic extent. The important others social norm was removed from the model and the SEM analysis was rerun. This model (Model A) showed a poor fit to the data ($\chi^2(19) = 853.30$, RMSEA = .209, CFI = .792, TLI = .693 , and NFI = .798). A full range of model-fit statistics for this, and for each of the models subsequently presented, is shown in

Table *6.4*, along with the difference tests carried out to illustrate improvements in model fit. Model modification indices illustrated a significant error covariance between attitude and PBC (MI = 364.71). In TPB models with latent factors representing attitudes and PBC, these latent factors would typically be allowed to freely correlate, so the model was adjusted to include the error covariance.

Goodness-of-fit indices for the adjusted model were inconsistent. The chi-square and RMSEA values suggest a poor model fit ($\chi^2(18) = 400.81$, RMSEA = .145), while the CFI and NFI indices signify a just acceptable model fit (CFI = .905, NFI = 901). Although model modification indices illustrated a significant error covariance between attitude and behaviour (MI = 101.66), basic TPB models assume that attitudes influence behaviour indirectly via intentions, so this modification will not be made and the current model will be used as the baseline against which the subsequent models will be tested[5]. A review of the unstandardised estimates highlighted another problem with the basic TPB model; the factor loading between SN and smoking intentions was not significant ($p = .08$). Standardised estimates for the baseline model are displayed in *Figure 6.3*. The SMCs indicated that 44.5% of the variance in smoking intent, and 57% of the variance in smoking status was accounted for by their respective predictors.

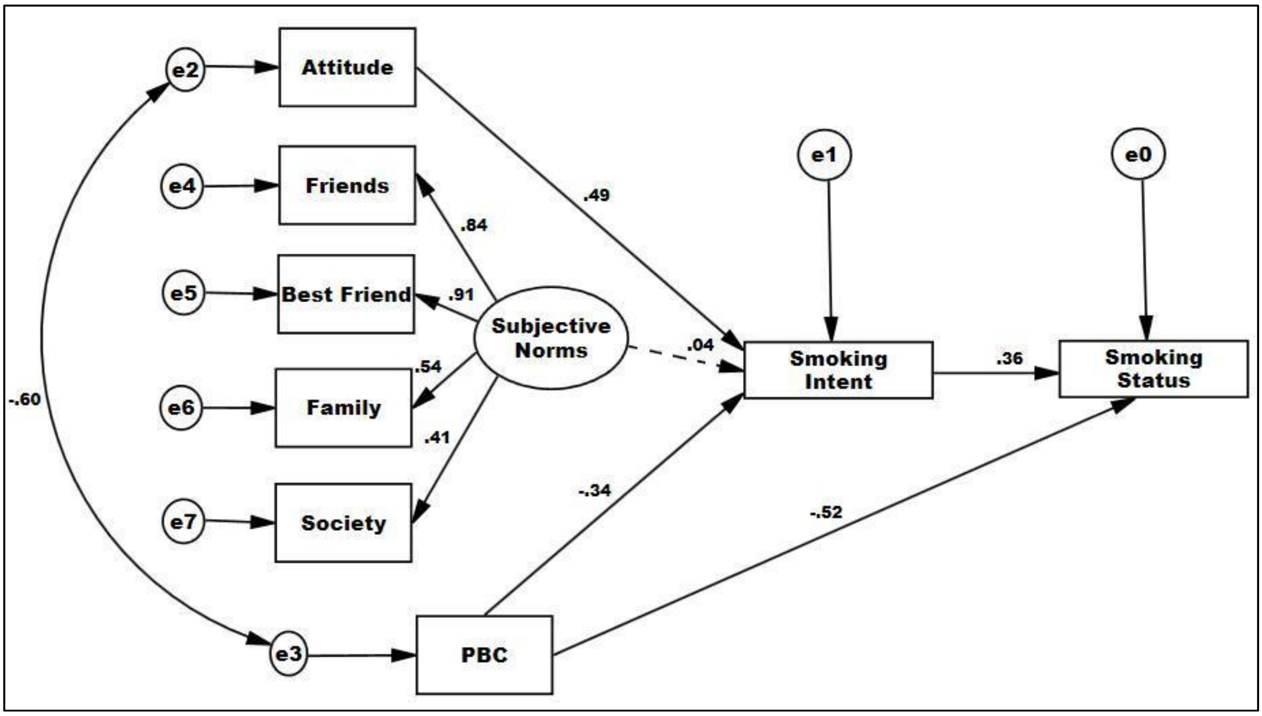


Figure 6.3. Model A: baseline TPB model of smoking intentions and current smoking status. All solid standardised path coefficients are significant (p < .001).

6.3.3.2 Extended Model. The additional smoking-related factors were added to the basic TPB model in four groups as outlined in the Data Analysis section above. A full list

[5] Analysis of a model adjusted to cater for this additional modification demonstrated slightly better fit to the data but goodness-of-fit indices remained inconsistent ($\chi^2(17) = 252.95$, RMSEA = .117, and CFI = .941). Subsequent extended models demonstrated significantly better fit regardless of which adjusted TPB model was selected as the baseline.

of the models tested, a summary of the adjustments made to each, and their associated goodness-of-fit statistics is presented in

Table *6.4*, which follows a summary of the key findings from modelling process.

Summary of the modelling process. Firstly, smoking expectancies (H-SCQ and FA difference scores) were added to the model. Although each improved the model fit when added alone, the combination of both expectancy measures (Model B) provided a substantial improvement in overall fit for the data ($\chi^2(28) = 126.40$, RMSEA = .059, CFI = .979, TLI = .966, and NFI = .973). The % of variance explained for smoking intentions rose from a baseline of 44.5% to 64% in this model, but the % variance explained for smoking status dropped from 57% to 47%. An SMC was also available for PBC in this model and 50% of the variance in PBC was explained by its predictors.

Descriptive norms, moral norms, and the participants own view of smoking, were then added to the model. An analysis of the RMSEA index indicated that the addition of clear overestimation of peer smoking prevalence ($\chi^2(36) = 149.22$, RMSEA = .056, CFI = .976, TLI = .964, and NFI = .969), and the inclusion of moral norms ($\chi^2(46) = 182.01$, RMSEA = .054, CFI = .973, TLI = .961, and NFI = .964), improved model fit (Model C). The model continued to explain 64% of the variance in smoking intentions, and 50% of the variance in PBC, while the % of smoking status variance explained rose to 49%. In addition, moral norms were found to best load onto the latent attitude factor. Neither the actual estimate of peer smoking prevalence, nor an individual's own view of smoking, was found to improve the model.

The remaining recommended TPB extension variables were then added one-by-one to the model; these included AR, self-identity, group identity, and behavioural willingness. Only group identity was found to improve model fit ($\chi^2(57) = 211.10$, RMSEA = .052, CFI = .970, TLI = .958, and NFI = .959), so this was the only variable retained (Model D). There were no changes to the % variance explained for smoking intentions or for PBC, but the % of smoking status variance explained rose to 49.2%. Finally, risk items, which included RG and RS risk, perceived general and immediate harm, and the avoidance of health-related thoughts, were considered. The combination of RG and RS risk, loading on to a new latent 'Risk' factor, improved overall model fit on each of the indices ($\chi^2(77)$ = 244.36, RMSEA = .046, CFI = .973, TLI = .963, and NFI = .961), so these were retained in the new extended-TPB model (Model E). The % variance explained rose to 64.6% for smoking intentions, to 53.7% for PBC, and to 58.1% for smoking status.

A full list of the models tested, a summary of the adjustments made to each, and their associated goodness-of-fit statistics is presented in

Table *6.4* below. The chi-square difference test refers to the difference between a model and subsequent versions which included adjustments recommended by the modification indices (MIs). Where MIs suggested the creation of a new path between items (for example, loading onto attitude rather than PBC), a new model was created. New models that significantly improved model fit relative to the previous baseline are recorded as improved fit, while those that did not significantly improve model fit, or suggested a similar fit to a previous more parsimonious model, are marked as not improved.

Table 6.4 *Summary Model-fit Statistics for the Extended-TPB Model Analysis*

Model	Model Notes	χ^2	*df* (*p*)	RMSEA	CFI	TLI	NFI	$\Delta\chi^2$ (*df*)	Decision
Model A. Basic TPB	Basic TPB Model	853.30	19*	.209	.792	.693	.789		
Baseline Model	**MI (364.71): e(attitude) – e(PBC)**	**400.81**	**18***	**.145**	**.905**	**.851**	**.901**	**452.49 (1)***	
Model B. Expectancies	H-SCQ only (with MIs)	160.95	20*	.084	.968	.968	.964		
	FA only (with MIs)	137.32	20*	.076	.973	.951	.968		
	H-SCQ and FA expectancies	336.93	30*	.101	.935	.902	.929		Both required
	MI (40.93): e(behaviour) – e(intention)	166.69	29*	.069	.971	.955	.965	170.24 (1)*	
New Model B	**MI (38.77): e(family) – e(society)**	**126.40**	**28***	**.059**	**.979**	**.966**	**.973**	**210.53 (2)***	**Improved fit**
Model C. Other Norms	Estimated peer prevalence (link to intent)	374.27	37*	.095	.933	.900	.926		
	MI (179.76): suggests link to PBC	276.40	36*	.081	.952	.927	.945	97.87 (1)*	
	MI (91.14): suggests forms part of attitude								
	Estimated peer prevalence (load onto attitude)	237.95	37*	.073	.960	.940	.953		
	MI (53.57): e(like smoke) – e(desc norm)	169.00	36*	.060	.973	.959	.967	68.95 (1)*	Not improved
	Clear overestimation (link to intent)	172.93	37*	.060	.971	.957	.964		
	MI (27.62): suggests link to PBC	**149.22**	**36***	**.056**	**.976**	**.964**	**.969**	**78.66 (1)***	**Improved fit**
	Clear overestimation (check load onto attitude)	162.59	37*	.058	.974	.961	.966		
	Moral norms (linked to intent)	454.90	46*	.094	.919	.884	.911		
	MI (229.17):suggests forms part of attitude								
New Model C	**Moral norms (load onto attitude)**	**182.01**	**46***	**.054**	**.973**	**.961**	**.964**		**Improved fit**
	Own view of smoking (load onto attitude)	286.08	57*	.063	.958	.942	.948		
	MI (57.14): e(MoralN) – e(Ownview)	226.86	56*	.055	.969	.956	.959	128.17 (1)*	Not improved

Table 6.4 *Summary Model-fit Statistics (Continued)*

Model	Model Notes	χ^2	*df* (*p*)	RMSEA	CFI	TLI	NFI	$\Delta\chi^2$ (*df*)	Decision
Model D. Other TPB items	Anticipated regret (link to intent)	495.40	57*	.087	.919	.889	.909		
	MI (224.20): suggests loads onto attitude								
	Anticipated regret (load onto attitude)	235.80	57*	.056	.967	.955	.957		Not improved
	Self-identity (linked to intent)	1031.33	57*	.130	.837	.777	.830		
	MI (504.69): suggests loads onto attitude								
	Self-identity (load onto attitude)	280.59	57*	.062	.963	.949	.954		Not improved
New Model D	**Group-identity (linked to intent)**	**211.10**	**57***	**.052**	**.970**	**.958**	**.959**		**Improved fit**
	Behavioural willingness (linked to intent)	1031.33	69*	.118	.846	.797	.837		
	MI (504.86): suggests loads onto attitude								
	Behavioural willingness (load onto attitude)	406.53	69*	.070	.946	.929	.936		Not improved
Model E. Risks	RG + RS (latent risk factor to intent)	350.45	79*	.058	.956	.941	.944		
	MI (36.84): e(PBC) – Risk factor								
	Suggests risk may better link to PBC								
	RG + RS (link to PBC)	340.54	79*	.057	.957	.943	.945		
	Option 1: MI (54.99): Risk - e(behaviour)	276.22	78*	.050	.968	.956	.956	64.32 (1)*	
	Option 2: MI (27.70): Risk - behaviour	274.21	78*	.050	.968	.957	.956	66.33 (1)*	Improved fit
New Model E	**MI (28.84): e(RS) – e(MN)**	**244.36**	**77***	**.046**	**.973**	**.963**	**.961**	**29.85 (1)***	**Improved fit**
	Avoid health risk (load onto Risk)	466.79	92*	.064	.942	.924	.929		
	MI (99.47): suggests loads onto attitude								
	Avoid health risk (load onto attitude)	370.73	92*	.055	.957	.944	.943		Not improved

Table 6.4 *Summary Model-fit Statistics (Continued)*

Model	Model Notes	χ^2	*df* (*p*)	RMSEA	CFI	TLI	NFI	$\Delta\chi^2$ (*df*)	Decision
	GH + IH (latent harm factor to intent)	462.91	103*	.059	.946	.929	.932		
	MI (41.02): e(MN) – Harm								Load items
	MI (49.13): e(likesmk) – Harm								separately into
	MI (34.80): Harm – Clear Over								model
	MI (34.46): Clear Over - PHarm								
	General Harm (link to PBC)	577.84	92*	.072	.925	.902	.912		
	MI (144.86): Suggests load onto attitudes								
	General Harm (load onto attitudes)	431.32	92*	.060	.947	.931	.934		
	MI (49.09): e(Gen Harm) – e(MN)	381.30	91*	.056	.955	.941	.942	50.02 (1)*	Not improved
	Immediate Harm (link to PBC)	432.06	92*	.060	.946	.930	.933		
	MI (65.93): Suggests load onto attitudes								
	Immediate Harm (link to PBC)	377.93	92*	.055	.955	.941	.941	34.03 (1)*	Not improved
	MI (33.32): e(Gen Harm) – e(MN)	343.90	91*	.052	.960	.947	.946		
Model F: parsimony	Remove non-significant paths								
New Model F	**Remove SN – PBC and SN – Intent**	**116.04**	**36***	**.047**	**.982**	**.973**	**.975**		**Improved fit**
	(essentially remove SN construct)								

Note. N = 1011; χ^2, chi-square goodness-of fit index; RMSEA, root-mean-square error of approximation; CFI, comparative fit index; TLI, Tucker-Lewis index; NFI, normed fit index; $\Delta\chi^2$, chi-square difference test; * p < .001.

Review of the extended-TPB model. The resulting model (Model E) demonstrated excellent fit to the data ($\chi^2(77) = 244.36$, RMSEA = .046, CFI = .973, TLI = .963, and NFI = .961), and the unstandardised parameter estimates (see Table *6.5*) demonstrate that significant contributions were made by each additional variable retained in the model. As can be seen from the standardised estimates presented in *Figure 6.4*, FA difference scores, H-SCQ difference scores, the *like-smoking* attitude item, and MN loaded positively onto a latent attitude variable with factor loadings ranging between .52 and .87. Attitudes were positively related to smoking intentions and negatively related to PBC. Clear overestimation was positively associated with smoking intentions and negatively associated with PBC; factor loadings were small in both cases. RG and RS risk loaded positively onto a latent risk variable with factor loadings of .87 and .74 respectively. Risk itself was negatively associated with PBC and positively associated with current smoking behaviour, with small-to-medium factor loadings in each case. Group identity was also positively associated with smoking intention, but its factor loading was very small. PBC had a small negative association with both smoking intentions and current smoking behaviour, while smoking intentions had a strong positive association with behaviour. Although each of the SN items loaded positively onto a latent SN variable (factor loadings ranged from .39 to .93), non-significant associations were found between SN and both smoking intentions and PBC. This replicates the findings for these relationships in the basic TPB model. The following were tested but were not retained in the model: peer prevalence estimates, own view of others' smoking, AR, self-identity, behavioural willingness, avoidance of health-related thoughts, and general and immediate perceived levels of smoking harm.

Table 6.5 *Model E Unstandardised Estimates, Standard Errors and Critical Ratios*

	Estimate	*SE*	*CR*	*p*
Attitude to H-SCQ Expectancies	1.00			
Attitude to FA Expectancies	2.70	0.18	14.84	<.001
Attitude to Like Smoking	1.44	0.72	19.96	<.001
Attitude to Moral Norms	0.54	0.04	14.06	<.001
Attitude to Intentions	11.59	0.84	13.79	<.001
Attitude to PBC	-0.69	0.06	-12.42	<.001
SN to Friend SN	1.00			
SN to Best Friend SN	1.10	0.44	25.03	<.001
SN to Family SN	0.60	0.04	16.72	<.001
SN to Society SN	0.42	0.04	12.10	<.001
SN to Intentions	0.04	0.21	0.17	.864 (ns)
SN to PBC	-0.01	0.02	-0.24	.807 (ns)
Clear Overestimation to Intentions	2.21	0.58	3.81	<.001
Clear Overestimation to PBC	-0.27	0.06	-4.93	<.001
Risk to RG Risk	1.00			
Risk to RS Risk	0.89	0.04	20.29	<.001
Risk to PBC	-0.08	0.01	-6.75	<.001
Risk to Smoking Status	0.11	0.01	7.95	<.001
Group Identity to Intentions	0.20	0.09	2.24	.025
PBC to Smoking Intentions	-2.06	0.48	-4.27	<.001
PBC to Smoking Status	-0.23	0.06	-4.14	<.001
Intentions to Smoking Status	0.08	0.01	13.65	<.001

Note. N = 1011; *SE*, standard error; *CR*, critical ratio; *p*, probability value.

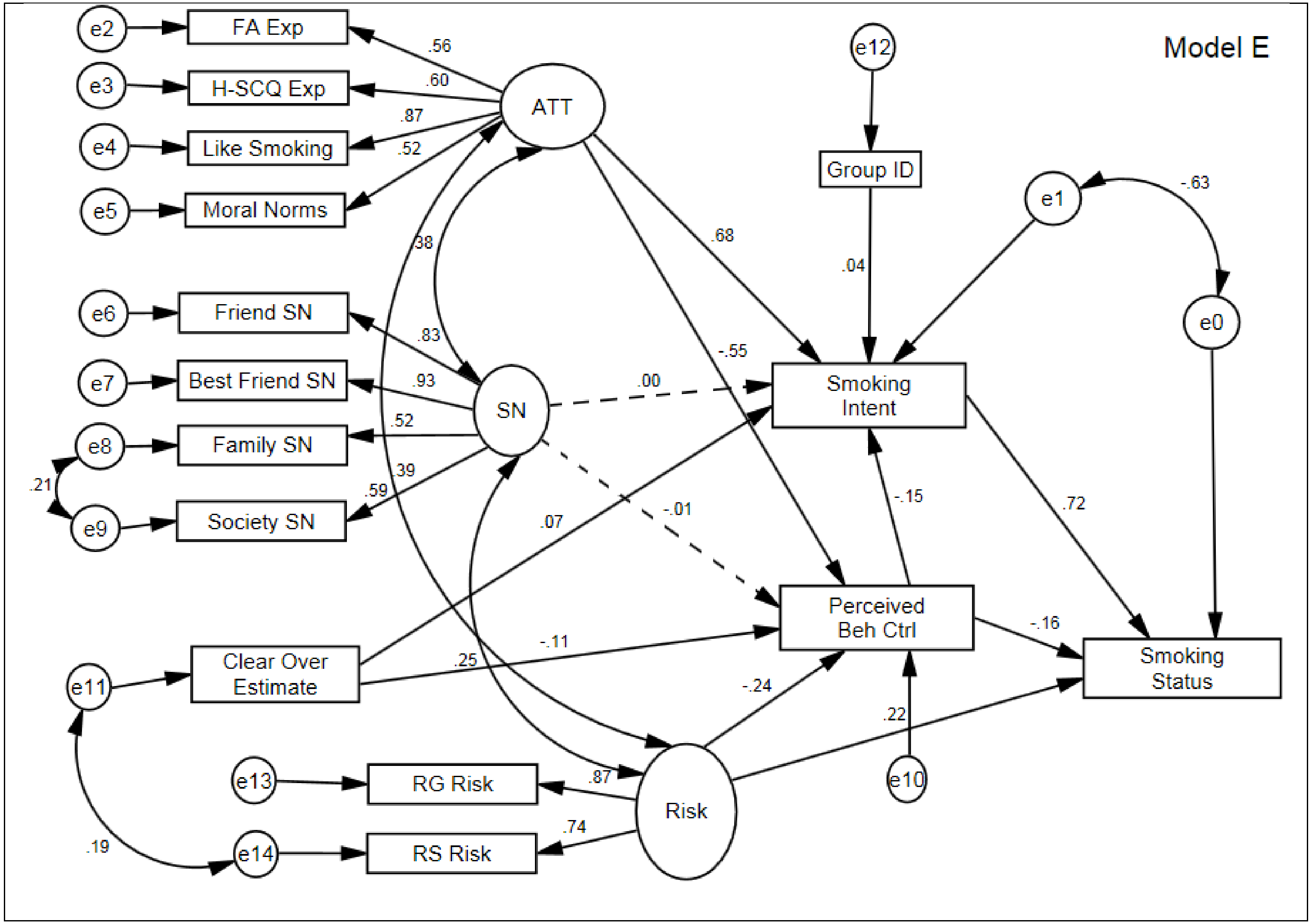


Figure 6.4. Model E: Extended TPB model of smoking intentions and current smoking behaviour. All solid standardised path coefficients are significant (all $p < .001$, except for Group ID – Intentions where $p < .05$).

6.3.3.3 Improving model parsimony. Despite the fact that SN is a core construct in TPB models, it did not contribute significantly to either smoking intentions or to PBC in this study. As a result, it was felt that removing SN items from the model might result in a more parsimonious solution without significantly compromising model fit. The final model (Model F) demonstrated excellent fit to the data ($\chi 2(36) = 116.04$, RMSEA = .047, CFI = .982, TLI = .973, and NFI = .975). No further modifications were needed. Very little difference was seen between SMCs in Model E and those in Model F. The % variance explained was 64.7% for smoking intentions, 53.8% for PBC, and 58.3% for smoking status. All parameters contributed significantly to the model (see Table 6.6) and Model F standardised estimates are displayed in *Figure 6.5*.

Table 6.6 *Model F Unstandardised Estimates, Standard Errors and Critical Ratios*

	Estimate	*SE*	*CR*	*p*
Attitude to H-SCQ Expectancies	1.00			
Attitude to FA Expectancies	2.69	0.18	14.86	<.001
Attitude to Like Smoking	1.43	0.72	20.01	<.001
Attitude to Moral Norms	0.54	0.04	14.09	<.001
Attitude to Intentions	11.62	0.82	14.25	<.001
Attitude to PBC	-0.69	0.05	-13.01	<.001
Clear Overestimation to Intentions	2.22	0.59	3.80	<.001
Clear Overestimation to PBC	-0.27	0.06	-4.91	<.001
Risk to RG Risk	1.00			
Risk to RS Risk	0.89	0.04	20.30	<.001
Risk to PBC	-0.08	0.01	-6.72	<.001
Risk to Smoking Status	0.11	0.01	7.94	<.001
Group Identity to Intentions	0.21	0.09	2.37	.018
PBC to Intentions	-2.03	0.49	-4.17	<.001
PBC to Smoking Status	-0.23	0.06	-4.18	<.001
Intentions to Smoking Status	0.08	0.01	13.57	<.001

Note. N = 1011; *SE*, standard error; *CR*, critical ratio; *p*, probability value.

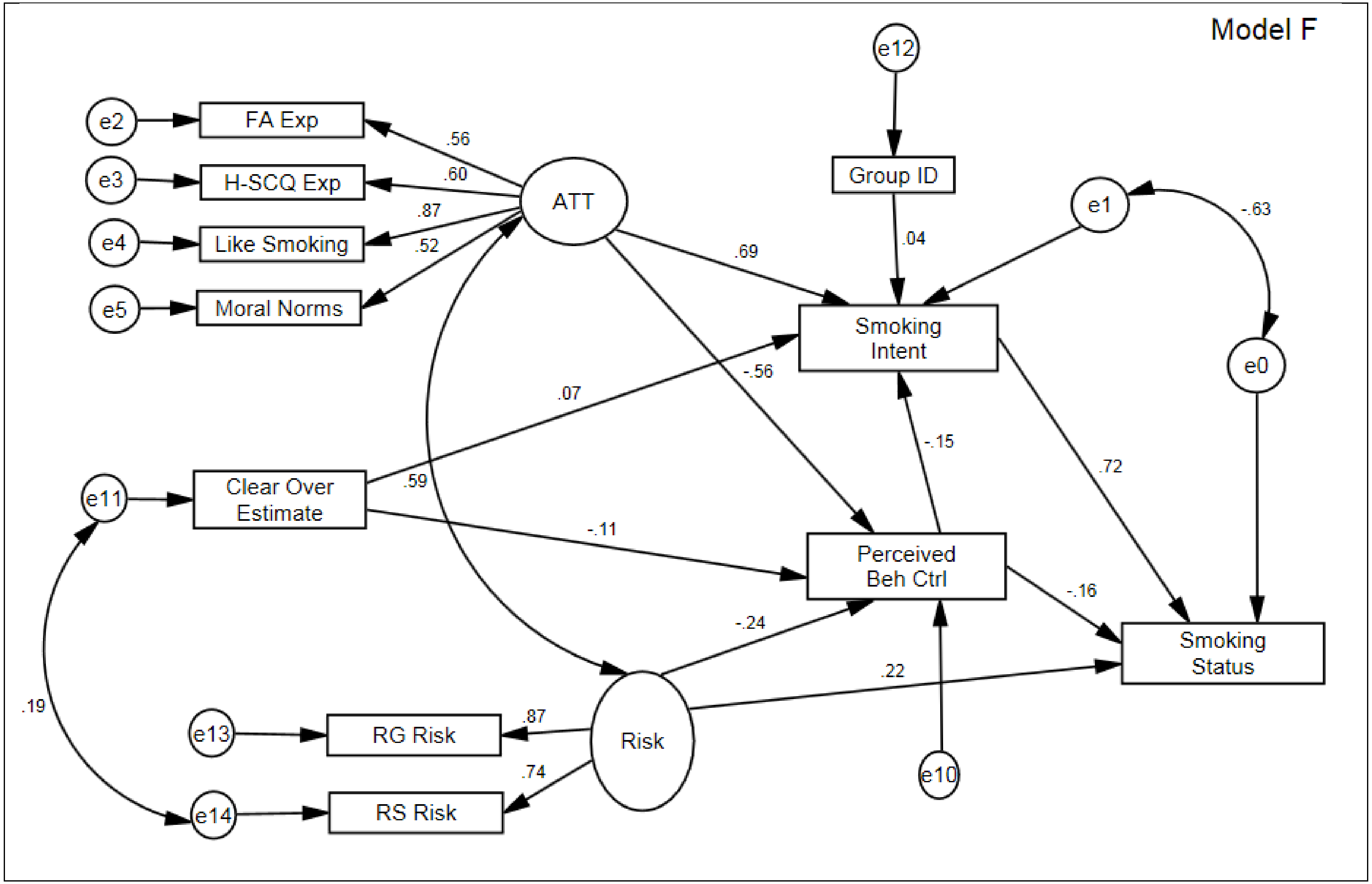


Figure 6.5. Model F: A more parsimonious model of smoking intentions and current smoking behaviour. All solid standardised path coefficients are significant (all $p < .001$, except for Group ID – Intentions where $p < .05$).

6.3.3.4 Analysis of model invariance across age groups. An additional concern in this study was whether the extended model would function in the same way for people of different ages. Participant data was split into three age groups: adolescents (*n* = 588), young adults (*n* = 251), and older adults (*n* = 172). AMOS multi-group functionality (Byrne, 2008) was used to test whether the recommended TPB model extensions applied equally well to each age group. This involved the same three step testing process that was outlined in the model invariance testing of the H-SCQ scale in Chapter 4 (see section 4.3.1.4). Both Model E and the more parsimonious Model F were tested, and the results of these analyses are presented in Table 6.7.

With regard to Model E, the goodness-of-fit characteristics for the configural model confirmed a good fit to the data across groups. The measurement model also fit the data well, but significant differences were found for both the $\chi 2$ and the CFI difference tests, demonstrating that at least some of the measurement components of the model varied across the age groups. Factor loading constraints were tested individually and it was determined that *like-smoking* and FA difference scores were inconsistent across the groups. Correlations between these items and the other attitudinal measures were examined in each age group in an attempt to locate the source of the difference. Correlations between H-SCQ difference scores and both like-smoking and FA difference scores were a lot smaller for older adults (*r* = .22 and *r* = .21 respectively) than for adolescents (*r* = .59 and *r* = .44) or for younger adults (*r* = .44 and *r* = .40). A similar reduction in correlation size was found with age for the relationship between like-smoking and MN: adolescents (*r* = .53); young adults (*r* = .41); older adults (*r* = .35).

The structural model was also found to fit the data well, but again significant differences were found for both the $\chi 2$ and the CFI difference tests. Covariance constraints were tested individually and attitude-SN and attitude-risk covariances were found to vary across age groups. In relation to Model F, the goodness-of-fit characteristics for the configural model confirmed a good fit to the data across groups. The measurement model also fit the data well, although the same age-related inconsistency was found for the *like-smoking* and FA difference scores. The structural model fit the data well and it was found to be equivalent across groups.

Table 6.7 *Summary Goodness-of-fit Statistics for Tests of Multi-group Invariance across Participant Age Groups*

Model Description	χ^2	*df*	$\Delta\chi^2$	Δdf (*p*)	RMSEA	CFI	ΔCFI
Model E							
1. Configural Model	476.06	231			.032	.962	
2. Measurement Model	538.99	251	62.93	20*	.034	.955	.007
Remove attitude constraints	498.93	245	22.87	14 (ns)	.032	.960	.002
Replace for FA	516.20	247	40.14	16*	.033	.958	.004
Replace for H_SCQ	499.90	247	23.84	16 (ns)	.032	.961	.001
Replace for Like_Smoking	509.10	247	33.04	16*	.032	.959	.003
3. Structural Model	512.95	253	36.89	22*	.032	.959	.003
Remove attitude-SN	511.25	251	35.19	20*	.032	.959	.003
Remove attitude-Risk	510.57	251	34.51	20*	.032	.960	.002
Remove SN-Risk	506.00	251	29.94	20 (ns)	.032	.960	.002
Model F (Parsimonious)							
1. Configural Model	228.57	108			.033	.975	
2. Measurement Model	278.44	120	49.87	12*	.036	.967	.008
Remove attitude constraints	238.90	114	10.33	6 (ns)	.033	.974	.001
Replace for FA	255.39	116	26.82	8*	.035	.971	.004
Replace for H_SCQ	239.86	116	11.29	8 (ns)	.033	.974	.001
Replace for Like_Smoking	249.44	116	20.87	8*	.034	.972	.003
3. Structural Model	2443.14	118	14.57	10 (ns)	.032	.974	.001

Note. χ^2, chi-square goodness-of fit index; $\Delta\chi^2$, chi-square difference between models; Δdf, degrees of freedom difference between models; RMSEA, root-mean-square error of approximation; TLI, Tucker-Lewis index; CFI, comparative fit index; ΔCFI, CFI difference between models; *, $p < .05$; ns, not significant; Configural model, no equality constraints imposed; Measurement model, all factor loadings constrained equal; Structural model, all covariances constrained equal.

Standardised estimates for each age group are presented for Model E and Model F in Table 6.8. In both models, age groups had similar loadings for FA difference scores and like-smoking, but H-SCQ difference scores and moral norms had weaker loadings in the older adult group. Attitudes were also seen to have less influence on intentions and on PBC in this group. In Model E, best friend SN had a similar loading onto SN in each age group, but stronger loadings were found for friend, family, and social SN in the older adult group. The influence of SN on intention and on PBC was not significant in any age group with the exception of SN to PBC in the younger adult group. A similar influence was found for clear overestimation of peer smoking in all age groups, and similar loadings were found for both relative risk items onto the latent risk factor, but the influence of risk itself was stronger on both PBC and current smoking behaviour in the older adult group. No significant impact of group identity was found in any age group despite being significant in Models E and F when the full dataset was analysed. In each model, PBC had a stronger influence on intentions in older adults, but a weaker influence on current smoking behaviour. Intentions influenced current smoking behaviour to a similar extent across all age groups in Model E, but intentions had a reduced influence on current behaviour in Model F. This may be due to the removal of the SN variables from the more parsimonious model, although the path from SN to intentions remained non-significant.

