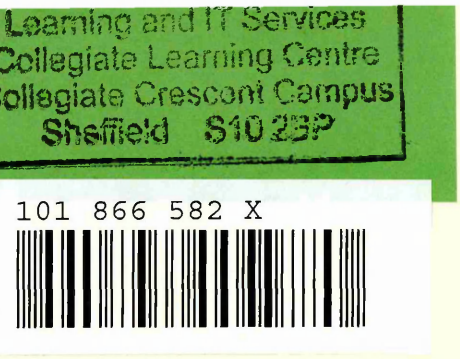

Physical Activity and Smoking Abstinence in Young People

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Abstract

A reduction in the number of young smokers and an increase in physical activity levels among young people are currently public health priorities, because of the lifetime health risks of smoking and inactivity from a young age. The aims of this thesis were to investigate the effects of exercise on desire to smoke, withdrawal symptoms and mood in young people, and to investigate the promotion of physical activity and exercise in young people who smoke, using a variety of methodologies. Five studies were conducted to investigate these aims. There was some evidence to suggest that a short bout of moderate intensity exercise can be beneficial in young adults, but this was not the case in adolescents. Overall, both moderate and vigorous intensity exercise reduced the desire to smoke relative to control, however moderate intensity exercise provided the most benefit in terms of withdrawal symptoms and mood in young adults. With regard to physical activity promotion, the theory of planned behaviour appears to be a useful framework for explaining physical activity behaviour among young people who smoke, however an exercise consultation intervention to promote physical activity in this population did not prove feasible regarding participant recruitment. In addition, an evaluation of physical activity prompts designed for young people (including smokers) revealed that such prompts are likely to be most effective if they contain intrinsically motivating messages. With regard to issues surrounding physical activity and exercise behaviour, young smokers appear to constitute a distinct population, and may present their own unique challenges for the promotion of physical activity. The findings of this research have important public health implications for physical activity promotion with young smokers.

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Publications

A number of publications have been produced from the research in this thesis. These are:

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Everson, E.S., Daley, A.J. & Ussher, M. (2007). Does exercise have an acute effect on desire to smoke, mood and withdrawal symptoms in abstaining adolescent smokers? *Journal of Sports Sciences, 25*, 298-299. (Abstract). [From Study 1.]

Everson, E.S., Daley, A.J. & Ussher, M. The effects of moderate and vigorous exercise on desire to smoke, withdrawal symptoms and mood in abstaining young smokers. Under submission, *Nicotine and Tobacco Research*. [From Study 2.]

Everson, E., Daley, A. & Ussher, M. (2005). Using the theory of planned behaviour to predict physical activity in young people who smoke. *Journal of Sports Sciences, 23*(11-12), 1245-1246. (Abstract). [From Study 3.]

Everson, E.S., Daley, A.J. & Ussher, M. (2007). Brief report: The theory of planned behaviour applied to physical activity in young people who smoke. *Journal of Adolescence, 30*, 347-351. [From Study 3.]

Everson, E.S., Daley, A.J. & Ussher, M. (2007). Developing physical activity promotion postcard-style prompts for young adults. *Journal of Sports Sciences, 25*, 299. (Abstract). [From Study 4.]

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Chapter 1

Introduction, literature review and rationale

1.1 Introduction

Smoking cessation is important for the future health of young smokers, a half of whom are predicted to die prematurely as a result of their habit if they continue to smoke (Department of Health, 1998). Previous efforts at promoting smoking cessation among young people have met with little success, and at best have produced mixed findings, therefore new approaches that may demonstrate success are needed. Among adults, physical activity and exercise have been found to be successful cessation aids, but no research has investigated these effects in younger smokers. This thesis describes a series of studies that investigate the effects of an acute bout of exercise on strength of desire to smoke and withdrawal symptoms, the determinants of regular physical activity in young smokers, the feasibility of a physical activity consultation intervention for increasing physical activity levels among young smokers, and the development and acceptability of physical activity prompts for young adults.

This chapter describes the health consequences of smoking and smoking cessation, the rationale for young smokers as a target population for intervention, nicotine addiction and dependence, and smoking cessation approaches in general and in young people specifically. The role of exercise within smoking cessation, and acute study and intervention study research will also be discussed. There is also an overview of young people and physical activity. Within this thesis, the term 'exercise' refers to purposeful bouts or sessions of activity, and the term 'physical activity' is used to reflect any lifestyle

activity taken by an individual for reasons that may or may not include health benefit.

1.2 Consequences of smoking and quitting

Cigarette smoking is the leading cause of death in the United Kingdom (UK), responsible for 12% of all deaths worldwide (Gavin, 2004) and an estimated 12 deaths per hour on average in the UK, excluding deaths caused by second-hand smoke (Twigg, Moon & Walker, 2004). If current smoking trends continue, the annual worldwide mortality rate of 4 million could potentially rise to 10 million by the year 2030 (Satcher, 2001; World Health Organization, 1997). Smoking is also associated with diminished quality of life due to the many acknowledged smoking-related illnesses, including every type of cancer except for skin cancer, cardiovascular, respiratory and digestive problems (Royal College of Physicians: RCP, 2000), amputation due to peripheral vascular disease (Mukherjee & Yadav, 2001), diabetes, cataracts, impotence and reproductive problems (Musk & de Klerk, 2003).

Quitting smoking can prevent or reverse many of these health problems, and thus increase life expectancy (Doll, Peto, Boreham & Sutherland, 2004). For example, recent evidence suggests that smokers but not ex-smokers tend to report poorer general health, physical functioning and mental health compared with never-smokers (Laaksonen, Rahkonen, Martikainen, Karvonen & Lahelma, 2006). In 2002, 70% of British smokers expressed a desire to give up smoking, and 70% of smokers intended to quit, however only 24% of smokers thought they would definitely or probably not be smoking in a year's time (Lader & Meltzer, 2003). Furthermore, in 2002, 53% of smokers had made a serious quit attempt in the previous five years, and 15% of smokers had made three or more

quit attempts over the previous year (Lader & Meltzer, 2003). Without cessation aids, only between 2% and 5% of smokers successfully quit and remain abstinent at 12 months (Hughes, Keely & Naud, 2004; West, McNeill & Raw, 2000).

1.3 Young people and smoking

Young people are at a pivotal stage of their lives, with regard to health behaviour. Epidemiological evidence suggests that trends in smoking, physical activity behaviour and sedentariness track over time from childhood and adolescence into adulthood (e.g., Steptoe et al, 2002). The lifelong health consequences of smoking in adolescence and young adulthood, and continuing to smoke, can be severe. To put this in perspective,

> For every 1000 20-year-old smokers it is estimated that while one will be murdered, six will die in motor accidents, 250 will die in middle age from smoking, and 250 will die in old age from smoking (Department of Health, 1998).

From a public health perspective, therefore, young smokers are an important population to target with smoking cessation interventions. Very often, the beliefs of young people may preclude any perceived need for smoking cessation. For example, in a UK Government survey, young smokers (aged 16-24) were the least likely of all the age groups to believe that smoking was the main cause of premature deaths in the UK (Lader & Meltzer, 2003). Although adolescent smokers often perceive that the health consequences of smoking will occur a long way into the future (Jamieson & Romer, 2001; Slovic, 2000), some evidence has suggested that the health impact of smoking may begin much sooner in life. Alarmingly, a recent longitudinal study followed smokers

over the course of seven to 15 years, and found that those who regularly smoked as adolescents and young adults were significantly more likely to have smoking-related cancer, cardiovascular diseases, and peptic ulcer before middle age compared with their never-smoking peers (Hozawa et al, 2006). Adolescent smokers are also two to three times more likely to suffer from respiratory complaints, such as shortness of breath and excess phlegm, than their non-smoking peers (Tonnesen, 2002). In addition, adolescent smokers are more likely to develop dependence on other substances, notably cannabis (Patton, Coffey, Carlin, Sawyer & Wakefield, 2006). Besides the well-documented long-term health problems associated with smoking tobacco, cigarette smoking has been found to have other less serious but more immediate physical consequences. For example, Stice and Martinez (2005) identified that smoking led to restricted growth among adolescent girls over a period of three years, compared with growth in non-smoking girls.

1.3.1 Prevalence of smoking in young people

Young people are the only population among whom smoking rates are still increasing (Twigg et al, 2004). Recent smoking rate data indicates that 11% of 11-15 year olds are regular smokers, with half of those aged 11-15 having smoked at some point, and 31% of 16-19 year olds are smokers, smoking an average of 72 cigarettes per week (Department of Health, 2000). The foundations for many lifetime health behaviours are laid down in adolescence, including exercise (Daley, 2002; Trudeau, Laurencelle, Tremblay, Rajic & Shephard, 1999) and smoking (Colby, Tiffany, Shiffman & Niaura, 2000; Kelder, Perry, Klepp, Lytle, 1994). Adolescent smokers often become the adult smokers of the future; for example, around half to a quarter of current smokers in 1999 started before the age of 16 (Department of Health, 2000). Moreover,

the health risks of smoking appear to be increased if smoking is initiated earlier in life. For example, the Department of Health (1998) report that the likelihood of death from cancer is three times greater among smokers who initiated their habit in their teens than among those who took up smoking in their twenties. Thus, a reduction in the number of young smokers is a priority on the Government's health agenda (Department of Health, 1998; 2004a).

1.4 Addiction to smoking tobacco

Nicotine addiction is widely regarded as responsible for the low success rates in attempted cessation (RCP, 2000). According to the DSM-IV (American Psychiatric Association, 1995) and the ICD-10 (World Health Organization, 1992) classification systems, symptoms of substance abuse or addiction include: using a greater amount than was originally intended; a strong desire to use the substance; difficulty or lack of success in controlling or decreasing use; spending much time obtaining, using, and recovering from substance use; prioritising the substance use over other important social, recreational and occupational commitments; continuing to use the substance despite suffering problems relating to it; tolerance to the substance; and withdrawal in the absence of the substance. Withdrawal symptoms and cigarette cravings are two commonly measured indicators of addiction to smoking, with the withdrawal symptoms of nicotine addition encompassing irritability, anxiety, restlessness, dysphoria/depressed mood, poor concentration, increased appetite and/or weight gain, sleep disturbance, decreased heart rate, and craving, desire or urge to smoke a cigarette (Shiffman, West & Gilbert, 2004).

Nicotine is believed to elicit pleasurable sensations in the smoker by acting on the mesolimbic dopamine pathway. Once in the brain, nicotine encourages

dopamine release in the nucleus accumbens, a brain area where the nicotinic receptor, a type of acetylcholine receptor, is abundant (Brody et al, 2004; Clarke, 1998). Although the quantity of dopamine released in the nucleus accumbens is lower than the amount released as a result of using cocaine, when it binds to the nicotinic acetylcholine receptors, nicotine causes similar activation patterns in the nucleus accumbens to those of cocaine. In addition to encouraging dopamine release, cigarette smoking is also known to stimulate the release of endogenous opioids within the brain (Pomerleau, 1998), which can also elicit an experience of pleasure. Cigarette smoking is the most effective delivery system of nicotine, reaching the brain in less than 10 seconds through inhalation, via the lungs and circulatory system (RCP, 1992). It is thought that this system of rapid reward makes nicotine addiction so difficult to conquer (RCP, 2000).

Despite a typically low tobacco intake and irregular smoking patterns, research indicates that adolescent smokers are dependent on nicotine and experience withdrawal symptoms and desire to smoke (DiFranza et al, 2002a,b; O'Loughlin, Kishchuk, DiFranza, Tremblay & Paradis, 2002; Prokhorov et al., 2001), which can be a barrier to cessation. If the prevalence of cigarette smoking and problematic nature of tobacco withdrawal among adolescents are considered in light of the health risks posed by tobacco, adolescent smoking has become a serious public health issue. Consequently, a successful adolescent smoking cessation intervention strategy, which can effectively combat withdrawal symptoms, undesirable affective responses and desire to smoke, would appear to be an important avenue of research.

1.5 Smoking cessation approaches

Smoking cessation techniques aim to increase quit rates in two ways; by attempting to reduce cravings and withdrawal symptoms on the one hand, and by increasing motivation to quit and remain abstinent on the other, and the two methods can be complimentary (RCP, 2000). Pharmacological approaches such as nicotine replacement therapy (NRT) and bupropion can alleviate withdrawal symptoms and cravings, whereas behavioural counselling approaches can increase motivation to quit and remain abstinent. The cessation success rates of quitting unaided can be increased to 15-20% using a combination of behavioural counselling and NRT or bupropion (West et al, 2000).

Six types of NRT are available at present: transdermal patch (16 hour and 24 hour), chewing gum (2mg and 4mg), inhalator, nasal spray, lozenge and sublingual tablet, and there is no evidence to suggest that one type of NRT is more efficacious than others (West et al, 2000). According to a Cochrane Library review of the efficacy of NRT (Silagy, Lancaster, Stead, Mant, & Fowler, 2004) and two recent meta-analyses (Etter & Stapleton, 2006; Hughes, Shiffman, Callas, & Zhang, 2003), NRT can increase a smoker's chances of quitting by double, regardless of the setting, or form of NRT. Only one in five smokers use NRT as an aid to smoking cessation however, due to concerns about cost, safety and efficacy, and inadequate nicotine dosage strength (Cummings & Hyland, 2005). In addition, despite nicotine being the main psychoactive substance in tobacco, the speed of nicotine delivery provided by cigarettes makes them a much more effective means of nicotine delivery than any NRT product (RCP, 2000). The anti-depressant bupropion (brand name Zyban) contains no nicotine, and acts by inhibiting the re-uptake of dopamine

and noradrenaline. Continuous abstinence rates (at 6 and 12 months) are two to three times higher with bupropion compared with placebo (Martinez-Raga, Keaney, Sutherland, Perez-Galvez, & Strang, 2003; Richmond & Zwar, 2003).

In addition to pharmacological treatment, psychological smoking cessation support includes motivation, support and advice in the form of self-help materials, individual counselling, and group therapy. Self-help materials providing advice and information have been more successful in increasing quit rates than no intervention, but did not provide an additional effect on cessation when used in conjunction with NRT or professional advice (Lancaster & Stead, 2005a). Individual behavioural smoking cessation counselling has been found to be more successful than a minimal behavioural intervention for quitting smoking, however this effect was not present in trials where all participants (intervention and control) received NRT (Lancaster & Stead, 2005b). Likewise, group behaviour therapy programmes have been documented to be more effective than self-help interventions and no-intervention controls, and similarly effective to individual counselling interventions, despite the additional component of mutual peer support (Stead & Lancaster, 2005).

Worksite and community cessation interventions have also been evaluated. For worksite interventions, the traditional methods of individual counselling, group counselling and NRT were effective for increasing the likelihood of cessation compared with no or minimal treatment, whereas self-help interventions were more effective than no intervention, but were less effective than individual or group counselling, and NRT (Moher, Hey & Lancaster, 2005). The Cochrane Library review by Moher et al (2005) did not reveal any evidence that worksite-specific approaches, such as incentive schemes, comprehensive approaches, or workplace tobacco bans are effective for smoking cessation in the long-term.

While the approach of multiple-channel community-targeted interventions may be intuitively appealing, an additional Cochrane Library review of community interventions has identified no differences between intervention and comparison communities, on smoking rates (Secker-Walker, Gnich, Platt, & Lancaster, 2002). Further, the evidence is inconclusive as to whether smoking cessation interventions delivered to customers by community pharmacy personnel can be effective in increasing quit rates compared with usual pharmacy support (Sinclair, Bond, & Stead, 2004).

1.5.1 Smoking cessation interventions in young people

Recent research has suggested that typical health promotion based cessation interventions (e.g., information leaflets, peer influence programmes, incentive programmes, and other behavioural interventions) are largely ineffective in young people and, at best, have shown mixed findings (e.g., Camenga & Klein, 2004; Garrison, Christakis, Ebel, Wiehe, & Rivara, 2003; Grimshaw & Stanton, 2006; Mermelstein et al, 2002; Schofield, Lynagh & Mishra, 2003; Sussman, Lichtman, Ritt & Pallonen, 1999). NRT (versus placebo) has also been unsuccessful thus far in increasing cessation rates among adolescents, although it can alleviate withdrawal symptoms and cravings (Camenga & Klein, 2004). However, at least among adult smokers, physical exercise as a smoking cessation intervention has recently received some attention, and positive results have been reported (Taylor & Ussher, 2005; Ussher, 2005). Exercise may also prove to be a useful adjunct to adolescent smoking cessation programmes; for example, through reducing the desire to smoke and withdrawal symptoms.

1.6 The role of exercise in smoking cessation

Several cross-sectional studies have reported a negative association between physical activity and smoking behaviour in both adults and young people (e.g., Aaron et al, 1995; Emmons, Marcus, Linnan, Rossi, & Abrams, 1994; Thorlindsson & Vilhjalmsson, 1991), and epidemiological evidence has suggested an association between smoking and sedentariness that tracks over time from childhood and adolescence into adulthood (Steptoe et al, 2002). In addition, prospective research has found that adolescents with higher physical activity levels are less likely to progress to smoking or increase their smoking behaviour than their less active peers (Audrain-McGovern, Rodriguez & Moss, 2003). Physical activity may potentially appeal to adolescents and young adults as an aid to smoking cessation because it is cost-effective and would not require them to learn any additional skills.

1.6.1 The benefits of exercise as an intervention

Traditional smoking cessation interventions are less likely to provide additional benefits in terms of the physical, functional and mental health of smokers attempting to quit, in the way that exercise can (deRuiter & Faulkner, 2006). In addition, many smokers gain weight or fear weight gain while quitting, and unlike other interventions, exercise can assist in reducing the amount of weight gained (Marcus et al, 1999). Given that many common smoking cessation treatments (e.g. cognitive behavioural therapy and hypnosis) can be expensive and are often in short supply, there is much to commend potentially more cost-effective and wide-reaching strategies, such as physical activity.

Exercise can be self-sustaining in that it can be maintained by individuals once the basic skills have been learned (Hillsdon, Foster, Naidoo & Crombie, 2004;

Martinsen, 1993), with no reliance on a therapist. Exercise can also be flexible, in that most individuals can perform some form of basic exercise or physical activity whenever they choose (e.g., taking a brisk walk, or performing seated isometric exercises while at work), on a momentary basis. This is a particularly valuable quality of exercise because cigarette cravings and urges to smoke are often experienced on a momentary basis, and these impulses can directly influence action and have the ability to over-ride any plans that may have been made not to smoke, according to the recently published PRIME theory (Plans, Responses, Impulses/inhibitory forces, Motives, and Evaluations; West, 2006). Therefore, the very moment that an urge to smoke is experienced, an individual could theoretically take instant action in the form of exercise.

The main adverse side effect of NRT is a local irritation at the site of nicotine delivery (e.g., skin, mouth, and nostrils, for patches, oral products and nasal spray respectively), and the adverse side effects of bupropion are dry mouth, sleeping problems, headache and very rarely, seizures (McEwen, Hajek, McRobbie & West, 2006). In comparison, the adverse side effects of exercise are minimal, and exercise is suitable for those who are not suited to or who prefer not to access pharmacological cessation treatments; for example, pregnant smokers (deRuiter & Faulkner, 2006). The psychological benefits of exercise are many, including improved mood, decreased stress and anxiety, a reduction in clinical depression and risk of depression and improved self-esteem (Biddle, Fox & Boutcher, 2000; Faulkner & Taylor, 2005; Landers & Arent, 2001; Lawlor & Hopker, 2001; Reed & Ones, 2006). Even if an individual continues to smoke, adopting a more active lifestyle can reduce the harm caused by smoking, by improving health and delaying smoking-related morbidity and mortality (deRuiter & Faulkner, 2006). For example, a recent

meta-analysis has suggested that engaging in leisure-time physical activity can lower the risk of developing lung cancer (Tardon, et al, 2005).

1.6.2 Possible mechanisms for the exercise effect

There are several mechanisms through which exercise may possibly aid smoking cessation by reducing cigarette cravings and withdrawal symptoms, including psychobiological mechanisms, distraction, and stress reduction and activation, (Taylor, Ussher & Faulkner, 2007). Testing the effects of these postulated mechanisms on the exercise-craving relationship is not the purpose of this thesis, however it is important to consider these mechanisms when conducting research in this field.

Exercise has been shown to act upon the same psychobiological mechanisms as cigarette smoking. There is evidence that exercise can trigger the release of dopamine (Meeusen et al, 2001; Sakai et al, 1995) and endogenous opioids such as beta-endorphins (Angelopoulos, 2001; Goldfarb & Jamurtas, 1997). The release of these pleasure-inducing brain chemicals is also stimulated by smoking (Brody et al, 2004; Clarke, 1998; Pomerleau, 1998). To date, however, the implication of these psychobiological mechanisms in the exercise effect on cravings and withdrawal symptoms has yet to be empirically demonstrated.

Second, the distraction hypothesis (Morgan, 1997) postulates that certain forms of exercise (in particular those that exceed the ventilatory threshold, or that require increased focus or attention, such as isometric exercise) may be sufficiently cognitively demanding to provide a distraction from withdrawal symptoms and cravings. Again, little research has directly examined this postulation, and present evidence suggests that distraction is unlikely to be the

primary mechanism responsible for the exercise effect (Daniel, Cropley & Fife-Schaw, 2006).

Third, Nesbitt's Paradox (Parrott, 1998) postulates that cigarette cravings are caused by simultaneous paradoxical changes in affect, namely increased activation or stimulation, and reduced tension, or increased relaxation. Therefore, any cessation aid (e.g., physical activity) should also be able to provide increases in stimulation and reductions in tension. Research into this phenomenon is, again, in its infancy, and has, however, only provided partial support for Nesbitt's Paradox. The only study to examine the mediating effects of affective valence and activation (using the Circumplex model of affect; Ekkekakis & Petruzzello, 2002; Russell, 1980) suggested that the reduction in cravings following a bout of exercise was mediated by reductions in tension, but not by increases in stimulation (Taylor, Katomeri & Ussher, 2006).

1.6.3 Acute exercise intervention studies

Research that has specifically examined the effects of exercise and physical activity in smokers has, to date, been conducted largely with adults, and two main types of study have been conducted: those investigating the effects of an acute bout of exercise on cravings (desire to smoke), withdrawal symptoms and mood during temporary abstinence; and those measuring the impact of exercise or physical activity as an adjunct to a smoking cessation programme on cessation rates. Collectively, these two bodies of research provide a promising evidence base in support of the role of exercise or physical activity within smoking cessation programmes among adults.

In smokers making a quit attempt, relapse to smoking can be reliably predicted by desire to smoke (Shiffman et al, 2004), therefore focusing on this outcome

with regard to exercise may be considered an important public health question and may eventually form an important component of a smoking cessation intervention. Fourteen studies to date (within a rapidly expanding body of literature) have examined the effects of an acute bout of aerobic exercise on mood or affective state, desire to smoke and withdrawal symptoms in temporarily abstaining adult smokers (Daley, Oldham & Townson, 2004; Daniel et al, 2006; Daniel, Cropley, Ussher & West, 2004; Katomeri & Taylor, 2005a, 2005b; Mikhail, 1983; Pomerleau et al, 1987; Reesor, 1983; Taylor & Katomeri, 2006; Taylor, Katomeri & Ussher, 2005, 2006; Thayer, Peters, Takahashi & Birkhead-Flight, 1993; Ussher, Nunziata, Cropley & West, 2001; Ussher, West, Doshi, & Sampuran, 2006; Table 1.1 provides a summary of the acute study research). An additional study also considered the acute effects of exercise on desire to smoke and withdrawal symptoms on abstaining smokers participating in an exercise intervention as an aid to smoking cessation (Bock, Marcus, King, Borelli & Roberts, 1999).

Despite some variation in methodologies, measurement scales, exercise parameters and smoker populations, acute benefits in the form of reductions in withdrawal symptoms, negative affect and desire to smoke have been consistently reported. Various doses of exercise have produced reductions in desire to smoke and withdrawal symptoms, and improvements in mood. Bock et al (1999) found reduced desire to smoke, withdrawal symptoms and negative affect, for all weeks following the quit date, pre-post 30-40 min of vigorous exercise (60-85% HRR) versus a contact control (wellness session), each of which were conducted three times a week over the course of 11 weeks. Subsequent research has since demonstrated the efficacy of much smaller (and possibly more acceptable) doses of exercise among abstaining smokers.

Table 1.1: Studies that have examined the effect of a bout of exercise on cravings, withdrawal symptoms, smoking behaviour and mood

Study	Participants and setting	Exercise	Control	Measures	Findings
Mikhail (1983)	18 M, aged 20-30 years, low-active, repeated measures design.	(1) 130-135 bpm (2) 160-165 bpm Both stationary cycling for 10 min	Quiet sitting with access to reading materials for 10 min	Smoking rate (following hour, observed; subsequent 23 hrs, self-reported), time to 1st cig, duration & puff frequency for 1st cig after condition.	Duration of 1st cig lower for both exercise conditions Compared with control.
Reesor (1983)	25 F & 12 M, aged 20-34, mean 23 cigs/day, between groups design	(1) cycling at 60% HR max (13 min) (2) stretching & isometric exercise for 20 min. Each condition performed 8 times, over 2 weeks	Quiet sitting with access to reading materials for 20 min	Smoking self-monitored over 4 weeks; STAI; 30 min observation post-condition: time to 1st cig, puff frequency, duration of cig & frequency of smokers & abstainers	Stretching & isometric exercise group lower on puff frequency & higher on time to next cig than control group.

Pomerleau et al (1987)	10 M, mean age 24 years, mean 28 cigs/day, sedentary counterbalanced repeated measures design.	(1) 80% VO_2max (2) 30% VO_2max Both stationary cycling for 30 min	No control	SWS, POMS, nicotine intake from a cig smoked 35 min after exercise & in 24 hrs following exercise	No significant differences on smoking measures (trend towards a decrease in desire to smoke for vigorous exercise); increase in perceived tiredness for vigorous exercise.
Thayer et al (1993)	5 M & 11 F, aged 18-44 years, natural setting, repeated measures design (random order).	Brisk walk for 5 min (6 occasions over 3 weeks)	Inactivity for 5 min (6 occasions over 3 weeks)	Short form AD-ACL (energy & tension), urge to smoke, time to next cig. Measured before & immediately after.	Reduced urge to smoke for walking vs control (pre-post) & increased time to next cig & energy for walking vs control (pre-post).
Bock et al (1999)	Study 1: 24 F, sedentary Study 2: 62 F, sedentary Both samples involved in an 11-week smoking cessation programme; between-groups design for study 2 (study 1: pre-post).	60-85% HRR, for 30-40 min, 3 times a week, for 11 weeks.	Contact control: wellness sessions, for 40-60 min, 3 times a week for 12 weeks.	ESR (desire to smoke and withdrawal symptoms); PANAS. Measured before & immediately after each session.	In both studies 1 & 2: reduced desire to smoke, withdrawal symptoms & negative affect in exercise vs control (pre-post). No effect on positive affect.

Ussher et al (2001)	42 F & 36 M, mean age 36 years, mean 18 cigs/day, between-groups design, 15 hrs abstinence.	40-60% HRR stationary cycling for 10 min, while watching video about gardening & home advice.	(1) Seated video watching (same as exercise group) for 10 min (2) Passive waiting for 10 min.	Desire to smoke (Tiffany item), MPSS. Measured before, during, immediately after, & 5 & 10 min after.	Desire to smoke & withdrawal symptoms were reduced in moderate exercise group vs both control groups, during, immediately after, & 5 & 10 min after.
Daley et al (2004)	9 F & 7 M, sedentary, aged 20-24 years, mean 13 cigs/day, between-groups design, ~17 hrs abstinence.	60-65% HRmax stationary cycling for 20 min.	Watching smoking cessation video for 30 min.	SWS, PANAS. Measured before, during, immediately after, & 30 & 60 min after.	Negative affect increased in control group vs exercise group. No other effects.
Daniel et al (2004)	43 F & 41 M, aged 19-65 years, mean age 30 years, mean 17 cigs/day, between-groups design, 11-14 hrs abstinence.	(1) 10-20% HRR (light intensity) (2) 40-60% HRR (moderate intensity) Both stationary cycling for 5 min.	Passive waiting.	Desire to smoke (Tiffany item), strength of desire to smoke, MPSS. Measured pre, during, immediately post, 5 & 10 min post.	Strength of desire to smoke reduced in moderate exercise vs light exercise & control (during – 5 min post). Restlessness, stress, tension & poor concentration reduced in moderate exercise vs light exercise & control (5 – 10 min post).

Taylor et al (2005; 2006)	5 F & 10 M, active, mean age 26 years, mean 17 cigs/day, repeated measures design (random order crossover design), 15 hrs abstinence.	1 mile self-paced brisk treadmill walk (mean 25% HRR, mean RPE 10.8, mean duration 18 min).	Passive waiting for 40 min.	Desire to smoke (Tiffany item), strength of desire to smoke, MPSS, QSU (2 factor), FS, FAS, POMS. Measured before, during, immediately after, 10 & 20 min after. (POMS & QSU only measures before & 20 min after).	Desire & strength of desire to smoke, & both the desire-behave & the desire-affect relief QSU subscales were reduced by walking (vs control) for up to 20 min after exercise. Tension was also reduced & affective valence & activation (FAS) were increased by walking (vs control) only immediately after exercise.
Ussher et al (2006)	27 F & 33 M, mean age 32 years, mean 18 cigs/day, between-groups design, 17 hrs abstinence.	Seated isometric exercise, for 5 min.	(1) Body scanning (2) Passive waiting Both for 5 min.	Strength of desire to smoke, MPSS. Measured before, immediately after, 5, 10, 15 & 20 min after.	Strength of desire to smoke reduced immediately after & 5 min after, poor concentration & tension reduced 15 min after, all for isometric exercise vs both control conditions.

Taylor & Katomeri (2006); Katomeri & Taylor (2005a,b)	34 F & 26 M, mean age 28 years, mean 15 cigs/day, between-groups design, mean 2 hrs abstinence.	Brisk self-paced treadmill walk for 15 min (mean 24 % HRR, mean RPE 10.9).	Passive waiting.	Desire to smoke (Tiffany item), MPSS, QSU (2 factor), SBP, DBP, HR. Measured before, during & immediately after exercise, before, during & after three smoking cue tasks (stroop task, speech task & lit cigarette).	Desire to smoke & withdrawal symptoms were reduced from baseline to all time points, for exercise vs control. Desire to smoke, tension, stress, poor concentration & SBP responses to lit cigarette were attenuated by exercise. SBP & DBP responses to stroop & speech tasks were also attenuated by exercise. Lag time to next cig was greater (by 57 min) for exercise vs control.
Daniel, Cropley & Fife-Schaw (in press)	17 F & 23 M, sedentary, mean age 23 years, mean 14 cigs/day, between-groups design, mean 14 hrs abstinence.	40-60% HRR stationary cycling for 10 min.	Seated cognitive distraction task.	Desire to smoke (Tiffany item), strength of desire to smoke, MPSS, PANAS. Measured before (3 times), during, immediately after, 5 & 10 min after.	Desire & strength of desire to smoke & withdrawal symptoms reduced from baseline to all time points, for exercise vs distraction control. For irritability, depression, tension, restlessness & stress, however, this was because ratings increased during distraction task.

MPSS = Mood and Physical Symptoms Scale; PANAS = Positive And Negative Affect Schedule; SWS = Shiffman Withdrawal Scale; POMS = Profile Of Mood States; QSU = Questionnaire on Smoking Urges; FS = Feeling Scale; FAS = Felt Arousal Scale; AD-ACL = Activation-Deactivation Adjective Checklist; ESR = Evening Symptom Report; STAI = State Trait Anxiety Inventory; SBP = systolic blood pressure; DBP = diastolic blood pressure

Regarding moderate intensity exercise (40-60% heart rate reserve; HRR), a 10 min bout reduced withdrawal symptoms and desire to smoke for up to 10 min after exercise compared with both passive waiting and watching a video (Ussher et al, 2001), and compared with passive waiting and a cognitive distraction task (Daniel et al, 2006). Furthermore, Daniel et al (2004) found that as little as 5 min of moderate intensity cycle ergometry (mean rating of perceived exertion (RPE) of 13.3, and 40-60% HRR) produced a reduction in withdrawal symptoms and strength of desire to smoke compared with passive waiting and 5 min of very light intensity exercise (mean RPE of 8.7, and 10-20% HRR).

Light intensity exercise has also been found to be effective. Early research in a natural setting identified that a brisk self-paced 5 min walk reduced the urge to smoke versus control (5 min of inactivity) and increased self-reported energy and time to the next cigarette on 6 occasions of each, over a 12-week period (Thayer et al, 1993). More recently, light intensity exercise for 1 mile (mean duration 18 min, mean 25% HRR, mean RPE 10.9) reduced desire to smoke for up to 20 min afterwards, and reduced tension and increased affective valence and activation immediately after exercise, compared with a passive control (Taylor et al, 2005; 2006). Furthermore, 15 min of light intensity exercise (mean 24% HRR, mean RPE 10.8) reduced desire to smoke, withdrawal symptoms, systolic and diastolic blood pressure response to stressors and increase lag time before the next cigarette, compared with a passive condition, even when exposed to smoking cues (Katomeri & Taylor, 2005a, 2005b).

In terms of exercise mode, positive effects on desire to smoke, withdrawal symptoms and mood have been detected using cycle ergometry at a moderate intensity (40-60% HRR) for 5 and 10 min (Daniel et al, 2004; Daniel et al, 2006;

Ussher et al, 2001) but not at a light intensity (10-20% HRR) for 5 min (Daniel et al, 2004). Meanwhile, a self-paced brisk treadmill walk at a light intensity (24-25% HRR) for 15 min or 1 mile has been beneficial not only for desire to smoke and withdrawal symptoms (including in the presence of smoking cues), but also for blood pressure response to stressful tasks (Katomeri & Taylor, 2005a,b; Taylor & Katomeri, 2006; Taylor et al, 2005; 2006). Finally, in addition to aerobic exercise, 5 min of seated isometric exercise has been beneficial in reducing desire to smoke for up to 5 min after exercise, relative to both a passive control condition and a body scanning control condition (Ussher et al, 2006). Thus, many modes of exercise can help control cravings and withdrawal symptoms during abstinence, even when smoking cues are present.

Two studies can be identified that examined the mechanisms of the exercise effect on desire to smoke and withdrawal symptoms (see section 1.6.2 for a more detailed discussion of the mechanisms). Taylor et al (2006) found the reduction in desire to smoke induced by exercise to be mediated through reduced tension but not increased affective valence, in partial support of Nesbitt's Paradox, using the Circumplex model. To investigate the possibility of distraction as a mechanism, Daniel et al (2006) compared exercise to a cognitive distraction task and a passive control condition. Daniel and colleagues found that the reduction in desire to smoke induced by exercise was not a consequence of distraction; the cognitive distraction task did not reduce desire to smoke and indeed increased the salience of some withdrawal symptoms.

While these studies have provided encouraging evidence regarding the role of exercise, we should also be mindful that a number of methodological limitations existed. For example, in each case, temporary abstinence was manipulated by

the researcher, rather than being investigated using smokers abstaining during a real quit attempt; and with the exception of Taylor et al (2006) and Daniel et al (2006), most studies have been conducted in an atheoretical context, with little attempt to explain the mechanisms of the exercise effect on desire to smoke (Taylor & Ussher, 2005; Taylor et al, in press). From a statistical perspective, it is interesting to note that many of these studies adopted a significance level of $p < 0.05$, without a Bonferroni correction, despite the measurement and analysis of multiple outcome variables, across two or three groups, at numerous time points, thus increasing the possibility of a Type I error.

It is also important to note that some acute studies did not find the expected effects on smoking withdrawal and craving measures. Two early unpublished studies (Masters theses) failed to find an effect of moderate-to-vigorous aerobic exercise on subsequent smoking behaviour, in a well-controlled environment where participants were unaware that their post-condition smoking behaviour was being monitored. Mikhail (1983) compared 10 min of stationary cycling at 130-135 bpm, at 160-165 bpm and quiet reading on subsequent smoking rate, time to first cigarette, and the duration and puff frequency of the first cigarette, and found that the first cigarette was smoked sooner for both exercise conditions compared with control. Reesor (1983) compared 13 min of stationary cycling at 60% HRmax, 20 min of stretching and 20 min of quiet reading on anxiety levels, time to first cigarette, duration and puff frequency of the first cigarette, and found that only the stretching group had a lower puff frequency and greater time to first cigarette, compared with control.

In the earliest published study, Pomerleau et al (1987) found no benefits of a 30 min bout of vigorous intensity stationary cycling (80% VO_2max) compared with a 30 min bout of light intensity stationary cycling (30% VO_2max), only identifying

a significant increase in perceived tiredness for vigorous exercise. There was, however, a non-significant trend towards a decrease in cigarette cravings for the vigorous exercise group compared with the light exercise group. More recently, Daley et al (2004) found no benefit of 20 min of moderate intensity stationary cycling (60-65% HRmax) compared with 30 min of watching a smoking cessation video, the only significant effect being an increase in negative affect in the control group, probably due to the content of the video. It is possible that the Daley et al (2004) study did not contain a sufficient sample size to be able to detect an effect, as the sample size was very small and a between-groups design was used, with only eight participants in each group (N = 16).

While numerous studies have focused on adult smokers, no studies to date have focused on young people when examining the effect of an acute bout of exercise on desire to smoke, withdrawal symptoms and mood states. Studies focusing on the acute effects of exercise in young people in their late teens and early twenties have demonstrated the effectiveness of a single bout of exercise for improving mood (e.g., Bartholomew & Miller, 2002; Petruzzello, Jones & Tate, 1997; Toskovic, 2001). Therefore, drawing from previous research in this field, coupled with the literature involving adult smokers, it is reasonable to assume that an acute bout of moderate intensity exercise may also positively influence affective responses in young smokers, as well as reducing their cigarette cravings and withdrawal symptoms.

1.6.4 Chronic exercise intervention studies

There is a growing body of evidence to suggest that exercise can reduce relapse rates among adult smokers attempting cessation (Taylor & Ussher, 2005; Ussher, 2005). Vigorous intensity exercise and moderate intensity exercise (including counselling to promote moderate intensity exercise) have been assessed within smoking cessation contexts.

Studies reporting regular vigorous intensity exercise as an adjunct to smoking cessation have generally reported positive findings. Marcus and colleagues (Marcus, Albrecht, Niaura, Abrams & Thompson, 1991; Marcus et al, 1995; Marcus et al, 1999) found that smoking cessation treatment plus supervised vigorous exercise (70-85% maximum HR, or 60-85% HRR) three times a week for 12-15 weeks resulted in improved quit rates and maintenance of cessation (for up to 12 months post-cessation; Marcus et al, 1999) compared with smoking cessation treatment with a health education contact control (Marcus et al, 1995; 1999), among women. The exercise and contact control sessions commenced three weeks prior to the smoking cessation treatment. Moreover, this type of exercise intervention has been found to improve the fitness of women during smoking cessation (Albrecht, Marcus, Roberts, Forman & Parisi, 1998), and decrease weight gain post-cessation (Marcus et al, 1999).

The efficacy of moderate intensity exercise in aiding smoking cessation is less clear-cut, however. In a large trial of female sedentary smokers, Marcus et al (2005) found moderate exercise (50-69% maximum HR or 45-59% HRR) five times a week (consisting of one supervised and four lifestyle sessions, totalling 165 min per week) for eight weeks increased quit rates at 3 months post-intervention (as measured using 7-day point-prevalent abstinence) compared

with a wellness programme contact control. No differences, however, were found between the groups at three months on continuous abstinence, nor at 12 months on either 7-day point-prevalent abstinence or continuous abstinence.

Ussher, West, McEwen, Taylor and Steptoe (2003) compared the effects of exercise counselling versus a health education control on smoking cessation, within a community-based cessation clinic. There were no group differences in continuous abstinence at six-week follow-up, however among only those who attended their quit day, the exercise group were more likely to remain abstinent than the control group at one and two weeks. Further research into the impact of exercise counselling on smoking cessation is needed, because individuals are more likely to continue to lead an active lifestyle after the end of an intervention with a counselling component than following an intervention consisting solely of fixed sessions of regular exercise (Hillsdon et al, 2004; Loughlan & Mutrie, 1995; Martinsen, 1993).

Although positive results were found for supervised regular vigorous intensity exercise sessions (Marcus et al, 1991, 1995, 1999), such exercise would be difficult for individuals to maintain following the end of the programme, and would also be costly for smoking cessation services to implement on a wide scale. Subsequent research, therefore, has considered the impact of moderate-intensity lifestyle physical activity sessions, but the findings of such research appear at present to be inconclusive. Strengths of Marcus and colleagues' research include the use of intent to treat analysis, which minimises the possibility of positive findings as a result of selection bias, and biochemical verification of smoking abstinence, in the form of salivary cotinine and exhaled air carbon monoxide measurement. The use of 7-day point prevalent abstinence as a measure of smoking cessation may be problematic because it

does not consider smoking lapses and relapses; typically, continuous abstinence is a more rigorous measure and is generally recommended (McEwen et al, 2006). The Ussher et al (2003) trial was the only study to exclusively report continuous abstinence rates, and the Marcus et al (1991, 1995, 1999, 2005) trials relied heavily on 7-day point-prevalent abstinence. In addition, Marcus and colleagues did not measure the continuation of regular exercise behaviour beyond the end of the intervention programme, thus it was not known whether or not exercise condition participants maintained their exercise routine. Poor adherence to the prescribed exercise regime may have complicated interpretation of the Marcus et al (2005) findings; only 15% of exercise condition participants met or exceeded the recommendation of 165 min of moderate exercise per week, particularly as those who adhered to the protocol were more likely than those who did not to maintain cessation. Finally, the use of NRT in the Ussher et al (2003) trial may have complicated the findings; the lack of effect at six weeks could have been due to the use of NRT, as the authors suggest, which can potentially double quit rates (e.g., Silagy et al, 2004).

1.7 Young people and physical activity

As well as understanding the effects of exercise on desire to smoke and withdrawal symptoms, it is also important to explore the determinants of exercise in young people who smoke. Thus, it seems important for researchers and practitioners to explore the question of *why* young smokers do and do not engage in health promoting behaviour such as exercise, and to investigate social-cognitive factors that might discriminate between those who are active and inactive. Biddle and Nigg (2000) recently reviewed several theories of exercise behaviour and highlighted the need to conduct research on this

particular issue from a theoretical perspective. At present, little is known about the determinants of exercise or physical activity behaviour in young people who smoke. Given that smoking accounts for 20% of all deaths in the United Kingdom (Department of Health, 2001), it seems critical for researchers and practitioners to actively pursue this line of enquiry. Understanding the determinants of physical activity is one of the first critical steps towards developing appropriate exercise interventions for young smokers.

Despite the well-documented physical and psychological health benefits of physical activity for young people (Biddle et al, 2000; Department of Health, 2004b; Hardman & Stensel, 2003), and despite the evidence that levels of physical activity taken during childhood and adolescence can impact on health outcomes in adulthood (Hardman & Stensel, 2003), recent survey data suggests that many young people are not active enough to gain health benefits. The Department of Health (2004b) reported that 16% of males and 33% of females aged 16-24 years were moderately active for less than 30 minutes in a week. Worryingly, levels of physical activity appear to decline with age from late childhood and adolescence onwards (Hardman & Stensel, 2003). As mentioned earlier, there is evidence that smoking is associated with physical inactivity in young people (Aaron et al, 1995; Thorlindsson & Vilhjalmsson, 1991), and that these trends can track over time from childhood and adolescence into adulthood (Steptoe et al, 2002), with long-term health repercussions.

On the basis of the available evidence, there is a clear need and justification for developing interventions to promote physical activity and exercise among young people who smoke. Young smokers may be able to use exercise to manage their cigarette cravings, and once they have made the transition to becoming

regularly active, these individuals may become more receptive to other health-promoting suggestions, such as smoking cessation. Because large numbers of young people smoke, any intervention to promote physical activity in young smokers would need to be pragmatic, low-cost, and able to reach large numbers of young people, particularly within a public health service context such as the UK National Health Service (NHS). The foundations for such an intervention need to be laid before such an intervention trial can reasonably be conducted.

To date, no published research has examined whether physical activity promotion is an acceptable type of lifestyle promotion intervention in young people who smoke. Additionally, no study has considered whether promoting exercise can discourage smoking related behaviour in this population of young people. These are important matters that warrant further investigation, and this thesis aims to investigate these issues.

1.8 The aims of the thesis

The objectives of this thesis are to investigate the effects of exercise on desire to smoke, withdrawal symptoms and mood in young people, and to investigate the promotion of physical activity and exercise in young people who smoke.

Specifically, this thesis aims to address the following questions:

1. Does an acute bout of exercise reduce strength of desire to smoke and withdrawal symptoms, and improve mood, in young people who smoke?

2. Does the intensity of an acute bout of exercise influence reductions in strength of desire to smoke and withdrawal symptoms, and improvements in mood, in young people who smoke?

3. Does the theory of planned behaviour predict physical activity in young people who smoke?

4. Which types of physical activity promotion message are likely to be acceptable to young people for intervention?

5. Is a physical activity consultation intervention feasible in young people who smoke?

1.9 The plan of the thesis

To ascertain whether a physical activity intervention would be useful in this population, Studies 1 and 2 investigate the acute effects of exercise on cravings, withdrawal symptoms and mood. Chapter 2 describes an investigation into the effects of moderate exercise (compared with placebo control) on strength of desire to smoke, withdrawal symptoms and mood in young people who smoke. Following on, Chapter 3 describes an investigation into the effects of moderate and vigorous intensity exercise (compared with passive control) on strength of desire to smoke, withdrawal symptoms and mood in young adults who smoke. Prior to conducting a physical activity intervention, it was necessary to investigate the determinants of physical activity in the target population and to develop the prompts to be used in the intervention in a systematic way, and Studies 3 and 4 address these issues. Chapter 4 reports an investigation of the determinants of exercise among young smokers using the framework of the theory of planned behaviour. Chapter 5a reports a systematic evaluation of prompts designed to promote physical activity in young people. While Chapter 5a focuses on the general population of young people, for more widely generalised findings, smoking status is also evaluated, so that the findings may be applied to the physical activity intervention study.

Finally, Chapter 5b reports on the feasibility of a physical activity promotion intervention for young people who smoke.

Chapter 2

Study 1: The effects of acute exercise on desire to smoke, mood and withdrawal symptoms in abstaining adolescent smokers

2.1 Introduction

It is well documented that cravings and withdrawal symptoms can present a barrier to cessation (Gilbert & Wartburton, 2000; Tiffany & Drobes, 1991). A short bout of exercise can be acutely effective for reducing cravings and withdrawal symptoms among abstaining adult smokers (Daniel et al, 2006; Daniel et al, 2004; Katomeri & Taylor, 2005a,b; Pomerleau et al, 1987; Taylor & Katomeri, 2006; Taylor et al, 2005, 2006; Thayer et al, 1993; Ussher et al, 2001; Ussher et al, 2006); however there has been little research into these effects among younger smokers.

Even with a low intake and irregular smoking patterns, young smokers are apparently dependent on nicotine and experience withdrawal symptoms and cravings as a result (Colby et al, 2000; DiFranza et al, 2002a; O'Loughlin et al, 2002; Prokhorov et al, 2001). It is therefore important for research to investigate the effect of a short bout of exercise on withdrawal symptoms and cravings (desire to smoke) in younger smokers.

Studies focusing on the acute effects of exercise in young people in their late teens and early twenties have demonstrated the effectiveness of a single bout of exercise for improving mood (e.g., Bartholomew & Miller, 2002; Petruzzello, et al, 1997; Toskovic, 2001). Therefore, drawing from the previous adult based studies in this field, an acute bout of moderate intensity exercise may also positively influence affective responses in young smokers, as well as reducing their cigarette cravings and withdrawal symptoms.

2.1.1 The present study

The current study aimed to investigate the impact of a short bout of moderate intensity aerobic exercise on cravings (strength of desire to smoke), withdrawal symptoms and mood in low-active adolescent smokers. The Department of Health (2004b) recommend that at least 30 min of moderate intensity physical activity should be undertaken on at least five days of the week for health benefits, but the 30 min of exercise can be accumulated in the form of a few short bouts throughout the day. Short bouts of moderate intensity activity should also be suitable and attainable for sedentary or low-active people, including smokers (Daniel et al, 2004), and can be easily applied and integrated into individuals' lifestyles. Based on research with other populations of smokers, it was hypothesised that adolescents in the moderate exercise condition would experience decreased desire to smoke and withdrawal symptoms, and improved mood during, 5 min after and 30 min after exercise, compared with those in a placebo control condition.

2.2 Method

2.2.1 Participants

Thirty-seven young people aged 16-19 years (19 males and 18 females) who self-reported exercising no more than twice per week, and who self-reported smoking 10 or more cigarettes per day for more than six months were recruited from institutions of further and higher education in the north east of England. Volunteers were not eligible if they had any medical conditions which were contraindicated for exercise, as determined by a university screening self-report questionnaire, approved by the research ethics committee (refer to Appendix 1).

2.2.2 Design

Condition assignment was stratified for gender to ensure that equal numbers of male and female participants would be allocated to the two conditions. Stratification was based on the order in which participants presented to the testing session. Participants were issued with standardised written instructions (Appendix 2), informing them of the purpose of the study and of their equal chance of being assigned to one of the two conditions. For both conditions, the interaction between investigator and participant was kept to a minimum throughout.

2.2.3 Measures

2.2.3.1 Demographics and smoking information

Participants' height, weight and baseline heart-rate (HR) were measured approximately 10 min prior to undertaking the exercise or placebo (see Appendix 3). Participants self-reported their age and gender. Additionally, the following single items were included: '*How many cigarettes per day do you usually smoke?*' '*At what time did you have your last cigarette (to the nearest quarter of an hour)?*' '*At what age did you start smoking on a daily basis?*' '*How difficult has it been to stop yourself smoking today?*' (on a 0-5 scale) '*How much of the time have you felt the urge to smoke today?*' (on a 0-5 scale) '*How strong have the urges been?*' (on a 0-5 scale) and '*How much have you craved cigarettes today?*' (on a 0-5 scale) (West, Courts, Beharry, May & Hajek, 1999). A single-item scale with a fully anchored response format was used to assess the frequency of physical activity over the previous three months (Gionet & Godin, 1989; Godin, Jobin & Bouillon, 1986) (see Appendix 4). This question has also been used recently (Godin, Lambert, Owen, Nolin & Prud'homme, 2004) to successfully classify participants according to their activity status.

Participants' dependence on nicotine was assessed using the Hooked on Nicotine Checklist (HONC; DiFranza et al, 2002a,b). This consists of a 10-item scale with a 'yes'/'no' response range, whereby 'yes' was scored with 1 point and 'no' with 0, with a 'yes' response to any item indicating dependence on nicotine (see Appendix 5). The higher the score (from 0 to 10), the greater the levels of nicotine dependence. The HONC has been found to be a reliable and valid measure of nicotine dependence among low-dose occasional adolescent smokers (Wheeler, Fletcher, Wellman & DiFranza, 2004), and the symptoms listed in this measure have been independently generated using focus group methodology (O'Loughlin et al, 2002). A high Cronbach's alpha value of 0.94 was attained for this scale by its authors (DiFranza et al, 2002a,b), and acceptable levels of internal reliability (α = 0.64) were found in the present study.

2.2.3.2 Strength of desire to smoke, withdrawal symptoms and affect

Emotional and cognitive withdrawal symptoms, and desire to smoke were measured using the Mood and Physical Symptoms Scale (MPSS; West & Hajek, 2004; West, Hajek & Belcher, 1989; West & Russell, 1985), and a strength of desire to smoke item ('*How strong is your desire to smoke right now?*'; West et al, 1989). All MPSS items and the desire to smoke item were phrased: '*How* _____ *do you feel right now?*' with the blank filled by the words: *irritable*, *depressed*, *tense*, *restless*, *stressed*, *happy*, *energetic*, and the question '*How difficult do you find it to concentrate right now?*' These were all rated on a 1 (*not at all*) to 7 (*extremely*) scale (see Appendix 6). Acceptable levels of internal reliability were reported by both the scale authors (α = 0.78; West & Hajek, 2004) and in the present study (overall sample α = 0.67; males α = 0.66; females α = 0.70).

It has recently been suggested (Shiffman et al, 2004) that the results of smoking withdrawal studies should be comparable to other studies of affect, by including validated measures of mood. Measuring mood is also important from the exercise adherence perspective; people tend to repeat behaviours that make them feel good and generally discontinue behaviours that make them feel bad (Ekkekakis, Hall & Petruzzello, 2005). These adherence issues are as relevant among smokers as they are among general populations of people (Taylor & Ussher, 2005). Therefore, in the present study, exercise-induced affect was measured using self-ratings on the Subjective Exercise Experience Scale (SEES; McAuley & Courneya, 1994). The SEES assesses changes in positive well-being (PWB), psychological distress (PD) and fatigue, and consists of a list of 12 adjectives pertaining to PWB, PD and fatigue, each rated on a 1 (*not at all*) to 7 (*very much so*) scale (see Appendix 7). The SEES has been shown to be a reliable and valid measure of affect in a variety of exercise settings (Lox & Rudolph, 1994; McAuley & Courneya, 1994). In the present study, acceptable levels of internal reliability were found at baseline for PWB (overall sample α = .72; males α = .74; females α = .67), PD (overall sample α = .71; males α = .61; females α = .77) and fatigue (overall sample α = .87; males α = .89; females α = .85). For all ratings given, the scales were enlarged to A3 size, presented on the wall directly in front of participants, and administered verbally.

2.2.4 Moderate intensity exercise condition

Participants assigned to the moderate intensity exercise condition exercised on a cycle ergometer for 10 min and were asked to maintain an intensity equivalent to a rating of perceived exertion (RPE) of 11-13 according to the Borg 6-20 RPE scale (Borg, 1998), after 1 min of familiarisation (see Appendix 8). HR was also measured during exercise using a Polar Beat® HR monitor. Cycle ergometry

was selected as it is an accessible form of exercise that requires minimal familiarisation for most people and has been used successfully in previous studies of exercise during tobacco withdrawal (e.g., Daniel et al, 2004; Pomerleau et al, 1987; Ussher et al, 2001). A 10 min duration was selected because current guidelines recommend 30 mins of physical activity on five or more days per week, and the 30 mins can be taken in the form of three 10-minute bouts (Department of Health, 2004b), a 10 min bout of exercise would have practical implications, as it should be achievable for most young people, and finally a 10 min bout of exercise has been found to successfully reduce cravings and withdrawal symptoms during abstinence in previous studies (e.g., Daniel et al, 2006; Ussher et al, 2001).

The Borg RPE scale (Borg, 1998) was administered verbally every minute during both conditions, and HR was also recorded at this time (see Appendix 9). If participants reported an RPE outside the target range for their condition, they were instructed to pedal faster or slower accordingly. The RPE scale was enlarged to A3 size and was presented on the wall directly in front of the participant as they exercised. The Borg RPE scale has been found to relate well to HR as a measure of exercise intensity (American College of Sports Medicine; ACSM, 1998, 2000), and has been used in previous research into affective responses to acute exercise as a regulator of exercise intensity (Petruzzello et al, 1997). RPE was used rather than HR to regulate exercise because RPE is indicative of a configuration of all the various physical sensations involved in exertion and, importantly, RPE ratings provide an individual-specific measure of exertion (Borg, 1998). In addition, smokers' resting HR typically decreases during abstinence (Hughes, Higgins & Bickel, 1994; Shiffman et al, 2004), and this may confound calculations of exercise

intensity based on HR (Ussher et al, 2001). Therefore, RPE was to be considered a more appropriate measure of exercise intensity than HR in this study.

2.2.5 Placebo control condition

Participants assigned to the placebo control condition completed 10 minutes of very low intensity exercise in the range of 7-9 on the Borg RPE Scale (Borg 1998) on a stationary cycle, after 1 min of familiarisation. RPE and HR were monitored each minute throughout both conditions.

This study included a placebo control condition for a number of important reasons. First, and perhaps most importantly, this process ensured that the environmental conditions for all participants, irrespective of condition assignment, were stable and identical, and the only variable that differed between the two conditions would be the aerobic stimulus. A placebo control is a useful control condition in cases where blinding of participants and investigators is not possible (Daley, Copeland, Wright, Roalfe & Wales, 2006), such as in the present study. Secondly, this study builds on the recent work by Daniel et al (2004), who reported no differences in cravings and withdrawal symptoms between abstaining smokers assigned to a very low intensity exercise or a passive control condition, highlighting that minimal intensity exercise is unlikely to alter the outcomes of interest. Thirdly, a placebo control was used in the present study because, it has been argued, sitting passively is not a comparable control condition with which to test the effects of exercise on psychological state (Daley & Maynard, 2003), and it is not necessarily an ecologically valid control condition since few people (including smokers) choose to sit quietly in a laboratory setting for no purpose at all. Indeed, it is possible

for passive sitting to increase anxiety in some individuals (Heide & Borkovec, 1984), the occurrence of which may make the interpretation of results problematic. Lastly, by creating a placebo-control condition that involved very low intensity exercise it may also be possible to begin to tease out the potential mechanism of affective change associated with participation in exercise for young people who smoke, given that the only difference between the groups lies in the aerobic stimulus. For example, with both groups receiving equal and similar attention from the investigator and with participants in both groups pedaling on a cycle ergometer, any differences between the two conditions in the outcome variables are unlikely to be due to distraction (Ussher, Sampuran, Doshi, West & Drummond, 2004).

2.2.6 Procedure

Ethical approval for this study was obtained from the University's Research Ethics Committee. All participants gave informed written consent (see Appendix 10). Participants were asked to abstain from smoking from a time between 9:00 p.m. and 10:00 p.m., until the end of the testing session on the following day, which took place between 12:00 noon and 3:00 p.m. (mean abstinence = 17.2 hours, SD = 4.04). Participants were sent a standardised text message to their mobile phone on the evening prior to the testing session, reminding them to abstain overnight and then attend the session the following day. On the day of the exercise session, abstinence was confirmed using an expired air carbon monoxide (CO) reading of <10ppm. Smoking abstinence was confirmed in all participants who attended the testing session.

All conditions took place in a testing room set up in each educational institution, which had similar environmental conditions in each location. Approximately 5

min prior to each condition, participants began completing the HONC, SEES, MPSS and desire to smoke scales, and reported demographic information. Following baseline data collection, the SEES, MPSS and desire to smoke questionnaires were also completed at the midpoint during (i.e., after 5 min), and 5 and 30 min after both conditions. Once participants had completed their follow-up measurement 5 min after both conditions, they left the testing room to pursue their normal activities and returned 30 min after the end of the exercise session to complete the final follow up measures. As this study was also concerned with the enduring effects of exercise, it was considered important to include a follow-up assessment of the study outcomes once participants had returned to their natural environment. Keeping participants in the testing room until completion of follow-up tests may not have provided any information regarding the longer term efficacy of an acute bout of exercise in reducing desire to smoke and withdrawal symptoms in the 'real world', when participants have returned to their ordinary lives. Indeed, a number of published studies (e.g., Daley & Huffen, 2003; Daley & Maynard, 2003; Daley & Welch, 2004; Focht & Hausenblas, 2001; Katomeri & Taylor, 2005a,b; McAuley, Mihalko & Bane, 1996, Taylor & Katomeri, 2006) have already attempted to gather naturalistic information on the acute psychological effects of exercise in a variety of populations, including smokers.

Before participants left the testing room they were asked not to smoke, drink alcohol, take illicit drugs, do any exercise or do anything out of the ordinary until they had completed the final follow-up assessment. When participants returned 30 min later, expired air CO concentration was measured again, and abstinence was confirmed among all participants. All participants who completed the exercise or placebo control session also attended the follow-up session. Upon

completion of the follow-up measurement session, participants received a £10.00 payment for their participation and for travel expenses related to their involvement in the study.

2.2.7 Statistical analyses and sample size calculations

Comparisons of the effects of condition on strength of desire to smoke, tobacco withdrawal symptoms and mood across time were made using a series of 2 x 3 (condition x time) repeated measures ANCOVAs, with the baseline value as the covariate. The effects of condition on strength of desire to smoke, the MPSS subscales (irritability, tension, restlessness, poor concentration, stress, happiness and energy), and SEES subscales (PWB, PD and fatigue) were assessed across time. The primary dependent variable was strength of desire to smoke. Sample size calculations were performed using data from Ussher et al (2001), which reported a large (Cohen's d = 4.0) effect size for desire to smoke. Using a more conservative estimation (Cohen's d = 1.0), sample size calculations indicated that 15 participants per condition were required to detect a significant difference between the exercise conditions versus the control condition on desire to smoke, the primary dependent variable in the present study ($p < 0.05$, 80% power).

2.3 Results

2.3.1 Demographic information

Table 2.1 presents the means for demographic and smoking characteristics, compared by group and gender. Baseline comparisons were also made on each of the MPSS variables, and on the three subscales of the SEES (see Table 2.2).

A series of independent t-tests revealed no significant differences between participants in the moderate exercise and placebo control conditions on demographic variables. Likewise, a multivariate analysis of variance (MANOVA) revealed no significant differences between groups on strength of desire to smoke, withdrawal symptoms or mood at baseline. A series of independent t-tests also revealed no significant differences between males and females on demographic variables. Additionally, a multivariate analysis of variance (MANOVA) revealed no significant gender differences on strength of desire to smoke, withdrawal symptoms or mood at baseline. Baseline nicotine dependence scores were high among participants in both conditions, as rated on the HONC (see Table 2.1).

2.3.2 Compliance with the exercise prescription

The average RPE was 12.3 (SD = 0.60) for the moderate exercise condition and 8.3 (SD = 0.58) for the placebo control condition. This indicated that participants were exercising at the correct intensity for each condition, respectively. The average HR over the 10 min was 112 bpm (SD = 22.20, 55% age-predicted HR max) for the moderate exercise condition and 89 bpm (SD = 14.53, 44% age-predicted HR max) for the placebo control condition.

Table 2.1: Means (and standard deviations) by condition and gender for demographic variables

	Moderate exercise (n = 18)			Placebo control (n = 19)		
	Overall	Males (n = 10)	Females (n = 8)	Overall	Males (n = 9)	Females (n = 10)
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Age	17.67 (1.09)	17.70 (1.25)	17.63 (0.92)	17.79 (0.92)	17.89 (0.93)	17.70 (0.95)
Body mass index (kg/m^2)	23.97 (5.68)	21.15 (2.85)	27.50 (6.51)	23.24 (3.71)	23.33 (4.66)	23.16 (2.87)
Cigarettes per day	13.39 (2.47)	12.60 (1.94)	14.38 (2.83)	13.84 (3.72)	13.78 (3.83)	13.90 (3.81)
Nicotine dependence (HONC)	7.41 (2.62)	7.56 (2.01)	7.25 (3.33)	7.00 (1.53)	6.78 (1.30)	7.20 (1.75)
Current exercise frequency (% exercising at least once per week)	38.9%	50.0%	25.0%	42.1%	44.4%	40.0%
Hours of abstinence	17.00 (2.14)	17.10 (1.85)	16.88 (2.58)	17.39 (5.32)	20.02 (6.88)	15.02 (1.13)
Difficulty abstaining from smoking	2.50 (0.92)	2.40 (0.84)	2.63 (1.06)	2.63 (1.12)	2.56 (1.42)	2.70 (0.82)
Frequency of smoking urges	2.67 (0.71)	2.80 (1.03)	2.50 (0.76)	2.47 (0.84)	2.44 (1.01)	2.50 (0.71)
Strength of smoking urges	2.44 (0.78)	2.50 (0.71)	2.38 (0.92)	2.58 (1.31)	2.67 (1.73)	2.50 (0.85)
Amount craved cigarettes	3.28 (1.07)	3.50 (0.97)	3.00 (1.20)	3.11 (1.29)	3.00 (1.58)	3.20 (1.03)

Table 2.2: Means/adjusted means and standard deviations/standard errors for strength of desire to smoke, withdrawal (MPSS) and mood (SEES), across time

	Baseline		During exercise		5 min post-exercise		30 min post-exercise		*F*	*p*
	Moderate *M (SD)*	Placebo *M (SD)*	Moderate *M (SE)*	Placebo *M (SE)*	Moderate *M (SE)*	Placebo *M (SE)*	Moderate *M (SE)*	Placebo *M (SE)*		
Desire to smoke	5.44 (1.15)	4.32 (2.21)	3.46 (0.37)	1.25 (0.36)	4.56 (0.57)	4.84 (0.28)	5.04 (0.25)	5.54 (0.24)	0.46	0.63
Irritability	2.44 (1.65)	2.11 (1.33)	2.36 (0.31)	2.41 (0.29)	2.36 (0.27)	2.31 (0.25)	2.73 (0.28)	2.34 (0.27)	0.88	0.40
Depression	1.89 (0.90)	1.32 (0.48)	1.51 (0.15)	1.83 (0.15)	1.53 (0.22)	1.97 (0.21)	1.50 (0.21)	1.73 (0.21)	0.38	0.69
Tension	2.56 (1.38)	2.84 (1.57)	2.82 (0.25)	2.69 (0.24)	2.75 (0.30)	2.45 (0.29)	2.68 (0.28)	2.62 (0.27)	0.21	0.81
Restlessness	3.00 (1.68)	2.89 (2.21)	2.53 (0.29)	3.18 (0.34)	2.92 (0.31)	3.28 (0.30)	2.93 (0.35)	3.12 (0.34)	0.73	0.47
Poor concentration	2.78 (1.00)	2.68 (1.60)	3.14 (0.29)	2.98 (0.27)	2.79 (0.29)	3.24 (0.27)	2.85 (0.34)	3.19 (0.32)	1.79	0.18
Stress	3.11 (1.41)	2.84 (1.57)	2.86 (0.31)	2.66 (0.30)	2.99 (0.34)	2.70 (0.33)	2.99 (0.31)	2.69 (0.31)	0.04	0.97
Happiness	4.11 (1.37)	4.63 (1.26)	4.57 (0.30)	4.14 (0.29)	4.07 (0.32)	4.14 (0.32)	4.44 (0.33)	4.12 (0.32)	0.99	0.38
Energy	3.44 (1.29)	3.53 (1.54)	3.75 (0.30)	4.08 (0.29)	3.02 (0.35)	3.71 (0.34)	3.47 (0.31)	3.56 (0.30)	1.31	0.27
SEES – PWB	3.79 (0.80)	4.08 (0.92)	3.74 (0.22)	3.81 (0.22)	3.93 (0.21)	3.71 (0.20)	4.08 (0.24)	3.86 (0.23)	1.06	0.35
SEES – PD	2.35 (0.83)	2.31 (1.15)	2.72 (0.22)	2.10 (0.22)	2.36 (0.23)	2.28 (0.23)	2.15 (0.27)	2.24 (0.27)	3.63	0.03
SEES – fatigue	2.49 (1.10)	2.82 (1.45)	3.78 (0.30)	2.97 (0.29)	3.78 (0.30)	2.67 (0.29)	3.05 (0.27)	2.60 (0.26)	3.19	0.08

Note: For all of the above variables, responses were rated on a 7-point scale ranging from 1 (low score) to 7 (high score)

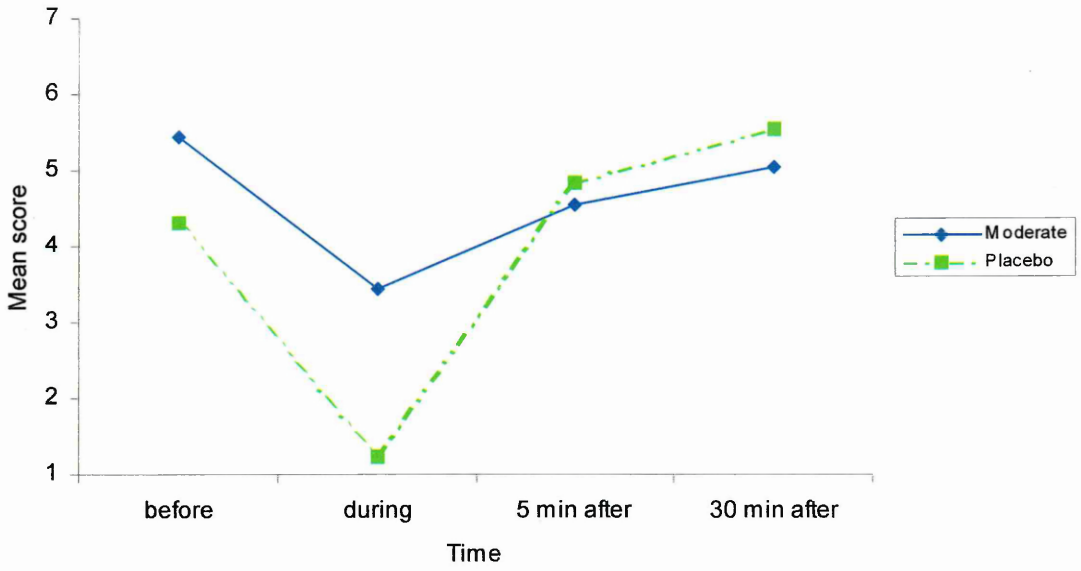


Figure 2.1: Strength of desire to smoke ratings across time for the moderate and placebo conditions

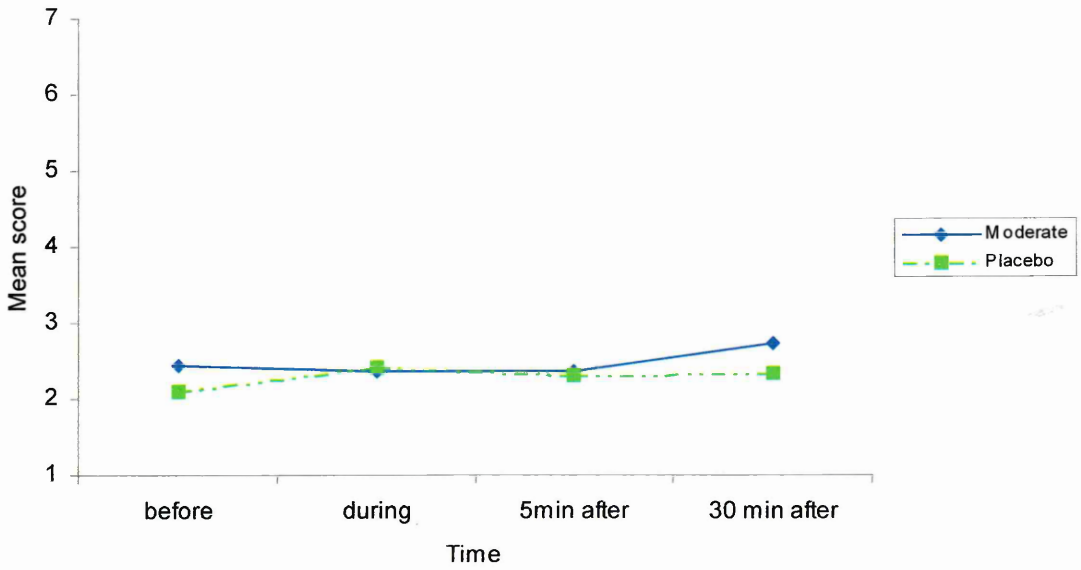


Figure 2.2: Irritability ratings across time for the moderate and placebo conditions

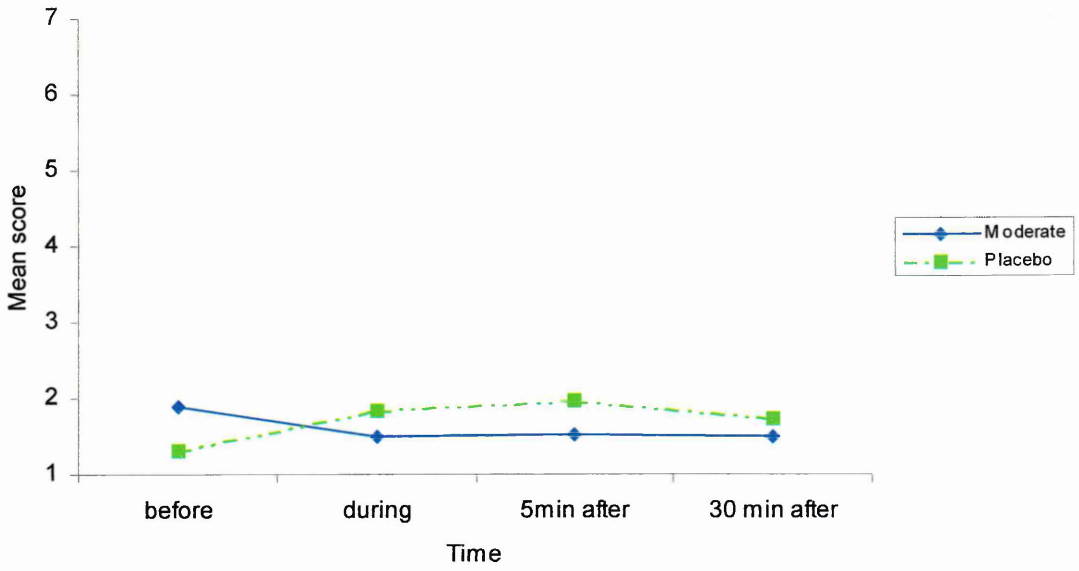


Figure 2.3: Depression ratings across time for the moderate and placebo conditions

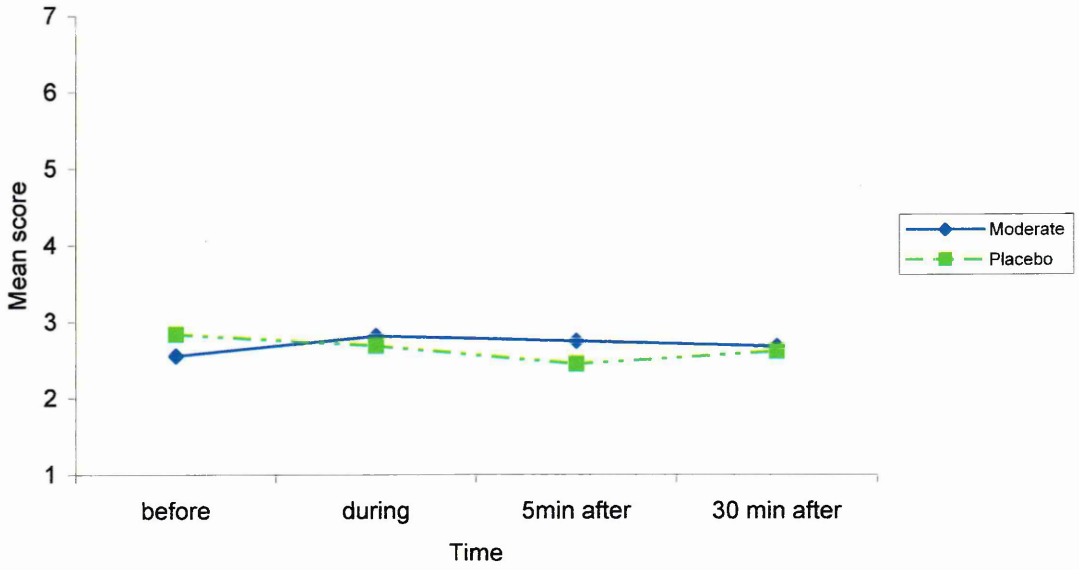


Figure 2.4: Tension ratings across time for the moderate and placebo conditions

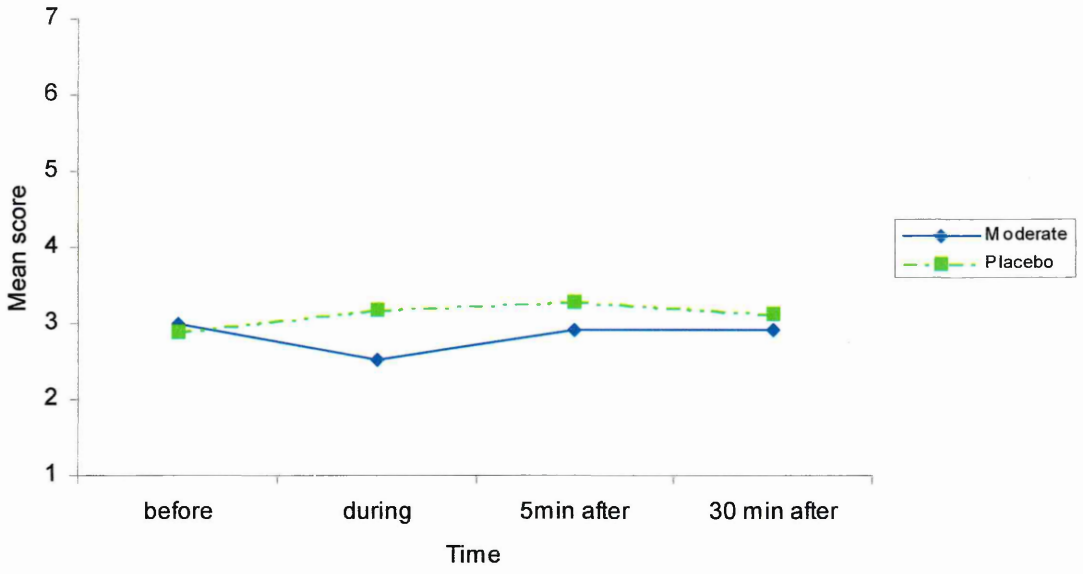


Figure 2.5: Restlessness ratings across time for the moderate and placebo conditions

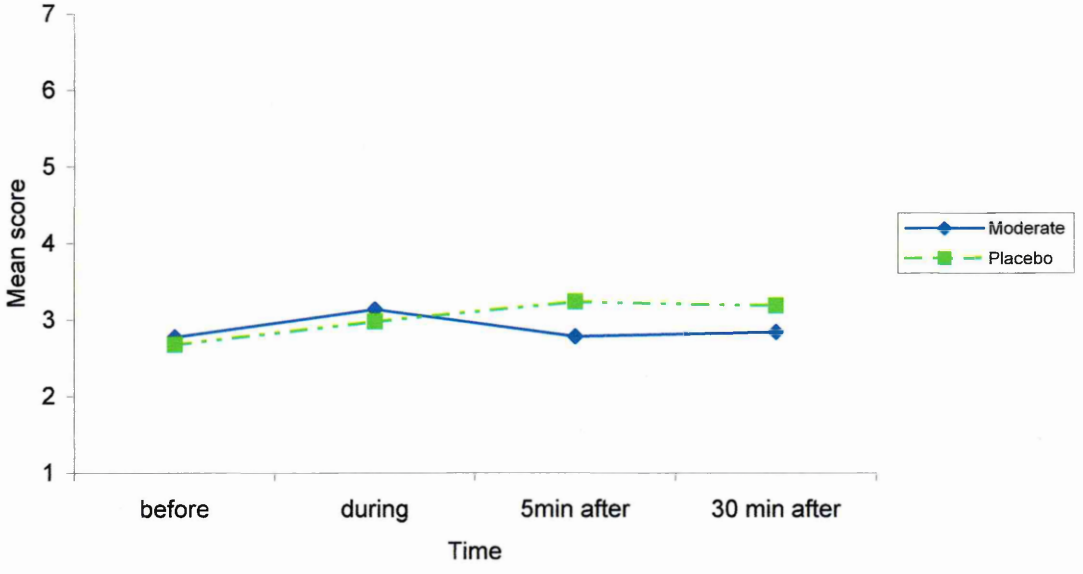


Figure 2.6: Poor concentration ratings across time for the moderate and placebo conditions

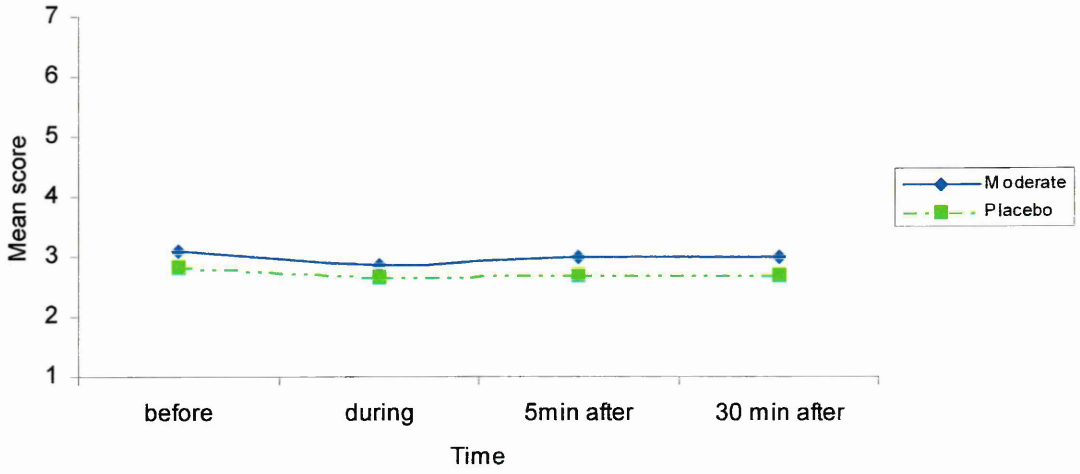


Figure 2.7: Stress ratings across time for the moderate and placebo conditions

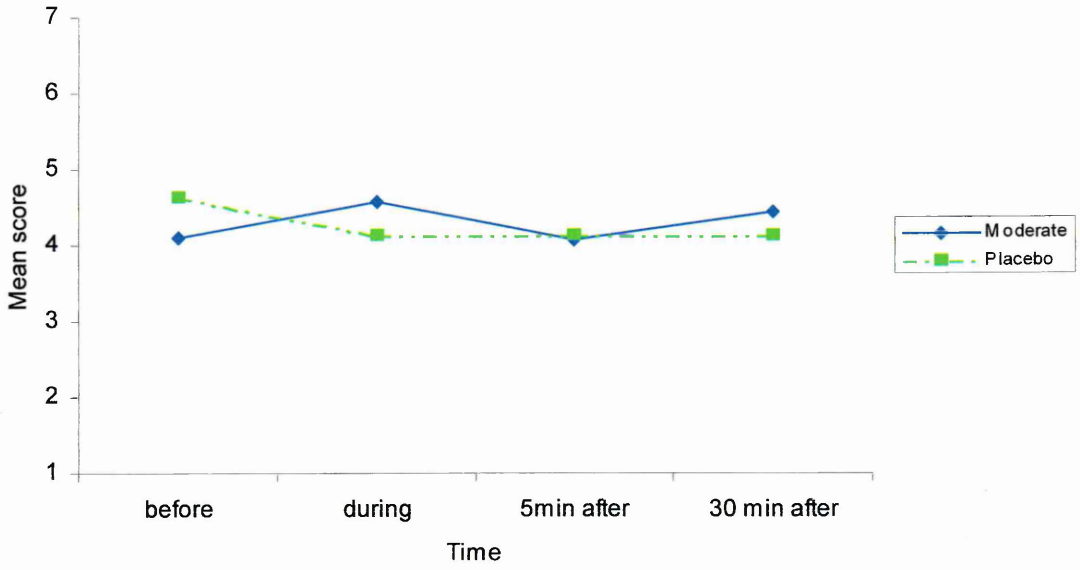


Figure 2.8: Happiness ratings across time for the moderate and placebo conditions

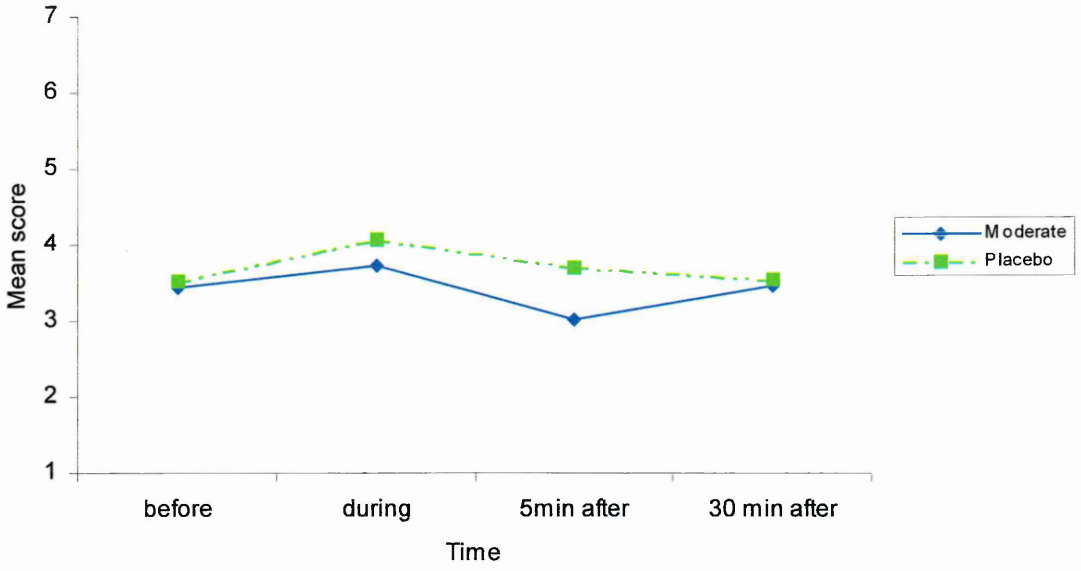


Figure 2.9: Energy ratings across time for the moderate and placebo conditions

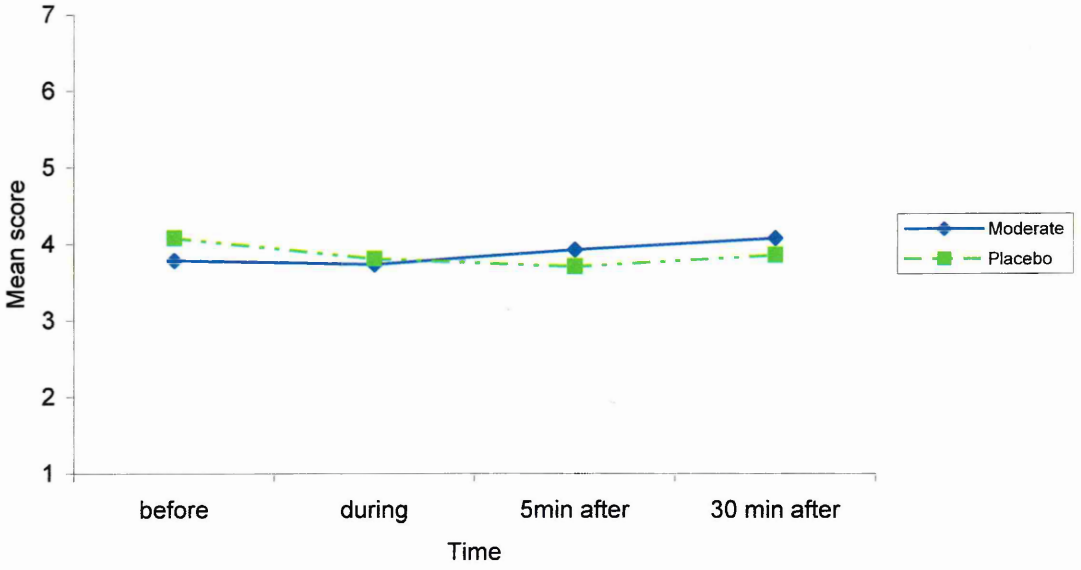


Figure 2.10: SEES positive well-being scores across time for the moderate and placebo conditions

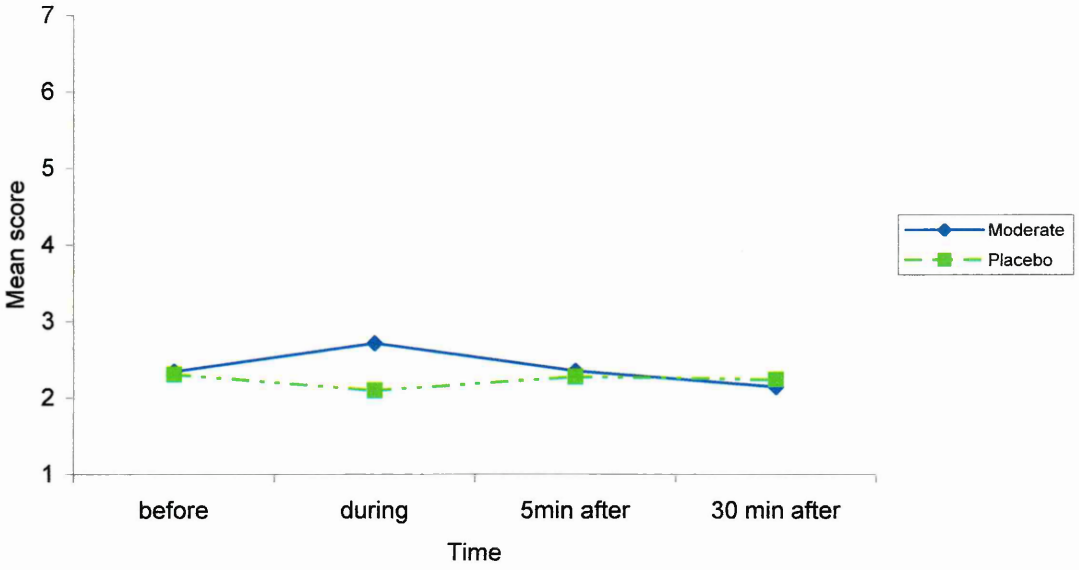


Figure 2.11: SEES psychological distress scores across time for the moderate and placebo conditions

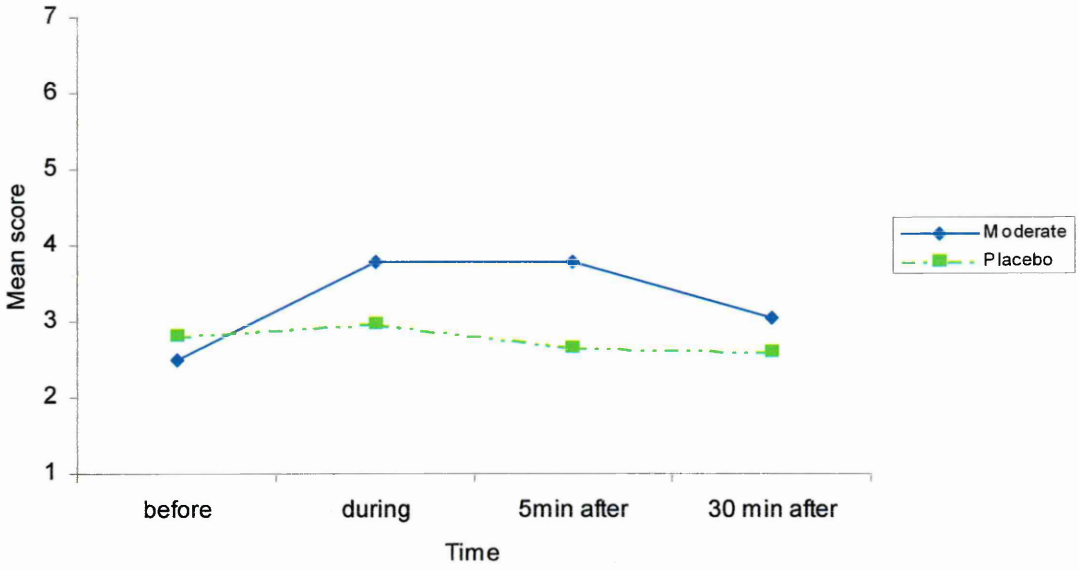


Figure 2.12: SEES fatigue scores across time for the moderate and placebo conditions

2.3.3 Exercise effects on strength of desire to smoke, withdrawal symptoms and mood

Means (and SDs) for strength of desire to smoke, withdrawal symptoms and mood are reported in Table 2.2 and displayed in Figures 2.1 to 2.12. A between-participants ANCOVA revealed a significant interaction effect for psychological distress (PD) scores ($F_{2,66}$ = 3.63, p < 0.05). Follow-up independent t-tests at each time point revealed that those in the moderate exercise condition reported significantly higher PD scores (t = 2.0, df = 35, p < 0.05) during exercise than did the placebo control condition. There were no other significant differences in PD scores between the groups 5 or 30 min after exercise. There were no time or condition main effects. No other significant effects were found for any other variables.

2.4 Discussion

It was hypothesised that 10 min of moderate intensity exercise would reduce the desire to smoke and withdrawal symptoms over time, in comparison with a placebo control condition that involved very light exercise, in adolescent smokers. No differences were detected between the conditions on strength of desire to smoke or withdrawal symptoms during or after each condition. Additionally, and contrary to prediction, when controlling for baseline scores exercise condition participants reported significantly higher PD scores during exercise than placebo condition participants, although there were no differences in PD scores after each condition. This finding is contrary to previous research (e.g., Bock et al, 1999; Ekkekakis & Petruzzello, 1999) that has reported exercise to have a positive effect upon affective responses. Further research should be conducted with young smokers to investigate this issue in more depth.

The higher psychological distress scores reported by participants in the moderate exercise condition could be attributed to the sample being sedentary or relatively inactive. These individuals may have been adapting to the demands of the exercise task, and this may have been made more distressing by the well-documented effects of smoking on respiratory function (e.g., Musk & de Klerk, 2003). Consistent with this, Petruzzello et al (1997) demonstrated that negative affect was higher among inactive than active young people during moderate intensity exercise. It should, however, be emphasised that in both the present study and the study by Petruzzello et al, the increases in distress experienced during moderate intensity exercise were not maintained after exercise.

In the present study, moderate exercise, compared with a placebo control, did not produce the hypothesised reduction in strength of desire to smoke and withdrawal symptoms found in studies with acutely abstaining adult smokers (Daniel et al, 2004; Pomerleau et al, 1987; Thayer et al, 1993; Ussher et al, 2001). This would suggest that 10 min of moderate intensity exercise might not be of sufficient intensity or duration to impact upon cravings and withdrawal symptoms among a younger smoker population. The results of the present study are contrary to findings of other studies demonstrating moderate exercise effects on cravings among adult populations (Daniel et al, 2004; Pomerleau et al, 1987; Thayer et al, 1993; Ussher et al, 2001). It is possible that a longer duration or more intense exercise session is required to produce effects among younger smokers, perhaps because of the relatively short length of time since leaving school. Studies that compare multiple intensities or durations of exercise would help to clarify this issue further.

One possible explanation for the null findings for strength of desire to smoke and withdrawal is that the adolescent smokers recruited in the present study were low-active or sedentary and may have responded to a short bout of exercise in different ways than might active young smokers. It is also possible that different types of exercise may lead to differential effects on strength of desire to smoke and withdrawal symptoms among young smokers. Further research should be undertaken to compare active and sedentary young smokers, and the effects of different exercise types among adolescent smokers.

It should be noted that the mean HONC (nicotine dependence) score in the present study was higher than those reported in previous samples with (younger) adolescents (DiFranza et al, 2004a,b) and was in fact closer to that found in an adult population, among whom the mean HONC score was 7.1 (Wellman et al, 2005). This suggests that the lack of any significant positive findings with regard to strength of desire to smoke and withdrawal symptoms cannot be attributed to the sample not being sufficiently dependent on nicotine.

While not hypothesised, and consistent with previous research (Ussher et al, 2001), it may be interesting to note that there was a small discrepancy between the RPE and HR data reported in this study. In the moderate exercise condition, mean HR corresponded with mean RPE relatively well, however RPE scores suggested participants were doing slightly more intense exercise (within the moderate range) than did HR scores. This is consistent with the observed phenomenon of a reduction in smokers' HR during abstinence (Hughes et al, 1994; Shiffman et al, 2004), and also with Ussher et al's (2001) findings that an aerobic stimulus was reported as being more intense when measured by RPE than HR in abstaining adult smokers. By contrast, in the placebo control condition in this study, HR values suggested participants were applying slightly

more exertion than did RPE values. It is possible that, in both conditions, the young smokers' HR had not fully stabilised following abstinence from smoking, making it problematic to rely solely on HR as an accurate estimate of the aerobic stimulus in abstaining smokers, and it might be the case that RPE provides a more accurate assessment of exercise intensity in this study. Nevertheless, it should be noted that despite these small discrepancies between HR and RPE, participants were within the moderate and very light intensity ranges suggested by the ACSM (1998, 2000).