Table 6.8 *Age-related Standardised Parameter estimates and Standard errors (SE) for Models E and F*

	Model E						Model F					
	Adolescents		Young Adults		Older Adults		Adolescents		Young Adults		Older Adults	
	Estimate	*SE*	Estimate	*SE*	Estimate	*SE*	Estimate	*SE*	Estimate	*SE*	Estimate	*SE*
Attitude to FA	.56***	0.35	.60***	1.00	.55***	2.26	.56***	0.33	.60***	0.87	.55***	2.17
Attitude to H-SCQ	.69***	0.15	.54***	0.28	.28**	0.50	.69***	0.13	.55***	0.13	.33***	0.13
Attitude to Like Smoking	.89***	0.16	.85***	0.38	.84***	0.93	.89***	0.14	.84***	0.30	.85***	0.87
Attitude to Moral Norms	.58***		.48***		.37***		.58***		.47***		.34	
Attitude to Intentions	.72***	1.83	.73***	4.19	.48***	6.51	.72***	1.67	.75***	3.69	.51***	6.41
Attitude to PBC	-.63***	0.12	-.51***	0.25	-.19	0.53	-.62***	0.11	-.51***	0.23	-.25	0.56
SN to Friend SN	.81***		.72***		.90***							
SN to Best Friend SN	.90***	0.06	.99***	0.12	.96***	0.06						
SN to Family SN	.52***	0.05	.43***	0.08	.67***	0.07						
SN to Society SN	.36***	0.05	.36***	0.07	.51***	0.07						
SN to Intentions	.02	0.26	.01	0.47	.01	0.49						
SN to PBC	.01	0.03	-.01*	0.04	-.13	0.05						
Clear Over to Intentions	.06**	0.99	.13***	1.21	.10*	1.42	.06***	0.98	.11**	1.23	.10*	1.54
Clear Over to PBC	-.04	0.10	-.10		-.11	0.13	-.04	0.10	-.08	0.11	-.10	0.13
Risk to RG Risk	.87***		.84***		.87***		.85***		.86***		.86***	
Risk to RS Risk	.72***	0.07	.87***	0.08	.81***	0.08	.73***	0.04	.85***	0.04	.82***	0.04
Risk to PBC	-.23***	0.01	-.29***	0.03	-.43**	0.04	-.23***	0.01	-.29***	0.03	-.42**	0.05
Risk to Smoking Status	.19***	0.02	.24***	0.02	.43***	0.05	.19***	0.02	.25***	0.02	.51***	0.04
Group Id to Intentions	.03	0.11	.06	0.20	.05	0.21	.03	0.11	.07	0.20	.04	0.24
PBC to Intentions	-.12**	0.62	-.07	1.02	-.30***	1.14	-.13**	0.61	-.06	1.01	-.28***	1.13
PBC to Smoking Status	-.21***	0.07	-.20***	0.08	.05	0.18	-.19***	0.07	-.22***	0.07	-.06	0.11
Intentions to Smoking Status	.69***	0.01	.71***	0.01	.70*	0.02	.71***	0.01	.67***	0.01	.45***	0.01

Note. N = 1011; *** p < .001; ** p < .01; * p < .05.

6.4 Discussion

The final aim of Study 3 was to develop an extended TPB model of smoking intentions and current smoking behaviour, and to examine the invariance of this model across adolescent, young adult, and older adult age groups. Constructs that had previously been suggested as possible TPB extensions in the literature, and the three cognitive biases found among smokers in the first part of this study, were considered as potential additions to the model. Results provide support for the ability of an extended TPB model to successfully predict smoking intentions and current smoking behaviour (Model E). As hypothesised, smoking expectancy positivity bias, DN measured as the clear overestimation of peer smoking norms, MN, group identity, and relative risk perceptions increased the predictive utility of Model E in comparison to the basic TPB model. The percentage of smoking intention variance explained by its predictors rose from 44.5% to 64.6%, while an increase from 57.1% to 58.1% was found for smoking status. The predictors of PBC in Model E were also capable of explaining 53.7% of the variance in this variable.

Contrary to expectations, AR, behavioural willingness, and optimistic smoking harm bias were not found to be effective additions to the model. However, results also suggested that a more parsimonious model, one that excluded SN (Model F), fit the data equally well, and it explained a similar percentage of the variance in the smoking intentions, PBC, and smoking status variables. Some age-related differences were found in the extended models. As expected, liking smoking and FA smoking expectancy difference scores differed across age groups in both models, although no other measurement differences were found. Age-related structural differences were found for the attitude-SN and attitude-risk covariances in Model E. No structural differences were found in Model F given the removal of the SN construct.

6.4.1 Extending TPB models of smoking behaviour

The baseline TPB model demonstrated a poor fit for the data in this sample. None of the SEM goodness-of-fit indicators approached acceptable values. The predictors of smoking intentions could only explain 44.5% of the variance in that construct, although smoking intentions and PBC were more successful in explaining the variance in current smoking status (57%). This supports the view that smoking intentions and behaviour are potentially influenced by a boarder range of smoking-related constructs than are captured by the original TPB model.

Support was found for the inclusion of additional attitudinal items in Model E. As hypothesised, smoking expectancy positivity bias - measured implicitly using the FA task and explicitly using the H-SCQ scale - emerged as a significant contributor to attitudes towards smoking. MN were also found to be more closely associated with attitudes than with other normative influences. A moral acceptance of smoking was associated with more positive attitudes towards smoking which supports the view that MN reflect an individual's disposition towards or against smoking (Manstead, 2000; Raats, et al., 1995). As expected, these extensions to the attitude component of the model increased prediction of intentions beyond that found in the basic TPB model (from 44.5% to 64%). They also directly influenced PBC. As a result, the more positive the attitudes held towards smoking, the more likely an individual was to develop intentions to smoke and the less PBC they were likely to feel. Basic TPB models tend to use simple attitude measures, similar to the single-item like-smoking measure used here, which only measure instrumental beliefs towards smoking (Conner & Armitage, 1998). It is likely that the combination of the multidimensional H-SCQ scale, the ability to freely generate expectancies in the FA task, and the MN item, facilitated the capturing of a wider range of beliefs, including those with more affective or moral components, each of which is important to the overall formation of attitudes. It is also possible that smokers' attitudes towards smoking have become more complex with the introduction of the smoking ban in Ireland, and the proliferation of negative smoking-related information encountered on a daily basis. Multi-dimensional measures of smoking attitudes are therefore essential in order to capture the potentially contradictory attitudes that individuals hold towards smoking at any time.

Contrary to expectations, SN did not emerge as a significant independent predictor of smoking intentions or PBC. This finding is inconsistent with the TPB itself (Ajzen, 1991), and with the assumption that salient SN exert a strong systematic influence on behaviour. It does, however, support many previous studies that found limited predictive ability for SN (Armitage & Conner, 2001; McMillan, et al., 2005; White, et al., 2009), which confirms the weakness of the SN construct and highlights the importance of considering a wider range of normative influences when modelling smoking intentions and behaviour. The inclusion of DN in Model E was supported, and as expected, clear overestimation of peer smoking prevalence was found to be independently associated with smoking intentions and with PBC, to a greater extent than basic peer prevalence estimates themselves. Those individuals who clearly overestimated peer norms were more likely to form intentions to smoke and to have lower levels of PBC, although it should be noted that while these relationships were significant, they were also small. This finding builds on previous work which has shown DN to be important predictors of drug use (Conner & McMillan, 1999; Grube, et al., 1986; Rivis & Sheeran, 2003), although while de Vries and Kok (1986) found a direct influence between DN and smoking behaviour, this was not the case in Model E.

The fact that DN, but not SN, predicted smoking intentions and PBC supports the view that social influence with regard to certain behaviours stems more from the attitudinal and behavioural characteristics of a psychologically relevant reference group than it does from the perceived approval or disapproval of other individuals (Ãstrom & Rise, 2001; Terry & Hogg, 1996). It had been hypothesised that group identity and self-identity would prove to be useful additions to the extended TPB model. As expected, group identity positively influenced smoking intentions, albeit that the relationship between the two was very small. Congruent with previous findings, medium-to-strong relationships were found between self-identity and liking smoking, behavioural willingness, relative risk, smoking intentions, PBC, and current behaviour (Charng, et al., 1988; Hertel & Mermelstein, 2012; McCusker, 2001). The more an individual identified with being a smoker, the more positive attitudes they held in relation to smoking, the higher their willingness and intentions to smoke, the more aware they were of their risk relative to similar others, and the lower their PBC. Yet contrary to expectations, self-identity did not improve the predictive ability of the model. Previous research found that it only accounted for an additional 1% of the variance in intention over the basic TPB components (Charng, et al., 1988), so given the extent of its relationships to other predictive variables in the model, it is possible that it did not exert enough independent influence on intentions to warrant inclusion here.

As hypothesised, support was found for the addition of risk perceptions to the extended model, but only in the case of RG and RS risk which was unexpected. These items formed a new latent relative risk factor in the model, which directly influenced PBC and also current smoking status. The addition of the risk items to the model brought the % of smoking status variance above that found in the baseline model. Although the increase was marginal (57% to 58.1%), the identification of risk as a significant predictor of both PBC and current smoking status has theoretical value. Interestingly, people who felt that they were more at risk than other individuals and other smokers their own age also felt that they had lower levels of PBC and were more likely to smoke. As discussed in Chapter 5, reporting high levels of relative risk supports the contention that smokers are aware of their own risk of smoking (Brady, et al., 2008; Slovic, 1998). These findings now challenge the idea that lower levels of perceived personal risk are predictive of increased smoking (Gerrard, et al., 2008); this challenge is further supported by the fact that smokers demonstrated an optimistic bias for immediate in comparison to general harm from smoking, and they were more likely to avoid thinking about the health risks associated with smoking, yet these items did not significantly improve the predictability of the model. Not only did the recognition of relative risk fail to act as a protective factor to smoking, it actually decreased PBC and increased the likelihood of smoking behaviour. Relative risk levels were positively associated with self-identity as a smoker, so individuals who see themselves as a smoker seem to feel powerless to change their behaviour despite an awareness of the risk to themselves from this behaviour. The association between self-identity and risk warrants further investigation, as does the fact that risk perceptions influence smoking behaviour directly and indirectly via PBC. They therefore represent a clear influence on behaviour that is not mediated by intentions.

In relation to other recommended TPB model extensions, neither AR nor behavioural willingness predicted smoking intentions or current smoking behaviour in this study. Medium-strength negative associations were found between AR and both intentions and behaviour, which suggests that it could act as a psychological deterrent against smoking. However, the lack of predictive ability for this construct only partially supports previous findings where AR was seen to be predictive of smoking initiation in adolescents, though not of actual smoking behaviour (Conner, et al., 2006). AR may tap into anticipated affective reactions to smoking, as suggested by Conner and Armitage (1998), but not to the extent that they significantly influence intention or current behaviour. Instead, AR may be more useful in models of smoking cessation (Moan & Rise, 2005) as it may predict intentions to quit smoking, or act as a protective factor against relapse. Similarly, despite strong relationships with attitudes, PBC, intentions, and current behaviour, behavioural willingness did not significantly increase model predictions. Contrary to previous arguments (Sutton, 1989; Warshaw & Davis, 1985), it may be that an individual's reporting of smoking intention incorporates their perceived likelihood of smoking or not smoking. It could also be argued that the need to separate behavioural willingness from intention is more important when looking at trying to resist a previously habitual behaviour, which again would make it a more suitable construct for models of smoking cessation.

Finally, consistent with the basic TPB model, both PBC and smoking intentions directly influenced smoking behaviour in Model E. Given that current smoking behaviour was included in the model, it is unsurprising that the largest influence on behaviour was via intentions. Both these and PBC were in turn most heavily influenced by attitudes to smoking. White and colleagues (2009) previously argued that attitudes and PBC were the primary determinants of intentions and, given the weaknesses of the SN construct, it could be completely removed from the model. These findings support this contention. Model E demonstrated that attitudes influenced both PBC and intentions and that SN failed to improve model predictions. SN was subsequently removed from Model F with almost no change to the ability of the model to predict intentions and behaviour in this group of participants. However, before concluding that SN cannot usefully be employed as a TPB construct when modelling smoking behaviour, it is important to consider whether the models perform equivalently well in each of the different age groups.

6.4.2 Efficacy of the extended TPB models in different age groups

The extended configural models fit the data well in each of the age groups, which indicates that the number of factors and the pattern of their structure were similar across adolescents and adults. Measurement differences were found in both models, however, and these related specifically to the like-smoking and FA difference score items. This suggests that these items are operating somewhat differently in their measurement of attitudes towards smoking in each age group. Nevertheless, age groups had very similar loadings for both parameters in each model, which suggests that the items demonstrate factorial invariance across the groups. There are several possible reasons for these inconsistencies in measurement invariance findings. It could be that the variation in responding relates to chance variation in the observed samples or to differences in sample size across the groups. It would therefore be important to replicate this analysis in a similar heterogeneous sample, but one that contains more equal group sizes. It is also possible that a higher degree of social desirability responding was evident in one of the groups. Adults, for example, have been shown to be more susceptible to socially desirable responding than adolescents (Welte & Russell, 1993) which may prevent them from expressing personally-held beliefs, although it is harder to understand why this bias would not also have been reflected in the H-SCQ scores. Issues with structural invariance were also found in Model E. These specifically rated to the degree to which attitude and SN, and attitude and risk, co-varied in each age group. In contrast, Model F was found to be structurally invariant across age groups. This suggests that the removal of SN from the extended model is particularly appropriate when examining smoking behaviour across different age groups.

Notwithstanding the partial measurement invariance found in the model, results demonstrated differences in the influence of some of the model parameters across age groups. As expected, smoking positivity bias had less influence on the smoking intentions of older adult smokers, but only when explicitly measured using the H-SCQ scale. MN also had less influence on attitude formation in this older age group, and attitudes themselves had less influence on intentions and on PBC than in both younger age groups. This is unsurprising given the earlier finding of this thesis that smoking-related positivity biases decline with age. It also supports similar findings in the literature (Leigh & Stacy, 2004; Leung & McCusker, 1999). In contrast, the influence of relative risk was much greater for older adults. It influenced PBC to a much greater extent than attitudes, and PBC exerted a stronger influence over attitudes than in other age groups. Moreover, the direct influence of relative risk on current smoking behaviour exceeded that of attitudes given that this influence was mediated by intentions. Despite having an understanding that they are at a greater risk relative to similar others, this knowledge reduces PBC and increases the likelihood of smoking in the older adult group. As discussed in the section above, the relationship between relative risk perception, PBC, and smoking behaviour warrants further research, particularly in terms of understanding how these perceptions influence older adult smoking. A clearer understanding of this unusual relationship may also help to explain why the robust relationship found between intentions and many health-related behaviours is weakened in addiction (Armitage & Conner, 2001; McCusker, 2001; McMillan & Conner, 2003; Sheeran, et al., 2002).

Contrary to expectations, the influence of clear overestimation of peer smoking was similar in each age group. Despite research that suggests that normative peer perceptions are especially influential on adolescents (Armitage & Conner, 2001; Flay, et al., 1994), the perceived behaviour of psychologically relevant groups would appear to influence intentions to a similar extent in all ages. Finally, no significant impact of group identity was found in any age group even though the impact of this item was significant when all participants were analysed together. This finding would support the removal of group identity from Model F in an attempt to further improve parsimony, although previous research suggests that this construct is related to the influence of perceived group norms (Ãstrom & Rise, 2001) so it would be preferable to replicate these analyses in a new sample before determining that group identity is not usefully employed in the extended model. Given the previous research finding that a strong commitment to a smoking group is associated with lower levels of quit intentions (Rise & Ommundsen, 2011), it may be that this construct is more suited to models of smoking cessation.

6.4.3 Limitations

This study has a number of strengths: the use of validated multi-dimensional measures for most of the TPB constructs; the addition of implicit as well as explicit measurement of smoking expectancies; perhaps most importantly the measurement of the relative strength of expectancies (FA and H-SCQ difference scores) which makes an allowance for the fact that individuals may simultaneously hold both positive and negative attitudes to smoking even in situations where their overall evaluation of smoking is negative (Lewis-Esquerre, et al., 2005; Rash & Copeland, 2008); the examination of age-related differences in smoking intentions and current smoking behaviour; and the use of SEM analyses which take error covariances and multiple indicators of the same construct into account in a way that regression analyses cannot. However, some methodological limitations should be taken into account in the interpretation of these results.

The cross-sectional nature of the study necessitated the modelling of smoking intentions and current smoking status, rather than the prediction of prospective behaviour which would have been possible with a longitudinal design. As a result, causal relationships cannot be inferred. For example, this study cannot explain whether the smoking attitudes, FCE effects, or relative risk perceptions are antecedents or consequences of an individual's current smoking status. Nevertheless, modelling current behaviour allowed the identification of the smoking-related factors that were most associated with current smoking status. This knowledge will assist in designing interventions for current smoking behaviour that take these additional smoking-related constructs into account. These interventions might specifically target attitudes, which would include positive smoking-expectancy bias and MN, FCE effects for peer smoking prevalence, and relative risk perceptions. Now that these influential constructs have been identified, it will be important for future research to examine these effects across time and to identify the causal relations between model variables.

Although self-report measures have been found to be reliable (Dolcini, Adler, & Ginsberg, 1996; Patrick et al., 1994), some socially desirable responding was possible. Smoking-related constructs were measured with previously validated items and good-to-excellent reliability was found for each. While this included the group identity variable, it was less reliable than the other constructs, which may have impacted its ability to influence intentions in the model. A final potential limitation is the unequal distribution of participant numbers across age and smoking status groups, as discussed in the previous chapter.

6.5 Conclusion

Although replication of these findings is undoubtedly required, they illustrate the value of extending TPB smoking models in an attempt to better understand smoking intentions and current smoking behaviour. They indicate clearly that attitudes and PBC exert more influence on smoking intentions and behaviour than do SN. They demonstrate that while normative influences can contribute to the model, MN does so via attitudes, and clear overestimation of peer norms is a better measure of normative group influence than the estimates of peer prevalence themselves. Finally, the study demonstrates the importance of understanding how the relationships between smoking constructs change with age and experience. This is a particularly relevant finding in terms of the influence of relative risk perceptions in an older adult group. These analyses should both further our understanding of the links between intentions and current smoking behaviour, and serve as a platform for further research into the suitability of the model for explaining prospective behaviour. Furthermore, these findings will inform prevention and treatment efficacy, as they demonstrate the need to consider how the factors related to smoking behaviour differ with age, and the practical implications of these differences with regard to smoking cessation and prevention programmes. This will be examined in more detail as part of the general discussion in the next chapter.

Chapter 7: General Discussion

The aim of this thesis was to examine the contribution of cognitive biases to the development and maintenance of tobacco smoking in adolescents and adults. Anomalies between self-reported smoking intentions and actual smoking behaviour are common, yet few studies investigate both the explicit and implicit measurement of smoking cognitions within the same sample. Concentrating on one measurement approach alone not only reduces our understanding of the cognitions that are related to addictive behaviour, but also limits the theoretical models that can be used to explain them. Furthermore, few studies consider implicit adolescent smoking cognitions, despite the knowledge that smoking onset typically occurs during this period.

The research presented in this thesis set out to address five specific questions: first, the extent to which smokers and non-smokers of different ages appreciate both the positive and negative consequences associated with smoking; second, how smokers and non-smokers of different ages manage negative smoking-related information and whether smokers cognitively avoid this information in some way; third, whether smokers overestimate peer prevalence rates of smoking and if this overestimation changes with age or smoking experience; fourth, whether smokers understand the risks involved when they decide to smoke, or if they exhibit optimistic risk biases for smoking-related health and addiction risks; and finally, whether an extended-TPB model incorporating measures of smoking-related cognitive biases could increase our understanding of smoking intentions and current smoking behaviour. This chapter will review the key findings from the three research studies presented in this thesis in terms of these five research questions (RQ). The theoretical and practical implications of these findings will be then discussed. Finally, methodological strengths and weaknesses will be addressed, along with suggestions for future research.

7.1 Summary of Empirical Findings

7.1.1 RQ1: Positive and Negative Smoking Expectancies

7.1.1.1 Positive expectancy bias. Study 1 revealed that although smokers of all ages explicitly endorsed a range of negative smoking expectancies, they gave more positive explicit evaluations of smoking than non-smokers. Adolescent smokers were found to be most positive about smoking while older adults were most negative. These findings confirmed earlier research that found consistent explicit positive memory biases for smoking-related information in smokers (Lewis-Esquerre, et al., 2005; Rash & Copeland, 2008). Study 3 replicated these findings in a larger and more heterogeneous group. Of particular interest was that although smoker and ex-smoker evaluations of smoking became more negative with age, this pattern was reversed in the experimental and never-smoker groups. The more detailed categorisation of smoking status in this study illustrated that younger experimental smokers were aware of the negative consequences of smoking, even when tempted to try smoking themselves. Both studies also found that positive, but not negative, smoking expectancies were significantly associated with nicotine dependence and cigarette use, which is consistent with the literature (Copeland, et al., 1995; Lewis-Esquerre, et al., 2005; Rash & Copeland, 2008; Schleicher, et al., 2008).

Study 1 also demonstrated that smokers of all ages were more positive about smoking than non-smokers when expectancies were implicitly measured. These findings are consistent with previous reports of a memory accessibility bias for positive smoking-related associations in smokers (C. B. Anderson, et al., 2002; Leung & McCusker, 1999). Most importantly, the size of the disparity between positive and negative implicit evaluations of smoking differed between smokers and non-smokers, suggesting that this relative expectancy measure could usefully be employed to predict smoking behaviour. Study 3 subsequently replicated this bias, but some differences were found between the overall implicit evaluations of smoking in the two studies. In contrast to previous research

(Leung & McCusker, 1999), a novel outcome of Study 1 was that adolescents and younger adults were shown to be net positive about smoking in the first half of the FA task. However, all groups in Study 3 gave an overall negative evaluation of smoking in the first half of the FA task, which supports Leung and McCusker's (1999) original results. The younger average age of Study 3 adolescents and young adult participants may have contributed to this (O'Connor, et al., 2007). These results can still be interpreted as a positive memory bias for smoking-related expectancies in smokers, as they could clearly be differentiated from non-smokers on the basis of their significantly less negative expectancy scores.

Differences were also found when explicit and implicit expectancy scores were compared. Study 1 smokers gave significantly more positive implicit than explicit evaluations of smoking, but the opposite pattern was found for daily smokers in Study 3. No differences were found between the two measurement approaches for weekly smokers. Two further novel findings emerged from Study 3. Firstly, adolescent never and experimental smokers gave more positive implicit, in comparison to explicit, evaluations of smoking. It is therefore possible that implicit smoking expectancy measures can provide an early indication of strengthening positive smoking associations, which could potentially be predictive of smoking initiation or escalation. Secondly, a unique relationship was found between implicit and explicit negative evaluations of smoking in older adult weekly smokers who commenced smoking at a young age. A strong positive correlation was found between the age smoking started and negative smoking expectancies generated implicitly, while explicit endorsement of negative smoking outcomes was strongly associated with nicotine dependence scores. Results from the two negative expectancy measures were also strongly related. Given that this group has been smoking for some time, this relationship suggests the possibility that highly accessible negative smoking expectancies act as a protective factor against escalation to daily smoking (Sherman, et al., 2003).

Finally, Study 1 demonstrated that the first half FA difference score was more successful in predicting self-reported current smoking status than the SCQ difference score alone, although the combination of the two measures was shown to be the most successful model. Both measurement approaches were also found to significantly contribute to the smoking behaviour models presented in Chapter 6. This suggests that each measurement approach is capable of explaining a unique portion of the smoking status variance.

7.1.1.2 Organisation of smoking expectancies. The development of a revised explicit smoking expectancy measure in Study 1, and its subsequent validation in Study 3, provided the opportunity to address the organisation of smoking expectancies in different age groups. Finding that an 8-factor H-SCQ model demonstrated the best fit for the data in both studies, and that this model was invariant across age groups, supports previous research that found evidence for larger factor models in adolescents (Lewis-Esquerre, et al., 2005) and in young adults (Schleicher, et al., 2008), and challenges research that promoted the use of less detailed factor structures in these age groups, on the basis that their smoking-related expectancies would be more global in nature (S. A. Brown, 1993; Copeland, et al., 2007). Alcohol research has found that the factor structure of outcome expectancy scales remained relatively stable across experience and age (Christiansen, et al., 1982; Wiers, et al., 2002), even though alcohol expectancies were shown to become more defined with increased use, and expectancy endorsement patterns varied across groups. As a result, this research recommends the use of the H-SCQ scale and a common factor structure when assessing smoking-expectancies across heterogeneous groups, although it would be inadvisable to conclude that the organisation of smoking expectancies is analogous across groups.

Consistent with previous research, a very clear pattern of results emerged from Studies 1 and 3 that demonstrate the ability of the H-SCQ to differentiate between smoking status groups (Copeland, et al., 1995; Lewis-Esquerre, et al., 2005; Rash &

Copeland, 2008). Smokers of all ages endorsed fewer smoking expectancies related to negative physical feelings, negative social impressions, and health risks than non-smokers, but they endorsed more outcomes associated with negative affect reduction, positive reinforcement, and in the case of adolescents, weight control. An interesting finding was that some of the perceived outcomes endorsed by non-smokers seemed unrelated to the expectancies that smokers had of their own behaviour. For example, non-smokers of all ages held a significantly higher expectation of social facilitation outcomes than smokers did themselves.

Each study found that as a person aged, they became more aware of the negative health and physical consequences of smoking, and the particularly high endorsement of these expectancies by older adult ex-smokers in Study 3 supports the view that they could be associated with cessation success in adult smokers (Copeland, et al., 1995; Wetter, et al., 1994). Age had a very different impact on the endorsement of negative social consequences; among smokers, older adults gave the highest ratings, whereas adolescents endorsed more negative social expectancies in the non-smoking group. Similar to the way non-smokers perceived social facilitation expectancies from smoking to a greater extent than smokers, older adult non-smokers held higher expectations that smoking would result in negative affect reduction than did smokers themselves, which could be interpreted as a perception held by older adults as to why people choose to smoke; in other words they see smoking primarily as a coping mechanism (Shiffman, et al., 1996).

7.1.2 RQ2: Management of smoking-related information

Study 2 demonstrated that, with the exception of adolescent non-smokers, all participants displayed a modified-Stroop attentional bias to smoking-related images, in comparison to neutral images. These findings confirmed earlier research that found smoking Stroop effects in both smokers and non-smokers (Domier, et al., 2007; Johnsen, et al., 1997). They only partially support the utility of the modified-Stroop task as a means of differentiating individuals by smoking status (Munafo, et al., 2003), since this distinction was only possible in the adolescent group. This general bias towards smoking information was seen only in the modified-Stroop task, which contrasts with previous studies that demonstrated an attentional bias to smoking-related information in smokers, relative to non-smokers, using a visual dot-probe task (Bradley, et al., 2004; Bradley, et al., 2003; Hogarth, Mogg, et al., 2003), and those that demonstrated that smoking status (Jarvik, et al., 1995) and alcohol use (Feldtkeller, et al., 2001; Hill & Paynter, 1992) influenced the speed of lexical decisions to substance-related words.

More specifically, Study 2 examined how a positive or negative depiction of smoking impacted cognitive processing in varied smoking status and age groups. Given the lack of consistent results across the three tasks, and the conflicting findings from previous research, it is difficult to reach any clear conclusions. Firstly, the study was unable to explain why a smoking Stroop effect was found in adolescent smokers, but not in adolescent non-smokers. Secondly, vigilance for general-negative words was observed for all participants on the LDT task. This vigilance was associated with general-negative dot-probe attentional bias in adolescents and older adults, but with modified-Stroop attentional bias scores to all but neutral images in younger adults. Thirdly, no support was found for the hyper-accessibility of smoking-positive words or the suppression of smoking-negative words in smokers until the smaller group of primed LDT participants were examined. Adolescents were found to inhibit smoking-negative words in comparison to general-negative. Smoking-positive words were also easily identified by adolescent smokers, but this accessibility was not seen in older smokers. The only attentional bias found to smoking-positive images was in adolescent non-smokers on the dot-probe task. Finally, no relationship was found between the self-report suppression measures in Study 1 and implicit cognitive reactions to negative information on any of the tasks in Study 2.

7.1.3 RQ3: False consensus effect for peer smoking prevalence

Study 3 examined perceived peer smoking prevalence in adolescent and adult smoking and non-smoking groups. Clear patterns of overestimation were found, and these were best predicted by having large numbers of friends who smoked, perceiving high levels of smoking in the work, college, or school group, participant age, and current smoking behaviour. It was found that the extent of the overestimation declined with age, but it generally increased with experience (i.e., if age is kept constant, increased experience leads to overestimation). These results are in line with previous reports of overestimation of peer smoking prevalence (Hoffman, et al., 2006; Otten, et al., 2009; Sutton & Bolling, 2003), and with research suggesting that the percentage of friends and the percentage of peers who smoke most influence the size of the FCE (Reid, et al., 2008; Unger & Rohrbach, 2002).

Finding that all adolescents clearly overestimated peer smoking prevalence, even those in the experimental and never-smoking groups, supports a selective exposure explanation of the FCE (Marks & Miller, 1987; Sherman, 1983; Sutton & Bolling, 2003), but this does not adequately account for the high levels of overestimation seen in older adult non-smokers. It was suggested that these adults were responding to their view as to the deviant nature of smoking and enhancing their own self-image by overestimating their distinctiveness relative to others of the same age (Sherman, 1983; Suls, et al., 1988; Sutton & Bolling, 2003). In fact, this motivational self-enhancement explanation of FCE can also account for the relatively higher peer prevalence estimates in adolescent smokers, relative to adolescent non-smokers. In this case, adolescent smokers may distort the consensus to support their smoking behaviour (Marks & Miller, 1987). It is interesting to note that these same non-smokers explicitly endorsed more social facilitation expectancies than did smokers themselves (see Chapter 4). The combination of a strong perception that individuals smoke for social reasons, and that more peers smoke than is actually the case, seems likely to influence smoking initiation in adolescents who feel motivated to conform to these social norms.

7.1.4 RQ4: Optimistic smoking-risk bias

Study 3 also examined optimistic risk biases in adolescent and adult smoking and non-smoking groups. Only daily smokers rated their own smoking-related health and addiction risk as higher than that of an average person and of a typical smoker their own age; all other groups displayed an optimistic relative risk bias, but an increasing awareness of risk was related to increased smoking experience. As a result, smokers were not deemed to be optimistic in assessing either their health-related smoking risk or the risk of addiction, which is in line with some (Slovic, 1998), but not all (Cohn, et al., 1995; Hansen & Malotte, 1986; Klein & Weinstein, 1997; Quadrel, et al., 1993; N. D. Weinstein, 2001) previous research. Both smokers and non-smokers also gave similar ratings for addiction-related H-SCQ expectancies, and small but significant relationships were found between addiction risk and both nicotine dependence and the age at which daily smoking commenced. It is therefore likely that those who are more dependent, and those who are older when they begin regular smoking, are more aware of and concerned about becoming addicted.

In contrast, smokers, and in particular adolescent smokers, were found to be optimistic in terms of perceived harm from smoking; while all groups perceived less immediate than general harm, the difference between the two was greatest in younger smokers. An increasing tendency to avoid health-related thoughts was also demonstrated with increased smoking experience, and by adolescents and young adults in comparison to older adults. These results are consistent with the view that context is important when assessing risk (Viscusi, 1992), and that adolescents hold a particularly optimistic view of the short-term harm from smoking (Cauffman & Steinberg, 2001; Gardner & Steinberg, 2005; Romer & Jamieson, 2001).

7.1.5 RQ5: Contribution of cognitive bias to smoking intentions and behaviour

Chapter 6 presented two extended-TPB models that incorporated relative smoking expectancy scores, overestimation of peer smoking prevalence, and optimistic relative risk bias. The first and larger model (Model E) was developed from the examination of all potential contributing variables. It demonstrated that the addition of smoking expectancy positivity bias, clear overestimation of peer smoking prevalence (descriptive norms), moral norms, group identity, and relative risk perceptions improved the explanatory power of the model in comparison to a basic TPB model. Anticipated regret, behavioural willingness, and an optimistic view of smoking harm were not found to be effective additions to the model. Furthermore, although subjective norms are typically included in a TPB framework, they were not found to significantly enhance the utility of the model in this case. Their exclusion resulted in the creation of a more parsimonious model (Model F) that demonstrated a correspondingly good fit to the data. These findings are compatible with previous studies that have also suggested that subjective norms have limited predictive ability (Armitage & Conner, 2001; McMillan, et al., 2005; White, et al., 2009), and those that recommend extending TPB models to include multi-item attitudinal measures (Conner & Armitage, 1998), moral norms (Manstead, 2000), descriptive norms (Grube, et al., 1986; McMillan & Conner, 2003; Rivis & Sheeran, 2003; Vries, et al., 1995), and group identity (Ãstrom & Rise, 2001; Rise & Ommundsen, 2011; Sussman, et al., 2007).

The examination of model invariance across age groups illustrated that the configuration of both models fit the data well in each case. Liking smoking and the implicit measurement of the relative balance of positive and negative smoking expectancies differed across age groups in both models. While this measurement difference suggests an age-related divergence in the way that these items are operating, similar loadings were found for both items in each group. No other measurement differences were found. Age-related structural differences in the covariances between attitudes and subjective norms, and between attitudes and risk, were also identified in Model E. These were resolved with the removal of the subjective norms in Model F, which suggests that this model is particularly appropriate for use when examining smoking behaviour across different age groups.

7.2 Theoretical Implications

As discussed in Chapter 1, incentive-sensitisation (Robinson & Berridge, 1993, 2001, 2003), cognitive processing (Tiffany, 1990), expectancy (Rather & Goldman, 1994), and associative memory (Collins & Loftus, 1975; Shiffrin & Schneider, 1977) models each propose that addictive behaviour is maintained by a combination of automatic and non-automatic processes, although they differ in the extent to which they describe the nature of the influence that each exerts on behaviour. As such, they can be considered as ‘special case’ dual-process models that attempt to explain addictive behaviour (Wiers, Gladwin, Hofmann, Salemink, & Ridderinkhof, 2013).

Different dual-process theories vary in their specifics, but each is based on the idea that there are at least two relatively independent processing systems: a fast associative ‘impulsive’ system based on automatic processes triggered in response to the emotional and motivational significance of drug-related stimuli, and a slower ‘reflective’ system containing more deliberative ‘control’ processes governed by an individual’s motivations and knowledge of long-term consequences (Fazio & Olsen, 2003; Slovic et al., 2004; Strack & Deutsch, 2004; Wilson, Lindsey, & Schooler, 2000). Contemporary models such as Deutsch and Strack’s (2006) Reflective-Impulsive Model (RIM) suggest that multiple processes are involved in both systems and that these interact to produce behaviour. While many of these models view explicit cognition as a control process which can override implicit impulses towards harmful behaviour, others such as the affect heuristic model (Slovic et al., 2004) suggest that automatic responses lead to cognitive biases that undermine rational decision-making. Although the balance between automatic and reflective processing varies across models, these systems can operate in parallel, so they can exert independent but additive effects on behaviour (McCusker, 2001). Each model describes a role for strengthened associative, impulsive, and relatively automatic processes which help to explain how pre-existing positive drug-related associations can bias cognitive processing and increase the likelihood of decisions that favour drug use.

The theoretical implications of the findings of this thesis will be considered for the dual-process models of addiction listed above, and also for the socio-cognitive theory of planned behaviour model (Ajzen, 1991) which, in this instance, acts as a framework in which to consider the integration of automatic and non-automatic influences on smoking behaviour in a population of diverse smoking status and age. The role of explicit and implicit measures in determining behaviour will then be considered in the context of this dual-processing approach.

7.2.1 Incentive-sensitisation and automatic cognitive processing models

Incentive-sensitisation (Robinson & Berridge, 1993, 2001) and automatic cognitive processing (Tiffany, 1990) models of addiction would suggest that attentional bias to smoking-related information should be observed in smokers but not in non-smokers. In Study 2, both smoking status groups, with the exception of adolescent non-smokers, displayed a modified-Stroop attentional bias to smoking-related images, relative to neutral images. This general bias was not found on the visual dot-probe task. These results are problematic for both theories.

The incentive-sensitisation model suggests that attentional bias is mediated by automatic, preconscious processes that arise as a result of continued drug use, from persisting neuroadaptations to motivation and reward centres in the brain (Robinson & Berridge, 1993). As a result, smokers would have been expected to exhibit an attentional bias towards smoking-related information on the dot-probe task. Smoking-positive and smoking-negative images were examined separately in this task, so if valence was a confounding factor this bias may not have been distinguishable in smoking/general image pairs. However, bias should have been observed in the smoking-positive/neutral and in the smoking-negative/neutral pairs. The observation of an attentional bias to smoking-related information in smokers on the modified-Stroop task would instead seem to support the automatic cognitive processing theory proposed by Tiffany (1990). In this model, the smoking cues would have triggered automatic action schema, and potentially other smoking-related associations in memory. However, being engaged in the modified-Stroop task meant that the smoker could not complete this automatic action plan, and Tiffany (1990) suggests that this impediment would have resulted in the activation of non-automatic processes in an attempt to control the urge to smoke, which produced attentional bias as they interfered with other non-automatic processes; in this case the colour-naming of the image border.

The ability to distinguish between adolescent smokers and controls on the modified-Stroop task would seem to provide support for both models, but this finding needs to be examined in light of the lack of distinction between adult smokers and non-smokers on the same task. Although the adolescent smokers displayed similar levels of nicotine dependence to both adult groups, they smoked significantly fewer cigarettes per day than older adult smokers, and they had been smoking for considerably less time than both other smoking groups. Given the central role for neuroadaptations in incentive-sensitisation theory, finding a distinction solely in the youngest smoking group is more problematic for this model. Furthermore, the lack of any relationship between dot-probe and modified-Stroop results suggests that they are not mediated by a common underlying mechanism, as indicated by the incentive-salience mechanism proposed by Robinson and Berridge (1993).

There still remains a need to explain the modified-Stroop attentional bias to smoking-related information found in adult non-smokers. Despite the suggestion that these findings may be driven by differences in the way that smokers and non-smokers respond to smoking-positive and to smoking-negative images (W. M. Cox, et al., 2006), Study 2 was unable to provide support for this hypothesis. It is possible that non-smokers have developed generalised smoking-related action schema, in response to a combination of positive and negative smoking-related information, that drive attentional bias irrespective of whether or not the smoking-cue itself is positive or negative. Further research would be required to examine this proposition in more detail. As a result, these models provide only a partial understanding of smoking-related addiction.

7.2.2 Expectancy and associative memory models

CSLT argues that an individual does not require direct experience of a particular behaviour to associate it with certain outcomes (Bandura, 1977; Petraitis, et al., 1995). The lack of strong correlations between explicit endorsement of positive smoking expectancies and either nicotine dependence or cigarette use in smokers, and the observation that smoking expectancies are similarly organised in individuals with diverse age ranges and smoking experience, supports the view that smoking-related associations can be developed and refined vicariously as well as with direct smoking experience. CSLT would also suggest that the balance of expectancies would be consistent for individuals across time, but this research instead supported the previous finding that smokers generate more of their positive associations earlier in a free association task than non-smokers (Leung & McCusker, 1999). Furthermore, not only did smokers display a positive memory bias for smoking-related associations, the relative nature of the measure implies that the size of the difference between positive and negative evaluations of smoking is theoretically important.

Associative memory models propose that as one node in memory is triggered, activation spreads across the network triggering other nodes representing related constructs in memory. The more practised the associations between nodes, the stronger the links become, the more likely they are to be triggered automatically (Shiffrin & Schneider, 1977), and the more accessible one becomes in the presence of the other. Automatically accessible associations are more likely to influence a particular cognitive processing sequence (Palfai, 2002), and to be closely linked to behaviour (Bargh, 1992). Given that expectancy networks can be conceptualised as associative memory systems (Collins & Loftus, 1975), the findings of this thesis provide clear support for the propositions made by associative memory models. In addition to finding positive smoking expectancy biases in smokers, the implicit measurement of this bias was found to predict more of the variation in current smoking behaviour than explicit expectancy measurement, although the most successful models found in Studies 1 and 3 were those that combined both measures. Social learning definitions typically see expectancy as an explicit construct (Bandura, 1977), so CSLT needs to be integrated with associative memory models in order to account for the independent influence that each measure of expectancy exerts on behaviour.

The research findings could not, however, determine whether this smoking expectancy positivity bias reflected the hyper-accessibility of positive smoking-related information in memory, or the automatic suppression of negative smoking-related associations. Both CSLT and associative memory theories would suggest that smokers would respond more quickly to positive smoking-related stimuli, in comparison to other stimulus categories, yet the only support for this hypothesis was the suppression of smoking-negative words by adolescent smokers on the ‘LDT-primed’ task (i.e., in the group that completed the LDT task after having completed both the modified-Stroop and the dot-probe tasks). It remains to be clarified whether these unexpected findings are the result of methodological limitations of Study 2, or deficiencies in the explanatory power of these models. Nevertheless, considering smoking-related addiction in the context of the combined explanatory power of automatic cognitive processing, CSLT, and associative memory models suggests that smoking stimuli do automatically grab attention is a way that compromises intentional behaviour. This automatic allocation of attention to smoking-related stimuli has the additional consequence of triggering automatic expectancies associated with these stimuli, which further increases the influence of implicit cognitive processes on behaviour, and essentially reduces the individual's explicit control over that behaviour.

7.2.3 Theory of planned behaviour models

CSLT and outcome-expectancy models (Marlatt, 1985) prescribe a key role for Bandura's (1977) concept of self-efficacy. This incorporates the perceived difficulty of the task, the persuasiveness of role models, and past experience with the behaviour. In contrast, TPB models can account for any number of behavioural influences, with the assumption that they are mediated through intentions and PBC. Although similar to self-efficacy, PBC incorporates a wider evaluation of behaviourally-relevant constructs, and the smoking-behaviour models developed in Study 3 demonstrate the influence that each has on PBC, as well as on smoking intentions. A persisting difficulty with TPB models of addictive behaviour, however, is that the relationship between intentions and behaviour is weaker than that found in other health-related models (McCusker, 2001). It has been suggested that addictive behaviour is less motivated than other health behaviours, and more likely to be triggered automatically (Conner & Armitage, 1998), and that there may be a more direct influence of addiction-related attitudes and norms (Harrison, et al., 1985).

Accepting that expectancies are essentially cognitive beliefs or attitudes (Collins & Loftus, 1975), this thesis supports the influence of implicit attitudes on smoking behaviour. Firstly, implicit measurement of smoking expectancies improved the prediction of current smoking behaviour more than explicit measurement alone. Secondly, smoking behaviour was best predicted by the combination of implicit and explicit expectancy measures, which confirms that smoking decisions are influenced by both automatic and non-automatic cognitions. Thirdly, the particular expectancy measures used in this research provided an index of the relative accessibility of positive and negative smoking expectancies which supports the view that an attitudinal positivity bias could facilitate decisions in favour of smoking (Conner & Armitage, 1998). Attitudes were not, however, found to directly influence current smoking behaviour in Study 3; their influence was mediated by both intentions and PBC. In contrast, relative smoking risk influenced behaviour both directly, and indirectly via PBC, and it therefore represented a clear influence on smoking behaviour that was not mediated by intentions.

Another important finding in Study 3 was that subjective norms did not emerge as a significant contributor to the model. This finding is inconsistent with Ajzen's (1991) description of the TPB model, which asserts that salient subjective norms exert a strong systematic influence on behaviour, but it does support previous accounts of their limited predictive ability (Armitage & Conner, 2001; McMillan, et al., 2005; White, et al., 2009). Instead, the model was significantly improved by the addition of moral and descriptive norms; the latter were measured as clear overestimation of peer smoking prevalence, which again demonstrates the importance of biased cognitive processes in smoking-related decisions. The addition of these norms confirms the theoretical importance of extending the TPB framework to incorporate a wider range of normative influences when modelling smoking intentions and behaviour. The results are also in keeping with the view that social influence with regard to certain behaviours stems more from the attitudinal and behavioural characteristics of a psychologically relevant reference group than it does from the perceived approval or disapproval of other individuals (Ãstrom & Rise, 2001; Terry & Hogg, 1996). Although descriptive norms had previously been found to have a direct influence on smoking behaviour (de Vries & Kok, 1986), this was not supported in this research.

Given the cross-sectional nature of these studies, current smoking behaviour was examined in this thesis and as a consequence, further research is required to establish that the theoretical implications of the research findings can be extended to prospective smoking behaviour. Nevertheless, the TPB model provides a framework suited to the investigation of the explicit and implicit influences on smoking behaviour. Extending the TPB framework to incorporate implicit cognitive measures, implicit and explicit measures of cognitive bias, and a broader range of norms, would allow the researcher to bring together the implicit and explicit aspects of each of each of the theories reviewed above in an attempt to provide a more holistic explanation for smoking behaviour, and one that could usefully be employed with diverse age and smoking groups.

7.2.4 Explicit and implicit measurement of cognition

Dual-process models suggest that behaviour is likely to involve a combination of automatic and controlled processing, yet they lack detailed explanations of why and when reflective control is exerted, and the form it takes; motivation, for example, is mentioned both in the reflective (motivation to control) and in the impulsive (appetitive motivation) systems. This suggests that at least two different forms of motivation exist (Wiers & Stacy, 2006) and it raises the need to be able to access and measure these forms appropriately. The models are consistent in regarding impulsive associative processing as fast, intuitive, and relatively effortless (Sloman, 1996). Associations are organised in memory by similarity, contiguity, and the degree to which they are retrieved together, rather than by logic, and they are automatically activated in the presence of drug-related cues which can bias simultaneous and subsequent searches for related information (Wiers & Stacy, 2006). Automatic associations can therefore be assumed to differ in speed, efficiency, and accessibility to those available with conscious introspection.

Yet, the explicit-implicit distinction inherent in dual-process models is problematic. In the dual-attitudes model proposed by Wilson and colleagues (2000), these terms refer to the attitudinal construct suggesting that both an explicit and an implicit attitude exist in memory. However, explicit measurement has not as yet confirmed that an explicit attitude is independently represented in memory (Fazio & Olson, 2003). It seems more appropriate, therefore, to regard the cognitive measure as explicit or implicit, rather than the construct itself. It is also important to recognise that an implicit measure not only reflects associations that an individual is unable to access through introspection, but also those which people may be unwilling to reveal on an explicit measure (Greenwald et al., 2002). As such, the explicit-implicit distinction does not solely reflect measurement of awareness and unawareness, and it has been suggested that the terms ‘direct’ and ‘indirect’ measurement would be more appropriate (Fazio & Olson, 2003), but these have yet to enter general use in the literature. A variety of implicit measures is available (see Fazio & Olson, 2003 for a review), but each needs to be validated in terms of its implicit nature (De Houwer, Custers, & De Clercq, 2006; De Houwer, Teige-Mocigemba, Spruyt, & Moors, 2009), which is difficult given the lack of consensus regarding this definition (Rooke et al., 2008). It is also important to question whether a relationship should be expected between different implicit measures of the same construct, and under what circumstances these would be expected to correlate with relevant explicit measures.

An FA task was chosen as the implicit measure of smoking expectancies in this thesis as it provides an open-ended evaluation of those first associations that are most highly linked in memory (Stacy et al., 2006; Stacy & Wiers, 2006), which in turn represents the associations most quickly accessed by the automatic impulsive system in the face of a smoking-decision (Leung & McCusker, 1999; McCusker 2001). When compared to a more traditional form of explicit measurement, results in this thesis revealed differences in explicit endorsement and implicit generation of smoking expectancies, and they suggested that each measurement was capable of explaining a unique portion of the variance associated with smoking behaviour. As an indirect measure such as the FA task is likely to contain both pre-conscious responses and information that may otherwise be subject to biased explicit reporting, it is important to understand the point at which measurement moves from implicit to explicit on this task. Previous research has used FA task durations such as 60 seconds (Anderson et al., 2002) and 90 seconds (Leung & McCusker, 1999), but it should be acknowledged that these studies do not specifically identify when the relatively fast retrieval of automatic associations shifts to slower and more deliberate searching. Furthermore, it is likely that this switch occurs at different times for different people indicating a need for individualised tools that can identify when FA word production slows and implies the use of more explicit cognitive processes. Continued investigation is required in order to better define and understand the interactions between the two systems inherent in dual-processing models, and the most appropriate way of measuring the cognitions associated with each.

7.3 Practical Implications

7.3.1 The case for combined explicit and implicit measures

The theory and research evidence presented in this thesis clearly support the likelihood that both explicit and implicit cognitive processes are implicated in smoking-related behaviour. A combination of explicit and implicit assessment techniques will therefore be required to properly understand smoking-related behaviour. Although explicit and implicit measurement of the same construct is likely to overlap, using one method alone (e.g., explicit assessment) will not necessarily capture details of the other form of cognition (e.g., implicit processes). This is demonstrated in Study 1 where implicit and explicit measurement assessed at least some different aspects of smoking expectancies. Implicit assessment was more successful than explicit in predicting the self-reported current smoking status of an individual, although the combination of the two was most successful, and each was capable of explaining a unique portion of the variance in current smoking behaviour.

There is some understanding of the degree to which different explicit assessments of the same construct overlap with each other (McCusker, 2001), but less is known about the extent of the overlap between implicit measures of the same construct. The lack of association between the implicit measures in Study 2 of this thesis is not uncommon, as many previous studies have found non-significant correlations between implicit tasks, in particular between Stroop and visual dot-probe tasks (Mogg & Bradley, 2002; Sherman, et al., 2003). This may just be a reflection of measurement error, but it is also likely to indicate that the different implicit tasks are measuring slightly different constructs. For example, the Stroop effect is generally inferred from the finding that an automatic response to one aspect of a stimulus interferes with the intentional and goal-directed processing of another aspect of that stimulus. As such, the Stroop effect is associated with early, pre-conscious, selective attention (W. M. Cox, Fadardi, & Pothos, 2006). In contrast, a visual dot-probe task measures the allocation of visual attention to pictorial scenes (Mogg & Bradley, 2002), that is the extent to which attention is automatically grabbed and maintained by an image. In this case attentional bias facilitates performance on the goal-directed task of locating the probe.

Although both measure attentional bias, the inhibitory interference effect on the modified-Stroop task may be indicative of an individual's preoccupation with smoking, or of their desire to smoke (Franken, Kroon, Wiers, et al., 2000; Zack, et al., 2001), whereas the facilitation effect seen on the visual dot-probe task addresses visuo-spatial orienting and reflects the degree to which individuals are prone to having their attention captured by smoking-related scenes (Mogg & Bradley, 2002). It would be important for future research to determine the precise aspects of selective attention that are measured by these two tasks; otherwise the influence of motivationally salient information on attention cannot be fully understood. Often constructs such as deprivation and smoking urge are manipulated in attentional bias studies, and it is possible that these procedures themselves are instrumental in eliciting attentional bias on different measures. It is therefore also necessary to establish which measure is more likely to provide a reliable indication of addiction-related attentional bias, and in which circumstances.

Clinical evaluation is typically based on explicit measurement alone, but this approach is unlikely to account for the more automatic smoking associations held by individuals. It would therefore be useful to test both explicit and implicit cognitions in diagnosis, treatment, and prevention of smoking-related addiction. Many of the implicit tasks used in research studies would be lengthy, tedious, and potentially subject to practise effects (Mogg & Bradley, 2002; Waters, Sayette, et al., 2003) if used as they are in a clinical setting. New clinically appropriate implicit measures will therefore be required, and research will be needed to establish the psychometric properties and ecological validity of these measures. There would also be merit in testing both implicit and explicit cognitions with existing interventions to determine which aspects of existing programmes successfully operate on both types of cognitive processing. The combination of implicit and explicit assessment is likely to result in more successful interventions, and ones that could be tailored to the specific needs of the individual, based on the degree of implicit and explicit influence on behaviour in their specific case.

7.3.2 Informing prevention and treatment programmes

The influence of the smoking-related cognitive biases themselves needs to be considered when designing and testing prevention and treatment programmes. In particular, these programmes need to consider those aspects of implicit cognition that might be indicative of an early indication of smoking tendencies, such as a bias towards positive smoking expectancies. Interventions not only need to acknowledge that these biases occur; they need to determine the most appropriate way to counteract their influence. Just as it is unreasonable to assume that explicit measures tell us something about implicit cognition, it would be equally wrong to presume that smoking behaviour can be influenced solely by focusing on the alteration of explicit smoking-related cognitions.

It is well established that motivation to change addictive behaviour strongly influences the behavioural change process itself and motivational interviewing is a technique often used to increase motivation to quit smoking and to help maintain abstinence (Wiers & Stacy, 2006). A recent review of the use of motivational interviewing in smoking interventions found that it could successfully deliver cessation, but with effect sizes lower than those achieved by individual counselling or group behaviour therapy (Lai, Cahill, Qin, & Tang, 2010). In contrast, Cognitive Behavioural Therapy (CBT) teaches the individual various techniques and strategies that can be used to reduce smoking, and in doing so, there is some evidence that it also strengthens aspects of executive control over smoking behaviour (Kiluk, Nich, Babuscio, & Carroll, 2010). Providing the smoker with skills that help override their dominant response to smoking-related decisions is certainly important for increasing treatment efficacy (Sofuoglu, DeVito, Waters, & Carroll, 2013), but this response is primarily driven by appetitive motivation, which can be triggered automatically and is therefore outside an individual's awareness. As a result, 'bottom-up' interventions that provide an alternate response to smoking in the face of smoking-related stimuli may be of value either alone, or in combination with existing interventions (Sofuoglu et al., 2013; Wiers et al., 2013).

One strategy would be to facilitate the encoding of new information that invalidates or redresses existing smoking-related memory associations, but there are a number of important considerations that must be taken into account to ensure that this information successfully hinders automatic processes. Firstly, programmes must acknowledge that positive smoking outcomes are experienced, and that these expectancies are highly accessible to smokers, and potentially to a subset of adolescent non- and experimental smokers who are at risk for smoking escalation. Given that memory is biased towards these positive expectancies, the associations between these concepts in memory are likely to be so strong that small amounts of exposure to preventative messages is unlikely to negate their influence. Secondly, new information aimed at inhibiting automatic processing must be encoded such that it can be triggered by the same cues that prompt the existing automatic processes (Stacy & Wiers, 2006). In other words, something from the intervention must be automatically activated in memory at the point where the smoking decision is made. Stacy and Wiers (2006) suggest that any memory from an intervention programme, not just those associated with negative smoking expectancies for example, can trigger prevention-focused processing.

As therapeutic interventions increase awareness of automatic processes and their accentuating factors, these processes will be hindered and eventually extinguished (McCusker, 2001). The accessibility of negative smoking-related associations is then more likely to increase, and more effortful abstinence strategies can successfully be employed. Evaluative conditioning, which is the pairing of an addiction-related stimulus with an evaluative positive or negative category, has achieved some success creating new and altering existing associations in alcohol-related research (Hofmann, De Houwer, Perugini, Baeyens, & Crombez, 2010; Houben, Havermans, Nederkoorn, & Jansen, 2012; Houben, Nederkoorn, Wiers, & Jansen, 2011). Given the influence between smoking-related associations and behaviour, it would be worthwhile to evaluate the effectiveness of this approach in that context.

Active avoidance of smoking-related cues has also been recommended as a potentially useful strategy for smokers attempting to quit and for ex-smokers attempting to remain abstinent (M. Field, et al., 2006; Waters, Shiffman, Sayette, et al., 2003), as it helps to avoid the triggering of the automatic processes that lead to smoking behaviour. Cognitive Bias Modification (CBM) techniques aim to change maladaptive cognitive biases while also attempting to increase executive control processes (Wiers et al., 2013).

Researchers are now beginning to look at interventions (Mathews & MacLeod, 2002) to determine if drug users can be trained to prevent their attention from being automatically grabbed by drug-related cues in an attempt to arrest the automatic processes that lead to addictive behaviour.

Some promising results have been found using modified visual dot-probe tasks for retraining attentional bias to alcohol (M. Field et al., 2007; M. Field & Eastwood, 2005; Schoenmakers et al., 2010) and to smoking stimuli (Attwood, O'Sullivan, Leonards, Mackintosh, & Munafò, 2008; M. Field, Duka, Tyler, & Schoenmakers, 2009), and Fadardi and Cox (2007; 2009) have designed the Alcohol Attention-Control Training programme based on the use of a pictorial Stroop task. It is interesting to note that the dot-probe tasks used to retrain attentional bias do so with shorter stimulus presentation durations (500 ms) despite the assertion that longer durations (2000 ms) are more successful at uncovering the existence of this bias (Bradley, et al., 2004). It may be that it is difficult to prevent automatic selective attention to smoking-related cues, but the training may prevent this attentional bias from strengthening and subsequently triggering other approach-oriented associations with smoking (Stacy & Wiers, 2006).

The long-term success rates of CBM are as yet unknown and further research is needed to determine the training approaches that work best with different biases, the persistence of change over time, the extent to which effects from one form of CBM (e.g., attentional retraining) may generalise to another bias (e.g., approach bias), and whether cognitive biases should be tackled separately, in combination, using CBT alone, or in conjunction with traditional proven interventions such as motivational interviewing or CBT (Wiers et al., 2013).

Recent research has also shown that mindfulness interventions can be effective treatments for substance use (Zgierska et al., 2009). It has been seen to reduce the influence of automatic affective responses on alcohol consumption (Ostafin & Marlatt,

2008) and difficulties disengaging from alcohol-related thoughts (Ostafin,Bauer, & Myxter, 2012), and it shows promise as an effective intervention for smoking (Bowen & Marlatt, 2009; Brewer et al., 2011; Elwafi, Witkiewitz, Mallik, & Brewer, 2012). As mindfulness is essentially a state of awareness of immediate experience and a non-judgemental acceptance of that experience (Ostafin & Marlatt, 2008), researchers have suggested that its success rests on the fact that it allows automatically generated cognitions to arise without an individual needing to act upon them, either as observed behaviour or by engaging in more reflective cognitive processing (Bowen & Marlatt, 2009; Brewer et al., 2011; Zgierska et al., 2009). There is also some evidence to support an increase in attentional control following mindfulness treatment (Chiesa & Serretti, 2013), although Waters and colleagues (2009) demonstrated that trait mindfulness was unrelated to an individual's ability to overcome Stroop attentional bias to smoking-related cues. Although many of these studies have been of a pilot nature, their findings suggest that further investigation of how mindfulness influences the implicit and explicit processes involved in addiction is warranted.

Finally, the clear overestimation of peer smoking prevalence by so many of the participant groups in Study 3 illustrates the importance of counteracting these biased perceptions in prevention and treatment programmes. Educating adolescents about the actual prevalence rates in their peer group has had some success (A. K. Brown, et al., 2010), but the persistence of this effect into adulthood suggests that similar mechanisms are required in all programmes to ensure realistic perceptions of peer smoking rates despite the potentially distorting influence of proximal social and environmental factors. Taken together, the findings of this thesis suggest that automatic cognitions influence smoking behaviour, so it is essential that these are modified to bring about changes in smoking behaviour. Prevention and intervention programmes therefore need to examine ways to change the smoking-related associations that individuals have available in memory, and also the strength of these associations, as this determines their automatic accessibility and the influence that they exert on cognitive evaluations of smoking-related constructs.

7.4 Methodological Considerations

7.4.1 Measuring smoking-risk biases

A comparative approach to risk measurement was taken in this thesis such that if an individual viewed their personal smoking risk as lower than an average person of the same sex and age, they were deemed to demonstrate an optimistic, or unrealistic, smoking-risk bias (Sutton & Bolling, 2003). Although unrealistic optimism is a widely recognised human phenomenon (N. D. Weinstein, 1987), and one that has been associated with smoking (Cohn, et al., 1995; Gerrard, et al., 1996; Hansen & Malotte, 1986; Klein & Weinstein, 1997; Quadrel, Fischhoff, & Davis, 1993; Sutton & Bolling, 2003), Harris and Hahn (2011) have suggested these findings reflect statistical artefacts rather than genuine cognitive bias. They argue that this is particularly the case when individuals evaluate their personal risk of relatively rare negative events using short response scales. When asked to estimate their chance of getting lung cancer, for example, it would be realistic for an individual to report a lower than average chance of personally experiencing that risk. In comparison to this majority response, the impact of an extreme rating from someone who is pessimisic about their chances of getting lung cancer is lost when an attenuated response scale is used. Even when assessing relatively common risk items, Otten and van der Pligt (1996) have demonstrated that individuals report higher levels of optimism on a 9-point scale than they do on a 201-point scale. Given that individuals also tend to overestimate the frequency of rare events, these issues can result in average risk assesements for a sample that appear to be overly optimistic (Harris & Hahn, 2011).

The results of this thesis suggest that smokers are neither optimistic about their health-related smoking risk, nor about their risk of addiction, and the optimistic relative risk bias displayed by the various non-smoking groups could be argued to be a ‘realistic’ assessment of their chances of encountering these risk items, which is in line with Harris and Hahn's interpretations. While smokers, and in particular adolescent smokers, were also found to be optimistic in terms of perceived harm from smoking, the more interesting finding was that all groups perceived less immediate than general harm, and the difference between the two estimates was greatest in younger smokers. This clearly demonstrates the importance of understanding whether the participant is in fact judging the short- or the long-term risk of smoking, regardless of the particular response method used. Finally, it should be noted that many researchers continue to support the existence of an optimistic risk bias (Shepperd, Klein, Waters, & Weinstein, 2013) and their efforts are now focused on developing measures that avoid the statistical limitations described above; for example, Sharot and colleagues (2012) examined the impact of L-DOPA on belief change and consistent with Incentive-sensitisation theory (Robinson & Berridge, 1993, 2001), they found that negative events were consistently underestimated as a result of selective belief updating. As well as supporting the view that smokers have an ability to inhibit the processing of negative smoking-related information in some way, it also helps to explain the unrealistic risk estimates given by this group in many studies, and supports the continued investigation of this phenomenon.

7.4.2 Assessment of SEM model fit

This thesis presented the chi-square goodness-of-fit statistic (χ^2), and the CFI, TLI, NFI, and RMSEA indices with each SEM analysis. SMC were also recorded for the smoking intent and smoking status variables in the extended-TPB models presented in Chapter 6. Although consistency across multiple indices has been suggested to be most indicative of model fit (Bentler & Bonett, 1980; Hu & Bentler, 1999; Mulaik et al., 1989), there continues to be intense debate regarding the precise indices and attendant cut-off points that should be used (Hu & Bentler, 1999), and even a call for the use of such fit indices to be completely eradicated in favour of sole reliance on the χ^2 statistic (Barrett, 2007).

Comparative fit indices such as the CFI were created specifically to resolve issues arising from the use of the χ^2 statistic; for example, difficulties distinguishing between poor- and well-fitting models due to reduced power with small sample sizes (Hu and Bentler, 1999), and the incorrect rejection of well-specified models when large samples are used (Bentler & Bonnett, 1980), or when the data deviates from multivariate normality (McIntosh, 2007). However, Barrett (2007) presents evidence that argues against the use of single-value thresholds for fit indices and demonstrates they can sometimes lead to situations where models were inaccurately shown to have adequate fit while at other times they result in the rejection of adequate models. He also argues that these thresholds have become a 'test of fit' rather than an indication of the level of misspecification in the model and that once passed, researchers can ignore unfavourable χ^2 results and fail to complete accurate model specification.

Although many researchers agree with Barrett's fundamental points that an unfavourable χ^2 test cannot be ignored, and that researchers should not treat index thresholds as 'golden rules' (Millsap, 2007), they suggest that he takes a very extreme position and that fit indices remain useful as relative measures of model fit (Markland, 2007). For example, Miles and Shevlin (2007) demonstrate that changes in the reliability of scale items in a CFA can influence the accuracy of model-fit decisions made solely on the basis of the χ^2 test, Steiger (2007) recommends the use of confidence intervals with fit indices so that poor fit can more easily be determined, Millsap (2007) suggests that researchers provide *a priori* levels of acceptable model fit pertinent to their specific study, and McIntosh (2007) advises researchers to conduct a detailed diagnosis of model misspecification when this is suggested by any of the methods used to assess model fit.

The current weight of opinion would therefore propose that reliance on a single indicator of model fit, whether that is the χ^2 statistic or any other measure, is ill-advised, and that model-fit indices can complement the χ^2 test providing that the limitations of each is understood (Mulaik, 2007). Markland (2007) suggests that as the most stringent criteria currently available, researchers should adopt the criteria suggested by Hu and Bentler (1999), and this was the position taken in this thesis. In addition, the results of each χ^2 test were reported here, along with the associated degrees of freedom and *p* value, as currently recommended in the literature (Barrett, 2007; Hayduk, Cummings, Boadu, Pazderka-Robinson, & Boulianne, 2007; Millsap, 2007). The result of each indicator was considered in each analysis and index thresholds are clearly exceeded indicating a pattern of adequate acceptance rather than reliance on a single value.

Another area of debate regarding the assessment of SEM model fit is the use of modification indices (MI). Some researchers argue against their use and suggest that they are masking a model misspecification that needs to be specifically diagnosed (Gerbing & Anderson, 1984). Others recommend that researchers explore the correlation of error terms in SEM models, particularly when modelling survey data, as socially desirable responding to one item increases the likelihood of similar responding to others, albeit that correlating within-factor error is easier to justify than correlating errors across variables (Bagozzi & Yi, 2012). The combined use of MIs and information on the power of the MI test has also been suggested as a valid approach to testing model misspecifications (Saris, Satorra, & van der Veld, 2009). Within this context, it is still essential that all modifications make theoretical sense; they should not be carried out solely on the basis of a large MI value in SEM software output. Tomarken and Waller (2003) additionally recommend a second iteration of model development that allows for the removal of parameters that are no longer necessary to maintain model fit.

It should also be noted that amending models based on MIs shifts the modelling process from a confirmatory to an exploratory one. As a result, the chances of making a Type I error increase and the generalizability of the model to other samples decreases (Tomarken & Waller, 2003). Although such modifications can be instructive in terms of evaluating competing theoretical models (Kline, 2010), MacCallum and colleagues (1992) counsel that it is unwise to modify a model that initially demonstrates adequate fit, in the hope of achieving even better fit as the results may simply illustrate the specific characteristics of that particular sample. Ullman (2001) also suggests that model modifications are like eating salted peanuts: “One is never enough” (p. 750). It there therefore important that researchers identify a small *a priori* set of theoretically-driven modifications that are likely to have been tested as plausible models anyway (Tomarken & Waller, 2003). This approach was followed in Chapter 6 when determining the best location for MN and risk measures in Model E, and the subsequent removal of subjective norms in Model F to improve parsimony. These models demonstrated good fit across age groups and sample size was relatively large (N = 1011), which suggests that the models are reasonably robust, but it must be acknowledged that the exploratory nature of this process may limit its generalizability to other samples. It therefore important that these findings are replicated in future research.

7.5 Strengths and limitations of this research

The research undertaken as part of this thesis has several strengths. The first, and perhaps the most important, is the heterogeneous nature of the sample. Participants were drawn from a wide age range and they represented a variety of different categories of smoking status. The benefit of examining different age and smoking-status groups together is that it allows both age- and experience-related differences in the factors associated with smoking behaviour to be analysed together, while also identifying their separate influence. This in turn is important, as although age and smoking experience are undoubtedly related, age should not be considered as a proxy for experience. For example, the examination of H-SCQ factor scores in Chapter 4 revealed that positive smoking expectancies were influenced by smoking experience more than by age. By contrast, a unique relationship was found between older adult weekly smokers who commenced smoking at a young age, and their stronger explicit endorsement of negative smoking-related expectancies. The replication of Study 1 findings using a larger and more diverse set of participants in Study 3 also highlighted differences between daily and weekly smokers, experimental and regular smokers, and demonstrated that ex-smokers variously resembled smokers and non-smokers depending upon the particular construct that was analysed.