The findings of the present study should be interpreted in the context of its methodological limitations and strengths. For example, participants were only temporarily abstinent from smoking; future research should examine the effects of exercise in young smokers during a quit attempt. In addition, the baseline scores on some withdrawal symptoms (e.g., depression) were relatively low. Therefore, the lack of a positive finding for withdrawal symptoms may be at least partially attributable to floor effects.

The inclusion of multiple follow-up points, including follow-up measurements after participants had returned to their normal environment, is a notable strength of this study. This is an important element of study design because it allows for a more accurate reflection of potential ratings of desire to smoke in a 'real life' abstinence attempt, away from a laboratory setting. Moreover, recent studies that have detected a positive effect of acute exercise on desire to smoke and withdrawal symptoms (Daniel et al, 2004; Taylor et al, 2005; Ussher et al, 2001) did not include a follow-up assessment outside the laboratory environment.

In conclusion, the findings of this study suggest that short bouts of exercise may not be an effective method of reducing cravings and withdrawal symptoms, in

abstaining young smokers. This study also raises the possibility that exercise may have a detrimental influence upon affective responses during exercise. That said, further research is needed to establish more exactly the exercise parameters that may impact on strength of desire to smoke and withdrawal symptoms among younger smokers who have been abstaining from cigarettes overnight. More intense exercise or a longer duration of exercise may be necessary in order to produce effects among younger smokers. This study has also highlighted measurement issues that need to be considered when regulating exercise intensity in abstaining smokers.

Chapter 3

Study 2: The effects of moderate and vigorous exercise on desire to smoke, withdrawal symptoms and mood in abstaining young smokers

3.1 Introduction

Study 1 (see Chapter 2), demonstrated no effects of a short bout of moderate intensity cycle ergometry (versus a placebo control) on strength of desire to smoke or withdrawal symptoms in abstaining adolescent smokers (mean age = 17.73 years). It is possible that moderate intensity exercise is not sufficiently intense to have an effect on cravings and withdrawal symptoms among younger smokers, although this supposition remains to be tested. Moreover, it is not known whether moderate or vigorous intensity exercise is more effective for reducing these symptoms (compared with no exercise) among smokers in general, as no controlled study to date has simultaneously included both intensities (Taylor et al, 2007), although trials showing a benefit for exercise as an aid to smoking cessation have tended to employ vigorous exercise (Ussher, 2005). Vigorous rather than moderate intensity exercise has been shown to trigger the release of dopamine (Meeusen et al, 2001; Sakai et al, 1995) and endogenous opioids (Angelopoulos, 2001; Goldfarb & Jamurtas, 1997; Leith, 1994); neurotransmitters that are known to enhance mood. Smoking is also known to stimulate dopamine and opioid release within the brain (Brody et al, 2004; Clarke, 1998; Pomerleau, 1998). Due to the stimulation of dopamine and opioid release by both vigorous intensity exercise and smoking, vigorous intensity exercise may be more likely to produce reductions in cigarette cravings and withdrawal symptoms, and greater enhancements in mood than moderate intensity exercise, when compared with no exercise. No controlled

investigations, however, have been conducted to this end, in any population of abstaining smokers.

3.1.1 The present study

The current study aimed to investigate the impact of a short bout of moderate and vigorous intensity aerobic exercise (compared with no exercise) on desire to smoke, withdrawal symptoms and mood in young adult smokers. Without such information it is difficult to know what dose of exercise is likely to produce optimum benefits over no exercise. It was hypothesised that participants assigned to the moderate and vigorous exercise conditions would experience reductions in desire to smoke and withdrawal symptoms, and improvements in mood during and after exercise, compared with those in a passive control condition.

3.2 Method

3.2.1 Participants

Forty-five young people aged 18-25 years (25 males and 20 females) who reported smoking 10 or more cigarettes per day for more than six months (mean cigarette consumption = 13.6 per day, SD = 3.47), and who were inactive (exercised on three or fewer days a week, for 30 min a day), were recruited from institutions of further and higher education in the north east of England and within the local community, through posters and leaflets. Volunteers were not eligible if they had any medical conditions which were contraindicated for exercise, as determined by a university screening self-report questionnaire, approved by the institutional research ethics committee (refer to Appendix 1). To be eligible for this study, participants were screened on the telephone or in person at the recruitment stage, to ensure they met the following criteria: (1)

currently smoking 10 or more cigarettes per day, (2) smoked for at least 6 months, (3) currently exercising less than four times a week, and (4) aged 18-25 years. In addition, those who had participated in Study 1 were excluded from participating in the present study, to eliminate the possibility of bias from prior experience of artificial abstinence from smoking (see Heil, Alessi, Plebani Lussier, Badger & Higgins, 2004). Each volunteer who responded to posters, leaflets and e-mails was screened over the telephone or in person for eligibility to participate. Of 166 respondents, 51 people were not eligible to participate, and 34 were not further contactable to assess eligibility. Of the 81 who were eligible, 36 subsequently withdrew their interest in the study, and 45 participated.

3.2.2 Design

Following baseline data collection, and after overnight abstinence, 15 participants were assigned to each condition using block randomisation stratified for gender. Participants were issued with standardised written instructions (Appendix 11), informing them of the purpose of the study and of their equal chance of being assigned to one of the three conditions. For all conditions, the interaction between investigator and participant was kept to a minimum.

3.2.3 Measures

3.2.3.1 Demographics, smoking information and exercise discomfort

At baseline, following overnight abstinence, participants' demographics, smoking characteristics and resting heart rate (HR) were measured (see Appendix 3). Additionally, the following single items were included: *'At what time did you have your last cigarette (to the nearest quarter of an hour)?'* *'At*

what age did you start smoking on a daily basis?' 'How difficult has it been to stop yourself smoking today?' (on a 0-5 scale) *'How much of the time have you felt the urge to smoke today?'* (0-5 scale) *'How strong have the urges been?'* (0-5) and *'How much have you craved cigarettes today?'* (0-5) (West et al, 1999). A single-item scale with a fully anchored response format was used to assess the frequency of physical activity over the previous three months (Gionet & Godin, 1989; Godin et al, 1986) (see Appendix 4). This item has also been used recently (Godin et al, 2004) to successfully classify participants according to their activity status.

Nicotine dependence was assessed using the Hooked on Nicotine Checklist (HONC; DiFranza et al, 2002a,b) (see Appendix 5) and the Fagerström Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker & Fagerström, 1991) (see Appendix 12). Acceptable levels of internal reliability were reported for the HONC ($\alpha = 0.68$) in the present study.

Exercise discomfort was measured using the following single item: *'How much discomfort did you feel during the exercise?'* (see Appendix 13). Responses to this item were measured on a five-point fully-anchored scale, where 1 = *just noticeable*, 2 = *very slightly*, 3 = *moderate*, 4 = *severe*, 5 = *very severe* (Daniel, 2004).

3.2.3.2 Strength of desire to smoke, withdrawal symptoms and affect

Withdrawal symptoms, and strength of desire to smoke were measured using the Mood and Physical Symptoms Scale (MPSS; West & Hajek, 2004; West et al, 1989; West & Russell, 1985). For example, *'How strong is your desire to smoke right now?'* or *'How tense do you feel right now?'* (1 *'not at all'* to 7 *'extremely'*) (see Appendix 6). The MPSS was scored both as individual

symptoms (e.g., irritability, tension, depression) and as an overall withdrawal syndrome, labelled 'composite MPSS score'. This approach is consistent with previous research (Ussher et al, 2006). Acceptable levels of internal reliability were attained for the MPSS in the present study (α = 0.84). Exercise-induced affect was self-rated on the Subjective Exercise Experience Scale (SEES; McAuley & Courneya, 1994) (see Appendix 7). In the present study, acceptable to high levels of internal reliability were found at baseline for the SEES subscales positive well-being (PWB; α = 0.85), psychological distress (PD; α = 0.92) and fatigue (α = 0.91).

3.2.5 Moderate intensity exercise condition

After 1 min of familiarisation, participants assigned to the moderate intensity exercise condition exercised on a cycle ergometer for 10 min at 40-59% heart rate reserve (HRR) and at a rating of perceived exertion (RPE) of 11-13 (Borg, 1998) (see Appendix 8). Heart rate (HR) was measured during exercise using a Polar Beat® HR monitor.

During both moderate and vigorous intensity exercise RPE and HR were assessed every minute (see Appendix 9). If participants' HR left the target range, they were instructed to pedal faster or slower accordingly, and/or the resistance was adjusted. The Borg RPE scale has been found to relate well to HR as a measure of exercise intensity (ACSM, 1998, 2000). RPE was used in addition to HR to regulate exercise because smokers' resting HR typically decreases during abstinence (Hughes et al, 1994; Shiffman et al, 2004; RCP, 2000).

3.2.6 *Vigorous intensity exercise condition*

After 1 min of familiarisation, participants assigned to the vigorous intensity exercise condition exercised on a cycle ergometer for 10 min at 60-84% HRR and at an RPE of 14-16 (Borg, 1998).

3.2.7 *Passive control condition*

Participants assigned to the passive control condition sat quietly for 10 min, without access to distractions. Since there were no effects of experimental condition when a placebo control was used in the previous study (see Chapter 2), a passive control condition was used in the present study, because previous studies of the acute effects of exercise on tobacco cravings and withdrawal have shown that such a control condition has no effect on these symptoms (Taylor & Ussher, 2005).

3.2.8 *Procedure*

Ethical approval for this study was obtained from the University's Research Ethics Committee. All participants gave informed written consent (see Appendix 14). Participants were asked to abstain from smoking from 10:00 p.m., until the end of testing, which took place on the following afternoon (mean abstinence = 17.0 hours, SD = 3.1). Participants were sent a standardised text message to their mobile phone on the evening prior to the testing session, reminding them to abstain overnight and then attend the session the following day. Overnight abstinence was confirmed using an expired air carbon monoxide (CO) reading of <10ppm. Two participants gave a CO reading of >10ppm, and were scheduled to attend on another day. Both participants reported a CO reading of <10ppm in the re-arranged session.

Approximately 10 min prior to each condition, participants began completing baseline measurements, including the MPSS, desire to smoke and SEES scales. Following baseline data collection, participants were stratified to condition. Strength of desire to smoke, SEES and MPSS were assessed again at the midpoint during exercise or passive sitting (i.e., after 5 min), and again 5 and 30 min after exercise or control. For all ratings given, the scales were enlarged to A3 size, presented on the wall directly in front of participants, and administered verbally.

Following the 5 min follow-up assessments, participants left the testing room to pursue their normal activities, and returned 30 min following the intervention for the final assessments. Similar to Study 1 (see Chapter 2; Everson et al, 2006), outcomes were assessed once participants had returned to their natural environment because this study was also concerned with the enduring and ecologically valid effects of exercise.

Prior to leaving the testing room, participants were asked not to smoke, drink alcohol, take illicit drugs, do any exercise or do anything out of the ordinary until after completing their final assessments. When participants returned to the testing room, abstinence was confirmed with an expired air CO reading of <10 ppm. Upon completion of the final assessment, participants received a £10.00 payment for their participation and for travel expenses related to their involvement in the study.

3.2.9 Statistical analyses and sample size calculations

Comparisons of the effects of moderate and vigorous exercise with passive control on strength of desire to smoke, tobacco withdrawal symptoms and mood were made across time using a series of three by three (exercise intensity x

time) repeated measures ANCOVAs, with baseline scores as the covariate. Pairwise comparisons (Tukey's HSD) were used to locate significant differences between pairs of adjusted means at each time point respectively. Sample size calculations were performed using data from Ussher et al (2001), which reported a large (Cohen's $d = 4.0$) effect size for desire to smoke. Using a more conservative estimation (Cohen's $d = 1.0$), sample size calculations indicated that 15 participants per condition were required to detect a significant difference between the exercise conditions versus the control condition on desire to smoke, the primary dependent variable in the present study ($p < 0.05$, 80% power). Bonferroni corrections ($p < 0.01$) were used on all dependent variables.

3.3 Results

3.3.1 Baseline comparisons

At baseline, there were no differences between the three conditions on demographic and smoking characteristics (Table 3.1); nor on strength of desire to smoke, each of the MPSS items, the composite MPSS score, nor any of the three subscales of the SEES (Table 3.2).

3.3.2 Exercise discomfort

Participants in the vigorous intensity exercise condition reported significantly higher levels of exercise discomfort (mean 2.80, SD = 0.56) than those in the moderate exercise condition (mean = 2.27, SD = 0.70; $t = -2.30$, $df = 28$, $p < 0.05$). Exercise discomfort was correlated with average RPE ($r = 0.50$, $p < 0.01$), but not with average HR ($r = 0.35$, $p = 0.06$), average percentage of HRR ($r = 0.26$, $p = 0.17$), or cigarettes per day ($r = -0.15$, $p = 0.44$).

3.3.3 Compliance with the exercise prescription

On average, participants in the moderate condition exercised at 49.8% HRR (SD = 4.25; mean HR = 131 bpm, SD = 7.56) and reported an RPE of 12.5 (SD = 0.82). Those in the vigorous exercise condition exercised at an average rate of 67.9% HRR (SD = 5.25; mean HR = 155 bpm, SD = 7.16), and reported a mean RPE of 14.8 (SD = 1.04). Thus, data indicated that participants were exercising at the correct intensity for each condition, respectively. Average RPE during exercise was significantly correlated with average HR during exercise (r = .53, $p < 0.01$) and average percentage of HRR during exercise (r = .57, $p < 0.01$).

3.3.4 Exercise effects on strength of desire to smoke

Analyses demonstrated a significant condition by time interaction ($F_{4,82} = 3.64$, $p = 0.009$, partial $\eta^2 = 0.15$). Pairwise comparisons ($p = 0.01$) indicated that strength of desire to smoke was reduced during and 5 min after both moderate ($d = 0.80$ and $d = 0.76$ respectively) and vigorous exercise ($d = 1.11$ and $d = 0.99$ respectively) compared with the control condition (see Table 3.2 and Figure 3.1).

Table 3.1: Means (and standard deviations) by condition for baseline characteristics

Characteristic	Moderate exercise (n = 15)	Vigorous exercise (n = 15)	Passive Control (n = 15)
	Mean (SD) or %	Mean (SD) or %	Mean (SD) or %
Age	22.40 (2.23)	21.53 (2.39)	21.60 (1.96)
Body mass index (kg/m^2)	23.21 (3.90)	22.81 (2.75)	24.77 (4.78)
Cigarettes per day	14.20 (3.76)	13.93 (3.96)	12.80 (2.60)
Nicotine dependence (FTND)	3.67 (1.88)	3.47 (1.96)	2.93 (1.87)
Nicotine dependence (HONC) (0-10)	7.40 (1.81)	7.53 (2.42)	7.79 (1.67)
Intention to quit (% yes)	80.0%	86.7%	80.0%
CO reading	3.53 (1.60)	4.20 (1.70)	3.33 (1.45)
Current exercise frequency (% exercising at least once per week)	46.6%	53.4%	86.6%
Hours of abstinence	16.42 (1.94)	17.13 (4.05)	17.42 (3.19)
Difficulty abstaining (0-5)	2.27 (1.49)	2.33 (1.18)	1.87 (1.19)
Frequency of smoking urges (0-5)	2.07 (1.22)	2.13 (0.92)	2.13 (0.83)
Strength of smoking urges (0-5)	2.27 (1.39)	2.47 (0.74)	2.20 (1.08)
Amount craved cigarettes (0-5)	2.87 (1.36)	3.00 (1.13)	2.67 (0.82)

Table 3.2: Means/adjusted means [a] (and standard deviations/standard errors) for strength of desire to smoke, withdrawal (MPSS) and mood across time

Variable & measurement time	Mean (SE) Moderate exercise (*n*=15)	Vigorous exercise (*n*=15)	Passive control (*n*=15)	*F*	*P*
Strength of desire to smoke				3.64	0.009
Baseline (SD)	5.20 (1.86)	4.73 (1.49)	4.01 (0.42)		
During	2.64 (0.43) [b]	2.13 (0.42) [c]	3.96 (0.43)		
5 min after	3.28 (0.42) [b]	2.93 (0.41) [c]	4.52 (0.42)		
30 min after	3.94 (0.40)	4.20 (0.39)	4.33 (0.40)		
Composite MPSS score				4.70	0.002
Baseline (SD)	17.60 (7.58)	17.57 (5.11)	13.50 (6.06)		
During	15.77 (1.73)	19.39 (1.79) [c]	14.36 (1.84)		
5 min after	12.05 (1.51) [b]	15.50 (1.56)	17.46 (1.60)		
30 min after	12.56 (1.35)	13.60 (1.40)	15.17 (1.43)		
Irritability				3.75	0.007
Baseline (SD)	2.40 (1.50)	2.87 (1.46)	2.20 (1.47)		
During	2.79 (0.34)	3.35 (0.35)	2.52 (0.35)		
5 min after	1.98 (0.33)	2.24 (0.34)	2.84 (0.34)		
30 min after	2.11 (0.32)	1.95 (0.32)	2.54 (0.32)		
Depression				3.36	0.013
Baseline (SD)	1.73 (1.16)	1.73 (1.44)	1.73 (1.10)		
During	1.47 (0.22)	2.20 (0.22)	1.67 (0.22)		
5 min after	1.33 (0.24)	1.73 (0.24)	2.13 (0.24)		
30 min after	1.60 (0.20)	1.47 (0.20)	1.60 (0.20)		
Tension				0.86	0.49
Baseline (SD)	3.33 (1.59)	3.13 (1.06	2.33 (1.40)		
During	2.77 (0.36)	3.52 (0.36)	2.92 (0.37)		
5 min after	2.22 (0.35)	2.61 (0.34)	2.83 (0.35)		
30 min after	1.82 (0.34)	2.31 (0.34)	2.48 (0.35)		

Restlessness				2.48	0.050
Baseline (SD)	3.33 (1.92)	3.67 (1.76)	2.73 (1.49)		
During	2.77 (0.39)	3.17 (0.40)	3.00 (0.40)		
5 min after	2.36 (0.35)	3.07 (0.35)	3.97 (0.35)		
30 min after	2.43 (0.28)	2.61 (0.28)	3.36 (0.29)		
Poor concentration				2.93	0.026
Baseline (SD)	3.53 (1.96)	2.80 (1.47)	2.29 (1.07)		
During	3.23 (0.43)	3.57 (0.42)	2.71 (0.44)		
5 min after	2.37 (0.35)	3.52 (0.34)	3.13 (0.37)		
30 min after	2.45 (0.36)	2.90 (0.35)	3.12 (0.37)		
Stress				2.38	0.059
Baseline (SD)	3.27 (1.71)	2.71 (1.38)	2.93 (1.34)		
During	2.82 (0.44)	3.47 (0.45)	2.34 (0.44)		
5 min after	2.04 (0.36)	2.52 (0.37)	2.68 (0.35)		
30 min after	2.37 (0.35)	2.59 (0.36)	2.55 (0.35)		
Happiness				7.63	0.000
Baseline (SD)	4.40 (1.50)	4.53 (0.99)	4.67 (1.11)		
During	4.41 (0.24)	3.20 (0.24)[c]	4.59 (0.24)		
5 min after	4.73 (0.23)	4.33 (0.23)	4.34 (0.23)		
30 min after	4.43 (0.21)	4.40 (0.21)	4.30 (0.21)		
Energy				1.57	0.192
Baseline (SD)	3.20 (1.47)	2.40 (1.24)	3.07 (1.44)		
During	3.72 (0.32)	3.30 (0.32)	2.52 (0.31)		
5 min after	3.80 (0.33)	3.45 (0.33)	2.55 (0.33)		
30 min after	3.29 (0.27)	3.43 (0.27)	3.01 (0.27)		
SEES positive well-being				4.04	0.009
Baseline (SD)	3.33 (1.59)	3.78 (0.72)	3.82 (1.20)		
During	3.98 (0.26)	3.19 (0.26)	3.72 (0.26)		
5 min after	4.31 (0.27)[b]	3.78 (0.26)	3.54 (0.27)		
30 min after	4.02 (0.29)	4.18 (0.29)	3.60 (0.29)		

SEES psychological distress				8.10	0.000
Baseline (SD)	2.42 (1.37)	2.18 (1.18)	2.22 (1.56)		
During	1.98 (0.26)	3.15 (0.26) [c]	1.80 (0.26)		
5 min after	1.56 (0.25) [b]	2.46 (0.25)	2.30 (0.25)		
30 min after	1.69 (0.20)	1.84 (0.20)	2.10 (0.20)		
SEES fatigue				3.50	0.011
Baseline (SD)	3.47 (1.48)	3.60 (1.61)	3.30 (1.61)		
During	3.48 (0.37)	4.53 (0.37)	3.29 (0.38)		
5 min after	3.03 (0.38)	4.10 (0.38)	3.23 (0.40)		
30 min after	2.95 (0.36)	3.05 (0.37)	3.02 (0.38)		

For all of the above variables, responses were rated on a 7-point scale ranging from 1 (low amount of the variable) to 7 (high amount of the variable).

[a] Means during, 5 min and 30 min after are adjusted for baseline scores.

Post-hoc tests (Tukey's HSD): [b] moderate exercise versus passive control, [c] vigorous exercise versus passive control (all significant at $p < 0.01$).

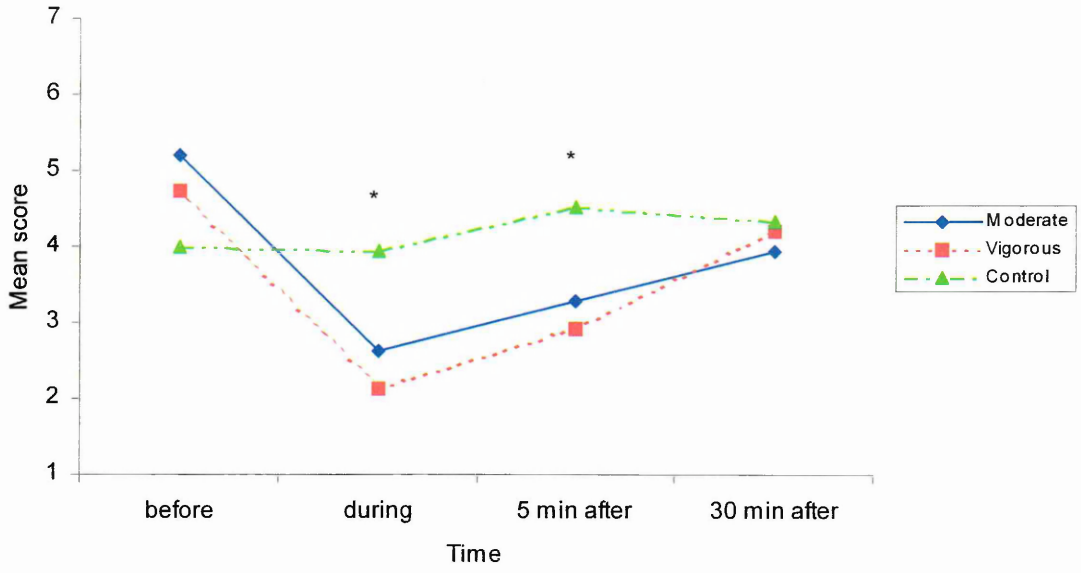


Figure 3.1: Strength of desire to smoke ratings across time for the moderate, vigorous and control conditions

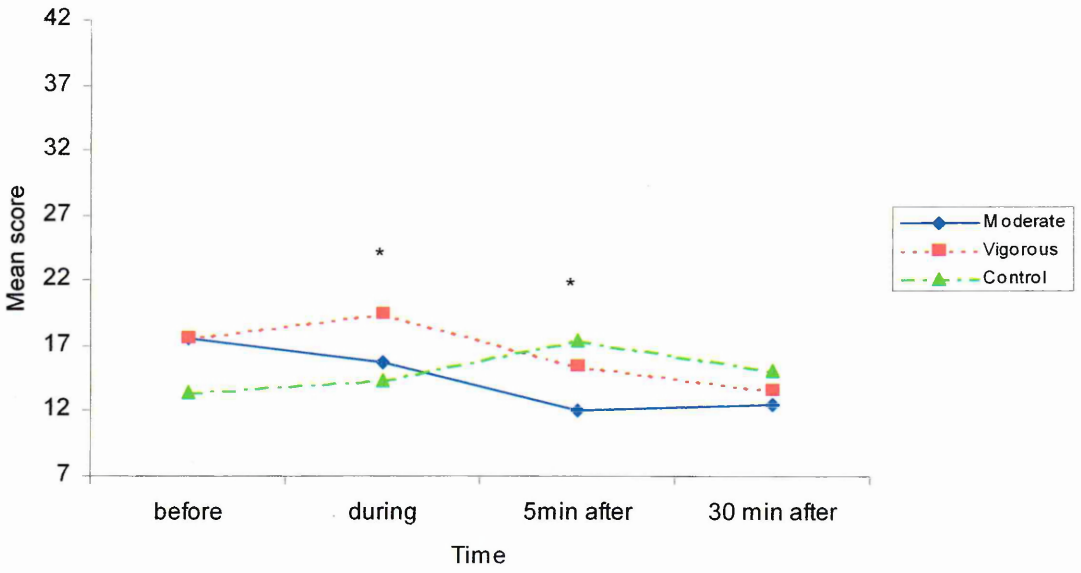


Figure 3.2: Composite MPSS scores across time for the moderate, vigorous and control conditions

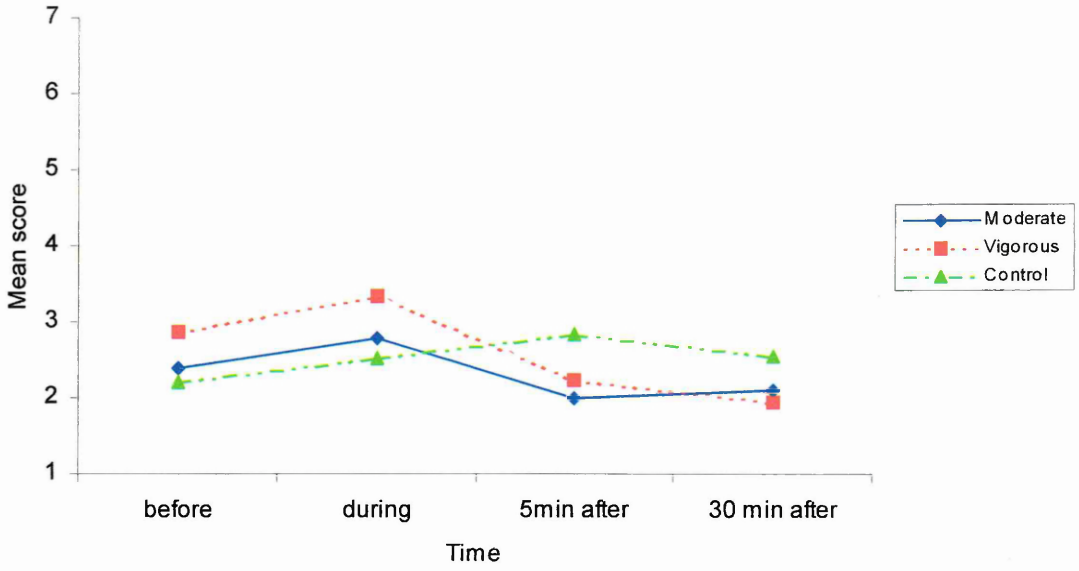


Figure 3.3: Irritability ratings across time for the moderate, vigorous and control conditions

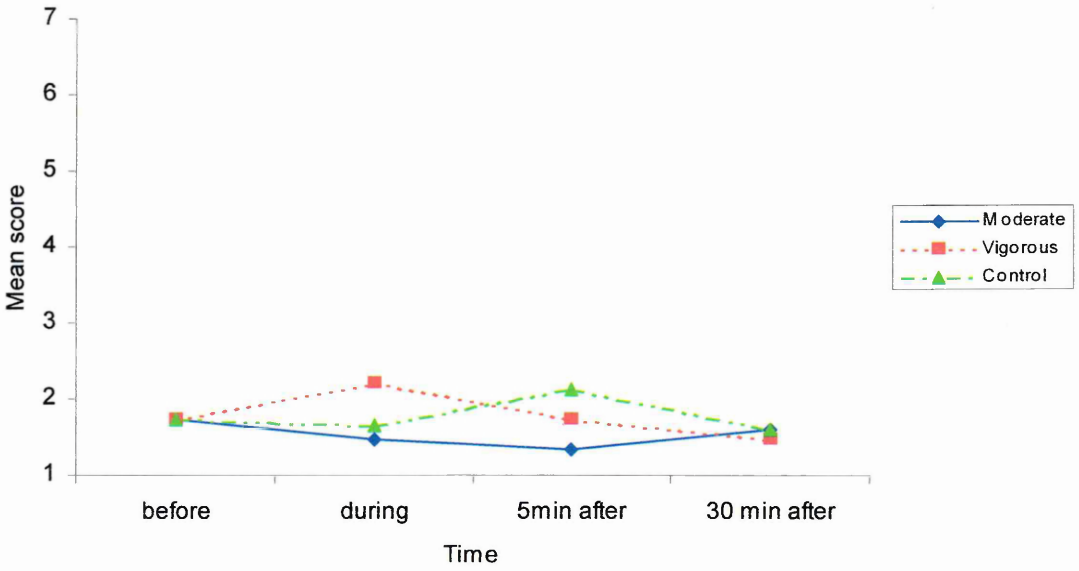


Figure 3.4: Depression ratings across time for the moderate, vigorous and control conditions

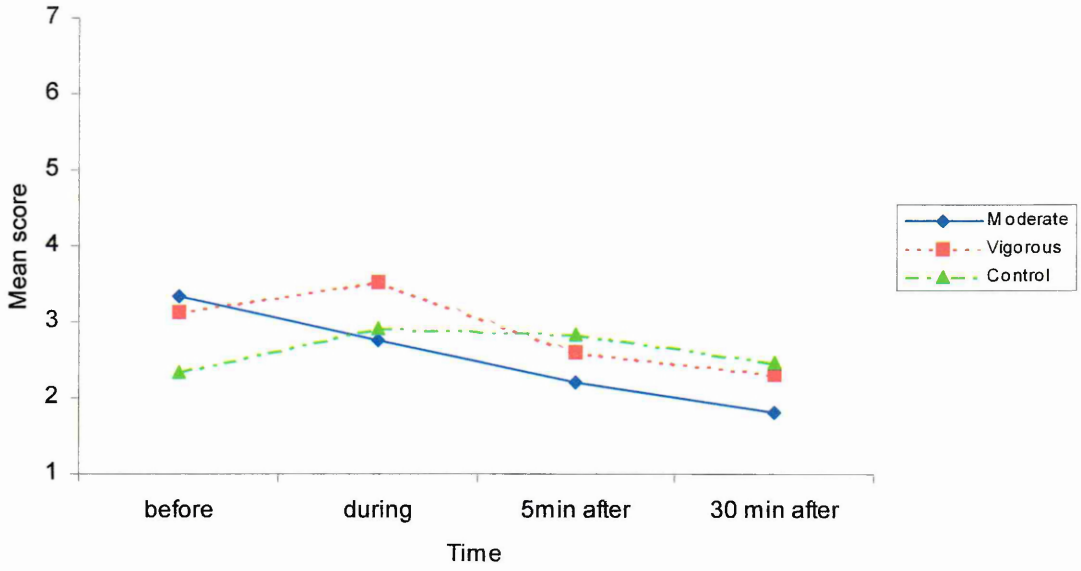


Figure 3.5: Tension ratings across time for the moderate, vigorous and control conditions

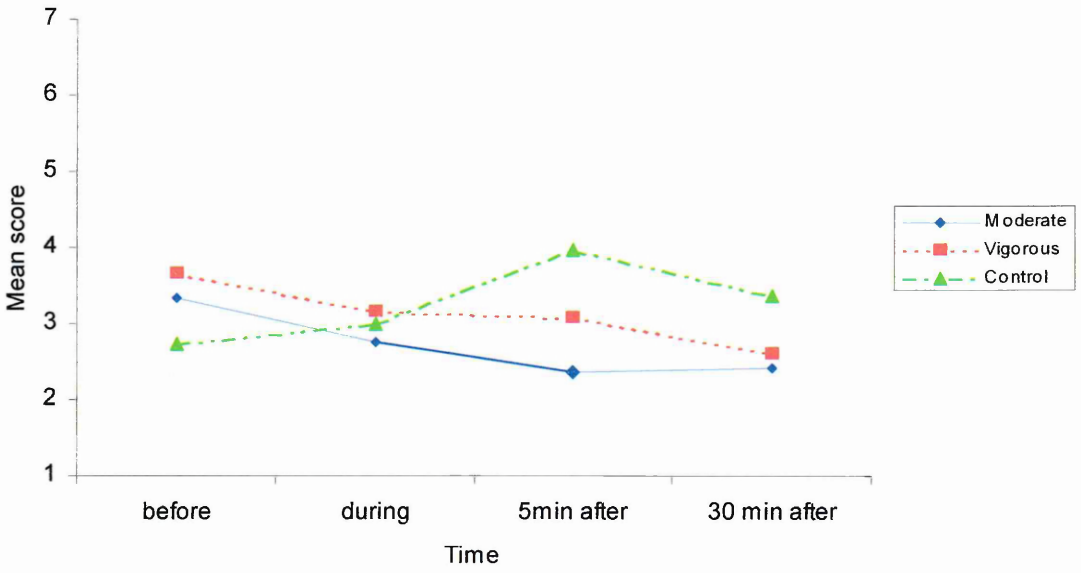


Figure 3.6: Restlessness ratings across time for the moderate, vigorous and control conditions

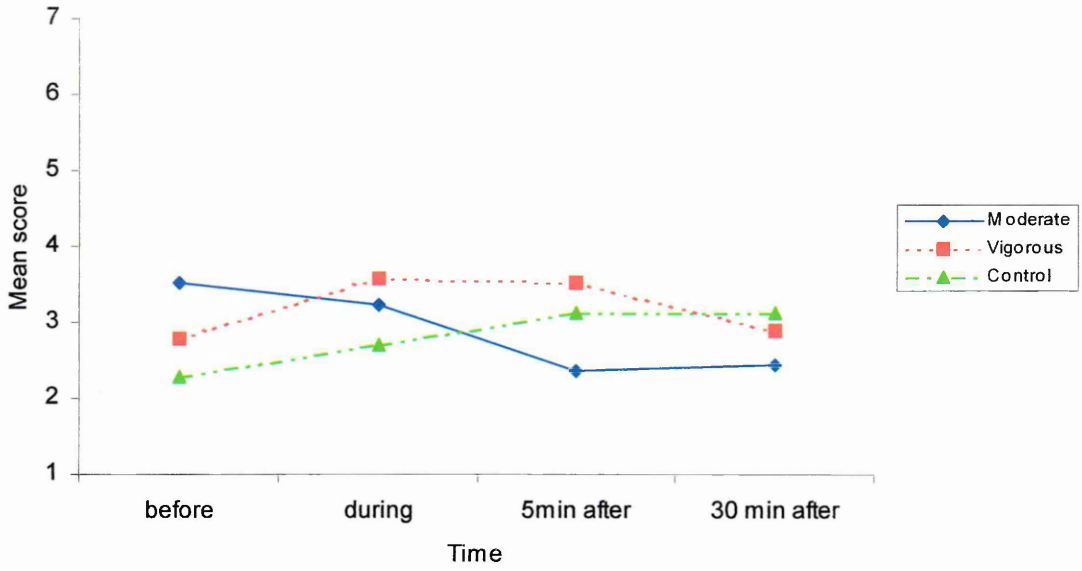


Figure 3.7: Poor concentration ratings across time for the moderate, vigorous and control conditions

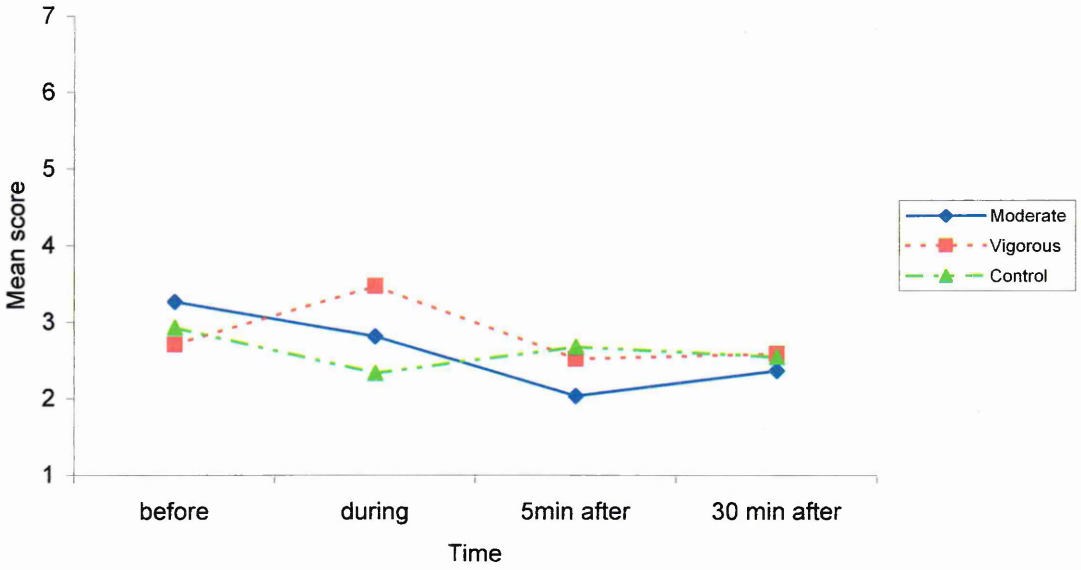


Figure 3.8: Stress ratings across time for the moderate, vigorous and control conditions

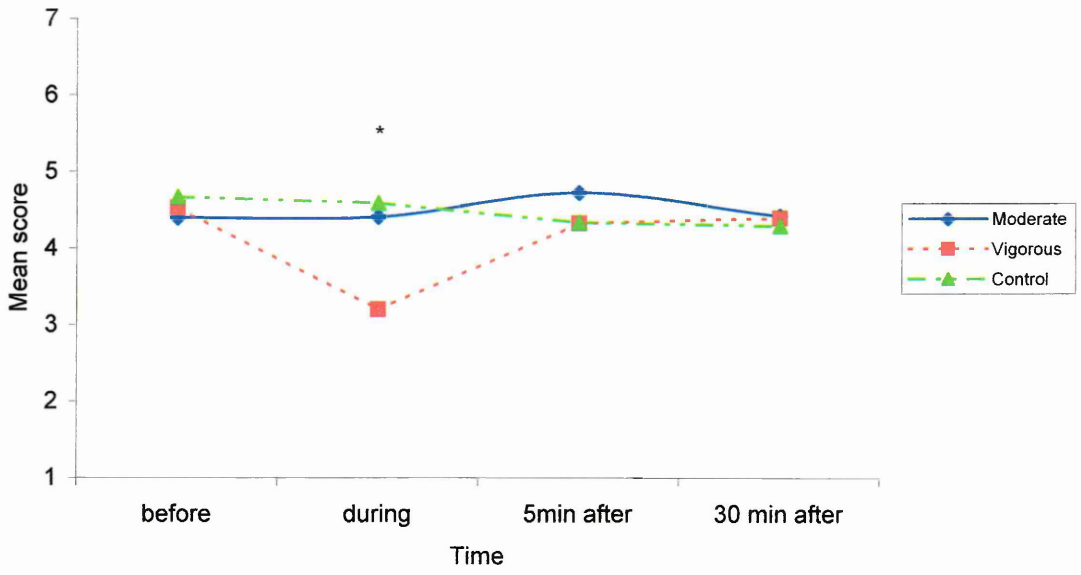


Figure 3.9: Happiness ratings across time for the moderate, vigorous and control conditions

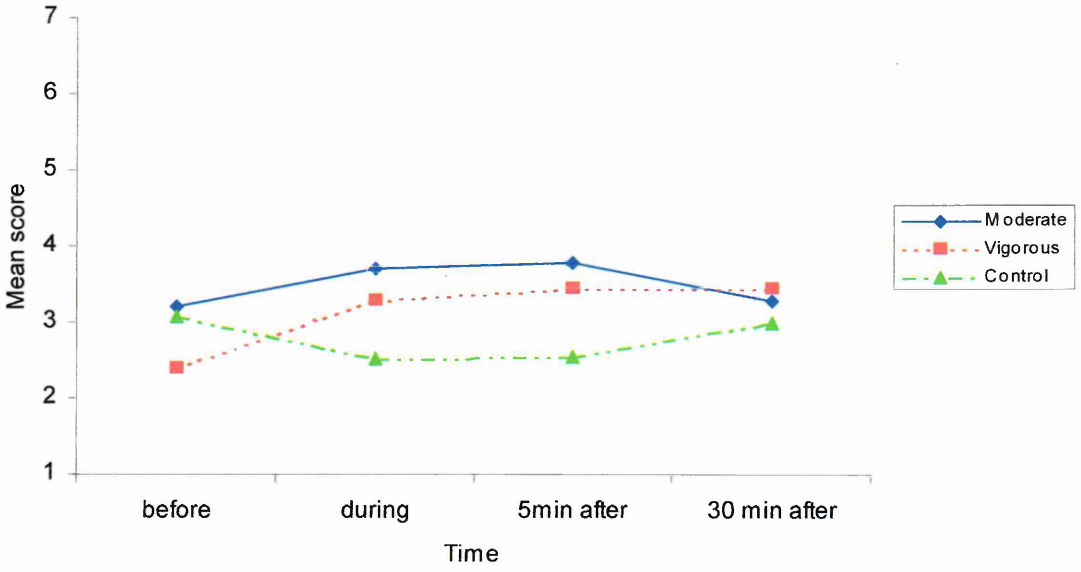


Figure 3.10: Energy ratings across time for the moderate, vigorous and control conditions

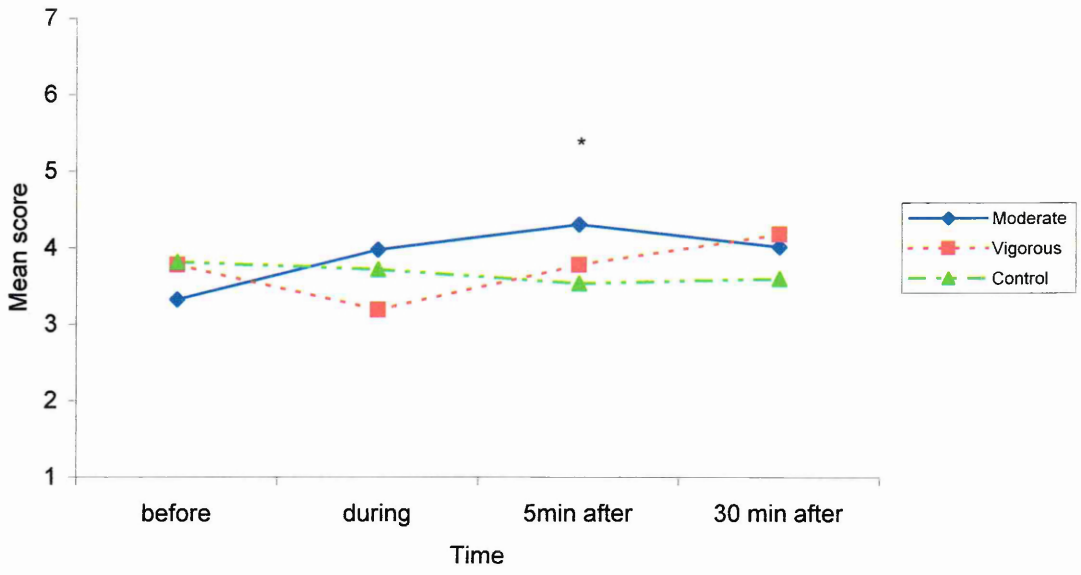


Figure 3.11: SEES positive well-being scores across time for the moderate, vigorous and control conditions

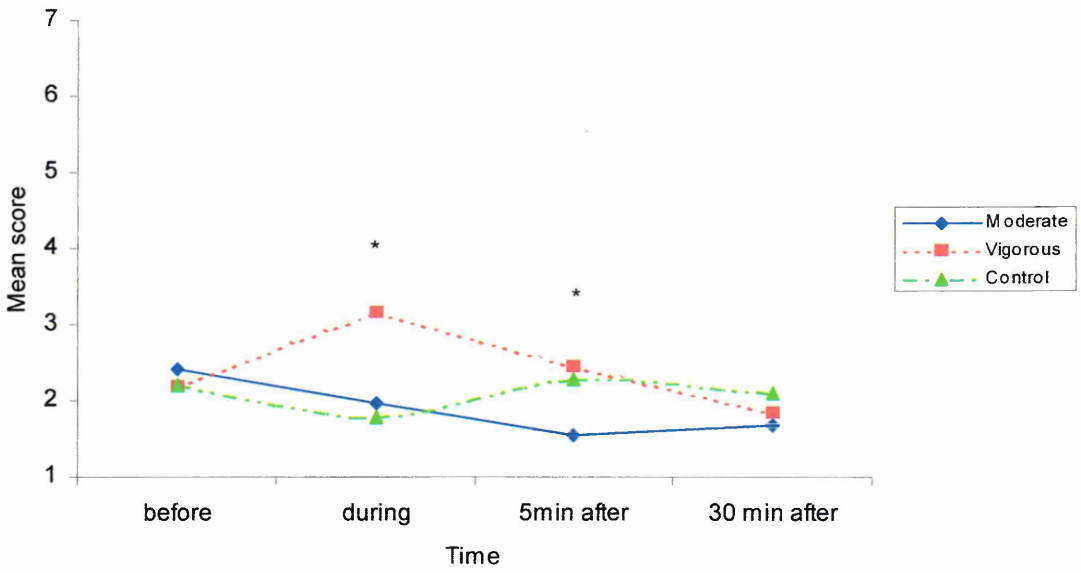


Figure 3.12: SEES psychological distress scores across time for the moderate, vigorous and control conditions

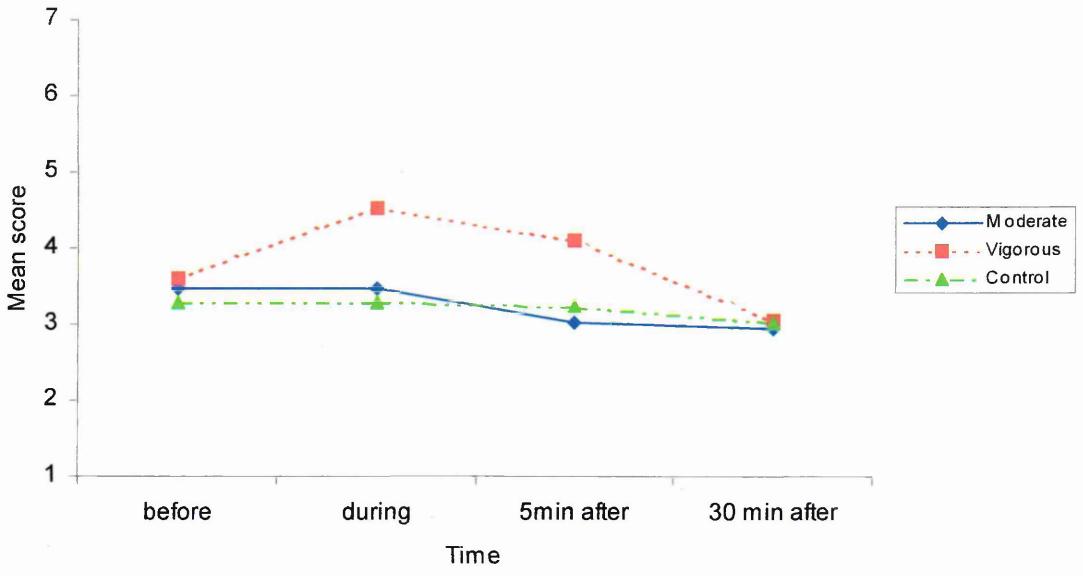


Figure 3.13:SEES fatigue scores across time for the moderate, vigorous and control conditions

3.3.5 Exercise effects on withdrawal symptoms and mood

ANCOVAs demonstrated a significant condition by time interaction for composite MPSS score ($F_{4,78}$ = 4.70, p = 0.002, partial η^2 = 0.19), irritability ($F_{4,82}$ = 3.75, p = 0.007, partial η^2 = 0.16), happiness ($F_{4,82}$ = 7.63, p < 0.001, partial η^2 = 0.27), PWB and PD subscales of the SEES ($F_{3.2,66.2}$ = 4.04, p = 0.009, partial η^2 = 0.17; $F_{4,82}$ = 8.10, p < 0.001, partial η^2 = 0.28). Pairwise comparisons indicated that the moderate exercise condition had significantly lower composite MPSS (p = 0.01, d = 0.90) and PD scores (p = 0.01, d = 0.76) and a significantly higher PWB score (p = 0.01, d = -0.74) 5 min after exercise, compared with the control condition. Pairwise comparisons revealed that the vigorous exercise condition experienced significantly lower levels of happiness (p = 0.01, d = 1.49) and higher composite MPSS scores (p = 0.01, d = -0.72) and PD scores (p = 0.01, d = -1.34) during exercise, relative to passive control (see Table 3.2 and Figures 3.2 to 3.13).