Additional strengths stem from the use of such diverse samples. As discussed in Chapters 2 and 4, more and more studies are investigating smoking measures in increasingly narrowly defined populations, which results in the development of evermore specific measurement items. While there are benefits to gaining a fine-grained understanding of the nuances of behaviour in these restricted samples, it remains important that research continues to look at behaviour across age-groups in an attempt to identify potential third variable influences that are developmental in nature and can subsequently be examined in longitudinal analyses. Measures are therefore required for use in heterogeneous populations. To the best of the author's knowledge Studies 1 and 3 represent the first examination of the SCQ scale in a diverse smoking status and age group, and their findings indicate that the H-SCQ is appropriate for use in such a sample. The replication of Study 1 findings using a larger and more diverse set of participants in Study 3 also highlighted differences between daily and weekly smokers, experimental and regular smokers, and demonstrated that ex-smokers variously resembled smokers and non-smokers based on the particular construct that was analysed.

Furthermore, as outlined in Chapter 2, the suitability of various nicotine dependence measures in different populations continues to be debated. Despite widespread use with smokers of different ages and experience levels (Nonnemaker & Homsi, 2007; Piper, et al., 2006), the use of the FTND (Heatherton, et al., 1991) in adolescent groups is still questioned (Carpenter, et al., 2010; Colby, et al., 2000; K. C. Wheeler, et al., 2004). Another strength of this research was that Study 1 demonstrated that the FTND was an appropriate measure for use in cross-age studies among diverse smoking populations. This is significant as the FTND is a short and very practical measure, and its use allows new research findings to be compared with those from a significant volume of pre-existing studies that have also used this measure.

Other key strengths included: the measurement of the relative strength of positive and negative smoking expectancies; the use of previously validated smoking and general images in the implicit attentional bias tasks in Study 2; the use of previously validated multi-dimensional measures for recommended TPB constructs in Study 3; and the use of SEM in developing the extended-TPB model. SEM is ideally suited to examining phenomena where many of the underlying constructs are themselves related, and where each may be measured by a variety of indicators such as those used in the smoking survey in Study 3 (Byrne, 2009). SEM also has the ability to take measurement error, missing data, outliers, the combination of different data types, non-normally distributed variables, and heterogeneous samples into account so that complex models, with multiple mediating variables and both indirect and direct effects, can be assessed simultaneously. Furthermore, it allows observed and latent variables to be examined separately, which helps the researcher to isolate the influence of the latent factors from the relationships between the items that make up those factors.

Some methodological limitations should be taken into account in the interpretation of these thesis findings. Specific limitations of each of the studies have been described in the chapters pertaining to those studies. Nevertheless, there are some general methodological issues that should be considered in the evaluation of their findings. Overall sample sizes were adequate in Study 1 and moderately large in Study 3, but the relative sample size of the groups within each study varied considerably. In Study 1, for example, the non-smoking adolescent group was up to three times the size of each of the other groups. Study 3 had substantially more adolescent never-smokers than smokers, low numbers of weekly smokers, and relatively low volumes of adolescent and young adult ex-smokers. It is possible that the unequal distribution of participants across age and smoking status groups may have influenced the results found, yet the overall pattern of smoking expectancy findings were similar across the two studies. Furthermore, the H-SCQ model and the two extended-TPB models performed well in each group. Gender was also unbalanced across the groups, so although few gender differences were found in these studies, it would be prudent to repeat this research in more gender-balanced groups.

Overall sample size is likely to have had more of an impact in Study 2, and the *a posteriori* analyses of the LDT-primed group are likely to have been underpowered. Nevertheless, the different pattern of results found in the LDT-primed analysis, relative to that found in the unprimed task, warrants further investigation in a larger group. Moreover, the results highlighted the importance of reconsidering the nature of the LDT task used in this research. The objective had been to try to increase the ecological validity of the task by allowing the fact that the individual was taking part in a smoking-related study to trigger, or to prime, the concept of smoking in their memory. While this does not appear to have had any influence on lexical decision speed, completing the LDT task following two other implicit tasks that included positive and negative smoking-related images does seem to have had some effect. These results require further exploration and it would also be interesting to compare them with a LDT that primes the trials themselves. This latter task would be similar to that used in the alcohol-related research discussed in Chapter 3, albeit that these triggers are more contrived than is likely outside a laboratory situation.

An important limitation that may have affected results is the use of self-report measures. Data pertaining to explicit smoking expectancies, smoking behaviour, and the survey items in Study 3 were all collected in this way. Although self-report measures are widely used, and they have generally been found to be reliable (Dolcini, et al., 1996; Patrick, et al., 1994), it is possible that social desirability may have led to biased responding. In an attempt to reduce this bias, it was clearly explained to all participants that data was being collected anonymously. They could also see that there was no link between their responses and any identifying information. Although adolescents were tested in school or youth-group premises, teaching staff were not involved in the administration of the tasks in any way. The students also placed all pen-and-paper responses in a sealed envelope which, they were assured, would only be opened on its return to Trinity College. From the perspective of adult participants, the use of an online survey in Study 3 should also have helped to reduce this bias as it has been shown that self-disclosure typically increases, and social desirability decreases, in online studies (Booth-Kewley, Larson, & Miyoshi, 2007; Dwight & Feigelson, 2000; Joinson, 1999). These measures should have helped to minimise socially desirable responding, but its presence cannot be totally ruled out.

Another important limitation is the cross-sectional nature of this research. Although potential antecedents of smoking behaviour can be suggested by the findings of this thesis, causation cannot be inferred. For example, this study cannot explain whether the smoking attitudes, FCE effects, or relative risk perceptions are antecedents or consequences of an individual's current smoking status. Prediction of prospective smoking behaviour will only be possible if the extended-TPB models are used in conjunction with a longitudinal analysis of smoking behaviour. Finally, smokers' dependence scores are consistent across the studies which facilitated comparison of findings between the samples, but they were quite low which potentially limits the generalisability of the results to more heavily dependent groups. It is possible that smokers with higher levels of nicotine dependence may differ in the balance between the implicit and explicit influences on their smoking behaviour.

7.6 Recommendations for future research

A number of theoretical and methodological issues have been identified as a result of these studies that require further research. Firstly, it remains unclear whether it is age or experience alone, or some combination of the two, which drives the changes seen in the relative balance of positive and negative smoking expectancies across the groups. For example, it may be that dependence influences the rate at which expectancies become more negative with age, or it could be that age and dependence independently produce changes to smoking-related cognitions. It would be important for future studies to consider how differing levels of cigarette use and nicotine dependence influence the explicit endorsement and implicit generation of smoking expectancies. It would also be of benefit for longitudinal research to track the development and change of these smoking-related associations over time. If it were possible to identify the key factors underlying this shift in smoking expectancies, these elements could be incorporated into age- or experience-appropriate smoking prevention and treatment programmes.

The Study 2 findings suggest that it would be constructive to continue to examine smoking status and age-related implicit cognitive reactions to the positive and negative affective properties of smoking-related cues. In particular, it would be important to replicate and explain the difference in the modified-Stroop results found in the adolescent group, relative to both adult groups. It would also be valuable to determine why the visual dot-probe task found an attentional bias to smoking-positive images in adolescent non-smokers, yet no Stroop effect was found for this image category. If this positivity bias can be reliably replicated, it may form the basis of identifying those adolescents who are most at risk for smoking initiation. This study would also suggest a more thorough investigation of the affective properties of smoking-related words, an examination of the influence of priming on the LDT task, and further investigation of the precise nature of the attentional processes measured by the modified-Stroop task and the visual dot-probe task at different durations of stimulus presentation.

Although the utility of the H-SCQ measure was demonstrated across two participant groups in Studies 1 and 3, it would be important to validate this measure in groups with varied levels of nicotine dependence. There is also a need to establish more robust psychometric properties for the health risk and the addiction risk subscales in this measure. In addition, it appeared that the combination of the ease with which an individual quit smoking and the length of time since cessation, influenced the smoking expectancies held by ex-smokers in Study 3. As the number of ex-smokers was limited in that sample, it would be instructive to examine expectancies within this group in more detail. The results may illustrate associations that smokers have with quitting that could undermine cessation attempts.

Finally, having identified smoking-related constructs that can be used within a TPB framework to improve explanation of smoking intentions and current smoking behaviour, future research is required to examine the effects of these constructs on prospective behaviour. This will allow causal relationships between the model variables to be established. Despite the fact that self-identity as a smoker did not significantly improve either model, the positive association found between self-identity and relative risk warrants further investigation from a theoretical perspective, particularly in terms of understanding how these perceptions influence older adult smoking; as does the finding that risk perceptions influence smoking behaviour both directly and indirectly through their influence on perceived behavioural control. They therefore represent a clear influence on current smoking behaviour that is not mediated by current smoking intentions, which may help explain the weaker intention-behaviour relationship found in many addiction studies.

7.7 Conclusion

The aim of this thesis was to examine the role that cognitive biases play in the development and maintenance of smoking-related addiction. These research studies have demonstrated the influence that implicit memory associations, automatic attentional bias, a false consensus effect for peer smoking prevalence, and relative risk bias have on smoking intentions and current smoking behaviour. In doing so, they illustrate the importance of investigating implicit processes in an attempt to understand the spontaneous nature of much smoking-related behaviour, and they establish the need to jointly consider smoking status and age when examining this behaviour. Utilising implicit measures of smoking-related constructs in combined adult and adolescent samples is rare, so the results of this thesis both add to our knowledge of cognitive bias within the field of smoking-related addiction, and also specifically extend the limited amount of information available on how these biases change with age.

Worldwide smoking rates remain high. By the year 2020, direct and indirect exposure to smoking is expected to account for 10% of worldwide deaths (WHO, 2011). The economic costs of smoking are €100 billion in the EU region alone (European Commission, 2012), while the social costs to family, friends, and wider communities are extensive. Given the automatic nature of at least some of the processes known to be involved in smoking, and the inherent difficulties trying to change these processes, analysing the implicit and explicit cognitive factors associated with smoking in a combined theoretical framework may help to predict initiation and relapse, and to provide new insights into the prevention, and treatment of smoking-related addiction. Although initially focusing on smoking behaviour, these research findings could potentially generalise to other addictions and to other risky behaviours commonly initiated in adolescence.

References

Abramowitz, J. S., Whiteside, S., Kalsy, S. A., & Tolin, D. F. (2003). Thought control strategies in obsessive-compulsive disorder: a replication and extension. *Behaviour Research and Therapy, 41*(5), 529-540. doi: 10.1016/s0005-7967(02)00026-8

Ajzen, I. (1988). *Attitudes, personality, and behavior*. Homewood, IL US: Dorsey Press.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211. doi: 10.1016/0749-5978(91)90020-t

Albery, I., & Munafò, M. (2008). *Key concepts in health psychology*: Sage Publications Limited.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th revised ed.). Washington, DC: Author.

American Psychiatric Association. (2012). DSM-5 Facts Retrieved 19/04/2013, from http://dsmfacts.org/issue-accuracy/apa-corrects-new-york-times-article-on-changes-to-dsm-5s-substance-use-disorders/

Anderson, C. B., Pollak, K. I., & Wetter, D. W. (2002). Relations between self-generated positive and negative expected smoking outcomes and smoking behavior: An exploratory study among adolescents. *Psychology of Addictive Behaviors, 16*(3), 196-204. doi: 10.1037/0893-164X.16.3.196

Anderson, J. R. (1983). A spreading activation theory of memory. *Journal of Verbal Learning & Verbal Behavior, 22*(3), 261-295. doi: 10.1016/s0022-5371(83)90201-3

Anthony, J. C., & Petronis, K. R. (1995). Early-onset drug use and risk of later drug problems. *Drug and Alcohol Dependence, 40*(1), 9-15. doi: 10.1016/0376-8716(95)01194-3

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology, 40*(4), 471-499. doi: 10.1348/014466601164939

Arnett, J. J. (1999). Adolescent storm and stress, reconsidered. *American Psychologist, 54*(5), 317. doi: 10.1037/0003-066X.54.5.317

Arnett, J. J. (2000). Optimistic bias in adolescent and adult smokers and nonsmokers. *Addictive Behaviors, 25*(4), 625-632. doi: 10.1016/S0306-4603(99)00072-6

Ãstrom, A. N., & Rise, J. (2001). Young adults' intention to eat healthy food: Extending the theory of planned behaviour. *Psychology & Health, 16*(2), 223-237. doi: 10.1080/08870440108405501

Attwood, A. S., O'Sullivan, H., Leonards, U., Mackintosh, B., & Munafò, M. R. (2008). Attentional bias training and cue reactivity in cigarette smokers. *Addiction, 103*(11), 1875-1882. doi: 10.1111/j.1360-0443.2008.02335.x

Austin, J. L., & Smith, J. E. (2008). Drinking for negative reinforcement: The semantic priming of alcohol concepts. *Addictive Behaviors, 33*(12), 1572-1580. doi: 10.1016/j.addbeh.2008.07.016

Baddeley, A. D. (1990). *Human memory: Theory and practice*. Needham Heights, MA US: Allyn & Bacon.

Bagozzi, R. P., & Yi, Y. (2012). Specification, evaluation, and interpretation of structural equation models. *Journal of the Academy of Marketing Science*, *40*(1), 8-34. doi: 10.1007/s11747-011-0278-x

Baker, T. B., Brandon, T. H., & Chassin, L. (2004). Motivational influences on cigarette smoking. *Annual Review of Psychology, 55,* 463-491. doi: 10.1146/annurev.psych.55.090902.142054

Baker, T. B., Morse, E., & Sherman, J. E. (1986). The motivation to use drugs: A psychobiological analysis of urges. *Nebraska Symposium on Motivation, 34*, 257-323.

Baker, T. B., Piper, M. E., McCarthy, D. E., Majeskie, M. R., & Fiore, M. C. (2004). Addiction Motivation Reformulated: An Affective Processing Model of Negative Reinforcement. *Psychological Review*, *111*(1), 33-51. doi: 10.1037/0033-295X.111.1.33

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, *84*(2), 191-215. doi: 10.1037/0033-295X.84.2.191

Bargh, J. A. (1992). The ecology of automaticity: Toward establishing the conditions needed to produce automatic processing effects. *American Journal of Psychology, 105*(2), 181-199. doi: 10.2307/1423027

Bargh, J. A., & Chartrand, T. L. (1999). The unbearable automaticity of being. *American Psychologist, 54*(7), 462-479. doi: 10.1037/0003-066X.54.7.462

Barnier, A. J., Levin, K., & Maher, A. (2004). Suppressing thoughts of past events: Are repressive copers good suppressors? *Cognition and Emotion*, *18*(4), 513-531. doi: 10.1080/02699930341000428

Barrett, P. (2007). Structural equation modelling: Adjudging model fit. *Personality and Individual Differences, 42*(5), 815-824. doi: 10.1016/j.paid.2006.09.018

Bartholow, B. D., & Heinz, A. (2006). Alcohol and Aggression Without Consumption: Alcohol Cues, Aggressive Thoughts, and Hostile Perception Bias. *Psychological Science, 17*(1), 30-37. doi: 10.1111/j.1467-9280.2005.01661.x

Bauer, D., & Cox, W. M. (1998). Alcohol-related words are distracting to both alcohol abusers and non-abusers in the Stroop colour-naming task. *Addiction, 93*(10), 1539-1542. doi: 10.1046/j.1360-0443.1998.9310153910.x

Bauman, K. E., Fisher, L. A., Bryan, E. S., & Chenoweth, R. L. (1984). Antecedents, subjective expected utility, and behavior: A panel study of adolescent cigarette smoking. *Addictive Behaviors, 9*(2), 121-136. doi: 10.1016/0306-4603(84)90050-9

Baxter, B. W., & Hinson, R. E. (2001). Is smoking automatic? Demands of smoking behavior on attentional resources. *Journal of Abnormal Psychology, 110*(1), 59-66. doi: 10.1037/0021-843X.110.1.59

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin, 88*(3), 588. doi: 10.1037/0033-2909.88.3.588

Bentler, P. M., & Speckart, G. (1981). Attitudes 'cause' behaviors: A structural equation analysis. *Journal of Personality and Social Psychology, 40*(2), 226-238. doi: 10.1037/0022-3514.40.2.226

Berridge, K., & Winkielman, P. (2003). What is an unconscious emotion?(The case for unconscious" liking"). *Cognition & Emotion, 17*(2), 181-211. doi: 10.1080/02699930302289

Bjork, R. A., Roediger, H. L., III, & Craik, F. I. M. (1989). Retrieval inhibition as an adaptive mechanism in human memory *Varieties of memory and consciousness: Essays in honour of Endel Tulving.* (pp. 309-330). Hillsdale, NJ England: Lawrence Erlbaum Associates, Inc.

Blais, A.-R., & Weber, E. U. (2006). A Domain-Specific Risk-Taking (DOSPERT) scale for adult populations. *Judgment and Decision Making, 1*(1), 33-47.

Blumberg, S. J. (2000). The white bear suppression inventory: Revisiting its factor structure. *Personality and Individual Differences, 29*(5), 943-950. doi: 10.1016/s0191-8869(99)00245-7

Boles, S. M., & Johnson, P. B. (2001). Gender, weight concerns, and adolescent smoking. *Journal of addictive diseases, 20*(2), 5-14. doi: 10.1300/J069v20n02_02

Bolles, R. C. (1972). Reinforcement, expectancy, and learning. *Psychological Review, 79*(5), 394-409. doi: 10.1037/h0033120

Boney-McCoy, S., Gibbons, F. X., & Gerrard, M. (1999). Self-esteem, compensatory self-enhancement, and the consideration of health risk. *Personality and Social Psychology Bulletin, 25*(8), 954-965. doi: 10.1177/01461672992511004

Booth-Kewley, S., Larson, G. E., & Miyoshi, D. K. (2007). Social desirability effects on computerized and paper-and-pencil questionnaires. *Computers in Human Behavior, 23*(1), 463-477. doi: 10.1016/j.chb.2004.10.020

Borland, R. (1997). What do people's estimates of smoking related risk mean? *Psychology & Health, 12*(4), 513-521. doi: 10.1080/08870449708406727

Borland, R., Owen, N., Hill, D., & Schofield, P. (1991). Predicting attempts and sustained cessation of smoking after the introduction of workplace smoking bans. *Health Psychology, 10*(5), 336-342. doi: 10.1037/0278-6133.10.5.336

Botvin, G. J., Botvin, E. M., Baker, E., & Dusenbury, L. (1992). The false consensus effect: Predicting adolescents' tobacco use from normative expectations. *Psychological Reports, 70*(1), 171-178. doi: 10.2466/pr0.1992.70.1.171

Bowen, S., & Marlatt, A. (2009). Surfing the urge: brief mindfulness-based intervention for college student smokers. *Psychology of Addictive Behaviors, 23*(4), 666. doi: 10.1037/a0017127

Bradley, B. P., Field, M., Healy, H., & Mogg, K. (2008). Do the affective properties of smoking-related cues influence attentional and approach biases in cigarette smokers? *Journal of Psychopharmacology, 22*(7), 737-745. doi: 10.1177/0269881107083844

Bradley, B. P., Field, M., Mogg, K., & Houwer, J. D. (2004). Attentional and evaluative biases for smoking cues in nicotine dependence: Component processes of biases in visual orienting. *Behavioural Pharmacology, 15*(1), 29-36. doi: 10.1097/00008877-200402000-00004

Bradley, B. P., Mogg, K., Wright, T., & Field, M. (2003). Attentional bias in drug dependence: Vigilance for cigarette-related cues in smokers. *Psychology of Addictive Behaviors, 17*(1), 66-72. doi: 10.1037/0893-164X.17.1.66

Brady, S. S., Song, A. V., & Halpern-Felsher, B. L. (2008). Adolescents report both positive and negative consequences of experimentation with cigarette use. *Preventive Medicine: An International Journal Devoted to Practice and Theory, 46*(6), 585-590. doi: 10.1016/j.ypmed.2008.01.019

Brandon, T. H., & Baker, T. B. (1991). The Smoking Consequences Questionnaire: The subjective expected utility of smoking in college students. *Psychological Assessment: A Journal of Consulting and Clinical Psychology, 3*(3), 484-491. doi: 10.1037/1040-3590.3.3.484

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*(Suppl1), 51-77. doi: 10.1111/j.1360-0443.2004.00737.x

Brandon, T. H., Wetter, D. W., & Baker, T. B. (1996). Affect, expectancies, urges, and smoking: Do they conform to models of drug motivation and relapse? *Experimental and Clinical Psychopharmacology, 4*(1), 29-36. doi: 10.1037/1064-1297.4.1.29

Breslau, N., Fenn, N., & Peterson, E. L. (1993). Early smoking initiation and nicotine dependence in a cohort of young adults. *Drug and Alcohol Dependence, 33*(2), 129-137. doi: 10.1016/0376-8716(93)90054-t

Breslau, N., Kilbey, M. M., & Andreski, P. (1993). Nicotine dependence and major depression: New evidence from a prospective investigation. *Archives of General Psychiatry, 50*(1), 31-35. doi: 10.1001/archpsyc.1993.01820130033006

Brewer, J. A., Mallik, S., Babuscio, T. A., Nich, C., Johnson, H. E., Deleone, C. M., . . . Weinstein, A. J. (2011). Mindfulness training for smoking cessation: Results from a randomized controlled trial. *Drug and Alcohol Dependence, 119*(1-2), 72. doi: 10.1016/j.drugalcdep.2011.05.027

Brown, A. K., Moodie, C., Hastings, G., Mackintosh, A.-M., Hassan, L., & Thrasher, J. (2010). The association of normative perceptions with adolescent smoking intentions. *Journal of Adolescence, 33*(5), 603-614. doi: 10.1016/j.adolescence.2009.12.003

Brown, S. A. (1993). Drug effect expectancies and addictive behavior change. *Experimental and Clinical Psychopharmacology, 1*(1), 55-67. doi: 10.1037/1064-1297.1.1-4.55

Brugha, R., Tully, N., Dicker, P., Shelley, E., Ward, M., & McGee, H. (2009). *SLAN 2007 : Survey of Lifestyle, Attitudes and Nutrition in Ireland. Smoking Patterns in Ireland: Implications for policy and services.*: Retrieved from http://epubs.rcsi.ie/psycholrep/12.

Bryant, F. B., & Yarnold, P. R. (1995). Principal-components analysis and exploratory and confirmatory factor analysis. In L. G. Grimm & P. R. Yarnold (Eds.), *Reading and understanding multivariate statistics.* (pp. 99-136). Washington, DC US: American Psychological Association.

Byrne, B. M. (2008). Testing for multigroup equivalence of a measuring instrument: A walk through the process. *Psicothema, 20*(4), 872-882.

Byrne, B. M. (2009). *Structural Equation Modeling With AMOS: Basic Concepts, Applications, and Programming, Second Edition*: Taylor & Francis.

Calvo, M. G., & Lang, P. J. (2005). Parafoveal semantic processing of emotional visual scenes. *Journal of Experimental Psychology-Human Perception and Performance, 31*(3), 502-519. doi: 10.1037/0096-1523.31.3.502

Camp, D. E., Klesges, R. C., & Relyea, G. (1993). The relationship between body weight concerns and adolescent smoking. *Health Psychology, 12*(1), 24-32. doi: 10.1037/0278-6133.12.1.24

Campos-Melady, M., & Smith, J. E. (2012). Memory associations between negative emotions and alcohol on the lexical decision task predict alcohol use in women. *Addictive Behaviors, 37*(1), 60-66. doi: 10.1016/j.addbeh.2011.08.010

Carpenter, M. J., Baker, N. L., Gray, K. M., & Upadhyaya, H. P. (2010). Assessment of nicotine dependence among adolescent and young adult smokers: A comparison of measures. *Addictive Behaviors, 35*(11), 977-982. doi: 10.1016/j.addbeh.2010.06.013

Carter, B. L., Robinson, J. D., Lam, C. Y., Wetter, D. W., Tsan, J. Y., Day, S. X., & Cinciripini, P. M. (2006). A Psychometric Evaluation of Cigarette Stimuli Used in a Cue Reactivity Study. *Nicotine & Tobacco Research, 8*(3), 361-369. doi: 10.1080/14622200600670215

Cattell, R. B. (1966). The scree test for the number of factors. *Multivariate Behavioral Research, 1*(2), 245-276. doi: 10.1207/s15327906mbr0102_10

Cauffman, E., Shulman, E. P., Steinberg, L., Claus, E., Banich, M. T., Graham, S., & Woolard, J. (2010). Age differences in affective decision making as indexed by performance on the Iowa Gambling Task. *Developmental Psychology, 46*(1), 193-207. doi: 10.1037/a0016128

Cauffman, E., & Steinberg, L. (2001). (Im) maturity of judgment in adolescence: why adolescents may be less culpable than adults. *Behavioral Sciences & the Law, 18*(6), 741-760. doi: 10.1002/bsl.416

Charng, H.-w., Piliavin, J. A., & Callero, P. L. (1988). Role identity and reasoned action in the prediction of repeated behavior. *Social Psychology Quarterly, 51*(4), 303-317. doi: 10.2307/2786758

Chassin, L. (1984). Predicting the onset of cigarette smoking in adolescents: A longitudinal study. *Journal of Applied Social Psychology, 14*(3), 224-243. doi: 10.1111/j.1559-1816.1984.tb02233.x

Chassin, L., Presson, C. C., Rose, J. S., & Sherman, S. J. (1996). The natural history of cigarette smoking from adolescence to adulthood: Demographic predictors of continuity and change. *Health Psychology, 15*(6), 478-484. doi: 10.1037/0278-6133.15.6.478

Chassin, L., Presson, C. C., & Sherman, S. J. (2005). Adolescent Cigarette Smoking: A Commentary and Issues for Pediatric Psychology. *Journal of Pediatric Psychology, 30*(4), 299-303. doi: 10.1093/jpepsy/jsi025

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling, 9*(2), 233-255. doi: 10.1207/S15328007SEM0902_5

Chiesa, A., & Serretti, A. (2013). Are Mindfulness-Based Interventions Effective for Substance Use Disorders? A Systematic Review of the Evidence. *Substance Use & Misuse*. doi: 10.3109/10826084.2013.770027

Christiansen, B. A., Goldman, M. S., & Inn, A. (1982). Development of alcohol-related expectancies in adolescents: Separating pharmacological from social-learning influences. *Journal of Consulting and Clinical Psychology, 50*(3), 336. doi: 10.1037/0022-006X.50.3.336

Cialdini, R. B., Kallgren, C. A., & Reno, R. R. (1991). A focus theory of normative conduct: A theoretical refinement and reevaluation of the role of norms in human behavior. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 24, pp. 201-234). New York: NY : Academic.

Cohen, S., Lichtenstein, E., Prochaska, J. O., Rossi, J. S., Gritz, E. R., Carr, C. R., . . . Ossip-Klein, D. (1989). Debunking myths about self-quitting: Evidence from 10 prospective studies of persons who attempt to quit smoking by themselves. *American Psychologist, 44*(11), 1355-1365. doi: 10.1037/0003-066X.44.11.1355

Cohn, L. D., Macfarlane, S., Yanez, C., & Imai, W. K. (1995). Risk-perception: Differences between adolescents and adults. *Health Psychology, 14*(3), 217-222. doi: 10.1037/0278-6133.14.3.217

Colby, S. M., Tiffany, S. T., Shiffman, S., & Niaura, R. S. (2000). Measuring nicotine dependence among youth: a review of available approaches and instruments. *Drug and Alcohol Dependence, 59, Supplement 1*(0), 23-39. doi: 10.1016/s0376-8716(99)00163-5

Colder, C. R., Chassin, L., Lee, M. R., & Villalta, I. K. (2010). Developmental perspectives: Affect and adolescent substance use. In J. D. Kassel (Ed.), *Substance abuse and emotion.* (pp. 109-135). Washington, DC US: American Psychological Association.

Collins, A. M., & Loftus, E. F. (1975). A spreading-activation theory of semantic processing. *Psychological Review, 82*(6), 407-428. doi: 10.1037/0033-295x.82.6.407

Conner, M., & Armitage, C. J. (1998). Extending the theory of planned behavior: A review and avenues for further research. *Journal of Applied Social Psychology, 28*(15), 1429-1464. doi: 10.1111/j.1559-1816.1998.tb01685.x

Conner, M., & McMillan, B. (1999). Interaction effects in the theory of planned behavior: Studying cannabis use. *British Journal of Social Psychology, 38*(2), 195-222. doi: 10.1348/014466699164121

Conner, M., Sandberg, T., McMillan, B., & Higgins, A. (2006). Role of anticipated regret, intentions and intention stability in adolescent smoking initiation. *British Journal of Health Psychology, 11*(1), 85-101. doi: 10.1348/135910705X40997

Conrad, K. M., Flay, B. R., & Hill, D. (1992). Why children start smoking cigarettes: Predictors of onset. *British Journal of Addiction, 87*(12), 1711-1724. doi: 10.1111/j.1360-0443.1992.tb02684.x

Cooney, N. L., Gillespie, R. A., Baker, L. H., & Kaplan, R. F. (1987). Cognitive changes after alcohol cue exposure. *Journal of Consulting and Clinical Psychology, 55*(2), 150-155. doi: 10.1037/0022-006X.55.2.150

Copeland, A. L., Brandon, T. H., & Quinn, E. P. (1995). The Smoking Consequences Questionnaire-Adult: Measurement of smoking outcome expectancies of experienced smokers. *Psychological Assessment, 7*(4), 484-494. doi: 10.1037/1040-3590.7.4.484

Copeland, A. L., Diefendorff, J. M., Kendzor, D. E., Rash, C. J., Businelle, M. S., Patterson, S. M., & Williamson, D. A. (2007). Measurement of smoking outcome expectancies in children: The Smoking Consequences Questionnaire-Child. *Psychology of Addictive Behaviors, 21*(4), 469-477. doi: 10.1037/0893-164X.21.4.469

Cowen, M. S., & Lawrence, A. J. (1999). The role of opioid-dopamine interactions in the induction and maintenance of ethanol consumption. *Progress in Neuro-Psychopharmacology and Biological Psychiatry, 23*(7), 1171-1212. doi: 10.1016/S0278-5846(99)00060-3

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

Cox, W. M., Fadardi, J. S., Klinger, E., Wiers, R. W., & Stacy, A. W. (2006). Motivational Processes Underlying Implicit Cognition in Addiction *Handbook of implicit* *cognition and addiction.* (pp. 253-266). Thousand Oaks, CA US: Sage Publications, Inc.

Cox, W. M., Fadardi, J. S., & Pothos, E. M. (2006). The Addiction-Stroop test: Theoretical considerations and procedural recommendations. *Psychological Bulletin, 132*(3), 443-476. doi: 10.1037/0033-2909.132.3.443

Cox, W. M., Hogan, L. M., Kristian, M. R., & Race, J. H. (2002). Alcohol attentional bias as a predictor of alcohol abusers' treatment outcome. *Drug and Alcohol Dependence, 68*(3), 237-243. doi: 10.1016/S0376-8716(02)00219-3

Cunningham, J. A., & Selby, P. (2007). Relighting cigarettes: How common is it? *Nicotine & Tobacco Research, 9*(5), 621-623. doi: 10.1080/14622200701239688

De Houwer, J., Custers, R., & De Clercq, A. (2006). Do smokers have a negative implicit attitude toward smoking? *Cognition & Emotion, 20*(8), 1274-1284.

De Houwer, J., Teige-Mocigemba, S., Spruyt, A., & Moors, A. (2009). Implicit measures: A normative analysis and review. *Psychological Bulletin, 135*(3), 347-368.

de Vries, H., & Kok, G. J. (1986). From determinants of smoking behaviour to the implications for a prevention programme. *Health Education Research, 1*(2), 85-94. doi: 10.1093/her/1.2.85

Dempster, A. P., Laird, N. M., & Rubin, D. B. (1977). Maximum Likelihood from Incomplete Data via the EM Algorithm. *Journal of the Royal Statistical Society. Series B (Methodological), 39*(1), 1-38.

Deutsch, R., & Strack, F. (2006). Reflective and impulsive determinants of addictive behavior. *Handbook of implicit cognition and addiction*, 45-57. doi: 10.4135/9781412976237.n4

DeWit, D. J., Adlaf, E. M., Offord, D. R., & Ogborne, A. C. (2000). Age at first alcohol use: A risk factor for the development of alcohol disorders. *The American Journal of Psychiatry, 157*(5), 745-750. doi: 10.1176/appi.ajp.157.5.745

DiFranza, J. R., Rigotti, N. A., McNeill, A. D., Ockene, J. K., Savageau, J. A., Cyr, D. S., & Coleman, M. (2000). Initial symptoms of nicotine dependence in adolescents. *Tobacco control, 9*(3), 313-319. doi: 10.1136/tc.9.3.313

DiFranza, J. R., Savageau, J. A., Fletcher, K., Ockene, J. K., Rigotti, N. A., McNeill, A. D., . . . Wood, C. (2002). Measuring the Loss of Autonomy Over Nicotine Use in Adolescents: The DANDY (Development and Assessment of Nicotine Dependence in Youths) Study. *Archives of Pediatric Adolescent Medicine, 156*(4), 397-403. doi: 10.1001/archpedi.156.4.397

Dolcini, M. M., Adler, N. E., & Ginsberg, D. (1996). Factors influencing agreement between self-reports and biological measures of smoking among adolescents. *Journal of Research on Adolescence, 6*(4), 515-542.

Dome, P., Lazary, J., Kalapos, M. P., & Rihmer, Z. (2010). Smoking, nicotine and neuropsychiatric disorders. *Neuroscience and Biobehavioral Reviews, 34*(3), 295-342. doi: 10.1016/j.neubiorev.2009.07.013

Domier, C. P., Monterosso, J. R., Brody, A. L., Simon, S. L., Mendrek, A., Olmstead, R., . . . London, E. D. (2007). Effects of cigarette smoking and abstinence on Stroop task performance. *Psychopharmacology, 195*(1), 1-9. doi: 10.1007/s00213-007-0869-x

Downey, K. K., & Kilbey, M. M. (1995). Relationship between nicotine and alcohol expectancies and substance dependence. *Experimental and Clinical Psychopharmacology, 3*(2), 174-182. doi: 10.1037/1064-1297.3.2.174

Drobes, D. J., Elibero, A., & Evans, D. E. (2006). Attentional Bias for Smoking and Affective Stimuli: A Stroop Task Study. *Psychology of Addictive Behaviors, 20*(4), 490-495. doi: 10.1037/0893-164X.20.4.490

Drummond, D. C. (2001). Theories of drug craving, ancient and modern. *Addiction, 96*(1), 33-46. doi: 10.1046/j.1360-0443.2001.961333.x

Dwight, S. A., & Feigelson, M. E. (2000). A quantitative review of the effect of computerized testing on the measurement of social desirability. *Educational and psychological measurement, 60*(3), 340-360. doi: 10.1177/00131640021970583

Elwafi, H. M., Witkiewitz, K., Mallik, S., & Brewer, J. A. (2012). Mindfulness training for smoking cessation: Moderation of the relationship between craving and cigarette use. *Drug and Alcohol Dependence*.

Emery, S., Wakefield, M. A., Terry-McElrath, Y., Saffer, H., Szczypka, G., O'Malley, P. M., . . . Flay, B. (2005). Televised State-Sponsored Antitobacco Advertising and Youth Smoking Beliefs and Behavior in the United States, 1999-2000. *Arch Pediatr Adolesc Med, 159*(7), 639-645. doi: 10.1001/archpedi.159.7.639

Engels, R. C. M. E., Knibbie, R. A., & Drop, M. J. (1999). Predictability of smoking in adolescence: Between optimism and pessimism. *Addiction, 94*(1), 115-124. doi: 10.1046/j.1360-0443.1999.9411158.x

Estes, Z., & Adelman, J. S. (2008). Automatic vigilance for negative words is categorical and general. *Emotion, 8*(4), 453-457. doi: 10.1037/a0012887

European Commission. (2012). *Special Eurobarometer 385: Attitudes of Europeans towards Tobacco*. Retrieved from http://ec.europa.eu/health/tobacco/docs/eurobaro_attitudes_towards_tobacco_2012_en.pdf.

Fadardi, J., & Cox, W. (2007). Alcohol Attention-Control Training Program.

Fadardi, J., & Cox, W. M. (2009). Reversing the sequence: Reducing alcohol consumption by overcoming alcohol attentional bias. *Drug and Alcohol Dependence, 101*(3), 137-145. doi: 10.1016/j.drugalcdep.2008.11.015

Fagerström, K. O. (1978). Measuring degree of physical dependence to tobacco smoking with reference to individualization of treatment. *Addictive Behaviors, 3*(3), 235-241. doi: 10.1016/0306-4603(78)90024-2

Farber, P. D., Khavari, K. A., & Douglass, F. M. (1980). A factor analytic study of reasons for drinking: Empirical validation of positive and negative reinforcement dimensions. *Journal of Consulting and Clinical Psychology, 48*(6), 780-781. doi: 10.1037/0022-006x.48.6.780

Fazio, R. H. (1990). A practical guide to the use of response latency in social psychological research. In C. Hendrick & M. S. Clark (Eds.), *Research methods in personality and social psychology.* (pp. 74-97). Thousand Oaks, CA US: Sage Publications, Inc.

Fazio, R. H., & Olson, M. A. (2003). Implicit measures in social cognition research: Their meaning and uses. *Annual Review of Psychology, 54*, 297-327. doi: 10.1146/annurev.psych.54.101601.145225

Fehm, L., & Hoyer, J. (2004). Measuring Thought Control Strategies: The Thought Control Questionnaire and a Look Beyond. *Cognitive Therapy and Research, 28*(1), 105-117. doi: 10.1023/B:COTR.0000016933.41653.dc

Fehr, T., Wiedenmann, P., & Herrmann, M. (2006). Nicotine Stroop and addiction memory--An ERP study. *International Journal of Psychophysiology, 62*(2), 224-232. doi: 10.1016/j.ijpsycho.2006.01.011

Feldtkeller, B., Weinstein, A., Cox, W. M., & Nutt, D. (2001). Effects of contextual priming of reactions to craving and withdrawal stimuli in alcohol-dependent participants. *Experimental and Clinical Psychopharmacology, 9*(3), 343-351. doi: 10.1037/1064-1297.9.3.343

Field, A. (2009). *Discovering statistics using SPSS (3rd ed.)*. Thousand Oaks, CA: Sage Publications, Inc.

Field, M., Duka, T., Eastwood, B., Child, R., Santarcangelo, M., & Gayton, M. (2007). Experimental manipulation of attentional biases in heavy drinkers: Do the effects generalise? *Psychopharmacology, 192*(4), 593-608. doi: 10.1007/s00213-007-0760-9

Field, M., Duka, T., Tyler, E., & Schoenmakers, T. (2009). Attentional bias modification in tobacco smokers. *Nicotine & Tobacco Research, 11*(7), 812-822. doi: 10.1093/ntr/ntp067

Field, M., & Eastwood, B. (2005). Experimental manipulation of attentional bias increases the motivation to drink alcohol. *Psychopharmacology, 183*(3), 350-357. doi: 10.1007/s00213-005-0202-5

Field, M., Mogg, K., & Bradley, B. P. (2004). Eye movements to smoking-related cues: Effects of nicotine deprivation. *Psychopharmacology, 173*(1), 116-123. doi: 10.1007/s00213-003-1689-2

Field, M., Mogg, K., Bradley, B. P., Wiers, R. W., & Stacy, A. W. (2006). Attention to Drug-Related Cues in Drug Abuse and Addiction: Component Processes *Handbook of implicit cognition and addiction.* (pp. 151-163). Thousand Oaks, CA US: Sage Publications, Inc.

Field, M., Mogg, K., Zetteler, J., & Bradley, B. P. (2004). Attentional biases for alcohol cues in heavy and light social drinkers: The roles of initial orienting and maintained attention. *Psychopharmacology, 176*(1), 88-93. doi: 10.1007/s00213-004-1855-1

Figner, B., Mackinlay, R. J., Wilkening, F., & Weber, E. U. (2009). Affective and deliberative processes in risky choice: Age differences in risk taking in the Columbia Card Task. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 35*(3), 709-730. doi: 10.1037/a0014983
10.1037/a0014983.supp (Supplemental)

Finch, J. F., West, S. G., & MacKinnon, D. P. (1997). Effects of sample size and nonnormality on the estimation of mediated effects in latent variable models. *Structural Equation Modeling: A Multidisciplinary Journal, 4*(2), 87-107. doi: 10.1080/10705519709540063

Fishbein, M., & Ajzen, I. (1974). Attitudes towards objects as predictors of single and multiple behavioral criteria. *Psychological Review, 81*(1), 59-74. doi: 10.1037/h0035872

Flay, B. R., Hu, F. B., Siddiqui, O., Day, L. E., Hedeker, D., Petraitis, J., . . . Sussman, S. (1994). Differential influence of parental smoking and friends' smoking on adolescent initiation and escalation and smoking. *Journal of Health and Social Behavior*, 248-265. doi: 10.2307/2137279

Flay, B. R., Orleans, C. T., & Slade, J. D. (1993). Youth tobacco use: Risks, patterns, and control *Nicotine addiction: Principles and management.* (pp. 365-384). New York, NY US: Oxford University Press.

Franken, I. H. A. (2003). Drug craving and addiction: integrating psychological and neuropsychopharmacological approaches. *Progress in Neuro-Psychopharmacology and Biological Psychiatry, 27*(4), 563-579. doi: 10.1016/S0278-5846(03)00081-2

Franken, I. H. A., Kroon, L. Y., & Hendriks, V. M. (2000). Influence of individual differences in craving and obsessive cocaine thoughts on attentional processes in cocaine abuse patients. *Addictive Behaviors, 25*(1), 99-102. doi: 10.1016/S0306-4603(98)00112-9

Franken, I. H. A., Kroon, L. Y., Wiers, R. W., & Jansen, A. (2000). Selective cognitive processing of drug cues in heroin dependence. *Journal of Psychopharmacology, 14*(4), 395-400. doi: 10.1177/026988110001400408

Friedman, L. S., Lichtenstein, E., & Biglan, A. (1985). Smoking onset among teens: An empirical analysis of initial situations. *Addictive Behaviors, 10*(1), 1-13. doi: 10.1016/0306-4603(85)90048-6

Garavan, H., Pankiewicz, J., Bloom, A., Cho, J.-K., Sperry, L., Ross, T. J., . . . Stein, E. A. (2000). Cue-induced cocaine craving: Neuroanatomical specificity for drug users and drug stimuli. *American Journal of Psychiatry, 157*(11), 1789-1798. doi: 10.1176/appi.ajp.157.11.1789

Gardner, M., & Steinberg, L. (2005). Peer Influence on Risk Taking, Risk Preference, and Risky Decision Making in Adolescence and Adulthood: An Experimental Study. *Developmental Psychology, 41*(4), 625-635. doi: 10.1037/0012-1649.41.4.625

Geer, J. H., & Bellard, H. S. (1996). Sexual content induced delays in unprimed lexical decisions: Gender and context effects. *Archives of Sexual Behavior, 25*(4), 379-395. doi: 10.1007/BF02437581

Gerbing, D. W., & Anderson, J. C. (1984). On the meaning of within-factor correlated measurement errors. *Journal of Consumer Research*, 572-580. doi: 10.1086/208993

Gerrard, M., Gibbons, F. X., Benthin, A. C., & Hessling, R. M. (1996). A longitudinal study of the reciprocal nature of risk behaviors and cognitions in adolescents: What you do shapes what you think, and vice versa. *Health Psychology, 15*(5), 344-354. doi: 10.1037/0278-6133.15.5.344

Gerrard, M., Gibbons, F. X., Houlihan, A. E., Stock, M. L., & Pomery, E. A. (2008). A dual-process approach to health risk decision making: The prototype willingness model. *Developmental Review, 28*(1), 29-61. doi: 10.1016/j.dr.2007.10.001

Gibbons, F. X., & Gerrard, M. (1995). Predicting young adults' health risk behavior. *Journal of Personality and Social Psychology, 69*(3), 505-517. doi: 10.1037/0022-3514.69.3.505

Gibbons, F. X., Gerrard, M., Blanton, H., & Russell, D. W. (1998). Reasoned action and social reaction: Willingness and intention as independent predictors of health risk. *Journal of Personality and Social Psychology, 74*(5), 1164-1180. doi: 10.1037/0022-3514.74.5.1164

Glassman, A. H., Helzer, J. E., Covey, L. S., Cottler, L. B., Stetner, F., Tipp, J. E., & Johnson, J. (1990). Smoking, smoking cessation, and major depression. *JAMA: the journal of the American Medical Association, 264*(12), 1546-1549. doi: 10.1001/jama.1990.03450120058029

Godin, G., Valois, P., Lepage, L., & Desharnais, R. (1992). Predictors of smoking behaviour: An application of Ajzen's theory of planned behaviour. *British Journal of Addiction, 87*(9), 1335-1343. doi: 10.1111/j.1360-0443.1992.tb02742.x

Goldberg, J., & Fischhoff, B. (2000). The long-term risks in the short-term benefits: Perceptions of potentially addictive activities. *Health Psychology, 19*(3), 299-303. doi: 10.1037/0278-6133.19.3.299

Goldman, M. S. (1999). Risk for substance abuse: Memory as a common etiological pathway. *Psychological Science, 10*(3), 196-198. doi: 10.1111/1467-9280.00133

Graham, J. W. (2009). Missing data analysis: Making it work in the real world. *Annual Review of Psychology, 60,* 549-576. doi: 10.1146/annurev.psych.58.110405.085530

Grant, I. C., Hassan, L. M., Hastings, G. B., MacKintosh, A. M., & Eadie, D. (2008). The influence of branding on adolescent smoking behaviour: Exploring the mediating role of image and attitudes. *International Journal of Nonprofit and Voluntary Sector Marketing, 13*(3), 275-285. doi: 10.1002/nvsm.329

Greening, L., & Dollinger, S. J. (1991). Adolescent smoking and perceived vulnerability to smoking-related causes of death. *Journal of Pediatric Psychology, 16*(6), 687-699. doi: 10.1093/jpepsy/16.6.687

Greenwald, A. G., Banaji, M. R., Rudman, L. A., Farnham, S. D., Nosek, B. A., & Mellott, D. S. (2002). A unified theory of implicit attitudes, stereotypes, self-esteem, and self-concept. *Psychological Review, 109*(1), 3. doi: 10.1037/0033-295X.109.1.3

Griffin, K. W. (2010). The epidemiology of substance use among adolescents and young adults: A developmental perspective. In L. Scheier (Ed.), *Handbook of drug use etiology: Theory, methods, and empirical findings.* (pp. 73-92). Washington, DC US: American Psychological Association.

Gross, T. M., Jarvik, M. E., & Rosenblatt, M. R. (1993). Nicotine abstinence produces content-specific Stroop interference. *Psychopharmacology, 110*(3), 333-336. doi: 10.1007/BF02251289

Grube, J. W., McGree, S. T., & Morgan, M. (1986). Beliefs related to cigarette smoking among Irish college students. *International Journal of the Addictions, 21*(6), 701-706.

Haaga, D. A. F., & Allison, M. L. (1994). Thought suppression and smoking relapse: A secondary analysis of Haaga (1989). *British Journal of Clinical Psychology, 33*(3), 327-331. doi: 10.1111/j.2044-8260.1994.tb01128.x

Hansen, W. B., & Malotte, C. K. (1986). Perceived personal immunity: The development of beliefs about susceptibility to the consequences of smoking. *Preventive Medicine, 15*(4), 363-372. doi: 10.1016/0091-7435(86)90004-6

Harakeh, Z., Engels, R. C. M. E., Monshouwer, K., & Hanssen, P. F. (2010). Adolescent's weight concerns and the onset of smoking. *Substance Use & Misuse, 45*(12), 1847-1860. doi: 10.3109/10826081003682149

Harris, A. J., & Hahn, U. (2011). Unrealistic optimism about future life events: a cautionary note. *Psychological Review, 118*(1), 135. doi: 10.1037/a0020997

Harrison, W., Thompson, V. D., & Rodgers, J. L. (1985). Robustness and sufficiency of the theory of reasoned action in longitudinal prediction. *Basic and Applied Social Psychology, 6*(1), 25-40. doi: 10.1207/s15324834basp0601_3

Hayduk, L., Cummings, G., Boadu, K., Pazderka-Robinson, H., & Boulianne, S. (2007). Testing! testing! one, two, three – Testing the theory in structural equation models! *Personality and Individual Differences, 42*(5), 841-850. doi: 10.1016/j.paid.2006.10.001

Heatherton, T. F., Kozlowski, L. T., Frecker, R. C., & Fagerström, K.-O. (1991). The Fagerström Test for Nicotine Dependence: A revision of the Fagerström Tolerance Questionnaire. *British Journal of Addiction, 86*(9), 1119-1127. doi: 10.1111/j.1360-0443.1991.tb01879.x

Hertel, A. W., & Mermelstein, R. J. (2012). Smoker identity and smoking escalation among adolescents. *Health Psychology, 31*(4), 467-475. doi: 10.1037/a0028923

Hester, R., Dixon, V., & Garavan, H. (2006). A consistent attentional bias for drug-related material in active cocaine users across word and picture versions of the emotional Stroop task. *Drug and Alcohol Dependence, 81*(3), 251-257. doi: 10.1016/j.drugalcdep.2005.07.002

Higgins, A., & Conner, M. (2003). Understanding adolescent smoking: The role of the Theory of Planned Behaviour and implementation intentions. *Psychology, Health & Medicine, 8*(2), 173-186. doi: 10.1080/1354850031000087555

Hill, A. B., & Paynter, S. (1992). Alcohol dependence and semantic priming of alcohol related words. *Personality and Individual Differences, 13*(6), 745-750. doi: 10.1016/0191-8869(92)90245-k

Hine, D. W., McKenzie-Richer, A., Lewko, J., Tilleczek, K., & Perreault, L. (2002). A comparison of the mediational properties of four adolescent smoking expectancy measures. *Psychology of Addictive Behaviors, 16*(3), 187-195. doi: 10.1037/0893-164X.16.3.187

Hine, D. W., Summers, C., Tilleczek, K., & Lewko, J. (1997). Expectancies and mental models as determinants of adolescents' smoking decisions. *Journal of Social Issues, 53*(1), 35-52. doi: 10.1111/j.1540-4560.1997.tb02430.x

Hine, D. W., Tilleczek, K., Lewko, J., McKenzie-Richer, A., & Perreault, L. (2005). Measuring adolescent smoking expectancies by incorporating judgments about the expected time of occurrence of smoking outcomes. *Psychology of Addictive Behaviors, 19*(3), 284-290. doi: 10.1037/0893-164X.19.3.284

Hoffman, B. R., Sussman, S., Unger, J. B., & Valente, T. W. (2006). Peer influences on adolescent cigarette smoking: A theoretical review of the literature. *Substance Use & Misuse, 41*(1), 103-155. doi: 10.1080/10826080500368892

Hofmann, W., De Houwer, J., Perugini, M., Baeyens, F., & Crombez, G. (2010). Evaluative conditioning in humans: A meta-analysis. *Psychological Bulletin, 136*(3), 390. doi: 10.1037/a0018916

Hogarth, L., Dickinson, A., & Duka, T. (2003). Discriminative stimuli that control instrumental tobacco-seeking by human smokers also command selective attention. *Psychopharmacology, 168*(4), 435-445. doi: 10.1007/s00213-003-1456-4

Hogarth, L., Mogg, K., Bradley, B. P., Duka, T., & Dickinson, A. (2003). Attentional orienting towards smoking-related stimuli. *Behavioural Pharmacology, 14*(2), 153-160. doi: 10.1097/00008877-200303000-00007

Höping, W., & de Jong-Meyer, R. (2003). Differentiating unwanted intrusive thoughts from thought suppression: What does the White Bear Suppression Inventory measure? *Personality and Individual Differences, 34*(6), 1049-1055. doi: 10.1016/s0191-8869(02)00089-2

Horn, K., Fernandes, A., Dino, G., Massey, C. J., & Kalsekar, I. (2003). Adolescent nicotine dependence and smoking cessation outcomes. *Addictive Behaviors, 28*(4), 769-776. doi: 10.1016/s0306-4603(02)00229-0

Houben, K., Havermans, R. C., Nederkoorn, C., & Jansen, A. (2012). Beer à no-go: learning to stop responding to alcohol cues reduces alcohol intake via reduced affective associations rather than increased response inhibition. *Addiction*, no-no. doi: 10.1111/j.1360-0443.2012.03827.x

Houben, K., Nederkoorn, C., Wiers, R. W., & Jansen, A. (2011). Resisting temptation: Decreasing alcohol-related affect and drinking behavior by training response inhibition. *Drug and Alcohol Dependence, 116*(1–3), 132-136. doi: 10.1016/j.drugalcdep.2010.12.011

Houwer, J. D., & Hermans, D. (1994). Differences in the affective processing of words and pictures. *Cognition & Emotion, 8*(1), 1-20. doi: 10.1080/02699939408408925

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*(1), 1-55. doi: 10.1080/10705519909540118

Hublet, A., Schmid, H., Clays, E., Godeau, E., Gabhainn, S. N., Joossens, L., & Maes, L. (2009). Association between tobacco control policies and smoking behaviour among adolescents in 29 European countries. *Addiction, 104*(11), 1918-1926. doi: 10.1111/j.1360-0443.2009.02686.x

Hughes, J. R., Higgins, S. T., Hatsukami, D., Kozlowski, L. T., Annis, H. M., Cappell, H. D., . . . Goodstadt, M. S. (1990). Effects of abstinence from tobacco: A critical review *Research advances in alcohol and drug problems, Vol. 10.* (pp. 317-398). New York, NY US: Plenum Press.

Hukkelberg, S. S., & Dykstra, J. L. (2009). Using the Prototype/Willingness model to predict smoking behaviour among Norwegian adolescents. *Addictive Behaviors, 34*(3), 270-276. doi: 10.1016/j.addbeh.2008.10.024

Hutcheson, G. D., & Sofroniou, N. (1999). *The multivariate social scientist: Introductory statistics using generalized linear models*: Sage Publications Limited.

Jamieson, P., & Romer, D. (2001). What do young people think they know about the risks of smoking? In P. Slovic (Ed.), *Smoking: Risk, perception, & policy.* (pp. 51-63). Thousand Oaks, CA US: Sage Publications, Inc.

Jarvik, M. E., Gross, T. M., Rosenblatt, M. R., & Stein, R. E. (1995). Enhanced lexical processing of smoking stimuli during smoking abstinence. *Psychopharmacology, 118*(2), 136-141. doi: 10.1007/bf02245831

John, U., Meyer, C., Hapke, U., Rumpf, H.-J., & Schumann, A. (2004). Nicotine dependence, quit attempts, and quitting among smokers in a regional population sample from a country with a high prevalence of tobacco smoking. *Preventive Medicine, 38*(3), 350-358. doi: 10.1016/j.ypmed.2003.11.003

Johnsen, B. H., Thayer, J. F., Laberg, J. C., & Asbjornsen, A. E. (1997). Attentional bias in active smokers, abstinent smokers, and nonsmokers. *Addictive Behaviors, 22*(6), 813-817. doi: 10.1016/S0306-4603(97)00010-5

Joinson, A. (1999). Social desirability, anonymity, and Internet-based questionnaires. *Behavior Research Methods, Instruments, & Computers, 31*(3), 433-438. doi: 10.3758/BF03200723

Jones, E. E., & Nisbett, R. E. (1971). *The actor and the observer: Divergent perceptions of the causes of behavior*: General Learning Press Morristown, NJ.

Juvonen, J., Martino, S. C., Ellickson, P. L., & Longshore, D. (2007). 'But Others do it!': Do Misperceptions of Schoolmate Alcohol and Marijuana Use Predict Subsequent Drug Use Among Young Adolescents? *Journal of Applied Social Psychology, 37*(4), 740-758. doi: 10.1111/j.1559-1816.2007.00183.x

Kallgren, C. A., Reno, R. R., & Cialdini, R. B. (2000). A focus theory of normative conduct: When norms do and do not affect behavior. *Personality and Social Psychology Bulletin, 26*(8), 1002-1012. doi: 10.1177/01461672002610009

Kassel, J. D., Evatt, D. P., Greenstein, J. E., Wardle, M. C., Yates, M. C., & Veilleux, J. C. (2007). The acute effects of nicotine on positive and negative affect in adolescent smokers. *Journal of Abnormal Psychology, 116*(3), 543-553. doi: 10.1037/0021-843x.116.3.543

Kassel, J. D., & Shiffman, S. (1997). Attentional mediation of cigarette smoking's effect on anxiety. *Health Psychology, 16*(4), 359-368. doi: 10.1037/0278-6133.16.4.359

Kelly, A. B., Masterman, P., & Marlatt, G. A. (2006). Adolescent tobacco-related associative memory: A cross-sectional and contextual analysis. *Nicotine & Tobacco Research, 8*(1), 49-55. doi: 10.1080/14622200500431676

Kiluk, B. D., Nich, C., Babuscio, T., & Carroll, K. M. (2010). Quality versus quantity: acquisition of coping skills following computerized cognitive–behavioral therapy for substance use disorders. *Addiction, 105*(12), 2120-2127. doi: 10.1111/j.1360-0443.2010.03076.x

Klein, W. M., & Weinstein, N. D. (1997). Social comparison and unrealistic optimism about personal risk. In B. P. Buunk & F. X. Gibbons (Eds.), *Health, coping, and well-being: Perspectives from social comparison theory.* (pp. 25-61). Mahwah, NJ US: Lawrence Erlbaum Associates Publishers.

Kleinjan, M., van den Eijnden, R. J. J. M., van Leeuwe, J., Otten, R., Brug, J., & Engels, R. C. M. E. (2007). Factorial and convergent validity of nicotine dependence measures in adolescents: Toward a multidimensional approach. *Nicotine & Tobacco Research, 9*(11), 1109-1118. doi: 10.1080/14622200701488459

Kline, R. B. (2010). *Principles and practice of structural equation modeling*: Guilford press.

Koob, G. F. (2009). Neurobiological substrates for the dark side of compulsivity in addiction. *Neuropharmacology, 56*(Suppl1), 18-31. doi: 10.1016/j.neuropharm.2008.07.043

Kramer, D. A., & Goldman, M. S. (2003). Using a modified Stroop task to implicitly discern the cognitive organization of alcohol expectancies. *Journal of Abnormal Psychology, 112*(1), 171-175. doi: 10.1037/0021-843X.112.1.171

Lai, D., Cahill, K., Qin, Y., & Tang, J. L. (2010). Motivational interviewing for smoking cessation. *Cochrane Database Syst Rev, 1*. doi: 10.1002/14651858.CD006936.pub2

Lamb, R. J., Preston, K. L., Schindler, C. W., & Meisch, R. A. (1991). The reinforcing and subjective effects of morphine in post-addicts: A dose-response study. *Journal of Pharmacology and Experimental Therapeutics, 259*(3), 1165-1173.

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (2005). *International affective picture system (IAPS): Affective ratings of pictures and instruction manual*: NIMH, Center for the Study of Emotion & Attention.

Larsen, R. J., Mercer, K. A., & Balota, D. A. (2006). Lexical characteristics of words used in emotional Stroop experiments. *Emotion, 6*(1), 62-72. doi: 10.1037/1528-3542.6.1.62

Lee, C. (1989). Perceptions of immunity to disease in adult smokers. *Journal of Behavioral Medicine, 12*(3), 267-277. doi: 10.1007/BF00844871

Leech, G. N., Rayson, P., & Wilson, A. (2001). *Word frequencies in written and spoken English*: Longman Harlow,, UK.

Leigh, B. C., & Stacy, A. W. (2004). Alcohol expectancies and drinking in different age groups. *Addiction, 99*(2), 215-227. doi: 10.1111/j.1360-0443.2003.00641.x

Leung, K. S., & McCusker, C. G. (1999). Accessibility and availability of smoking-related associations in smokers. *Addiction Research, 7*(3), 213-226. doi: 10.3109/16066359909004384

Leventhal, H., & Cleary, P. D. (1980). The smoking problem: A review of the research and theory in behavioral risk modification. *Psychological Bulletin, 88*(2), 370-405. doi: 10.1037/0033-2909.88.2.370

Lewinsohn, P. M., Rohde, P., & Brown, R. A. (1999). Level of current and past adolescent cigarette smoking as predictors of future substance use disorders in young adulthood. *Addiction, 94*(6), 913-921. doi: 10.1046/j.1360-0443.1999.94691313.x

Lewis-Esquerre, J., Rodrigue, J. R., & Kahler, C. W. (2005). Development and validation of an adolescent smoking consequences questionnaire. *Nicotine & Tobacco Research, 7*(1), 81-90. doi: 10.1080/14622200412331328475

Litz, B. T., Payne, T. J., & Colletti, G. (1987). Schematic processing of smoking information by smokers and never-smokers. *Cognitive Therapy and Research, 11*(3), 301-313. doi: 10.1007/BF01186281

Logan, G. D. (1988). Toward an instance theory of automatization. *Psychological Review, 95*(4), 492-527. doi: 10.1037/0033-295X.95.4.492

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods, 1*(2), 130-149. doi: 10.1037/1082-989x.1.2.130

MacCallum, R. C., Roznowski, M., & Necowitz, L. B. (1992). Model modifications in covariance structure analysis: the problem of capitalization on chance. *Psychological Bulletin, 111*(3), 490. doi: 10.1037/0033-2909.111.3.490

MacLeod, C. M. (1991). Half a century of research on the Stroop effect: An integrative review. *Psychological Bulletin, 109*(2), 163-203. doi: 10.1037/0033-2909.109.2.163

MacLeod, C. M., & MacDonald, P. A. (2000). Interdimensional interference in the Stroop effect: uncovering the cognitive and neural anatomy of attention. *Trends in Cognitive Sciences, 4*(10), 383-391. doi: 10.1016/S1364-6613(00)01530-8

MacPherson, L., Strong, D. R., & Myers, M. G. (2008). Using an item response model to examine the nicotine dependence construct as characterized by the HONC and the mFTQ among adolescent smokers. *Addictive Behaviors, 33*(7), 880-894. doi: 10.1016/j.addbeh.2008.02.007

Maher, R. A., & Rickwood, D. (1997). The theory of planned behavior, domain specific self–efficacy and adolescent smoking. *Journal of Child & Adolescent Substance Abuse, 6*(3), 57-76. doi: 10.1300/J029v06n03_04

Manstead, A. S. R. (2000). The role of moral norm in the attitude–behavior relation. In D. J. Terry & M. A. Hogg (Eds.), *Attitudes, behavior, and social context: The role of norms and group membership.* (pp. 11-30). Mahwah, NJ US: Lawrence Erlbaum Associates Publishers.

Mansvelder, H. D., & McGehee, D. S. (2000). Long-Term Potentiation of Excitatory Inputs to Brain Reward Areas by Nicotine. *Neuron, 27*(2), 349-357. doi: 10.1016/S0896-6273(00)00042-8

Markland, D. (2007). The golden rule is that there are no golden rules: A commentary on Paul Barrett's recommendations for reporting model fit in structural equation modelling. *Personality and Individual Differences, 42*(5), 851-858. doi: 10.1016/j.paid.2006.09.023

Marks, G., & Miller, N. (1987). Ten years of research on the false-consensus effect: An empirical and theoretical review. *Psychological Bulletin, 102*(1), 72-90. doi: 10.1037/0033-2909.102.1.72

Marlatt, G. A. (1985). Cognitive factors in the relapse process. *Relapse prevention*, 128-200.

Marlatt, G. A. (1996). Taxonomy of high-risk situations for alcohol relapse: Evolution and development of a cognitive-behavioral model. *Addiction, 91*(12), S37-S49. doi: 10.1111/j.1360-0443.1996.tb02326.x

Mathews, A., & MacLeod, C. (2002). Induced processing biases have causal effects on anxiety. *Cognition & Emotion, 16*(3), 331-354. doi: 10.1080/02699930143000518

McCusker, C. G. (2001). Cognitive biases and addiction: An evolution in theory and method. *Addiction, 96*(1), 47-56. doi: 10.1046/j.1360-0443.2001.961474.x

McCusker, C. G., & Gettings, B. (1997). Automaticity of cognitive biases in addictive behaviours: Further evidence with gamblers. *British Journal of Clinical Psychology, 36*(4), 543-554. doi: 10.1111/j.2044-8260.1997.tb01259.x

McIntosh, C. N. (2007). Rethinking fit assessment in structural equation modelling: A commentary and elaboration on Barrett (2007). *Personality and Individual Differences, 42*(5), 859-867. doi: 10.1016/j.paid.2006.09.020

McKenzie, M., Olsson, C. A., Jorm, A. F., Romaniuk, H., & Patton, G. C. (2010). Association of adolescent symptoms of depression and anxiety with daily smoking and nicotine dependence in young adulthood: Findings from a 10-year longitudinal study. *Addiction, 105*(9), 1652-1659. doi: 10.1111/j.1360-0443.2010.03002.x

McMillan, B., & Conner, M. (2003). Applying an Extended Version of the Theory of Planned Behavior to Illicit Drug Use Among Students. *Journal of Applied Social Psychology, 33*(8), 1662-1683. doi: 10.1111/j.1559-1816.2003.tb01968.x

McMillan, B., Higgins, A. R., & Conner, M. (2005). Using an extended theory of planned behaviour to understand smoking amongst schoolchildren. *Addiction Research & Theory, 13*(3), 293-306. doi: 10.1080/16066350500053679

Meyer, D. E., & Schvaneveldt, R. W. (1971). Facilitation in recognizing pairs of words: Evidence of a dependence between retrieval operations. *Journal of experimental psychology, 90*(2), 227-234. doi: 10.1037/h0031564

Miles, J., & Shevlin, M. (2007). A time and a place for incremental fit indices. *Personality and Individual Differences, 42*(5), 869-874. doi: 10.1016/j.paid.2006.09.022

Miller, E. T., Neal, D. J., Roberts, L. J., Baer, J. S., Cressler, S. O., Metrik, J., & Marlatt, G. A. (2002). Test-retest reliability of alcohol measures: Is there a difference between Internet-based assessment and traditional methods? *Psychology of Addictive Behaviors, 16*(1), 56. doi: 10.1037/0893-164X.16.1.56

Miller, M. A., & Fillmore, M. T. (2010). The effect of image complexity on attentional bias towards alcohol-related images in adult drinkers. *Addiction, 105*(5), 883-890. doi: 10.1111/j.1360-0443.2009.02860.x

Millsap, R. E. (2007). Structural equation modeling made difficult. *Personality and Individual Differences, 42*(5), 875-881. doi: 10.1016/j.paid.2006.09.021

Moan, I. S., & Rise, J. (2005). Quitting Smoking: Applying an Extended Version of the Theory of Planned Behavior to Predict Intention and Behavior. *Journal of Applied Biobehavioral Research, 10*(1), 39-68. doi: 10.1111/j.1751-9861.2005.tb00003.x

Moan, I. S., & Rise, J. (2006). Predicting smoking reduction among adolescents using an extended version of the theory of planned behaviour. *Psychology & Health, 21*(6), 717-738. doi: 10.1080/14768320600603448

Mogg, K., & Bradley, B. P. (2002). Selective processing of smoking-related cues in smokers: Manipulation of deprivation level and comparison of three measures of processing bias. *Journal of Psychopharmacology, 16*(4), 385-392. doi: 10.1177/026988110201600416

Mogg, K., Bradley, B. P., Field, M., & De Houwer, J. (2003). Eye movements to smoking-related pictures in smokers: relationship between attentional biases and implicit and explicit measures of stimulus valence. *Addiction, 98*(6), 825-836. doi: 10.1046/j.1360-0443.2003.00392.x

Mucha, R. F., Pauli, P., & Weyers, P. (2006). Psychophysiology and Implicit Cognition in Drug Use: Significance and Measurement of Motivation for Drug Use With Emphasis on Startle Tests. In R. W. Wiers & A. W. Stacy (Eds.), *Handbook of implicit cognition and addiction.* (pp. 201-214). Thousand Oaks, CA US: Sage Publications, Inc.