3.4 Discussion

The present findings suggest that, in temporarily abstaining young adult smokers, both moderate and vigorous intensity exercise were effective in reducing ratings of strength of desire to smoke relative to passive waiting both during and up to 5 min after exercise. In addition, the moderate intensity exercise condition participants reported lower levels of composite tobacco withdrawal and psychological distress, and higher positive well-being scores 5 min after exercise than did passive control condition participants. In contrast, vigorous exercise was associated with adverse mood outcomes (including composite withdrawal score) during exercise. Given that existing smoking cessation programmes (e.g., nicotine replacement therapy, information leaflets,

peer influence programmes, incentive programmes, and other behavioural interventions) have been found to have limited success among young people (e.g., Camenga & Klein, 2004; Garrison et al, 2003; Grimshaw & Stanton, 2006) and smoking rates are comparatively high in this population (Department of Health, 2000; Twigg et al, 2004), there appears to be an increasingly persuasive case for the evaluation of alternative cessation interventions such as exercise. Regardless of the differential effects of exercise intensity, these findings, which support the potential role of exercise during smoking abstinence in young adults, are encouraging.

Unlike previous research (see Chapter 2, Study 1; Everson et al, 2006), which reported no changes in desire to smoke in smokers aged 16-19, the present study did find reductions in desire to smoke and withdrawal symptoms during and up to 5 min after exercise, in smokers aged 18-25. The present findings are also supportive of research involving older smokers (Bock et al, 1999; Daniel et al, 2006; Daniel et al, 2004; Katomeri & Taylor, 2005a,b; Taylor & Katomeri, 2006; Taylor et al, 2005, 2006; Thayer et al, 1993; Ussher et al, 2001; Ussher et al, 2006), which has also reported reductions in cravings and withdrawal symptoms during and after exercise. A reduction in composite withdrawal score was found only for moderate intensity exercise versus control, this finding lending support to previous studies that evaluated the effects of shorts bouts of moderate intensity exercise in temporarily abstaining adult smokers (Daniel et al, 2006; Daniel et al, 2004; Thayer et al, 1993; Ussher et al, 2001). In contrast, participants in the vigorous exercise condition reported significantly lower happiness and higher composite withdrawal scores and psychological distress scores during exercise, relative to control.

Collectively, these findings suggest it cannot be assumed that all outcomes will be influenced in the same direction by different intensities of exercise in this population of smokers. Overall, the results of this study suggest that moderate intensity exercise may be beneficial for young adult smokers, as this intensity had positive effects on mood and withdrawal symptoms in addition to desire to smoke, whereas vigorous intensity exercise only had a beneficial effect on desire to smoke and was associated with adverse mood outcomes. This conclusion is consistent with research among the general population, showing that high intensity exercise results in decreased positive affect and increased negative affect (Ekkekakis et al, 2005; Hall, Ekkekakis & Petruzzello, 2002). Discomfort during exercise may also play a role in affective response, as exercise discomfort levels were rated as being greater in the vigorous than the moderate intensity condition. Further, because of the well-documented adverse effects of smoking on lung function (Musk & de Klerk, 2003; Samet, 2001), inactive smokers are likely to find high levels of exertion aversive and this could be reflected in their mood responses. As the present study is the first study in this field, further research is clearly needed to clarify the effects and the mechanisms that might be responsible.

The present study has several methodological limitations and strengths. Participants were only temporarily abstinent from smoking, and future research should consider the effects of moderate and vigorous intensities of exercise among young adult smokers who are attempting cessation. The sample size of the present study was sufficient to detect significant differences between the two exercise conditions relative to control but not between the exercise conditions, therefore any inferences about such effects should be made with caution until such a study takes place. Finally, this study assessed a number of

outcome variables across multiple time points, therefore it is possible that the results are spurious, although the use of Bonferroni corrections will have reduced the potential for this to have occurred. It should be noted that analyses revealed a number of null results for outcomes included in this study.

Regarding strengths, this is the first study of the benefits of exercise in abstaining smokers to include both moderate and vigorous intensity exercise conditions. In addition, previous research that has reported exercise-related reductions in desire to smoke and withdrawal symptoms (see Taylor et al, 2007) had been conducted entirely in a research laboratory setting. As in Study 1, the present study allowed participants to return to their usual surroundings prior to the final assessment, and this process provided the opportunity to assess the benefits of exercise upon outcomes under more realistic conditions and where participants' usual smoking cues may have been present.

In conclusion, this study has highlighted the beneficial role that short bouts of exercise may have in aiding smoking cessation in young adults. It appears both moderate and vigorous intensity exercise can effectively reduce cigarette cravings for up to 5 min after exercise in this population, compared with no exercise. Given the knowledge gained from this study and from related literature on exercise intensity and mood, moderate intensity exercise appears to be preferential. This conclusion has positive implications for exercise intervention, as moderate exercise may be easier than vigorous exercise for low active young people, in particular those who smoke, to perform. Moderate intensity activities can also be integrated into smokers' lifestyles with more ease than more intense activities.

Chapter 4

Study 3: The theory of planned behaviour applied to physical activity in young people who smoke

4.1 Introduction

The foundations of many lifetime behaviours are laid down in adolescence, including physical activity (Daley, 2002; Trudeau et al, 1999) and smoking (Colby et al, 2000; Kelder et al, 1994), as discussed in Chapter 1. Exercise adherence is a difficult challenge for 'apparently healthy' populations, and is likely to be even more difficult in those who are practicing 'unhealthy behaviours'. Not surprisingly then, several studies have reported links between smoking and physical inactivity in both adults and young people (e.g., Aaron et al, 1995; Emmons et al, 1994; Thorlindsson & Vilhjalmsson, 1991), which can track over time from childhood and adolescence into adulthood (e.g., Steptoe et al, 2002). This evidence implies that people who smoke may reduce their smoking behaviour if their corresponding physical activity levels were to increase. It is also possible that if people who smoke were to adopt a healthier lifestyle through becoming more active, smoking may no longer be compatible with this particular way of life, possibly resulting in them becoming more likely to quit smoking. Thus, it seems important for researchers and practitioners to explore the question of *why* young adult smokers do and do not engage in health promoting behaviour such as exercise, and to investigate social-cognitive factors that might discriminate between those who are active and inactive. Biddle and Nigg (2000) have highlighted the need to conduct research into physical activity determinants from a theoretical perspective. At present, little is known about the determinants of exercise or physical activity behaviour in

young people who smoke. Given that smoking accounts for 20% of all deaths in the United Kingdom (Department of Health, 2001), it seems critical for researchers and practitioners to actively pursue this line of enquiry. Understanding the determinants of physical activity is one of the first critical steps towards developing exercise interventions to help young smokers quit.

4.1.1 Social cognition models and physical activity

Many theoretical models have been developed to explain the determinants of health behaviour among various populations. The theory of planned behaviour (TPB; Ajzen, 1991), the health belief model (HBM; Becker, 1974), social cognitive theory (SCT, Bandura, 2001) and protection motivation theory (PMT, Maddux & Rogers, 1983) are among the most frequently used and validated theories of health behaviour that have been applied to understanding physical activity behaviour. It has been suggested that for a model to provide a sound framework for intervention design, it should (1) have predictive utility; (2) describe the relationships between key constructs; (3) provide guidelines for measuring the key constructs; (4) allow for the design of interventions to change the key constructs; and (5) provide the basis for identifying why an intervention succeeds or failed (Brawley, 1993).

Norman and Conner (2005) have evaluated the major social cognition models according to these characteristics. They conclude that the TPB, SCT and PMT have demonstrated medium to strong effect sizes, with regard to predictive utility, although there is less empirical support for the predictive utility of the PMT. The TPB, SCT & PMT (but not the HBM) provide description of the relationships between the key constructs, and the TPB (but not the PMT or HBM) provide guidance for key construct measurement, with guidance also

provided for self-efficacy, but not for the other SCT constructs. With the exception of the SCT, no clear guidelines on the design of interventions to manipulate the key variables are provided for most social cognition models. Finally all social cognition models provide the basis for understanding why an intervention succeeds or fails in theory, as the intervention effect should be mediated through the key constructs, although mediators are rarely measured in such research. The TPB meets most of these criteria, and in addition has been validated as a means of understanding the determinants of a broad spectrum of health behaviours, including physical activity, smoking, alcohol use, illicit drug use, sexual risk behaviours, dietary behaviours, road use behaviours, sun protection behaviours, self-examination behaviours, attendance at health screening, and medication adherence (Conner & Sparks, 2005).

4.1.2 The theory of planned behaviour and physical activity

The central tenets of the theory of planned behaviour are that behaviour is primarily determined by an intention to carry out that behaviour, which is perhaps the best summary measure of motivation and probably an important precursor to all stages of change (Courneya, 1995). Intention in turn is determined by three conceptually independent variables. The first determinant is attitude, which is reflected in a positive or negative evaluation of performing the behaviour. Indeed, according to Ajzen (1991), attitude is arguably the most fundamental construct in social psychology and is a strong determinant of health behaviour, including physical activity behaviour (Godin & Kok, 1996). The second determinant is subjective norm (SN), which reflects the perceived social pressure that individuals may feel to perform or not perform the behaviour. Social influence has been shown to be a consistent determinant of exercise behaviour (Chogahara, Cousins & Wankel, 1998). The final

determinant is perceived behavioural control (PBC), which indicates the perceived ease or difficulty of performing the behaviour and may have both direct and indirect effects on behaviour. In summary, the TPB proposes that individuals intend to perform behaviour when they evaluate it positively, believe that important others think they should perform it, and perceive it to be under their control (see Figure 4.1).

A recent critique of the TPB (and social cognition models in general) contends that the theory cannot be tested, that it is true by definition rather than observation, and that the measurement tools may create or change behaviour and cognitions rather than describing them (Ogden, 2003). On the basis of a sample of articles that used social cognition models to examine health behaviour, Ogden argues that the TPB cannot apparently be disproven, because in cases where one of the variables fails to predict intention or behaviour in regression analysis, the results are discussed as being supportive of the theory.

This evidence does not suggest, however, that the TPB is not falsifiable. For example, the TPB could be disconfirmed if neither attitude, SN or PBC significantly predicted intention, or if neither intention nor PBC significantly predicted behaviour, (Ajzen & Fishbein, 2004). Ogden's second argument, that the interrelationships between the model's constructs are due to an overlap between the measurement tools for each construct, can be contested on the grounds that (1) Ogden's first argument suggests that these constructs are not always related, and (2) the TPB can still explain significant amounts of the variance in objectively measured behaviour in addition to self-reported behaviour (Ajzen & Fishbein, 2004). Finally, Ogden's argument that the measurement tools may create or change the cognitions they are designed to

measure was also addressed by Ajzen & Fishbein (2004), who admit that this is a concern that warrants further empirical investigation, but also contend that evidence from a recent study where participants completed surveys either before or after an observed behaviour demonstrated no evidence of the questionnaire altering the behaviour, or the behaviour altering subsequent cognitions.

The TPB has been widely used in the context of understanding and predicting physical activity behaviour, and is arguably "the most validated model for understanding 'why' people exercise" (Courneya, Nigg & Estabrooks, 2000, p.191). Two meta-analyses encompassing 72 and 31 studies respectively (covering a broad spectrum of age groups) have found intention and perceived behavioural control to significantly correlate with physical activity (Hagger, Chatzisarantis & Biddle, 2002a; Hausenblas, Carron & Mack, 1997). Consistent with TPB (Ajzen, 1991), these meta-analyses reported intention to be the best predictor of physical activity, with large β values and effect sizes. Both meta-analyses also found attitude to be the best predictor of intention, followed by perceived behavioural control, with similarly high β values and large effect sizes. In addition, Hagger and colleagues' (2002a) meta-analysis indicated that attitude, subjective norm and perceived behavioural control explained nearly half of the variance in intention.

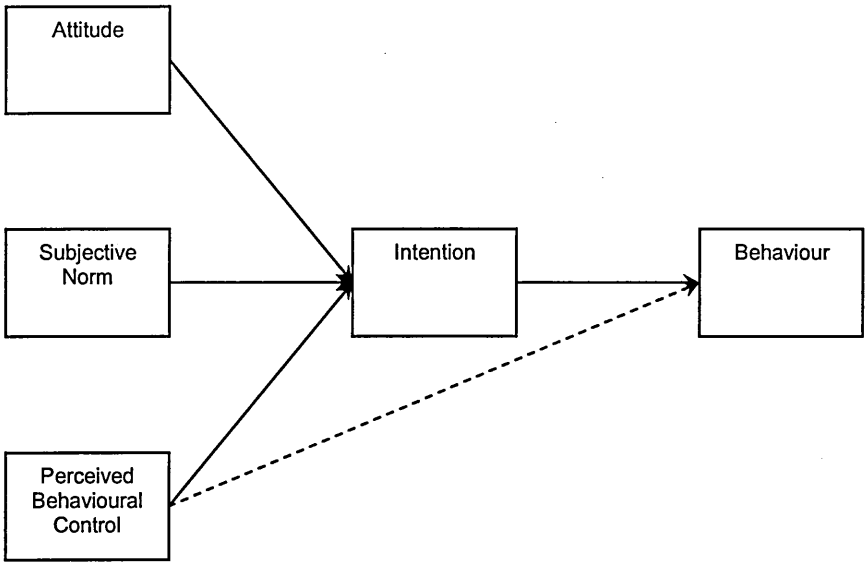


Figure 4.1: The Theory of Planned Behaviour

4.1.3 The theory of planned behaviour and physical activity in adolescents

Research with adolescent and youth populations has yielded similar results to research with adults. In most studies examining the relationship between intention to exercise and subsequent physical activity, a significant correlation or prediction has been attained (Baker, Little & Brownell, 2003; Kerner & Kurrant, 2003; Mummery & Wankel, 1999; Rivis & Sheeran, 2003; Saunders, Motl, Dowda, Dishman & Pate, 2004; Symons Downs, Graham, Yang, Bargainnier & Vasil, 2006; Trost et al, 2002), although in one study a significant intention-behaviour relationship was not demonstrated (Motl et al, 2002). Additionally, where the relationship between perceived behavioural control and physical activity was measured a significant relationship was attained, which was weaker than the relationship between intention and physical activity. Somewhat surprisingly however, in many studies (Mummery & Wankel, 1999; Rivis & Sheeran, 2003; Trost et al, 2002), perceived behavioural control has not added to the prediction of physical activity in young people.

A number of studies (Craig, Goldberg & Dietz, 1996; de Bruijn et al, 2006; Hagger & Armitage, 2004; Hagger, Chatzisarantis & Biddle, 2002b; Kerner & Kurrant, 2003; Mummery, Spence & Hudec, 2000; Mummery & Wankel, 1999; Rivis & Sheeran, 2003; Saunders et al, 2004; Symons Downs et al, 2006; Trost et al, 2002) have also indicated that all predictor variables (attitude, subjective norm and perceived behavioural control) significantly correlate with and/or predict intention to participate in physical activity among young people. Another study found that attitude and perceived behavioural control predicted physical activity intention in young people, but that subjective norm did not (Hagger, Chatzisarantis & Biddle, 2001). In the majority of studies (e.g. Craig et al, 1996; de Bruijn et al, 2006; Kerner & Kurrant, 2003; Rivis & Sheeran, 2003; Symons Downs et al, 2006) the highest correlate and best predictor of intention was found to be attitude. One of the limiting factors of research to date has been the large amount of variation between studies, in relation to sample characteristics, type of physical activity, and measurement of physical activity behaviour (see Table 4.1). It is also important to note that none of the studies reviewed here have so far focused specifically on young people who smoke.

Table 4.1: Studies examining the TPB and physical activity in young people

Study	N	Participants & Setting	Measure of PA	Type of study	Predictors of intention	Predictors of behaviour
Craig, Goldberg & Dietz (1996)	310	5th & 8th graders, 10-14 years old, in PE class	Vigorous PA 3 x week for 20 mins, outside PE. (Selection from a list of activities)	Retro-spective / concurrent	Correlated with attitude (0.45), SN (0.24) & PBC (0.30). Predicted by attitude & PBC (37%)	Not measured
Mummery & Wankel (1999)	116	11-18 year old competitive swimmers	Following training programme during major cycle of swim season.	Pros-pective	Predicted by attitude, SN & PBC (45%).	Predicted by intention (10%). Correlated with (0.23), but not predicted by PBC.
Mummery, Spence & Hudec (2000)	746	8-16 year olds in schools	All organised and leisure-time PA over the next 4 weeks	Retro-spective / concurrent	Predicted by attitude & SN (38%), & by attitude, SN & PBC (47%).	Not measured
Hagger, Chatzisarantis & Biddle (2001)	1152	12-14 year olds, in school	Moderate+ PA >=3 times a week, during free time	Retro-spective / concurrent	Intention predicted by attitude and PBC (48.2%)	Not measured
Hagger, Chatzisarantis & Biddle (2002)	1108	12-14 year olds, in school	Moderate+ PA >=3 times a week, during free time	Retro-spective / concurrent	Correlated with attitude (0.72), SN (0.35) & PBC (0.74).	Not measured

Motl et al (2002)	1797	13-year-old girls (SD=0.6), split by racial background	3-Day Physical Activity Recall self-report – moderate and vigorous PA modelled separately	Retro-spective / concurrent	Intention related to attitude & SN in structural model.	Intention unrelated to physical activity in structural model. PBC related to vigorous but not moderate PA.
Trost et al (2002) – sample 1	1030	13-14 year old white girls	Moderate-vigorous physical activity (3-Day Physical Activity Recall self-report)	Retro-spective / concurrent	In both white and African-American girls, correlated with attitude (0.40), SN (0.28) & PBC (0.43). Predicted by attitude, SN, PBC (25%).	Correlated with intention (0.28) & PBC (0.17). Predicted by intention (8%) but not PBC.
Trost et al (2002) – sample 2	1114	13-14 year old African American girls	Moderate-vigorous physical activity (3-Day Physical Activity Recall self-report)	Retro-spective / concurrent	Correlated with attitude (0.32), SN (0.25) & PBC (0.31). Predicted by attitude, SN & PBC (17%).	Correlated with intention (0.18) & PBC (0.14). Predicted by intention (3%) but not PBC.
Baker, Little & Brownell (2003)	279	13-17 year olds, school-based, split by gender	Godin Leisure-Time Exercise Questionnaire, over past 2 weeks	Retro-spective / concurrent	Peer norm predicted intention in boys only. Intraself PBC predicted intention in boys & girls.	Intention related in boys & girls, in structural model.

Kerner & Kurrant (2003)	129	14 year old girls, in PE classes in school	Leisure-time PA - 21-day PA diary, in 10-minute blocks of PA	Pro-spective	Correlated with attitude (0.66), SN (0.37) & PBC (0.28). Predicted by attitude & SN (46%), & attitude, SN & PBC (48%).	Correlated with (0.19) and predicted by intention (3%). PBC not related.
Rivis & Sheeran (2003)	225	18-19 year old undergrad students	Exercise (>=20 min moderate/vigorous) >=6 times in the next 2 weeks (T1-T2)	Pros-pective	Correlated with attitude (0.57), SN (0.40) & PBC (0.35). Predicted by attitude, SN & PBC (41%).	Correlated with intention (0.57), and PBC (0.19). Predicted by intention (34%), but not PBC.
Hagger & Armitage (2004)	1198	Mean age = 13.5, school-based.	Not measured.	Retro-spective / concurrent	Correlated with attitude (0.72), SN (0.37) & PBC (0.08). Related to attitude & SN in a structural model.	Not measured.
Saunders et al (2004)	1797	8th grade females, mean age = 13.6, school-based.	Moderate-vigorous physical activity (MVPA; 3-Day Physical Activity Recall self-report). Team sport involvement (TSI) during past 12 months (both inside & outside of school).	Retro-spective / concurrent	Correlated with attitude (0.57), SN (0.40) & PBC (0.58). Related to attitude, SN & PBC in a structural model.	Correlated with intention (MVPA 0.33; TSI 0.40) & PBC (MVPA 0.28; TSI 0.34). MVPA was related to intention in a structural model.

de Bruijn et al (2006)	221	12-18 year old p's from a larger cohort trial	Average mins of PA per day (walking, cycling, jogging, swimming, gymnastics, tennis, martial arts, field sports, skating), self-reported.	Retro-spective / concurrent	Correlated with attitude (0.58), SN (0.29) & PBC (0.34). Predicted by attitude & SN in a structural model.	Correlated with PBC (0.23) but not significantly correlated with intention. Predicted by PBC in a structural model.
Symons Downs et al (2006)	676	8th & 9th grade students, mean age = 14, school-based.	Leisure-Time Exercise Questionnaire (LTEQ) modified: >=60 min of moderate to strenuous exercise done in the past week. Categorised into moderate exercise, strenuous exercise, and total exercise.	Retro-spective / concurrent	Correlated with attitude (0.49), SN 0(.44) & PBC (0.41). Predicted by attitude & SN (33%), and attitude, SN & PBC (55%).	Correlated with intention (total ex 0.70; moderate ex 0.62; strenuous ex 0.66) & PBC (total ex 0.56; moderate ex 0.47, strenuous ex 0.54). Predicted by intention & PBC (51%).

4.1.4 Physical activity behaviour and stages of change

Physical activity behaviour and adherence can be conceptualised as multi-dimensional and dynamic, where individuals can move through a series of stages of physical activity behaviour beginning at living a sedentary lifestyle to regularly maintaining an active life. Dishman (1982) suggested that researchers examine the utility and potential contributions of stage theories, and several researchers have identified the transtheoretical model (TTM; Prochaska & DiClemente, 1983) as a useful framework in this regard. The TTM has been widely used in research into health behaviour change, including physical activity (Martin-Diener, Thuring, Melges & Martin, 2004). The most popular construct from the TTM has been the stages of change construct, which reflects the temporal dimension of health behaviour change (Prochaska & Velicer, 1997). A particular strength of the stages of change model is that it highlights the dynamic nature of health behaviour change and identifies when meaningful change has occurred. Prochaska and DiClemente (1983), postulated that a person could be classified into any one of five stages of change: precontemplation (no intention of becoming active), contemplation (not active, but an intention of becoming active), preparation (intention to be active, some attempt at being active), action (being physically active, but for less than six months), and maintenance (being physically active, for more than six months). Attempts are currently being made within the adult physical activity research field to integrate the TPB and TTM (e.g., Courneya & Bobick, 2000; Courneya et al, 2000; Nigg, 2005).

4.1.5 The present study: Physical activity determinants in young smokers

Research evidence suggests that the TPB can be useful for understanding and predicting the determinants of physical activity among the general population of

adolescents (Baker et al, 2003; Craig et al, 1996; Hagger et al, 2002b; Kerner & Kurrant, 2003; Mummery & Wankel, 1999; Rivis & Sheeran, 2003; Saunders et al, 2004; Symons Downs et al, 2006; Trost et al, 2002). In an attempt to better understand such relationships this investigation has integrated the TPB with the stages of change construct from the TTM, which might provide theoretically comprehensive information about physical activity behaviour in people who smoke. It is clear that physical activity may be a viable intervention in helping smokers to quit (e.g., Marcus et al, 1995; Marcus et al, 1999) although such studies did not explicitly state that they followed a theoretical framework in the development of their interventions. Thus, it seems appropriate and timely to examine the predictive utility of the TPB in predicting physical activity behaviour in young people who smoke, before embarking upon the development of theoretically driven exercise interventions for such populations. In general, past studies that have focussed on adult populations have indeed provided promising evidence that the TPB may be a useful model for guiding interventions that promote physical activity participation. It is, however, important to consider including population-specific samples when attempting to predict physical activity behaviour, since diverse populations are likely to have differing perceptions and needs concerning their health behaviours. Indeed, the characteristics and circumstances of smokers are sufficiently different to preclude direct application from this previous research. As indicated earlier, exercise and smoking behaviour have been negatively correlated in both adult and adolescent smokers (Aaron et al, 1995; Emmons et al, 1994; Thorlindsson & Vilhjalmsson, 1991). Such evidence indicates that smokers, irrespective of their age, may perhaps have lower regard for their own long-term health than

non-smokers, and consequently may hold rather negative attitudes towards health-enhancing behaviours such as physical activity.

Research with adult populations has tended to report a weak relationship between subjective norm and intention to be physically active with personal factors (i.e., attitudes and PBC) typically emerging as stronger predictors of exercise intentions than subjective norm (e.g., Blue, 1995; Hagger et al, 2002a; Hausenblas et al, 1997). The comparative weakness of the subjective-norm-intention relationship is of particular relevance here because young people (and those who smoke) may be more suggestive to the influence of others than might typically be expected with adult populations. It may, therefore, be reasonable to expect subjective norm to have a strong predictive relationship with health (physical activity) behaviours in young people (Biddle & Mutrie, 2001). It is possible that young people who smoke may be more likely to perceive that their peers (many of whom are also likely to smoke) hold similarly negative attitudes about exercise and to perceive they have little control over their exercise behaviour patterns. This might particularly be true if exercising causes smokers to experience uncomfortable breathing patterns and/or leads to feelings of exhaustion, possibly due to the well-documented effects of smoking on lung function (Musk & de Klerk, 2003; Samet, 2001). Indeed, research has reported that young people who smoke may also suffer from shortness of breath, asthma and increased respiratory tract infections (Royal College of Physicians, 1992), all of which in turn may affect young smokers' decisions and intentions regarding physical activity behaviour.

4.1.6 Purpose and hypotheses

Due to the success of the TBP in predicting and explaining exercise intention and behaviour in healthy populations, further research examining the TPB in 'unhealthy' populations is warranted. Based upon the theoretical propositions of the TPB and TTM, the purpose of the present study was to ascertain the relationships between the social-cognitive factors that constitute the TPB and the continuum of stages of change fundamental to TTM. Cognitive-behavioural variables like attitude have been negatively associated for smoking and exercise in adult smokers (King, Marcus, Pinto, Emmons & Abrams, 1996). With this in mind, smoking behaviour variables such as nicotine dependence and cigarette consumption may also be key variables in understanding the physical activity behaviour of young people who smoke. The hypothesis of this study is consistent with the recommendations of Ajzen (1991): The primary determinant of physical activity behaviour will be intention, with perceived behavioural control making a significant contribution; and attitude, subjective norm and perceived behavioural control will determine intention to participate in physical activity in adolescents who smoke.

4.2 Method

4.2.1 Participants and design

One hundred and twenty-four young people aged 16-19 who self-reported smoking 10 or more cigarettes per day for more than six months were recruited from institutes of further and higher education in the North East of England. According to Tabachnick and Fidell (2007), a sample size of N=74 would have been sufficient for testing the multiple correlation, and N=107 would have been sufficient for testing individual predictors, with an alpha-level of 0.05 and a beta

value of 0.20. The study sample included 58 males and 63 females (three did not report their gender). A community-based cross-sectional survey design was used and participants were recruited in designated smoking areas within the colleges and universities or in tutorials.

4.2.2 Demographics and smoking information

Participants were asked to self-report their age, height, weight and gender. Single items that assessed the number of cigarettes smoked per day and the age at which participants first started smoking on a daily basis were also included (see Appendix 3). Self-reported height and weight data has been shown to be a reliable proxy to measured height and weight among young people (Brener, McManus, Galuska, Lowry & Wechsler, 2003).

4.2.3 Measures

4.2.3.1 Nicotine dependence

A measure of dependence on nicotine was included in this study to ascertain whether the participants were representative of nicotine dependent smokers. Nicotine dependence was measured using the Hooked on Nicotine Checklist (HONC; DiFranza et al, 2002a,b), a measure of nicotine dependence developed for use with young people, and described within Chapter 2 and Chapter 3 (see Appendix 5). A high Cronbach's alpha value of 0.94 was attained for this scale by its authors (DiFranza et al, 2002b), and acceptable levels of internal reliability (α = 0.75) were found in the present study. Nicotine dependence was also assessed using items '*How many cigarettes per day do you usually smoke?*' and '*How soon after waking up do you smoke your first cigarette?*' from the Fagerström Test for Nicotine Dependence (FTND; Heatherton et al, 1991) (see Appendix 12). These items in particular were selected from the

FTND as they were considered most appropriate among a population of young smokers.

4.2.3.2 Theory of Planned Behaviour

Scales measuring participants' attitudes and normative beliefs concerning regular physical activity, perceived control over their own physical activity behaviour and their intentions to carry out regular physical activity, were used to assess the proximal determinants of intention to participate in physical activity (see Appendix 16). These scales were developed in accordance with guidelines specified by Ajzen and Fishbein (1980). In the current study, the internal reliability of each scale within the TPB was acceptable, with Cronbach's alpha values of 0.85 (attitude; subjective norm), 0.70 (perceived behavioural control) and 0.82 (intention). **Intention** was assessed by two items commonly used in research applying TPB to exercise (Courneya, 1994; Courneya & McAuley, 1993). The two items were '*I plan to exercise an average of* _____ *times per week*' and '*My goal is to participate in physical exercise at least 3 times per week every week*' rated on a 7 point scale from 1 (*strongly disagree*) to 7 (*strongly agree*) (refer to Appendix 15 for the full questionnaire). **Attitude** was measured using six 7-point semantic differential adjectives scales that tapped both instrumental (*useless-useful*, *harmful-beneficial*, *wise-foolish*, *bad-good*) and affective (*unenjoyable-enjoyable*, *unpleasant-pleasant*, *stressful-relaxing*) aspects of attitude (Ajzen & Fishbein, 1980). **Subjective norm** was measured using the three items '*Most people who are important to me think I should participate in regular physical exercise*', '*Most people who are important to me encourage me to participate in regular physical exercise*', and '*Most people who are important to me support me in participating in regular physical exercise*', all rated on a 7 point scale from 1 (*strongly disagree*) to 7 (*strongly*

agree). These measures have been employed in previous research by Courneya, Friedenreich, Arthur and Bobick (1999). **Perceived behavioural control** was measured by five items drawn from Ajzen and Madden (1986) commonly used to operationalise PBC. The five items were '*How much control do you have over participating in regular physical exercise?*' rated on a 7 point scale from 1 (*very little control*) to 7 (*complete control*), '*For me to participate in regular physical exercise is*' rated on a 7 point scale from 1 (*extremely difficult*) to 7 (*extremely easy*), '*If I wanted to I could easily participate in regular physical exercise*' and '*How much I participate in regular physical exercise is completely up to me*' rated on a 7 point scale from 1 (*strongly disagree*) to 7 (*strongly agree*), and '*How confident are you that you are capable of participating in regular physical exercise?*' rated on a 7 point scale from 1 (*not at all confident*) to 7 (*extremely confident*).

4.2.3.3 Physical activity behaviour

Physical activity behaviour was assessed in two ways (see Appendix 4). The stage of readiness to change ladder, a visual semi-anchored single-item rating scale (Biener & Abrams, 1991; Marcus, Rakowski & Rossi, 1992), was used to assess participants' varying degrees of readiness to change and/or involvement in the exercise behaviour change process within the framework of the transtheoretical model. After giving a definition of exercise, this scale asks participants to report their exercise behaviour over the previous six months and forthcoming six months. The labels at each stage represent the minimum requirements for membership of a particular stage of exercise change with rungs in the ladder representing different stages of change for exercise. Responses on this scale range from 0 to 10, with 0 being '*I currently don't exercise and I don't intend to start within the next 6 months*', and 10 being '*I*

exercise regularly and have done so for longer than 6 months'. The term 'regularly' was defined on the scale as being three or more times per week for 20 minutes or longer of moderate intensity exercise. The ladder scores were categorised into one of four stages of change: *prepreparation* (0 to 2), *preparation* (3 to 5), *action* (6 to 8) and *maintenance* (9 to 10). This outcome variable will be referred to as 'stage of change'. Evidence for the validly of this measure in exercise contexts has been provided by Marcus and Simkin (1993) using the Seven Day Physical Activity Recall Questionnaire.

The other behavioural outcome measure was a single-item scale with a fully anchored response format (referred to as 'frequency of physical activity'). The phrasing of this item was '*How often have you participated in physical activities for 20-30 minutes per session during your free time over the past three months?*'. The continuous response choices offered were: 1 = *never*, 2 = *about once per month*, 3 = *about 2 or 3 times per month*, 4 = *about once per week*, 5 = *about 2 times per week*, 6 = *about 3 times per week*, 7 = *about 4 times or more per week*. This method for assessing behaviour was based on previous validated studies (Gionet & Godin, 1989; Godin et al, 1986; Godin & Shephard, 1985). This question has also been used recently (Godin et al, 2004) to successfully classify participants according to their activity status. Additionally, evidence suggests that current physical activity can act as a reasonable indictor of future physical activity (Rhodes & Plotnikoff, 2005). The test-retest reliability of this scale had been reported to be satisfactory, at 0.64 (Godin et al, 1986).

There were several reasons for including more than one measure of behaviour in this study. Previous studies in this field have tended to rely exclusively on single measures of behaviour. In using two measures simultaneously, a greater understanding of the utility of the TPB in predicting adolescent smokers'

physical activity behaviours may be gained, thus adding to and expanding upon the current research literature. As no previous research has examined this issue and because different behavioural outcomes may vary in their predictive ability, it seemed important to try to contribute to the literature by considering more than one type of behavioural outcome. Additionally, while the stage of change ladder provides a useful broad global assessment of participants' readiness or intention to change, it does not provide any specific information about the actual *amount* of physical activity that respondents engage in.

4.2.4 Procedure

Prior to conducting the research, the questionnaire was piloted to ensure timing and clarity. To be eligible for this study participants needed to meet the following inclusion criteria: (1) smoked 10 or more cigarettes a day, (2) smoked for at least 6 months, and (3) aged 16-19 years. Informed consent was indicated by completion of the questionnaire. Some participants completed the questionnaire in the vicinity of the researcher, while others who were not able to complete the questionnaire at the time returned it in a sealed envelope to their tutor, or to the student services office. The completed questionnaires were placed in an envelope, sealed, and presented anonymously to the researcher.

4.3 Results

4.3.1 Demographics

Table 4.2 provides information on means and standard deviations for the demographic variables (age, body mass index, number of cigarettes smoked per day, nicotine dependence, participants' age of commencing daily smoking, frequency of physical activity) and the TPB variables. A series of independent t-tests revealed no significant gender differences on demographic variables.

Likewise a multivariate analysis of variance (MANOVA) revealed no significant gender differences on attitude ($F_{1,94}$ = 2.04, p = 0.16), subjective norm ($F_{1,94}$ = 0.82, p = 0.37), perceived behavioural control ($F_{1,94}$ = 0.25, p = 0.62), intention ($F_{1,94}$ = 0.07, p = 0.80), stage of change ($F_{1,94}$ = 0.35, p = 0.55) or frequency of physical activity ($F_{1,94}$ = 0.97, p = 0.33). Therefore, data for male and female participants has been pooled for the main statistical analyses in this study. A small number of participants reported being in the precontemplation stage (8.5%) and contemplation stage (12%). Consequently the precontemplation and contemplation stages were combined to form a single stage referred to as prepreparation. This procedure is consistent with previous research (e.g., Landry & Solmon, 2004; Mullan & Markland, 1997; Rose, Parfitt & Williams, 2005). Thus, 20.5% reported being in the prepreparation stage, 17.9% in the preparation, 35.9% in the action and 25.7% in the maintenance stages.

4.3.1.1 Smoking behaviour

Closer examination of the means displayed in Table 4.2 highlights that nicotine dependence scores are high among both male and female participants (as rated on the HONC). Furthermore, this finding is corroborated by responses to the two FTND items, where nearly two thirds of participants (65.6%) reported that they smoked on average 11-20 cigarettes per day, and 33.3% of participants reported that they smoked their first cigarette of the day within the first quarter of an hour after waking up. A further third (32.5%) reported having their first cigarette within 15-29 minutes of waking. Collectively, this data indicates that participants in this study self-reported being nicotine dependent.

Table 4.2: Mean (SD) demographic values and TPB variables by gender

Variable	Males	Females	Total
Age	17.67 (0.94)	17.37 (0.79)	17.50 (0.87)
Body mass index	22.77 (3.73)	22.61 (0.79)	22.66 (4.58)
Cigarettes per day	15.38 (6.82)	14.44 (5.32)	14.83 (6.01)
Nicotine dependence – HONC	7.42 (2.15)	7.55 (2.47)	7.52 (2.30)
Age when started smoking on daily basis	15.03 (1.63)	14.10 (1.85)	14.48 (1.86)
Attitude	4.99 (1.43)	5.42 (1.19)	5.24 (1.31)
Subjective norm	4.79 (1.46)	4.53 (1.47)	4.68 (1.46)
Perceived behavioural control	4.62 (1.13)	4.78 (1.12)	4.74 (1.14)
Intention	2.98 (1.41)	2.92 (1.16)	2.96 (1.28)
Frequency of physical activity	4.24 (2.03)	3.87 (1.91)	4.09 (1.98)

Note: Response choices offered for frequency of physical activity were: 1 = 'never', 2 = 'about once per month', 3 = 'about 2 or 3 times per month', 4 = 'about once per week', 5 = 'about 2 times per week', 6 = 'about 3 times per week', 7 = 'about 4 times or more per week'.

4.3.2 Data analysis

To allow for consistency and ease of interpretation the open-ended question '*I plan to exercise an average of _____ times per week*' from the intention subscale was transformed so that responses were standardised to reflect a 1 to 7 scale. Negatively worded items were also reversed, for ease of interpretation. Pearson correlation coefficients were calculated to determine the relationships between attitude, subjective norm, perceived behavioural control, intention, and measures of exercise behaviour.

The main hypotheses in this study were examined using regression analysis. Regression analysis was considered appropriate because the stage of change construct is at least ordinal in nature (Courneya & Bobick, 2000) and its relationship with all the independent predictor variables in this study was linear (see Table 4.3). Additionally, linear regression as opposed to logistical regression was used because involvement in exercise is considered to be a matter of degree (i.e., a continuous outcome) than kind (i.e., a dichotomous outcome).

Table 4.3: Means (SD) for all TPB variables according to stage of change

Variables	Stage				$F_{3,94}$
	Pre-preparation	Preparation	Action	Maintenance	
Attitude	4.58(1.28)	4.73 (1.44)	5.52 (1.04)	5.71 (1.29)	3.54
SN	4.33 (1.68)	4.40 (1.21)	4.57 (1.32)	5.18 (1.53)	2.01
PBC	4.09 (0.88)	4.25 (0.84)	4.79 (1.05)	5.54 (1.14)	9.12
Intention	1.93 (1.18)	2.35 (0.96)	3.13 (0.99)	4.00 (1.05)	16.99
Frequency of physical activity	1.63 (0.77)	3.35 (1.63)	4.62 (1.45)	5.87 (1.11)	49.45

Three separate hierarchical regression analyses (HRA) consistent with the theoretical tenets of TPB were then performed. The first two HRAs examined the predictors of behaviour. In each case, behaviour was regressed on intention (block 1), followed by perceived behavioural control (block 2) (n = 110 for the stage of change HRA and n = 109 for the frequency of physical activity HRA). In the third regression analysis, intention was regressed on attitude and subjective norm (block 1), followed by perceived behavioural control (block 2) (n = 99). Two outliers were removed from the sample based on the Mahalonobis distance criterion (Tabachnick & Fidell, 2007). An examination of the data for normality, linearity and homoscedasticity revealed that these assumptions had been met. Due to a small number of missing responses for some of the variables, the N was variable in each regression analysis.

4.3.3 Correlation analyses

As presented in Table 4.4, intention correlated strongly with both measures of behaviour; frequency of physical activity (r = 0.65, p < 0.01) and stage of change for physical activity (r = 0.59, p < 0.01). Perceived behavioural control also correlated, to a lesser extent, with frequency of physical activity (r = 0.40, p < 0.01) and stage of change (r = 0.46, p < 0.01). Intention significantly correlated with attitude (r = 0.47, p < 0.01), perceived behavioural control (r = 0.42, p < 0.01) and subjective norm (r = 0.42, p < 0.01). All measures of behaviour were significant and highly correlated. These relationships are represented diagrammatically in Figure 4.2.

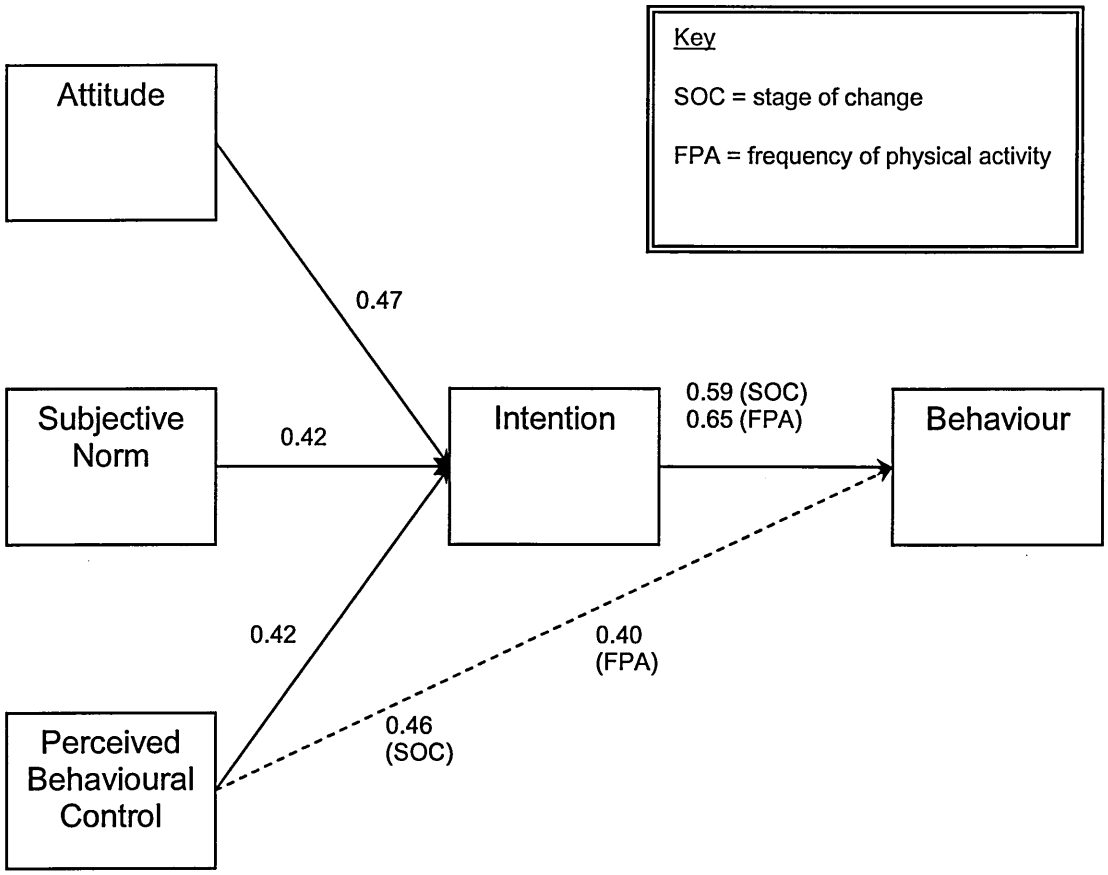


Figure 4.2: TPB correlations for frequency of physical activity and stage of change

Table 4.4: TPB variable means, SDs, alpha values and correlations

Variable	1	2	3	4	5	6
1. Frequency of physical activity	-	0.76**	0.65**	0.23*	0.16	0.40**
2. Stage of change		-	0.59**	0.35**	0.20*	0.46**
3. Intention			-	0.47**	0.42**	0.42**
4. Attitude				-	0.28**	0.41**
5. Subjective norm					-	0.20*
6. Perceived behavioural control						-
7. Means	4.09	2.67	2.96	5.24	4.68	4.74
8. Standard deviations	1.98	1.07	1.28	1.31	1.46	1.14
9. Alpha coefficients	-	-	0.77	0.85	0.85	0.70

* significant at the 0.05 level ** significant at the 0.01 level

4.3.4 Regression analysis: Determining behaviour

The results of the three HRAs are summarised in Table 4.5. Intention explained 34% of the variance in stage of change ($F_{1,108}$ = 57.67, p < 0.01), making a significant contribution to the predictive model (β = 0.59, p < 0.01). The inclusion of perceived behavioural control explained an additional 6% of the variance in this outcome ($F_{1,107}$ = 10.70, p < 0.01). Both intention (β = 0.48, p < 0.01) and perceived behavioural control (β = 0.27, p < 0.01) made significant contributions to this model.

A total of 42% of the variance in frequency of physical activity ($F_{1,107}$ = 75.88, p < 0.01) was explained by intention (β = 0.64, p < 0.01). An additional 2% of the variance was explained upon the addition of perceived behavioural control ($F_{1,106}$ = 4.39, p < 0.05), where intention (β = 0.58, p < 0.01) and perceived behavioural control (β = 0.17, p < 0.05) provided significant contributions to this model.

4.3.6 Determining intention

Attitude and subjective norm explained 33% of the variance in intention ($F_{2,96}$ = 24.72, p < 0.01), with both attitude (β = 0.41, p < 0.01) and subjective norm (β = 0.31, p < 0.01) contributing significantly. The addition of perceived behavioural control explained an extra 4% of the variance in intention ($F_{1,95}$ = 7.96, p < 0.01). Attitude (β = .31, p < 0.01), subjective norm (β = .29, p < 0.01) and perceived behavioural control (β = .25, p < 0.01) made significant contributions to this model.

Table 4.5: Hierarchical regression analyses for behaviour and intention

Variable	Adjusted R^2	F_{change}	p level	β
Determining stage of change				
Block 1	0.34	57.67	0.000	
1. Intention			0.000	0.59
Block 2	0.40	10.70	0.001	
1. Intention			0.000	0.48
2. Perceived Control			0.001	0.27
Determining frequency of physical activity				
Block 1	0.42	75.88	0.000	
1. Intention			0.000	0.64
Block 2	0.44	4.39	0.039	
1. Intention			0.000	0.58
2. Perceived Control			0.039	0.17
Determining intention				
Block 1	0.33	24.72	0.000	
1. Attitude			0.000	0.41
2. Subjective Norm			0.000	0.31
Block 2	0.37	7.96	0.006	
1. Attitude			0.001	0.31
2. Subjective Norm			0.001	0.29
3. Perceived Control			0.006	0.25

4.3.7 Smoking behaviours and nicotine dependence

The contribution of smoking behaviour and nicotine dependence scores to the predictive model was also explored. When the amount smoked and nicotine dependence scores were entered into the regression analyses in the first block, they did not significantly explain intention (adjusted R^2 = 0.01, $F_{2,77}$ = 0.07, p = 0.94) or either measure of behaviour; stage of change (adjusted R^2 = -0.01, $F_{2,82}$ = 0.81, p = 0.45) or frequency of physical activity (adjusted R^2 = 0.01, $F_{2,82}$ = 0.19, p = 0.83).