Mulaik, S. A., James, L. R., Van Alstine, J., Bennett, N., Lind, S., & Stilwell, C. D. (1989). Evaluation of goodness-of-fit indices for structural equation models. *Psychological Bulletin, 105*(3), 430. doi: 10.1037/0033-2909.105.3.430

Munafo, M., & Albery, I. P. (2006). *Cognition and addiction*. New York, NY US: Oxford University Press.

Munafo, M., Mogg, K., Roberts, S., Bradley, B. P., & Murphy, M. (2003). Selective processing of smoking-related cues in current smokers, ex-smokers and never-smokers on the modified Stroop task. *Journal of Psychopharmacology, 17*(3), 310-316. doi: 10.1177/02698811030173013

Muris, P., Merckelbach, H., & Horselenberg, R. (1996). Individual differences in thought suppression. The White Bear Suppression Inventory: Factor structure, reliability, validity and correlates. *Behaviour Research and Therapy, 34*(5-6), 501-513. doi: 10.1016/0005-7967(96)00005-8

Myers, M. G., MacPherson, L., McCarthy, D. M., & Brown, S. A. (2003). Constructing a short form of the Smoking Consequences Questionnaire with adolescents and young adults. *Psychological Assessment, 15*(2), 163-172. doi: 10.1037/1040-3590.15.2.163

Neely, J. H. (1991). Semantic priming effects in visual word recognition: A selective review of current findings and theories. *Basic processes in reading: Visual word recognition, 11*.

Newell, K. M. (1978). Some issues on action plans. In G. E. Stelmach (Ed.), *Information processing in motor control and learning* (pp. 41-54): New York:Academic Press.

Niaura, R. S., Rohsenow, D. J., Binkoff, J. A., Monti, P. M., Pedraza, M., & Abrams, D. B. (1988). Relevance of cue reactivity to understanding alcohol and smoking relapse. *Journal of Abnormal Psychology, 97*(2), 133-152. doi: 10.1037/0021-843X.97.2.133

Nielsen, J., & Shapiro, S. (2009). Coping with fear through suppression and avoidance of threatening information. *Journal of Experimental Psychology: Applied, 15*(3), 258-274. doi: 10.1037/a0017018

Nonnemaker, J. M., & Homsi, G. (2007). Measurement properties of the Fagerström Test for nicotine dependence adapted for use in an adolescent sample. *Addictive Behaviors, 32*(1), 181-186. doi: 10.1016/j.addbeh.2006.03.028

Norman, P., Conner, M., & Bell, R. (1999). The theory of planned behavior and smoking cessation. *Health Psychology, 18*(1), 89. doi: 10.1037/0278-6133.18.1.89

O'Connor, R. M., Fite, P. J., Nowlin, P. R., & Colder, C. R. (2007). Children's beliefs about substance use: An examination of age differences in implicit and explicit cognitive precursors of substance use initiation. *Psychology of Addictive Behaviors, 21*(4), 525-533. doi: 10.1037/0893-164X.21.4.525

O'Loughlin, J., DiFranza, J. R., Tyndale, R. F., Meshefedjian, G., McMillan-Davey, E., Clarke, P. B. S., . . . Paradis, G. (2003). Nicotine-Dependence Symptoms are Associated with Smoking Frequency in Adolescents. *American Journal of Preventive Medicine, 25*(3), 219-225. doi: 10.1016/s0749-3797(03)00198-3

Oei, T. P. S., & Morawska, A. (2004). A cognitive model of binge drinking: The influence of alcohol expectancies and drinking refusal self-efficacy. *Addictive Behaviors, 29*(1), 159-179. doi: 10.1016/s0306-4603(03)00076-5

Office of Tobacco Control. (2008). Office of Tobacco Control Annual Report 2008

Office of Tobacco Control. (2010). *Annual Report 2010*. Retrieved from http://www.drugsandalcohol.ie/18254/.

Ostafin, B. D., Bauer, C., & Myxter, P. (2012). Mindfulness decouples the relation between automatic alcohol motivation and heavy drinking. *Journal of Social and Clinical Psychology, 31*(7), 729-745. doi: 10.1521/jscp.2012.31.7.729

Ostafin, B. D., & Marlatt, G. A. (2008). Surfing the urge: Experiential acceptance moderates the relation between automatic alcohol motivation and hazardous drinking. *Journal of Social and Clinical Psychology, 27*(4), 404-418. doi: 10.1521/jscp.2008.27.4.404

Otten, R., Engels, R. C. M. E., & Prinstein, M. J. (2009). A Prospective Study of Perception in Adolescent Smoking. *Journal of Adolescent Health, 44*(5), 478-484. doi: 10.1016/j.jadohealth.2008.09.004

Otten, W., & Van Der Pligt, J. (1996). Context effects in the measurement of comparative optimism in probability judgments. *Journal of Social and Clinical Psychology, 15*(1), 80-101. doi: 10.1521/jscp.1996.15.1.80

Palfai, T. P. (2002). Positive outcome expectancies and smoking behavior: The role of expectancy accessibility. *Cognitive Therapy and Research, 26*(3), 317-333. doi: 10.1023/A:1016024927094

Palfai, T. P., Monti, P. M., Colby, S. M., & Rohsenow, D. J. (1997). Effects of suppressing the urge to drink on the accessibility of alcohol outcome expectancies. *Behaviour Research and Therapy, 35*(1), 59-65. doi: 10.1016/s0005-7967(96)00079-4

Parker, D., Manstead, A. S., & Stradling, S. G. (2011). Extending the theory of planned behaviour: The role of personal norm. *British Journal of Social Psychology, 34*(2), 127-138. doi: 10.1111/j.2044-8309.1995.tb01053.x

Patrick, D. L., Cheadle, A., Thompson, D. C., Diehr, P., Koepsell, T., & Kinne, S. (1994). The validity of self-reported smoking: a review and meta-analysis. *American Journal of Public Health, 84*(7), 1086-1093. doi: 10.2105/AJPH.84.7.1086

Petraitis, J., Flay, B. R., & Miller, T. Q. (1995). Reviewing theories of adolescent substance use: Organizing pieces in the puzzle. *Psychological Bulletin, 117*(1), 67-86. doi: 10.1037/0033-2909.117.1.67

Pfizer. (2009). *The voice of young people: A report on teenagers' attitude to smoking*. Retrieved from http://www.pfizer.ie/UserFiles/File/Smoking_Report/2009_Smoking_Report_final.pdf.

Physicians for a Smoke-Free Canada. (2010). Picture Based Cigarette Warnings Retrieved February, 2010, from http://www.smoke-free.ca/warnings/default.htm

Piko, B. (2001). Smoking in adolescence: Do attitudes matter? *Addictive Behaviors, 26*(2), 201-217. doi: 10.1016/s0306-4603(00)00101-5

Piper, M. E., McCarthy, D. E., & Baker, T. B. (2006). Assessing tobacco dependence: A guide to measure evaluation and selection. *Nicotine & Tobacco Research, 8*(3), 339-351. doi: 10.1080/14622200600672765

Polivy, J. (1998). The effects of behavioral inhibition: Integrating internal cues, cognition, behavior, and affect. *Psychological Inquiry, 9*(3), 181-204. doi: 10.1207/s15327965pli0903_1

Pollard, J. W., Freeman, J. E., Ziegler, D. A., Hersman, M. N., & Goss, C. W. (2000). Predictions of Normative Drug Use by College Students. *Journal of College Student Psychotherapy, 14*(3), 5-12. doi: 10.1300/J035v14n03_03

Pomerleau, O. F., Pomerleau, C. S., & Namenek, R. J. (1998). Early experiences with tobacco among women smokers, ex-smokers, and never-smokers. *Addiction, 93*(4), 595-599. doi: 10.1046/j.1360-0443.1998.93459515.x

Posner, M. I. (1980). Orienting of attention. *Quarterly journal of experimental psychology, 32*(1), 3-25. doi: 10.1080/00335558008248231

Powell, J., Gray, J. A., Bradley, B. P., & Kasvikis, Y. (1990). The effects of exposure to drug-related cues in detoxified opiate addicts: A theoretical review and some new data. *Addictive Behaviors, 15*(4), 339-354. doi: 10.1016/0306-4603(90)90044-x

Powell, J., Tait, S., & Lessiter, J. (2002). Cigarette smoking and attention to signals of reward and threat in the Stroop paradigm. *Addiction, 97*(9), 1163-1170. doi: 10.1046/j.1360-0443.2002.00117.x

Prinstein, M. J., & Wang, S. S. (2005). False Consensus and Adolescent Peer Contagion: Examining Discrepancies between Perceptions and Actual Reported Levels of Friends' Deviant and Health Risk Behaviors. *Journal of Abnormal Child Psychology, 33*(3), 293-306. doi: 10.1007/s10802-005-3566-4

Prokhorov, A. V., Hudmon, K. S., de Moor, C. A., Kelder, S. H., Conroy, J. L., & Ordway, N. (2001). Nicotine dependence, withdrawal symptoms, and adolescents' readiness to quit smoking. *Nicotine & Tobacco Research, 3*(2), 151-155. doi: 10.1080/14622200110043068

Quadrel, M. J., Fischhoff, B., & Davis, W. (1993). Adolescent (in)vulnerability. *American Psychologist, 48*(2), 102-116. doi: 10.1037/0003-066X.48.2.102

Raats, M. M., Shepherd, R., & Sparks, P. (1995). Including moral dimensions of choice within the structure of the theory of planned behavior. *Journal of Applied Social Psychology, 25*(6), 484-494. doi: 10.1111/j.1559-1816.1995.tb01763.x

Rash, C. J., & Copeland, A. L. (2008). The Brief Smoking Consequences Questionnaire-Adult (BSCQ-A): Development of a short form of the SCQ-A. *Nicotine & Tobacco Research, 10*(11), 1633-1643. doi: 10.1080/14622200802409990

Rather, B. C., & Goldman, M. S. (1994). Drinking-related differences in the memory organization of alcohol expectancies. *Experimental and Clinical Psychopharmacology, 2*(2), 167-183. doi: 10.1037/1064-1297.2.2.167

Reid, J. L., Manske, S. R., & Leatherdale, S. T. (2008). Factors related to adolescents' estimation of peer smoking prevalence. *Health Educ. Res., 23*(1), 81-93. doi: 10.1093/her/cym006

Reno, R. R., Cialdini, R. B., & Kallgren, C. A. (1993). The transsituational influence of social norms. *Journal of Personality and Social Psychology, 64*(1), 104-112. doi: 10.1037/0022-3514.64.1.104

Rise, J., Kovac, V., Kraft, P., & Moan, I. S. (2008). Predicting the intention to quit smoking and quitting behaviour: Extending the theory of planned behaviour. *British Journal of Health Psychology, 13*(2), 291-310. doi: 10.1348/135910707X187245

Rise, J., & Ommundsen, R. (2011). Predicting the intention to quit smoking: A comparative study among Spanish and Norwegian students. *Europe's Journal of Psychology, 7*(1), 143-163. doi: 10.5964/ejop.v7i1.109

Rivis, A., & Sheeran, P. (2003). Descriptive Norms as an Additional Predictor in the Theory of Planned Behaviour: A Meta-Analysis. *Current Psychology: A Journal for Diverse Perspectives on Diverse Psychological Issues, 22*(3), 218-233. doi: 10.1007/s12144-003-1018-2

Robins, L. N., & Przybeck, T. R. (1985). Age of onset of drug use as a factor in drug and other disorders. *Etiology of drug abuse: implications for prevention. NIDA Research Monograph, 56*, 178-192.

Robinson, T. E., & Berridge, K. C. (1993). The neural basis of drug craving: An incentive-sensitization theory of addiction. *Brain Research Reviews, 18*(3), 247-291. doi: 10.1016/0165-0173(93)90013-P

Robinson, T. E., & Berridge, K. C. (2000). The psychology and neurobiology of addiction: An incentive-sensitization view. *Addiction, 95*, S91-s117. doi: 10.1080/09652140050111681

Robinson, T. E., & Berridge, K. C. (2001). Incentive-sensitization and addiction. *Addiction, 96*(1), 103-114. doi: 10.1046/j.1360-0443.2001.9611038.x

Robinson, T. E., & Berridge, K. C. (2003). Addiction. *Annual Review of Psychology, 54,* 25-53. doi: 10.1146/annurev.psych.54.101601.145237

Robinson, T. E., & Berridge, K. C. (2008). The incentive sensitization theory of addiction: some current issues. *Philosophical Transactions of the Royal Society B: Biological Sciences, 363*(1507), 3137-3146. doi: 10.1098/rstb.2008.0093

Romer, D., & Jamieson, P. (2001). The role of perceived risk in starting and stopping smoking. In P. Slovic (Ed.), *Smoking: Risk, perception, & policy.* (pp. 64-80). Thousand Oaks, CA US: Sage Publications, Inc.

Rooke, S. E., Hine, D. W., & Thorsteinsson, E. B. (2008). Implicit cognition and substance use: A meta-analysis. *Addictive Behaviors, 33*(10), 1314-1328. doi: 10.1016/j.addbeh.2008.06.009

Ross, L., Greene, D., & House, P. (1977). The "false consensus effect": An egocentric bias in social perception and attribution processes. *Journal of Experimental Social Psychology, 13*(3), 279-301. doi: 10.1016/0022-1031(77)90049-X

Rubin, D. B., & Little, R. J. (2002). *Statistical analysis with missing data*. Hoboken, NJ: J. Wiley & Sons.

Salkovskis, P. M., & Reynolds, M. (1994). Thought suppression and smoking cessation. *Behaviour Research and Therapy, 32*(2), 193-201. doi: 10.1016/0005-7967(94)90112-0

Saris, W. E., Satorra, A., & van der Veld, W. M. (2009). Testing Structural Equation Models or Detection of Misspecifications? *Structural Equation Modeling: A Multidisciplinary Journal, 16*(4), 561-582. doi: 10.1080/10705510903203433

Sayette, M. A. (1993). An appraisal-disruption model of alcohol's effects on stress responses in social drinkers. *Psychological Bulletin, 114*(3), 459-476. doi: 10.1037/0033-2909.114.3.459

Sayette, M. A., & Hufford, M. R. (1994). Effects of cue exposure and deprivation on cognitive resources in smokers. *Journal of Abnormal Psychology, 103*(4), 812-818. doi: 10.1037/0021-843X.103.4.812

Schafer, J. L., & Graham, J. W. (2002). Missing data: Our view of the state of the art. *Psychological Methods, 7*(2), 147-177. doi: 10.1037/1082-989x.7.2.147

Schleicher, H. E., Harris, K. J., Catley, D., Harrar, S. W., & Golbeck, A. L. (2008). Examination of a brief Smoking Consequences Questionnaire for college students. *Nicotine & Tobacco Research, 10*(9), 1503-1509. doi: 10.1080/14622200802323175

Schneider, W., & Shiffrin, R. M. (1977). Controlled and automatic human information processing: I. Detection, search, and attention. *Psychological Review, 84*(1), 1-66. doi: 10.1037/0033-295X.84.1.1

Schoenbaum, M. (1997). Do smokers understand the mortality effects of smoking? Evidence from the health and retirement survey. *American Journal of Public Health, 87*(5), 755-759. doi: 10.2105/ajph.87.5.755

Schoenmakers, T. M., de Bruin, M., Lux, I. F., Goertz, A. G., Van Kerkhof, D. H., & Wiers, R. W. (2010). Clinical effectiveness of attentional bias modification training in abstinent alcoholic patients. *Drug and Alcohol Dependence, 109*(1), 30-36. doi: 10.1016/j.drugalcdep.2009.11.022

Sharot, T., Guitart-Masip, M., Korn, C. W., Chowdhury, R., & Dolan, R. J. (2012). How dopamine enhances an optimism bias in humans. *Current Biology*. doi: 10.1016/j.cub.2012.05.053

Sheeran, P., Trafimow, D., Finlay, K. A., & Norman, P. (2002). Evidence that the type of person affects the strength of the perceived behavioural control-intention relationship. *British Journal of Social Psychology, 41*(2), 253-270. doi: 10.1348/014466602760060129

Shepperd, J. A., Klein, W. M., Waters, E. A., & Weinstein, N. D. (2013). Taking Stock of Unrealistic Optimism. *Perspectives on Psychological Science, 8*(4), 395-411. doi: 10.1177/1745691613485247

Sher, K. J., Wiers, R. W., & Stacy, A. W. (2006). Toward a Cognitive Theory of Substance Use and Dependence *Handbook of implicit cognition and addiction.* (pp. 473-476). Thousand Oaks, CA US: Sage Publications, Inc.

Sherman, S. J. (1983). The false consensus effects in estimates of smoking prevalence: Underlying mechanisms. *Personality and Social Psychology Bulletin, 9*(2), 197-207. doi: 10.1177/0146167283092003

Sherman, S. J., Presson, C. C., & Chassin, L. (1984). Mechanisms underlying the false consensus effect: The special role of threats to the self. *Personality and Social Psychology Bulletin, 10*(1), 127-138. doi: 10.1177/0146167284101015

Sherman, S. J., Rose, J. S., Koch, K., Presson, C. C., & Chassin, L. (2003). Implicit and explicit attitudes toward cigarette smoking: The effects of context and motivation. *Journal of Social & Clinical Psychology, 22*(1), 13-39. doi: 10.1521/jscp.22.1.13.22766

Shiffman, S., Gwaltney, C. J., Balabanis, M. H., Liu, K. S., Paty, J. A., Kassel, J. D., . . . Gnys, M. (2002). Immediate antecedents of cigarette smoking: An analysis from ecological momentary assessment. *Journal of Abnormal Psychology, 111*(4), 531-545. doi: 10.1037/0021-843X.111.4.531

Shiffman, S., Paty, J. A., Gnys, M., Kassel, J. A., & Hickcox, M. (1996). First lapses to smoking: Within-subjects analysis of real-time reports. *Journal of Consulting and Clinical Psychology, 64*(2), 366-379. doi: 10.1037/0022-006X.64.2.366

Shiffman, S., & Waters, A. J. (2004). Negative Affect and Smoking Lapses: A Prospective Analysis. *Journal of Consulting and Clinical Psychology, 72*(2), 192-201. doi: 10.1037/0022-006X.72.2.192

Shiffrin, R. M., & Schneider, W. (1977). Controlled and automatic human information processing: II. Perceptual learning, automatic attending and a general theory. *Psychological Review, 84*(2), 127-190. doi: 10.1037/0033-295X.84.2.127

Siegel, S., Baptista, M. A. S., Kim, J. A., McDonald, R. V., & Weise-Kelly, L. (2000). Pavlovian psychopharmacology: The associative basis of tolerance. *Experimental and Clinical Psychopharmacology, 8*(3), 276-293. doi: 10.1037/1064-1297.8.3.276

Skinner, M. D., & Aubin, H.-J. (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

Sloman, S. A. (1996). The empirical case for two systems of reasoning. *Psychological Bulletin, 119*(1), 3-22. doi: 10.1037/0033-2909.119.1.3

Slovic, P. (1998). Do Adolescent Smokers Know the Risks? *Duke Law Journal, 47*(6), 1133-1141. doi: 10.2307/1373033

Slovic, P. (2000). What does it mean to know a cumulative risk? Adolescents' perceptions of short-term and long-term consequences of smoking. *Journal of Behavioral*

Decision Making, 13(2), 259-266. doi: 10.1002/(SICI)1099-0771(200004/06)13:2<259::AID-BDM336>3.0.CO;2-6

Slovic, P. (2001). Cigarette smokers: Rational actors or rational fools? In P. Slovic (Ed.), *Smoking: Risk, perception, & policy.* (pp. 97-124). Thousand Oaks, CA US: Sage Publications, Inc.

Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2004). Risk as Analysis and Risk as Feelings: Some Thoughts about Affect, Reason, Risk, and Rationality. *Risk Analysis, 24*(2), 311-322. doi: 10.1111/j.0272-4332.2004.00433.x

Soetens, B., Braet, C., Dejonckheere, P., & Roets, A. (2006). 'When Suppression Backfires': The Ironic Effects of Suppressing Eating-related Thoughts. *Journal of Health Psychology, 11*(5), 655-668. doi: 10.1177/1359105306066615

Sofuoglu, M., DeVito, E. E., Waters, A. J., & Carroll, K. M. (2013). Cognitive enhancement as a treatment for drug addictions. *Neuropharmacology, 64*(0), 452-463. doi: 10.1016/j.neuropharm.2012.06.021

Spear, L. P. (2000). The adolescent brain and age-related behavioral manifestations. *Neuroscience and Biobehavioral Reviews, 24*(4), 417-463. doi: 10.1016/s0149-7634(00)00014-2

Spear, L. P. (2009). Heightened stress responsivity and emotional reactivity during pubertal maturation: Implications for psychopathology. *Development and Psychopathology, 21*(01), 87-97. doi: 10.1017/S0954579409000066

Spijkerman, R., van den Eijnden, R. J., Vitale, S., & Engels, R. C. (2004). Explaining adolescents' smoking and drinking behavior: The concept of smoker and drinker prototypes in relation to variables of the theory of planned behavior. *Addictive Behaviors, 29*(8), 1615-1622. doi: 10.1016/j.addbeh.2004.02.030

Stacy, A. W. (1997). Memory Activation and Expectancy as Prospective Predictors of Alcohol and Marijuana Use. *Journal of Abnormal Psychology, 106*(1), 61-73. doi: 10.1037/0021-843X.106.1.61

Stacy, A. W., Ames, S. L., Grenard, J. L., & Wiers, R. W. (2006). Word Association Tests of Associative Memory and Implicit Processes: Theoretical and Assessment Issues *Handbook of implicit cognition and addiction.* (pp. 75-90). Thousand Oaks, CA US: Sage Publications, Inc.

Stacy, A. W., Ames, S. L., Wiers, R. W., & Krank, M. D. (2010). Associative memory in appetitive behavior: Framework and relevance to epidemiology and prevention. In P. L. Scheier (Ed.), *Handbook of drug use etiology: Theory, methods, and empirical findings.* (pp. 165-182). Washington, DC US: American Psychological Association.

Stacy, A. W., Leigh, B. C., & Weingardt, K. R. (1994). Memory accessibility and association of alcohol use and its positive outcomes. *Experimental and Clinical Psychopharmacology, 2*(3), 269-282. doi: 10.1037/1064-1297.2.3.269

Stacy, A. W., & Wiers, R. W. (Eds.). (2006). *An implicit cognition, associative memory framework for addiction*.

Steiger, J. H. (2007). Understanding the limitations of global fit assessment in structural equation modeling. *Personality and Individual Differences, 42*(5), 893-898. doi: 10.1016/j.paid.2006.09.017

Steinberg, L. (2008). A social neuroscience perspective on adolescent risk-taking. *Developmental Review, 28*(1), 78-106. doi: 10.1016/j.dr.2007.08.002

Stewart, J., de Wit, H., & Eikelboom, R. (1984). Role of unconditioned and conditioned drug effects in the self-administration of opiates and stimulants. *Psychological Review, 91*(2), 251-268. doi: 10.1037/0033-295X.91.2.251

Stormark, K. M., Field, N. P., Hugdahl, K., & Horowitz, M. (1997). Selective processing of visual alcohol cues in abstinent alcoholics: An approach-avoidance conflict? *Addictive Behaviors, 22*(4), 509-519. doi: 10.1016/S0306-4603(96)00051-2

Stormark, K. M., Laberg, J. C., Nordby, H., & Hugdahl, K. (2000). Alcoholics' selective attention to alcohol stimuli: Automated processing? *Journal of Studies on Alcohol, 61*(1), 18-23.

Strack, F., & Deutsch, R. (2004). Reflective and Impulsive Determinants of Social Behavior. *Personality and Social Psychology Review, 8*(3), 220-247. doi: 10.1207/s15327957pspr0803_1

Suls, J., Wan, C. K., & Sanders, G. S. (1988). False consensus and false uniqueness in estimating the prevalence of health-protective behaviors. *Journal of Applied Social Psychology, 18*(1), 66-79. doi: 10.1111/j.1559-1816.1988.tb00006.x

Sussman, S. (2010). Cognitive misperceptions and drug misuse. In P. L. Scheier (Ed.), *Handbook of drug use etiology: Theory, methods, and empirical findings.* (pp. 617-629). Washington, DC US: American Psychological Association.

Sussman, S., Dent, C. W., Mestel-Rauch, J., & Johnson, C. A. (1988). Adolescent nonsmokers, triers, and regular smokers' estimates of cigarette smoking prevalence: When do overestimations occur and by whom? *Journal of Applied Social Psychology, 18*(71), 537-551. doi: 10.1111/j.1559-1816.1988.tb00035.x

Sussman, S., Pokhrel, P., Ashmore, R. D., & Brown, B. B. (2007). Adolescent peer group identification and characteristics: A review of the literature. *Addictive Behaviors, 32*(8), 1602-1627. doi: 10.1016/j.addbeh.2006.11.018

Sussman, S., Skara, S., & Ames, S. L. (2008). Substance abuse among adolescents. *Substance Use & Misuse, 43*(12), 1802-1828. doi: 10.1080/10826080802297302

Sutton, S. (1999). How accurate are smokers' perceptions of risk? *Health, risk & society, 1*(2), 223-230. doi: 10.1080/13698579908407020

Sutton, S. (Ed.). (1989). *Smoking attitudes and behavior: Applications of Fishbein and Ajzen's Theory of Reasoned Action to predicting and understanding smoking decisions*.

Sutton, S., & Bolling, K. D. (2003). Adolescents' perceptions of the risks and prevalence of smoking. *Zeitschrift für Gesundheitspsychologie, 11*(3), 107-111. doi: 10.1026//0943-8149.11.3.107

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics (5th ed.)*. Boston, MA: Allyn & Bacon/Pearson Education.

Taylor, W. C., Ayars, C. L., Gladney, A. P., Peters, R. J., Jr., Roy, J. R., Prokhorov, A. V., . . . Gritz, E. R. (1999). Beliefs about smoking among adolescents: Gender and ethnic differences. *Journal of Child & Adolescent Substance Abuse, 8*(3), 37-54. doi: 10.1300/J029v08n03_03

ter Doest, L., Dijkstra, A., Gebhardt, W. A., & Vitale, S. (2009). Cognitions about smoking and not smoking in adolescence. *Health Education & Behavior, 36*(4), 660-672. doi: 10.1177/1090198107301329

Terry, D. J., & Hogg, M. A. (1996). Group norms and the attitude-behavior relationship: A role for group identification. *Personality and Social Psychology Bulletin, 22*(8), 776-793. doi: 10.1177/0146167296228002

Thush, C., Wiers, R. W., Ames, S. L., Grenard, J. L., Sussman, S., & Stacy, A. W. (2007). Apples and oranges? Comparing indirect measures of alcohol-related cognition predicting alcohol use in at-risk adolescents. *Psychology of Addictive Behaviors, 21*(4), 587-591. doi: 10.1037/0893-164X.21.4.587

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

Tiffany, S. T. (1995). The role of cognitive factors in reactivity to drug cues. In D. C. Drummond, S. T. Tiffany, S. Glautier & B. Remington (Eds.), *Addictive behaviour: Cue exposure theory and practice.* (pp. 137-165). Oxford England: John Wiley & Sons.

Tomarken, A. J., & Waller, N. G. (2003). Potential Problems With 'Well Fitting' Models. *Journal of Abnormal Psychology, 112*(4), 578-598. doi: 10.1037/0021-843x.112.4.578

Townshend, J. M., & Duka, T. (2001). Attentional bias associated with alcohol cues: Differences between heavy and occasional social drinkers. *Psychopharmacology, 157*(1), 67-74. doi: 10.1007/s002130100764

Turner, L., Mermelstein, R., & Flay, B. (2004). Individual and contextual influences on adolescent smoking. In R. E. Dahl & L. P. Spear (Eds.), *Adolescent brain development: Vulnerabilities and opportunities.* (pp. 175-197). New York, NY US: New York Academy of Sciences.

Ullman, J. B. (2001). Structural equation modeling. In B. G. Tabachnick & L. S. Fidell (Eds.), *Using multivariate statistics (4th ed.).* Needham Heights, MA: Allyn & Bacon.

Unger, J. B., & Rohrbach, L. A. (2002). Why do adolescents overestimate their peers' smoking prevalence? Correlates of prevalence estimates among California 8th-grade students. *Journal of Youth and Adolescence, 31*(2), 147-153. doi: 10.1023/A:1014074027415

van Hanswijck de Jonge, L., & Gormley, M. (2005). Responses to positive and negative smoking-related images: Effects of current smoking status and degree of smoking addiction. *Addictive Behaviors, 30*(8), 1587-1591. doi: 10.1016/j.addbeh.2005.03.006

Vandenberg, R. J., & Lance, C. E. (2000). A review and synthesis of the measurement invariance literature: Suggestions, practices, and recommendations for organizational research. *Organizational Research Methods, 3*(1), 4-69. doi: 10.1177/109442810031002

Viscusi, W. K. (1991). Age variations in risk perceptions and smoking decisions. *The Review of Economics and Statistics*, 577-588. doi: 10.2307/2109396

Viscusi, W. K. (1992). *Smoking: Making the risky decision*. New York, NY US: Oxford University Press.

Vitória, P. D., Salgueiro, M. F., Silva, S. A., & de Vries, H. (2011). Social influence, intention to smoke, and adolescent smoking behaviour longitudinal relations. *British Journal of Health Psychology, 16*(4), 779-798. doi: 10.1111/j.2044-8287.2010.02014.x

Vries, H. D., Backbier, E., Kok, G., & Dijkstra, M. (1995). The Impact of Social Influences in the Context of Attitude, Self-Efficacy, Intention, and Previous

Behavior as Predictors of Smoking Onset1. *Journal of Applied Social Psychology, 25*(3), 237-257. doi: 10.1111/j.1559-1816.1995.tb01593.x

Wahl, S. K., Turner, L. R., Mermelstein, R. J., & Flay, B. R. (2005). Adolescents' smoking expectancies: Psychometric properties and prediction of behavior change. *Nicotine & Tobacco Research, 7*(4), 613-623. doi: 10.1080/14622200500185579

Warshaw, P. R., & Davis, F. D. (1985). Disentangling behavioral intention and behavioral expectation. *Journal of Experimental Social Psychology, 21*(3), 213-228. doi: 10.1016/0022-1031(85)90017-4

Waters, A. J., Carter, B. L., Robinson, J. D., Wetter, D. W., Lam, C. Y., & Cinciripini, P. M. (2007). Implicit attitudes to smoking are associated with craving and dependence. *Drug and Alcohol Dependence, 91*(2–3), 178-186. doi: 10.1016/j.drugalcdep.2007.05.024

Waters, A. J., Carter, B. L., Robinson, J. D., Wetter, D. W., Lam, C. Y., Kerst, W., & Cinciripini, P. M. (2009). Attentional bias is associated with incentive-related physiological and subjective measures. *Experimental and Clinical Psychopharmacology; Experimental and Clinical Psychopharmacology, 17*(4), 247. doi: 10.1037/a0016658

Waters, A. J., & Feyerabend, C. (2000). Determinants and Effects of Attentional Bias in Smokers. *Psychology of Addictive Behaviors, 14*(2), 111-120. doi: 10.1037/0893-164X.14.2.111

Waters, A. J., & Li, Y. (2008). Evaluating the utility of administering a reaction time task in an ecological momentary assessment study. *Psychopharmacology, 197*(1), 25-35. doi: 10.1007/s00213-007-1006-6

Waters, A. J., Reitzel, L. R., Cinciripini, P., Li, Y., Marcus, M. T., Vidrine, J. I., & Wetter, D. W. (2009). Associations between mindfulness and implicit cognition and self-reported affect. *Substance Abuse, 30*(4), 328-337. doi: 10.1080/08897070903252080

Waters, A. J., & Sayette, M. A. (2006). Implicit Cognition and Tobacco Addiction. In R. W. Wiers & A. W. Stacy (Eds.), *Handbook of implicit cognition and addiction.* (pp. 309-338). Thousand Oaks, CA US: Sage Publications, Inc.

Waters, A. J., Sayette, M. A., & Wertz, J. M. (2003). Carry-over effects can modulate emotional Stroop effects. *Cognition & Emotion, 17*(3), 501-509. doi: 10.1080/02699930143000716

Waters, A. J., Shiffman, S., Bradley, B. P., & Mogg, K. (2003). Attentional shifts to smoking cues in smokers. *Addiction, 98*(10), 1409-1417. doi: 10.1046/j.1360-0443.2003.00465.x

Waters, A. J., Shiffman, S., Sayette, M. A., Paty, J. A., Gwaltney, C. J., & Balabanis, M. H. (2003). Attentional Bias Predicts Outcome in Smoking Cessation. *Health Psychology, 22*(4), 378-387. doi: 10.1037/0278-6133.22.4.378

Waters, A. J., Shiffman, S., Sayette, M. A., Paty, J. A., Gwaltney, C. J., & Balabanis, M. H. (2004). Cue-Provoked Craving and Nicotine Replacement Therapy in Smoking Cessation. *Journal of Consulting and Clinical Psychology, 72*(6), 1136-1143. doi: 10.1037/0022-006X.72.6.1136

Wegner, D. M. (1994). Ironic processes of mental control. *Psychological Review, 101*(1), 34-52. doi: 10.1037/0033-295X.101.1.34

Wegner, D. M., & Erber, R. (1992). The hyperaccessibility of suppressed thoughts. *Journal of Personality and Social Psychology, 63*(6), 903-912. doi: 10.1037/0022-3514.63.6.903

Wegner, D. M., & Zanakos, S. (1994). Chronic thought suppression. *Journal of Personality, 62*(4), 615-640. doi: 10.1111/j.1467-6494.1994.tb00311.x

Weingardt, K. R., Stacy, A. W., & Leigh, B. C. (1996). Automatic activation of alcohol concepts in response to positive outcomes of alcohol use. *Alcoholism: Clinical and Experimental Research, 20*(1), 25-30. doi: 10.1111/j.1530-0277.1996.tb01038.x

Weinstein, A., & Cox, W. M. (2006). Cognitive processing of drug-related stimuli: The role of memory and attention. *Journal of Psychopharmacology, 20*(6), 850-859. doi: 10.1177/0269881106061116

Weinstein, N. D. (1987). Unrealistic optimism about susceptibility to health problems: Conclusions from a community-wide sample. *Journal of Behavioral Medicine, 10*(5), 481-500. doi: 10.1007/bf00846146

Weinstein, N. D. (1998). Accuracy of smokers' risk perceptions. *Annals of Behavioral Medicine, 20*(2), 135-140. doi: 10.1007/bf02884459

Weinstein, N. D. (2001). Smokers' recognition of their vulnerability to harm. In P. Slovic (Ed.), *Smoking: Risk, perception, & policy.* (pp. 81-96). Thousand Oaks, CA US: Sage Publications, Inc.

Weinstein, N. D., Marcus, S. E., & Moser, R. P. (2005). Smokers’ unrealistic optimism about their risk. *Tobacco control, 14*(1), 55-59. doi: 10.1136/tc.2004.008375

Wellman, R. J., DiFranza, J. R., Savageau, J. A., & Dussault, G. F. (2004). Short term patterns of early smoking acquisition. *Tobacco control, 13*(3), 251-257. doi: 10.1136/tc.2003.005595

Wellman, R. J., Savageau, J. A., Godiwala, S., Savageau, N., Friedman, K., Hazelton, J., & DiFranza, J. R. (2006). A comparison of the Hooked on Nicotine Checklist and the

Fagerstrom Test for Nicotine Dependence in adult smokers. *Nicotine & Tobacco Research, 8*(4), 575-580. doi: 10.1080/14622200600789965

Wells, A., & Davies, M. I. (1994). The Thought Control Questionnaire: A measure of individual differences in the control of unwanted thoughts. *Behaviour Research and Therapy, 32*(8), 871-878. doi: 10.1016/0005-7967(94)90168-6

Welte, J. W., & Russell, M. (1993). Influence of socially desirable responding in a study of stress and substance abuse. *Alcoholism: Clinical and Experimental Research, 17*(4), 758-761. doi: 10.1111/j.1530-0277.1993.tb00836.x

Wentura, D., Rothermund, K., & Bak, P. (2000). Automatic vigilance: the attention-grabbing power of approach-and avoidance-related social information. *Journal of Personality and Social Psychology, 78*(6), 1024. doi: 10.1037/0022-3514.78.6.1024

Wenzlaff, R. M., & Wegner, D. M. (2000). Thought suppression. *Annual Review of Psychology, 51*, 59-91. doi: 10.1146/annurev.psych.51.1.59

Wertz, J. M., & Sayette, M. A. (2001). Effects of Smoking Opportunity on Attentional Bias in Smokers. *Psychology of Addictive Behaviors, 15*(3), 268-271. doi: 10.1037/0893-164X.15.3.268

West, R., & Schneider, N. (1987). Craving for cigarettes. *British Journal of Addiction, 82*(4), 407-415. doi: 10.1111/j.1360-0443.1987.tb01496.x

Wetter, D. W., Smith, S. S., Kenford, S. L., Jorenby, D. E., Fiore, M. C., Hurt, R. D., . . . Baker, T. B. (1994). Smoking outcome expectancies: Factor structure, predictive validity, and discriminant validity. *Journal of Abnormal Psychology, 103*(4), 801-811. doi: 10.1037/0021-843X.103.4.801

Wheeler, K. C., Fletcher, K. E., Wellman, R. J., & Difranza, J. R. (2004). Screening adolescents for nicotine dependence: The hooked on nicotine checklist. *Journal of Adolescent Health, 35*(3), 225-230. doi: 10.1016/j.jadohealth.2003.10.004

Wheeler, R. A., Twining, R. C., Jones, J. L., Slater, J. M., Grigson, P. S., & Carelli, R. M. (2008). Behavioral and electrophysiological indices of negative affect predict cocaine self-administration. *Neuron, 57*(5), 774-785. doi: 10.1016/j.neuron.2008.01.024

White, K. M., Smith, J. R., Terry, D. J., Greenslade, J. H., & McKimmie, B. M. (2009). Social influence in the theory of planned behaviour: The role of descriptive, injunctive, and in-group norms. *British Journal of Social Psychology, 48*(1), 135-158. doi: 10.1348/014466608X295207

Wiers, R. W., de Jong, P. J., Havermans, R., & Jelicic, M. (2004). How to Change Implicit Drug Use-Related Cognitions in Prevention: A Transdisciplinary Integration of

Findings from Experimental Psychopathology, Social Cognition, Memory, and Experimental Learning Psychology. *Substance Use & Misuse, 39*(10), 1625-1684. doi: 10.1081/JA-200033206

Wiers, R. W., Gladwin, T. E., Hofmann, W., Salemink, E., & Ridderinkhof, K. R. (2013). Cognitive Bias Modification and Cognitive Control Training in Addiction and Related Psychopathology: Mechanisms, Clinical Perspectives, and Ways Forward. *Clinical Psychological Science, 1*(2), 192-212. doi: 10.1177/2167702612466547

Wiers, R. W., & Stacy, A. W. (2006). Implicit Cognition and Addiction. *Current Directions in Psychological Science, 15*(6), 292-296. doi: 10.1111/j.1467-8721.2006.00455.x

Wiers, R. W., Van Woerden, N., Smulders, F. T. Y., & De Jong, P. J. (2002). Implicit and explicit alcohol-related cognitions in heavy and light drinkers. *Journal of Abnormal Psychology, 111*(4), 648-658. doi: 10.1037/0021-843X.111.4.648

Williams, J. M. G., Mathews, A., & MacLeod, C. (1996). The Emotional Stroop Task and Psychopathology. *Psychological Bulletin, 120*(1), 3-24. doi: 10.1037/0033-2909.120.1.3

Williams, T., & Clarke, V. A. (1997). Optimistic bias in beliefs about smoking. *Australian Journal of Psychology, 49*(2), 106-112. doi: 10.1080/00049539708259861

Wilson, T. D., Lindsey, S., & Schooler, T. Y. (2000). A model of dual attitudes. *Psychological Review, 107*(1), 101-126. doi: 10.1037/0033-295X.107.1.101

Wise, R. A., & Bozarth, M. A. (1987). A psychomotor stimulant theory of addiction. *Psychological Review, 94*(4), 469-492. doi: 10.1037/0033-295X.94.4.469

Witte, K. (1992). Putting the fear back into fear appeals: The extended parallel process model. *Communication Monographs, 59*(4), 329-349. doi: 10.1080/03637759209376276

Wolfson, S. (2000). Students' estimates of the prevalence of drug use: Evidence for a false consensus effect. *Psychology of Addictive Behaviors, 14*(3), 295-298. doi: 10.1037/0893-164X.14.3.295

World Health Organisation. (2011). *Global status report on noncommunicable diseases 2010*. Retrieved from http://www.who.int/nmh/publications/ncd_report2010/en/index.html.

World Health Organisation. (2012a), from http://www.who.int/substance_abuse/terminology/definition1/en/

World Health Organisation. (2012b). *Tobacco Fact Sheet No. 339.* Retrieved from http://www.who.int/mediacentre/factsheets/fs339/en/index.html.

Zack, M., Belsito, L., Scher, R., Eissenberg, T., & Corrigall, W. A. (2001). Effects of abstinence and smoking on information processing in adolescent smokers. *Psychopharmacology, 153*(2), 249-257. doi: 10.1007/s002130000552

Zack, M., Toneatto, T., & MacLeod, C. M. (1999). Implicit activation of alcohol concepts by negative affective cues distinguishes between problem drinkers with high and low psychiatric distress. *Journal of Abnormal Psychology*, *108*(3), 518-531. doi: 10.1037/0021-843X.108.3.518

Zajonc, R., Crandall, R., Kail Jr, R. V., & Swap, W. (1974). Effect of extreme exposure frequencies on different affective ratings of stimuli. *Perceptual and Motor Skills, 38*(2), 667-678. doi: 10.2466/pms.1974.38.2.667

Zgierska, A., Rabago, D., Chawla, N., Kushner, K., Koehler, R., & Marlatt, A. (2009). Mindfulness meditation for substance use disorders: a systematic review. *Substance Abuse*, *30*(4), 266-294. doi: 10.1080/08897070903250019

Zinser, M. C., Baker, T. B., Sherman, J. E., & Cannon, D. S. (1992). Relation between self-reported affect and drug urges and cravings in continuing and withdrawing smokers. *Journal of Abnormal Psychology*, *101*(4), 617-629. doi: 10.1037/0021-843x.101.4.617

Appendix 1: Ethical Approval for Studies 1 and 2

COLÁISTE NA TRÍONÓIDE, BAILE ÁTHA CLIATH | TRINITY COLLEGE DUBLIN
Ollscoil Átha Cliath | The University of Dublin

12th February 2010

F.A.O. Louise Hopper

School of Psychology Research Ethics Committee

Dear Louise,

I am pleased to inform you that your application entitled "Suppression of smoking-related information" has been approved by the School of Psychology Research Ethics Committee.

Yours sincerely,

Dr. Tim Trimble
Chair
School of Psychology Research Ethics Committee

SCHOOL OF PSYCHOLOGY
Aras an Phairsaigh
Trinity College
Dublin 2

Scoil na Siceolaíochta,
Dámh na nEolaíochtaí Sóisialta agus Daonna,
Áras an Phiarsaigh, Coláiste na Tríonóide,
Baile Átha Cliath 2, Éire

School of Psychology,
Faculty of Arts, Humanities and Social Sciences,
Áras an Phiarsaigh, Trinity College,
Dublin 2, Ireland

T 353 (0)1 896 1886
F 353 (0)1 671 2006
psychology@tcd.ie
www.psychology.tcd.ie

Appendix 2: Consent Forms, and Debrief Sheets for Studies 1 and 2

2.1 School Consent Form

<School>
<Address>

22/02/2010

Dear <Principal>,

My name is Louise Hopper and I am a postgraduate research student in the School of Psychology, Trinity College, Dublin. As part of my PhD research project, I am investigating how adults and adolescents think about smoking, what they see as the potential costs or benefits of smoking, and what kind of differences exist across the age groups. I will also be investigating if smokers are more inclined to suppress negative smoking-related information than positive or neutral information. It is hoped that the results will contribute to our understanding of why many adolescents start to smoke, if there are differences in the way they view smoking information, when compared with adults, and if this information can help in the development of smoking prevention and cessation programmes. I am hoping you will agree to allow students from your school to participate in this research.

The study itself will be carried out in two parts each taking approximately 30 minutes to complete. In the first instance groups of participants will be asked to complete some questionnaires. They will be asked for a small amount of personal information (age, gender, current smoking status) and for an indication of their intention to smoke/not smoke in the next six months. They will also be asked to provide details such as, how many cigarettes they smoke a day/week, how long they have been smoking, and how dependent they are on cigarettes, using questions such as '*Have you ever felt like you really need a cigarette*?' and '*Is it hard to keep from smoking in places where you are not supposed to, like school*?'

Once these responses have been analysed, an equal number of smokers and non-smokers will be randomly selected to take part in phase two of the study. Here participants will be tested individually. They will be asked to complete a series of computerized tasks which include indicating whether a set of letters make up a word or are just nonsense, identifying the colour of a border that surrounds an image, and pinpointing the location of a symbol which will replace one of two displayed images. Some of the words and images used will be smoking-related and participants will be asked to rate these for the clarity of their smoking content and for the positive or negative feelings they generate.

With your agreement, the testing will take place on the school premises. For phase two, it would be preferable to have a quiet area that minimises distractions and allows the participant to concentrate. All materials will be provided by the researcher including the laptop and software required to run the computerized tasks. All information collected will be treated in the strictest confidence. Each participant will be assigned an ID code which will be used throughout the study instead of their name. This will ensure all answers remain anonymous. Computerised data will be password protected and printed documents will be kept in a secure filing cabinet accessed only by the researcher and the research supervisor. Participants will be entitled to access their data in accordance with the Freedom of Information Act.

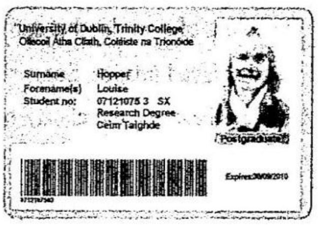
I will be recruiting up to 120 adolescent participants for this study. This number is broken down into 60 students aged 12-15 years (30 smokers and 30 non-smokers) and 60 students aged 16-18 years (30 smokers and 30 non-smokers). Information and consent forms will be provided for both parental and participant consent. Both parents and students are free to withdraw from the study at any time without any negative consequences. The school is not obliged to participate in this study and it is free to withdraw at any time by informing one of researchers in person, by email, or by telephone. There will be no negative consequences should the school choose to withdraw from all or any part of the study.

I very much hope that you will allow students from your school to engage in this research. If you agree to participate, please sign and the return the enclosed 'Intention to Participate' form. Please also keep this letter and a copy of the form for your own records. If you have questions on any aspect of this study, or queries regarding your participation in it, please contact me. I would be delighted to discuss it in more detail with you if you wish. This research project is supervised by Dr. Michael Gormley, who may also be contacted if required.

Researcher: Louise Hopper
School of Psychology
Trinity College Dublin
Dublin 2
Ph: (086) 8186470
hopperl@tcd.ie

Supervisor: Dr. Michael Gormley
School of Psychology
Trinity College Dublin
Dublin 2
Ph: (01) 8963903
Michael.Gormley@tcd.ie

Yours sincerely,



____
Louise Hopper

Intention to Participate Form (Schools)

Name of Participating School: ____

Address: ____

____

I have read and understand the information provided in the letter dated 22/02/2010 and I hereby consent that this school will take part in this study. I understand that the school is not obliged to participate and that it is free to withdraw at any time by informing one of researchers in person, by email, or by telephone. There will be no negative consequences should the school choose to withdraw from all or any part of the study.

Signed: ______________________________________

Print Name: ______________________________

Position: ____________________________________

Email: ______________________________________

Telephone number: ___________________________

Please keep a copy of this consent form for your own records.

2.2 Parental Consent Form

Dear Parent,

My name is Louise Hopper and I am a postgraduate research student in the School of Psychology, Trinity College, Dublin. As part of my PhD research project, I am investigating how adults and adolescents think about smoking, what they see as the potential costs or benefits of smoking, and what kind of differences exist across the age groups. This research has been approved by the Psychology Ethics Committee at Trinity College Dublin. It is hoped that the results will contribute to our understanding of why many adolescents start to smoke, if there are differences in the way they view smoking information, when compared with adults, and if this information can help in the development of smoking prevention and cessation programmes.

The research will be conducted in two parts. Each will take approximately 30 minutes and will take place on school premises. Phase one involves completing a number of questionnaires. Participants will be asked to indicate their age, gender, whether or not they currently smoke and if they intend to smoke/not smoke in the next six months. They will also be asked to provide details such as, how many cigarettes they smoke a day/week and how long they have been smoking, and to answer a series of questions measuring how dependent they are on cigarettes, such as '*Have you ever felt like you really need a cigarette*?' and '*Is it hard to keep from smoking in places where you are not supposed to, like school*?'

Once the results of the first phase have been analysed some smoking and non-smoking participants will be randomly selected to take part in phase two of the study which will also take approximately 30 minutes. Participants will be asked to complete a series of computerized tasks which involve measuring the difference in reaction times to smoking-related and non-smoking-related pictures.

All information collected will be treated in the strictest confidence. Each participant will be assigned an ID code which will be used throughout the study instead of their name. All materials that students have completed will remain anonymous. Computerised data will be password protected and printed documents will be kept in a secure filing cabinet accessed only by the researcher and the research supervisor. Participants will be entitled to access their data in accordance with the Freedom of Information Act.

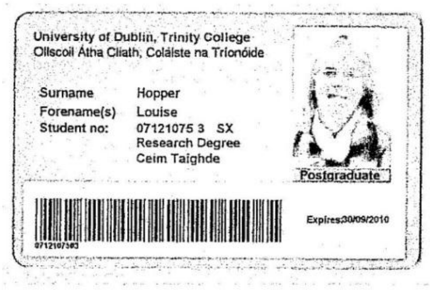
Your child does not have to take part in this study if you do not want them to and he/she is free to withdraw at any time without any negative consequences. If you agree to their participation, please sign the consent form overleaf and return to the school. Please keep this letter for your own personal records.

If you have questions on any aspect of this study, or queries regarding your participation in it, please contact me. This research project is supervised by Dr. Michael Gormley, who may also be contacted as required.

Researcher: Louise Hopper
School of Psychology
Trinity College Dublin
Dublin 2
Ph: (086) 8186470
hopperl@tcd.ie

Supervisor: Dr. Michael Gormley
School of Psychology
Trinity College Dublin
Dublin 2
Ph: (01) 8963903
Michael.Gormley@tcd.ie

Yours sincerely,



____
Louise Hopper

Copy of consent details for own records

School: ____

Name of Student: ________________________ **Date of Birth:** ______________ **Class:** ______

I have read and understand the information provided in this letter and I hereby consent that my son/daughter can take part in this study. I understand that he/she is not obliged to participate and that he/she is free to withdraw at any time. There will be no negative consequences should he/she choose to withdraw from all or any part of the study.

Signed:________________________ **Name:**________________________ **Date:** ______________

(Signature) *(Block Capitals)*

Parental Consent Form

Please list each child separately and return to the school when complete.

School: ______________________________________

Name of Student	Date of Birth	Class

I have read and understand the information provided in this letter and I hereby consent that my son/daughter can take part in this study. I understand that he/she is not obliged to participate and that he/she is free to withdraw at any time. There will be no negative consequences should he/she choose to withdraw from all or any part of the study.

Signed:______________________________ **Name:**______________________________

(Signature) *(Block Capitals)*

Date: ____________

2.3 Adolescent Consent Form

Dear potential participant,

My name is Louise Hopper and I am a postgraduate research student in the School of Psychology, Trinity College, Dublin. As part of my PhD research project, I am investigating how adults and adolescents think about smoking and I would like to ask you to take part in a study that will take place in your school.

The first part of the study will take approximately 30 minutes to complete. It will involve answering a number of questions related to smoking and to how you generally think about things in every-day life. Some of you, both smokers and non-smokers, will be asked to take part in a second phase of the study on another day. It will also take about 30 minutes. This time you will be asked to complete a series of computer-based tasks which will involve deciding if a series of letters displayed on the screen make a word or are just nonsense, where a particular symbol appears each time on a screen, and to identify the colour of a border around a series of images.

This research has been approved by the Psychology Ethics Committee at Trinity College Dublin. All information collected will be treated in the strictest confidence. ID codes, rather than names, will be used throughout the study to ensure that all tasks you complete remain anonymous. Computerised data will be password protected and printed documents will be kept in a secure filing cabinet accessed only by the researcher and the research supervisor. You will be entitled to access your data in accordance with the Freedom of Information Act.

You do not have to take part in this study if you do not want to and you are free to withdraw at any time without prejudice. If you agree to participate, please sign the consent form overleaf and keep a copy of this letter for your own personal records. If you have questions on any aspect of this study, or queries regarding your participation in it, please contact me. This research project is supervised by Dr. Michael Gormley, who may also be contacted as required.

Researcher: Louise Hopper
School of Psychology
Trinity College Dublin
Dublin 2
hopperl@tcd.ie

Supervisor: Dr. Michael Gormley
School of Psychology
Trinity College Dublin
Dublin 2
Ph: (01) 8963903
Michael.Gormley@tcd.ie

Yours sincerely,

____
Louise Hopper

To Be Returned to the Researcher

Consent Form – Study 1

I have read and understand the information provided in this letter and I agree to take part in the first phase of this study. I understand that I am not obliged to participate and that I am free to withdraw at any time without any negative consequences.

School: ______________________________ **Class:** __________

Name:______________________ **Date of Birth:** ____________
(Block Capitals)

Signed:______________________ **Date:**______________
(Signature)

Consent Form – Study 2

I have read and understand the information provided in this letter and I agree to take part in the second phase of this study. I understand that I am not obliged to participate and that I am free to withdraw at any time without any negative consequences.

Name:______________________ **Date of Birth:** ____________
(Block Capitals)

Signed:______________________ **Date:**______________
(Signature)

2.4 Adult Consent Form

Dear potential participant,

My name is Louise Hopper and I am a postgraduate research student in the School of Psychology, Trinity College, Dublin. As part of my PhD research project, I am investigating how adults and adolescents think about smoking. This involves a 30 minute study during which you will be asked to answer a number of questions related to smoking and to how you generally think about things in every-day life. Once these responses have been analysed, you may be selected to take part in a second 30 minute study. In this case, you will be asked

to complete a series of computerized tasks which involve indicating whether a set of letters make up a word or are just nonsense, identifying the colour of a border that surrounds an image, and pinpointing the location of a symbol which appears in different locations on a screen. The resulting data will hopefully provide a better understanding of the differences between how adolescent and adult smokers and non-smokers process smoking-related information.

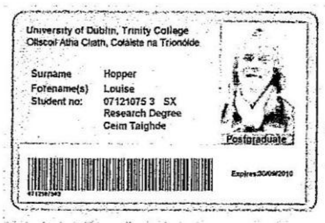
This research has been approved by the Psychology Ethics Committee at Trinity College Dublin. All information collected will be treated in the strictest confidence. Participant ID codes will be used throughout the study to ensure that all tasks completed will remain anonymous. Computerised data will be password protected and printed documents will be kept in a secure filing cabinet accessed only by the researcher and the research supervisor. You will be entitled to access your data in accordance with the Freedom of Information Act.

You do not have to take part in this study if you do not want to and you are free to withdraw at any time without prejudice. If you agree to participate, please sign the consent form overleaf and keep a copy of this letter for your own personal records. You are also asked to provide email and/or phone contact details so that a study time can be arranged with you. If you have questions on any aspect of this study, or queries regarding your participation in it, please contact me. This research project is supervised by Dr. Michael Gormley, who may also be contacted as required.

Researcher: Louise Hopper
School of Psychology
Trinity College Dublin
Dublin 2
Ph: (086) 8186470
hopperl@tcd.ie

Supervisor: Dr. Michael Gormley
School of Psychology
Trinity College Dublin
Dublin 2
Ph: (01) 8963903
Michael.Gormley@tcd.ie

Yours sincerely,



____
Louise Hopper

To Be Returned to the Researcher

Consent Form – Study 1

I have read and understand the information provided in this letter and I hereby consent that I will take part in phase 1 of this study. I understand that I am not obliged to participate and that I am free to withdraw at any time by informing one of the researchers in person, by email, or by telephone. There will be no negative consequences should I choose to withdraw from all or any part of the study.

Signed:______________________ **Name:**____________________ **Date of Birth:** _______

(Signature) *(Block Capitals)*

Date:__________________ **Email:**______________________________ **Phone:**___________

Consent Form – Study 2

I have read and understand the information provided in this letter and I hereby consent that I will take phase 2 of this study. I understand that I am not obliged to participate and that I am free to withdraw at any time by informing one of the researchers in person, by email, or by telephone. There will be no negative consequences should I choose to withdraw from all or any part of the study.

Signed:______________________ **Name:**____________________ **Date of Birth:** _______

(Signature) *(Block Capitals)*

Date:__________________

2.6 Debriefing Sheet (Study 1)

Participant Debriefing Sheet - Study 1

Dear Participant,

Thank you for taking part in this research study.

The initial questionnaires that you responded to specifically measured smoking consequences. The remaining questionnaires measured how you control the information that you think about on a daily basis and they gathered some personal information, details of your own smoking behaviour and a measure your level of dependence on nicotine. All results will be analysed across four age ranges (12-15 years, 15-18 years, 19-25 years and 26-40 years) and for both smokers and non-smokers. The results are expected to show differences in consequences generated by smokers and non-smokers in each age group and differences between smokers across age groups.

All information that you have provided during these tasks, will be analysed as part of this research study. It will be treated with the strictest of confidence and stored on file anonymously and securely. In accordance with the Freedom of Information Act 1977 (amended 2003), you have the right to request access to your personal data, and the overall results of the study, at any time.

If you have any further questions or concerns please feel free to contact myself or my supervisor.

Researcher: Louise Hopper
School of Psychology
Trinity College Dublin
Dublin 2
Ph: (086) 8186470
hopperl@tcd.ie

Supervisor: Dr. Michael Gormley
School of Psychology
Trinity College Dublin
Dublin 2
Ph: (01) 8963903
Michael.Gormley@tcd.ie

2.7 Debriefing Sheet (Study 2)

Participant Debriefing Sheet - Study 2

Dear Participant,

Thank you for taking part in this research study which was designed to examine the positive and negative consequences that you associate with smoking and if they bear any relation to how your attention is captured by smoking, in comparison to neutral, images. Study results will be analysed across four age ranges (12-15 years, 15-18 years, 19-25 years and 26-40 years) and for both smokers and non-smokers.

The initial questionnaires that you responded to specifically measured smoking consequences. The remaining questionnaires measured how you control the information that you think about on a daily basis and they gathered some personal information, details of your own smoking behaviour and a measure your level of dependence on nicotine. The results are expected to show differences in consequences generated by smokers and non-smokers in each age group and differences between smokers across age groups. The first computer task assessed the speed with which you identified valid smoking-related words in comparison to non-smoking related words, while the second and third tasks assessed the extent to which your attention was captured by smoking related pictures, as opposed to neutral images. Again differences are expected between smokers and non-smokers and across the different age ranges.

All information that you have provided during these tasks, will be analysed as part of this research study. It will be treated with the strictest of confidence and stored on file anonymously and securely. In accordance with the Freedom of Information Act 1977 (amended 2003), you have the right to request access to your personal data, and the overall results of the study, at any time.

If you have any further questions or concerns please feel free to contact myself or my supervisor.

Researcher: Louise Hopper
School of Psychology
Trinity College Dublin
Dublin 2
Ph: (086) 8186470
hopperl@tcd.ie

Supervisor: Dr. Michael Gormley
School of Psychology
Trinity College Dublin
Dublin 2
Ph: (01) 8963903
Michael.Gormley@tcd.ie

Appendix 3: Revised-SCQ Measure used in Study 1

Participant Identifier:__________________________ **Date:**__________

Section 2: Using the scale provided below, please circle the value which most indicates how strongly you agree or disagree with each of the following statements.

1	*2*	*3*	*4*	*5*	*6*
Extremely Unlikely	*Unlikely*	*Somewhat Unlikely*	*Somewhat Likely*	*Likely*	*Extremely Likely*

1.	When I'm angry, a cigarette can calm me down.	1	2	3	4	5	6
2.	By smoking I risk heart disease and lung cancer.	1	2	3	4	5	6
3.	Cigarettes taste good.	1	2	3	4	5	6
4.	If I'm tense, a cigarette helps me to relax.	1	2	3	4	5	6
5.	Cigarettes help me deal with anxiety or worry.	1	2	3	4	5	6
6.	Smoking makes me look ridiculous or silly.	1	2	3	4	5	6
7.	The more I smoke, the more I risk my health.	1	2	3	4	5	6
8.	I enjoy parties more when I am smoking.	1	2	3	4	5	6
9.	Just handling a cigarette is pleasurable.	1	2	3	4	5	6
10.	If I have nothing to do, a smoke can help kill time.	1	2	3	4	5	6
11.	I feel more at ease with other people if I have a cigarette.	1	2	3	4	5	6
12.	Smoking makes me look tough or cool.	1	2	3	4	5	6
13.	Smoking makes me feel older or more mature.	1	2	3	4	5	6
14.	Cigarettes help me concentrate.	1	2	3	4	5	6
15.	Cigarettes keep me from overeating.	1	2	3	4	5	6
16.	Smoking makes me seem less attractive.	1	2	3	4	5	6
17.	I will become more dependent on nicotine if I continue smoking.	1	2	3	4	5	6
18.	When I am worrying about something, a cigarette is helpful.	1	2	3	4	5	6
19.	Cigarettes make my lungs hurt.	1	2	3	4	5	6
20.	The look and feel of a cigarette in my mouth is good.	1	2	3	4	5	6
21.	My throat burns after smoking.	1	2	3	4	5	6
22.	People look up to those who smoke.	1	2	3	4	5	6

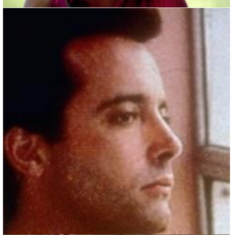
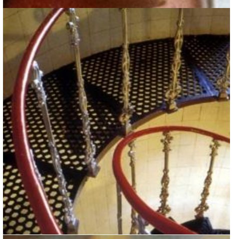
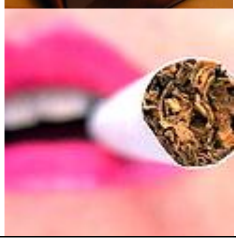
Please continue overleaf

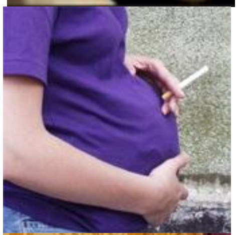
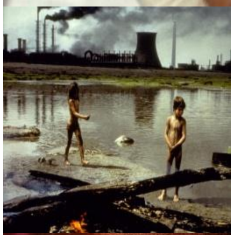
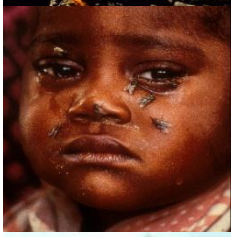
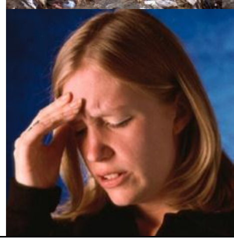
1	2	3	4	5	6
Extremely Unlikely	*Unlikely*	*Somewhat Unlikely*	*Somewhat Likely*	*Likely*	*Extremely Likely*

23.	Cigarettes are good for dealing with boredom.	1	2	3	4	5	6
24.	People think less of me if they see me smoking.	1	2	3	4	5	6
25.	I feel like part of a group when I'm around other smokers.	1	2	3	4	5	6
26.	Smoking helps if I feel bad about myself.	1	2	3	4	5	6
27.	Smoking calms me down when I'm feeling nervous.	1	2	3	4	5	6
28.	Smoking helps me stay slim.	1	2	3	4	5	6
29.	Smoking gives me something to do with my hands.	1	2	3	4	5	6
30.	Smoking will make me cough.	1	2	3	4	5	6
31.	People gain weight when they stop smoking.	1	2	3	4	5	6
32.	I think most popular people smoke cigarettes.	1	2	3	4	5	6
33.	Smoking irritates my mouth and throat.	1	2	3	4	5	6
34.	Smoking helps me control my weight.	1	2	3	4	5	6
35.	When I'm upset with someone, a cigarette helps me cope.	1	2	3	4	5	6
36.	I become more addicted the more I smoke.	1	2	3	4	5	6
37.	Smoking controls my appetite.	1	2	3	4	5	6
38.	Smoking makes me feel more friendly or outgoing.	1	2	3	4	5	6

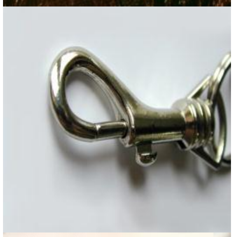
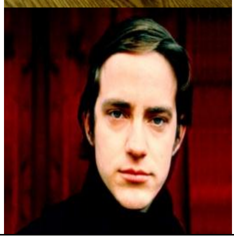
When all questions have been answered you may proceed to Section 3 on the next page

Appendix 4: Images used in the Modified-Stroop Task (Study 2)

#	Smoking Positive	IAPS	General Positive
70		232	
21		632	
13		659	
99		213	
76		381	
119		727	
103		094	

#	Smoking Negative	IAPS	General Negative
202 (HW)		330	
68		911	
85		110	
84		912	
91		289	
11		874	
73		194	

Note. HW, Health warning image

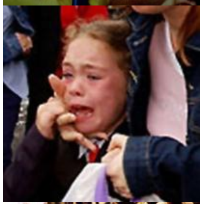
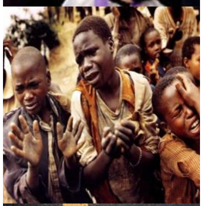
IAPS	Neutral	#	Practise
606		90	
183		123	
634		IAPS 512	
630		IAPS 228	
621			
669			
127			

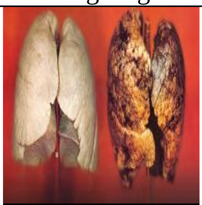
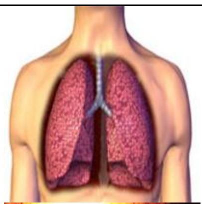
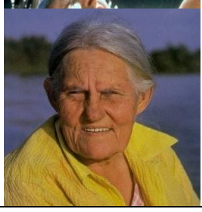
An example of a stimulus presentation in each of the four border colours

Appendix 5: Image Pairs used in the Visual Dot-probe Task (Study 2)

#	Smoking Positive	IAPS	General Positive
72		222	
58		683	
78		091	
116		622	

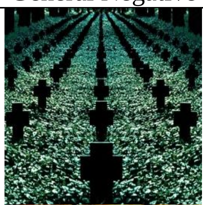
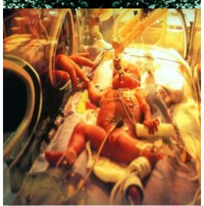
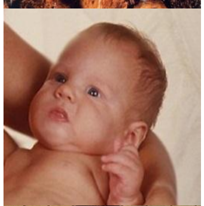
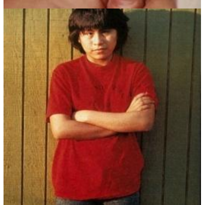
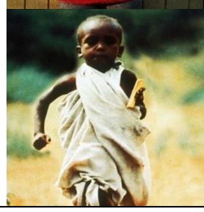
#	Smoking Positive	IAPS	Neutral
14		637	
54		198	
39		134	
102		607	

#	Smoking Negative	IAPS	General Negative
203 (HW)		918	
129		897	
86		258	
88		876	

#	Smoking Negative	IAPS	Neutral
204			
205		097	
81		766	
80		219	

Note. HW, Health warning image

IAPS	General Positive	IAPS	Neutral
627		177	
464		511	
797		133	
090		608	

IAPS	General Negative	IAPS	Neutral
828		489	
100		119	
836		197	
839		556	

Appendix 6: Ethical Approval for Study 3

COLÁISTE NA TRÍONÓIDE, BAILE ÁTHA CLIATH | TRINITY COLLEGE DUBLIN
Ollscoil Átha Cliath | The University of Dublin

8th December 2011

F.A.O. Louise Hopper

School of Psychology Research Ethics Committee

Dear Louise,

I am pleased to inform you that your application entitled "Perception of smoking risks and prevalence" has been approved by the School of Psychology Research Ethics Committee.