4.4 Discussion

The results of this study provide preliminary evidence to suggest that the TPB can be used successfully to explain physical activity behaviour in young people who smoke. The present findings are supportive of the TPB (Ajzen, 1991), and are also largely supportive of previous research by Baker et al (2003), Kerner and Kurrant (2003), Mummery and Wankel (1999), Rivis and Sheeran (2003), Saunders et al (2004), Symons Downs et al (2006) and Trost et al (2002), who have all found significant intention-behaviour correlations or predictions among adolescents. In the present study, nearly half of the variance in behaviour was explained by intention and perceived behavioural control, whereas in previous studies with young people (aged 14 years), the largest amount of variance explained has been 51% (Symons Downs et al, 2006). Thus, it seems, in smokers, intention appears to play as important a role in the prediction of physical activity behaviours as it does among general populations of young people. It was also encouraging to note however, that the predictive model did not vary considerably when different behavioural outcomes were considered (i.e., stage of change versus frequency of physical activity).

In terms of the determinants of intention, the present findings are also largely supportive of previous research by Craig et al (1996), de Bruijn et al (2006), Hagger and Armitage (2004), Hagger et al (2002b), Kerner and Kurrant (2003), Mummery et al (2000), Mummery and Wankel (1999), Rivis and Sheeran (2003), Saunders et al (2004), Symons Downs et al (2006) and Trost et al (2002), who have reported that attitude, subjective norm and perceived behavioural control are correlated with and/or predictive of intention to participate in physical activity. One of the key findings of the present study was that the amount of variance in intention explained by the TPB variables (37%) was comparable to previous research with other populations of young people.

It should also be noted that smoking behaviour variables of amount smoked and nicotine dependence did not influence the predictive model. This was unexpected, since it seems intuitively possible that heavy and highly nicotine-dependent smokers may be less likely to intend to be active or to participate in physical activity. As alluded to earlier, it might be expected that smokers would have a considerably lower degree of perceived behavioural control over their physical activity behaviour than non-smokers, possibly because of the respiratory effects of smoking, or because physical activity may not be compatible with their health beliefs. Closer examination of the data, however, indicates that participants actually reported relatively high PBC scores, although their intention scores were low. Such data might indicate that young people who smoke feel that they can choose to exercise if they wish and do not perceive any strong barriers to being active, but translating such thoughts into intentions appears to be a difficult process.

Although it appears that the TPB is useful in explaining exercise intention, the relative importance of attitudes, subjective norm and PBC in this study differed

with data reported by other researchers. In particular, previous studies have found subjective norm to play a much smaller role in determining intentions to be active. For example, Hagger and Armitage (2004) found a 0.35 difference between the beta values for attitude and subjective norm, and de Bruijn et al (2006) reported a differential beta score of 0.29 between attitude and subjective norm in younger populations. In contrast, this investigation found subjective norm to be at least as important as attitude, with beta values for attitude and subjective norm differing by only 0.02. The finding that subjective norm was equally as important as attitude is interesting both theoretically and practically. A number of psychosocial theorists would also argue that peers play an important role not only in the development of young people's behaviours, but also their attitudes (Biddle & Mutrie, 2001). Peer influence also appears to be an important factor in adolescent smoking transition from never smoking to regular smoking, and subsequent decisions to continue smoking or to quit (Lloyd, Lucas, Holland, McGrellis & Arnold, 1998). Regarding exercise behaviour, data from this study would certainly support the importance of peer influence in young smokers. Strategies that involve social support, or strategies that can influence normative beliefs may be important when promoting physical activity in young people who smoke. At this stage such a suggestion is somewhat speculative, however, and future research is needed to corroborate the present findings.

While this study has yielded some useful information about the determinants of physical activity in young people who smoke, there are some limitations that should be considered when interpreting and applying the findings. In using a cross-sectional design, this study did not consider the possibility of temporal fluctuations among the TPB variables. Because this study examined a

relatively new area of research, a cross-sectional approach was adopted rather than a more rigorous longitudinal or intervention-based approach. In addition, consistent with almost all other studies that have used the TPB to understand exercise and physical activity behaviours, all measures were self-reported, and more accurate measures of physical activity behaviours might in future be gained by using a combination of self-report and objective measures (Armstrong & van Mechelen, 1998). Lastly, few participants were classified as precontemplators in this study and future investigations might strive to obtain an even broader, more heterogeneous sample in order to test the usefulness of the TPB in young smokers. Future studies should also bear in mind that past research (Godin et al, 2004; Kraft, Sutton & McCreath Reynolds, 1999) has indicated that the precontemplation and contemplation stages are sufficiently similar with respect to attitudes to warrant considering them as a single stage. Moreover, while different algorithms have been used in the transtheoretical model (Richards Reid, Velicer, Prochaska, Rossi & Marcus, 1997), it is generally acknowledged that the precontemplation and contemplation stages are defined by intention and the last three stages are related to behaviour (Marcus, Eaton, Rossi & Harlow, 1994; Prochaska & Marcus, 1994). In simple terms, precontemplators and contemplators are distinguished only in terms of their readiness to change and not their actual behaviour. On this basis, and because both predictive models of behaviour were relatively consistent, it is not felt that the validity of the study has been compromised by grouping precontemplators and contemplators together.

There were several methodological strengths to this study, including the testing of more than one measure of physical activity behaviour in the predictive model. The similar pattern of predictive utility of the two measures of behaviour would

indicate that these findings are robust and these consistent results add to the existing body of evidence suggesting that the TPB model has strength in explaining physical activity. Secondly, little is known about the determinants of exercise or physical activity behaviour in young people who smoke and researchers have called for more theoretically based evidence concerning exercise behaviour (Biddle & Nigg, 2000). This study contributes to that effort.

Ultimately, the TPB may be a useful guiding framework to consider in the development of physical activity interventions for young people who smoke. This investigation suggests ways in which the prediction of, and participation in, physical activity may be improved among young people who smoke, such as the salience of subjective norm in this population. Interventions aimed at promoting physical activity in young people who smoke may benefit by promoting positive attitudinal, normative and control beliefs, and also by encouraging intentions to be regularly active.

Chapter 5a

Study 4: Evaluation of physical activity promotion postcard-style prompts for young adults: Preliminary findings

5.1 Introduction

Print based prompts have been identified as a useful component of interventions designed to increase physical activity among a range of populations, but limited studies have evaluated the characteristics of the physical activity message. A recent review identified print and telephone based interventions to be effective in increasing physical activity levels among various populations, with tailored interventions increasing success rates (Marcus, Owen, Forsyth, Cavill & Fridinger, 1998). Studies postdating the Marcus et al (1998) review have also reported physical activity behaviour change from interventions involving physical activity prompts. In a 'real world' setting, Kerr, Eves and Carroll (2000) demonstrated that a poster placed at the point of choice between the stairs and the escalator in a British shopping mall increased stair use, even among less active people.

Conn, Burks, Minor and Mehr (2003) also reported that mailed prompts successfully increased physical activity to a greater extent than receiving no prompts among adults. Research with adolescents and young adults has demonstrated similar positive effects. For example, Patrick et al (2001) found that mailed prompts increased physical activity regardless of their frequency or the addition of telephone prompts among 11-18 year olds, and Woods, Mutrie and Scott (2002) found mailed prompts to be effective at increasing physical activity in sedentary young adults (mean age 19 years) compared with a no-intervention control. Interestingly, the Woods et al study is the only published

study where the prompts were in some way evaluated, and whereby only materials rated as 'good' by their staff and student colleagues on production quality, content, information and attractiveness were subsequently used in the intervention. The characteristics of the 'good' prompts, however, remain unknown, despite the value of such information for the future design of physical activity prompts.

Theories of behaviour change can enhance the effectiveness of physical activity interventions. The transtheoretical model (TTM; Prochaska & DiClemente, 1983; see Chapter 5b) has been useful in guiding physical activity interventions by matching the physical activity promotion message provided with the readiness of the individual to be physically active. According to the TTM, individuals who are less active are likely to engage in cognitive or informational change processes, such as consciousness raising, whereas individuals who are more ready to be active on a regular basis are more likely to engage in motivational change processes, which are grounded in the behavioural domain. Physical activity promotion prompts used in interventions may therefore benefit from being initially informational in nature, with further prompts assuming a more motivational message.

In addition, theories suggest that the extent to which a message is intrinsically or externally motivating may affect its success in promoting physical activity in the long term. Self-determination theory (Deci & Ryan, 1985), achievement goal theory (Nicholls, 1984) and the hierarchical model of intrinsic and extrinsic motivation (Vallerand, 1997) maintain that intrinsic motivations have greater potential than extrinsic motivations to nurture health promoting behaviours.

5.1.1 The present study

Young adulthood is a key stage for interventions to promote the adoption and maintenance of an active lifestyle (Dishman, 1994; Furstenberg, 2006), and research has shown that health behaviours established during an individual's younger years often transfer into middle and late adulthood (Barnekow-Berkvist, Hedberg, Janlert & Jansson, 1996; Sallis & Patrick, 1994). Obtaining young people's views about physical activity prompts may help to guide physical activity promotion strategies involving this population.

For some time, written prompts in the form of leaflets and posters have formed an important part of physical activity promotion strategies. Indeed, this is an important public health issue given that print based interventions are typically less costly, more easily accessible to large numbers of people and more easily disseminated than other approaches to physical activity behaviour change. Very little is known, however, about the types of prompts that are most acceptable for promoting physical activity among young people. Thus, the present study aimed to evaluate a series of postcard-style prompts designed to promote physical activity in a general population of young people, through ascertaining which kinds of prompts are most and least preferred by this audience, in terms of a range of practical characteristics that relate to promoting physical activity. In addition, exploratory analyses of gender, activity level, and smoking status were conducted to evaluate the kinds of prompts preferred by males, females, active participants, inactive participants, smokers and non-smokers. The most popular informational prompt and most popular motivational prompt were used in Study 5 (see Chapter 5b).

5.2 Method

5.2.1 Participants and design

One hundred and forty-four volunteers aged 16-25 years (mean age = 20.0 years; SD = 2.1) were recruited on the University campus and in a local sixth form college, in the north of England. In each institution, participants were approached in person in public areas. The sample consisted of 59 males and 82 females, 52 smokers and 86 non-smokers (3 did not report their smoking status), 75 active and 65 inactive participants (1 did not report whether they were active or not). Due to the novelty of the research conducted for this study, a general population of young people was recruited. This population was selected to ensure applicability of the research findings to physical activity promotion among young people in general, at a crucial time in the life cycle, when physical activity levels begin to fall (Hardman & Stensel, 2003).

5.2.2 Design

A cross-sectional opinion survey design was used. The messages for the prompts were selected on the basis of brevity and relevance to the audience (i.e., young people). A range of different types of messages was selected, including informational and motivational messages, and intrinsically and extrinsically motivating messages.

5.2.3 Measures and procedure

Ethical approval was obtained from the University's Research Ethics Committee. Leaflets from national health organisations (British Heart Foundation, 2003; Department of Health & Doctor Foster Ltd, 2005; Health Promotion England, 1997) were explored for messages about physical activity targeting the general public (and in particular young people). A variety of brief

messages from these sources were re-cast onto postcard-sized paper, of which there were 12 altogether. These were classified into 'informational' (six messages) and 'motivational' (six messages), a simplification of the processes of change described in the TTM.

5.2.3.1 Survey development

A six-item opinion survey was developed to rate each of the two sets of prompts. The six-item survey asked participants to rank each message in order from the most to least motivational, informative, appealing, likely to prompt physical activity, preferable to receive through the post and likely to be kept. These characteristics were chosen because they were deemed to reflect the way prompts can be perceived and used in health promotion settings. The final selection measures are included in Appendix 16.

5.2.3.2 Pilot with experts

Prior to surveying the prompts with participants, eight 'experts' within physical activity and sports settings (four male and four female; three were practicing sport and exercise psychologists and five were researchers in the field of exercise and health) were asked to complete the original version of the six-item survey using the 12 original prompts, and were consulted for feedback about the prompts and the survey. As a result of a combination of the ratings provided and feedback comments given by the experts, four postcards (two from each classification) were then eliminated, leaving eight; four informational (see Figures 5.1-5.4) and four motivational (see Figures 5.5 to 5.8).

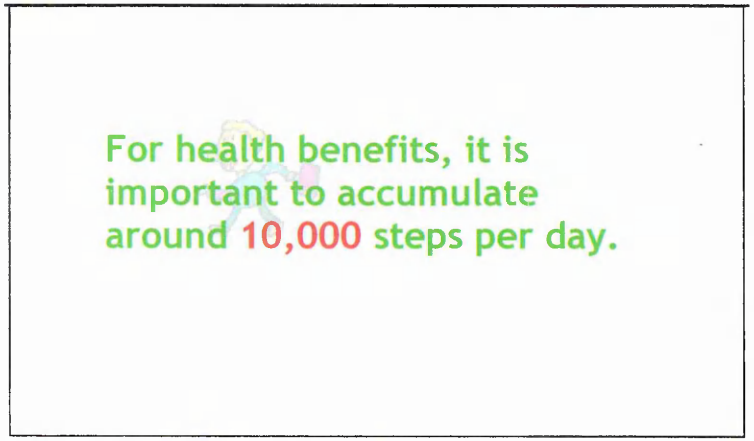


Figure 5.1: Card 1 (informational)

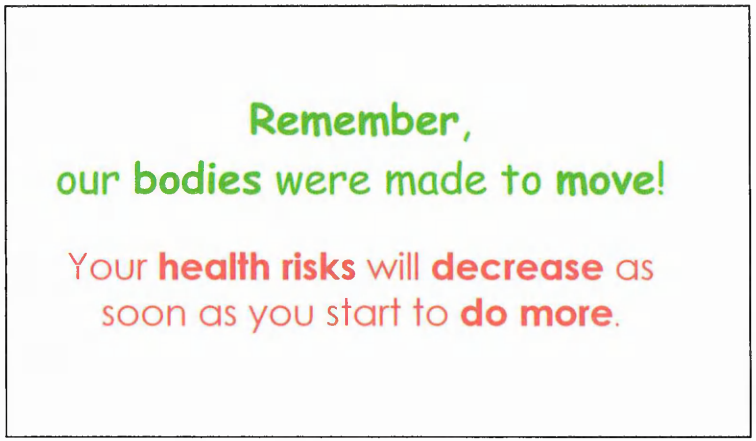


Figure 5.2: Card 2 (informational)

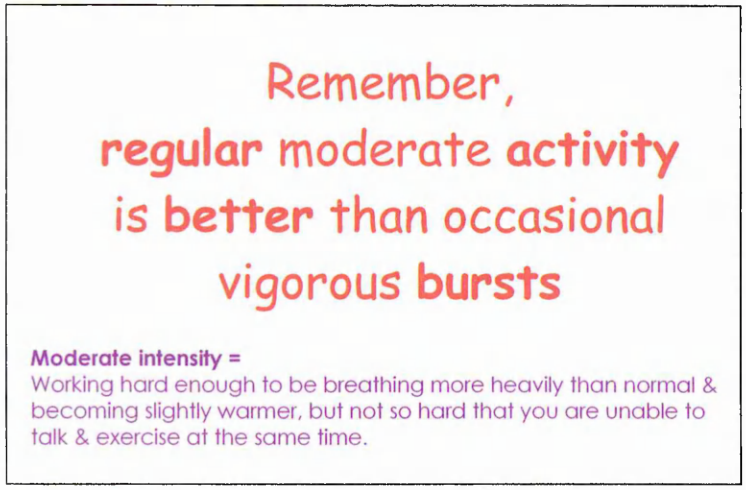


Figure 5.3: Card 3 (informational)

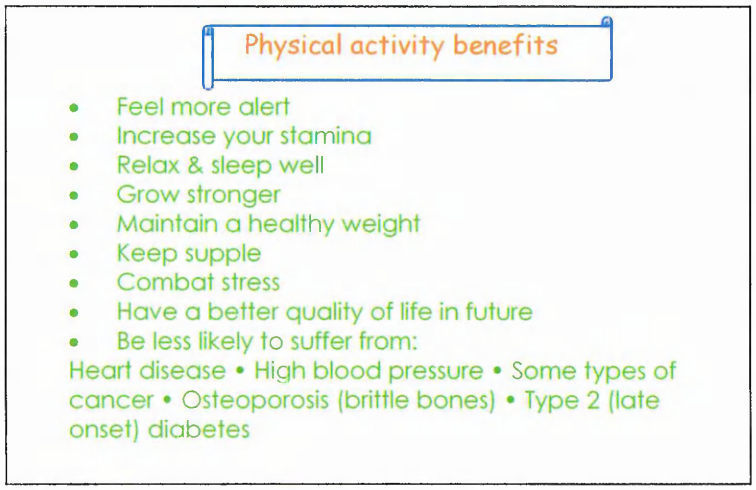


Figure 5.4: Card 4 (informational)

Figure 5.5: Card 5 (motivational)

Figure 5.6: Card 6 (motivational)

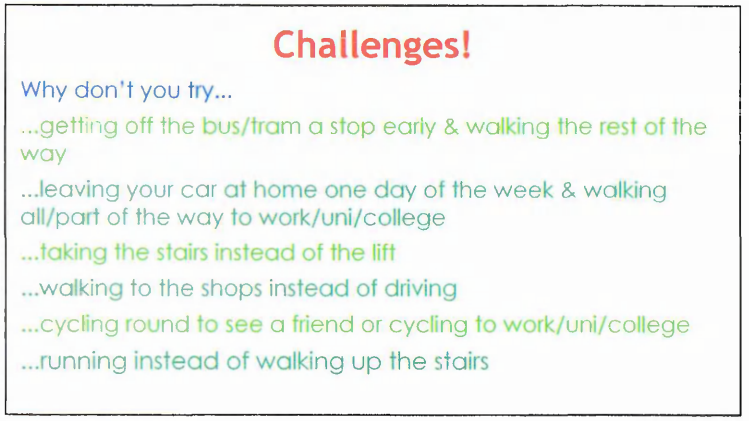


Figure 5.7: Card 7 (motivational)

Figure 5.8: Card 8 (motivational)

As a consequence of feedback from the experts the survey was also amended before being used with study participants. The sixth survey item was amended from 'which one are you least likely to disregard' to 'which one are you most likely to keep' to eliminate the potentially confusing double negative in '*least* likely to *disregard*'.

5.2.3.3 Ratings by participants

Each set of messages was mounted on a large piece of card, and participants were presented with the four messages in each set simultaneously. Participants rated the set of informational prompts first, followed by the set of motivational prompts. Participants were also required to self-report their age, gender, smoking status, and whether or not they were physically active (i.e., currently exercising for 30 min on 5 days per week, at a moderate intensity).

5.2.4 Data analyses

The most popular postcard-style prompt for each set was determined using a series of binominal tests of proportions (proportion set at 0.25). The proportion was set at 0.25 because participants had four choices of card for each survey item in each set of prompts, and the null hypothesis was that all cards had an equal chance of being selected as most popular. Therefore, the proportion of any given card being evaluated as most popular was tested against 0.25. The most popular card was the one ranked highest across the greatest number of survey items, for each of the informational and motivational sets. This procedure was repeated to ascertain the least popular postcard-style prompt in each set. Exploratory analyses of the most and least popular prompts by gender, smoking status and physical activity level were also determined using a series of binominal tests of proportions.

5.3 Results

5.3.1 Demographics and sample size

Descriptive statistics revealed that 58% of the sample were female, 37% were smokers and 53% were physically active. Of the total sample, active participants (mean age = 20.6 years, SD = 2.1) were significantly older than inactive participants (mean age = 19.5 years, SD = 2.1) (t = 2.98, df = 138, p < 0.01). Males were significantly more likely to be active than females (t = -2.23, df = 127.7, p < 0.01). The sample size was sufficient to estimate card preference within 8% precision (95% confidence interval).

5.3.2 Main findings

5.3.2.1 Informational prompts

Analyses revealed that card 4 (see Figure 5.4) was significantly ranked most highly on the items 'informative' (p < 0.01), 'likely to prompt physical activity' (p < 0.01), 'like to receive in the post' (p < 0.01) and 'likely to keep' (p < 0.01), whereas card 2 (see Figure 5.2) was significantly ranked most highly on the item 'appealing' (p < 0.01) (see Table 5.1). Thus, card 4 was deemed to be the most popular prompt in the informational set.

Analyses revealed that card 1 (see Figure 5.1) was significantly ranked lowest on the items 'informative' (p < 0.01), 'likely to prompt physical activity' (p < 0.05), 'like to receive in the post' (p < 0.01) and 'likely to keep' (p < 0.01), whereas card 4 (see Figure 5.4) was significantly ranked lowest on the item 'appealing' (p < 0.01) (see Table 5.1). Thus, card 1 was deemed to be the least popular informational prompt.

5.3.2.2 Motivational prompts

Analyses revealed that card 5 (see Figure 5.5) was significantly ranked most highly on the items 'motivational' ($p < 0.01$), 'appealing' ($p < 0.01$) and 'likely to prompt physical activity' ($p < 0.01$), whereas card 7 (see Figure 5.7) was significantly ranked most highly on the items 'like to receive in the post' ($p < 0.01$), and 'likely to keep' ($p < 0.01$) (see Table 5.1). As card 5 was ranked most highly most often, this was deemed to be the most popular card in the motivational set.

Analyses revealed that card 7 (see Figure 5.7) was significantly ranked lowest on the items 'motivational' ($p < 0.01$) and 'appealing' ($p < 0.01$), and card 8 (see Figure 5.8) was significantly ranked lowest on the items 'likely to prompt physical activity' ($p < 0.01$), 'like to receive in the post' ($p < 0.01$) and 'likely to keep' ($p < 0.01$) (see Table 5.1). Thus, card 8 was deemed to be the least popular motivational prompt.

5.3.3 Exploratory analyses of subgroups

The exploratory analyses of subgroups based on gender, physical activity status and smoking status are displayed in Tables 5.2, 5.3 and 5.4. As can be seen in Table 5.2, males differed from the sample as a whole in that they ranked both cards 5 and 7 as equally most popular for the motivational prompts, as cards 5 and 7 were the significantly highest ranked cards for two characteristics each. The same is also true of inactive participants (see Table 5.3) and smokers (see Table 5.4).

Table 5.1: Frequencies for rankings of prompt cards by characteristic

Characteristic	Frequencies for highest ranked cards (N = 141)				Frequencies for lowest ranked cards (N = 141)			
	Informational cards (number of card underlined)							
	1	2	3	4	1	2	3	4
Informative	8	1	10	**122***	**66***	62*	6	7
Appealing	33	**60***	23	23	32	9	29	**70***
Prompt PA	19	50*	19	**53***	**46***	20	33	42
Receive in post	19	33	14	**75***	**72***	23	20	26
Keep	14	28	15	**83***	**70***	30	16	24
	Motivational cards (number of card underlined)							
	5	6	7	8	5	6	7	8
Motivational	**52***	44	19	25	12	11	**59***	58*
Appealing	**72***	36	5	27	7	6	**87***	40
Prompt PA	**50***	41	26	23	12	14	42*	**72***
Receive in post	47*	29	**56***	9	11	15	32	**83***
Keep	37	37	**51***	16	16	16	30	**79***

Note: Cards 1 to 4 were informational, and cards 5 to 8 were motivational. Cards marked in bold indicate the card ranked highest or lowest by the greater frequency of participants.

* Significant at $p < 0.05$ on test of proportions

Table 5.2: Frequencies for the ranking of prompt cards for males versus females by characteristic

Characteristic	Highest ranked								Lowest Ranked							
	Males (n = 59)				Females (n = 82)				Males (n = 59)				Females (n = 82)			
	Informational cards (number of card underlined)															
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Informative	4	0	5	**50***	4	1	5	**72***	**33***	18	5	3	33*	**44***	1	4
Appealing	13	**30***	6	9	20	**30***	17	14	12	4	10	**33***	20	5	19	**37***
Prompt PA	11	**21***	11	16	8	29	8	**37***	19	7	10	**23***	**27**	13	23	19
Receive in post	3	14	6	**36***	16	19	8	**39***	**32***	7	5	15	**40***	16	15	11
Keep	6	12	6	**34***	8	16	9	**49***	**33***	5	7	13	**37***	25	9	11
	Motivational cards (number of card underlined)															
	5	6	7	8	5	6	7	8	5	6	7	8	5	6	7	8
Motivational	**25***	15	6	13	27	**29***	13	12	5	10	**26***	18	7	1	33*	**40***
Appealing	**25***	15	3	15	**47***	21	2	12	6	2	**34***	16	1	4	**53***	24
Prompt PA	**17**	12	16	13	**33***	29	10	10	7	8	17	**26***	5	6	25	**46***
Receive in post	13	14	**27***	5	**34***	15	29*	4	7	7	11	**34***	4	8	21	**49***
Keep	10	15	**24***	10	27	22	27	6	9	7	15	**28***	7	9	15	**51***

Note: Cards marked in bold indicate the card ranked highest or lowest by the greater frequency of participants.

* Significant at $p < 0.05$ on test of proportions

Table 5.3: Frequencies for the ranking of prompt cards for physically active and inactive participants by characteristic

Characteristic	Highest ranked								Lowest Ranked							
	Active (n = 75)				Inactive (n = 65)				Active (n = 75)				Inactive (n = 65)			
	Informational cards (number of card underlined)															
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Informative	4	0	3	**68***	4	1	6	**54***	**39***	30*	2	4	27*	**31***	4	3
Appealing	17	**26***	14	16	16	**33***	9	7	22	6	15	**31***	10	3	14	**38***
Prompt PA	7	23	14	**31***	12	**26***	5	22	**28***	11	18	18	18	9	15	**23***
Receive in post	8	15	9	**43***	11	17	5	**32***	**42***	11	5	17	**30***	12	15	8
Keep	5	15	9	**45***	9	13	5	**38***	**41***	13	7	13	**29***	17	9	10
	Motivational cards (number of card underlined)															
	5	6	7	8	5	6	7	8	5	6	7	8	5	6	7	8
Motivational	**27***	23	13	12	**24***	21	6	13	5	7	**32***	30*	7	4	26*	**28***
Appealing	**39***	16	4	15	**32***	20	1	12	5	2	**45***	22	2	4	**41***	18
Prompt PA	**35***	15	14	11	14	**26***	12	12	6	9	22	**38***	6	5	19	**34***
Receive in post	28*	13	**32***	2	18	16	**24***	7	7	7	15	**46***	4	8	16	**37***
Keep	22	17	**26***	10	14	20	**25***	6	8	9	18	**40***	8	7	11	**39***

Note: Cards marked in bold indicate the card ranked highest or lowest by the greater frequency of participants.

* Significant at $p < 0.05$ on test of proportions

Table 5.4: Frequencies for the ranking of prompt cards for smokers versus non-smokers by characteristic

Characteristic	Highest ranked								Lowest Ranked							
	Smokers (n = 52)				Non-smokers (n = 86)				Smokers (n = 52)				Non-smokers (n = 86)			
	Informational cards (number of card underlined)															
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Informative	6	1	4	**41***	2	0	5	**79***	**26***	17	4	5	39*	**43***	2	2
Appealing	11	**26***	6	9	21	**32***	17	14	15	3	10	**24***	16	6	19	**44***
Prompt PA	10	14	9	**19***	9	33*	10	**34***	**20***	5	14	13	25	15	19	**27**
Receive in post	5	9	2	**36***	13	22	12	**39***	**28***	5	12	7	**43***	18	7	18
Keep	5	9	6	**32***	8	18	8	**51***	**28***	8	10	6	**41***	22	5	17
	Motivational cards (number of card underlined)															
	5	6	7	8	5	6	7	8	5	6	7	8	5	6	7	8
Motivational	**19***	15	7	11	**31***	28	12	14	4	6	20*	**22***	8	5	36*	36*
Appealing	**20***	13	3	15	**49***	23	2	12	1	3	**30***	17	6	3	**55***	22
Prompt PA	13	13	13	13	**35***	27	13	10	3	7	15	**27***	9	7	26	**43***
Receive in post	11	6	**28***	7	**34***	23	27	2	5	7	10	**30***	6	8	21	**51***
Keep	10	9	**26***	7	25	**27**	25	9	6	6	11	**29***	10	10	18	**48***

Note: Cards marked in bold indicate the card ranked highest or lowest by the greater frequency of participants.

* Significant at $p < 0.05$ on test of proportions

5.4 Discussion

The aim of the present study was to evaluate a series of postcard-style physical activity prompts designed to promote physical activity in young adults, in terms of a range of characteristics relating to the practical application of the prompts, with a view to using the most popular informational prompt and most popular motivational prompt in weeks 9 and 11 of the physical activity promotion intervention in Study 5 (see following chapter). Card 4 (see Figure 5.4) was the most popular informational prompt, and card 5 (see Figure 5.5) was the most popular motivational prompt, among the sample. Meanwhile, card 1 (see Figure 5.1) was the least popular informational prompt, and card 8 (see Figure 5.8) was the least popular motivational prompt. Exploratory analyses of subgroups showed that the card preferences of males, females, active participants, inactive participants, smokers and non-smokers concurred with the main findings, with the exception of the most popular motivational prompt, which was split between card 5 and card 7 in males, inactive participants and smokers. Based on the results of the present study, cards 4 and 5 were selected for inclusion in Study 5 (see Chapter 5b). The present study compliments the effort made by Woods et al (2002), in that an array of physical activity prompts were evaluated on six characteristics relating to their practical use.

5.4.1 Informational prompts

From these findings, it may be possible to identify some common features of popular and unpopular types of prompts among young people in the present evaluation. The most popular informational prompt (card 4) contains the heading 'physical activity benefits', followed by simple points, such as 'feel more alert' and 'combat stress' (see Figure 5.4). It is possible that this card was

chosen by participants because it meets their expectations about and perceptions of physical activity. Many people exercise for the kinds of reasons listed on card 4 (Biddle, 1995; Sherwood & Jeffery, 2000), including young adults (Kilpatrick, Herbert & Bartholomew, 2005), and thus it might be expected that prompts reaffirming these reasons should be popular. According to the TTM (Prochaska & DiClemente, 1983), raising awareness of the pros and cons of behaviour change is an important process in the early stages of behaviour change, and thus would be beneficial in the early stages of physical activity promotion interventions. It is also interesting that card 2 was selected as the most popular on the characteristic 'appealing' only. Like card 4, card 2 also highlights the beneficial effect of physical activity, but the content may have been considered to be too informationally bland, thus it is not surprising that this card ranked highly for its appeal only. Thus, it would seem that the *way* information is presented, in addition to its content, is important.

The least popular informational prompt (card 1) contains the sentence 'For health benefits, it is important to accumulate around 10,000 steps per day' (see Figure 5.1). Although the message is colourful and simple, it contains very specific information about the number of steps that should be taken every day, and participants in this study may have found this type of information less worthwhile. This finding is interesting, because many public health campaigns focus on promoting 10,000 steps a day (Tudor-Locke & Bassett, 2004). While the 10,000 steps postcard aimed to promote the benefits of physical activity, albeit less precisely than some of the other cards, it was not popular. Possible explanations are that 10,000 steps may be perceived as an unachievable goal for many people, and one of the key principles in sustained behaviour change is to encourage individuals to set realistic and achievable goals (Loughlan &

Mutrie, 1995; Prochaska & DiClemente, 1983). With these findings in mind, health promotion schemes may want to consider the relevance of the 10,000 steps a day message with young people, as it seems that prompts containing this message are less likely to be appealing and therefore less likely to promote physical activity in this population. This study highlights a tension between the dissemination of knowledge about physical activity related health benefits and promoting a realistic message that young people will act upon.

5.4.2 Motivational prompts

The most popular motivational prompt (card 5) contains a simple message that suggests an active lifestyle can positively influence the way one looks and feels: 'An active lifestyle... look good! feel great!' (see Figure 5.5). Like card 4, many people exercise for these reasons (Biddle, 1995; Kilpatrick, Herbert & Bartholomew, 2005; Sherwood & Jeffery, 2000), and young people appear to find prompts containing information about the benefits of physical activity as most motivational. Half of the motivational content in this message is intrinsic in nature ('feel great'). As mentioned earlier, self-determination theory (Deci & Ryan, 1985), achievement goal theory (Nicholls, 1984) and the hierarchical model of intrinsic and extrinsic motivation (Vallerand, 1997), have suggested that motivations that are intrinsic in nature have greater potential to nurture health-promoting behaviours over the longer term. The selection of card 5 as most popular lends some support to these theories, although caution must be exercised in this interpretation, because card 5 also contains an extrinsically motivating message ('look good'). Further research is needed to clarify these preliminary findings, however there is some reason to believe that conveying intrinsic messages may be useful when designing physical activity messages and prompts for young people.

Card 7, the joint most popular prompt among males, inactive participants and smokers, contains a list of physical activity 'challenges' (see Figure 5.7). The popularity of this card in addition to card 5 confuses the role of intrinsically and extrinsically motivating messages in prompt preference, because the main element of this message is externally motivating (the suggestion to do certain activities pertaining to an active lifestyle), however the very idea of responding to challenges is inherent in intrinsic motivation and intrinsic regulation, and intrinsic motivation focuses on individuals' needs for competence and autonomy (Ryan & Deci, 2000). It may be perceived that the suggestions in card 7, while externally generated, are promoting competence and autonomy, because many of the specific suggestions made are easily achievable for most young people, for example, taking the stairs instead of the lift. The physical activity message in card 7 is also framed as a series of suggestions ('why don't you try...') rather than an explicit command.

The least popular motivational prompt (card 8) simply contains the message 'Do some physical activity!' in large letters (see Figure 5.8). This prompt may have been perceived by participants as being command-style, and generally externally motivating in nature. Indeed, according to widely used motivational theories (as mentioned earlier), external or controlling motivations are less desirable for health behaviour promotion since they are less likely to foster involvement and long-term commitment to physical activity. Thus the lack of theoretical support for direct commanding messages combined with the unpopularity of card 8 implies that this type of message would not be advantageous in physical activity promotion interventions.

Data from this study should be interpreted in the context of its strengths and limitations. One limitation is that no data were collected on *why* each prompt

was preferred. Future studies exploring this issue would yield a valuable insight into health message preferences for target populations. Due to the preliminary nature of this study, another important limitation to consider is that the efficacy of the prompts was not measured; it would be useful for further research to evaluate the prompts while being used in intervention studies aimed at promoting physical activity. It may be that the most popular cards were those that did not make participants feel uncomfortable, which may not necessarily be the best at promoting physical activity behaviour. Another limitation of the present study is that the young people surveyed were recruited in educational settings, and thus the results may be biased towards those who are more intelligent or educated than the general population of young people. In addition, the sample size was modest, although participants in this study were broadly ranging in terms of demographic and health behaviour characteristics, which would allow the present findings to be widely generalised. Because the primary purpose of this investigation was to select a prompt to use in the physical activity promotion intervention (reported in Chapter 5b), ordinal data were gathered; future research may benefit by using a Likert scale. Finally, this study may also have benefited by using members of the target population in addition to 'experts' to pilot the prompts and the survey, however the inclusion of a developmental stage involving experts to ensure that the prompts were likely to be appropriate at the outset can be considered a strength of the study..

Of studies that have reported the effects of physical activity prompts on physical activity behaviour (Conn et al, 2003; Kerr et al, 2000; Marcus et al, 1998; Woods et al, 2002), none have evaluated the prompts prior to use, or published or described in detail the written content of the prompts. It is therefore difficult to know what kinds of prompts are likely to provide benefit, or to replicate these

prompts for use in subsequent trials. Thus, in studies that found little change in behaviour (for example, some of the stair climbing prompt studies; see Eves & Webb, 2006), it might simply be that the prompts used were not appealing or attractive to participants, not that the intervention approach itself was ineffective.

In conclusion, the present study is innovative in that it was designed to evaluate the acceptability of a series of physical activity postcard-style messages on characteristics relating to the practical use of the physical activity prompts, among young adults. This preliminary evidence suggests that messages that promote autonomy are the most popular, including messages on the benefits of being physically active and suggestions that may help to achieve this, and messages that are externally directing in nature are the least popular among young people, including command-style messages and fixed goals (e.g., the 10,000 steps message). Such information may well be useful for the subsequent design of prompts within physical activity promotion interventions, whether the interventions are aimed at smokers or non-smokers, those who are active and those who are inactive.

Chapter 5b

Study 5: Is a physical activity consultation intervention feasible in young people who smoke? A pilot randomised controlled trial

5.5 Introduction

If the prevalence of cigarette smoking and problematic nature of tobacco withdrawal among adolescents (see Chapter 1) are considered in light of the health risks posed by tobacco, then adolescent smoking has become a serious public health issue. Consequently, a successful adolescent smoking cessation intervention strategy, which can effectively combat withdrawal symptoms, undesirable affective responses and desire to smoke, would appear to be an important avenue for research to explore.

Typical health promotion based smoking cessation interventions have been largely unsuccessful in young people, while exercise and physical activity have been found to be beneficial in aiding cessation attempts among adults (see Chapter 1 for a detailed discussion). Among young smokers, there is some evidence that exercise can reduce cigarette cravings and withdrawal symptoms, and improve mood (see Study 2, Chapter 3). Exercise may therefore be a useful adjunct to smoking cessation programmes in young smokers, through reducing the desire to smoke and withdrawal symptoms. To date, no published research has examined whether lifestyle physical activity promotion is an acceptable type of intervention in young people who smoke. Additionally, no study has considered whether promoting exercise can discourage smoking behaviour and encourage positive beliefs about quitting in this population of young people.

Typical smoking cessation interventions (e.g. NRT, group counselling, cognitive behavioural therapy) are less likely to adequately address the physical and functional health of smokers attempting to quit, in the way that regular physical activity might. In addition, many smokers gain weight or fear weight gain while quitting, and regular exercise can assist in reducing the amount of weight gained (Marcus et al, 1999). Given that many common smoking cessation treatments can be expensive and are often in short supply, other smoking cessation strategies would be desirable, particularly among young people. Exercise behaviour can be self-sustaining in that it can be maintained by individuals once the basic skills have been learned (Martinsen, 1993).

Study 3 suggested that the theory of planned behaviour is useful in explaining the determinants of physical activity intentions and behaviour in young people who smoke. Therefore, any intervention designed to increase physical activity levels in this population should target attitudes, normative beliefs, control beliefs and intentions. These constructs should also be measured to investigate their potential for mediating increases in physical activity (Norman & Conner, 2005). Study 2 suggested that moderate intensity exercise is effective for reducing cravings and withdrawal symptoms and improving mood, therefore moderate intensity physical activity should be recommended for young people who smoke.

5.5.1 Aims and hypotheses

The evidence base summarised here suggests a clear need to conduct a controlled investigation into the effects of a physical activity promotion intervention as an adjunct to a smoking cessation programme in young people who smoke. Before proceeding with further research in this area, however, it is

necessary to establish that such a physical activity intervention is efficacious among young people who smoke. The present study, therefore, aimed to evaluate the feasibility and acceptability of an exercise intervention in young people who smoke, and to examine whether a lifestyle exercise intervention decreases smoking behaviour and smoking attitudes in young smokers. The primary hypothesis is: Physical activity levels will be increased from baseline following a physical activity consultation intervention, compared with a control condition. The secondary hypothesis is: Cigarette consumption will be decreased following a physical activity consultation intervention, compared with a control condition.

5.6 Method

5.6.1 Participants

Seven young adult smokers participated in this study, although it was initially intended that 40 participants would participate in this study.

5.6.2 Design

Ethical approval for this study was obtained from the University's Research Ethics Committee. Participants were randomised to either the physical activity consultation group or the control group after they had completed their baseline assessment. An independent researcher randomised participants to the groups and participants were informed of their group allocation within one week of completing their baseline assessment. Participants were issued with standardised written instructions (Appendix 17), informing them of the purpose of the study and of their equal chance of being assigned to one of the two conditions. Due to the nature of the intervention, group allocation could not be blinded to participants or the investigator.

5.6.3 *Inclusion/exclusion criteria*

Volunteers aged 16-25 years who smoked at least 10 cigarettes per day and had smoked for at least six months were eligible to participate in this study. Volunteers also had to be willing to attend five sessions (three assessment sessions plus two consultations). Volunteers with insulin treated diabetes were ineligible to participate in this study, as were volunteers who were physically active (three or more times per week at a moderate intensity or greater for at least 30 min per session during the previous 3 months) or known to be pregnant. Volunteers who were unable to provide written informed consent and for whom exercise might be contraindicated (as determined by a university screening self-report questionnaire, approved by the institutional research ethics committee; see Appendix 1) were also ineligible. Volunteers were screened in person or on the telephone.

5.6.4 *Recruitment of participants*

Participants were recruited in seven ways: (1) through eye-catching posters containing a brief description of the study and contact details of the investigator; (2) through leaflets (similar to the posters but a quarter of the size); (3) through the local media; (4) by approaching smokers in person; (5) by placing a notice on the students' electronic notice board within the institution; (6) by making announcements in lectures; and (7) by asking eligible participants from another study (see Chapter 3) if they would like to participate in the present study. Posters were placed throughout all three campuses of the institution, on official and departmental notice boards, in prominent places, including within halls of residence. Posters were also placed on departmental notice boards and on official notice boards in the Students' Union in another local institute of higher education, as well as on official notice boards in four local sixth form colleges.

In addition to this, posters were placed in the windows and on notice boards of local shops, in local public houses, and within local places of work. Leaflets were also placed throughout the institution, including in the mailboxes of the halls of residence, by the cash registers at the food outlets, and at the desk in the student services centre. Leaflets were also placed in another local higher education institution, as well as four local institutes of further education, and local public houses, shops, food outlets and workplaces. Five hundred leaflets were also handed out at the Student Union trade fair on the first week of term. Young smokers were approached in person on campus, and also in the smoking areas of another local higher education institution and four local further education institutions.

Following liaison with the Publicity Department, a press release was developed (Appendix 18). Three articles were generated from the press release; two in institutional publications and one in the local newspaper. A half-page article on the study featured in the 'Healthy Living' section of *The Star*, Sheffield's local newspaper, *SHU Print*, an institutional publication for students and *Newview*, an institutional publication for staff (Appendix 18). In all cases, the investigator's contact details were provided, and interested volunteers were encouraged to contact the investigator for further information. Volunteers were assessed for eligibility, and those who were eligible for participation provided informed written consent (see Appendix 19).

5.6.5 Outcome measures

5.6.5.1 Primary outcome

The primary outcome measure was physical activity behaviour, which was self-reported physical activity using the 7-Day Physical Activity Recall (PAR; Sallis

et al, 1985), a structured interview that has been extensively validated against objective measures (Montoye, Kemper, Saris & Washburn, 1996) and has been previously used in physical activity consultation studies (e.g., Kirk, Mutrie, MacIntyre & Fisher, 2003; 2004). The 7-Day PAR asks respondents about their moderate and vigorous intensity physical activity participation for each day over the previous seven days (see Appendix 20). Participants also recorded their physical activity participation using a simple daily recall diary (Appendix 21) over the 12-week study period.

5.6.5.2 Secondary outcomes

Cigarette consumption was measured, in the form of self-reported number of cigarettes smoked per day, expired air carbon monoxide level and self-reported smoking behaviour using a simple daily recall diary (Appendix 22) over the 12-week study period. Stage of change for exercise and smoking behaviour were measured, using the stage of readiness to change ladder (Biener & Abrams, 1991) (see Appendices 4 and 27).

Norman and Conner (2005) argue that it is important to examine the mediating effects of the TPB variables on any changes in physical activity where the TPB is implicated in intervention design. Therefore the framework of the theory of planned behaviour was utilised to assess the cognitive and informational motivational influences on participants' physical activity and smoking behaviour (see Appendices 7 and 25). Scales measuring participants' attitudes, subjective norm beliefs, perceived behavioural control and intentions relative to physical activity behaviour and quitting smoking were used. These scales were developed in accordance with guidelines specified by Ajzen and Fishbein (1980) and are described in detail in Chapter 4.

Depression was assessed using the Beck Depression Inventory-II (BDI-II, Beck, Steer & Brown, 1996). The BDI-II is a 21-item self-report inventory designed to assess the behavioural and cognitive symptoms of depression (see Appendix 23). Affect was measured using the Positive and Negative Affect Schedule (PANAS; Watson, Clark & Tellegen, 1988), which consists of two subscales, measuring positive affect (PA) and negative affect (NA) (see Appendix 24). High levels of internal consistency have been reported for both the BDI-II (α = 0.92; Steer, Clark, Beck & Ranieri, 1998) and the PANAS (α = 0.86-0.90 for PA and α = 0.84-0.87 for NA; Watson et al, 1988).

5.6.6 Participant assessments

Assessments took place at baseline and 12 weeks after commencement of the exercise intervention. It was intended that participants would also be followed up three months later to provide an indication as to whether there were any sustained benefits to the intervention, however this assessment was not conducted because only three participants were still actively involved in the study at the 12 week assessment. Demographic data and data on current smoking habits (FTND, HONC, motivations for smoking, age of onset, previous quit attempts and duration, intention to quit and current consumption) were reported (see Appendices 5, 12 and 25). At the end of the baseline assessment session, participants were given standardised health information, in the form of the informal government-produced magazine '*Choosing Health*' (Department of Health & Dr Foster Ltd, 2005). Participants were informed of their group allocation after their baseline assessment had been completed.

5.6.7 Physical activity consultation intervention

The intervention involved offering participants two individual person-centred physical activity consultations over the 12-week intervention. Physical activity consultations have been reported to be an effective method of increasing physical activity participation and well-being and reducing body weight (Farnham & Mutrie, 1998; Loughlan & Mutrie, 1995; Lowther, Mutrie & Scott, 2002). Furthermore, this intervention, if successful, can be easily integrated into current healthcare practice. In accordance with the transtheoretical model (TTM; Prochaska & DiClemente, 1983) the intervention is focused on equipping individuals with skills, knowledge and confidence so that they feel able to participate in regular physical activity. The TTM also advocates the use of stage-matched cognitive and behavioural strategies and techniques when helping individuals to change their health behaviours.

The TTM can be useful approach for increasing physical activity with a variety of populations (Kirk et al, 2003; Kirk et al, 2004; Mutrie et al, 2002; Woods et al, 2002). In a review of systematic reviews of physical activity promotion strategies, Hillsdon et al (2004) stated that physical activity interventions based on theories of behaviour change, which teach behavioural skills, involve unsupervised moderate intensity physical activity, undertaken in, or close to, the home and that are tailored to individuals' needs, are associated with longer-term changes in behaviour.

5.6.7.1 Consultations

The consultations lasted approximately 50 minutes, and took place at the Centre for Sport and Exercise Science, Sheffield Hallam University. A standardised consultation form was used, detailing all relevant sections for each

participant, ensuring adherence to the intervention protocol (see Appendix 26). Research within this thesis has suggested that the theory of planned behaviour would be useful as a framework for guiding physical activity interventions (see Study 3, Chapter 4; Everson, Daley & Ussher, 2007), therefore attitudes towards physical activity (with regard to specific types of activity), normative beliefs, perceived behavioural control and intentions to be active were addressed within the consultation. Moderate intensity physical activity was encouraged, because it should be achievable and also because Study 2 (see Chapter 3) demonstrated benefits in terms of craving and withdrawal symptom reduction and mood improvement from moderate intensity exercise in young smokers who were temporarily abstinent. Walking for health was particularly encouraged because it is an activity that the majority of people are capable of performing, including sedentary individuals.

The first consultation focused on physical activity uptake, enhancing attitudes, motivation, normative beliefs and perceived control beliefs for exercise, overcoming barriers and developing appropriate activity plans. Participants were given a World Health Institute (WHI) pedometer (along with instructions for use and a step count log) to be used as a motivational tool and to assist participants in quantifying the amount of activity they were achieving. In addition, participants were provided with a laminated A6 size copy of the Borg RPE scale (Borg, 1998), and were offered the opportunity to go for a brief supervised walk.

The second consultation (four weeks later) focused on the prevention of relapse back to sedentary behaviour and/or improving maintenance of an active lifestyle. The participant's physical activity patterns and how they felt about

their activity over the previous four weeks were reviewed. The strategies used during the first consultation were revisited.

5.6.7.2 Prompts

Participants were also given a brief telephone call during the intervention, midway between the first and second consultation, to discuss their progress and provide support for participants. In addition, participants were also mailed physical activity prompts (see Study 4, Chapter 5a for a description of the process of developing and evaluating the prompts). An informational prompt (see Chapter 5a, Figure 5.4) was sent approximately four weeks after the second consultation, and a motivational prompt (see Chapter 5a, Figure 5.5) was sent two weeks subsequently (see Figure 5.9 for a pictorial representation of the timing of the intervention procedure).

5.2.8 Control group

The control group were asked not to change their current physical activity patterns, and completed the baseline and 12-week follow-up assessments in the same manner as the physical activity consultation group.

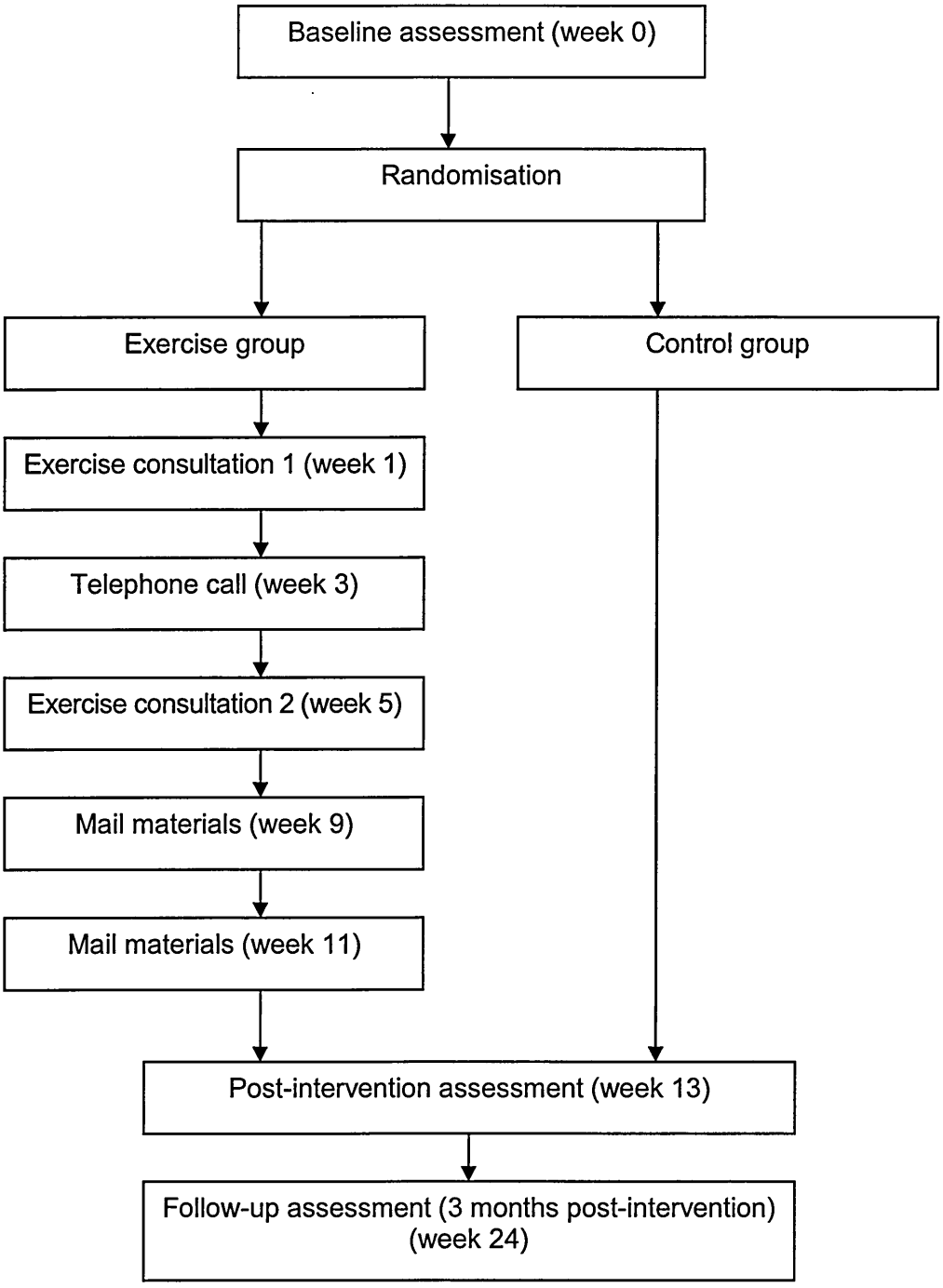


Figure 5.9: The timing of the intervention

5.7 Results

5.7.1 Recruitment of participants

Seven young smokers participated in this study, four males and three females. In response to posters and leaflets, nine people telephoned the investigator about the study. Of these, three subsequently participated in the study. A further four were identified as not being eligible according to telephone screening, and two subsequently decided not to participate upon further contact. Two people expressed an interest in participating following announcements in lectures. Of these, one subsequently participated in the study, and the other was identified as not being eligible to participate. One participant was recruited while handing out leaflets at the Student's Union trade fair, and subsequently took part in the study. Seventeen people were recruited in person in smoking areas, and were identified at the time as being eligible and interested; of these, two subsequently participated in the study. A further two were subsequently found to be ineligible to participate, four were subsequently not contactable, and nine volunteers subsequently rescinded their desire to participate. In one case this was due to a change in health, two people had subsequently moved house and were no longer able to reach the centre, two people reported they did not have the time to commit to the study, and four people reported that they no longer wished to participate. Six eligible volunteers were recruited from another ongoing study, however three became subsequently not contactable, and the remaining three decided not to participate because they would not be able to commit the requisite amount of time to the study. Therefore, seven people participated in the study, three of whom were randomised to physical activity consultations, and four of whom

were randomised to control. Of these seven, four participants (two from each condition) dropped out of the study. The two dropouts from the control condition both dropped out of the study just before the 12 week follow up assessment, and the two dropouts from the physical activity consultation condition both dropped out between the first and second consultations. In one case, the participant dropped out without giving a reason, however the remaining three dropouts were not contactable.

5.7.2 Baseline sample characteristics

5.7.2.1 Demographic data and smoking information

At baseline, the mean age of participants was 21.0 years (SD = 2.52), mean BMI was 26.3 (SD = 5.09), mean cigarette consumption was 13.7 (SD = 6.08), mean CO reading was 15.3 ppm (SD = 8.22), mean FTND score was 4.57 (SD = 2.51), mean HONC score was 7.71 (SD = 1.50), and mean number of minutes per week spent in vigorous and moderate physical activity (7-Day PAR) was 867.86 (SD = 682.65).

Due to the low number of participants in the present study, and thus the increased risk of making a Type II error when comparing groups, it was not practicable to conduct statistical analyses on baseline data. There were some interesting trends in the data, for example, there was a trend for dropouts to be slightly younger on average (19.75 years versus 22.67 years) and have higher FTND scores (5.25 versus 3.67). There was also a trend for dropouts to have a higher baseline CO reading (15.75 ppm versus 14.67 ppm), but to report smoking less (12.75 versus 15.00 cigarettes per day) than completers. Trends suggested that dropouts were less active (on the 7-day PAR) at baseline than completers (798.75 versus 960.00 minutes per week of moderate and vigorous

intensity exercise), and also had slightly lower positive affect scores on PANAS (32.25 versus 37.67) and higher depression scores on the BDI (9.25 versus 4.00) than completers at baseline. These trends, however, need to be explored in a study with a larger sample size.

5.7.2.2 Outcome measures

Due to the small numbers of participants, it was not possible to conduct meaningful statistical analyses on the data, to determine differences in physical activity levels between baseline and 12 weeks, between the groups. The following section contains a case report of an intervention condition completer, and from this it may be possible to gain some useful information from the data collected in Study 4 on the feasibility of a physical activity counselling intervention in young people who smoke.

5.8 Case study: Intervention condition completer

By examining one case in detail, it may be possible to gain some useful information on the feasibility of the intervention in the target population, which may help to inform the direction of future research in this field. This section reports an exploratory case study (Yin, 2003) of one participant, Joanne (not her real name) who was randomised to the intervention condition, and completed the study. This summary is a descriptive case study based on pre-recorded information and Joanne's results.

Joanne self-reported smoking 16 cigarettes per day, and initially joined the study in the hope of becoming fitter, to be able to play team sports again, to become healthier, and also because she believed that being more active may eventually help her to quit smoking. At baseline, Joanne reported doing physical activity (for a 20-30 minutes session, at a moderate intensity) once a

week, and reported being in the preparation stage of change for both physical activity and smoking cessation. She intended to quit smoking, but in more than a month's time. Joanne appeared to be well motivated to become more physically active, with a positive attitude towards physical activity. Her physical activity experiences mostly consisted of team sports at school, and had access to a cycle ergometer, although this was rarely used, lack of time being the main barrier to physical activity. She suggested planning breaks for physical activity into the day as a possible solution to this barrier, with her partner and family as possible sources of social support, if needed. At the conclusion of the initial consultation, Joanne set a goal of exercising on the cycle ergometer once a week for half an hour, on a set day at a set time. This goal was set as it was agreed to be realistic, due to Joanne's time restraints, and this kind of activity could be gradually increased over time.

At the second consultation, Joanne reported that she had met her goal with regard to exercising on the cycle ergometer at home once a week, and reported that where this had not been possible at the time planned, she had set another time for cycling, and had adhered to the re-arranged time. In addition, she had been increasing the amount and speed of walking as a mode of transport. Joanne's experiences of these increases in activity were generally positive, and this may have been because she was previously very sporty, and seemed keen to return to this identity. Joanne reported feeling that the same activities had become easier to do over the course of the four weeks, and she felt fitter, healthier and good about herself. Time was still the main barrier, however the regular cycle ergometry and walking for transport appeared to fit into her lifestyle. She had not felt much need for social support during the four weeks, but still felt that the people she had suggested would be dependable if required.

Joanne's goals were to continue with the current regime of cycle ergometry once a week, and making a part of her usual journeys on foot.

While Joanne had not used the RPE scale she was provided with, the step counter had been useful, and she had recorded the number of steps taken each day throughout the duration of the study. Indeed, Joanne reported that she found it reassuring to be reaching at least half of the 10,000 steps guideline on most days.

At the follow-up assessment, Joanne reported smoking 17 cigarettes a day (one greater than at baseline), and being physically active (for a 20-30 minute session, at a moderate intensity) twice a week (compared with once a week at baseline). She also reported being in the preparation stage for smoking cessation (no change from baseline), but in the action stage for physical activity (compared with the preparation stage at baseline), and reported an intention to quit smoking within the forthcoming month.

Contrary to the self-report data, however, an examination of the physical activity diary, smoking diary and step count records over the 12 weeks of the study appeared to suggest that on the whole physical activity and smoking behaviour remained largely unchanged from week to week. On average, Joanne reported doing 131.3 minutes per week (SD = 3.61) of moderate intensity physical activity, 6642.3 steps per day (SD = 643.60) and smoking 116.4 cigarettes per week (SD = 10.38), an average of 16-18 cigarettes per day. Since the step count records and physical activity diary did not appear to indicate an increase in physical activity behaviour across the 12 study weeks, it may be that for this individual, simply participating in the study was sufficient to motivate her to

adopt a more active lifestyle from the baseline assessment to the first recording of the physical activity diary and step count.

It is likely that data from one participant is not representative of all young adult smokers, nevertheless it may be possible to extract useful information from the case to contribute to the development of future intervention studies. A two-session physical activity consultation intervention was suitable for this young adult smoker, and may be for others who specifically have a history of being previously active, and who are motivated to make the change towards being more active. The pedometer in particular appeared to be a valuable tool in the intervention, and the feedback provided appeared to reinforce Joanne's motivation. It may be that a telephone intervention, or a step-counter based intervention, or a physical activity prompt-based intervention may also have facilitated physical activity adoption in this type of motivated individual. Future research should investigate the effects of the type and intensity of intervention on young adult smokers with varying previous physical activity experiences and motivation to become active in order to ascertain this suggestion, because minimal-contact interventions might be cost-effective. Inactive people who are less motivated to change than Joanne, however, may require more intensive interventions, where more support is provided, and future research should seek to determine this.

5.9 Discussion

It was originally intended that forty individuals would participate in this trial designed to assess the feasibility of a physical activity consultation intervention for young adult smokers, to be recruited over nine months. Despite a variety of extensive recruitment strategies however, only seven eligible participants could

be recruited, and this small number precluded statistical analysis of the data, limiting the strength of any conclusions that can be made. The lack of success in recruiting participants is contrary to other studies examining the influence of regular exercise or physical activity in smoking cessation with older smokers (Marcus et al, 1999; Marcus et al, 1991; Marcus et al, 1995; Ussher et al, 2003), where it was possible to recruit sufficient participants to complete the research. This study contributes to the recent drive within medical health research to make studies with null findings and research where recruitment was not possible publicly available, since such information can be equally valuable to researchers as studies demonstrating positive recruitment and intervention effects.

Due to the extensive efforts made to recruit participants into the present study, it seems reasonable to reach two main conclusions: (1) a two-session physical activity consultation intervention may not be appealing to young adult smokers in particular; and (2) young adult smokers are a difficult population to reach in terms of health promotion strategies, and the extensive recruitment methods used were not effective in reaching the target population. First, previous studies that have demonstrated the success of a two-session physical activity consultation intervention for increasing physical activity levels have used much older patient populations, who have already been diagnosed with a medical condition, such as type 2 diabetes (Kirk et al, 2003, 2004) and those in cardiac rehabilitation (Hughes et al, 2002). Such individuals, however, may be more motivated to adopt healthy behaviours than healthy young adult smokers, who may well view the consequences of their current health behaviour as occurring far into the future (Jamieson & Romer, 2001).

Second, the problems of recruiting young adult smokers using posters, leaflets and approaching smokers in smoking areas could have been due to either the methods themselves (e.g., there was not enough publicity for the trial, or the methods used were inappropriate), the logistics of attending the research centre, or the difficulty of reaching young adults who smoke in health promotion contexts. It may be that more appealing or further widespread recruitment methods could have been used, for example offering an incentive for participation, such as a cash sum or entry into a prize draw, or more widespread advertising, for example posters on public transport networks. Recruitment may also have been more successful if the World Wide Web had been implicated, possibly via links from widely used websites. Due to the extensive recruitment efforts documented in section 5.2.4 however, it seems unlikely that there was insufficient publicity for the trial. The need to attend between three and five sessions at the research centre may have been an obstacle for young smokers (in particular inactive young smokers), who may have had less extensive access to transport than older adults. This issue could be addressed by conducting future trials in participants' own environment, for example within their educational institution or workplace, or in a local community centre. It may be more difficult to address the issue of reaching inactive young adults who smoke with respect to health promotion. To this end, future research may benefit from preliminary interviews with young adult smokers, both active and inactive, to ascertain the health promotion methods that best suit them.

The smoking status of participants in physical activity promotion research is an important matter that warrants discussion. The present study was only concerned with recruiting young adult smokers who were not in the process of

quitting smoking. It may be that young adult smokers who are attempting cessation, and may possibly also be making other efforts and lifestyle changes to enhance their cessation attempt, may be more receptive to increasing their physical activity behaviour, for example as with the adult smokers in the Ussher et al (2003) study, and the Marcus et al (1991, 1995, 1999) studies. Thus, conducting this type of trial with smokers making a quit attempt may meet with more success in terms of recruitment, because the smokers are more likely to be open to suggestions that may aid their quit attempt. This would be a fruitful direction for future research.

The lack of success in recruiting participants has also been mirrored in the number of participants who completed the study. Over half of the participants who initially entered the study dropped out. By examining the baseline characteristics of the dropouts and the completers, it may be possible to gain some insight into the type of people to whom the study was appealing. Relative to completers, there were trends for dropouts being younger, more dependent on nicotine, younger when they commenced smoking, more likely to have made a cessation attempt, less active, more depressed, and lower on positive affect. From these trends, it may be inferred that those who did not complete the trial might have been those most in need of an effective health promotion intervention (i.e., more nicotine dependent, less active and more depressed, with more failed cessation attempts), which suggests that those most in need of the intervention are the most difficult people to reach in terms of recruiting and maintaining their participation. Thus serious thought (and ideally qualitative preliminary research) is required for future studies attempting to recruit young adult smokers into health promotion interventions. Due to the small sample

size, however, all these interpretations of trends in the data must be considered with much caution.

An important limitation to the study is that no pilot study or detailed consultation with prospective participants (i.e., young adults who smoke) was conducted. Future research would benefit by conductive preliminary investigations, for example through interviews or focus groups with members of the target population prior to conducting any physical activity intervention. Such investigations would help to determine the physical activity needs of this hard-to-reach population and thus make it easier to recruit participants into and increase the likelihood of success of any physical activity intervention aimed at young smokers.

In conclusion, it does not appear to be feasible to recruit young adult smokers into a physical activity consultation intervention using posters, leaflets, newspaper articles, e-mail postings, advertisements and by personally approaching smokers in smoking areas. It is not therefore possible to comment on the feasibility of a two-session physical activity consultation intervention for increasing physical activity levels among young adult smokers until further research with a larger sample size has been conducted. It may be possible to suggest, however, that the type of intervention investigated here was not feasible among the target population, on the grounds that it was not possible to recruit sufficient participants to the study. It would therefore be useful for future research to focus on understanding why recruitment was difficult, and also understanding the needs of young people who smoke, for example through interviews or focus groups with such individuals.

Chapter 6

Thesis discussion

6.1 Introduction

This chapter will summarise and discuss the findings of the five studies within this thesis, and will present the implications, limitations, future directions, and conclusions of this research.

6.2 Summary of the main findings

Since cravings and withdrawal symptoms can increase the risk of relapse to smoking during a cessation attempt, the impact of a short bout of exercise on cravings, withdrawal symptoms and mood in abstaining young smokers was investigated in Study 1, and the results suggested no benefit of exercise. It was thought that one of the possible reasons for the lack of findings in Study 1 regarding cravings and withdrawal symptoms was that moderate intensity exercise may not be sufficiently intense to provide benefit. Therefore a second study was conducted, where the intensity of the exercise bout varied, to compare each of moderate and vigorous intensity exercise with a no-exercise control. In Study 2, both intensities of exercise reduced cravings, and moderate intensity exercise provided mood benefits in addition, relative to control. Regardless of intensity, it was demonstrated that a short bout of exercise can reduce the desire to smoke in young adults who have been abstinent from smoking overnight, relative to control. Thus, Study 2 provides some evidence that exercise (in particular exercise of a moderate intensity) may be a useful adjunctive intervention within smoking cessation programmes involving young people.

Before such programmes can be designed and implemented, it was necessary for the feasibility of physical activity promotion interventions in young people to be ascertained, to first establish whether or not such an intervention is likely to be efficacious in increasing physical activity levels of young people who smoke over the longer term. A study was conducted to assess the feasibility of a two-session physical activity consultation intervention in young people (Study 5). In addition, preliminary modelling of young smokers' physical activity determinants using the theory of planned behaviour (TPB) revealed that this model was relatively successful in predicting physical activity in young people who smoke (Study 3), therefore strategies based on the salient features of the TPB were focused on within the physical activity intervention consultations. In addition, an integral component of the physical activity intervention in Study 5 was the use of postcard-style physical activity prompts, which were sent to participants on two occasions during the intervention period. To ensure the most appealing messages were used, a systematic evaluation of a range of potential physical activity prompt messages was conducted (Study 4). Overall, the most popular prompts were a prompt containing information on the benefits of physical activity, and a prompt containing a positive suggestion about the way an active lifestyle can make one look and feel. These prompts were subsequently included in the intervention as described previously. Information on the most and least popular types of prompts may be useful for guiding physical activity prompt content in future intervention studies with young people.

Despite extensive recruitment efforts over nine months, it was not possible to recruit sufficient participants into Study 5 to perform statistical data analysis; however some descriptive observations from the data collected may be made. There was a trend for dropouts to have higher FTND scores, higher baseline

CO readings, lower self-reported daily smoking rates, lower levels of moderate and vigorous physical activity according to seven-day recall, lower positive affect scores on the PANAS, and higher depression scored on the BDI, than completers. This suggests that those who did not complete the trial may have been those most in need of an effective health promotion intervention, and, in turn, that those most in need are the most difficult people to reach in terms of recruitment and retention. A case study of a completer, based on information from consultation records and data collected from the participant, suggested that a two-session physical activity consultation intervention was suitable for a motivated individual who had been physically active in the past. The pedometer was also perceived as a particularly useful tool in the intervention. While case studies can provide the opportunity for detailed analysis of participants' experiences, readers should be mindful that the extent to which conclusions from case studies can be generalised may be limited.

Overall, Study 5 highlighted the potential difficulties associated with recruiting young people (and those who smoke) into physical activity intervention trials and it may be that a physical activity consultation approach is not an appropriate intervention method for promoting physical activity in this population. It might be that other types of interventions are more appealing to young people who are sedentary and smoke; future research should consider this issue in more detail. Given the difficulties in recruiting sufficient participants into the intervention study (Study 5), it appears that it is not feasible to successfully complete a physical activity consultation intervention with this population, and future studies should consider assessing the feasibility of alternative intervention methods (e.g., internet-based or smoking cessation clinic-based methods).

6.3 Implications

6.3.1 Desire to smoke and withdrawal symptoms during abstinence from smoking in young people

Smoking cessation is important for the future health of young smokers, a half of whom are predicted to die prematurely as a result of their habit if they continue to smoke (Department of Health, 1998). Previous efforts at promoting smoking cessation among young people have met with little success, however, and at best have produced mixed findings (Camenga & Klein, 2004; Garrison et al, 2003; Grimshaw & Stanton, 2006; Mermelstein et al, 2002; Schofield et al, 2003; Sussman et al, 1999). New approaches that may demonstrate success are therefore needed. Among adults, some preliminary studies have shown that physical activity and exercise may be useful as an aid to smoking cessation (Taylor & Ussher, 2005; Ussher, 2005), and the findings of the current research have implications for the use of exercise and physical activity in smoking cessation programmes among young people.

Findings suggest that short bouts of exercise may be useful for young adult (i.e., aged 18-25 years old) smokers to manage their cravings during a cessation attempt, but this did not appear to be the case for adolescent smokers (i.e., 16-19 years old). The discrepancy in findings between Studies 1 and 2 is interesting and may be a function of the methodological approaches used in these studies. For example, while the mean RPE ratings within the moderate intensity exercise bouts of both studies were comparable, the mean HR of Study 2 participants was noticeably higher (but still within the moderate intensity range) than the mean HR of Study 1 participants during moderate intensity exercise. It should also be noted, therefore, that the measurement of exercise intensity using two methods is a notable strength of the research in this

thesis, and future studies should continue to use multiple methods for determining or measuring exercise intensity among temporarily abstinent smokers.

The differences in findings between the two acute exercise studies could also be related to the age of the participants in the studies; participants were aged 16-19 years (mean age = 17.7) and 18-25 years (mean age = 21.8) respectively in Studies 1 and 2. It may be the case that the older the smoker, the greater the benefit gained from a short bout of exercise. This suggestion is supported by research with abstaining adult smokers, which has reported decreases in desire to smoke and many individual withdrawal symptoms (Taylor & Ussher, 2005). The only other recent acute exercise study with abstaining smokers that failed to demonstrate an effect was conducted with 20-24 year olds (Daley et al, 2004), although this study may have been statistically underpowered to detect an effect, limiting its contribution to this debate. In order to elucidate this supposition, future research should investigate whether reductions in cravings and withdrawal symptoms induced by moderate intensity exercise are moderated by age in this population. Larger sample sizes would also enable future research of this nature to detect small to moderate sized effects, if they exist.

Finally, it is also possible that the differences in findings between the two acute studies may be attributable to the control conditions employed. Initially, a placebo control condition was used to eliminate the possibility that the findings could be caused by any other variable than moderate intensity aerobic exercise, since all other environmental conditions were identical. This supposition was supported by Daniel et al (2004), who found no differences in cravings and withdrawal symptoms for very light intensity exercise and a passive control.

However, it is likely that the participants in the placebo control condition in Study 1 found it difficult to adhere to the very light intensity exercise, and it is possible that they found it difficult to pedal slow enough to make it a meaningful placebo to exercise. This supposition is reflected in the average heart rates of Study 1 participants (see Section 2.3.2), which, although reflective of moderate and light intensity activity, were nevertheless relatively similar at 55% and 44% HR max, respectively. Since there were no effects in Study 1 when a placebo control was used, and since further evidence had emerged to suggest that a passive control condition had no effect on cravings and withdrawal symptoms in abstaining smokers, a passive control condition was employed in Study 2. This makes it somewhat problematic to compare the results of Studies 1 and 2, and indeed the nature of control conditions in research is an issue that may be open to some debate. Future research could seek to compare the effects of different control conditions (e.g., passive waiting, placebo, video watching) on cravings and withdrawal symptoms in young smokers.

The findings of Study 2 imply that both moderate and vigorous intensity exercise are beneficial for reducing cigarette cravings, and moderate intensity exercise is also beneficial for reducing withdrawal symptoms and improving mood. Moderate intensity exercise is likely to be the best 'all-rounder', since vigorous intensity exercise may be difficult for sedentary smokers to sustain. Indeed, the wider literature suggests that moderate intensity exercise may be the most effective intensity of exercise for mood benefit and adherence (Ekkekakis et al, 2005).

6.3.2 Evaluation in the development of physical activity messages

The systematic evaluation of physical activity promotion messages also has implications for future research. Published physical activity promotion studies have reported the use of physical activity prompts and messages (Conn et al, 2003; Kerr et al, 2000; Marcus et al, 1998; Patrick et al, 2001; Woods et al, 2002), without first evaluating the messages they have used (or first examining particular populations to see if they differ, e.g., smokers and non-smokers). In addition, such studies do not typically provide much explicit information concerning the details of their messages and prompts, thus making it difficult to replicate their findings in further research or in a public health intervention. At present, Study 5 in this thesis is the only identified study that has attempted to clarify the characteristics of desirable and undesirable prompts by obtaining opinions from the target population about the prompt characteristics (e.g., how appealing it is, how likely it is to prompt them to do physical activity) pertaining to the practical use of the prompts. The findings of this study provide important knowledge to future researchers and public health service providers, because it is preferable to use physical activity promotion messages that are more likely to be effective. As an example of this, the two most popular postcard-style prompts, as determined by the findings of Study 5, formed part of the intervention in Study 4. Ultimately, sharing knowledge on favourable and unfavourable physical activity messages and making the details of such messages explicit (e.g., by printing an example in publications) could accelerate progress in the field of physical activity promotion in all populations, in addition to smokers. It is also now good practice to involve users in the development of interventions, to ensure that they are appropriate and relevant.

6.3.3 Smoking cessation and physical activity in young people

Smoking cessation interventions using health promotion techniques, behavioural interventions and NRT have been largely ineffective for increasing cessation rates among young people, and at best have produced mixed findings (Camenga & Klein, 2004; Garrison et al, 2003; Grimshaw & Stanton, 2006; Sussman et al, 1999). Yet half of all 20-year-old smokers will eventually be killed by their habit (Department of Health, 1998). Therefore, there is a serious need to identify new and effective smoking cessation aids for young people. Research among adult smokers attempting cessation has demonstrated that a supervised programme of regular vigorous exercise can increase a smoker's chances of successfully quitting and remaining abstinent (Marcus et al, 1991; 1995; 1999). Physical activity may therefore be an additional tool with which to aid cessation in younger smokers.

The findings of this thesis are partially supportive of this supposition, since they suggest that cigarette cravings and withdrawal symptoms during abstinence from smoking may be eased by a short bout of exercise. This finding, however, requires further confirmation, as Study 1 did not identify any benefit of exercise. The findings of this thesis also suggest that it is not feasible to use a two-session physical activity consultation intervention with young continuous smokers. Therefore, further investigation needs to be conducted into the feasibility of physical activity promotion in young people who smoke (and young people who are attempting to quit smoking). The methods and results reported in this thesis provide a platform for future research in this new, but important area to build upon.

Although there is a need for further research to clarify many of the outstanding issues raised by the current research, it is possible to discuss the implications for the application of the findings of this thesis. First, among young smokers attempting to quit, short bouts of exercise at a moderate or vigorous intensity should be recommended (alongside their usual smoking cessation treatment) to help them control cravings for cigarettes. Moderate exercise may be recommended for alleviating withdrawal symptoms and negative mood states, and enhancing positive mood states. In terms of exercise or physical activity promotion on a long-term basis, no firm recommendations can be made regarding whether physical activity consultations are effective (at either increasing physical activity levels or reducing cigarette consumption), however it is possible to suggest that such an intervention will not capture the interest of enough members of the target population to be effective. Although untested in an intervention context, the findings of this thesis also suggest that young people prefer physical activity messages and prompts that contain information on the benefits of physical activity over prompts that contain extrinsically-motivating messages instructing them about physical activity, and therefore any physical activity promotion intervention may benefit from these findings.

6.3.4 Young smokers as a population

The suggestion that young smokers may comprise a distinct population in terms of the causes and effects of their exercise behaviour may be an important consideration for researchers and practitioners. Indeed, the distinctiveness of young smokers as a population may extend beyond the exercise field, and into other health behaviours. In much the same way as pregnant smokers constitute a particularly hard to reach population (Taylor & Ussher, 2005), it appears to be a difficult challenge to recruit young smokers into health-oriented

interventions, as demonstrated by the difficulties in Study 4, and to find smoking cessation methods that are effective and appealing to young people who smoke. Young smokers may also differ from other populations in terms of acute exercise effects. The findings of the two acute studies reported here and involving adolescents and young adults differ (to varying degrees) from the findings of acute studies using adults, and from the findings of acute exercise and mood studies among general populations of young people (Bartholomew & Miller, 2002; Petruzzello et al, 1997; Toskovic, 2001). Findings reported here on the social-cognitive determinants of exercise also suggest that young smokers form a distinct population. For example, in Study 3, subjective norm was an important determinant of intention to be active within the TPB, whereas previous research both with adults (e.g., Hagger et al, 2002a) and young people (e.g., de Bruijn et al, 2006; Trost et al, 2002) has found SN to be of far less importance (Hagger & Chatzisarantis, 2005). At present, research into young smokers as a specific population is sparse, but an animal model has suggested that nicotine affects the adolescent brain in a different way to the adult brain and foetal brain, such that adolescent smokers may experience pronounced withdrawal symptoms and particular difficulty in cessation (Slotkin, 2002).

When discussing research young people, it is also important to raise the issue of defining this population. In investigating young people, it is important to target a population that are young enough to be still laying down the foundations for many lifetime behaviours, such as regular physical activity and smoking, but old enough to be making decisions about their lives independently, and, crucially, old enough to have developed a smoking habit. For example, according to the Department of Health (2000), 11% of 11-15 year olds smoke regularly, compared with 31% of 16-19 year olds. Therefore, if 11-15 year olds

were identified as the target population for smoking cessation, we may be 'jumping the gun', as a further 20% may take up smoking before they turn 19. It was initially decided to exclusively research smokers aged 16-19, however there is information to suggest that young adulthood (i.e., the early twenties) can be as important for targeting future health behaviour as the teenage years in modern times (e.g., Furstenberg, 2006). Similarly, many government surveys tend to refer to young people as those aged in the late teens and early twenties (e.g., Lader & Meltzer, 2003), therefore the current research investigated young people within the 16-25 year age bracket, in order to maintain this common frame of reference.

6.3.5 Mechanisms for the exercise effect

This thesis has not explicitly examined potential mechanisms of the exercise effect on cravings and withdrawal symptoms, however it may be possible to make some suggestions based on the finding of Studies 1 and 2. For example, the use of a placebo control condition in Study 1 should have addressed the possibility that the results were not due to distraction, as both conditions were stable and identical, with the only variable of difference being the aerobic stimulus. Since no benefit of exercise (versus placebo) was in found in this case however, it is not possible to provide any further information regarding the distraction hypothesis.

Although the measurement of affect was made using the SEES rather than a scale suited to application to the affective circumplex (Russell, 1980), it may be tentatively suggested that the findings of Study 2 may offer support Nesbitt's paradox (Parrott, 1998) for the effects of moderate intensity exercise. Moderate intensity exercise produced a reduction in psychological distress (which may be

connected with a reduction in tension) and an increase in positive well-being (which may be connected with an increase in relaxation), although further research is required using the circumplex model to confirm these suggestions in young temporarily abstinent smokers.

Finally, while again the current research did not explicitly investigate the proposed psychobiological mechanisms of the exercise effect on cravings and withdrawal symptoms (e.g., dopamine release: Meeusen et al, 2001; Sakai et al, 1995; and beta-endorphin release: Angelopoulos, 2001; Goldfarb & Jamurtas, 1997) in young smokers, it is possible to make some tentative suggestions based on the findings of this thesis. Vigorous rather than moderate intensity exercise is known to trigger the release of these mood-enhancing neurotransmitters, however although Study 2 demonstrated both intensities to reduce cravings, only moderate intensity exercise enhanced mood, relative to a passive control. Although it is not possible to eliminate the psychobiological mechanisms on such speculative evidence, this finding at least suggests that there are more mechanisms causing the exercise benefits than merely psychobiological ones, and that the relationship between the various hypothesised mechanisms is likely to be complex and should be investigated in future research.

6.4 Limitations and strengths

The findings from the studies reported here should be considered in the light of several limitations and strengths. In the acute studies, smokers were only required to be temporarily abstinent, and future studies should consider recruiting individuals who are abstinent for longer, for example during a cessation attempt. An acute period of abstinence for research purposes, where

the participant is aware that they may continue to smoke as normal after the period of abstinence, may not relate to abstinence experiences during a cessation attempt (Taylor & Ussher, 2005). Where the effects of an intervention were tested, it was not possible to blind either the participants or the investigator to condition. While care was taken to reduce the possibility of bias, by limiting the information given to participants, it is possible that participants' expectations of effects may have influenced results. The studies reported in this thesis all relied on self-reported measures of physical activity. Future research with young smokers should consider using a combination of self-report and objective measures to further advance the knowledge in this field.

The use of randomised control trial methodologies in the acute and intervention studies is a notable strength of this research. Because of the problematic nature of using heart rate alone in abstaining smokers, the use of two measures of exercise intensity in the acute exercise studies is considered a methodological strength. Future studies should continue to employ such measurement practices. In addition, allowing participants to return to their usual surroundings prior to the final assessment is a notable strength of Studies 1 and 2, because this process offered the opportunity to assess the effects of exercise under more realistic conditions than has previous entirely laboratory-based research. Finally, this research explored a novel area of enquiry in young people who smoke, which may guide the development of future research and intervention implication regarding physical activity and exercise in young smokers.

6.5 Future directions

While the findings of this thesis are valuable, the investigation of the effects of exercise on desire to smoke, withdrawal symptoms and mood among young smokers, and the investigation of physical activity as a smoking cessation aid is in its infancy. There are still many outstanding questions that remain unanswered, and still many promising avenues for future research. It seems probable that adolescents and young adult smokers constitute a distinct population of smokers, therefore it would seem prudent for young smokers to be interviewed about their exercise preferences, and for future acute studies to then be conducted using an exercise type, intensity and duration of preference. Allowing participants to return to their usual surroundings prior to the final assessment is a notable strength of Studies 1 and 2. Future research needs to expand upon this methodological strength by assessing the effects of acute bouts of exercise and lifestyle physical activity in the natural environment, for example by asking participants to record their cravings in 'real time' using palm-top computers and/or diaries.

There is some evidence within this thesis to suggest that future research needs to direct quantitative and qualitative effort towards understanding more about young smokers as a population, with respect to their exercise and smoking thoughts, desires and behaviours. Because of the health risks posed by smoking, the health gains of a physically active lifestyle, and evidence to suggest that the foundations for lifetime health behaviour are often laid in adolescence and early adulthood, it is therefore critical that research continues to investigate the best methods of physical activity and exercise promotion, and smoking cessation within this population. Once an association has been

established, exercise promotion strategies may be offered as a component of smoking cessation programmes for young people in the long term.

A suitable quantitative starting point for future research into young smokers' determinants of exercise would be to replicate the TPB study in this thesis (Study 3) using a prospective or longitudinal design, since the preliminary results reported here support the use of the TPB as a predictive model for physical activity behaviour in young smokers. Future research now needs to employ objective assessments of physical activity (Armstrong & van Mechelen, 1998). In addition to the TPB, it would also be useful for future research to explore other established and emerging theories and predictive models of physical activity behaviour with young smokers, for example, the social cognitive theory (Bandura, 2001), the health belief model (Becker, 1974), the protection motivation theory (Maddux & Rogers, 1983) and the recent PRIME theory (West, 2006), and compare these models along with the TPB for explaining and predicting physical activity behaviour in young smokers.

Young smokers may respond positively to an internet-based interactive intervention, and this possibility should be researched, for example by conducting a randomised controlled trial whereby interested respondents receive either an interactive internet-based health education intervention, or an interactive internet-based physical activity promotion intervention. Or, if conducted in a smoking cessation context, two interactive internet-based smoking cessation interventions could be used, one with physical activity promotion and one without. It may also be possible to monitor physical activity levels using this method, if the participants are provided with equipment for downloading data from heart rate monitors, pedometers or accelerometers.

Mechanisms for and moderators of the exercise benefits reported in this research among young smokers on desire to smoke should also now be investigated to clarify the role of exercise during smoking abstinence. For example, research should investigate levels of dopamine and beta-endorphin activation following smoking and following exercise to investigate whether they are comparable, and then investigate levels of dopamine and beta-endorphin release following various types, intensities and durations of exercise, compared with control, for example, using brain imagery techniques. Comparing these effects between young smokers and older smokers may also ascertain if there are any psychobiological differences between young and older smokers. Brain imagery research would also be useful for determining the effect of more long-term physical activity interventions on smoking cessation (and relapse) in young smokers and also in the general population of smokers.

Since nicotine is the main psychoactive ingredient in cigarettes, it would be beneficial for future research to investigate the effects of exercise in conjunction with NRT on cravings and withdrawal symptoms in young smokers and in smokers in general. For example, a short bout of exercise could be compared with NRT alone, NRT plus exercise and control in temporarily abstinent smokers within an acute study, or during smoking cessation treatment in a longitudinal trial, using multiple doses of NRT and multiple bouts of exercise or lifestyle physical activity. Such research would provide valuable information regarding the comparative efficacy of exercise and NRT, which would have implications for certain populations (in particular younger people) who may not want to use NRT during a cessation attempt. It would also be useful to examine the psychobiological mechanisms of action of NRT and exercise within such research.

Since Study 2 found that a short bout of moderate intensity exercise can reduce cravings and withdrawal symptoms and improve mood among young adult smokers, and previous research has identified similar effects among adults (see Taylor et al, 2007), it would be appropriate for future research to investigate the use of short bouts of exercise within a smoking cessation intervention. For example, rather than prescribing a regular supervised exercise programme, designed for fitness gain and weight loss, with the supposition that a higher level of fitness will protect the quitter from lapsing (e.g., Marcus et al, 1991; 1995; 1999), exercise could be recommended to enable a smoker specifically to manage cravings and withdrawal symptoms using physical activity. Randomised controlled trials of interventions to promote physical activity as a tool for managing unpleasant experiences during smoking cessation would provide useful information about how the results of acute studies such as Study 2 can be applied in more externally valid contexts. The findings of such trials may have implications for the way that physical activity is promoted within smoking cessation support, both with younger and older smokers.

In an ideal world, before conducting such trials, large-scale investigations into the dose-response effect of exercise would need to be conducted, to ascertain the optimal dose for an effect on cravings and withdrawal symptoms. This could be done in the context of acute study research (either with temporarily abstinent smokers or with quitters), comparing specific exercise intensities, durations and types in a systematic manner. It may well be that different doses differentially affect cigarette cravings, the various withdrawal symptoms, and mood, therefore such research would enable specific recommendations to be made across the cycle of quitting, since there is evidence to suggest that

different withdrawal symptoms can be experienced at different stages of the cessation process (McEwen et al, 2006).

Of course, in searching for a dose-response effect in the manner suggested, individual differences may be encountered, and this may make it problematic to determine an exact 'optimum' dose of exercise for every smoker. Therefore, the dose-response research should also seek to investigate the impact of these individual differences. For example, as suggested in Section 6.3.4, young smokers appear to be different from older adult smokers on some important characteristics, therefore age should be investigated. Although there were no differences between males and females on baseline variables in the research reported in this thesis, it is nevertheless possible that gender may impact upon the dose-response relationship and should therefore be considered. Other individual difference variables of interest, such as level of nicotine dependence, current physical activity level and history of smoking, quitting and physical activity may also affect the intensity, duration and dose of exercise required to reduce cravings and withdrawal symptoms in smokers attempting to quit. If such variables are taken into account in future research, it may one day be possible to be able to make specific and tailored recommendations about the kinds of activities that can help individuals, including young smokers, to quit successfully, thus eventually helping to reduce future numbers of smokers.

6.6 Conclusions

With reference to the benefits of exercise for cigarette cravings, withdrawal symptoms and mood during abstinence in young smokers, the results were inconsistent. That said, Study 2 suggested some benefits from participating in a

short bout of moderate and vigorous exercise among young adult smokers aged 18-25.

With reference to exercise promotion, it can be concluded that it was not feasible to recruit young continuing smokers into a physical activity consultation intervention. Young smokers' physical activity behaviour, however, can be explained by the theory of planned behaviour; thus elements of this theory can be useful for guiding future physical activity promotion interventions for this specific population. In addition, print based physical activity promotion prompts are preferred among young people, smokers and non-smokers alike, if they contain intrinsically motivating messages.

Finally, young smokers appear to constitute a distinct population with regard to issues surrounding physical activity and exercise behaviour. Future research should not assume that methods and outcomes from research with adult smokers or young people in general would directly translate to young smokers.

Together the studies reported here provide valuable information on the issues surrounding physical activity and exercise promotion in young people who smoke, and the benefits of exercise for smoking cessation considerations with specific reference to this population.

References

Aaron, D.J., Dearwater, S.R., Anderson, R., Olsen, T., Kriska, A.M., & Laporte, R.E. (1995). Physical activity and the initiation of high-risk health behaviours in adolescents. *Medicine and Science in Sports and Exercise, 27*(12), 1639-1645.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179-211.

Ajzen, I. & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, New Jersey: Prentice-Hall.

Ajzen, I. & Fishbein, M. (2004). Questions raised by a reasoned action approach: Comment on Ogden (2003). *Health Psychology, 23*, 431-434.

Ajzen, I. & Madden, T. (1986). Prediction of goal-directed behavior: Attitudes, intentions and perceived behavioral control. *Journal of Experimental Social Psychology, 22*(5), 453-474.

Albrecht, A. E., Marcus, B. H., Roberts, M., Forman, D. E., & Parisi, A. F. (1998). Effect of smoking cessation on exercise performance in female smokers participating in exercise training. *American Journal of Cardiology, 82*, 950-955.

American College of Sports Medicine. (1998). The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. *Medicine and Science in Sports and Exercise, 30*(6), 975-991.

American College of Sports Medicine. (2000). *Guidelines for exercise testing and prescription (6th Edition)*. Philadelphia: Lea & Febiger.

American Psychiatric Association. (1995). *Diagnostic and Statistical Manual of Mental Disorders, 4th Edition*. Washington: American Psychiatric Association.

Angelopoulos, T.J. (2001). Beta-endorphin immunoreactivity during high-intensity exercise with and without opiate blockade. *European Journal of Applied Physiology, 86*, 92-96.

Armstrong, N. & Van Mechelen, W. (1998). Are young people fit and active? In: S. Biddle, J. Sallis & N. Cavill (Eds). *Young and active? Young people and health-enhancing physical activity: Evidence and implications* (pp. 69-97). London: Health Education Authority.

Audrain-McGovern, J., Rodriguez, D., & Moss, H.B. (2003). Smoking progression and physical activity. *Cancer Epidemiology, Biomarkers and Prevention, 12*, 1121-1129.

Baker, C.W., Little, T.D., & Brownell, K.D. (2003). Predicting adolescent eating and activity behaviors: The role of social norms and personal agency. *Health Psychology, 22*(2), 189-198.

Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology, 52*, 1-26.

Barnekow-Bergkvist, M., Hedberg, G., Janlert, U. & Jansson, E. (1996). Physical activity pattern in men and women at the ages of 16 and 34 and the development of physical activity from adolescence to adulthood. *Scandinavian Journal of Medicine and Science in Sport, 6*, 359-370.

Bartholomew, J.B., & Miller, B.M. (2002). Affective responses to an aerobic dance class: The impact of perceived performance. *Research Quarterly for Exercise and Sport, 73*(3), 301-309.

Beck, A.T, Steer, R.A. & Brown, G.K. (1996). *Beck Depression Inventory-Manual.* San Antonio, TX: The Psychological Corporation.

Becker, M.H. (1974). The health belief model and personal health behavior. *Health Education Monographs, 2*, 324-508.

Biddle, S.J.H. (1995). Exercise motivation across the life span. In: S.J.H. Biddle (Ed). *European Perspectives on Exercise and Sport Psychology.* Leeds: Human Kinetics.

Biddle, S.J.H., Fox, K.R., & Boutcher, S.H. (Eds.) (2000). *Physical activity and psychological well-being.* London: Routledge.

Biddle, S.J.H., & Mutrie, N. (2001). *Psychology of physical activity: Determinants, well-being and interventions.* London: Routledge.

Biddle, S.J.H. & Nigg, C.R. (2000). Theories of exercise behavior. *International Journal of Sport Psychology, 31*, 290-304.

Biener, L. & Abrams, D.B. (1991). The contemplation ladder: Validation of a measure of readiness to consider smoking cessation. *Health Psychology, 10*, 360-365.

Blue, C.L. (1995). The predictive capacity of the theory of reasoned action and the theory of planned behavior in exercise research: An integrated literature review. *Research in Nursing and Health, 18*(2), 105-121.

Bock, B. C., Marcus, B. H., King, T. K., Borrelli, B., & Roberts, M. R. (1999). Exercise effects on withdrawal and mood among women attempting smoking cessation. *Addictive Behaviors, 24*(3), 399-410.

Borg, G. (1998). *Borg's Perceived Exertion & Pain Scales.* Champaign, Illinois: Human Kinetics.

Brawley, L.R. (1993). The practicality of using social psychological theories for exercise and health research and intervention. *Journal of Applied Sport Psychology, 5*, 99-115.

Brener, N.D., McManus, T., Galuska, D.A., Lowry, R., & Wechsler, H. (2003). Reliability and validity of self-reported height and weight among high school students. *Journal of Adolescent Health, 32*, 281-287.

British Heart Foundation. (2003). *Get Active!* London: British Heart Foundation.

Brody, A.L., Olmstead, R.E., London, E.D., Farahi, J., Meyer, J.H., Grossman, P., Lee, G.S., Huang, J., Hahn, E.L. & Mandelkern, M.A. (2004). Smoking-induced ventral striatum dopamine release. *American Journal of Psychiatry, 161*, 1211-1218.

Camenga, D.R., & Klein, J.D. (2004). Adolescent smoking cessation. *Current Opinion in Pediatrics, 16*, 368-372.

Chogahara, M., Cousins, S.O.B., & Wankel, L.M. (1998). Social influences on physical activity in older adults: A review. *Journal of Aging and Physical Activity, 6*(1), 1-17.

Clarke, P.B.S. (1998). Tobacco smoking, genes and dopamine. *Lancet, 352*, 84-85.

Colby, S.M., Tiffany, S.T., Shiffman, S., & Niaura, R.S. (2000). Are adolescent smokers dependent on nicotine? A review of the evidence. *Drug and Alcohol Dependence, 59*(Suppl.1), S83-S95.

Conn, V.S., Burks, K.J., Minor, M.A., & Mehr, D.R. (2003). Randomized trial of 2 interventions to increase older women's exercise. *American Journal of Health Behavior, 27*(4), 380-388.

Conner, M. & Sparks, P. (2005). Theory of planned behaviour and health behaviour. In: M. Conner & P. Norman (Eds.). *Predicting health behaviour (2nd edition)* (pp.170-222). Maidenhead: Open University Press.

Courneya, K.S. (1994). Predicting repeated behavior from intention: The issue of scale correspondence. *Journal of Applied Social Psychology, 24*(7), 580-594.

Courneya, K.S. (1995). Understanding readiness for regular physical activity in older individuals: An application of the theory of planned behaviour. Health Psychology, 14,80-87.

Courneya, K.S. & Bobick, T.M. (2000). Integrating the theory of planned behavior with the processes and stages of change in the exercise domain. *Psychology of Sport and Exercise, 1*, 41-56.

Courneya, K.S., Friedenreich, C.M., Arthur, K., & Bobick, T.M. (1999). Understanding exercise motivation in colorectal cancer patients: A prospective study using the theory of planned behavior. *Rehabilitation Psychology, 44*, 68–84.