Yours sincerely,

Dr. Tim Trimble
Chair
School of Psychology Research Ethics Committee

SCHOOL OF PSYCHOLOGY
Aras an Phairsaigh
Trinity College
Dublin 2

Scoil na Siceolaíochta,
Dámh na nEolaíochtaí Sóisialta agus Daonna,
Áras an Phiarsaigh, Coláiste na Tríonóide,
Baile Átha Cliath 2, Éire

School of Psychology,
Faculty of Arts, Humanities and Social Sciences,
Áras an Phiarsaigh, Trinity College,
Dublin 2, Ireland

T 353 (0)1 896 1886
F 353 (0)1 671 2006
psychology@tcd.ie
www.psychology.tcd.ie

Appendix 7: Consent Forms and Debrief Sheet for Study 3

7.1 Group Information Sheet

TCD Smoking Perceptions study: Group Information Sheet

My name is Louise Hopper and I am a postgraduate research student in the School of Psychology, Trinity College, Dublin. As part of my PhD research project, I am investigating how adults and adolescents think about smoking, what they see as the potential costs or benefits of smoking, and what kind of differences exist across the age groups. It is hoped that the results will contribute to our understanding of why many adolescents start to smoke, whether there are differences in their perceptions of smoking, when compared with adults, and if this information can help in the development of smoking prevention and cessation programmes.

I would hope to recruit a minimum of 80 smokers (approximately age 15 and older) which, based on current smoking prevalence rates for this age group, is likely to require testing approximately 450 individuals. The study itself involves completing a survey which asks participants what they think about smoking, how widespread they think it is across different age groups, and what risks and benefits they think might be associated with it. Participants will complete the survey individually but groups of participants can be tested together, for example a class/group at a time. The survey itself should take no longer than 30 minutes to complete and either paper-based or web-based versions may be used. I would be very grateful for any level of participation that you feel your group can provide. With your agreement, the studies would take place on your premises in a quiet area thus minimising distractions and allowing participants to concentrate.

All information collected will be treated in the strictest confidence. Each participant will be assigned an ID code which will be used throughout the study instead of their name. This will ensure all answers remain anonymous. Computerised data will be password protected and printed documents will be kept in a secure filing cabinet accessed only by the researcher and the research supervisor. Participants will be entitled to access their data in accordance with the Freedom of Information Act. Information and consent forms will be provided for participants and for parents of those under the age of 18. Both parents and students are free to withdraw from the study at any time without any negative consequences.

Your group is not obliged to participate in this study and it is free to withdraw at any time by informing me in person, by email, or by telephone. There will be no negative consequences should you choose to withdraw from all or any part of the study. If you are happy to participate, please sign and the return the enclosed 'Willing to Participate' form and keep a copy for your own records. I will contact you on receipt to discuss your participation in more detail and to arrange a suitable test schedule. If you would like to find out more information about the study, please feel free to contact me by phone or email. This research project is supervised by Dr. Michael Gormley, who may also be contacted as required.

Researcher: Louise Hopper
School of Psychology
Trinity College Dublin
Dublin 2
Ph: (086) 8186470
hopperl@tcd.ie

Supervisor: Dr. Michael Gormley
School of Psychology
Trinity College Dublin
Dublin 2
Ph: (01) 8963903
Michael.Gormley@tcd.ie

Yours sincerely,

Louise Hopper

7.2 Group Consent Form

Willing to Participate Form (Schools/Youth Groups)

Name of School/Group:____

Address: ____

I have read and understood the information provided in the letter dated ____________ and

☐ the school/youth group is willing to take part in this study.

☐ I would like to find out more information about this study and can be contacted using the details provided below.

☐ the school/youth group is unable to participate in this study.

I understand that the school/youth group is not obliged to participate and that it is free to withdraw at any time by informing one of researchers in person, by email, or by telephone. There will be no negative consequences should we choose to withdraw from all or any part of the study.

Signed: ________________________ **Print Name:** ____________________

Position: ____

Preferred point of contact (if different to the above):

____

Email: _________________________ **Telephone number:** ______________

Please keep a copy of consent form for your own records.

7.3 Parental Consent Form

Dear Parent,

My name is Louise Hopper and I am a postgraduate research student in the School of Psychology, Trinity College, Dublin. As part of my PhD research project, I am investigating how adults and adolescents think about smoking, what they see as the potential costs or benefits of smoking, and what kind of differences exist across the age groups. It is hoped that the results will contribute to our understanding of why many adolescents start to smoke, if there are differences in their perceptions of smoking, when compared with adults, and if this information can help in the development of smoking prevention and cessation programmes.

This requires a study of approximately 30 minutes in length which will take place on school premises. Participants will be asked questions about what they think about smoking, how widespread they think it is across different age groups, and what risks and benefits they think might be associated with it. They will also be asked to indicate their age, gender, whether or not they currently smoke and if they intend to smoke/not smoke in the next six months. Smokers will be asked to provide additional details such as, how many cigarettes they smoke a day/week and how long they have been smoking. They will also be asked a series of questions to measure how dependent they are on cigarettes, such as '*Have you ever felt like you really need a cigarette*?' and '*Is it hard to keep from smoking in places where you are not supposed to, like school*?'.

All information collected will be treated in the strictest confidence. Each participant will be assigned an ID code which will be used throughout the study instead of their name. This will ensure all answers remain anonymous. Computerised data will be password protected and printed documents will be kept in a secure filing cabinet accessed only by the researcher and the research supervisor. Participants will be entitled to access their data in accordance with the Freedom of Information Act.

Your child does not have to take part in this study if you do not want them to and he/she is free to withdraw at any time without any negative consequences. If you agree to their participation, please sign the consent form overleaf and keep a copy of this letter for your own personal records.

If you have questions on any aspect of this study, or queries regarding your child's participation in it, please contact me. This research project is supervised by Dr. Michael Gormley, who may also be contacted as required.

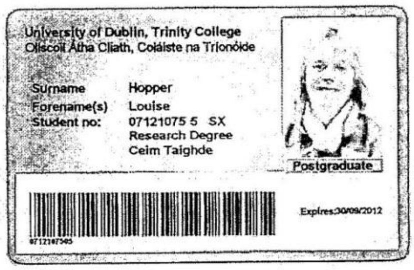
Researcher: Louise Hopper
School of Psychology
Trinity College Dublin
Dublin 1
Ph: (01) 8963494
hopperl@tcd.ie

Supervisor: Dr. Michael Gormley
School of Psychology
Trinity College Dublin
Dublin 1
Ph: (01) 8963903
Michael.Gormley@tcd.ie

Yours sincerely,

Louise Hopper

Louise Hopper



CONSENT FORM: TCD Smoking Perceptions Study (2012)

Child(s) Name(s): ____ **Date of Birth:** ________________

I have read and understand the information provided in this letter and I hereby consent that my son/daughter can take part in this study. I understand that he/she is not obliged to participate and that he/she is free to withdraw at any time. There will be no negative consequences should he/she choose to withdraw from all or any part of the study.

Signed:_________________________ **Name:**_______________________
(Signature) *(Block Capitals)*

Date:___________________________

Please keep a copy of this letter for your own personal records.

7.4 Participant Consent Form

Dear potential participant,

My name is Louise Hopper and I am a postgraduate research student in the School of Psychology, Trinity College, Dublin. As part of my PhD research project, I am interested in what you think about smoking, how widespread you believe it is among different age groups, and what risks and benefits you think might be associated with it. You will be asked to complete a survey which should take no longer than 30 minutes. The resulting data will hopefully provide a better understanding of the differences between how adolescent and adult smokers and non-smokers view smoking.

All information collected will be treated in the strictest confidence. ID codes will be used throughout the study to ensure anonymity. Computerised data will be password protected and printed documents will be kept in a secure filing cabinet accessed only by the researcher and the research supervisor. You will be entitled to access your data in accordance with the Freedom of Information Act.

You do not have to take part in this study if you do not want to and you are free to withdraw at any time without prejudice. If you agree to participate, please sign the consent form overleaf and keep a copy of this letter for your own personal records. You are also asked to provide email and/or phone contact details so that a study time can be arranged with you. If you have questions on any aspect of this study, or queries regarding your participation in it, please contact me. This research project is supervised by Dr. Michael Gormley, who may also be contacted as required.

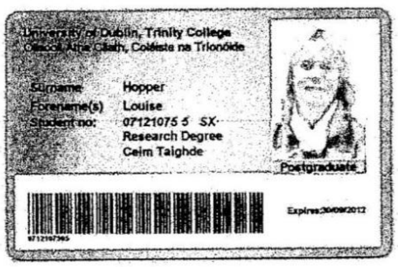
Researcher: Louise Hopper
School of Psychology
Trinity College Dublin
Dublin 1
Ph: (01) 8963494
hopperl@tcd.ie

Supervisor: Dr. Michael Gormley
School of Psychology
Trinity College Dublin
Dublin 1
Ph: (01) 8963903
Michael.Gormley@tcd.ie

Yours sincerely,

Louise Hopper

Louise Hopper



Consent Form: TCD Smoking Perceptions Study (2012)

I have read and understand the information provided in this letter and I hereby consent that I will take part in this study. I understand that I am not obliged to participate and that I am free to withdraw at any time by informing one of the researchers in person, by email, or by telephone. There will be no negative consequences should I choose to withdraw from all or any part of the study.

Signed:________________________ **Name:**______________________

(Signature) *(Block Capitals)*

Date:__________________________

Email:_________________________ **Phone:**______________________

Please keep a copy of this letter and consent form for your own personal records.

7.5 Debriefing Sheet

Perception of smoking risks and prevalence: Debriefing information

Dear participant,

Thank you for taking part in this research study which was designed to examine:

- the positive and negative consequences that you associate with smoking
- how prevalent you think smoking is among peers and among other age groups, and how these estimates relate to actual prevalence rates in each age group
- your perception of the risks associated with smoking, and your perception of your own susceptibility to these risks

Results will be analysed for adolescent and adult smokers and non-smokers.

Study results are expected to show differences in consequences generated by smokers and non-smokers in each age group and differences between smokers across age groups. Smokers are expected to over-estimate smoking prevalence and the size of the over-estimation is expected to be largest for their peer group. They are also expected to under-estimate the risks associated with smoking, especially personal risk, when they first begin smoking but the estimates are expected to become more accurate with age and experience.

All information that you have provided during these tasks, will be analysed as part of this research study. It will be treated with the strictest of confidence and stored on file anonymously and securely. In accordance with the Freedom of Information Act 1977 (amended 2003), you have the right to request access to your personal data, and the overall results of the study, at any time.

If you have any further questions or concerns please feel free to contact myself or my supervisor.

Researcher:	Louise Hopper	Supervisor:	Dr. Michael Gormley
	School of Psychology		School of Psychology
	Trinity College Dublin		Trinity College Dublin
	Dublin 1		Dublin 1
	Ph: (01) 8963494		Ph: (01) 8963903
	hopperl@tcd.ie		Michael.Gormley@tcd.ie

Appendix 8: An Example of a Paper Survey used in Study 3

Participant Identifier:____________________________ **Date:**__________

Question 1: Write down whatever comes to mind when you think about smoking. This can include how smoking makes you feel and how you feel about it. Don't think too deeply about the words just jot down what comes to mind. Choose one line for each word or thought. Please leave out brand names or nouns such as cigarettes, cigars, pipe etc.

1 ____

2 ____

3 ____

4 ____

5 ____

6 ____

7 ____

8 ____

9 ____

10 ____

11 ____

12 ____

13 ____

14 ____

15 ____

16 ____

17 ____

18 ____

19 ____

20 ____

21 ____

22 ____

23 ____

24 ____

25 ____

Please place this sheet into the envelope before continuing with the survey.

Q2 : Using the scale provided below, please circle the value which best describes how likely or unlikely you think each of the following statements are.

If you smoke, or have ever tried smoking, answer the following questions based on your experience.

If you have never smoked, think about what you know or have ever heard about smoking, and use this information to decide if each of the following items are likely or unlikely.

Don't spend too long thinking about each item as there are no right or wrong answers.

1	*2*	*3*	*4*	*5*	*6*
Extremely Unlikely	*Unlikely*	*Somewhat Unlikely*	*Somewhat Likely*	*Likely*	*Extremely Likely*

When I'm angry, a cigarette can calm me down.	1	2	3	4	5	6
By smoking I risk heart disease and lung cancer.	1	2	3	4	5	6
Cigarettes taste good.	1	2	3	4	5	6
If I'm tense, a cigarette helps me to relax.	1	2	3	4	5	6
Cigarettes help me deal with anxiety or worry.	1	2	3	4	5	6
Smoking makes me look ridiculous or silly.	1	2	3	4	5	6
The more I smoke, the more I risk my health.	1	2	3	4	5	6
I enjoy parties more when I am smoking.	1	2	3	4	5	6
Just handling a cigarette is pleasurable.	1	2	3	4	5	6
If I have nothing to do, a smoke can help kill time.	1	2	3	4	5	6
I feel more at ease with other people if I have a cigarette.	1	2	3	4	5	6
Smoking makes me look tough or cool.	1	2	3	4	5	6
Smoking makes me feel older or more mature.	1	2	3	4	5	6
Cigarettes help me concentrate.	1	2	3	4	5	6
Cigarettes keep me from overeating.	1	2	3	4	5	6
Smoking makes me seem less attractive.	1	2	3	4	5	6
I will become more dependent on nicotine if I continue smoking.	1	2	3	4	5	6
When I am worrying about something, a cigarette is helpful.	1	2	3	4	5	6
Cigarettes make my lungs hurt.	1	2	3	4	5	6
The look and feel of a cigarette in my mouth is good.	1	2	3	4	5	6
My throat burns after smoking.	1	2	3	4	5	6
People look up to those who smoke.	1	2	3	4	5	6
Cigarettes are good for dealing with boredom.	1	2	3	4	5	6
People think less of me if they see me smoking.	1	2	3	4	5	6

1	2	3	4	5	6
Extremely Unlikely	*Unlikely*	*Somewhat Unlikely*	*Somewhat Likely*	*Likely*	*Extremely Likely*

I feel like part of a group when I'm around other smokers.	1	2	3	4	5	6
Smoking helps if I feel bad about myself.	1	2	3	4	5	6
Smoking calms me down when I'm feeling nervous.	1	2	3	4	5	6
Smoking helps me stay slim.	1	2	3	4	5	6
Smoking gives me something to do with my hands.	1	2	3	4	5	6
Smoking will make me cough.	1	2	3	4	5	6
People gain weight when they stop smoking.	1	2	3	4	5	6
I think most popular people smoke cigarettes.	1	2	3	4	5	6
Smoking irritates my mouth and throat.	1	2	3	4	5	6
Smoking helps me control my weight.	1	2	3	4	5	6
When I'm upset with someone, a cigarette helps me cope.	1	2	3	4	5	6
I become more addicted the more I smoke.	1	2	3	4	5	6
Smoking controls my appetite.	1	2	3	4	5	6
Smoking makes me feel more friendly or outgoing.	1	2	3	4	5	6

3) Which description fits you best?

A. ( ) I have never smoked a cigarette, not even a few puffs

B. ( ) I have smoked a cigarette or a few cigarettes just to try it out, but I have not smoked in the past two months

C. ( ) I used to smoke but now I've stopped

D. ( ) I don't smoke every day, but every week

E. ( ) I smoke everyday or almost every day

4) Are you male or female? ( ) Male ( ) Female

5) What age are you? ____________

6) What is your date of birth? ____________________ **(dd/mm/yyyy)**

7) How many of your family smoke? (include parents, brothers/sisters, partner, children) ____________

8) What percentage of your friends smoke?

0-10%	11-20%	21-30%	31-40%	41-50%	51-60%	61-70%	71-80%	81-90%	91-100%
( )	( )	( )	( )	( )	( )	( )	( )	( )	( )

9) Please tell me if you think you would get any benefits from the following activities.

1	*2*	*3*	*4*	*5*	*6*	*7*
No benefits at all	*Slight benefits*	*Some benefits*	*Moderately benefits*	*Reasonable benefits*	*Many benefits*	*Great benefits*

Admitting that your tastes are different from those of a friend	1	2	3	4	5	6	7
Going camping in the wilderness	1	2	3	4	5	6	7
Drinking heavily at a social function	1	2	3	4	5	6	7
Disagreeing with an authority figure on a major issue	1	2	3	4	5	6	7
Going down a ski run that is beyond your ability	1	2	3	4	5	6	7
Going whitewater rafting in high water in the spring	1	2	3	4	5	6	7
Engaging in unprotected sex	1	2	3	4	5	6	7
Driving a car without wearing a seatbelt	1	2	3	4	5	6	7
Taking a skydiving class	1	2	3	4	5	6	7
Riding a motorbike without a helmet	1	2	3	4	5	6	7
Choosing a career that you would really enjoy over a safer one	1	2	3	4	5	6	7
Speaking your mind about an unpopular issue in a work or class discussion	1	2	3	4	5	6	7
Sunbathing without sunscreen	1	2	3	4	5	6	7
Bungee jumping off a tall bridge	1	2	3	4	5	6	7
Piloting a small plane	1	2	3	4	5	6	7
Walking home alone at night in an unsafe area	1	2	3	4	5	6	7
Moving to a city far away from your extended family	1	2	3	4	5	6	7
Starting a new career in your mid-thirties	1	2	3	4	5	6	7

10) I am confident I could resist smoking over the next 3 months

( ) Strongly disagree ( ) Disagree ( ) Neutral ( ) Agree ( ) Strongly agree

11) For me to NOT smoke would be ...

( ) Very difficult ( ) Somewhat difficult ( ) Neutral ( ) Somewhat easy ( ) Very easy

12) How much control do you feel you have over not smoking?

( ) No control ( ) A little control ( ) Neutral ( ) Quite a lot of control ( ) Complete control

13) Please select the option that is most true for each of the following statements.

"I can say no to smoking even..."

	Certain I cannot	Maybe I cannot	Don't know	Maybe I can	Certain I can
at work/school/college	( )	( )	( )	( )	( )
if offered a cigarette	( )	( )	( )	( )	( )
if my friends want me to smoke	( )	( )	( )	( )	( )
if I am the only one in the group not smoking	( )	( )	( )	( )	( )
if I feel left out of the group	( )	( )	( )	( )	( )
if I feel like smoking	( )	( )	( )	( )	( )

14) People often see some risk in situations that contain uncertainty about what the outcome will be, and when there is the possibility of negative consequences. However, riskiness is a very personal idea and we are interested in your gut feeling of how risky you think each of the following are.

1	*2*	*3*	*4*	*5*	*6*	*7*
Not at all Risky	*Slightly Risky*	*Somewhat Risky*	*Moderately Risky*	*Risky*	*Very Risky*	*Extremely Risky*

Admitting that your tastes are different from those of a friend	1	2	3	4	5	6	7
Going camping in the wilderness	1	2	3	4	5	6	7
Drinking heavily at a social function	1	2	3	4	5	6	7
Disagreeing with an authority figure on a major issue	1	2	3	4	5	6	7
Going down a ski run that is beyond your ability	1	2	3	4	5	6	7
Going whitewater rafting in high water in the spring	1	2	3	4	5	6	7
Engaging in unprotected sex	1	2	3	4	5	6	7
Driving a car without wearing a seatbelt	1	2	3	4	5	6	7
Taking a skydiving class	1	2	3	4	5	6	7
Riding a motorbike without a helmet	1	2	3	4	5	6	7
Choosing a career that you would really enjoy over a safer one	1	2	3	4	5	6	7
Speaking your mind about an unpopular issue in a work or class discussion	1	2	3	4	5	6	7
Sunbathing without sunscreen	1	2	3	4	5	6	7
Bungee jumping off a tall bridge	1	2	3	4	5	6	7
Piloting a small plane	1	2	3	4	5	6	7
Walking home alone at night in an unsafe area	1	2	3	4	5	6	7
Moving to a city far away from your extended family	1	2	3	4	5	6	7
Starting a new career in your mid-thirties	1	2	3	4	5	6	7

15) Please indicate how likely or unlikely each of the following statements are for you*

	Very unlikely	Somewhat unlikely	Neither likely nor unlikely	Somewhat likely	Very likely
If I had smoked in the past two months, I would wish I had not	( )	( )	( )	( )	( )
I would feel depressed if I had smoked in the past two months	( )	( )	( )	( )	( )

16) Think about the people in your school, college or work place. How many do you think smoke?

0-10%	11-20%	21-30%	31-40%	41-50%	51-60%	61-70%	71-80%	81-90%	91-100%
( )	( )	( )	( )	( )	( )	( )	( )	( )	( )

17) Please select the option that is most true of each of the following people or groups of people.*

	Should not smoke	Maybe should not smoke	Don't mind if I smoke or not	Maybe should smoke	Should smoke
My friends think I ...	( )	( )	( )	( )	( )
My best friend thinks I ...	( )	( )	( )	( )	( )
My family think I ...	( )	( )	( )	( )	( )
People who are important to me think I ...	( )	( )	( )	( )	( )
Society as a whole thinks I ...	( )	( )	( )	( )	( )

18) Do you intend NOT smoking in the next 6 months?

Definitely won't smoke	Probably won't	Might not	Don't know	Might	Probably will	Definitely will smoke
( )	( )	( )	( )	( )	( )	( )

19) Imagine someone who starts to smoke a pack of cigarettes a day at age 16. How much do you agree with the following statements about this person?

	Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagree
There is usually no risk to the person at all for the first few years	( )	( )	( )	( )
Although smoking may eventually harm this person's health, there is really no harm to him or her from smoking the very next cigarette	( )	( )	( )	( )

20) To what extent are your friends important to you?

Not at all important	Moderately unimportant	Slightly unimportant	Neutral	Somewhat important	Moderately important	Very important
( )	( )	( )	( )	( )	( )	( )

21) Compared with other people your age, how likely do you think you are to _____?

	Much less likely	A bit less likely	About the same	A bit more likely	Much more likely
Get lung cancer in the future	( )	( )	( )	( )	( )
Have a heart attack in the future	( )	( )	( )	( )	( )
Be hooked on cigarettes in 5 years	( )	( )	( )	( )	( )

22) I often see others smoking in, or outside, school/college/work everyday, or almost everyday

( ) Strongly Agree ( ) Agree ( ) Disagree ( ) Strongly Disagree

23) Think about your wider school, college or work group. To what extent do you feel that you belong to this group?

Very much	Quite a lot	A little	Neutral	Not really	Probably not	Definitely not
( )	( )	( )	( )	( )	( )	( )

24) How likely is it that you will NOT smoke in the next 6 months?

Very unlikely	Quite unlikely	A little unlikely	Neutral	A little likely	Quite likely	Very likely
( )	( )	( )	( )	( )	( )	( )

25) How risky do you think smoking every day would be for your health?

( ) Very risky ( ) Somewhat risky ( ) A little risky ( ) Not at all risky

26) Think about each of the following people, or groups of people. How much does their attitude to smoking influence your own smoking behaviour.

	No effect at all	Not really important	Don't know	Has a bit of an effect	Effects it a lot
My friends	( )	( )	( )	( )	( )
My best friend	( )	( )	( )	( )	( )
My family	( )	( )	( )	( )	( )
People who are important to me	( )	( )	( )	( )	( )
Society	( )	( )	( )	( )	( )

27) Do you like smoking?

( ) Very much ( ) A little ( ) Neither yes or no ( ) Not really ( ) Definitely not

28) How many people your age do you think smoke?

0-10%	11-20%	21-30%	31-40%	41-50%	51-60%	61-70%	71-80%	81-90%	91-100%
( )	( )	( )	( )	( )	( )	( )	( )	( )	( )

29) How likely is concern for your health to influence your decision to smoke or not to smoke?

Very unlikely	Quite unlikely	A little unlikely	Neutral	A little likely	Quite likely	Very likely
( )	( )	( )	( )	( )	( )	( )

30) Do you intend to smoke in the next 6 months?

Definitely	Probably	Maybe	Don't know	Maybe not	Probably not	Definitely not
( )	( )	( )	( )	( )	( )	( )

31) To what extent do you feel that you belong to your group of friends?

Very much	Quite a lot	A little	Neutral	Not really	Probably not	Definitely not
( )	( )	( )	( )	( )	( )	( )

32) How risky do you think smoking is for your health?

( ) very risky ( ) somewhat risky ( ) a little risky ( ) not at all risky

33) How often are you around people your age who smoke?

( ) Never ( ) Hardly ever ( ) Sometimes ( ) Often

34) Please select the option that most closely reflects your own opinion for each of the following.

	Should not smoke	**Maybe should not smoke**	**Don't know**	**Maybe should smoke**	**Should smoke**
I think my best friend...	( )	( )	( )	( )	( )
I think my family members...	( )	( )	( )	( )	( )
I think people who are important to me...	( )	( )	( )	( )	( )

35) How likely is it that you will smoke in the next 6 months?

Very unlikely	Quite unlikely	A little unlikely	Neutral	A little likely	Quite likely	Very likely
( )	( )	( )	( )	( )	( )	( )

36) If you found yourself in the following situations, how likely is it that you would do what is being described?

1	*2*	*3*	*4*	*5*	*6*	*7*
Extremely Unlikely	***Quite Unlikely***	***Somewhat Unlikely***	***Not Sure***	***Somewhat Likely***	***Quite Likely***	***Extremely Likely***

Admitting that your tastes are different from those of a friend	1	2	3	4	5	6	7
Going camping in the wilderness	1	2	3	4	5	6	7
Drinking heavily at a social function	1	2	3	4	5	6	7
Disagreeing with an authority figure on a major issue	1	2	3	4	5	6	7
Going down a ski run that is beyond your ability	1	2	3	4	5	6	7
Going whitewater rafting in high water in the spring	1	2	3	4	5	6	7
Engaging in unprotected sex	1	2	3	4	5	6	7
Driving a car without wearing a seatbelt	1	2	3	4	5	6	7
Taking a skydiving class	1	2	3	4	5	6	7
Riding a motorbike without a helmet	1	2	3	4	5	6	7
Choosing a career that you would really enjoy over a safer one	1	2	3	4	5	6	7
Speaking your mind about an unpopular issue in a work or class discussion	1	2	3	4	5	6	7
Sunbathing without sunscreen	1	2	3	4	5	6	7
Bungee jumping off a tall bridge	1	2	3	4	5	6	7
Piloting a small plane	1	2	3	4	5	6	7
Walking home alone at night in an unsafe area	1	2	3	4	5	6	7
Moving to a city far away from your extended family	1	2	3	4	5	6	7
Starting a new career in your mid-thirties	1	2	3	4	5	6	7

37) The harmful effects of cigarettes have been exaggerated. Do you ____?

( ) Strongly agree ( ) Somewhat agree ( ) Somewhat disagree ( ) Strongly disagree

38) I personally think that smoking is ...

( ) Wrong ( ) Somewhat wrong ( ) Neither wrong nor right ( ) Somewhat right ( ) Right

39) To what extent do you agree or disagree with the following statements?

	Strongly disagree	Moderately disagree	Slightly disagree	Neutral	Slightly agree	Moderately agree	Strongly agree
I look at myself as a person who smokes	( )	( )	( )	( )	( )	( )	( )
I'm a good example of a person who smokes	( )	( )	( )	( )	( )	( )	( )
I would feel that I missed out on something if I didn't smoke	( )	( )	( )	( )	( )	( )	( )

40) Compared with a typical smoker your age, how likely do you think you are to _____?

	Much less likely	A bit less likely	About the same	A bit more likely	A lot more likely
Get lung cancer in the future	( )	( )	( )	( )	( )
Have a heart attack in the future	( )	( )	( )	( )	( )
Be hooked on cigarettes in 5 years	( )	( )	( )	( )	( )

Non-Smokers: Please skip down to the "Thank you" box on last page

<u>Ex-smokers, occasional and current smokers: please answer Qs 41 and 42</u>

41) Please answer each of the following questions. The answer in each case should be a number.*

If any question does not apply, please answer with a 0 (zero)

	Answer
What age were you when you first started smoking?	
What age were you when you became a daily smoker?	
How many cigarettes do (did) you smoke a day?	
How many cigarettes do (did) you smoke a week?	

42) Have you ever previously tried to stop smoking? ( ) Yes ( ) No

If yes, how many times did you try to quit smoking but were unsuccessful?

_______________________________________ (please enter a number as your answer)

Ex-Smokers: Please skip down to the "Thank you" box on last page

Smokers (occasional, weekly and daily): please answer remaining questions

43) Do you plan to quit smoking at any point in the future? ( ) Yes ( ) No

If yes, when?

( ) Within the next 6 months
( ) Between 6 months and a year
( ) Sometime after a year but within the next 5 years
( ) Sometime after the next 5 years
( ) I do plan to quit but I don't know when that will be

44) How soon after you wake up do you smoke your first cigarette?

( ) Within 5 minutes ( ) 6 - 30 minutes ( ) 31 - 60 minutes ( ) After 60 minutes

45) Do you find it difficult to refrain from smoking in places where it is forbidden (e.g. in church, at the library, in the cinema, etc)?

( ) Yes ( ) No

46) Which cigarette would you hate most to give up?

( ) The first one in the morning ( ) Any other

47) How many cigarettes per day do you smoke?

( ) 10 or less ( ) 11 – 20 ( ) 21 – 30 ( ) 31 or more

48) Do you smoke more frequently during the first hours of waking than during the rest of the day?

( ) Yes ( ) No

49) Do you smoke more if you are so ill that you are in bed most of the day?

( ) Yes ( ) No

Thank you for taking part in this survey

Could I contact you if there is a follow-up sometime in the next 6 months?

( ) Yes ( ) No