Courneya, K.S., & McAuley, E. (1993). Predicting physical activity from intention: Conceptual and methodological issues. *Journal of Sport and Exercise Psychology, 15*, 50–62.

Courneya, K.S., Nigg, C.R., & Estabrooks, P.A. (2000). Relationships among the theory of planned behaviour, stages of change, and exercise behaviour in older persons over a three year period. In: P. Norman, C. Abraham & M. Conner (Eds). *Understanding and changing health*

behaviour: From health beliefs to self-regulation (pp.189-205). Amsterdam, NL: Harwood Academic Publishers.

Craig, S., Goldberg, J., & Dietz, W.H. (1996). Psychosocial correlates of physical activity among fifth and eighth graders. *Preventive Medicine, 25*, 506-513.

Cummings, K.M., & Hyland, A. (2005). Impact of nicotine replacement therapy on smoking behavior. *Annual Review of Public Health, 26*, 583-599.

Daley, A.J. (2002). School based physical activity in the United Kingdom: Can it create physically active adults? *Quest, 54*, 21-33.

Daley, A.J., Copeland, R.J., Wright, N.P., Roalfe, A., & Wales, J.K.H. (2006). Exercise therapy as a treatment for psychopathology in obese and morbidly obese adolescents: A randomised controlled trial. *Pediatrics, 118*, 2126-2134.

Daley, A.J., & Huffen, C. (2003). The effects of low and moderate intensity exercise on subjective exercise experiences in a naturalistic health and fitness club setting. *Journal of Health Psychology, 8*(6), 685-691.

Daley, A.J., & Maynard, I.W. (2003). Preferred exercise mode and affective responses in physically active adults. *Psychology of Sport and Exercise, 4*(4), 347-356.

Daley, A.J., Oldham, A.R.H. & Townson, M. (2004). The effects of acute exercise on affective responses and desire to smoke in sedentary temporarily abstaining smokers: A preliminary study. *Journal of Sports Sciences, 22*, 303-304. (Abstract).

Daley, A.J., & Welch, A. (2004). The effects of 15 min and 30 min durations of exercise upon affective responses both during and after exercise. *Journal of Sports Sciences, 22*, 621-628.

Daniel, J.Z. (2004). The effects of acute exercise on short term smoking withdrawal symptoms and desire to smoke. Doctoral Thesis, Surrey: University of Surrey.

Daniel, J.Z., Cropley, M. & Fife-Schaw, C. (2006). The effect of exercise in reducing desire to smoke and cigarette withdrawal symptoms is not caused by distraction. *Addiction, 101*, 1187-1192.

Daniel, J., Cropley, M., Ussher, M. & West, R. (2004). Acute effects of a short bout of moderate versus light intensity exercise versus inactivity on tobacco withdrawal symptoms in sedentary smokers. *Psychopharmacology, 174*, 320-326.

de Bruijn, G., Kremers, S.P.J., Lensvelt-Mulders, G., de Vries, H., van Mechelen, W. & Brug, J. (2006). Modeling individual and physical environmental factors with adolescent physical activity. *American Journal of Preventive Medicine, 30*(6), 507-512.

Deci, E.L. & Ryan, R.M. (1985). *Intrinsic motivation and self-determination in human behavior.* New York: Plenum Publishing Company.

Department of Health. (1998). *Smoking Kills – A White Paper on Tobacco.* London: The Stationery Office.

Department of Health. (2000). *Statistics on Smoking: England, 1978 Onwards.* London: The Stationery Office.

Department of Health (2001). Report of the Scientific Committee on Tobacco and Health. Internet website: http://www.offical-documents.co.uk/document/doh/tobacco/part-4htm

Department of Health. (2004a). *Choosing health: Making health choices easier. Public Health White Paper*. London: The Stationery Office.

Department of Health (2004b). *At least five a week: Evidence on the impact of physical activity and its relationship to health: A report from the Chief Medical Officer*. London: Crown.

Department of Health & Dr Foster Ltd. (2005). *Choosing Health*. London: Department of Health & Dr Foster Ltd. (Magazine).

deRuiter, W. & Faulkner, G. (2006). Tobacco harm reduction strategies: The case for physical activity. *Nicotine and Tobacco Research, 8*, 157-168.

DiFranza, J.R., Savageau, J.A., Rigotti, N.A., Fletcher, K., Ockene, J.K., McNeill, A.D., Coleman, M. & Wood, C. (2002a). Development of symptoms of tobacco dependence in youths: 30 month follow up data from the DANDY study. *Tobacco Control, 11*, 228-235.

DiFranza, J.R., Savageau, J.A., Fletcher, K., Ockene, J.K., Rigotti, N.A., McNeill, A.D., Coleman, M. & Wood, C. (2002b). Measuring loss of autonomy over nicotine use in adolescents: The DANDY (Development and Assessment of Nicotine Dependence in Youths) study. *Archives of Pediatrics and Adolescent Medicine, 156*(4), 397-403.

Dishman, R.K. (1982). Compliance/adherence in health-related exercise. *Health Psychology, 1*, 237-267.

Dishman, R.K. (1994). *Advances in exercise adherence*. Champaign, Illinois: Human Kinetics.

Doll, R., Peto, R., Boreham, J. & Sutherland, I. (2004). Mortality in relation to smoking: 50 years' observations on male British doctors. *British Medical Journal, 328*, 1519-1533.

Ekkekakis, P., Hall, E.E. & Petruzzello, S.J. (2005). Variation and homogeneity in affective responses to physical activity of varying intensities: An alternative perspective on dose-response based on evolutionary considerations. *Journal of Sports Sciences, 23*, 477-500.

Ekkekakis, P. & Petruzzello, S.J. (1999). Acute aerobic exercise and affect: Current status, problems and prospects regarding dose-response. *Sports Medicine, 28*(5), 337-374.

Ekkekakis, P. & Petruzzello, S.J. (2002). Analysis of the affect measurement conundrum in exercise psychology: IV: A conceptual case for the affect circumplex. *Psychology of Sport and Exercise, 2*, 205-232.

Emmons, K.M., Marcus, B.H., Linnan, L., Rossi, J.S. & Abrams, D.B. (1994). Mechanisms in multiple risk factor interventions: Smoking, physical activity, and dietary fat intake among manufacturing workers. *Preventive Medicine, 23*, 481-489.

Etter, J. & Stapleton, J.A. (2006). Nicotine replacement therapy for long-term smoking cessation: A meta-analysis. *Tobacco Control, 15*, 280-285.

Everson, E.S., Daley, A.J. & Ussher, M. (2006). Does exercise have an acute effect on desire to smoke, mood and withdrawal symptoms in abstaining adolescent smokers? *Addictive Behaviors, 31*, 1547-1558.

Everson, E.S., Daley, A.J. & Ussher, M. (2007). Brief report: The theory of planned behaviour applied to physical activity in young people who smoke. *Journal of Adolescence, 30*, 347-351.

Eves, F.F. & Webb, O.J. (2006). Worksite interventions to increase stair climbing: Reasons for caution. *Preventive Medicine, 43*(1), 4-7.

Farnham, M. & Mutrie, N. (1998). An evaluation of exercise consultation in a community setting. *International Journal of Health Education, 36*, 4-8.

Faulkner, G.E.J. & Taylor, A.H. (2005). Exercise and mental health promotion. In: G.E.J. Faulkner & A.H. Taylor (Eds.). *Exercise as therapy: Emerging relationships* (pp. 1-8). London: Routledge.

Focht, B.C. & Hausenblas, H.A. (2001). Influence of quiet rest and acute aerobic exercise performed in a naturalistic environment on selected psychological responses. *Journal of Sport and Exercise Psychology, 23*, 108-121.

Furstenberg, F.F. (2006). Growing up healthy: Are adolescents the right target group? *Journal of Adolescence, 39*, 303-304.

Garrison, M.M., Christakis, D.A., Ebel, B.E., Wiehe, S.E. & Rivara, F.P. (2003). Smoking cessation interventions for adolescents: A systematic review. *American Journal of Preventive Medicine, 25*(4), 363-367.

Gavin, A. (2004). Smoking is a major cause of premature death worldwide. *Evidence-based Healthcare, 8*, 95-96.

Gilbert, H.M. & Warburton, D.M. (2000). Craving: A problematic concept in smoking research. *Addiction Research, 8*(4), 381-397.

Gionet, N.J. & Godin, G. (1989). Self-reported exercise behaviour of employees: A validity study. *Journal of Occupational Medicine, 31*, 969-973.

Godin, G., Jobin, J. & Bouillon, J. (1986). Assessment of leisure time exercise behaviour by self-report: A concurrent validity study. *Canadian Journal of Public Health, 77*, 359-361.

Godin, G. & Kok, G. (1996). The theory of planned behavior: A review of its applications to health-related behaviors. *American Journal of Health Promotion, 11*(2), 87-98.

Godin, G., Lambert, L.D., Owen, N., Nolin, B. & Prud'homme, D. (2004). Stages of motivational readiness for physical activity: A comparison of different algorithms of classification. *British Journal of Health Psychology, 9*(2), 253-267.

Godin, G. & Shephard, R.J. (1985). A simple method to assess exercise behaviour in the community. *Canadian Journal of Applied Sport Sciences, 10*, 141-146.

Goldfarb, A.H. & Jamurtas, A.Z. (1997). B-Endorphin response to exercise: An update. *Sports Medicine, 24*, 8-16.

Grimshaw, G.M. & Stanton, A. (2006). Tobacco cessation interventions for young people. *The Cochrane Database of Systematic Reviews*, 4, CD003289.pub4.

Hagger, M.S. & Armitage, C.J. (2004). The influence of perceived loci of control and causality in the theory of planned behavior in a leisure-time exercise context. *Journal of Applied Biobehavioral Research, 9*(1), 45-64.

Hagger, M. & Chatzisarantis, N. (2005). *The social psychology of exercise and sport*. Maidenhead: Open University Press.

Hagger, M.S., Chatzisarantis, N. & Biddle, S.J.H. (2001). The influence of self-efficacy and past behaviour on the physical activity intentions of young people. *Journal of Sports Sciences, 19*, 711-725.

Hagger, M.S., Chatzisarantis, N.L.D. & Biddle, S.J.H. (2002a). A meta-analytic review of the theories of reasoned action and planned behavior in physical activity: Predictive validity and the contribution of additional variables. *Journal of Sport and Exercise Psychology, 24(1)*, 3-32.

Hagger, M.S., Chatzisarantis, N.L.D. & Biddle, S.J.H. (2002b). The influence of autonomous and controlling motives on physical activity intentions within the theory of planned behaviour. *British Journal of Health Psychology, 7*, 283-297.

Hall, E.E., Ekkekakis, P. & Petruzzello, S.J. (2002). The affective beneficence of vigorous exercise revisited. *British Journal of Health Psychology, 7*, 47-66.

Hardman, A.E. & Stensel, D.J. (2003). *Physical activity and health: The evidence explained.* London: Routledge.

Hausenblas, H.A., Carron, A.V. & Mack, D.E. (1997). Application of the theories of reasoned action and planned behavior to exercise behavior: A meta-analysis. *Journal of Sport and Exercise Psychology, 19*, 36-51.

Health Promotion England. (1997). *The Health Guide*. London: Health Promotion England.

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*, 1119-1127.

Heide, J.F. & Borkovek, T.D. (1984). Relaxation-induced anxiety: Mechanisms and theoretical implications. *Behavioral Research Therapy, 22*, 1-12.

Heil, S.H., Alessi, S.M., Plebani Lussier, J., Badger, G. & Higgins, S.T. (2004). An experimental test of the influence of prior cigarette smoking abstinence on future abstinence. *Nicotine and Tobacco Research, 6*, 471-479.

Hillsdon, M., Foster, C., Naidoo, B. & Crombie, H. (2004). The effectiveness of public health interventions for increasing physical activity among adults: a review of reviews. London, Health Development Agency.

Hozawa, A., Houston, T., Steffes, M.W., Widome, R., Williams, O.D., Iribarren, C., Pletcher, M.J., Daviglus, M.L., Carr, J.J. & Jacobs, D.R. (2006). The association of cigarette smoking with self-reported disease before middle age: The Coronary Artery Risk Development in Young Adults (CARDIA) study. *Preventive Medicine, 42*, 193-199.

Hughes, A.R., Gillies, F., Kirk, A., Mutrie, N., Hillis, W.S. & MacIntyre, P.D. (2002). Exercise consultation improves short term adherence to exercise during phase IV cardiac rehabilitation. *Journal of Cardiopulmonary Rehabilitation, 22*, 421-425.

Hughes, J.R., Higgins, S.T. & Bickel, W.K. (1994). Nicotine withdrawal versus other drug withdrawal syndromes: Similarities and dissimilarities. *Addiction, 89*, 1461-1470.

Hughes, J.R., Keely, J. & Naud, S. (2004). Shape of the relapse curve and long-term abstinence among untreated smokers. *Addiction, 99*, 29-38.

Hughes, J.R., Shiffman, S., Callas, P. & Zhang, J. (2003). A meta-analysis of the efficacy of over-the-counter nicotine replacement. *Tobacco Control, 12*, 21-27.

Jamieson, P. & Romer, D. (2001). What do young people think they know about the risks of smoking? In: P. Slovic (Ed.). *Smoking: Risk, perception and policy* (pp. 51-63). Thousand Oaks, California: Sage.

Katomeri, M. & Taylor, A.H. (2005a). Effects of walking on cigarette cravings during smoking cue simulation and on lag time to the next cigarette. Paper presented at the British Association of Sport and Exercise Sciences Annual Student Conference. Wales: Aberystwyth.

Katomeri, M. & Taylor, A.H. (2005b). Effects of walking on cigarette cravings and withdrawal symptoms during smoking cue simulation. *Journal of Sports Sciences, 23*, 1250-1251.

Kelder, S.H., Perry, C.L., Klepp, K. & Lytle, L.L. (1994). Longitudinal tracking of adolescent smoking, physical activity, and food choice behaviors. *American Journal of Public Health, 84*, 1121-1126.

Kerner, M.S. & Kurrant, A.B. (2003). Psychosocial correlates to high school girls' leisure-time physical activity: A test of the theory of planned behavior. *Perceptual and Motor Skills, 97*, 1175-1183.

Kerr, J., Eves, F. & Carroll, D. (2000). Posters can prompt less active people to use the stairs. *Journal of Epidemiology and Community Health, 54*, 942-943.

Kilpatrick, M., Herbert, E. & Bartholomew, J. (2005). College students' motivation for physical activity: Differentiating men's and women's

motives for sport participation and exercise. *Journal of American College Health, 54*, 87-94.

King, T.K., Marcus, B.H., Pinto, B.M., Emmons, K.M. & Abrams, D.B. (1996). Cognitive-behavioral mediators of changing multiple behaviors: Smoking and a sedentary lifestyle. *Preventive Medicine, 25*, 684-691.

Kirk, A., Mutrie, N., MacIntyre, P. & Fisher, M. (2003). Increasing physical activity in people with Type 2 diabetes. *Diabetes Care, 26*, 1186-1192.

Kirk, A., Mutrie, N., MacIntyre, P. & Fisher, M. (2004). Promoting and maintaining physical activity in people with Type 2 diabetes. *American Journal of Preventive Medicine, 27*, 289-296.

Kraft, P., Sutton, S.R. & McCreath Reynolds, H. (1999). The transtheoretical model of behaviour change: Are the stages qualitatively different? *Psychology and Health, 14*(3), 433-450.

Laaksonen, M., Rahkonen, O., Martikainen, P., Karvonen, S. & Lahelma, E. (2006). Smoking and SF-36 health functioning. *Preventive Medicine, 42*, 206-209.

Lader, D. & Meltzer, H. (2003). *Smoking related behaviour and attitudes, 2002.* London: Office for National Statistics.

Lancaster, T. & Stead, L.F. (2005a). Self-help interventions for smoking cessation (Review). *The Cochrane Database of Systematic Reviews*, 3, CD001118.pub2.

Lancaster, T. & Stead, L.F. (2005b). Individual behavioural counselling for smoking cessation (Review). *The Cochrane Database of Systematic Reviews*, 2, CD001292.pub2.

Landers, D.M. & Arent, S.M. (2001). Physical activity and mental health. In: R.N. Singer, H.A. Hausenblas & C.M. Janelle (Eds). *Handbook of Sport Psychology (2nd Edition)* (pp. 740-765). New York: John Wiley & Sons.

Landry, J.B. & Solmon, M.A. (2004). African American women's self-determination across the stages of change for exercise. *Journal of Sport and Exercise Psychology, 26*, 457-469.

Lawlor, D.A. & Hopker, S.W. (2001). The effectiveness of exercise as an intervention in the management of depression: Systematic review and meta-regression analysis of randomised control trials. *British Medical Journal, 322*, 1-8.

Leith, L.M. (1994). *Foundations of exercise and mental health*. Morgantown, W.Va.: Fitness Information Technology.

Lloyd, B., & Lucas, K., Holland, J., McGrellis, S. & Arnold, S. (1998). *Smoking in adolescence: Images and identities*. London: Routledge.

Loughlan C. & Mutrie, N. (1995). Conducting an exercise consultation: Guidelines for health professions. *International Journal of Health Education, 33*, 78-82.

Lowther, M., Mutrie, N. & Scott, E.M. (2002). Promoting physical activity in a socially and economically deprived community: a 12-month randomised control trial of a fitness assessment and exercise consultation. *Journal of Sports Sciences, 20*, 577-588.

Lox, C.L. & Rudolph, D.L. (1994). The subjective exercise experiences scale (SEES): Factorial validity and effects of acute exercise. *Journal of Social Behaviour and Personality, 9*, 837-844.

Maddux, J.E. & Rogers, R.W. (1983). Protection motivation and self-efficacy: A revised theory of fear appeals and attitude change. *Journals of Experimental Social Psychology, 19*, 469-479.

Marcus, B.H., Albrecht, A.E., King, T.K., Parisi, A.F., Pinto, B.M., Roberts, M., Niaura, R.S. & Abrams, D.B. (1999). The efficacy of exercise as an aid for smoking cessation in women. *Archives of Internal Medicine, 159*, 1229-1234.

Marcus, B.H., Albrecht, A.E., Niaura, R.S., Abrams, D.B. & Thompson, P.D. (1991). Usefulness of physical exercise for maintaining smoking cessation in women. *American Journal of Cardiology, 68*, 406-407.

Marcus, B.H., Albrecht, A.E., Niaura, R.S., Taylor, E.R., Simkin, L.R., & Feder, S.I., Abrams, D.B. & Thompson, P.D. (1995). Exercise enhances the maintenance of smoking cessation in women. *Addictive Behaviors, 20*(1), 87-92.

Marcus, B.H., Eaton, C.A., Rossi, J.S. & Harlow, L.L. (1994). Self-efficacy, decision-making, and stages of change: An integrative model of physical exercise. *Journal of Applied Social Psychology, 24*(6), 489-508.

Marcus, B.H., Lewis, B.A., Hogan, J., King, T.K., Albrecht, A.E., Bock, B., Parisi, A.F., Niaura, R. & Abrams, D.B. (2005). The efficacy of moderate-intensity exercise as an aid to smoking cessation in women: A randomised controlled trial. *Nicotine & Tobacco Research, 7*, 871-880.

Marcus, B.H., Owen, N., Forsyth, L., Cavill, N.A. & Fridinger, F. (1998). Physical activity interventions using mass media, print media, and information technology. *American Journal of Preventive Medicine, 15*(4), 362-378.

Marcus, B.H., Rakowski, W. & Rossi, J.S. (1992). Assessing motivational readiness and decision making for exercise. *Health Psychology, 11*(4), 257-261.

Marcus, B.H. & Simkin, L.R. (1993). The stages of exercise behaviour. *Journal of Sports Medicine and Physical Fitness, 33*, 83-88.

Martin-Diener, E., Thuring, N., Melges, T. & Martin, B.W. (2004). The stages of change in three stage concepts and two models of physical activity: A comparison of stage distributions and practical implications. *Health Education Research, 19*, 406-417.

Martinez-Raga, J., Keaney, F., Sutherland, G., Perez-Galvez, B. & Strang, J. (2003). Treatment of nicotine dependence with bupropion SR: Review of its efficacy, safety and pharmacological profile. *Addiction Biology, 8*, 13-21.

Martinsen, E.W. (1993). Therapeutic implications of exercise for clinically anxious and depressed patients. *International Journal of Sport Psychology, 24*, 185-199.

McAuley, E. & Courneya, K.S. (1994). The Subjective Exercise Experience Scale (SEES): Development and preliminary validation. *Journal of Sport and Exercise Psychology, 16*, 163-177.

McAuley, E., Mihalko, S.L. & Bane, S.M. (1996). Acute exercise and anxiety reduction: Does the environment really matter? *Journal of Sport and Exercise Psychology, 18*, 408-419.

McEwen, A., Hajek, P., McRobbie, H. & West, R. (2006). *Manual of smoking cessation: A guide for counsellors and practitioners.* Oxford: Blackwell.

Meeusen, R., Piacentini, M.F., Kempenaers, F., Busschaert, B., De Schutter, G., Buyse, L. & De Meirleir, K. (2001). Brain neurotransmitter levels during exercise. Deutsche Zeitschrift fur Sportmedizin, 52, 361-368.

Mermelstein, R., Colby, S.M., Patten, C., Prokhorov, A., Brown, R., Myers, M., Adelman, W., Hudmon, K. & McDonald, P. (2002). Methodological issues in measuring smoking cessation treatment outcome in adolescent smoking. *Nicotine and Tobacco Research, 4*, 395-403.

Mikhail, C. (1983). The acute effects of aerobic exercise on cigarette smoking. Master of Arts Thesis, British Columbia, Canada: University of British Columbia, Canada.

Moher, M., Hey, K. & Lancaster, T. (2005). Workplace interventions for smoking cessation. *The Cochrane Database of Systematic Reviews*, 2, CD003440.pub2.

Montoye, H.J., Kemper, H.C.G., Saris, W.H.M. & Washburn, R.A. (1996). *Measuring physical activity and energy expenditure*. Champaign, IL: Human Kinetics.

Morgan, W. (1997). *Physical activity and mental health*. Bristol: Taylor & Francis.

Motl, R.W., Dishman, R.K., Saunders, R.P., Dowda, M., Felton, G., Ward, D. & Pate, R.R. (2002). Examining social-cognitive determinants of intention and physical activity among black and white adolescent girls using structural equation modeling. *Health Psychology, 21*(5), 459-467.

Mukherjee, D. & Yadav, J.S. (2001). Update on peripheral vascular diseases: From smoking cessation to stenting. *Cleveland Clinic Journal of Medicine, 68*, 723-733.

Mullan, E. & Markland, D. (1997). Variations in self-determination across the stages of change for exercise in adults. *Motivation and Emotion, 21*(4), 349-362.

Mummery, W.K., Spence, J.C. & Hudec, J.C. (2000). Understanding physical activity intention in Canadian schoolchildren and youth: An application of the theory of planned behaviour. *Research Quarterly for Exercise and Sport, 71*(2), 116-124.

Mummery, W.K. & Wankel, L.M. (1999). Training adherence in adolescent competitive swimmers: An application of the theory of planned behavior. *Journal of Sport and Exercise Psychology, 21*, 313-328.

Musk, A.W. & de Klerk, N.H. (2003). History of tobacco and health. *Respirology, 8*, 286-290.

Mutrie, N., Carney, C., Blamey, A., Crawford, F., Aitchison, T. & Whitlaw, A. (2002). "Walk in to work out": A randomised controlled trial of a self-help intervention to promote active commuting. *Journal of Epidemiology and Community Health*, *56*, 407-412.

Nicholls, J.G. (1984). Achievement motivation: Conceptions of ability, subjective experience, task choice, and performance. *Psychological Review, 91*, 328-346.

Nigg, C.R. (2005). There is more to stages of exercise than just exercise. *Exercise and Sport Sciences Reviews, 33*, 32-35.

Norman, P. & Conner, M. (2005). Predicting and changing health behaviour: Future directions. In: M. Conner & P. Norman (Eds.). *Predicting health behaviour (2nd edition)* (pp. 324-371). Maidenhead: Open University Press.

Ogden, J. (2003). Some problems with social cognition models: A pragmatic and conceptual analysis. *Health Psychology, 22*, 424-428.

O'Loughlin, J., Kishchuk, N., DiFranza, J., Tremblay, M. & Paradis, G. (2002). The hardest thing is the habit: A qualitative investigation of adolescent smokers' experience of nicotine dependence. *Nicotine and Tobacco Research, 4*, 201-209.

Parrott, A.C. (1998). Nesbitt's Paradox resolved? Stress and arousal modulation during cigarette smoking. *Addiction, 93*, 27-39.

Patrick, K., Sallis, J.F., Prochaska, J.J., Lydston, D.D., Calfas, K.J., Zabinski, M.F., Wilfley, D.E., Saelens, B.E. & Brown, D.R. (2001). A multicomponent program for nutrition and physical activity change in primary care: PACE+ for adolescents. *Archives of Pediatrics and Adolescent Medicine, 155*, 940-946.

Patton, G.C., Coffey, C., Carlin, J.B., Sawyer, S.M. & Wakefield, M. (2006). Teen smokers reach their mid-twenties. *Journal of Adolescent Health, 39*, 214-220.

Petruzzello, S.J., Jones, A.C. & Tate, A.K. (1997). Affective responses to acute exercise: A test of opponent-process theory. *Journal of Sports Medicine and Physical Fitness, 37*, 205-212.

Pomerleau, O.F. (1998). Endogenous opioids and smoking: A review of progress and problems. *Psychoneuroendocrinology, 23*, 115-130.

Pomerleau, O.F., Scherzer, H.H., Grunberg, N.E., Pomerleau, C.S., Judge, J., Fertig, J.B. & Burleson, J. (1987). The effects of acute exercise on subsequent cigarette smoking. *Journal of Behavioral Medicine, 10*(2), 117-127.

Prochaska, J.O. & DiClemente, C.C. (1983). Stages and processes of self-change in smoking: Towards an integrative model of change. *Journal of Consulting and Clinical Psychology, 51*, 390-395.

Prochaska, J.O. & Marcus, B.H. (1994). The transtheoretical model: Applications to exercise. In: R.K. Dishman (Ed). *Advances in exercise adherence* (pp. 161-180). Champaign, Ill.: Human Kinetics.

Prochaska, J.O. & Velicer, W.F. (1997). The transtheoretical model of health behavior change. *American Journal of Health Promotion, 12*(1), 38–48.

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 and Tobacco Research, 31*, 151-155.

Reed, J. & Ones, D.S. (2006). The effect of acute aerobic exercise on positive activated affect: A meta-analysis. *Psychology of Sport and Exercise, 7*, 477-514.

Reesor, K.A. (1983). The effects of repeated aerobic and non-aerobic exercise on cigarette smoking. Master of Arts Thesis, British Columbia, Canada: University of British Columbia, Canada.

Rhodes, R.E. & Plotnikoff, R.C. (2005). Can current physical activity act as a reasonable proxy measure of future physical activity? Evaluating cross-sectional and passive prospective designs with the use of social cognition models. *Preventive Medicine, 40*(5), 547-555.

Richards Reed, G., Velicer, W.F., Prochaska, J.O., Rossi, J.S. & Marcus, B.H. (1997). What makes a good staging algorithm: Examples from regular exercise. *American Journal of Health Promotion, 12*, 57-66.

Richmond, R. & Zwar, N. (2003). Review of bupropion for smoking cessation. *Drug and Alcohol Review, 22*, 203-220.

Rivis, A. & Sheeran, P. (2003). Social influences and the theory of planned behaviour: Evidence for a direct relationship between prototypes and young people's exercise behaviour. *Psychology and Health, 18*(5), 567-583.

Rose, E.A., Parfitt, G. & Williams, S. (2005). Exercise causality orientations, behavioural regulations for exercise and stage of change for exercise: Exploring their relationships. *Psychology of Sport and Exercise, 6*, 399-414.

Royal College of Physicians. (1992). *Smoking and the young*. London: Royal College of Physicians, 130pp.

Royal College of Physicians (2000). *Nicotine Addiction in Britain: A report of the Tobacco Advisory Group of the Royal College of Physicians*. Royal College of Physicians, London. Retrieved 29 October 2003 from the World Wide Web: http://www.rcplondon.ac.uk/pubs/books/nicotine/index.htm

Russell, J.A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology, 39*, 1161-1178.

Ryan, R.M. & Deci, E.L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*, 68-78.

Sakai, T., Maeda, H., Matsumoto, N., Kinoshita, A., Sasaguri, M., Ideishi, M., Tanaka, H., Shindo, M. & Arakawa, K. (1995). Plasma free and

sulfoconjugated dopamine before and after a half-marathon. *Hypertension Research, 18*(Suppl.1), S161-S163.

Sallis, J.F., Haskell, W.L., Wood, P.D., Fortmann, S.P., Rogers, T., Blair, S.N. & Paffenbarger, R.S (1985) Physical activity assessment methodology in the Five-City Project. *American Journal of Epidemiology, 121*, 91-106.

Sallis, J.F. & Patrick, K. (1994). Physical activity guidelines for adolescents: Consensus statements. *Pediatric Exercise Science, 6*, 305-314.

Samet, J.M. (2001). The risks of active and passive smoking. In: P. Slovic (Ed.). *Smoking: Risk, perception and policy* (pp. 3-28). Thousand Oaks, California: Sage.

Satcher, D. (2001). Why we need an international agreement on tobacco control. *American Journal of Public Health, 91(2)*, 191-193.

Saunders, R.P., Motl, R.W., Dowda, M., Dishman, R.K. & Pate, R.R. (2004). Comparison of social variables for understanding physical activity in adolescent girls. *American Journal of Health Behavior, 28*(5), 426-436.

Schofield, M.J., Lynagh, M. & Mishra, G. (2003). Evaluation of a health promotion schools program to reduce smoking in Australian secondary schools. *Health Education Research, 18*(6), 678-692.

Secker-Walker, R.H., Gnich, W., Platt, S. & Lancaster, T. (2002). Community interventions for reducing smoking among adults (Review). *The Cochrane Database of Systematic Reviews*, 3, CD001745.

Sherwood, N.E. & Jeffery, R.W. (2000). The behavioral determinants of exercise: Implications for physical activity interventions. *Annual Review of Nutrition, 20*, 21-44.

Shiffman, S., West, R.J. & Gilbert, D.G. (2004). Recommendations for the assessment of tobacco craving and withdrawal in smoking cessation trials. *Nicotine and Tobacco Research, 6*, 599-614.

Silagy, C., Lancaster, T., Stead, L., Mant, D. & Fowler, G. (2004). Nicotine replacement therapy for smoking cessation. *The Cochrane Database of Systematic Reviews*, 3, CD000146.pub2.

Sinclair, H.K., Bond, C.M. & Stead, L.F. (2004). Community pharmacy personnel interventions for smoking cessation (Review). *The Cochrane Database of Systematic Reviews*, 1, CD003698.pub2.

Slotkin, T.A. (2002). Nicotine and the adolescent brain: Insights from an animal model. *Neurotoxicology and Teratology, 24*, 369-384.

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*, 259-266.

Stead, L.F. & Lancaster, T. (2005). Group behaviour therapy programmes for smoking cessation. *The Cochrane Database of Systematic Reviews*, 2, CD001007.pub2.

Steer, R.A., Clark, D.A., Beck, A.T. & Ranieri, W.F. (1998). Common and specific dimensions of self-reported anxiety and depression: The BDI-II versus the BDI-IA. *Behaviour Research and Therapy, 37*, 183-190.

Steptoe, A., Wardle, J., Cui, W., Bellisle, F., Zotti, A., Baranyai, R. & Sanderman, R. (2002). Trends in smoking, diet, physical exercise, and attitudes toward health in European university students from 13 countries, 1990-2000. *Preventive Medicine*, 35, 97-104.

Stice, E. & Martinez, E.E. (2005). Cigarette smoking prospectively predicts retarded physical growth among female adolescents. *Journal of Adolescent Health, 37*(5), 363-370.

Sussman, S., Lichtman, K., Ritt, A. & Pallonen, U.E. (1999). Effects of thirty-four adolescent tobacco use cessation and prevention trials on regular users of tobacco products. *Substance Use and Misuse, 34*(11), 1469-1503.

Symons Downs, D., Graham, G., Yang, S., Bargainnier, S. & Vasil, J. (2006). Youth exercise intention and past exercise behavior: Examining the moderating influences of sex and meeting exercise recommendations. *Research Quarterly for Exercise and Sport, 77*(1), 91-99.

Tabachnick, B.G. & Fidell, L.S. (2007). *Using multivariate statistics (5^{th} Edition)*. Boston, MA: Allyn & Bacon.

Tardon, A., Lee, W.J., Delgado-Rodriguez, M., Dosemeci, M., Albanes, D., Hoover, R. & Blair, A. (2005). Leisure-time physical activity and lung cancer: A meta-analysis. *Cancer Causes and Control, 16*, 389-397.

Taylor, A.H. & Katomeri, M. (2006). Effects of a brisk walk on blood pressure responses to the Stroop, a speech task and a smoking cue among temporarily abstinent smokers. *Psychopharmacology, 184*, 247-253.

Taylor, A.H., Katomeri, M. & Ussher, M. (2005). Acute effects of self-paced walking on urges to smoke during temporary smoking abstinence. *Psychopharmacology, 181*, 1-7.

Taylor, A.H., Katomeri, M. & Ussher, M. (2006). Effects of walking on cigarette cravings and affect in the context of Nesbitt's Paradox and the circumplex model. *Journal of Sport and Exercise Psychology, 28*, 18-31.

Taylor, A.H. & Ussher, M.H. (2005). Effects of exercise on smoking cessation and coping with withdrawal symptoms and nicotine cravings. In: G.E.J. Faulkner & A.H. Taylor (Eds.). *Exercise as therapy: Emerging relationships* (pp. 135-158). London: Routledge.

Taylor, A.H., Ussher, M.H. & Faulkner, G. (2007). The acute effects of exercise on cigarette cravings, withdrawal symptoms, affect and smoking behaviour: A systematic review. *Addiction, 102*, 534-543.

Thayer, R.E., Peters, D.P.I., Takahashi, P.J. & Birkhead-Flight, A.M. (1993). Mood and behavior (smoking and sugar snacking) following moderate exercise: A partial test of self-regulation theory. *Personality & Individual Differences, 14*(1), 97-104.

Thorlindsson, T. & Vilhjalmsson, R. (1991). Factors related to cigarette smoking and alcohol use among adolescents. *Adolescence, 26*(102), 399-418.

Tiffany, S.T. & Drobes, D.J. (1991). The development and initial validation of a questionnaire on smoking urges. *British Journal of Addiction, 86*, 1467-1476.

Tonnesen, P. (2002). How to reduce smoking among teenagers. *European Respiratory Journal, 19*, 1-3.

Toskovic, N.N. (2001). Alterations in selected measures of mood with a single bout of dynamic taekwondo exercise in college-age students. *Perceptual and Motor Skills, 92*, 1031-1038.

Trost, S.G., Pate, R.R., Dowda, M., Ward, D.S., Felton, G. & Saunders, R. (2002). Psychosocial correlates of physical activity in white and African-American girls. *Journal of Adolescent Health, 31*, 226-233.

Trudeau, F., Laurencelle, L., Tremblay, J., Rajic, M. & Shephard, R.J. (1999). Daily primary school physical education: Effects on physical activity during adult life. *Medicine and Science in Sport and Exercise, 31*(1), 111-117.

Tudor-Locke, C. & Bassett, D.R. (2004). How many steps/day are enough? Preliminary pedometer indices for public health. *Sports Medicine, 34*(1), 1-8.

Twigg, L., Moon, G. & Walker, S. (2004). *The smoking epidemic in England.* London: Health Development Agency. (www.hda.nhs.uk)

Ussher, M. (2005). Exercise interventions for smoking cessation. *The Cochrane Database of Systematic Reviews*, 1, CD002295.pub2.

Ussher, M., Nunziata, P., Cropley, M. & West, R. (2001). Effect of a short bout of exercise on tobacco withdrawal symptoms and desire to smoke. *Psychopharmacology, 158*, 66-72.

Ussher, M., Sampuran, A.K., Doshi, R., West, R. & Drummond, C. (2004). Acute effect of a brief bout of exercise on alcohol urges. *Addiction, 99*, 1542-1547.

Ussher, M., West, R., Doshi, R. & Sampuran, A.K. (2006). Acute effect of isometric exercise on desire to smoke and tobacco withdrawal symptoms. *Human Psychopharmacology: Clinical and Experimental, 21*, 39-46.

Ussher, M., West, R., McEwen, A., Taylor, A. & Steptoe, A. (2003). Efficacy of exercise counselling as an aid for smoking cessation: A randomised controlled trial. *Addiction, 98*, 523-532.

Vallerand, R.J. (1997). Toward a hierarchical model of intrinsic and extrinsic motivation. In: M.P. Zanna (Ed). *Advances in Experimental Social Psychology*. New York: Academic Press.

Watson, D., Clark, L.A. & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*, 1063-1070.

Wellman, R.J., DiFranza, J.R., Savageau, J.A., Godiwala, S., Friedman, K. & Hazelton, J. (2005). Measuring adults' loss of autonomy over nicotine use: The Hooked on Nicotine Checklist. *Nicotine and Tobacco Research, 7*(1), 157-161.

West, R. (2006). *Theory of addiction*. Oxford: Blackwell.

West, R., Courts, S., Beharry, S., May, S. & Hajek, P. (1999). Acute effect of glucose tablets on desire to smoke. *Psychopharmacology, 147*, 319-321.

West, R. & Hajek, P. (2004). Evaluation of the mood and physical symptoms scale (MPSS) to assess cigarette withdrawal. *Psychopharmacology, 177*, 195-199.

West, R., Hajek, P. & Belcher, M. (1989). Severity of withdrawal symptoms as a predictor outcome of an attempt to quit smoking. *Psychological Medicine, 19*, 981-985.

West, R., McNeill, A. & Raw, M. (2000). Smoking cessation guidelines for health professionals: An update. *Thorax, 55*, 987-999.

West, R. & Russell, M. (1985). Pre-abstinence smoke intake and smoking motivation as predictors of severity of cigarette withdrawal symptoms. *Psychopharmacology, 87*, 334-336.

Wheeler, K.C., Fletcher, K.E., Wellman, R.J. & DiFranza, J.R. (2004). Screening adolescents for nicotine dependence. *Journal of Adolescent Health, 35*(3), 225-230.

Woods, C., Mutrie, N. & Scott, M. (2002). Physical activity intervention: A transtheoretical model-based intervention designed to help sedentary young adults become active. *Health Education Research, 17*(4), 451-460.

World Health Organization. (1992). *International Statistical Classification of Diseases and related Health Problems, 10th revision*. Geneva: World Health Organization.

World Health Organization. (1997). *Tobacco or Health: A Global Status Report*. Geneva: World Health Organization.

Yin, R.K. (2003). *Applications of case study research (2nd Edition)*. Thousand Oaks, California: Sage Publications.

APPENDIX 1: Pre-test medical questionnaire

Sheffield Hallam University

School of Sport and Leisure Management

Research Ethics Committee

Pre-Test Medical Questionnaire

Name: .....

Date of Birth: ..... Age: ..... Sex: .....

Please answer the following questions by putting a circle round the appropriate response or filling in the blank.

1. How would you describe your present level of activity?
   Sedentary / Moderately active / Active / Highly active

2. How would you describe you present level of fitness?
   Unfit / Moderately fit / Trained / Highly trained

3. How would you consider your present body weight?
   Underweight / Ideal / Slightly over / Very overweight

4. Smoking Habits

Are you currently a smoker?	Yes / No
How many do you smoke	..... per day
Are you a previous smoker?	Yes / No
How long is it since you stopped?	..... years
Were you an occasional smoker?	Yes / No
	..... per day
Were you a regular smoker?	Yes / No
	..... per day

5. Do you drink alcohol? Yes / No
   If you answered **Yes**, do you have?
   An occasional drink / a drink every day / more than one drink a day?

6. Have you had to consult your doctor within the last six months? Yes / No
   If you answered **Yes**, please give details.....

   .....

   .....

7. Are you presently taking any form of medication? Yes / No
If you answered **Yes**, please give details.....

.....

.....

8. As far as you are aware, do you suffer or have you ever suffered from:

a Diabetes?	Yes / No	**b** Asthma?	Yes / No
c Epilepsy?	Yes / No	**d** Bronchitis?	Yes / No
e *Any form of heart complaint?	Yes / No	**f** Raynaud's Disease?	Yes / No
g *Marfan's Syndrome?	Yes / No	**h** *Aneurysm/embolism?	Yes / No
I Anaemia	Yes / No		

9. *Is there a history of heart disease in your family? Yes / No

10. *Do you currently have any form of muscle or joint injury? Yes / No
If you answered **Yes**, please give details.....
.....
....

11. As far as you are aware, is there anything that might prevent you from successfully completing the tests that have been outlined to you? Yes / No

---

IF THE ANSWER TO ANY OF THE ABOVE IS YES THEN:

a) ***Discuss with the Centre for Sport and Exercise Science the nature of the problem.***

b) ***Questions indicated by (*) Allow your Doctor to fill out the 'Doctors Consent Form provided.***

As far as I am aware the information I have given is accurate.

Signature: .....

Signature of Parent or Guardian if the subject is under 18:

....

Date: ...../...../.....

APPENDIX 2: Participant information for Study 1

Sheffield Hallam University

School of Sport and Leisure Management

Research Ethics Committee

Participant Information Sheet

Project Title	Exercise and smoking abstinence study
Name of Participant	
Supervisor/Director of Studies	Dr. Amanda Daley
Principal Investigator	Miss Emma Everson

Purpose of Study and Brief Description of Procedures
(Not a legal explanation but a simple statement)

What is the purpose of this study?
The main aim of this research study is to examine the relationship between exercise and your feelings for cigarettes. It is an experimental study and does not involve any form of treatment.

What will it involve?
You will be asked to attend the temporary laboratory in your school or college twice, first at lunchtime and then half an hour after you first attended. The researcher will arrange a time and day which is convenient for you. You will be asked not to smoke at all, or use any other nicotine/tobacco-based product from a time between 9pm and 10pm the previous evening until you have completed the experiment the following day (i.e. you will be asked to completely abstain from using tobacco/nicotine overnight, for approximately 15-17 hours). You will also need to wear loose, comfortable clothing.

The first session will take about 45 minutes. At the start of the visit, you will be asked to blow into a machine that will **confirm that you have not smoked**. You will then be asked to fill in a series of questions, that will ask you to rate your desire for a cigarette and your mood. You will then be asked to do either some moderate intensity exercise or some minimal intensity exercise, for 10 minutes on an exercise bicycle. You will have an equal chance of being in either of these conditions. Halfway through exercising, you will be asked to complete the same series of questions. You will also be asked to complete the same series of questions again five minutes after you stop exercising.

Please turn over.

Continued.

You will then be asked to leave the mobile laboratory, and return again 25 minutes later. The second session will take about five minutes. Again, you will be asked to blow into a machine that will **confirm that you have not smoked** during your time away from the laboratory. You will then be asked to complete the same series of questions. Once you have completed the questions for the final time, you will receive a **payment of £10** to thank you for your time.

Are there any risks involved with taking part in the study?
If your general practitioner has advised you against any form of exercise you should not take part in the study. It is possible that you may experience some psychological changes as a result of abstaining from smoking over the duration of the study. Otherwise there are no known risks of taking part in the study.

Are you eligible to join the study?
You are eligible to join the study if you smoke 72 or more cigarettes in a week and have done so for at least six months, and if you exercise no more than once per week. You should not take part in the study if you are under 16 or over 19 years of age. All information that is collected during the course of the research will be kept strictly confidential. If you do decide to take part you will be given this information sheet to keep and you will be asked to sign a consent form. You will be free to withdraw from the study at any time and without giving a reason. Thank you for taking the time to read this information sheet.

If you have any queries please phone Emma on 07890 353265

REMEMBER, IT IS ESSENTIAL FOR THE RESEARCH THAT YOU HAVE NOT SMOKED, OR USED ANY TOBACCO OR NICOTINE PRODUCT SINCE 9PM-10PM THE NIGHT BEFORE YOUR VISIT

It has been made clear to me that, should I feel that these Regulations are being infringed or that my interests are otherwise being ignored, neglected or denied, I should inform Professor Edward Winter, Chair of the School of Sport and Leisure Management Research Ethics Committee (Tel: 0114 225 4333) who will undertake to investigate my complaint.

APPENDIX 3: Demographic and smoking information collected in Studies 1, 2 and 3

Case Report Form

Centre for Sport & Exercise Science

Sheffield Hallam University

Smoking & exercise study

Volunteer Name:	
Volunteer Number:	

Appointment:

Date	Time

Experimental condition: (circle one only)

Moderate exercise	1
Minimal exercise	2

Confirmation of overnight abstinence from smoking
(To be completed by researcher)

At what time did you have your last cigarette (to the nearest quarter of an hour):.....

Time now:.....

Time since last cigarette: .....hrs .....minutes

.....hour

Record carbon monoxide reading:
(Should be <10ppm to confirm
smoking abstinence)

Has the volunteer abstained from smoking as required?	YES	1
(ABSTAIN)	NO	2

Demographic details

Height	cm
Weight	kg

Age	**Gender**	
	Male	Female
	1	2

Preferred mode of exercise ..... (what it would be if sedentary)

Previously used an exercise bike? YES / NO

Resting Heart Rate ..... beats/min

Course/s studying at school/college?

.....

.....

These questions help us to understand your reasons for smoking.

Please answer all seven questions (Circle one number for each question)

S1. Do you use smoking to help you cope with stress?	Yes very much	5
	Yes quite a bit	4
	Yes a little	3
	Not really	2
	Not at all	1
S2. Do you use smoking to help you socialise?	Yes very much	5
	Yes quite a bit	4
	Yes a little	3
	Not really	2
	Not at all	1
S3. Do you use smoking to give you something to do when you are bored?	Yes very much	5
	Yes quite a bit	4
	Yes a little	3
	Not really	2
	Not at all	1
S4. Do you use smoking to help you to concentrate and stay alert?	Yes very much	5
	Yes quite a bit	4
	Yes a little	3
	Not really	2
	Not at all	1
S5. Do you smoke because you feel uncomfortable if you don't?	Yes very much	5
	Yes quite a bit	4
	Yes a little	3
	Not really	2
	Not at all	1
S6. Do you use smoking to help you to keep your weight down?	Yes very much	5
	Yes quite a bit	4
	Yes a little	3
	Not really	2
	Not at all	1
S7. Do you enjoy smoking?	Yes very much	5
	Yes quite a bit	4
	Yes a little	3
	Not really	2
	Not at all	1

PLEASE GO TO THE NEXT PAGE

B1. At what age did you have your first puff on a cigarette? ☐ yrs

B2. At what age did you start smoking on a daily basis? ☐ yrs

B3. Have you made a serious attempt to stop smoking in the past? *(Circle one number)*

Yes 1

No 2

B4. In the past year, what is the longest you have gone without a cigarette? ☐ days

C1. How difficult has it been to stop yourself smoking today? *(Circle one number)*

Extremely difficult	Very difficult	Difficult	Moderately difficult	Slightly difficult	Not at all
5	4	3	2	1	0

C2. How much of the time have you felt the urge to smoke today? *(Circle one number)*

All the time	Almost all the time	A lot of the time	Some of the time	A little of the time	Not at all
5	4	3	2	1	0

C3. How strong have the urges been today? *(Circle one number)*

Extremely strong	Very strong	Strong	Moderate	Slight	No urges
5	4	3	2	1	0

C4. How much have you craved cigarettes today? *(Circle one number)*

A great deal	Quite a bit	somewhat	A little	Hardly at all	Not at all
5	4	3	2	1	0

PLEASE GO TO THE NEXT PAGE

Are you thinking at all about stopping smoking? Yes 1
(Please circle one number)

No 2

If YES, do you intend trying to stop in the next month or might you prefer to try to stop at a later time?
(Please circle one number)

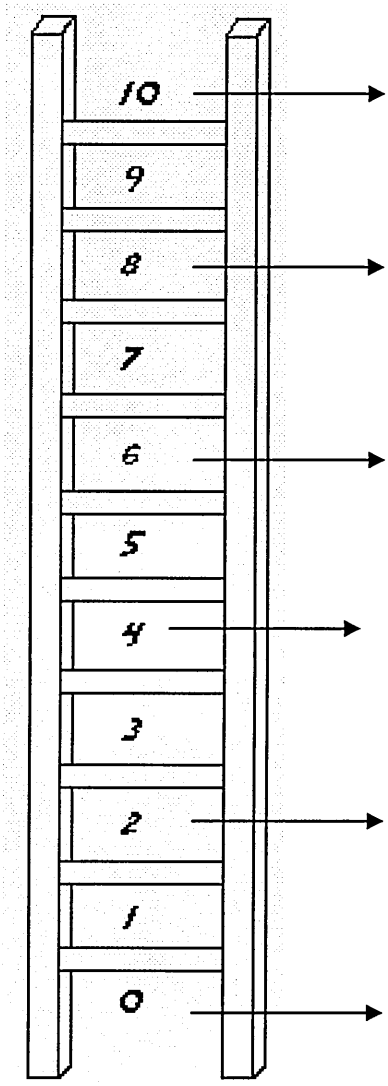
In the next month 1

Later than that 2

APPENDIX 4: The Stage of Readiness to Change Ladder and Frequency of Physical Activity Item

We would just like to find out how physically active you are at the moment.

1. Please circle the **number on the ladder** that best describes your levels of activity. Please answer this question as honestly as you can.



I exercise regularly* and have done so for longer than 6 months.

I exercise regularly* but have done so for less than 6 months.

I currently exercise some, but not regularly*

I have exercised in the past 6 months but have not done so recently

I currently don't exercise but I am thinking about starting in the next

I currently don't exercise and I do not intend to start in the next 6 months

*Regular exercise = three or more times per week for 20 minutes or longer of moderate exercise e.g. walking briskly or cycling, swimming.

2. How **often** have you participated in physical activities for 20 to 30 minutes per session during your free time in the last three months? Please tick one box.

never ☐
about once per month ☐
about 2 or 3 times per month ☐
about once per week ☐
about 2 times per week ☐
about 3 times per week ☐
about 4 times or more per week ☐

APPENDIX 5: The Hooked On Nicotine Checklist (HONC)

Please tick the box that applies to you.

	1 YES	0 NO
H1) Have you ever tried to quit, but couldn't?		
H2) Do you smoke <u>now</u> because it is really hard to quit?		
H3) Have you ever felt like you were addicted to tobacco?		
H4) Do you ever have strong cravings to smoke?		
H5) Have you ever felt like you really needed a cigarette?		
H6) Is it hard to keep from smoking in places where you are not supposed to, like college?		

When you tried to stop smoking... (or, when you haven't used tobacco for a while...)

H7) did you find it hard to concentrate because you couldn't smoke?		
H8) did you feel more irritable because you couldn't smoke?		
H9) did you feel a strong need or urge to smoke?		
H10) did you feel nervous, restless or anxious because you couldn't smoke?		

APPENDIX 6: Mood and Physical Symptoms Scale (including strength of desire to smoke item)

CIGARETTE CRAVINGS AND WITHDRAWAL SYMPTOMS

STUDY QUESTIONNAIRE
(TO BE ADMINISTERED VERBALLY)

The next set of questions ask about how strongly you are feeling right now. You respond by circling one number in each row.

1. How irritable do you feel right now?

	Not at all			Somewhat			Extremely
a. Before	1	2	3	4	5	6	7
b. 5 minutes during	1	2	3	4	5	6	7
c. 5 minutes after	1	2	3	4	5	6	7
d. 30 minutes after	1	2	3	4	5	6	7

2. How depressed do you feel right now?

	Not at all			Somewhat			Extremely
a. Before	1	2	3	4	5	6	7
b. 5 minutes during	1	2	3	4	5	6	7
c. 5 minutes after	1	2	3	4	5	6	7
d. 30 minutes after	1	2	3	4	5	6	7

3. How tense do you feel right now?

	Not at all			Somewhat			Extremely
a. Before	1	2	3	4	5	6	7
b. 5 minutes during	1	2	3	4	5	6	7
c. 5 minutes after	1	2	3	4	5	6	7
d. 30 minutes after	1	2	3	4	5	6	7

4. How restless do you feel right now?

	Not at all			Somewhat			Extremely
a. Before	1	2	3	4	5	6	7
b. 5 minutes during	1	2	3	4	5	6	7
c. 5 minutes after	1	2	3	4	5	6	7
d. 30 minutes after	1	2	3	4	5	6	7

5. How difficult do you find it to concentrate right now?

	Not at all			Somewhat			Extremely
a. Before	1	2	3	4	5	6	7
b. 5 minutes during	1	2	3	4	5	6	7
c. 5 minutes after	1	2	3	4	5	6	7
d. 30 minutes after	1	2	3	4	5	6	7

6. How stressed do you feel right now?

	Not at all			Somewhat			Extremely
a. Before	1	2	3	4	5	6	7
b. 5 minutes during	1	2	3	4	5	6	7
c. 5 minutes after	1	2	3	4	5	6	7
d. 30 minutes after	1	2	3	4	5	6	7

7. How happy do you feel right now?

	Not at all			Somewhat			Extremely
a. Before	1	2	3	4	5	6	7
b. 5 minutes during	1	2	3	4	5	6	7
c. 5 minutes after	1	2	3	4	5	6	7
d. 30 minutes after	1	2	3	4	5	6	7

8. How energetic do you feel right now?

	Not at all			Somewhat			Extremely
a. Before	1	2	3	4	5	6	7
b. 5 minutes during	1	2	3	4	5	6	7
c. 5 minutes after	1	2	3	4	5	6	7
d. 30 minutes after	1	2	3	4	5	6	7

9. How strong is your desire to smoke right now?

	Not at all			Somewhat			Extremely
a. Before	1	2	3	4	5	6	7
b. 5 minutes during	1	2	3	4	5	6	7
c. 5 minutes after	1	2	3	4	5	6	7
d. 30 minutes after	1	2	3	4	5	6	7

APPENDIX 7: The Subjective Exercise Experiences Scale (SEES)

By circling a number on the scale below each of the following items, please indicate the degree to which you are experiencing each feeling now, at this point in time.

I FEEL

1. Great	1 not at all	2	3	4 moderately	5	6	7 very much so
2. Awful	1 not at all	2	3	4 moderately	5	6	7 very much so
3. Drained	1 not at all	2	3	4 moderately	5	6	7 very much so
4. Positive	1 not at all	2	3	4 moderately	5	6	7 very much so
5. Crummy	1 not at all	2	3	4 moderately	5	6	7 very much so
6. Exhausted	1 not at all	2	3	4 moderately	5	6	7 very much so
7. Strong	1 not at all	2	3	4 moderately	5	6	7 very much so
8. Discouraged	1 not at all	2	3	4 moderately	5	6	7 very much so
9. Fatigued	1 not at all	2	3	4 moderately	5	6	7 very much so
10. Terrific	1 not at all	2	3	4 moderately	5	6	7 very much so
11. Miserable	1 not at all	2	3	4 moderately	5	6	7 very much so
12. Tired	1 not at all	2	3	4 moderately	5	6	7 very much so

APPENDIX 8: The Borg Rating of Perceived Exertion (RPE) scale

6 7 8	No exertion at all
9 10	Very light
11 12	Fairly light
13 14	Somewhat hard
15 16	Hard
17 18	Very hard
19 20	Extremely hard Maximal exertion

APPENDIX 9: Record of HR and RPE

	BORG RPE RATINGS	HEART RATE	
After 1 min adjustment period	.....	.....	
After 1 min of exercise (2 min)	.....	.....	
After 2 min of exercise (3 min)	.....	.....	
After 3 min of exercise (4 min)	.....	.....	
After 4 min of exercise (5 min)	.....	.....	--> MPSS (4-5 min)
After 5 min of exercise (6 min)	.....	.....	--> SEES (5-6 min)
After 6 min of exercise (7 min)	.....	.....	
After 7 min of exercise (8 min)	.....	.....	
After 8 min of exercise (9 min)	.....	.....	
After 9 min of exercise (10 min)	.....	.....	
After 10 min of exercise (11 min)	.....	.....	

16-year-old: (**204** - ***RHR***) x **.40 to .59** (40-59% HRR - moderate) or **.20** (<20% HRR - minimal) + ***RHR***

17-year-old: (**203** - ***RHR***) x **.40 to .59** (40-59% HRR - moderate) or **.20** (<20% HRR - minimal) + ***RHR***

18-year-old: (**202** - ***RHR***) x **.40 to .59** (40-59% HRR - moderate) or **.20** (<20% HRR - minimal) + ***RHR***

19-year-old: (**201** - ***RHR***) x **.40 to .59** (40-59% HRR - moderate) or **.20** (<20% HRR - minimal) + ***RHR***

Age: ..... ((..... - .....) x .....) + ... = ...beats/min (for % HRR)
220 - age resting HR intensity resting HR

RHR: .....

APPENDIX 10: Informed consent form for Study 1

Sheffield Hallam University

School of Sport and Leisure Management

Research Ethics Committee

INFORMED CONSENT FORM	
TITLE OF PROJECT: The effects of exercise on desire to smoke, affective responses and withdrawal symptoms in adolescent smokers	
The participant should complete the whole of this sheet himself/herself	
Have you read the Participant Information Sheet?	YES/NO
Have you had an opportunity to ask questions and discuss this study?	YES/NO
Have you received satisfactory answers to all of your questions?	YES/NO
Have you received enough information about the study?	YES/NO
To whom have you spoken? ..... Do you understand that you are free to withdraw from the study: • at any time • without having to give a reason for withdrawing • and without affecting your future medical care	YES/NO
Have you had sufficient time to consider the nature of this project?	YES/NO
Do you agree to take part in this study?	YES/NO
Signed ..... Date ..... (NAME IN BLOCK LETTERS).....	

APPENDIX 11: Participant information sheet for Study 2

Sheffield Hallam University

Faculty of Health and Wellbeing Research Ethics Committee
Sport and Exercise Research Ethics Operating Group

Participant Information Sheet

Project Title	Exercise and smoking abstinence study
Name of Participant	
Supervisor/Director of Studies	Dr. Amanda Daley
Principal Investigator	Miss Emma Everson
Principal Investigator telephone/mobile number	0114 225 5634 (office hours) or 07890 353265

Purpose of Study and Brief Description of Procedures
(Not a legal explanation but a simple statement)

What is the purpose of this study?
The main aim of this research study is to examine the relationship between two intensities of exercise and your feelings about smoking. It is an experimental study and does not involve any form of treatment.

What will it involve?
You will be asked to attend the Centre for Sport and Exercise Science at Sheffield Hallam University twice, first in the afternoon and then half an hour after you first attended. The researcher will arrange a time and day which is convenient for you. You will be asked not to smoke at all, or use any other nicotine/tobacco-based product from 10pm the previous evening until you have completed the experiment the following day (i.e. you will be asked to completely abstain from using tobacco/nicotine overnight, for approximately 15-17 hours). You will also need to wear loose, comfortable clothing.

The first session will take about 45 minutes. At the start of the visit, you will be asked to blow into a machine that will **confirm that you have not smoked**. You will then be asked to fill in a series of questions that will ask you to rate your desire for a cigarette and your mood. You will then be randomly assigned to do either (1) some moderate intensity exercise on an exercise bicycle, or (2) some vigorous intensity exercise on an exercise bicycle, or (3) to sit quietly, for 10 minutes. You will have an equal chance of being in either of these three conditions. Halfway through exercising or sitting quietly, you will be asked to complete the same series of questions. You will also be asked to complete the same series of questions again five minutes after you stop exercising.

Please turn over.

Continued.

You will then be asked to leave the Centre, and return again 25 minutes later. The second session will take about five minutes. Again, you will be asked to blow into a machine that will **confirm that you have not smoked** during your time away from the laboratory. You will then be asked to complete the same series of questions. Once you have completed the questions for the final time, you will receive a **payment of £10** to thank you for your time and for any travel expenses that you may have incurred.

Are there any risks involved with taking part in the study?
If your general practitioner has advised you against any form of exercise you should not take part in the study. It is possible that you may experience some psychological changes as a result of abstaining from smoking over the duration of the study. Otherwise there are no known risks of taking part in the study.

Are you eligible to join the study?
You are eligible to join the study if you smoke 10 or more cigarettes in a day and have done so for at least six months, and if you exercise on three or fewer days a week (for 30 minutes a day, at a moderate intensity). You should not take part in the study if you are under 18 or over 25 years of age. All information that is collected during the course of the research will be kept strictly confidential. If you do decide to take part you will be given this information sheet to keep and you will be asked to sign a consent form. You will be free to withdraw from the study at any time and without giving a reason. Thank you for taking the time to read this information sheet.

If you have any queries please phone Emma on (0114) 225 5634 or 07890 353265

REMEMBER, IT IS ESSENTIAL FOR THE RESEARCH THAT YOU HAVE NOT SMOKED, OR USED ANY TOBACCO OR NICOTINE PRODUCT SINCE 10PM THE NIGHT BEFORE YOUR VISIT

It has been made clear to me that, should I feel that these Regulations are being infringed or that my interests are otherwise being ignored, neglected or denied, I should inform Professor Edward Winter, Chair of the Faculty of Health and Wellbeing Research Ethics Committee (Tel: 0114 225 4333) who will undertake to investigate my complaint.

APPENDIX 12: The Fagerström Test for Nicotine Dependence (FTND)

Please circle the number appropriate to your answer.

How many cigarettes per day do you usually smoke? *(write the number in the box and circle one response)*	.....	(CIGDAY)
(F1)	10 or less	0
	11 to 20	1
	21 to 30	2
	31 or more	3
(F2) How soon after you wake up do you smoke your first cigarette? *(circle one response)*	Within 5 minutes	1
	5-14 minutes	2
	15-29 minutes	3
	10 minutes but less than one hour.	4
	1 hour but less than 2 hours.	5
	2 hours or more	6
(F3) Do you find it difficult to stop smoking in no-smoking areas? *(circle one response)*	No	0
	Yes	1
(F4) Which cigarette would you most hate to give up? *(circle one response)*	The first of the morning	1
	Other	0
(F5) Do you smoke more frequently in the first hours after waking than during the rest of the day *(circle one)*	No	0
	Yes	1
(F6) Do you smoke if you are so ill that you are in bed most of the day? *(circle one response)*	No	0
	Yes	1

APPENDIX 13: Exercise discomfort measure

Please circle the number appropriate to your answer.

How much discomfort did you feel during the exercise?

1	2	3	4	5
Just noticeable	Very slightly	Moderate	Severe	Very severe

APPENDIX 14: Informed consent form for Study 2

Sheffield Hallam University

Faculty of Health and Wellbeing Research Ethics Committee
Sport and Exercise Research Ethics Operating Group

INFORMED CONSENT FORM	
TITLE OF PROJECT: Exercise and smoking abstinence study	
The participant should complete the whole of this sheet himself/herself	
Have you read the Participant Information Sheet?	YES/NO
Have you had an opportunity to ask questions and discuss this study?	YES/NO
Have you received satisfactory answers to all of your questions?	YES/NO
Have you received enough information about the study?	YES/NO
To whom have you spoken? ..... Do you understand that you are free to withdraw from the study: • at any time • without having to give a reason for withdrawing • and without affecting your future medical care	YES/NO
Have you had sufficient time to consider the nature of this project?	YES/NO
Do you agree to take part in this study?	YES/NO
Signed ..... Date ..... (NAME IN BLOCK LETTERS).....	

APPENDIX 15: Theory of Planned Behaviour (TPB) scales

Your Feelings about Exercise Participation.

Please consider the statement below, then for each scale, circle one score that best describes your feeling about exercise participation.

Statement: For me to participate in regular physical exercise is:

Useless	-3	-2	-1	0	+1	+2	+3	**Useful**
harmful	-3	-2	-1	0	+1	+2	+3	**beneficial**
Foolish	-3	-2	-1	0	+1	+2	+3	**wise**
Bad	-3	-2	-1	0	+1	+2	+3	**good**
un-enjoyable	-3	-2	-1	0	+1	+2	+3	**enjoyable**
unpleasant	-3	-2	-1	0	+1	+2	+3	**pleasant**
stressful	-3	-2	-1	0	+1	+2	+3	**relaxing**

Your thoughts on participating in physical exercise

Please circle a number that best describes your response to the statements below.

- My goal is to participate in physical exercise at least 3 times per week every week

1	2	3	4	5	6	7
Strongly Agree		Agree	Neutral		Disagree	Strongly disagree

- I intend to participate in physical exercise as much as I can every week

1	2	3	4	5	6	7
Strongly Agree		Agree	Neutral		Disagree	Strongly disagree

- I plan to participate in physical exercise at least _____ times per week

Your thoughts on participating in physical exercise (contd.)

Please indicate your agreement / disagreement with the statements listed below by choosing a number as a score.

- Most people who are important to me think I should participate in regular physical exercise

1	2	3	4	5	6	7
Strongly Agree		Agree	Neutral		Disagree	Strongly disagree

- Most people who are important to me encourage me to participate in regular physical exercise

1	2	3	4	5	6	7
Strongly Agree		Agree	Neutral		Disagree	Strongly disagree

- Most people who are important to me support me participating in regular physical exercise

1	2	3	4	5	6	7
Strongly Agree		Agree	Neutral		Disagree	Strongly disagree

PLEASE GO TO THE NEXT PAGE

Your thoughts on participating in physical exercise (contd.)

Again, please circle the number that best indicates your response.

How much control do you have over participating in regular physical exercise?

1	2	3	4	5	6	7
very little control		limited control	neutral	some control		complete control

---

For me to participate in regular physical exercise is

1	2	3	4	5	6	7
extremely difficult		difficult	neutral	easy		extremely easy

If I wanted to I could easily participate in regular physical exercise

1	2	3	4	5	6	7
strongly agree		Agree	neutral	disagree		strongly disagree

How much I participate in regular physical exercise is completely up to me

1	2	3	4	5	6	7
strongly agree		Agree	neutral	disagree		strongly disagree

How confident are you that you are capable of participating in regular physical exercise?

1	2	3	4	5	6	7
not all confident		somewhat confident	neutral	very confident		extremely confident

---

THANK YOU FOR YOUR PARTICIPATION

APPENDIX 16: Survey used in Study 5

Rating the postcards (Cards 1 to 4)

Please can you rate these four postcards on the following characteristics.

1. Which is most **motivational**?
Can you please place the postcards in order, from most motivational (1st) to least motivational (4th)

_____ _____ _____ _____

2. Which is most **informative**?
Can you please place the postcards in order, from most informative (1st) to least informative (4th)

_____ _____ _____ _____

3. Which one is **most appealing**?
Can you please place the postcards in order, from the one that is most appealing (1st) to the one that is least appealing (4th)

_____ _____ _____ _____

4. Which would make you **most likely to do physical activity**?
Can you please place the postcards in order, from the one that is most likely to prompt you to do some physical activity (1st) to the one that is least likely to prompt you to do some physical activity (4th)

_____ _____ _____ _____

5. Which one would you **most like to receive through the post**?
Can you please place the postcards in order, from the one you would most like to receive (1st) to the one you would least like to receive (4th)

_____ _____ _____ _____

6. Which one are you **most likely to keep**?
Can you please place the postcards in order, from the one you are most likely to keep (1st) to the one you are least likely to keep (4th)

_____ _____ _____ _____

How old are you? _____ years. Are you male or female? M / F

Do you smoke? YES / NO

Do you exercise regularly (30min, 5 days/week, at a moderate intensity)? YES / NO

Rating the postcards (Cards 5 to 8)

Please can you rate these four postcards on the following characteristics.

1. Which is most **motivational**?
Can you please place the postcards in order, from most motivational (1st) to least motivational (4th)

_____ _____ _____ _____

2. Which is most **informative**?
Can you please place the postcards in order, from most informative (1st) to least informative (4th)

_____ _____ _____ _____

3. Which one is **most appealing**?
Can you please place the postcards in order, from the one that is most appealing (1st) to the one that is least appealing (4th)

_____ _____ _____ _____

4. Which would make you **most likely to do physical activity**?
Can you please place the postcards in order, from the one that is most likely to prompt you to do some physical activity (1st) to the one that is least likely to prompt you to do some physical activity (4th)

_____ _____ _____ _____

5. Which one would you **most like to receive through the post**?
Can you please place the postcards in order, from the one you would most like to receive (1st) to the one you would least like to receive (4th)

_____ _____ _____ _____

6. Which one are you **most likely to keep**?
Can you please place the postcards in order, from the one you are most likely to keep (1st) to the one you are least likely to keep (4th)

_____ _____ _____ _____

Thank you for your help.

APPENDIX 17: Participant information sheet for Study 4

Sheffield Hallam University

Faculty of Health and Wellbeing
Sport and Exercise Research Ethics Committee

Participant Information Sheet

Project Title	Physical activity in young adults who smoke
Supervisor/Director of Studies	Dr Amanda Daley
Principal Investigator	Miss Emma Everson
Principal Investigator telephone/mobile number	0114 225 5634 (office hours) or 07890 353265

Purpose of Study and Brief Description of Procedures
(Not a legal explanation but a simple statement)

You are being invited to take part in a research project. But before you decide whether you would like to take part it is important for you to understand why the research is being conducted and what it will involve. Please take time to read the following information carefully, and ask us if there is anything that is not clear or if you would like more information. Please take your time to decide whether or not you wish to take part.

In order to make sure that you have some general information about this study we have compiled a list of questions and answers. We hope that this will allow you to make an informed decision as to whether you would like to become involved in this project.

Q: What is the purpose of this study?
A: This research project will consider the usefulness of integrating exercise into the lifestyles of young people who smoke. Your involvement in the study will last 6 months.

Q: Why have I been chosen?
A: Young people who smoke are being invited to participate in this project.

Q: Do I have to take part?
A: It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason.

Q: What will be involved if I agree to take part in the study?
A: Once the consent form has been signed you will be asked to participate in one of 2 groups. The requirements of each of these groups are outlined below. It is important to understand that you will be allocated to one of the groups in a random order. We have to do this in order to make sure the results are scientific.

Please turn over.

Over the course of the study we would like you (irrespective of which group you are in) to complete a series of questionnaires that will ask you to indicate your feelings about smoking and exercise, and we would also like to measure your height and weight. We would like to do this in person, on three occasions throughout the study. If it is not possible for you, we can post these questionnaires to you.

Group 1: Physical activity

If you are allocated to this group you will be invited to participate in two physical activity consultations. These consultations will explore your thoughts and attitudes about exercise and will take place at the Centre for Sport and Exercise Science, at Sheffield Hallam University. The consultations will be lead by a specialist exercise researcher and should take no more than 1 hr.

Group 2: Comparison Group

If you are allocated to this group, you will not take part in the physical activity consultations. Throughout the course of the study you should continue to live your life as normal. Once you have finished the study we will provide you with information about physical activity.

After you have completed all assessments, you may be asked if you wish to participate in an interview about your experiences of the study, reasons for volunteering, and attitudes towards exercise. Further information about the interview will be provided when you are asked about this.

Q: What are the side effects?
A: Sometimes when people have not taken part in physical activity for a long time they can experience shortness of breath and muscle soreness. If you suffer from epilepsy, asthma or diabetes you should inform the researcher before taking part in the study.

Q: What are the possible benefits of taking part?
A: If you are assigned to the physical activity group, you will be encouraged to take part in regular physical activity, particularly walking, and you will be given additional help and guidance regarding your health and lifestyle. If you are assigned to the comparison group, we will give you advice about exercise at the end of your involvement in the project, if you wish.

Q: Can I withdraw from the study at any time?
A: You can refuse to join the study and may withdraw at any time or choose not to answer certain questions. If you think you might be pregnant you should inform the researcher.

Q: Will the information obtained in the study be confidential?
A: Anything you say will be treated in confidence. Your name will not be mentioned in any reports of the study and you will not be identified from details in reports. Only those researchers who are directly related to this project will have access to the research data. All data will be kept in a locked cupboard.

Q: What will happen to the results of the research project?
A: We hope to publish the findings from this project in appropriate health research journals. The data may also be presented at health and exercise science conferences.

Thank you for taking the time to consider your participation in this study.

It has been made clear to me that, should I feel that these Regulations are being infringed or that my interests are otherwise being ignored, neglected or denied, I should inform Professor Edward Winter, Chair of the Faculty of Health and Wellbeing Sport and Exercise Research Ethics Committee (Tel: 0114 225 4333) who will undertake to investigate my complaint.

APPENDIX 18: Press release and publicity for Study 4

NEWS from *Sheffield Hallam University*

Immediate release

Could exercise help young smokers curb the craving?

29 June 2005

Young smokers are invited to sign up for a new study to find out if exercise can help them kick the habit.

Young people are becoming less active and are the only group in Britain among whom smoking is on the increase. Every day in Britain 450 children take up smoking. In 2003/04 two thirds (66 per cent) of cigarette smokers in Great Britain said that they wanted to give up, though 55 per cent said it would be difficult to go without smoking for a whole day*.

Sheffield Hallam University's Centre for Sport and Exercise Science is running a project to offer young people advice about becoming more physically active and hopefully encouraging them to think about giving up smoking. The study will pave the way for research into exercise as an aid to giving up smoking.

PhD student Emma Everson, who is running the project, said:

"So far, there has been little research investigating exercise among younger smokers, yet this is important because research has shown that levels of both exercise and smoking behaviour in adolescents are usually continued into adulthood."

Regular smokers aged 16 to25 are invited to take part in the exercise scheme which might eventually help them to consider quitting smoking. Cigarette smoking is more

common among adults aged 20 to 34 than other age groups. In 2003 36 per cent of adults aged 20 to were smokers*.

The exercise advice sessions take place at the University's Centre for Sport and Exercise Science on Collegiate Crescent, are free of charge and participants can receive expert individual exercise advice, and a free pedometer. The study will encourage physically inactive young smokers to become interested in exercise, with the focus on 'lifestyle' physical activity, particularly walking.

It will involve an initial assessment followed by two initial consultations of no more than an hour each. Some of the participants will be asked to take part in an interview after completion of the study, to assess how it helped them.

The project will be receiving applicants up to February 2006. To take part please contact Emma Everson (0114) 225 5634

*Statistics taken from National Office of Statistics and www.ash.org.uk

For further information: contact Joe Field on (0114) 225 2074

Find all our recent releases at http://www.shu.ac.uk/news. *Journalists and broadcasters can now visit* www.shu.ac.uk/news/experts, *our searchable media experts guide on the web, containing contact details for more than 200 university staff able to provide informed comment, facts and expert opinion on hundreds of subjects. For radio interviews the University now has its own ISDN mixer.*

/ends

Advice sessions give people better chance to kick cigarette habit

YOUNG smokers are being invited to sign up for a new study to find out if taking up exercise can help them to kick the habit.

Every day in Britain, 450 children take up smoking.

But research shows that many people hooked on cigarettes would like to quit. One study found that two thirds of cigarette smokers in Great Britain said that they wanted to give up. But, as many as 55 per cent of those surveyed admitted it would be difficult to go without smoking for a whole day.

Studies show that children and teenagers are becoming less active and are the only group in Britain among whom smoking is on the increase.

Now Sheffield Hallam University's Centre for Sport and Exercise Science is trying to help improve tackle both issues, by running a project to offer young people advice about becoming more physically active and also encouraging them to think about giving up smoking.

"So far, there has been little research investigating exercise among younger smokers, yet this is important because research has shown that levels of both exercise and smoking behaviour in adolescents are usually continued into adulthood," said PhD student Emma Everson, who is running the project.

The study will pave the way for research into exercise as an aid to giving up smoking.

Regular smokers aged 16 to 25 are invited to take part in the exercise scheme, which might eventually help them to consider quitting smoking.

This age group is being targetted as cigarette-smoking is more common among adults aged 20 to 34 than other age groups. In 2003 as many as 36 per cent of adults aged 20 to were smokers.

The exercise advice sessions take place at the University's Centre for Sport and Exercise Science on Collegiate Crescent, are free of charge and those who sign up can receive expert individual exercise advice, and a free pedometer.

The study will also encourage physically inactive young smokers to become interested in exercise, with the focus on changing their 'lifestyle' by doing more physical activity, particularly walking.

Those taking part will have an initial assessment followed by two initial consultations of no more than an hour each.

Some will be asked to take part in an interview after completion of the study, to assess how it has helped them.

The project will be receiving applicants up to next February.To take part please contact Emma Everson (0114) 225 5634.

Tobacco addiction: As many as 55 per cent of people who take up smoking are aware of the risks and would like to quit

VOLUNTEERS NEEDED FOR NEW RESEARCH INTO KICKING THE HABIT

Young smokers are invited to sign up for a new study to find out if exercise can help them quit smoking.

Sheffield Hallam University's centre for Sport and Exercise Science is running a project to offer regular smokers, aged 16 to 25, advice about becoming more physically active and hopefully encouraging them to think about giving up smoking..

The study will pave the way for research into exercise as an aid to give up smoking.

PhD student Emma Everson, who is running the project, said: "So far, there has been little research investigating exercise among young smokers, yet this is important because research has shown that levels of both exercise and smoking behaviour in adolescents are usually continued into adulthood."

Cigarette smoking is more common among adults aged 20 to 34 than any other age groups. In 2003 36 per cent of adults aged 20 to 34 were smokers.

The exercise sessions will take place at the Centre for Sport and Exercise Science on Collegiate Crescent campus.

The study aims to encourage physically inactive young smokers to become interested in exercise, with the focus on 'lifestyle' physical activity, especially walking.

The sessions will be free of charge and participants can receive expert individual exercise advice, and a free pedometer.

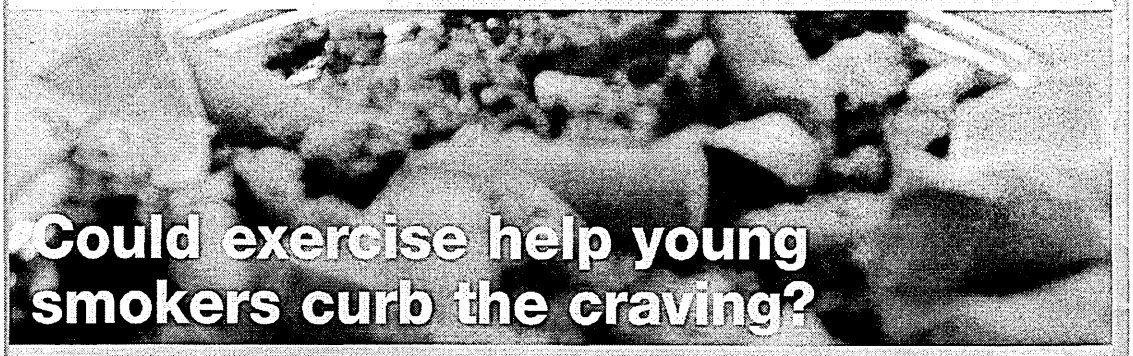
The study will involve an initial assessment followed by two consultations of no more than an hour each.

Some of the participants will be asked to take part in an interview after completion of the study, to assess how it helped them.

The project will be receiving applicants up to February 2006.

To take part contact Emma Everson on (0114) 225 5634. Emma will also be present on the day of the Trade Fair (4th October) to answer any further questions.

Laura Hannam



Could exercise help young smokers curb the craving?

Exercise is good for you. It helps fight the flab, the endorphins that kick in during a bit of sweat and graft make you feel better about yourself and it's an all-round healthy lifestyle choice.

Now, in the wake of new evidence that proves smoking is stopping young couples from conceiving, young smokers are being urged to sign up for a Sheffield Hallam study to find out if exercise can also help them to quit smoking.

Studies show young people are becoming less active and worse still, they are the only group in Britain where smoking is on the increase. Every day in Britain 450 children take up smoking and it is more common among adults aged 20 to 34 than other age groups. Figures in 2003 revealed that 36 per cent of adults aged 20 were smokers*.

The University's Centre for Sport and Exercise Science is running a project to offer young people advice about becoming more physically active in a bid to get them to think about giving up smoking. The study will pave the way for research into exercise as an aid to quitting.

PhD student Emma Everson, who is running the project, said 'So far, there has been little research investigating exercise among younger smokers, yet this is important because evidence suggests that levels of both exercise and smoking behaviour in adolescents are usually continued into adulthood.'

Regular smokers aged 16 to 25 are invited to take part in the exercise scheme.

Sessions take place at Collegiate Crescent Campus, are free and recruits can receive expert individual exercise advice, and a free pedometer.

The project will be receiving applicants up to February 2006. For more details contact Emma Everson 0114 225 5634

**Statistics taken from National Office of Statistics and www.ash.org.uk*

APPENDIX 19: Informed consent form for Study 4

Sheffield Hallam University

Faculty of Health and Wellbeing
Sport and Exercise Research Ethics Committee

INFORMED CONSENT FORM	
TITLE OF PROJECT: Physical activity in young adults who smoke	
The participant should complete the whole of this sheet himself/herself	
Have you read the Participant Information Sheet?	YES/NO
Have you had an opportunity to ask questions and discuss this study?	YES/NO
Have you received satisfactory answers to all of your questions?	YES/NO
Have you received enough information about the study?	YES/NO
To whom have you spoken? ..... Do you understand that you are free to withdraw from the study: • at any time • without having to give a reason for withdrawing • and without affecting your future medical care	YES/NO
Have you had sufficient time to consider the nature of this project?	YES/NO
Do you consent to receive telephone calls and mailings about this study, during the course of this study?	YES/NO
Do you agree to take part in this study?	YES/NO
Signed ..... Date ..... (NAME IN BLOCK LETTERS).....	

APPENDIX 20: 7-day Physical Activity Recall (7-day PAR)

PAR#: 1 2 3 4 5 6 7 Participant_____

Interviewer_____ Today is_____ Today's date_____

1. Were you employed in the last seven days? 0. **No** (Skip to **Q#4**) 1. **Yes**
2. How many days of the last seven did you work? ..... days
3. How many total hours did you work in the last seven days? ..... hours last week
4. What two days do you consider your weekend days? ....
   (mark days below with a squiggle)

WORKSHEET **DAYS**

	SLEEP	**1 ___**	**2 ___**	**3 ___**	**4 ___**	**5 ___**	**6 ___**	**7 ___**
MORNING	**Moderate**							
	Hard							
	Very Hard							
AFTERNOON	**Moderate**							
	Hard							
	Very Hard							
EVENING	**Moderate**							
	Hard							
	Very Hard							
Total Min Per Day	**Strength:**	---------	---------	---------	---------	---------	---------	---------
	Flexibility:							

4a. Compared to your physical activity over the past three months, was last week's physical activity more, less, or about the same?
1. More
2. Less
3. About the same

Worksheet key:

An asterisk (*) denotes a work-related activity.
A squiggly line through a column (day) denotes a weekend day.

Rounding:
10-22 min = .25
23-37 min = .50
38-52 min = .75
53-1:07 hr/min = 1.0
1:08-1:22 hr/min = 1.25

INTERVIEWER:

Please answer any questions below and note any comments on interview

5. Were there problems with the 7-Day PAR interview?
   0. No
   1. Yes (If yes

6. Do you think this was a valid 7-Day PAR interview?
   0. No
   1. Yes

7. Please list below any activities reported by the participant which you don't classify.

_____

_____

_____

_____

8. Please provide any other comments you may have in the space below.

_____

_____

_____

_____

APPENDIX 21: Physical activity daily recall diary

Exercise diary

Week commencing date: .....

How many minutes in total (to the nearest 5 min) did you spend doing physical activity, at a moderate intensity (or higher) on:

Monday? .....

Tuesday? .....

Wednesday? .....

Thursday? .....

Friday? .....

Saturday? .....

Sunday? .....

Note: Moderate intensity = working hard enough to be breathing more heavily than normal, and becoming slightly warmer, but not so hard that you are unable to talk and exercise at the same time.

INTERVIEWER:

Please answer any questions below and note any comments on interview.

5. Were there problems with the 7-Day PAR interview?
   0. No
   1. Yes (If yes, please explain.)

6. Do you think this was a valid 7-Day PAR interview?
   0. No
   1. Yes

7. Please list below any activities reported by the participant which you don't know how to classify.

_____

_____

_____

_____

8. Please provide any other comments you may have in the space below.

_____

_____

_____

_____

APPENDIX 21: Physical activity daily recall diary

Exercise diary

Week commencing date: .....

How many minutes in total (to the nearest 5 min) did you spend doing physical activity, at a moderate intensity (or higher) on:

Monday? .....

Tuesday? .....

Wednesday? .....

Thursday? .....

Friday? .....

Saturday? .....

Sunday? .....

Note: Moderate intensity = working hard enough to be breathing more heavily than normal, and becoming slightly warmer, but not so hard that you are unable to talk and exercise at the same time.

APPENDIX 22: Smoking daily recall diary

Smoking diary

Week commencing date: .....

How many cigarettes did you smoke on:

Monday? .....

Tuesday? .....

Wednesday? .....

Thursday? .....

Friday? .....

Saturday? .....

Sunday? .....

APPENDIX 23: Beck Depression Inventory (BDI)

HOW HAVE YOU BEEN FEELING IN THE LAST TWO WEEKS

Instructions: This questionnaire consists of 21 groups of statements. Please read each group of statements carefully, and then pick out the **one statement** in each group that best describes the way you have been feeling during the **past two weeks, including today**. Circle the number beside the statement you have picked. If several statements in the group seem to apply equally well, circle the highest number for that group.

1.
- 0 I do not feel sad
- 1 I feel sad much of the time
- 2 I am sad all the time
- 3 I am so sad or unhappy that I can't stand it

2.
- 0 I am not discouraged about my future
- 1 I feel more discouraged about my future than I used to be
- 2 I do not expect things to work out for me
- 3 I feel my future is hopeless and will only get worse

3.
- 0 I do not feel like a failure
- 1 I have failed more than I should have
- 2 As I look back, I see a lot of failures
- 3 I feel I am a total failure as a person

4.
- 0 I get as much pleasure as I ever did from the things I enjoy
- 1 I don't enjoy things as much as I used to
- 2 I get very little pleasure from the things I used to enjoy
- 3 I can't get any pleasure from the things I used to enjoy

5.
- 0 I don't feel particularly guilty
- 1 I feel guilty over many things I have done or should have done
- 2 I feel quite guilty most of the time
- 3 I feel guilty all of the time

6.
- 0 I am no more restless or wound up than usual
- 1 I feel more restless or wound up than usual
- 2 I am so restless or agitated that it's hard to stay still
- 3 I am so restless or agitated that I have to keep moving or doing something

7.
- 0 I don't feel I am being punished
- 1 I feel I may be punished
- 2 I expect to be punished
- 3 I feel I am being punished

8.
- 0 I feel the same about myself as ever
- 1 I have lost confidence in myself
- 2 I am disappointed in myself
- 3 I dislike myself

9.
- 0 I don't criticise or blame myself more than usual
- 1 I am more critical of myself than I used to be
- 2 I criticise myself for all of my faults
- 3 I blame myself for everything bad that happens

10.
- 0 I don't have any thoughts of killing myself
- 1 I have thoughts of killing myself, but I would not carry them out
- 2 I would like to kill myself
- 3 I would kill myself if I have the chance

11.
- 0 I don't cry anymore than I used to
- 1 I cry more than I used to
- 2 I cry over every little thing
- 3 I feel like crying, but I can't

12.
- 0 I am no more irritable than usual
- 1 I am more irritable than usual
- 2 I am much more irritable than usual
- 3 I am irritable all the time

13.

0	I have not lost interest in other people or activities
1	I am less interested in other people of things than before
2	I have lost most of my interest in other people or things
3	It's hard to get interested in anything

14.

0	I make decisions about as well as ever
1	I find it more difficult to make decisions than usual
2	I have much greater difficulty in making decision than I used to
3	I have trouble making any decisions

15.

0	I do not feel I am worthless
1	I don't consider myself as worthwhile and useful as I used to
2	I feel more worthless as compared to other people
3	I feel utterly worthless

16.

0	I have as much energy as ever
1	I have less energy than I used to have
2	I don't have enough energy to do very much
3	I don't have enough energy to do anything

17.

0	I have not experienced any change in my sleeping pattern
1a	I sleep somewhat more than usual
1b	I sleep somewhat less than usual
2a	I sleep a lot more than usual
2b	I sleep a lot less than usual
3a	I sleep most of the day
3b	I wake up 1-2 hours early and can't get back to sleep

18.

0	I have not experienced any change in my appetite
1a	My appetite is somewhat less than usual
1b	My appetite is somewhat greater than usual
2a	My appetite is much less than before
2b	My appetite is much greater than usual
3a	I have no appetite at all
3b	I crave food all the time

19.

0	I can concentrate as well as ever
1	I can't concentrate as well as usual
2	It's hard to keep my mind on anything for very long
3	I find I can't concentrate on anything

20.

0	I am no more tired or fatigued than usual
1	I get more tired or fatigued more easily than usual
2	I am too tired or fatigued to do a lot of the things I used to do
3	I am too tired or fatigued to do most of the things I used to do

21.

0	I have not noticed any recent change in my interest in sex
1	I am less interested in sex than I used to be
2	I am much less interest in sex now
3	I have lost interest in sex completely

APPENDIX 24: The Positive and Negative Affect Schedule (PANAS)

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you have felt this way in the past few weeks.

1	2	3	4	5
very slightly or not at all	a little	moderately	quite a bit	extremely

____interested	____irritable
____distressed	____alert
____excited	____ashamed
____upset	____inspired
____strong	____nervous
____guilty	____determined
____scared	____attentive
____hostile	____jittery
____enthusiastic	____active
____proud	____afraid

Case Report Form

Centre for Sport & Exercise Science

Sheffield Hallam University

Smoking & exercise study

Volunteer Number:	

Appointment:

Date	Time	Week (baseline = 0)

Experimental condition: (circle one only)

Exercise counselling	1
Control	2

Demographic details

Height	cm
Weight	kg

Age	**Gender**	
	Male	Female
	1	2

Student	**Course**		**P/t Job**	
Non-student	**Occupation**			

To which racial or ethnic group do you consider you belong? Please tick one box

White ❑ Indian ❑ Pakistani ❑

Black - African ❑ Black - Caribbean ❑ Bangladeshi ❑

Black - Other (please specify) ❑ _____ Chinese ❑

Other (please specify) ❑ _____

Carbon monoxide reading .....ppm

These questions help us to understand your reasons for smoking.

Please answer all seven questions (Circle one number for each question)

S8. Do you use smoking to help you cope with stress?	Yes very much	5
	Yes quite a bit	4
	Yes a little	3
	Not really	2
	Not at all	1
S9. Do you use smoking to help you socialise?	Yes very much	5
	Yes quite a bit	4
	Yes a little	3
	Not really	2
	Not at all	1
S10. Do you use smoking to give you something to do when you are bored?	Yes very much	5
	Yes quite a bit	4
	Yes a little	3
	Not really	2
	Not at all	1
S11. Do you use smoking to help you to concentrate and stay alert?	Yes very much	5
	Yes quite a bit	4
	Yes a little	3
	Not really	2
	Not at all	1
S12. Do you smoke because you feel uncomfortable if you don't?	Yes very much	5
	Yes quite a bit	4
	Yes a little	3
	Not really	2
	Not at all	1
S13. Do you use smoking to help you to keep your weight down?	Yes very much	5
	Yes quite a bit	4
	Yes a little	3
	Not really	2
	Not at all	1
S14. Do you enjoy smoking?	Yes very much	5
	Yes quite a bit	4
	Yes a little	3
	Not really	2
	Not at all	1

B1. At what age did you have your first puff on a cigarette? ☐ yrs

B2. At what age did you start smoking on a daily basis? ☐ Yrs

B3. Have you made a serious attempt to stop smoking in the past? *(Circle one number)*

Yes 1

No 2

B4. In the past year, what is the longest you have gone without a cigarette? ☐ Days

PLEASE GO TO THE NEXT PAGE

ITQ

Are you thinking at all about stopping smoking? Yes 1
(Please circle one number)

No 2

If YES, do you intend trying to stop in the next month or might you prefer to try to stop at a later time?
(Please circle one number)

In the next month 1

Later than that 2

Your Feelings about Quitting Smoking.

Please consider the statement below, then for each scale, circle one score that best describes your feeling about quitting smoking.

Statement: For me to quit smoking is:

Useless	-3	-2	-1	0	+1	+2	+3	**Useful**
harmful	-3	-2	-1	0	+1	+2	+3	**beneficial**
foolish	-3	-2	-1	0	+1	+2	+3	**wise**
bad	-3	-2	-1	0	+1	+2	+3	**good**
un-enjoyable	-3	-2	-1	0	+1	+2	+3	**enjoyable**
unpleasant	-3	-2	-1	0	+1	+2	+3	**pleasant**
stressful	-3	-2	-1	0	+1	+2	+3	**relaxing**

PLEASE TURN TO THE NEXT PAGE

Your thoughts on quitting smoking

Please circle a number that best describes your response to the statements below.

- My goal is to quit smoking

1	2	3	4	5	6	7
Strongly agree		Agree	Neutral		Disagree	Strongly disagree

- I intend to give up cigarettes

1	2	3	4	5	6	7
Strongly agree		Agree	Neutral		Disagree	Strongly disagree

- I plan to quit smoking

1	2	3	4	5	6	7
Strongly agree		Agree	Neutral		Disagree	Strongly disagree

Please indicate your agreement / disagreement with the statements listed below by choosing a number as a score.

- Most people who are important to me think I should give up smoking

1	2	3	4	5	6	7
Strongly agree		Agree	Neutral		Disagree	Strongly disagree

- Most people who are important to me encourage me to quit smoking

1	2	3	4	5	6	7
Strongly agree		Agree	Neutral		Disagree	Strongly disagree

- Most people who are important to me support me in giving up smoking

1	2	3	4	5	6	7
Strongly agree		Agree	Neutral		Disagree	Strongly disagree

PLEASE GO TO THE NEXT PAGE

Your thoughts on quitting smoking (contd.)

Again, please circle the number that best indicates your response.

How much control do you have over giving up smoking?

1	2	3	4	5	6	7
very little control		limited control	neutral		some control	complete control

---

For me to give up smoking is

1	2	3	4	5	6	7
extremely difficult		difficult	neutral		easy	extremely easy

If I wanted to I could easily give up smoking

1	2	3	4	5	6	7
strongly agree		Agree	neutral		disagree	strongly disagree

How much I smoke is completely up to me

1	2	3	4	5	6	7
strongly agree		Agree	neutral		disagree	strongly disagree

How confident are you that you are capable of giving up smoking?

1	2	3	4	5	6	7
not all confident		somewhat confident	neutral		very confident	extremely confident

---

APPENDIX 26: Physical activity consultation form

Current PA behaviour (activities the client enjoyed & felt they could do on a regular basis, emphasise 'moderate intensity physical activity message', ways of fitting PA into daily life; previous exercise experiences, why worked / failed)

Decision balance sheet (possible gains and losses that might occur as a result of increased activity levels)

Perceived barriers to becoming more active (and how the major barriers may be overcome; suggest benefits client may not have considered; what they would have to give up / what may be unpleasant)

Prompt to seek out social support for increased activity (family, friends, workmates, or possibly beginners' exercise class; others who might encourage participation in exercise, someone to talk to when exercising is difficult, ways in which to exercise with others)

Goal setting (client states own goals, I help client to determine short term [e.g., cycling/walking to work 3x/wk], intermediate [e.g., join exercise class at end of next month, plan long walks at weekends with friends], & long term [e.g., weight loss – realistic] goals)
NB. ST goals must provide an exercise prescription designed to meet needs – bear in mind specific motivations & barriers

Safety advice (if walking / cycling in the dark, make sure you can be seen, avoid busy / dangerous roads, and try to find someone to accompany you).

Go for a brisk walk round the block together, using the laminated RPE scale

Basic lifestyle information (dietary info - portion size, fat; smoking; hydration – generally & during activity)

APPENDIX 27: The readiness to change ladder for smoking cessation

Each rung on this ladder represents where various smokers are in their thinking about quitting. **Circle the number** that indicates where you are now. Please answer this question as honestly as you can.